1	2	3

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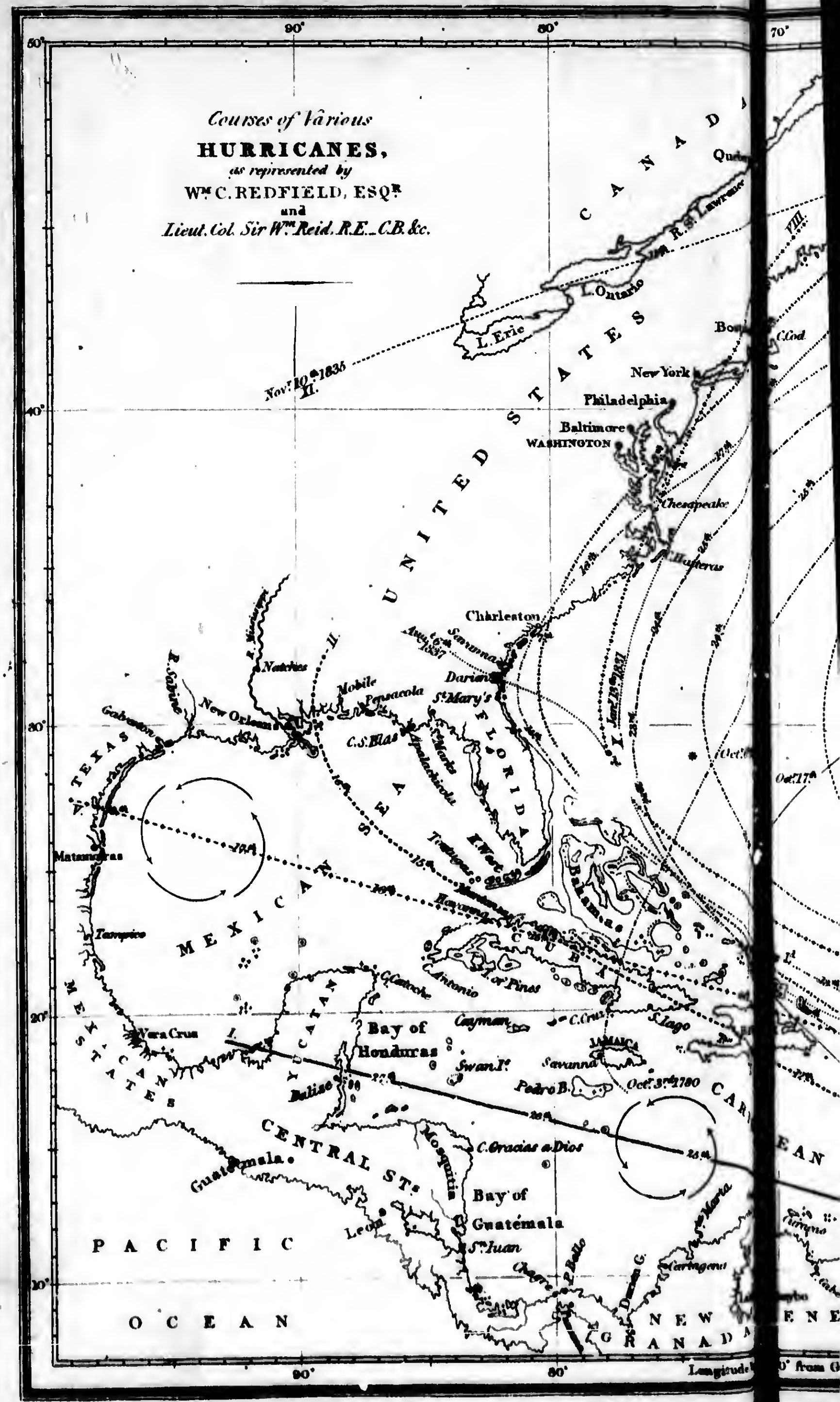
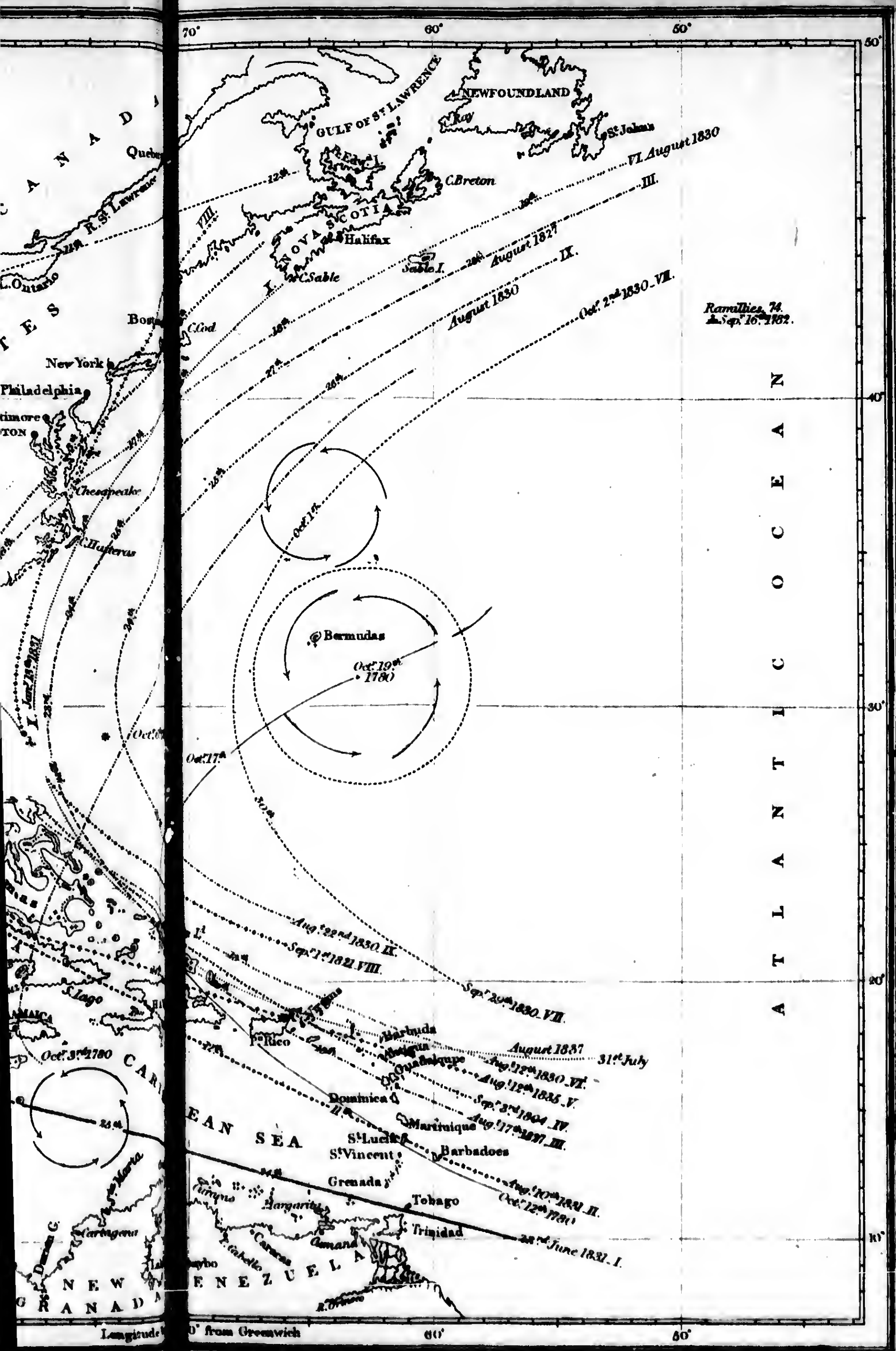


Published by R.H. Laurie, Fleet Str



...ed by R.H. Laurie, ... Street, London, 1861

MEMOIR,

DESCRIPTIVE AND EXPLANATORY,

OF THE

NORTHERN ATLANTIC OCEAN;

AND COMPRISING

INSTRUCTIONS, GENERAL AND PARTICULAR,

FOR

THE NAVIGATION OF THAT SEA.

BY JOHN PURDY.

ELEVENTH EDITION; MATERIALLY IMPROVED,

BY ALEXANDER G. FINDLAY,

Fellow of the Royal Geographical Society.

LONDON:
PRINTED BY AND FOR RICHARD HOLMES LAURIE,
53, FLEET STREET, E.C.
1861.

"O'ER the glad waters of the dark blue Sea,
Our thoughts as boundless, and our souls as free,
Far as the breeze can bear, the billows foam,
Survey our EMPIRE, and behold our HOME."

(*Lord Byron.*)

[ENTERED AT STATIONERS' HALL.]

PREFAÇE.

E present Work has been before the Public for half a century,—a period that has nessed a total change in the aspect and requirements of Hydrography, as in most er departments of knowledge.

Professing to deal with the subject in its present condition, this Edition bears no emblance to the Work in its original form, except in the title it bears: every topic l every page has been changed by the gradual or sudden accession of facts which dern industry and refinement bring to bear upon every branch of inquiry.

There has been no greater advance made during any portion of the long time that s elapsed since its first appearance, than has taken place during the last ten years; l to represent that advance this Edition has been entirely remodelled, and may be isidered rather as a new Work upon the former arrangement, than as a revised oduction.

The great distinction between modern progress and that which the various itions in former years had to record, is, that each branch of Science is now elabo- ely investigated by Government, and to these labours the painstaking individual scarcely hope to add anything.

The most refined and exact Surveys of the shores and banks, with all their endant features, have in many cases been completed and published within these years. In the subject of Meteorology vast progress has been made in the same erval; and the United States' Government claim the gratitude of every sailor for labors in this department.

The examination of the bottom of the ocean, almost a new subject, and yet in its fancy, has already dispelled many of those dangers which were formerly believed to ist. The beautiful Lighthouse systems; the various features which have been minated in the Wind and Current systems, and their bearing upon the best routes traversing the Ocean; the more exact acquaintance with the magnetical condition the Earth, and the most important connexion this has with the increasing number iron ships, with many other subjects, will be duly discussed in the ensuing pages.

To enumerate the authorities to which we are indebted would be to offer a long t; we have duly acknowledged them throughout the Work: and we trust that this *eventh Edition* may do good service to the mariner in its quiet utility, as has been ne by those which have preceded it.

A. G. FINDLAY.

LONDON, *Sept.* 2, 1861.

PREFACE TO THE EIGHTH EDITION.

THIS work is designed to impart to the Navigator the MEANS of SAFETY over the ATLANTIC; to develop the silent and imperceptible CAUSES of ERROR and SHIPWRECK; to point out the BEST ROUTES to the numerous Ports of this Ocean; and to communicate useful Hints on GENERAL NAUTICAL PRACTICE.

Seven editions have already been honoured by the public approbation; and, stimulated by such encouragement, no attention has been spared in rendering an Eighth still more worthy of acceptance.

A comparison of the latter Editions with those that preceded them, will show how much we have been indebted to numerous friends for recent and important information. We have had, again and again, to thank CAPTAIN LIVINGSTON, of Liverpool, for his numerous and valuable communications. In like manner have we been indebted to LIEUTENANT JOHN EVANS (*a*), R.N., and to COMMANDER EDWARD DUNSTERVILLE, whose information more fully appears in another work.*

To the subject of Currents, in particular, it will be found that our attention has been directed. These currents have at length excited that inquiry into their nature and causes which the importance of the subject demands. This has been especially evinced by the curious and elaborate work composed by the late MAJOR RENNELL; which has confirmed, generally, all that we had previously stated, and has, moreover, explained several essential particulars before unknown. Further investigations have been promised; so that we may expect, ultimately, an accurate view of all the *Atlantic Currents*, as they predominate in the different seasons.

We enlarge the more especially upon the Currents, because, as now treated on, they are to seamen almost a NEW SUBJECT. To the majority it is, at least, one on which they particularly require information. If this position be doubted, consult the melancholy events produced by them, which are described in the present volume, and take into consideration the incomparable number of similar cases which must necessarily have escaped our noticed; and of which many have been the indubitable effects effects of a confidence arising from *ignorance* and self-conceit.†

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* "The Colombian Navigator," Editions of 1839.

† The numerous wrecks that formerly occurred on the rocks and islands of Scilly, from ignorance of the tides and currents, are notorious. Add to these the wrecks, still more numerous, which have occurred on the coasts of Spain, Portugal, and Africa; upon which side of the ocean the currents have uniformly produced more mischief than on the opposite coasts. Among these were the British frigate *Apollo*, and about forty ships under her convoy, on the coasts of Portugal, as described hereafter, p. 275; of the vessel with M. de Brisson, in 1787, on the coast upon which, in 1810, the American ship *Charles* was wrecked, as noticed and described in a succeeding page; of the *Montezuma*, of the *Eliza* and *Olymphe*, both in 1827; of the brig *Commerce*; of the *Oswego;* and of the *Medusa;* and about thirty other vessels lost on the African coast, of which, according to the respectable authority of Mr. Jackson, about seventeen were English, and five American; twenty-six others wrecked on the Bar of Senegal, at different times, according to M. Golbery.

Many ships, also, have been lost by the currents, &c., on Allegranza, Graciosa, and Santa Clara, of the Canaries; the *Hartwell*, East Indiaman, on the reefs of Bonavista, the *Cynthia*, *George*, *Cora*, &c., on the South shore of Barbadoes; and, by similar causes, several others, on the Rocas, &c., off the Brasilian coast. Many are recorded as being wrecked

In presenting the former *Edition*, we had to return our thanks for their valuable communications, to *John Mackellar*, Esq., since Rear-Admiral of the White; and to the Mercantile Captains, *James Wallace Monteath*, of Liverpool; *John Wilson* and *Thomas Hamlin*, of Greenock; *Wm. J. Capes*, then of the *Lady Mackworth; John Steele Park*, of the *Carshalton Park;* and *Thos. Wilson*, of the *Henry Wellesley*. To several of these gentlemen, to the late *Captain Midgley*, and to Captain *George Cheveley*, we have *again* been obliged for important and valuable additions, now incorporated in the work.

To Lieutenant *Charles Hare*, R.N., we are indebted for the route described by him for ships bound to New Brunswick, &c., in the succeeding pages 437, 439. This route is so evidently and greatly advantageous to every commander and merchant in that trade, as to demand particular notice. To the friendship of Mr. *Wm. Heron*, of Greenock (since deceased), we have been indebted for several matters of importance; among which will be found some explanation of the currents about the southern coast of Newfoundland; currents which, *while unknown*, have probably been the cause of so many wrecks on that coast.

The important communications of an accomplished officer, *Lieutenant Greevelink*, late of the Dutch Royal Navy, which have added so considerably to a due knowledge of the West Indian Seas, have been incorporated and acknowledged in the "Colombian Navigator;" and so much of a general nature, as the subject required, has been re-introduced in the present volume.

In the Tables of Positions and Directions, many additions have been made from the Observations and Surveys of the officers appointed to the surveying service by their Lordships of the Admiralty, as well as by other scientific men. The new documents more especially include the Memoir and Surveys of the *Baron Roussin*, of the French Navy; with those of *Captains Wm. F. Owen, Richard Owen, Edward Belcher, Thos. Boteler, Wm. Mudge, A. T.E. Vidal, John Washington*, and *H. W. Bayfield*, of the British Navy; *Colonel Sabine*, of the Royal Artillery; with many articles from the "Nautical Magazine, &c., as noticed and acknowledged hereafter.

The Directors of the "Deposito Hydrografico" of Madrid have done us the honour of translating for, and inserting into, the "Derrotero de las Antillas" all that we had heretofore collected on the subject of CURRENTS, and have superadded thereto some additional and valuable remarks, which we have incorporated in this work. Numerous facts, of late date, illustrating the general set of currents, will be found described under their proper heads.

The summary descriptions of all the LIGHTHOUSES on the different coasts, will, we trust, be considered as an important and useful addition; inasmuch as they will, if attended to, prevent those accidents which have so frequently happened from mistaking one light for another, examples of which will be noticed hereafter.

Our ardent wishes are, as our strenuous efforts have been, devoted to the improvement of Hydrography; and we therefore, again, earnestly solicit communications for future correction, &c. Such communications are particularly acceptable, because ORIGINAL and AUTHENTIC; and, therefore, more to be depended upon than the imperfect statements commonly given in newspapers and other publications, as we have already had occasion to notice. The great importance of the latter has, however, been admitted; and we may here repeat the observation, that "A series of such notices, PROPERLY AUTHENTICATED, announcing the discovery and position of DANGERS, new determinations of the situations of places, &c., with the particulars of the observations, and names of the observers, would be very beneficial to the public service. Had such a measure been adopted years ago, many fine ships which, and

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about Newfoundland, including the *Tweed*, the *Comus*, the *Harpooner*, the *Drake*, and the *Spence;* and to these may be added the *Lady Sherbrooke*, from Londonderry to the River St. Lawrence, lost near Port-au-Basque, East of Cape Raco, Newfoundland, in July, 1831, when 300 persons perished!

brave sailors who, have been lost, might still have been in existence." We have urged this argument repeatedly, and have had the pleasure of seeing that, to a certain degree, the suggestion has been adopted.

The Volume lately published, entitled "A Sailing Directory for the Ethiopic or Southern Atlantic Ocean," may be considered as a continuation of the present work. It describes, in a similar manner, the Islands and Dangers of that Ocean, the Coast of Africa from Sherboro' Island to the Cape of Good Hope and Algoa Bay, and the Coasts of Brasil, &c., from the River Marañon Southward, to Cape Horn, including the Falkland Islands, South Shetland, &c.

JOHN PURDY.

The First Edition of this work appeared, without preface or apology, in the year 1812; a second was soon required, and, during the lifetime of its original composer, *eight* editions were called for, to the last of which the foregoing preface was affixed.

Before submitting a NINTH to public notice, the present Editor felt some diffidence in attempting to improve that which had employed so much of the time and talent of the late Mr. Purdy; but, as Hydrography, and the many branches of science therewith connected, are continually receiving fresh accessions, from the zeal and activity of the numerous observers that are at present labouring in the wide field of research, some revision was rendered absolutely necessary.

In the performance of this task, many redundances were to be removed, many important points to be dilated on. It is hoped that no source of authentic information has been overlooked, and that the work, as it is, offers a correct picture of the state of our Hydrographical knowledge at the present time.

Our thanks are due to many kind contributors, whose names and observations are recorded throughout the work, and we here tender them our acknowledgments.

ALEX. G. FINDLAY.

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SECTION III.

GENERAL OBSERVATIONS ON THE WINDS, TIDES, AND CURRENTS, AND ON THE DIFFERENT PASSAGES OVER THE NORTH ATLANTIC OCEAN.

MEMOIR, ETC.

*** THROUGHOUT THIS WORK THE GIVEN LONGITUDE IS THE LONGITUDE FROM GREENWICH. IN THE SAILING DIRECTIONS THE BEARINGS AND COURSES ARE THOSE BY COMPASS, UNLESS WHERE OTHERWISE EXPRESSED; BUT THOSE GIVEN THUS [*W.S.W.*] SIGNIFY THE TRUE; AND THE GIVEN DIRECTION OF WIND, TIDE, AND CURRENT, IS GENERALLY TO BE CONSIDERED AS THE TRUE.

SECTION I.

REMARKS ON THE CHART, WITH TABLES OF DETERMINED POSITIONS, AND THE AUTHORITIES, ETC., WITH THE VARIATION OF THE COMPASS.

The NORTH ATLANTIC OCEAN is the smallest of all the great divisions of the Ocean, but it has ever been of far greater importance to man than all others collectively. It owes this great maritime superiority to the great proportionate length of its varied coast line, which perhaps nearly equals all other navigable seas, and to the vast area drained by the rivers falling into it, which give ready access and intercommunication to seats of dense and inland population. It is from these causes that the inhabitants of its maritime countries, have, in all ages, applied themselves to navigation; and it is more than probable that the facilities afforded by it for commerce and travel, that the nations who inhabit the vicinities of those vast inland seas and bays which distinguish the Atlantic, have made greater progress in civilization than in any other part of the globe.

The area of the North Atlantic, does not comprise more than about one eleventh part of the entire ocean. From its having been the great highway for so many ages, its history, features, and phenomena, are better known than any other, and we are now enabled to give a far more perfect view of it—in every aspect—than of the rest of the world of waters.

It may be important in some mercantile questions to define the boundaries of the various divisions of the Ocean but this has not been authoritively done for the whole of the world.

In 1845, the Royal Geographical Society of London, appointed a committee to define the limits of the various oceans; and their report defines:—

"The limits of Arctic and Antarctic Oceans, respectively to be the Arctic and Antarctic Circles; that the limits of the Atlantic on the north and south, be the Arctic and Antarctic Circles; that its western limit be the coast of America, as far south as Cape Horn, and thence prolonged on the meridian of that cape, until it meets the Antarctic Circle; that its eastern limit be the shores of Europe, and Africa, as far south as the Cape of Good Hope, and thence prolonged on the meridian of Cape Lagulhas, till that meridian cuts the Antarctic Circle."

Our present work deals exclusively with the northern portion of the area thus defined, or that part which is separated from the southern by the Equator.

The length of the coast lines which bound the North Atlantic and its chief bays, (except the Mediterranean,) measured around their principal sinuosities, is not less than 62,000 miles; if more minutely estimated it would amount to much more. A table is given presently, which will shew the numbers which make up this sum, and which are relatively equal. Of these coasts about 7,000 miles, or one ninth, remain unsurveyed; but they are the Arctic regions, unfrequented by commerce. Of the remainder, two-fifths have been surveyed by the British Government, and three-fifths by foreign powers.

The coasts of the Atlantic are now represented with the most minute accuracy in nearly all places of interest to the sailor. The elaborate surveys which have now nearly approached completion, have been in progress during a greater portion of the present century; and in some cases, as the coasts of Spain, and some parts of our own shores, at the latter part of the last century.

The first portion of this volume consists of a selection of the principal geographical points established in these operations, and appended to them are some notes, which will sufficiently explain their nature. In former editions we were led to discuss the merits of various authorities and the discrepances between them, which were often considerable in amount; but now these differences have been so removed, and such minute exactness attained, that whatever notes there may be on this topic, must be rather taken as subjects of curiosity, than of practical utility.

It is therefore manifestly impossible that the seaman in the ordinary pursuit of his calling can hope to improve what has cost so much labour, and such refined appliances. Almost every point in the geographic tables which follow may be taken as a point of departure by which he may correct his reckoning or rate his chronometer; and the explanatory notes appended, will serve to give him confidence, and afford information upon this important section of hydrography.

The first chart of the Atlantic upon a large scale, was published in Amsterdam by the predecessors in the still existing and respectable house of Van Keulen, in the middle of the last century. It was issued under the title of the *Spanish* or *West Indian Sea;* it contained some useful details, amidst a thousand errors. The second, entitled a *Chart of the Atlantic Ocean,* was engraved at London, on the circular projection, invented by Mr. Murdoch, but was found to be extremely inaccurate; and the constructor added to the Archipelego of Cape Verde, two islands, under the names of St. Philip and St. John, neither of which existed; these names being sometimes given by the Portuguese to the Islands Fogo and Brava.

The next, which was the first of the kind published in this country, was constructed by M. de la Rochette, a painstaking and talented hydrographer, in 1777; and was published by the house whence the present work issues, in that year. It was drawn upon the basis of the observations of M. Fleurieu, and for many years was in large demand; of which some degree of proof may arise from its having been during the period repeatedly copied, and illegally republished. In the course of time many improvements were obtained, and it was superseded in 1812, by another of the same scale and size, constructed by Mr. John Purdy, a name well known to mariners for many years. This chart, in its various editions, did good service to seamen for a long period, and still is deserving of confidence, as representing most of the features requisite, with sufficient accuracy, to ensure the safety of navigation.

These charts in their turn, having required many improvements, from the great acquisition of exact knowledge which characterizes the present day, it was deemed necessary to supersede them by the new charts before alluded to, which have lately been published by the proprietor of this work, as compiled from the now nearly perfect geographical data. They moreover exibit, at one view, a summary, in a graphic form, of all that range of phenomena with which hydrography has of late been enriched.

But there is one drawback to the great increase of observation. Each department of hydrography is overloaded for practical every day use, and the seaman would waste much time in endeavouring to elicit some system from the multifarious authorities he has now before him. A system of mean results has therefore been adopted, as will be hereafter explained, under the various sections which follow.

Hydrography, as at present understood, commenced with Captain Cook, in his celebrated first voyage to the South Seas, in 1768. Previous to this, our coasts were represented and corrected by the rude draughts and imperfect reckonings of painstaking mariners, in the pursuit of their profession; but the extended practice of lunars, and the use of chronometers, soon made great improvements in geographic representation. Captain Cook, prior to his appointment to the great Exploring Expedition, was employed in surveying portions of the Gulf of St. Lawrence; and the first work which he published was a series of charts of the south and west coasts of Newfoundland. It is very interesting to know that the great circumnavigators' earliest works have outlived all their contemporaries. His charts, published by the predecessor of the proprietor of this work, are still in demand, as the only faithful representations extant.

Our present object is not to give a history of the progress of charts, or we might here present a long catalogne of those worthy observers, who, by patient investigation, and multiplied observation, made the geography of the ocean nearly as good for the mariner's use, as the far more elaborate public surveys which have superseded them. These last have the exclusive merit of being connected, and each portion placed in exact relation to every other portion—a feature which is owing to the magnificent systems of triangulation, which are now extended over the the most important portions of the civilized world. The degree of accuracy, and the extent of these, may be understood, when it is asserted that the whole of the positions hereafter given on the coasts of Europe, between Norway and Spain, do not vary from the *absolute* truth, more than a few feet.

It is the defect of detached observations that they do not exactly accord with those by different individuals. It was the discrepancies arising from this source, which necessitated the discussions formerly given on Atlantic geography. But still there is much that was useful which is now eclipsed in the works of the predecessors of modern surveyors. Toward the end of last century, there were several names which deserve especial mention here, as their works will bear every comparison with those of their more favored successors. Among these was Murdoch Mackenzie, who surveyed a large portion of the western shores of Scotland, and all the coasts in the north of Ireland. Græme Spence, an admirable surveyor, whose labors have even yet not been entirely superseded, surveyed the southern coasts of England, between 1772 and 1812.

The coasts of Spain and Portugal laid down in accordance with the valuable Surveys of Tofiño, Franzini, &c., and in the delineation of the African Coasts, with the islands off the same, the positions afforded by Messrs. Fleurieu, Verdun de la Crenne, Borda, Pingré, and Roussin of France, were the authorities for our charts.

The American Coasts were originally exhibited according to the observations and surveys of our illustrious countryman, Captain Cook, as before mentioned; those of Lieutenant Michael Lane, of Mr. Des Barres, of Captain Holland, of Messrs. Wright, Mason, Dixon, and De Mayne, rectified with the observations of Dr. Rittenhouse, Mr. Ellicott, Mr. Hassler, and other astronomers, &c., of the United States.

For the correct delineation of the West India Islands, much of our earlier information was derived from the labors of Messrs. Puysegur, Verdun, Borda, Pingré, and other foreign officers, whose names will be for ever entitled to respect. They were the pioneers who were followed by the skilful observers acting under the orders of the Hydrographic Directors of Madrid; particularly the Captains Joaquin Fr. Fidalgo, Cosme de Churruca, and Jose del Rio; to whom, and to the Baron von Humboldt, Messrs.Oltmanns, &c., we were indebted for the proximate situations of many points of Spanish America. These have again been adjusted by British Officers.

The numerous surveyors who have seconded these scientific leaders in the completion of our hydrographic representions, will be alluded to in connection with their respective labors hereafter.

While we can refer with confidence to the charts of the various coast lines, as being so perfect, that no possible alteration will be made in the fixed features of the land, that could be rendered applicable upon a general chart, there is one branch that is not so satisfactory. This is the list of detached dangers, as rocks or shoals, which have been from time to time reported, and which, disproved, are a constant and daily source of great anxiety to those who have to pass their vicinity. To deal with the conflicting and ambiguous statements recorded, is most perplexing. Still it is most essential that no danger should remain unmarked, although its existence or situation may be involved in great doubt. It is of the utmost importance to the facility and safety of navigation, that these dangers should be correctly placed and characterized, and in the case of a fresh discovery, some test, as by the sounding lead, ought to be applied, to determine its absolute existence. This is now most imperative; without such guarantee, any such announcement is next to worthless, as being authentic, and most mischievous, as leading to distrust and anxiety. All that we know of this subject is recorded in a later part of this work, and in the chart, but it may be stated that of late the extended practice of deep sea soundings, has actually disproved the existence of many apparently well-authenticated dangers, and thrown very great doubt upon many others.

It has been above stated that the length of the coast line of the North Atlantic Ocean, between the Arctic Circle and the Equator (excluding the Mediterranean), is about 62,000, miles more or less. This estimate is higher than has been usually attributed, but it is the result of a measurement around the present surveyed coasts omitting the minor sinuosities and smaller islets. If these were taken into the account the sum would be much greater, as may be supposed, upon an examination, for example, of the vast range of islets which front the coasts of Norway and Finland, but it is the length of line over which the patient marine surveyor has had to toil in the execution of his arduous but most important duties. These numbers, however, but faintly express, as indeed anything we could say here would fall short of telling how much has been done to bring the hydrography of this ocean to its present condition. It is enough here to draw the seaman's attention to a few of the results of those costly and laborious surveys which he benefits by.

Of the 62,334 miles of sea coast, the English Government have surveyed about 23,600 miles; foreign governments about 31,600 miles, the remaining being unsurveyed.

Of the coasts of Europe, the English Admiralty and Ordnance have only surveyed about one fourth, or 5000 miles out of 20,000 miles.

The following table of the details of the length, &c., of each country, is therefore given rather as a matter of curiosity, than material utility, and will form a fitting introduction to the Geographic tables which follow.

COUNTRY.	SURVEYED BY.	DATE OF SURVEY.	Extent of Coast G. miles	TOTAL G. Miles.
England; South Coast and Channel Islands	Brit. Ordnce. & Admiralty.	1792-1852.	488.	
„ East Coast	Ditto.	1830-1859.	470.	
„ West Coast	Ditto.	1772-1860.	748.	
Scotland; East and North Coasts, and Islands	Ditto.	1815-1850.	810.	
„ West Coast and Islands	Ditto.	1750-1860.	400.	
Ireland	Ord. & Admlty.	1828-1858.	1320.	
TOTAL BRITISH ISLES	......	......	....	5236.
Norway; East and South Coasts	Dan.&Nor.Gts.			2900.
Denmark; East Coast and Isl.	Danish Govt.		1585.	
Mecklenburg	Ditto		95.	
Prussia	Prus.&Dan.Gt.		530.	
Russia and Finland	Russ.&Sw. Gt.		2720.	

COUNTRY.	SURVEYED BY.	DATE OF SURVEY.	Extent of Coast G. miles	TOTAL G. Miles.
Sweden	Swedish Gov.		2360.	
TOTAL BALTIC, &c.	......	......	....	7290.
Denmark; West Coast and Færöe Islands	Danish Govt.	1841-1806.		730.
Hanover	Dutch Govt.			180.
Holland	Ditto.			540.
Belgium	French Govt.	1816-1839.		64.
France	Ditto.	" "		1687.
Spain (to Gibraltar)	Spanish Govt.			915.
Portugal	Various.			540.
TOTAL COASTS OF EUROPE	......	......	....	20,082.
Marocco &c.	Fr. & Brit. Gts.	1835-1858.	460.	
Agadir to Equator	British Govt.	1826.	4430.	
TOTAL AFRICA	......	......	....	4890.
TOTAL ATLANTIC ISLANDS ..	British Govt.	1783-1846.	....	2990.
Iceland	Danish Govt.	1826.	1500.	
Greenland	not surveyed.		2000.	
Hudson's Bay, &c., ...	Ditto.		4000.	
Labrador; East Coast	Ditto.		1140.	
TOTAL ARCTIC ISLANDS ..	......	......	....	7140.
Newfoundland; E.and S.Coasts	British Govt.	1765-1834.		2765.
Gulf of St. Lawrence	Ditto.	1766,1819,1849.		2820.
Cape Breton, Nova Scotia, and New Brunswick	Ditto.	1824-1860.		1765.
United States East Coast	U. S. Govt.	1817——	3735.	
" South Coast....	Ditto.		2770.	
TOTAL UNITED STATES ..	......	......	....	6505.
Mexico, and Central America	Span.&Brit.Gt.	1808.		3295.
Colombia and Guayana......	Span.F. & Brit.			4100.
West India Islands, (British)	Various.		2947.	
Haiti and Cuba	not proply. sur.		2350.	
Various Islands	......		685.	
TOTAL WEST INDIES	......	......	....	5982.
TOTAL EUROPE	......	......	....	20,082.
AFRICA................	......	......	....	4890.
ISLANDS	......	......	....	2990.
AMERICA...............	......	......	....	34,372.

TOTAL LENGTH of the Coasts of the North Atlantic Ocean.... 62,334 Geo. Miles.

POSITIONS OF PLACES, ETC.

I. ENGLAND AND WALES.

*** *The* FIGURES *in Brackets refer to the* NOTES *subjoined to each section.*

The VARIATIONS OF THE COMPASS &c., follow these Notes.

	LATITUDE.	LONGITUDE.
	° ′ ″	° ′ ″
GREENWICH; ROYAL OBSERVATORY ....[1]	51 28 40	0 0 0 *
ONDON; Cupola of St. Paul's Cathedral	51 30 49	0 5 47 W.
ravesend; Church	51 26 39	0 22 10 E.
heerness; Flagstaff	51 26 47	0 44 50 —
Harwich; Lighthouse....	51 56 38	1 17 25 —
Orfordness; North Lighthouse	52 5 36	1 35 12 —
owestoft Lighthouse....	52 29 12	1 45 28 —
romer Lighthouse	52 55 27	1 19 5 —
purn High Lighthouse..	53 34 41	0 7 11 —
lamborough Lighthouse	54 6 58	0 4 51 —
artlepool Heugh Light.	54 41 47	1 10 27 —
underland LighthouseNo. 1..................	54 55 5	1 21 37 —
ynemouth Lighthouse ..	55 1 5	1 24 52 —
arn Island; S. W. Lighthouse..............	55 36 55	1 39 15 —
erwick Lighthouse	55 45 53	1 58 57 —
North Foreland; Lighthouse..............	51 22 30	1 26 48 —
outh Foreland; High Lighthouse	51 8 23	1 22 22 —
Dover Castle; the Keep..	51 7 46	1 19 23 —
olkstone Church	51 4 45	1 11 6 —
New Romney Church	50 59 7	0 56 22 —
ydd Church	53 57 5	0 54 29 —
ungeness Lighthouse ..	50 54 46	0 58 18 —
exhill Church	50 50 45	0 28 48 —
eachey Head Lighthouse	50 44 15	0 12 58 —
righton Church	50 49 32	0 7 40 W.
horeham Church	50 50 0	0 16 19 —
elsey Church	50 45 19	0 45 55 —
hichester Spire	50 50 11	0 46 43 —
ea-Ower Light-vessel ..	50 39 41	0 39 52 —
ortsmouth College	50 48 2	1 6 15 —
embridge Light-vessel ..	50 41 40	1 1 40 —
outh-sea Castle	50 46 39	1 5 14 —
alshot Castle	50 49 7	1 18 6 —
outhampton Pier	50 53 42	1 24 23 —
urst Castle; East Light	50 42 26	1 32 5 —
unnose; Station in the Survey	50 37 8	1 11 50 —
. Catherine's Lighthouse, Isle of Wight	50 34 30	1 17 47 —

AUTHORITIES.

The Astronomers Royal.

The GRAND TRIGONOMETRICAL or ORDNANCE SURVEY, one of the great works of which our country ought to feel proud. It was commenced with a view to ascertain the difference of longitude between the Observatories of Paris and Greenwich, under General Roy. The principal triangulation was gradually extended under the successive directions of Colonel Williams, General Mudge, General Colby, Col. Hall, and Col. Sir Henry James. It was completed and the account of it published in 1858. The bases upon which it is constructed were measured on the shore of Plain, and upcn Salisbury Lough Foyle, Ireland, and the refinement attained may be judged of when it is stated that the difference between the calculated and measured lengths of these bases was less than 2¼ inches. The mean length of the sides of the great triangles is 35·4 miles, of which 11 exceed 100 miles in length; the longest is 111 miles, *i. e.* from Slieve Donard in Ireland, county Down, to Sca Fell, Cumberland.

[1] GREENWICH.—From 720 observations of the Pole Star, made during eighteen months of 1825 and 1826, the latitude of the Royal Observatory was deduced as 51° 28′ 38″. By a later correction it is placed 51° 28′ 40″.16.

ENGLAND AND WALES—CONTINUED.

	LATITUDE.			LON. W.		
	°	′	″	°	′	″
Needles Lighthouse	50	39	40	1	34	32
Christchurch Head	50	42	38	1	44	31
Poole Church	50	42	51	1	58	55
Portland Upper Lighthouse	50	31	18	2	27	18
Lyme Cobb	50	43	11	2	55	29
Hob's or Bob's nose	50	27	50	3	26	43
Berry Head; Flagstaff ..	50	24	2	3	28	14
Start Point; Lighthouse..	50	13	18	3	38	28
Bolt Head; Signal Station	50	13	15	3	48	0
Eddystone Lighthouse ..	50	10	49	4	15	53
Mewstone, near Plymouth Sound	50	18	31	4	5	33
Plymouth New Church ..	50	22	22	4	7	16
Plymouth Old Church ..	50	22	15	4	7	32
St. Nicholas' or Drake's Island, Plymouth Sound..	50	22	4	4	18	18
Lighthouse, on the Breakwater	50	20	22	4	9	27
Meridian Tablet, on the Breakwater ....[2]	50	19	59	4	8	52
Penlee Beacon	50	12	25	4	10	40
Rame Head; Flagstaff ..	50	18	53	4	12	29
Dodman or Deadman Point; Flagstaff	50	13	20	4	48	1
St. Anthony's Head; Lighthouse	50	8	35	4	59	31
Pendennis Castle; Flagstaff	50	8	49	5	2	45
St Kevern Steeple	50	3	7	5	5	8
Blackhead; Flagstaff	50	0	27	5	6	35
LIZARD East Lighthouse..	49	57	34	5	12	4
St. Michael's Mount	50	7	3	5	28	37
St. Paul's Steeple, Mount's Bay	50	5	26	5	32	43
St. Leven's, or Guethensbras Point; Flagstaff ..	50	2	16	5	40	46
Wolf Rock; Beacon	49	56	45	5	48	14
Land's End Stone	50	4	8	5	41	31
Longships Lighthouse	50	4	4	5	44	43
SCILLY ISLANDS; St. Agnes' Lighthouse ..[3]	49	53	30	6	20	40
————; St. Mary's Windmill	49	54	32	6	16	59
————; St. Mary's Flagstaff at the Fort ..	49	55	0	8	18	13
————; St. Martin's; Day-Mark	49	58	2	6	15	53
Bishop Rock Lighthouse	49	52	29	6	26	39
St. Agnes' Beacon, Cornwall	50	18	28	5	12	57
Godrevy Island Lighthouse	50	14	32	5	23	56
Trevose Head; Lighthouse	50	32	55	5	2	3
Hartland Point..........	51	1	21	4	31	21
LUNDY ISLAND; Lighthouse	51	10	0	4	40	20
Minehead Steeple........	51	12	42	3	28	4
Braunton Sands, Lower Lighthouse	51	4	17	4	12	19

AUTHORITIES.

The GRAND TRIGONOMETRIC or ORDNANCE SURVEY of England, &c., described in the preceding page.

REMARKS.

As a matter of curiosity it may be mentioned that by these elaborate computations the Equatorial radius of the Earth is found to be 20,926,500 feet; and the Polar radius is 20,855,400 feet, and a mean degree of the meridian contains 364,616 feet. The ellipticity of the earth is as 293 to 294, and the mean density is 5.316.

In the public journals of 1834, it was stated that Dr. TIARKS, had ascertained, in the summer of 1822, by the comparison of sixteen excellent chronometers, carried backward and forward between Greenwich and Falmouth, that the western longitude of the latter had been given at 4.4 seconds of time, or 1 minute and 6 seconds too little, by the first Trigonometric Survey. In consequence, 29 of the best chronometers belonging to the Admiralty were subsequently committed to the care of the doctor, and a vessel was appointed wherein he was to sail, backward and forward, between Dover and Falmouth, until the longitude in time, between these stations, and between them and Portsmouth, as an intermediate station, was settled beyond any doubt. The result was, as to all places on the South Coast of England, between the meridians of Greenwich and Falmouth, if 1 second be added to every 4 minutes of longitude, as given by the original Survey, the exact longitude, according to the chronometers, will be obtained. These differences have since been entirely settled by the re-examination of the triangles, now completed.

ENGLAND AND WALES—Continued.

	Latitude. °	′	″	Lon. W. °	′	″	Authorities.
Burnham (or Bridgewater) Lighthouse	51	14	54	2	59	52	The Grand Trigonometric or Ordnance Survey of England, &c.
Usk Lighthouse	51	32	24	2	59	33	
Bridgewater Spire	51	7	41	2	59	39	
Avon Lights	51	30	2	2	42	15	
Bristol Cathedral	51	27	6	2	35	29	
Flatholm Lighthouse	51	22	30	3	7	28	
Swansea Castle	51	37	13	3	55	32	
Mumble's Lighthouse	51	33	59	3	58	12	
Worm's Head	51	33	56	4	18	56	
Nash Point, E. Lighthouse	51	24	13	3	33	3	
Rosilly Barrow	51	34	35	4	15	51	
Pembrea Steeple	51	41	18	4	15	28	
Tenby Spire	51	40	20	4	41	51	
Caldy Island; Lighthouse	51	37	52	4	40	59	
Milford Steeple	51	42	43	5	0	39	
Hulberton Church	51	42	56	5	3	11	
St. Anne's High Lighthouse	51	40	55	5	10	28	
The Islet Grassholm	51	43	55	5	28	40	
Smalls Lighthouse	51	43	14	5	40	86	
St. David's Cathedral	51	52	56	5	14	53	
Ramsey Island; highest point	51	51	43	5	20	44	
Bishop and Clerks; northernmost	51	54	10	5	23	6	
Cardigan Isle; highest point	52	7	54	4	41	26	
Cardigan Steeple	52	4	59	4	39	17	
Aberystwith; Lighthouse	52	24	48	4	5	24	
Aberystwith; Station	52	25	49	4	3	19	
Holyhead Lighthouse	53	18	50	4	37	76	
Skerries Light	53	25	15	4	36	25	
Bardsey Lighthouse	52	44	58	4	47	55	
South Stack Lighthouse	53	18	23	4	41	54	
The West Mouse	53	25	4	4	33	11	
Amlwch Station	53	23	0	4	19	17	
Great Orme's Head; Signal	53	20	6	3	51	7	
Abergelé or Abergali Steeple	53	17	8	3	34	57	
Air Point Lighthouse	53	21	24	3	19	15	
Leasowe Lighthouse	53	24	46	3	7	28	
Bidstone Lighthouse	53	24	2	3	4	23	
Blackrock Lighthouse	53	26	38	3	2	2	
Liverpool; St. Paul's Church	53	24	30	2	59	30	
Formby Lighthouse	53	32	19	3	3	55	
Formby N.W. Mark	53	32	32	3	5	28	
Rossal Point Landmark	53	55	15	3	2	56	
Fleetwood New Lighthouse	53	55	35	3	0	22	
Wyre Lighthouse	53	57	12	3	1	46	
Lancaster Steeple	54	3	4	2	48	14	
Walney I. Light	54	2	54	3	10	33	
St. Bees Head; Lighthouse	54	30	48	3	38	8	
Whitehaven; Pier-head Lighthouse	54	33	10	3	35	50	
Lee Scar Lighthouse	54	51	46	3	24	43	

ENGLAND AND WALES—Continued.

	Latitude.	Lon. W.	Authorities.
	° ′ ″	° ′ ″	
Skinburness Lighthouse ..	54 52 46	3 22 46	The Grand Trigonometric or Ordnance Survey of England.
Workington Chapel......	54 38 28	3 34 11	
Southerness; Lighthouse	54 52 22	3 35 37	
Criffell; Station in the Survey, 1,831 ft. above the sea	54 56 44	3 36 55	
Isle of Man.			
Point of Ayre Light....	54 24 56	4 22 1	
North Berule; Station, 1,804 feet high......	54 17 27	4 23 32	
Snea Fell; Stat. 2,400ft.	54 15 50	4 27 35	
Calf of Man, Upper Lighthouse	54 3 14	4 49 37	
Peel; Lighthouse......	54 12 45	4 42 33	

NOTES.

1. The Maritime Surveys of our coasts are now so complete (with some partial exceptions,) that little can be desired for the use of the navigator. These works, based chiefly upon the Ordnance Survey, would occupy too much space here to enumerate, but it would seem to be somewhat unjust if no allusion was made to the predecessors of our present government surveyors, who, with very limited means and great personal labour produced such excellent charts, that even in the present day they would be most trustworthy guides. The names of the two Murdoch Mackenzies, Græme Spence, and Joseph Huddart, deserve all gratitude.

2. *On the inside of Plymouth Breakwater* is a landing-pier, and on the East end of this, which is about equi-distant from either end of the breakwater, is a granite pillar, with a brass plate, on which is engraved its correct latitude and longitude, 50° 19′ 59″, and 4° 8′ 52″ W. Here ships of war, by Admiralty Order, rate their chronometers before proceeding to sea.

Admiral FitzRoy has remarked in his voyage of the 'Beagle,' that the longitude of this station, by the Ordnance Survey, would be 4° 7′ 41″·7; but, by applying a portion of the error detected by Dr. Tiarks, in his chronometric observations between Greenwich and Falmouth, viz. 47″·09″, or 1′ 1″·35, the corrected longitude of the station will be 4° 8′ 52″. "Our chronometers made it 0′ 40″·2 to the eastward of the corrected longitude, and 0′ 19″·6 to the westward of the original determination by the Ordnance Survey."—*Captain FitzRoy's Appendix*, p. 320.

3. St. Agnes' Lighthouse, Scilly.—The observations made for determining the situation of St. Agnes' Lighthouse, at the commencement of the third voyage of Captain Cook, proved to be incorrect. It appeared from these observations, to be in latitude 49° 55′, longitude 6° 45′. This error, of more than 25 minutes of longitude, was very injurious; inasmuch as many Charts were subsequently regulated by the deduction. For, the Lizard Point having been previously determined by Dr. Bradley, these islands were, in consequence, placed that distance too far from the Land's End. Notwithstanding this great error, however, it does not appear that it was the cause of any serious disaster to shipping.

VARIATIONS OF THE COMPASS, 1861.

In the latter part of this volume, some observations on the general subject will be found, among which, the secular change, which has now increased to a considerable amount, since many of the surveys were made, and which therefore requires attention, the more especially since the introduction of an improved class of instruments, and the care demanded in the navigation of iron-ships. We here give the present variation, reserving such remarks upon former results, for the section specially devoted to the subject.

The variation is now decreasing on the south-east Coast of England at the rate of about 6′ 27″ per annum; on the north-east of England about 6′ per annum, and on the west coast, about 5′ 20″.

The *Westerly Variation* at Greenwich is 21° 20′. In 1853 it was 23° 8′; in 1855, 21° 46′; in December, 1858, 21° 29. In the Thames mouth, at the Nore, 20° 3′; off the North Foreland, 20° 35′. When Græme Spence made his survey in 1795, it was 22° 50′; it went on increasing till 1818, and has since decreased. Off Hastings, it is now 21° 0′; at Spithead, in 1813, it was nearly 25°, and at Portsmouth Observatory it was stated to be 24° 15′; it is now 21° 45°; at Poole, Dorsetshire, it is 22° 0′; at Dartmouth, 22° 40′; At Plymouth, 23° 0′; at the Scilly Islands, 24°.

At Bristol it is 22° 35′; at Cardiff, 23° 0′; at Milford Haven, 24°; at Lundy Island, 23° 50′; at Bardsey Island and Holyhead, 24° 10; at Liverpool, about 23° 33′ (in 1838, it was 26°); in the fairway of the Irish Sea, 24° 40′; the Isle of Man, 24° 50′.

On the Eastern Coast, it is at Yarmouth, 20° 50′; Cromer, 21° 0′; Lynn Deeps, 21° 30′; Hull, 22° 0′; Hartlepool and Tees Bay, 23° 0′; the Tyne, 23° 25′; Berwick-on-Tweed, 24° 0′.

2. ISLANDS AND COASTS OF SCOTLAND.

	LAT. N. ° ′ ″	LON. W. ° ′ ″	AUTHORITIES.
EDINBURGH; the Observatory ....[1]	55 57 23	3 10 46	The GRAND TRIGONOMETRICAL or ORDNANCE SURVEY of Great Britain, at present under the direction of COLONEL SIR HENRY JAMES.
Inchkeith Lighthouse..[2]	56 2 1	3 8 5	
Isle of May Lighthouse ..	56 11 8	2 33 21	
East Lomond 1471 ft.....	56 14 31	3 13 10	
Fifeness	56 17 0	2 34 40	
Bell Rock Lighthouse	56 26 4	2 23 7	
Dundee Law	56 28 41	2 58 26	
Buddon-ness; High Light	56 28 7	2 44 53	
Arbroath; the Abbey	66 33 45	2 34 53	
Red Head	56 36 55	2 29 24	
MONTROSE: Round Tower	56 42 5	2 26 6	
——— Spire	56 42 31	2 27 51	
Girdleness Lighthouse....	57 8 15	2 3 2	
ABERDEEN; Marischal College	57 8 57	2 5 42	
Aberdeen Lighthouse	57 8 33	2 4 6	
Old Aberdeen; Northern blunt Spire	57 10 11	2 6 3	
Belhelvie or Orrock; Dovecote................	57 15 52	2 3 57	
Buchanness Lighthouse ..	57 28 14	1 46 22	
Peterhead; Old Mill	57 30 44	1 47 32	
Rattery Head; Pile......	57 36 52	1 50 39	
Fraserburgh Lighthouse ..	57 41 51	2 0 6	
Kinnaird Head Lighthouse	57 42 0	2 1 0	
Troup Head; Staff	57 41 38	2 17 38	
Macduff; Spire	57 40 5	2 30 0	
Covesea Skerries; Lighthouse	57 43 15	3 20 20	
TARBETNESS; Lighthouse	57 51 55	3 46 31	
Noss Head; Lighthouse ..	58 28 38	3 2 5	
Duncansby Head; Station	58 40 22	3 1 7	
Dunnet Head; Lighthouse	58 40 19	3 22 29	
ORKNEY.—Pentland Skerries; Upper Lt[8]	58 41 26	2 55 23	
Stromness; Church	58 57 49	3 23 41	
Hoy; Wart Hill	58 42 2	3 20 19	
Cantick Head; Light ..	58 47 0	3 31 50	

ISLANDS AND COASTS OF SCOTLAND—Continued.

	LAT. N. °	'	"	LON. W. °	'	"	AUTHORITIES.
Start Point of Sanda; Lighthouse	59	16	42	2	22	30	The Grand Trigonometrical or Ordnance Survey, as before stated.
North Ronaldshay; Lighthouse	59	23	5	2	22	10	
Stronsay; Station in Survey	59	5	38	2	32	34	
Fair Island; Summit	59	32	54	1	37	50	
Foul Island; summit (1,369 feet)	60	8	28	2	5	40	
North Rona Island	59	7	16	5	48	47	
SHETLAND.—Sumburgh Head Lighthouse..[4]	59	51	17	1	16	23	The Observations of Mr. Geo. Thomas, R.N., on his Survey of Shetland, &c., 1825 to 1833.
Brassa Island; summit	60	7	51	1	5	49	
Lerwick; the Fort Flagstaff	60	9	22	1	8	41	
Gardie House on Brassa	60	9	24	1	7	40	
Whalsey Island; summit	60	20	1	1	0	22	
Brury Isle, Out Skerries	60	2	41	0	45	2	
Yell Isle; Reafrith Kirk	60	35	55	1	3	46	
Strandburg Ness, Fetlar	60	33	51	0	33	36	
Fetlar Isle; summit	60	37	12	0	51	56	
Haaf Gruna; summit	60	39	44	0	50	24	
Balta Island; summit	60	45	3	0	47	17	
Saxavord; Stn. in Survey	60	49	39	0	50	20	
Lambness, on Unst	60	49	0	0	45	40	
Burraford Holmes	60	51	0	0	53	30	
Ramna Stacks	60	39	36	1	18	40	
Ve Skerries, off Saint Magnus Bay	60	22	30	1	49	10	
Fugloe Skerry, near Papa	60	20	15	1	45	0	
Scalloway Castle	60	8	31	1	16	25	
Western Coasts							The Admiralty Survey, based on the Ordnance Triangulation.
Holburn Head	58	37	30	3	31	50	
Cape Wrath; Lighthouse	58	37	33	4	9	52	
Laxford; N. W. Point	58	24	40	5	8	20	
Ru Stoer, Light Building	58	15	52	5	22	12	
Butt of the Lewis	58	31	0	6	15	35	
RuRea; Station in Survey	57	50	8	5	45	53	
Stornoway Lighthouse, in Lewis	58	11	30	6	22	10	
Cleisham in Lewis	57	57	49	6	48	38	
Glash or Scalpa; Lighthouse	57	51	26	6	38	3	
Storr Hill, in Mull	57	30	25	6	10	52	
St. Kilda; Peak at N.E. end	57	49	2	8	35	30	
Ben More, S. Uist; Statn.	57	15	31	7	17	35	
Barra Head; Lighthouse	56	47	8	7	39	9	
Skerryvore Lighthouse	56	19	24	7	6	45	
Ardnamurchan Point Lighthouse	56	43	45	6	13	30	
Tobermorey, Mull; Lt. on Runa Gal Rock	56	38	35	6	8	40	
Lismore Lighthouse; Sound of Mull	56	27	20	5	36	23	
Ben Tartevil, on Tart-a-bhaile, Islay Island	55	43	32	6	26	32	

ISLANDS AND COASTS OF SCOTLAND—CONTINUED.

	LAT. N. ° ′ ″	LON. W. ° ′ ″	AUTHORITIES.
Rhynns of Islay Lighthouse	55 40 23	6 30 44	The ORDNANCE SURVEY, &c.
Jura Island; North Pap, 2659 feet	55 54 8	6 0 8	
Mull of Cantyre; Lighthouse	55 18 38	5 48 8	
Sanda Island; Ship Rock Light	55 16 30	5 34 55	
Campbelltown; Devaar Lt.	55 25 45	5 32 16	
Goat Fell, Arran Island ..	55 37 52	5 11 24	
Ben Lomond; Station in Survey	56 11 24	4 37 52	
Troon Lighthouse........	55 34 37	4 41 39	
Pladda Lighthouse; Arran Island	55 25 30	5 7 2	
Little Cumbrae; New Lighthouse	55 43 16	4 57 57	
Toward Point; Lighthouse	45 51 44	4 58 43	
Ayr Lighthouse	55 28 9	4 38 11	
Corsewell Point; Lighthouse	55 0 25	5 9 30	
Mull of Galloway; Lighthouse	54 38 5	4 51 22	
Southernness Lighthouse..	55 52 22	3 35 37	

NOTES.

1. EDINBURGH.—The geographic position of the Astronomical Observatory on the Calton Hill, was given by the Ordnance Survey, in 1816, as 3° 10′ 54,″ W. But this result appears to have been affected by a singular cause, which demonstrates the refinement to which these operations have been carried. It has since been found that the attraction of the mass of Arthur's Seat, (a hill to the southward of it,) has drawn the plumb-line (or zenith sector) towards it, and thus produced an error of several seconds in the calculation. This error was established in 1839, by Professor Henderson, who made the longitude 3° 10′ 45″. Some very interesting experiments were made on this curious point, during the late Ordnance Survey, by which, not only the effect of mountainous masses on surveying operations was ascertained, but also the density of the earth was established.

Since the completion of the triangulation of the Ordnance Survey, a new principle for ascertaining the difference of longitude has come into operation. The extension of the electric telegraph has placed Greenwich Observatory in direct connexion with most other important observatories; and in April, 1857, a series of instantaneous signals was transmitted between it and Edinburgh, under the direction, at the latter place, of Professor Piazzi Smyth, the worthy son of the excellent Admiral Smyth, well known to all sailors. These experiments definitely settled its longitude at $12^m\ 43^s.048$ in time, or 3° 10′ 45″.72 in arc, confirming Mr. Henderson's previous result.

2. EASTERN COASTS OF SCOTLAND.—The Eastern Coasts of Scotland have all been well surveyed by our Admiralty, upon the basis of the Ordnance triangulation. The off-shore soundings, however, are not yet completed.

3. ORKNEYS., &c.—The Orkney Islands were originally surveyed by the elder Mackenzie. Murdoch Mackenzie, F.R.S., was the first surveyor of our coasts who conducted his operations on right principles. His first work, *Orcadia; or the Orkney Islands, with part of Lewis*, was done at his own expense. Its accuracy is great, and its utility is still unequalled. It was published in 1750. He was afterwards employed by the king in surveying the coasts of Ireland, &c. Later in life, his

works were attacked, most unjustly, by Dr. Anderson, which called forth suitable replies, and justification from John Clark, of Eldin, in 1785. This work may be said to have commenced the Admiralty Surveys.

They have since employed very many years of examination under the late Commander Thomas, R.N., and others.

4. West of Scotland, and the Hebrides.—Up to quite a recent date, the charts of the whole of this portion of our shores remained nearly in the same state that they were left by Murdoch Mackenzie. Notwithstanding their imperfections, however, statistics have shewn that no great detriment to navigation arose from their "disgraceful" condition, an epithet which will take 25 years of organized surveying parties, and £250,000 to remove. We may here add that they were examined, and partially surveyed, by Captain Joseph Huddart, whose charts were long of good service.

3. COASTS OF IRELAND, ETC.

	Lat. N. °	′	″	Lon. W. °	′	″	Authorities.
The Northern Coast.							
Tory Island; Lighthouse	55	16	27	8	15	0	The Surveys of Captain Wm. Mudge, R.N., F.R.A.S., made in co-operation with the Grand Trigonometrical Survey of Ireland, 1828-52.
Fannet Point; Lighthouse	55	16	34	7	37	52	
Innistrahul; Lighthouse..	55	25	56	7	13	37	
Inishowen Head; Lighthouse	55	13	38	6	55	38	
Magilligan Tower, L. Foyle	55	11	32	6	57	58	
Port Rush	55	12	30	6	50	15	
Bengore Head ....[1]	55	15	0	6	28	35	
Rathlin Isle; Church	55	17	35	6	12	2	
——— Lighthouse	55	18	10	6	10	40	
Knocklaid Mountn. (1690ft)	55	9	43	6	14	57	
Fair Head	55	13	30	6	9	30	
The Eastern Coast.							
Tor Point	55	11	50	6	4	10	
Garron Point	55	3	0	5	58	30	
The Maidens; South Rock Light	54	55	54	5	43	5	
Hunter Rock (9 feet)	54	52	45	5	45	30	
Black Head	54	46	0	5	42	0	
Carrickfergus Castle	54	42	35	5	49	15	
Belfast; Mouth of the Lagan	54	36	0	5	56	0	
——Divis Mount (1800 ft.)	54	36	40	6	1	0	
Bangor Castle	54	39	20	5	40	40	
Copeland Lighthouse	54	41	45	5	31	80	
Donaghadee; Pier Head	54	38	38	5	32	25	
Ballyhalbert; Fort	54	29	30	5	28	10	
South Rock, Lighthouse..	54	23	56	5	25	4	
St. John's Point; Lighthouse	54	13	4	5	39	30	
Slieve Donard, (2797 feet)	54	10	48	5	55	9	
Carlingford Lighthouse ..	54	1	11	6	4	4	
————Hill (1580 feet)	54	2	39	6	13	9	
Clogher Head	53	47	40	6	14	0	
Drogheda; Centre	53	42	50	6	22	0	
Balbriggan Light	53	36	46	6	10	53	
St. Patrick's Island	53	34	45	6	5	20	
Rockabill Lighthouse	53	35	45	6	0	30	
Lambay Island; summit..	53	20	20	6	2	0	

COASTS OF IRELAND, ETC.—CONTINUED.

	LAT. N.			LON. W.			AUTHORITIES.
	°	′	″	°	′	″	
Howth Hill; peak (565 ft.)	53	22	23	6	4	3	The GRAND TRIGONOMETRICAL SURVEY of Ireland, and the Surveys of the late Captain MUDGE and other Officers, 1828-52.
Howth Bailey; Lighthouse	53	21	4	6	3	5	
Poolbeg Lighthouse	53	20	31	6	9	1	
DUBLIN; Nelson's Pil.[2]	53	21	0	6	16	45	
Kingstown; Lighthouse ..	53	18	5	6	9	0	
Wicklow Head Upper Light	52	57	54	6	0	5	
Tara Hill	52	41	56	6	12	58	
Forth Mountain	52	18	57	6	33	39	
Roslare Sand Hill	52	19	45	6	22	21	
Tuskar Lighthouse	52	12	9	6	12	22	
THE SOUTHERN COAST.							
Saltees Light-vessel	52	2	18	6	38	15	
Coningmore Rock	52	4	45	6	37	49	
Hook Lighthouse, near Waterford	52	7	24	6	55	43	
Helwick Head	52	3	6	7	32	40	
Mount Knockmeldown ..	52	13	33	7	55	0	
Roche Point; Lighthouse	51	47	33	8	15	14	
Robert Head	51	43	55	8	20	0	
Kinsale; Southern Light..	51	36	11	8	31	58	
Stags of Castlehaven	51	28	15	9	13	46	
Cape Clear; Old Lighthouse ....[3]	51	26	2	9	29	30	
Fastnet Rock, Lighthouse	51	23	18	9	36	25	
Crookhaven; Lighthouse	51	28	35	9	42	31	
Mizen Head	51	27	15	9	50	0	
Mount Gabriel	51	33	30	9	32	0	
Sheep Head	51	32	55	9	51	40	
Hungry Hill; Station in Survey.	51	41	13	9	47	27	
RoanharricR. in Bantry Bay	51	41	5	9	47	6	
Signal Tower, Bear Island	51	37	43	9	53	40	
THE WESTERN COAST.							
Dursey Island, South Point	51	35	5	10	14	10	
Bull Rock ....[4]	51	35	50	10	18	30	
Skelligs; Lighthouse	51	46	6	10	32	20	
Valentia Isle; Fort Cromwell	51	56	50	10	19	15	
———— Feaghmaan Station at West end [4]	51	55	22	10	20	41	
Doulus Head	51	57	6	10	19	0	
Dunmore Head, Dingle Bay	52	6	3	10	29	0	
Foze Rock	52	1	0	10	39	40	
Inishtuiskero Island......	52	7	20	10	34	30	
Mount Brandon, Station..	52	14	6	10	15	10	
Kilcradan Head, Lighthouse	52	34	4	9	42	34	
Scattery I., Round Tower	52	36	42	9	31	15	
Loop Head, Lighthouse ..	52	13	38	9	55	56	
Mutton Island, Lighthouse	53	15	14	9	3	10	
Arran Island, Lighthouse	53	7	38	9	42	6	
Slyne Head, N. Lighthouse	53	23	59	10	14	1	
Inishgort Lighthouse	53	49	35	9	40	12	

COASTS OF IRELAND, ETC.—Continued.

	LAT. N. ° ′ ″	LON. W. ° ′ ″	AUTHORITIES.
Clare Island, Lighthouse..	53 49 38	9 58 58	The Grand Trigonometrical Survey, &c.
Achil Head	53 58 20	10 16 0	
Slieve More, Achil Island	54 0 35	10 3 26	
Eagle Island; Lighthouse	54 16 59	10 5 32	
Tawnaghmore, Station ..	54 17 39	9 35 47	
Telling or Teelin Head ..	54 40 30	8 46 10	
RathlinO'Birne Lighthouse	54 39 47	8 49 52	
St. John's Point, Lighthouse	54 34 8	8 27 33	
Ballyshannon Church	54 30 11	8 11 47	
Slieve League (*summit* 1979 feet)	54 39 5	8 42 38	
Bloody Farland (*summit* 1060 feet)	55 8 14	8 15 41	
Muckish Hill; Eastern part	55 6 21	7 59 49	

NOTES.

1. The positions of places on the Irish coasts depend upon the observations made in the Trigonometrical or Ordnance Survey. The principal triangles, commencing with the measurement of the base on the east side of Lough Foyle, in 1826-8, have been extended over the whole area, between that period and 1832, and give results which may be practically taken as absolutely correct.

Since that period, the minute surveys of the land on a very large scale, have also been completed; and upon this basis our Admiralty surveyors have constructed our present charts, by adding the soundings and maritime features outside the low water-line. This series has only recently been completed for the use of the sailor, as shewn on our charts. The names of Mudge, Bedford, Wolfe, Beechey, Frazer, Church, and other officers, should be mentioned in connexion with these operations.

2. Dublin.—The Astronomic Observatory, 3 miles N.W. of Dublin, in latitude 52° 23′ 13″, and longitude 6° 20′ 30″, is a point verified by triangulation as well as by observation.

3. South-West Coasts.—The surveys by Mackenzie, for many years the only guide to the mariner, placed all the south-west part of Ireland several miles too far to the south, an error, however which has been corrected a long period.

4. Valentia.—One of the most important geodetical operations in connexion with the Ordnance Survey, was the chronometric determination of the difference of longitude between Valentia and Greenwich, in December, 1845. This arc, one of the largest that could be measured in the British Isles, has been of very great importance, as well in verifying the accuracy of the Trigonometrical Survey, as in determining the true figure of the earth. It was carried on by Professor Airy, the Astronomer Royal, assisted by Mr. Sheepshanks, Mr. Hartnup, Mr. Hind, and several other observers, by means of 30 pocket chronometers. The stations were Greenwich, Liverpool Observatory, a temporary observatory at Kingstown, and Feaghmaan, at Valentia. The final determination of the longitudes chronometrically, were—Liverpool, $12^m\ 0^s.05$; Kingstown, $24^m\ 31^s.20$; and Valentia, $41^m\ 23^s.23$. By the Ordnance Survey, these longitudes were made,—Liverpool, $12^m\ 0^s.35$; Kingstown, $24^m\ 31^s.48$; and Valentia, $41^m\ 23^s.07$.

VARIATIONS OF THE COMPASS, 1861.

Dublin, 25° 25′ W.; Wicklow and the Tuskar Rock, 25° 0′ W.; Waterford, 25° 12′ W.; Cork, 25° 50′ W.; Kinsale, 26° W.; Fastnet Rock, 26° 25′ W.; Valentia, 26° 40′ W.; Mouth of the Shannon, 26° 50′ W.; Galway, 26° 45′ W.; Broadhaven, 27° 35′ W.; Donegal Bay, 27° W.; Lough Foyle, 26° 45′ W.; Raghlin Island, 26° W.; Belfast, 25° 42′ W.; Lough Strangford, 25° 30′ W.

4. NORWAY AND SWEDEN.

	LAT. N.			LON. E.			AUTHORITIES.
	°	′	″	°	′	″	
Trænen Island; summit[1]	66	30	20	12	4	30	The TRIGONOMETRICAL SURVEY, made by order of the Norwegian Government, by CAPT. VIBE, &c., as explained in the Notes.
Mangvardkua; conical beacon	66	18	30	12	41	20	
Donnæs öe; Church at N. end	66	12	5	12	36	30	
——— Björn Market-pl...	66	5	0	12	35	30	
——— Donnæs Fjeld....	66	2	0	12	24	0	
Alsten öe; Syv Sostre Mts. S. one..................	65	55	0	12	32	0	
Skjærvær I; Klep harbour	65	46	45	11	35	40	
Sola Island; summit	65	40	20	11	45	0	
Vegen Island; Gulsvaagfjeld Mountain	65	39	15	11	51	0	
——— Vegtinden Mt. ..	65	37	45	11	54	0	
Sjelva beacon, off Minland	65	42	25	12	19	50	
Höiholmtinderne Mt., S. peak	65	36	0	12	26	0	
Ana[illegible]tten Mountain ..	65	33	32	12	26	0	
Kvalöe; summit	65	13	30	12	1	0	
Helgeland Oflissen beacon, off Kvalöe............	65	13	10	11	54	30	
Heilhornet; remarkable Mountain...........	65	4	32	12	9	12	
Leköe; summit	65	4	43	11	37	30	
Vigten Islands; outer Island, N.E. point	64	58	25	11	11	0	
————Sulafjeld Mount.	64	54	0	10	49	0	
————Indre or Inner Id., Rorvig on E. side......	64	51	30	11	15	0	
Folden Fjord; Grinna beacon on North side......	64	45	10	10	59	20	
Kværnholmen beacon	64	47	25	11	9	30	
Præstoe Light, near Nærðe	64	43	35	10	46	45	
Gjöen; Brakstad	64	40	20	11	13	40	
Otter öen; Findanger Fjeld	64	36	25	11	7	0	
Halmöe; Villa Lighthouse	64	32	46	10	41	56	
Oxbaasheia; Village at North end	64	32	30	10	25	50	
Buholmene, cone beacon ..	64	25	0	10	26	20	
Vigs Sjelen; summit	64	15	30	10	24	0	
Osen, Church	64	17	45	10	31	30	
Alminding oe; Hvalhovden or S. point.........	64	10	0	10	1	30	
Fro öerne; Halten Island; centre..................	64	10	35	9	28	0	
Leikua beacon, off Lysö ..	63	55	40	9	57	30	
Suuls Fjord; Sulen Tower	63	50	45	8	33	10	
Fröien Island; Titterodden, or West point	63	40	5	8	22	10	
Uiv ö; centre	63	40	30	9	10	0	
Great Kopperen Hill; on Mainland	63	48	4	9	43	0	
Hitteren Island; W. point	63	29	36	8	25	0	
——Omdasfjeld on N. side	63	33	35	8	38	0	
Trondhjem Channel; Terningen Lighthouse	63	20	35	9	9	0	

NORWAY AND SWEDEN—Continued.

	LAT. N. ° ′ ″	LON. E. ° ′ ″	AUTHORITIES.
Trondhjem Channel; Agddenæs Lighthouse......	63 38 15	9 49 30	The TRIGONOMETRICAL SURVEY, made by order of the Norwegian Government, by CAPT. VIBE, &c., as explained in the Notes.
TRONDHJEM; Munkholmen Light................	63 27 10	10 24 50	
———Cathedral [2]	63 25 49	10 23 45	
Smoelen Island; Maaberg Tuva on North side	63 26 38	8 0 30	
Eddö; Trondhjem S. channel, Light on Ringholm	63 18 45	8 13 25	
Grib Islands,——centre ..	63 14 0	7 35 0	
Stavenæs Lighthouse	63 7 20	7 38 15	
Aver ö, N.E. point....... ———Mæknokken Mt. ..	62 59 0	7 32 30	
Christiansand; Light on Leervig Island	63 6 30	7 42 0	
Frey öen; Frey Kollen Mt.	63 2 30	7 44 0	
Qvitholm; Lighthouse ..	63 2 15	7 12 30	
Stevshest; summit	62 59 0	7 12 0	
Böesund; Boeværet church	62 55 0	6 54 15	
Sandö; Church	62 49 31	6 35 0	
Romsdals Oerne; Harr ö church	62 47 0	6 28 10	
———Harams ö; Church at W. end	62 39 40	6 10 50	
———Lepsö; Light-vessel on reef	62 35 30	6 14 30	
Walderö; Light on S point	62 30 5	6 7 25	
God-ö; Light on Hogstein Point	62 28 0	6 1 20	
———Lt. on Halnæs Tang	62 30 0	5 58 10	
Hessö; Sugar Loaf	62 27 50	6 4 50	
Rondö; Lighthouse......	62 35 0	5 35 10	
Svinö; centre	62 19 35	5 16 10	
Stadtland; Quitenæs at North end............	62 12 15	5 14 15	
———Fureness ..	62 5 30	5 8 5	
Bremanger Land; Olderveggen Point..........	61 50 20	4 46 40	
Froe Soen; Smor Haven..	61 45 30	4 58 0	
Battalen; summit	61 38 0	4 49 30	
Kind ö; summit	61 32 50	4 45 25	
Alden; summit..........	61 29 0	4 48 0	
Bue Land; Ytsteen	61 17 30	4 36 10	
Udvær; Anchorage	61 2 30	4 30 30	
Feye Oosen; Light on Hellisö	60 45 0	4 43 5	
Bergen North Channel; Holmengraa	60 50 40	4 40 15	
———Holzenö; Light on Skællanger	60 36 30	4 57 20	
Bergen; Cathedral	60 23 30	5 21 0	
———Light on Nordnæs	60 24 0	5 18 42	
Leerö; Light on W. side..	60 14 0	5 11 0	
Kors Fjord; Marsteen beacon	60 7 45	5 2 2	

NORWAY AND SWEDEN—Continued.

	LAT. N. °	′	″	LON. E. °	′	″	AUTHORITIES.
Piir holm Light	60	5	15	5	12	20	The Trigonometrical Survey, &c., as before stated.
Selbö; Oxhammer Lt. on East end	59	59	15	5	14	0	
Selbö Fiord; Furren beacon	59	58	0	5	4	50	
———Slotterö Light ..	59	54	30	5	5	0	
Stoksund; Light on Folger öe..............	59	48	0	5	20	0	
Bommel Fiord; Ryvarden Light	59	31	40	5	14	40	
Roevaer Island; Light on Gletta	59	25	40	5	8	0	
Särhougsund; N. entrance Light	59	25	15	5	15	30	
Udsire Island; Two Lighthouses	59	19	30	5	20	20	
Karmö; Skudesnæs Lighthouse	69	9	10	5	17	0	
Bukkesund; Light on Bukken	59	13	15	5	29	0	
Hviddings ö; Lighthouse	59	3	57	5	23	6	
Stavanger; Church......	58	58	12	5	45	15	
Tungenæs; Lighthouse ..	59	2	0	5	36	45	
Rotö; Anchorage	58	55	30	5	31	0	
Egefield; summit.........	58	51	30	5	36	45	
Jedderen Reef; W. extreme	58	45	30	5	29	0	
Warhoug; Church	58	37	18	5	37	50	
Ekersund; Vibberodden Lighthouse ....[3]	58	25	20	5	59	35	
Varnæs Lighthouse	58	10	35	6	37	20	
Lister Lighthouse on Gunnarshoug	58	6	35	6	34	10	
Lindesnæs or Naze; Lighthouse	56	58	48	7	3	0	
Ryvingen beacon	57	58	10	7	30	0	
Helleö; beacons	58	3	5	7	51	5	
Christiansand; Church ..	58	8	4	8	3	2	
Odderö; Lighthouse	58	8	10	8	0	30	
Oxö; Lighthouse.........	58	4	25	8	3	35	
Ulvö; Outer beacon......	58	6	50	8	13	5	
Justö beacon on Reierskjær	58	11	50	8	23	45	
Homborgö; beacon at E. end.................	58	15	20	8	31	30	
Hesnæs; beacon	58	20	20	8	41	0	
Torungen; Inner Lighthouse	58	24	50	8	48	0	
Sandvigodden Lighthouse	58	26	20	8	47	25	
Hiser ö; Outer Lighthouse	58	24	5	8	47	45	
Tromö; Church	58	27	10	8	52	15	
Tromö Sund; Bonden beacon at Entrance	58	31	30	8	59	40	
Sandö; cone beacon at N.E. point	58	36	10	9	5	5	
Österrisör; Stangholmen Lighthouse	58	42	40	9	15	0	
ondelov; Church........	58	46	0	9	5	28	

NORWAY AND SWEDEN—CONTINUED.

	LAT. N. ° ′ ″	LON. E. ° ′ ″	AUTHORITIES.
Kragerö; S. end of Town	58 52 0	9 25 20	The TRIGONOMETRICAL SURVEY, by Lieut. Schie, and Messrs. Diriks and Wille.
Jomfruland Lighthouse	58 52 10	9 36 15	
Langötangen; Lighthouse	58 59 45	9 45 50	
Frederiksværn; Staværnsö Lighthouse	58 59 10	10 4 30	
Little Færder Lighthouse	59 2 5	10 32 5	
Fulehuk Lighthouse	59 11 0	10 36 45	
Christiania; New Observatory	59 54 42	10 43 28	
Torbiornskiær; beacon	58 59 15	10 49 0	
North Koster Lighthouse	58 54 10	11 0 0	
Segelskiær	58 46 35	11 0 40	
Stromstad; Church	58 56 18	11 12 25	
Great Waderö	58 34 55	11 5 0	
Hällö Lighthouse	58 20 30	11 13 0	
Karingo beacon	58 6 25	11 20 0	
Marstrand; Carlsten Light	57 53 30	11 35 0	
Winga Lighthouse	57 38 0	11 36 0	
Gotheborg town	57 41 55	11 56 40	

NOTES.

1. COAST OF NORWAY.—The Trigonometrical Survey of the Western coasts of Norway to the northward of Trondhjem, was commenced by Lieut. Vibe, assisted by Lieuts. Paludan and Hagerup, in June, 1828, by order of the Norwegian Government. It was continued by those officers, under the direction of Captain Vibe, to the frontiers of Russian Lapland, till 1849. Their elaborate charts, published at intervals, between 1835 and 1849, shew the extraordinary features of this coast, a complete labyrinth of islets and rocks, which all written description must utterly fail in giving any notion of. We have given the positions of the more prominent landmarks, but there are few points which can be made available for the mariner's use, except the information afforded by their valuable charts.

2. TRONDHJEM, &c.—The ancient cathedral of Trondhjem or Drontheim, once one of the finest in Europe, lies as stated in the table, and was the northern limit of the survey carried on by the Danish Government, prior to the transfer of the courts to Sweden.

The coasts to the south were trigonometrically and astronomically surveyed by Commissioner N. A. Vibe, before mentioned, assisted by Lieut. D'Aubert, and Captain C. F. Grove, as far as Stavanger and Egefield. The charts issued under Admiral Klint, (a well-known name,) leave little to be desired, and the nature of the country, the geological formation being of primary gneiss, granite, and other very hard rocks, will prove that but little change can arise from the wear of the sea.

3. EKERSUND OR EGGERSUND, &c.—The charts of the south coast of Norway, between Eglefield and Jedderen and Christiansand, were published in 1800. The triangulation was carried on by the same officers as before mentioned, Captains Grove and Vibe, and Lieut. D'Aubert.

This section of the coast is dependant on the positions of Stavanger and Christiansand Churches. Lindersnæs, or the Naze of Norway, as it is generally called, was made by the triangulation to be in latitude 57° 58′ 0″ N. By the Astronomical observations of Messrs. Rich and Vibe, in 1781, 57° 58° 48″ N.

Between Ekersund and Christiansand, the triangulation was re-examined in 1855-6, by Lieut. Schie, assisted by Herr C. Diriks and Lieut. H. Wille; between Arendal Jomfruland, these operations were carried on by the same officers in 1853-5. The portion of coast between Arendal and Christiansand was examined in 1854-5, by Herr Diriks and Lieut. Wille, under Major Vibe.

VARIATIONS OF THE COMPASS, 1861.

At the Trænen Islands, 16° W. (It was observed as 19° in 1837); at the Vigten Islands, between 17° and 18° W.; at Trondhjem, 17° 40′ W.; Christiansand 19° 42′ W.; at Stadtland, 21° W.; at Bergen, 20° 35′ W.; at Stavanger, 20° 0′ W; at Ekersund, 19° 45′ W.; at the Naze, 19° 10′ W.; at Arendal, 18° W.; at Christiania Fjord, 17° W.; at Gotheborg, 15° 40′ W.

These variations are now *decreasing* at the rate of 6′ to 6′ 30″ per annum.

5. DENMARK, GERMANY, AND HOLLAND.

	LAT. N.			LON. E.			AUTHORITIES.
	°	′	″	°	′	″	
WEST COAST OF DENMARK.							The Chart published by the DANISH GOVERNMENT 1841.
Skagen or Skaw Point; New Lighthouse	57	44	9	10	37	56	
Hirtshals; extreme point	57	35	25	9	56	30	
Löibierg; Horne Church	57	35	15	10	0	0	
Venneberg; Church	57	27	28	9	49	30	
Lökken; Life-boat house	57	22	0	9	42	40	
Börglum Kloster; mansion	57	22	5	9	47	40	
Bolbierg Bluff (360 feet) ..	57	9	7	8	59	30	
Hantsholm; Lighthouse ..	57	6	50	8	36	10	
Klitmölle	57	2	55	8	30	0	
Blokkenbierg	56	49	45	8	14	56	
Agger Channel; Light-vessel in entrance	56	45	30	8	12	15	
Husby; Church	56	7	45	8	10	45	
Holmsland; New Sogns Church	56	16	55	8	10	55	
Ringkiöbing; Church, 5 miles inland	56	5	30	8	15	0	
Nymind Gab; Entrance	55	47	40	8	11	25	
Blaavands Huk; extreme	55	33	30	8	4	15	
Horn Reef; Outer patch, 16 feet	55	30	0	7	41	5	
Hjerting; Landing place	51	31	35	8	21	10	
Fanö; Nordby N. beacon	55	27	30	8	23	30	
Manö; Church..........	55	16	25	8	31	40	
Romö; St. Clemens Church	55	6	55	8	32	30	
Sylt Island; Lighthouse on List, or north end	55	3	10	8	23	40	
——Rode Klif, or red Cliff Light	54	57	42	8	20	0	
——Hornum Odde; Station in Survey	54	45	58	8	16	32	
Amrum; St. Clemen's Church at Nebel	54	39	22	8	21	35	
——Lighthouse at S.end	54	38	28	8	22	32	
Fartrapdyb; entrance....	54	36	0	8	13	30	
Smalldypt; outer buoy ..	54	30	0	8	17	0	
Föhr Island; Wyk Church	54	41	25	8	34	12	
Dagebüll harbour light ..	54	43	40	8	41	20	
New Hever Channel; outer buoy	54	19	0	8	25	0	
Husum; Church	54	28	45	9	3	10	
Ording; Church	51	20	15	8	36	25	

DENMARK, GERMANY, AND HOLLAND—CONTINUED.

	LAT. N. °	′	″	LON. E. °	′	″	AUTHORITIES.
Eider Channel; Lightvessel	54	10	45	8	34	35	
Eiderstedt; Hitz Bank beacon	45	17	10	8	39	0	
Tonning; South Church ..	54	18	55	8	56	30	
Büsum; Harbour	54	7	40	8	51	50	
Helgoland; Lighthouse ..	54	10	49	7	53	0	
Bösch Sand beacon ....[1]	54	5	30	8	37	50	
Elbe River; Light-vessel, No 1.	54	0	10	8	18	11	
—— Scharhörn beacon ..	53	57	16	8	24	35	
—— Light-vessel No. 3...	43	58	30	8	31	50	The Survey made by the PRUSSIAN ADMIRALTY—1858-9.
HANOVER, OLDENBURG &c.							
Neuwerk High Lighthouse	53	55	3	8	29	50	
Kugel or Ball beacon	53	53	20	8	41	18	
Cuxhaven Lighthouse	53	52	28	8	42	20	
Glückstadt; Pier Light ..	53	47	25	9	25	50	
ALTONA; Observatory....	53	32	45	9	56	39	
Hamburg; Observatory ..	53	31	59	9	58	31	
Weser River; New Channel Lightship	53	48	25	8	8	20	
———Ever Sand beacons	53	4	15	8	21	30	
——Bremer beacon Lighthouse	53	42	50	8	14	40	
Longwarden; Church....	53	36	20	8	18	32	
Bremerhaven; Church ..	53	32	48	8	34	15	
Bremen; Observatory....	53	4	36	8	42	48	
Jade River; Minsener Olde Ooge beacon	53	46	45	8	0	35	
Hooksiel; Windmill	53	38	0	8	1	22	
Heppens; Navy Harbour Entrance	53	31	0	8	9	20	
———Waterworks tower	53	31	3	8	7	43	
Wangeroog; New Lighthouse	53	47	28	7	53	59	
———— Church	53	47	32	7	51	5	
Spikeroog, centre	53	45	30	7	42	0	
Langeroog; beacon on Osterende	53	45	25	7	35	55	
———Osterende village	53	45	0	7	29	0	
Baltrum; Village at W. end	53	44	5	7	22	50	
Norderney beacon	53	43	20	7	9	50	
——; Conversation House	53	42	25	7	8	35	
Juist; Eastern Village....	53	40	40	7	0	0	
COAST OF HOLLAND [2]							
Borkum; Light tower ..	53	35	10	6	40	16	The Great TRIANGULATION by BARON KRAYENHOFF, and the Surveys of Admiral Ryk, Capts. Keuchenius, and Van Rhyn.
Rottum; House	53	32	20	6	31	46	
Delfzyl; Church	53	19	58	6	55	38	
Emden; Church	53	22	2	7	12	15	
Schiermonnik-oog; High Lighthouse	53	29	19	6	9	42	
Ameland; Hollum church Tower	53	26	12	5	38	31	
Terschelling; Brandaris Lighthouse	53	21	40	5	12	54	

DENMARK, GERMANY, AND HOLLAND—CONTINUED.

	LAT. N. ° ′ ″	LON. E. ° ′ ″	AUTHORITIES.
Harlingen; W. Ch. Tower	53 10 29	5 24 45	
Vlieland; Lighthouse near East end	53 17 48	5 3 31	
—— Posthuis near West end	53 14 44	4 59 3	
Franeker; Steeple	53 11 14	5 32 42	
Makkum; Church tower	53 3 37	5 23 59	
Bolsward; church tower	53 3 55	5 3 35	
Hindeloopen; tower	52 56 37	5 23 57	
Stavoren; Church tower	52 52 57	5 21 39	
Urk Island; Church tower	52 39 46	5 35 38	The GREAT TRIANGULATION by BARON KRAYENHOFF, and the Surveys of Admiral Ryk, Capts. Keuchenius and Van Rhyn.
Vollenhoven; station	52 40 53	5 57 4	
Muiden Church	52 19 54	5 4 11	
AMSTERDAM; West tower of Cathedral [3]	52 22 32	4 5 2	
Monnikendam	52 27 29	5 2 3	
Enkhuisen; Church tower	52 42 15	5 17 35	
WieringenOosterlandtower	52 55 55	5 0 40	
Eyerland; beacon at N.E. point	53 9 50	4 50 10	
Texel; Oostereind Tower	53 5 5	4 53 40	
——Hoorn; Church tower	52 38 30	5 3 32	
Willemsoord; Time ball on the palace [5]	52 57 50	4 46 36	
Kykduin Lighthouse	52 57 5	4 43 20	
Calandsoog; Steeple	52 50 10	4 41 35	
Egmond aan-Zee; Lighthouse	52 37 10	4 37 20	
Zandvoort; Lighthouse	52 22 28	4 31 38	
Nordwyk; Lighthouse	52 14 35	4 25 43	
Katwyk; Lighthouse	52 12 2	4 23 28	
LEIDEN; Observatory [4]	52 9 28	4 29 9	
Scheveningen Lighthouse	52 6 17	4 16 4	
Voorne Island; Brielle Lighthouse	51 54 11	4 10 40	
———Hellevoetsluis; time ball on the hospital	51 49 25	4 7 44	
Goedereede; Church Tower Light	51 49 8	3 58 32	
———Stone beacon Light, on North side	51 48 54	3 55 22	
Schouwen Island; Brouwershaven Mill	51 43 32	3 54 32	
———Renisse; East Light	51 44 32	3 47 52	
———Lighthouse at W. end	51 42 33	3 34 30	
———Zierikzee; Great Tower	51 39 2	3 54 52	
Walcheren Island; Veere great Tower	51 32 52	3 40 2	
———West Kapelle; Lt. on Church Tower	51 31 46	3 26 49	
——Middelburg tower	51 30 0	3 35 31	
——Flushing or Vlissingen; time ball at the Arsenal	51 26 20	3 35 16	

DENMARK, GERMANY, AND HOLLAND—CONTINUED.

	LAT. N.	LON. E.	AUTHORITIES.
	° ′ ″	° ′ ″	
BELGIUM.			The GREAT TRIANGULATION by BARON KRAYENHOFF, &c.
BRUSSELS; Royal Observatory ....[5]	50 51 11	4 17 13	
Paard Markt Lightvessel	51 23 40	3 20 0	
North Hinder Lightvessel	51 36 40	2 34 35	
Heist; Lighthouse	51 20 0	3 14 0	
Blankenberg; Light on Fort	51 18 55	3 8 0	
Ostende; New Light .. :	51 14 25	2 55 57	
Nieuport; Light at Entrance...............	51 8 25	2 43 50	

NOTES.

1. ELBE and WESER RIVERS.—The details given in the table, are taken from the New Survey of these entrances, made by the Prussian Admiralty, and published in 1859. The longitudes are dependant on that of the well-known Observatory at Altona.

2. HOLLAND.—The charts of the Coasts of Holland, are based upon the great triangulation of that country, by the Lieut-General C.R.T., Krayenhoff, the account of which was published in 1813. Upon the points thus established, the coasts and channels about Vlieland, Ameland, &c., were surveyed by the late Captain-Lieut. S. J. Keuchenius, published in 1831-34; the Texel Channels by Lieut. A. Van Rhyn, 1840; the Zuider Zee, by the same in 1841; the Schelde Channels, by the late Vice-Admiral J. E. Ryk, 1841; Goeree and the Maas, by the same, in 1827; and Brouwershaven Gat, by Captain Keuchenius, 1826. These fine surveys are deserving of all confidence.

3. AMSTERDAM.—The triangulation of the Baron Krayenhoff was dependant on the position of the western tower of the Cathedral of Amsterdam, which was considered to be in longitude 4° 53′ 16″.86 E. Its true longitude, by electric signal, appears to be as shewn 4° 53′ 2″.55 E. By a Government notice, dated August 1st 1826, Greenwich is named as the first meridian for Netherlands hydrography.

4. LEIDEN.—The National Observatory of Leiden was established in 1854, under Professor Kaiser. Its longitude was obtained by electric telegraph time-signals, between Paris and Leiden, and is fixed at $17^m\ 56^s.60$ in time, or 4° 29′ 9″.0. E. in arc. From this longitude, that of Amsterdam, and all others have been regulated.

4. TIME SIGNALS have been established at Willemsoord for the Nieuwe Diep, at Hellevoetsluis, and at Flushing. They were placed in electric connexion with the Observatory at Leiden, in September, 1859.

5. BRUSSELS.—The Observatory at Brussels was considered by the observations conducted therein, to be in latitude 50° 51′ 10″.7, longitude, $0^h\ 17^m\ 29^s.0$ in time, E. of Greenwich. Although this position may not affect those of the coast, which were obtained by an independent process of triangulation, yet the change in the assumed longitude of the Observatory of Paris, with corresponding alterations in the relative connexions between that and other observatories, will affect the longitudes of places on the coasts, in such a minute degree, it is true, that it is perfectly inappreciable by the means at the ordinary sailor's command; yet it is noticed here to shew to what refinement these operations are carried on. It will also demonstrate the almost insuperable difficulty there is in arriving at an exact conclusion. This subject has been alluded to in connexion with the Edinburgh Observatory, and will be hereafter with that of Paris.

In 1859, a series of instantaneous electric signals was made to connect the observatories of Brussels, Berlin, Altona, &c., and the longitude of Brussels, as given by M. Quetelet, comes out as $17^m\ 28^s.9$, or 4° 17′ 30″.50, East of Greenwich—a very close approximation to the independent assumption.

VARIATIONS OF THE COMPASS.—1861.

At the Scaw Point, 16° 25′ W.; at Hantsholmen, 17° 43′ W.; at the Horn Reefs, 17° 45′ W.; at Hamburg, 16° 0′ W.; Bremerhaven 17° 0′; Helgoland, 17° 40′ W.; Emden; 17° 50′ W.

At Terschelling, 18° 45′ W.; at the Texel and Amsterdam, 19° 0′ W.; at Urk, &c., 18° 30′; Brouwershaven, Walcheren, &c., 19° 20′; Ostende, 19° 45′ W.

These variations are decreasing at the rate of 6′ 30″ per annum.

6. COASTS OF FRANCE.

	LATITUDE.	LONGITUDE.	AUTHORITIES.
NORTHERN COAST.	° ′ ″	° ′ ″	
PARIS; Imperial Observatory ....[1]	48 50 13	2 20 9 E.	Originally from the triangles intended merely for the admeasurement of the degrees of the meridian in France, but ultimately carried on throughout the kingdom. These were commenced by M. Picard, who effected an admeasurement between Paris and Amiens in 1669, and finally completed by Messrs. Mechain and Delambre, in 1798; after having exercised the abilities and industry of M. Cassini the elder, his son, and grandson; and of MM. Miraldi and De la Caille, with other of the most eminent French astronomers, &c., to the present time.
Belgian Frontier; Corps de Gard ....[2]	51 4 55	2 31 13 —	
Bergues; great Spire	50 58 8	2 26 20 —	
Dunkirk; great Tower ..	51 2 12	2 22 33 —	
——Leuguenaard Tower	51 2 28	2 22 41 —	
Cassel; Western Mount ..	50 48 1	2 15 48 —	
Gravelines; Church Spire	50 59 10	2 7 44 —	
Oye; Station in Survey ..	50 58 43	2 2 32 —	
Calais; Spire	50 57 33	1 51 9 —	
—— New Lighthouse..	50 57 45	1 51 7 —	
Coquelles; West Mill	50 55 41	1 48 53 —	
Blanc-Nez; Guard-house..	50 55 33	1 43 34 —	
Mont Couple; summit....	50 52 17	1 33 11 —	
Gris-Nez Lighthouse	50 52 10	1 34 56 —	
Ambleteuse; Windmill ..	50 48 45	1 37 34 —	
Boulogne; Colonne de la Grand Armée	50 44 31	1 37 0 —	
—— Cathedral	50 43 38	1 36 53 —	
Cape d'Alprec'h Lighthouse	50 41 57	1 35 41 —	
Cornel Pt. Light	50 33 38	1 34 36 —	
Étaples	50 30 52	1 38 30 —	
Touquet; S. Light	50 31 43	1 35 11 —	
Berck; Light on Haut-Banc	50 23 52	1 33 24 —	
Cayeux Lighthouse	50 11 42	1 30 41 —	
Tréport, Steeple	50 3 39	1 31 21 —	
Dieppe; St. Jacques Ch.	49 55 35	1 4 38 —	
Ailly Lighthouse	49 55 7	0 57 30 —	
St. Valery en Caux; Chapel	49 53 12	0 42 47 —	
Fécamp; Abbey	49 55 22	0 21 50 —	
C. d' Antifer	49 44 17	0 9 46 —	
C. La Hève; N. Lighthouse	49 30 46	0 4 4 —	
Le Havre; Steeple of Notre Dame	49 29 15	0 6 24 —	
Honfleur; Western Light	49 25 32	0 13 38 —	
Oyestreham Church......	49 16 38	0 15 33 W.	
Merville	49 22 24	0 44 21 —	
St. Marcouf Is., Lighthouse	49 29 55	1 8 52 —	
La Hougue Lighthouse ..	49 34 27	1 16 36 —	
Cape Barfleur Lighthouse	49 41 50	1 16 2 —	
Cherbourg; Fort Central on the Digue.........	49 40 28	1 37 14 —	

COASTS OF FRANCE—Continued.

	Latitude. ° ′ ″	Longitude. ° ′ ″	Authorities.
Querqueville; Spire	49 39 55	1 42 0 W.	
Cape La Hague; Lighthouse	49 43 21	1 57 21 —	
Alderney; East Mill	49 42 52	2 22 7 —	The Survey by Capt. Martin White, R.N.
Casquets; S. Lighthouse	49 43 22	2 22 42 —	
Guernsey; St. Pierre Pier head	49 27 0	2 33 0 —	
Jersey; St. Helier, Victoria Pier	49 10 33	2 7 18 —	
Chausey Island; Lighthouse	48 52 13	1 49 40 —	
C. Carteret; Lighthouse	49 22 27	1 48 31 —	The excellent Surveys of the Coast by the French Engineers, under the direction of M. Beautemps Beaupré, 1830-31. The account of the operations has been drawn up by M. Bégat.
Granville; Lighthouse	48 50 7	1 36 52 —	
Cape Fréhel; Lighthouse	48 41 5	2 19 15 —	
Le Rohinet; Islet	48 40 33	2 28 53 —	
Cape d'Erqui	48 38 45	2 29 24 —	
Les Comtesses; Western Rock	48 38 58	2 34 36 —	
Grand Lejon (Rock)	48 45 0	2 39 58 —	
Harbour Isle, off St. Quay	48 40 2	2 48 35 —	
Isle Bréhat; N. E. Point	48 51 54	2 59 21 —	
Héaux de Bréhat; Lighthouse	48 54 33	3 5 17 —	
Les Sept Iles; Lighthouse	48 52 46	3 29 33 —	
Ile de Bas; Lighthouse near the West end	48 44 45	4 1 42 —	
Ouessant or Ushant; Lighthouse	48 28 31	5 3 31 —	
The Bay of Biscay.			
Lampaul	48 33 40	4 38 5 —	
Kermorvan; Lighthouse	48 21 44	4 47 31 —	
St. Mathieu; Lighthouse	48 19 49	4 47 57 —	
Portzic; Lighthouse	48 21 29	3 32 10 —	
Brest; St. Louis	48 23 20	4 28 14 —	
Crozon; Church	48 14 48	4 28 38 —	
Bec du Ras; Lighthouse	48 2 22	4 44 3 —	
Ile de Sein; Lighthouse	48 2 35	4 52 9 —	
Penmarc'h; Lighthouse	47 47 53	4 22 36 —	
Penfret; Lighthouse	47 43 17	3 57 21 —	The Hydrographic Surveys of the Western Coasts of France, made under the direction of M. Beautemps Beaupré; an Exposition of which, by M. Daussy, was published at Paris, by authority, in the years 1829 and 1839.
Ile de Groix; Western Lighthouse	47 38 55	3 30 41 —	
Port Louis; St. Pierre	47 42 31	3 20 34 —	
Belle Ile; Lighthouse on S.W. Point	47 18 43	3 13 43 —	
——; Borderun Signal	47 21 1	3 13 55 —	
Ile Hœdic; Lighthouse	47 20 32	2 52 11 —	
Le Four; Lighthouse	47 17 53	2 38 9 —	
Aiguillon; Lighthouse	47 14 33	2 15 0 —	
Pilier; Lighthouse	47 2 36	2 21 55 —	
Ile d'Yeu; Lighthouse	46 43 5	2 23 0 —	
St. Gilles sur Vie	46 41 46	1 55 14 —	
La Chaume; Lighthouse	46 29 42	1 47 50 —	
Sables d'Olonne; Lighthouse	46 29 28	1 47 35 —	

Remarks.

It is to be remarked, that the longitudes, as given in the *Connaissance des Temps*, compared with those in the Charts of the

COASTS OF FRANCE—Continued.

	LATITUDE.	LONGITUDE.	AUTHORITIES.
	° ′ ″	° ′ ″	
Ile de Ré; Baleine Lighthouse	46 14 44	1 33 48 W.	*Pilote Français*, constructed between 1816 and 1827, under the direction of *M. Beautemps Beaupre*, show a difference amounting to, at the least, 51.5, the former Survey being so much less; which is occasioned by the latter determination of the geographical position of Crozon, near Brest, as explained in the Note. The corrected longitudes are given in the Table.
——Port of St. Martin	46 12 26	1 21 57 —	
Rochelle; Harbour Light	46 9 21	1 9 30 —	
Oleron; Chassiron Lighthouse	46 2 52	1 24 47 —	
Isle of Aix; Harbour Light	46 0 36	1 10 48 —	
Point de la Coubre; Light	45 41 30	1 15 25 —	
Port of Royan; Light	45 37 8	1 1 54 —	
Cordouan Lighthouse	45 35 14	1 10 30 —	
Pauillac; Harbour Light	45 11 55	0 44 46 —	
Bordeaux; West Point of St. André	44 50 16	0 33 55 —	
Point de Grave; Lighthouse	45 34 29	1 3 39 —	The Hydrographic Surveys.
Beacons East of Capbreton	43 39 26	1 25 44 —	
La Tête de Buch	44 37 57	1 8 13 —	
Signal Tower of the River Adour	43 31 36	1 30 6 —	
Bayonne	43 29 26	1 27 57 —	
Biarits; Lighthouse	43 29 38	1 33 40 —	
Socoa; Harbour Light	43 23 44	1 41 19 —	

NOTES.

Paris.—The grand operations, in point of accuracy, for the determination of the length of the degrees of the meridian, have taken place since 1783. In that year, a memorial was transmitted by M. Cassini de Thury to the Right Hon. Charles James Fox, then Secretary of State. This application caused the operations by General Roy, already explained, which afterwards extended into a General Survey. This gentleman, in England, acted in conjunction with Messrs. Cassini, Mechain, and Legendre, in France; but it unfortunately happened that the results of the two parties did not exactly agree; that of the British officers being, for the difference of longitude, 2° 19′ 51″, while that of the French was 2° 23′ 15″.

In order to determine this question, the subject was resumed in 1821, on the suggestion of the French authorities. The operations were consequently repeated under the direction of commissioners, nominated, respectively, by the Academy of Sciences and the Royal Society. An account of the operations and results have been given in the "Transactions" of the latter, and the determination was that 2° 20′ 22″ is the difference between the meridians of Paris and Greenwich. It was also attempted in 1825, by the respective governments on a plan suggested we believe by Mr. (now Sir John Herschel,) and Captain (now General) Sabine, and Colonel Bonne, of simultaneous observations of rocket signals at a chain of stations; but they failed on the French side, and the result, 2° 20′ 22″, was not considered satisfactory.

Notwithstanding the immense labour and consummate skill employed in these measurements, the results obtained were doubtful, and it was reserved for the private means of a commercial association to settle the question by means of the electric telegraph. The death of M. Arago, delayed the French preparatious which were organized when M. Le Verrier became Superintendent of the Paris Observatory, and several thousand signals were transmitted in 1854, so many, in fact, that a large portion were rejected, leaving 1700, or nearly 2,000, which were thought unexceptionable. Each observation is probably as accurate as the mean of all former observations, and the means of all shew previous results to be in error nearly a second of time (a large quantity in astronomy,) and which, corrected, is nearly certain to its hundredth part.

The mean result of these final electric observations, is that the D.L. between Greenwich and Paris Observatories, is $9^{m}\ 20^{s}.63$ of time, or 2° 20′ 9″.45 in arc.

We have been more diffuse, perhaps, than necessary on this point, but it is perhaps the most important geodetical operation ever undertaken.

2. The re-examination of the northern coasts of France and the triangulated Survey of the Western Shores was originated in 1814, by a memorial addressed to Louis XVIII. by Admiral Rosily, and Admiral Rossel, but from political events it was not commenced till 1816, and then M. Beautemps Beaupré started the Survey from Brest. The triangulation was based upon the carefully observed position of the Tour de Crozon, and carried out by M. Daussy down to the frontiers of Spain. The noble Atlas, since completed, is the best eulogy that can be presented for these important works.

VARIATIONS OF THE COMPASS—1861.

At Dunkirk, 19° 50′ W.; Calais, 20° 0′ W.; Dieppe, 20° 25′ W.; Le Havre, 20° 42′ W.; Cherbourg, 21° 36′ W.; Alderney, 22° 0′ W.; Jersey, 21° 45′ W.; St. Malo, 21° 15′ W.; Brest, 22° 25′; Ushant, 22° 50′ W.; Belle Isle, 22° 0′ W.; Mouth of the Loire River, 21° 0′ W.; Ile de Ré, 20° 20° 25′ W.; Corduan Lighthouse, 20° 18′ W.; Bordeaux, 19° 55′ W.; Bayonne and Socoa, 20° 0′ W.

7. COASTS OF SPAIN AND PORTUGAL.

	LATITUDE.	LON. W.	AUTHORITIES.
	° ′ ″	° ′ ″	
NORTH COAST OF SPAIN [1]			The valuable Surveys of Don VICENTE TOFINO, and Don JOSEF VARELA, of the Spanish Marine, and of Major FRANZINI, of the Portuguese Royal Engineers, corrected by later observations of M. Saulnier de Vauhello, Capt. Florez, Capt. W. H. Smyth, R.N., and others.
Cape La Higuera; Lighthouse	43 23 35	1 46 58	
Fuenterrabia............	43 21 46	1 47 0	
Port Passages; Cape La Plata Lighthouse	43 20 21	1 59 33	
San Sebastian; Mt. Igualdo Lighthouse	43 19 28	2 0 26	
Guetaria; Atalaya or tower	43 18 50	2 12 30	
Motrico; Atalaya	43 20 0	2 24 25	
Cape Machichaco; Lighthouse	43 28 0	2 49 26	
Punta Galea; Lighthouse	43 22 36	3 4 2	
Portugalete	43 20 0	3 3 0	
Bilbao; Bridge	43 15 10	2 55 25	
Castro Urdiales; Santa Ana Castle Light......	43 24 10	3 16 6	
Santona; Light Building on Mount	43 27 30	3 16 40	
Cape Ajo; extreme;	53 32 0	3 26 25	
Santander; Mouro Island Lighthouse	43 28 37	3 45 43	
Cape Mayor; Lighthouse	43 30 15	3 47 6	
San Martin de la Arena; Suances Church	43 26 10	4 0 35	
Cape Oyambre; extreme	43 25 30	4 20 55	
San Vicente de la Barquera	43 23 50	4 24 45	
Llanes; San Pedro Point	43 27 30	4 45 40	
Cape Prietro; extremity...	43 28 48	4 50 40	
Sella R.; E. point near Rivadesella	43 31 0	5 6 0	
Cape Lastres	43 33 20	4 17 45	
Gijon; Sta. Catalina Point Lighthouse	43 35 13	5 38 2	
——Cape Torres	43 37 0	5 39 0	

COASTS OF SPAIN AND PORTUGAL—CONTINUED.

	LAT. N. °	′	″	LON. W. °	′	″	AUTHORITIES.
Cape Peñas; Lighthouse..	43	42	20	6	50	20	The Charts published by the SPANISH GOVERNMENT, &c.
Aviles R.; Forçada Point	43	38	30	5	56	0	
Cudillero; Revallera Point Light................	43	36	10	6	9	3	
Cape Bidio; extreme	43	38	0	6	15	0	
Cape Busto; Lighthouse	43	36	10	6	28	48	
Ria de Navia; Campel Pt.	43	34	30	6	44	20	
Orrio de Tapia Island; Lighthouse	44	35	36	6	58	26	
Rivadeo; Pancha Island Lighthouse	43	34	40	7	4	15	
Foz; Point de los Cairos	43	35	25	7	16	0	
Port Vivero; Socastro Pt.	43	43	28	7	37	40	
Estaca Point; Lighthouse	43	47	30	7	43	24	
Cape Ortegal; extreme ..	43	46	10	7	56	50	
Candelaria Point; Tower	43	41	56	8	3	0	
Cedeira; Point Pantin....	43	40	48	8	6	5	
Cape Prior; Lighthouse ..	43	33	40	8	19	9	
Cape Priorino; Lighthouse on the Little Cape	43	27	50	8	20	33	
Ferrol; West Mole....[2]	43	28	35	8	14	25	
Coruña; Tower of Hercules Light................	43	23	0	8	24	8	
——— St. Antonio Castle	43	22	0	8	22	5	
Sisargas Is.; Lighthouse on I. Mayor	43	21	50	8	50	13	
Cape Villano; Lighthouse	43	9	50	9	12	58	
Camarinas; Mole	43	8	0	9	10	40	
WEST COAST OF SPAIN.							
ape Toriñana; extreme..	43	4	30	9	17	15	
ape Finisterre; Light-on S. extreme	42	52	39	9	15	24	
orcubion; Light on Cape Ce	42	54	50	9	10	8	
emedios Point; extreme	42	47	45	9	7	35	
uros Bay; Lourp Mt. on North side............	42	44	30	9	3	30	
ape Corrobedo; Light.	42	34	38	9	4	48	
alcoeiro Point; extreme	42	31	0	9	1	3	
rosa Bay; Sta. Eugenia Church	42	33	0	8	57	56	
———; Salbora Island; Light on South Point ..	42	27	50	9	0	23	
———; Carril Church	42	36	40	8	45	0	
———; Arosa Island; Light on North Point ..	42	34	8	8	51	58	
nza Island; Galera Point	42	20	7	8	54	30	
ontevedra Bay; Cape Udra	42	20	0	8	48	50	
———Pontevedra; centre	42	25	30	8	37	20	
yona or Cies Islands; Caballo or North Point	42	14	50	8	53	25	
———; Middle Island; Light on Mount Faro ..	42	12	2	8	54	6	

COASTS OF SPAIN AND PORTUGAL—CONTINUED.

	LAT. N. ° ′ ″	LON. W. ° ′ ″	AUTHORITIES.
Bayona Is.; Boeiro Island, off S. end	42 10 12	8 52 56	The Charts published by the SPANISH GOVERNMENT, &c.
Vigo Bay; Cape Hombre, rock off	42 14 45	8 50 40	
——Vigo; Castro Castle	42 13 35	8 41 30	
——N.S. de la Guia; Castle Light *	42 15 6	8 41 2	
——Cape Sentoulo; Mt. Ferro	42 8 50	8 49 0	
Bayona Church	42 6 45	8 49 0	
Cape Silleyro; extreme	42 6 0	8 52 7	
Orullada Point; extreme	42 1 0	8 53 0	
Minho River; Mount St. Tecla Chapel	41 5 50	8 49 25	
COAST OF PORTUGAL.			
River Minho; Castillo Point	41 50 6	8 48 30	
Viana; Castello de Santiago	41 41 25	8 43 45	
River Neiva; Entrance	41 37 30	8 42 0	
Esposende	41 31 0	8 39 30	
Villa do Conde	41 21 30	8 35 0	
River Douro; Light at N.S. de Suz [3]	41 9 9	8 37 10	Captain Sir Edward Belcher, R.N., 1833.
Oporto; San Joao de Foz	41 8 48	8 37 0	
Aveiro; Town	40 38 0	8 39 30	
Cape Mondego Lighthouse	40 12 0	8 55 12	
Peniche; Lighthouse on Cape Carvoeiro	39 21 8	9 24 16	
Berlengas; Light on great Island	39 25 0	9 30 17	
Farilhoens; centre	39 29 0	9 31 56	
Cape Roca; Lighthouse	38 46 6	9 30 0	
Tagus River; Bugio Fort Light	38 39 0	9 18 9	
LISBON; Observatory [4]	38 42 25	9 8 15	
Cape Espichel; Lighthouse	38 24 9	9 13 0	
Setuval or St. Ubes; Light on Fort d'Outao	38 31 9	8 53 0	
Cape Sines; Fort	38 0 0	8 51 30	
Cape Sardao	37 31 30	8 49 0	
Cape St Vicente; Convent Light	37 2 54	9 0 54	
Lagos; principal Church	37 8 40	8 37 45	
Piedade Point	37 6 54	8 37 30	
Villa de Nueva do Pontiñao	36 7 30	8 31 10	
Baliera Point	37 3 0	8 14 0	
Cape Santa Maria; Light	36 56 0	7 46 0	
SOUTH COAST OF SPAIN.			
Guadiana River; Ayamonte Mouth	37 11 0	7 18 0	
Odiel River; Lights for Huelva	37 13 22	6 51 34	

COASTS OF SPAIN AND PORTUGAL—CONTINUED.

	LAT. N. ° ′ ″	LON. W. ° ′ ″	AUTHORITIES.
Guadalquiver River; Pta. de Malandar Light	36 46 20	6 21 53	The Charts published by the SPANISH GOVERNMENT, &c.
San Lucar de Barrameda; great Church	36 45 5	6 22 10	
Chipiona; Church tower Light	36 44 15	6 25 46	
CADIZ; San Fernando Observatory........[5]	36 27 45	6 12 16	
——San Sebastian Castle; Light...........	36 31 10	6 18 54	
Cape Trafalgar; Tower on West side...........	36 10 45	6 2 12	
Pta. Gracia; Tower......	36 5 5	5 49 58	
Mt. Sella del Papa, summit (1567 feet)...........	36 6 16	5 46 20	
Pt. Paloma	36 36 20	5 42 40	
Tarifa; Lighthouse on S. point	35 59 47	5 36 45	
Pta. Acebuche	36 2 48	5 28 15	
Carnero Tower	36 4 30	5 25 50	
Algesiras; Verte I. Light	36 7 15	5 26 16	
Gibraltar; New Mole Light ....[6]	36 7 20	5 21 32	
Europa Point; Victoria Lighthouse	36 6 22	5 21 0	

NOTES.

1. The NORTH COAST OF SPAIN.—The whole of the North coasts of Spain were excellently surveyed and delineated by Don Vicente Toflño de San Miguel in the years 1787-81; at the same period that our hydrography was being enriched by the talent and labours of Mackenzie, Spence, and others. The Spanish Charts, still most useful, exhibit the minute details of this iron-bound coast with such fidelity, that but little change has been found necessary upon a re-amination. This doubtless is in some degree owing to the geological structure of the country, which, devoid of sloping beaches, presents a much more effective barrier to the degrading action of the sea, while the South-West Coast of France, at the bottom of the Bay of Biscay, is embarrassed by those immeuse collections of sand, &c., the debris of the coasts to the west of it, which is carried thither by the prevalent wind-waves and currents.

But while the details of this Survey are so excellent, later, and more correct observations shew that there are some great errors in the relative position of the principal points. This was detected, among other operations, by the early observations of M. Bory. and perhaps by the Spanish surveys, which were taken possession of by the French, at the investment of Madrid. Later, the Survey made by M. SAULNIÈR DE VAUHELLO, of the French Marine, shewed that Cape Machichaco was placed nearly 10′ too far eastward, and other points from 4′ upwards, also too far to the east. These great errors are now, if not entirely removed, so nearly adjusted, that the discrepances are too small to affect navigrtion. The positions, especially the longitudes, given in the table, are in accordance with the charts published by the Deposito Hidrográfico at Madrid in 1846.

2. COAST OF GALICIA.—The North-west coast of Spain was re-examined by

Capt. DON J. F. FLOREZ, of the Spanish Navy, in 1835-36. His Survey seems to shew the accuracy of his predecessor Tofiño. The positions of Captain Florez have been followed.

3. RIVER DOURO.—This river was surveyed by Commander (now Sir Edward) Belcher, R.N., in 1833. His determinations, which coincide with those made by Admiral W. H. Smyth, when a lieutenant, in 1811-12, serve to correct the positions previously given by Tofiño. In former editions of this work, we had to acknowledge our obligations in this, as in many other instances, to Admiral Smyth, for his improvements in hydrography. It is sufficient here to repeat them.

4. LISBON.—The longitude of Lisbon had been previously assumed as 9° 8′ 40″, being a mean result of observations made by the astronomers De la Caille. Pingré, and Messier, according to a great number of eclipses of the first satellite of Jupiter. The occultation of a star by the moon, October 5, 1753, with a corresponding one at Paris, gave one minute more. Captain Fitzwilliam Owen, in the memoir of his important expeditions to Portugal and Africa, assigns to the Arsenal of Lisbon 38° 42′ 18″ N., and 9° 8′ 54″ W., from observations made in H.M.S. *Leven*, in 1819 and 1822.

5. CADIZ.—The position of the Observatory in the city of Cadiz is established as 36° 32′ 0″ N., and 6° 17′ 30″ W. The New Observatory (*Real Observatorio*) of San Fernando, in the Isle of Leon, is in 36 37′ 43″ N., and 6° 12′ 16″ W.

6. GIBRALTAR, &c.—Mr. Charles Rumker gives the position of Europa Point, Gibraltar, as 36° 5′ 15″ W.—(*Edinburgh Phil. Journal*, vol i. p. 322.) The late Captain Bauza, of the Hydrographic establishment at Madrid, gave Tarifa in 36° 0′. This accords with Mr. Rumker; but Captain Livingston made the latitude of Europa Point, by sextant and artificial horizon, in 1820, 36° 6′ 10‴, and exactly the same on another day, by the sea horizon. Captain Symth has given Gibraltar in 36° 6′ 30″, and 5° 21′ 12″.

It is to be observed that Lieutenant Raper adopts 5° 21′ 17″, as the longitude of the Mole (or Europa Point in 5° 22° 0″), and this is from the observations of Captain Smyth; Captain Shirreff, 5° 20′ 16″; and Captain Vidal, 5° 21′ 42. This position is important, as it affects the longitudes of the West Coast of Africa.

The Hydrographic features of the important Strait of Gibraltar appear to have been very imperfectly known, and a single sounding made by Captain Smyth, which brought up water containing three times the ordinary quantity of salt, has served as material for speculation ever since. It is singular, that amongst the thousands of ships which have passed through this channel, not one should have recorded an attempt to verify such an important point. The depth, too, appears to have been much misunderstood, and overrated, the greatest being about 500 fathoms, instead of above 1000 fathoms, as was argued from one imperfect experiment. These facts have been brought to light by the Survey made by the French Government, by M. C.A. Vincendon Dumoulin, underthe orders of the indefatigable Capt. Ch. Philippe de Kerhallet in H.I.S. Phare, in 1854-5.

VARIATIONS OF THE COMPASS—1861.

At Fuenterrabia, 20° W.; Bilbao, 20° 35′ W.; Santander, 21° 0′ W.; Cape Peñas, 21° 45′ W.; Cape Ortegal, 22° 40′ W.; Coruña, 22° 3′ W.; Corcubion and Cape Finisterre, 22° 50′ W.; Vigo, 22° 45′ W.; Minho River Entrance, 22° 30′ W.

At Villa do Conde, 22° 15′ W.; Lisbon, 21° 50′ W.; Cape St Vincent, 21° 25′ W. Cape Sta. Maria, 21° W.; Cadiz, 23° 25′ W.; Cape Trafalgar, 20° 10′ W. Tarifa, 19° 52′ W.; Gibraltar, 19° 48′ W.

These variations are *decreasing* at the rate of from 2′ in the S.W. portions of the coast, to 4′ per annum in the Eastern parts.

8. COAST OF AFRICA.

	LAT. N. °	′	″	LON. W. °	′	″	AUTHORITIES.
Ceuta; Almina Pt. Light	35	53	38	5	17	3	Capt. C. P. de Kerhallet and M. C. A. Vincendon Dumoulin.
Sierra Bullones or Apes Hill; (summit)........	35	53	35	5	25	0	
Tangier Bay; Cape Malabata, tower	35	48	50	5	45	12	
Tangier; N.E. part of town	35	47	5	5	48	40	
Cape Spartel; Pitch ..[1]	35	47	0	5	56	0	
Arzilla	35	29	30	6	0	0	Captain Washington and Lieutenant Smith, R.N., 1830.
El Araiche	35	12	50	6	9	0	
Old Mamora..........	34	52	30	6	25	0	Captain T. Boteler, R.N., 1828.
Mehedia..............	34	18	0	6	36	0	Captain Washington, R.N., 1830.
Faz or Fez	34	6	3	4	58	15	Don Juan Badia y Leblich, otherwise called Ali Bey, 1804.
Mekinez	33	58	30	7	30	0	
Slaa or Salee..........	34	2	45	6	45	30	Captains Boteler and Washington 1828 and 1830.
Rabat................	34	2	30	6	46	0	
El Mansoria ....[2]	33	46	10	7	20	0	
Point Fidallah	33	44	0	7	23	32	Captain Washington and Lieutenant Smith, R.N., on the Mission to Marocco, 1829, 1830; and the Survey of Lieutenants William Arlett and H. Kellett, in 1835.
Dar-el-Beida..........	33	36	30	7	35	24	
Azamor	33	17	37	8	15	0	
Mazagan	33	15	0	8	29	0	
Cape Blanco; North	33	8	0	8	38	0	
El Waladia	33	48	0	8	48	0	
Cape Cantin	32	32	27	9	14	50	
Asfee or Saffi	32	18	15	9	12	0	Captain T. Boteler, R.N., 1828.
MAROCCO; Centre ....[3]	31	37	0	7	36	0	Don Juan Badia and Captain Washington.
SUERRAH, or MOGODOR ..	31	30	30	9	46	0	
Cape Tefelneh	31	4	0	9	47	30	Lieutenant Arlett.
Cape Ghir or Geer	30	38	0	9	53	0	Captain T. Boteler, 1828.
Ras Aferni ....[4]	30	37	30	9	52	0	The Chevalier de Borda, 1776.
Agadir, or Santa Cruz....	30	26	35	9	35	56	Observations of Lieutenants Arlett and Kellett, R.N., 1835.
Cape Aguluh	29	49	0	9	48	0	
Cape Nun, or Inoon......	28	45	45	11	4	10	
Porto Cansado; Entrance[4]	28	2	0	12	14	0	
Cape Juby..............	27	57	50	12	51	0	
False Cape Boiador	26	25	15	14	12	30	Lieutenant Arlett, &c., 1835.
Cape Boiador, or Bojador	26	7	2	14	30	34	
Penha Grande; summit ..	25	7	6	14	50	53	
Seven Capes; Central Cape	24	41	12	15	0	30	
Angra dos Cavallos	24	8	12	15	36	18	The observations of Captain W. Fitzwilliam Owen, and those of M. le Baron Roussin, compared with those of the Chevalier Borda. (*See Note* 4.)
Rio do Ouro, or Gold River; Entrance, North Point..	23	36	18	15	58	30	
Cintra Bay; North Point	23	7	0	16	9	15	
———; South Point	22	56	36	16	14	10	
Cape Barbas ....[5]	22	19	30	16	39	12	
Pedra da Gall; Centre ..	22	12	30	16	48	4	*** In 1830, Captain Belcher, by repeated observations, found Capo Blanco in latitude 20° 46′ 26″, longitude 17° 4′ 10″.
Cape Corvoeiro .. ...[6]	21	46	44	16	56	40	
Cape Blanco	20	47	0	17	4	36	
Cape Mirik; the Down ..	19	25	0	16	32	0	
Tanit Bay; the Down....	19	3	48	16	12	20	
Angel's Hillocks; Southern	18	29	30	16	2	0	
The Two Palm Trees of Portandik ....[7]	18	18	54	16	2	12	H.M.S. *Esk*, Captain Purchas, 1826.
Down of Red Sand	17	25	0	16	12	0	Latitudes, Captain Roussin; Longitudes inferred by Chart, and uncertain.
Second ditto	16	55	0	16	25	0	
Huts of Inguiagher	16	35	24	16	30	0	

COAST OF AFRICA—Continued.

	LAT. N. ° ′ ″	LON. E. ° ′ ″	AUTHORITIES.
St. Louis, Senegal; Lighthouse on Govt. House ..	16 0 48	16 31 1	Captain (afterwards Admiral and Baron) Roussin, in the years 1817 and 1818.
Bar of the Senegal; North Point	15 55 18	16 30 0	
Little Paps, near Cape Verde; Northern one ..	14 56 24	17 4 30	
Cape Verde; extremity	14 44 30	17 32 0	Captain Roussin, and M. Givry.
Almadia Rocks, off C. Verde; Highest and Westernmost	14 44 29	17 33 30	Captain Fitzwilliam Owen.
Goree; the Lighthouse [8]	14 39 50	17 24 30	Captains Owen and Boteler.
Cape Naze	14 31 30	17 7 20	
Portudal; Village........	14 27 18	17 3 12	Captain W.F. Owen, R.N., 1824.
Point Serine	14 18 0	16 56 30	Captain T. Boteler, 1829.
Joal; Town	14 10 0	16 49 45	Captains Owen and Boteler.
RIVER GAMBIA:—			
Bathurst Town; Flagstaff	13 28 0	16 35 18	Survey of the River Gambia, from its Entrance to Pisania, by Captain Richard Owen, R.N., assisted by Messrs. E. O. Tudor and S. M. Mercer, 1826.
Bird Island; Flagstaff..	13 39 12	16 40 30	
Cape St. Mary ..[9]	13 30 12	16 41 24	
James Fort	13 9 40	16 22 12	
Tankrowell	13 25 0	16 3 48	
Elephant Isle: West Point	13 26 30	15 20 36	
Yamamaroo Town	13 42 0	14 58 30	Survey of the River Gambia, &c.
M'Carthy's Isle; Fort George	13 33 0	14 45 30	
Pisania, or Pisaneea....	13 31 54	14 34 18	
Bald Cape	13 22 30	16 49 20	
Point St. Pedro	13 7 15	16 48 0	Captain Thomas Boteler, in H.M. sloop *Hecla*, 1829.
River Souta; Bird Islet ..	12 43 30	16 49 0	
River Casamanza; North Point of the entrance ..	12 35 20	16 48 0	
Cape Roxo	12 21 0	16 44 40	
Breakers of Falulo; West Point	12 5 0	16 38 30	Captains Roussin and W. F. Owen, 1818, 1821, 1826.
Isle of Cayo; South Point	11 49 50	16 20 0	
Bissao; Portuguese Fort	11 51 0	15 37 6	
BIJOOGA ISLANDS, &c.			
Papakawa Islet........	11 36 30	15 54 12	
Arcas Isle; Centre	11 41 15	15 39 0	
Bolola Town; Rio Grande	11 35 0	15 2 18	Survey of the Bijooga Islands, and the adjacent Coast of Africa, by the officers of H.M. ship *Leven*, Captain W. F. Owen, 1826.
Bulama Island; East End	11 34 42	15 30 24	
Bossessamé, or Tombelly; North Point	11 29 0	15 30 0	
S.W. Point	11 19 24	15 32 12	
Gallinha Isle; West Point	11 27 42	15 46 30	
N. E. Hog Island; E. Point	11 20 0	15 40 42	
Kanyabac; N.E. Point	11 18 4	15 43 0	
——————; S.W. Point	11 10 12	15 48 12	
Orango; S.E. Point ..	11 3 12	15 55 12	
————; West Point ..	11 6 0	16 15 30	

*** In 1830, *Captain Belcher*, in H.M.S. *Etna*, from his observations, made Pullam Island, South end, in 10° 51′ 53″ N., and 15° 43′ 5″ W.; the North end of Alcatraz, in 10° 38′ 1″ N., and 15° 20′ 30″ W.

COAST OF AFRICA—CONTINUED.

	LAT. N. ° ′ ″	LON. W. ° ′ ″	AUTHORITIES.
South Breaker	10 56 18	15 57 40	Sandy Isle in 10° 36′ 37″ N, and 14° 42′ 19″ W.—*Geog. Journal*, vol ii. pp. 284, 291, 295.
Pullam Island; South Point	10 51 42	15 45 6	
Alcatras Islet; Centre ..	13 37 12	15 26 30	
Conflict Reef; Centre....	10 30 0	15 11 0	
Rio Nunez; Entrance, Sand Isle	10 36 37	14 42 0	Captain (now Sir E.) Belcher.
———; Rebucko Town	10 57 0	14 21 48	Lieut. Austin, in the *African*, 1827.
Cape Verga; Summit....	10 11 40	14 28 5	
Pongas River; Entrance	10 2 0	14 6 0	Captain Belcher.
Mount Kakulimah	9 45 0	13 28 0	
ISLES DE LOS:—			
Crawford Isle Establishment...............	9 27 24	13 48 30	
Tamara; Arethusa, or North Point	9 31 0	13 40 30	
———; West Point	9 26 30	13 51 30	
Matacong Island; Centre	9 14 0	13 25 30	
Yelleboa Island; Centre ..	8 55 42	14 17 45	Captain W. F. Owen, in the *Leven*, 1826; confirmed by himself in the *Eden*, and by Captain Purchas in the *Esk*, 1827.
Parrot Island; Centre....	8 53 0	13 15 0	
CAPE SIERRA LEONE; Extremity, lighthouse[10]	8 30 0	13 17 45	
SIERRA LEONE; King Tom's Point	8 30 6	13 14 30	
———Freetown Citadel	8 29 42	13 14 18	
False Cape; Extremity ..	8 25 48	13 17 48	
Cape Chilling or Shilling	8 9 30	13 10 12	
Banana Isles; Highest peak	8 5 48	13 16 12	
———; West Point	8 5 0	13 15 12	
Plantain Islands; Gillmorris	7 55 12	13 3 12	
———; Bengal Rocks..	7 54 36	13 2 48	
…assa; Extreme Point ..	7 55 30	13 2 12	
Turtle Isles; North Isle; Centre	7 40 48	13 4 18	
Cape St. Anne; Extremity	7 34 0	12 57 0	
Shoals of St. Anne:—			Captain W. F. Owen, in the *Leven*, 1826.
Northern Extremity ..	7 56 0	(Not ascertained.)	
Southern Extremity ..	7 31 30		
Western Limit	7 38 0	13 29 0	
York Isle, in Sherbro' River; Huts...........	7 32 0	12 26 42	
…hebar, Sherbro' River ..	7 22 48	12 31 30	
…oom Kittam River; Forks	7 14 24	12 8 36	
River Galinhas; Entrance	7 0 1	11 38 5	Capt. A. T. E. Vidal, in H.M. ships Etna and Raven, 1835 to 1839.
Cape Mount, (1,046 feet); Western Beach........	6 43 0	11 21 9	
St. Paul's River; Entrance	6 22 0	10 37 0	
CAPE MESURADO; Extremity (Lighthouse) ..	6 19 15	10 49 0	
Monrovia; Govt. House..	6 19 5	10 48 55	
Junk River; Marshall, an American Settlement; Agent's House	6 8 6	10 22 45	
…assa; Director's House..	5 54 50	10 4 5	

COAST OF AFRICA—CONTINUED.

	LAT. N.	LONGITUDE.	AUTHORITIES.
	° ″ ′	° ′ ″	
River Sestros, or Grand Cestos; South Entrance	5 26 25	9 34 45 W.	Captain A. T. E. Vidal, in H.M. ships, *Etna* and *Raven*, 1835 to 1839.
Baffou Point	5 9 10	9 17 30 —	
Bloo Bara, or Barbarra Factory; Sinou	4 59 15	9 2 5 —	
Middle Neefoo, or Niffou	4 45 3	8 32 2 —	
CAPE PALMAS; Lighthouse	4 22 9	7 44 16 —	
Tahou	4 24 47	7 21 30 —	
Grand Bereby	4 39 3	6 54 30 —	
St. Andrew's River, King George's Town, within Swartou Corner	4 57 8	6 3 47 —	
River Fresco, or Rio de Lagos; off the Mouth	5 1 8	5 32 5 —	
Grand Lahou	5 8 3	4 57 40 —	
Jack Jaques	5 11 8	4 26 8 —	
Assinee River; Anchorage S.E. of the Mouth	5 3 5	3 12 7 —	
Apollonia	4 58 45	2 35 5 —	
Fort St. Anthony	4 52 18	2 14 45 —	
Cape Three Points	4 44 30	2 5 45 —	
Acquidah	4 45 27	2 2 8 —	
Dixcove	4 47 45	1 56 40 —	
Elmina, or St. George del Mina	5 5 0	1 22 30 —	
CAPE COAST CASTLE.; Southern Turret; Time-ball	5 5 25	1 12 5 —	George Maclean, Esq.
Mauree, or Moree; Flag-staff	5 7 30	1 12 0 —	Captain W. F. Owen, in the *Eden*, 1827; and Capt. Purchas, in the *Esk*, same year.
Annamaboe; Flagstaff	5 10 12	1 7 12 —	
Cormantine; Flagstaff	5 10 30	1 5 36 —	
Tantumquerry; Flagstaff	5 13 30	0 46 48 —	*Lon. of Accra*, by 4 good chronometers of H.M. ship *Dryad*, Captain Hayes, in Feb., 1832, 0° 15′ 20″ W., lat. 5° 32′ 27″ N.
———Extreme Point	5 12 30	— — —	
Devil's Hill; summit	5 18 36	0 39 0 —	
Barracoe; Point	5 29 0	0 24 0 —	
Accra; British Flagstaff	5 32 0	0 11 30 —	Captain Vidal.
———	5 32 0	0 18 12 —	Captain Purchas.
Ningo; Fort	5 45 0	0 1 48 E.	Captains Owen and Purchas.
Volta River; Entrance	5 47 18	0 42 18 —	Captain Kelly, in the *Pheasant*.
Cape St. Paul	5 44 30	0 52 18 —	Captains Owen and Purchas.
Quitta; Flagstaff	5 54 36	0 54 18 —	Captain B. M. Kelly.
———	5 55 0	0 55 48 —	Captain Purchas.
Padiana; Town	5 57 42	0 57 18 —	
Little Popoe; Road	6 13 0	1 36 0 —	Captain B. M. Kelly.
Grand Popoe; Road	6 19 0	1 46 0 —	
———	6 16 0	1 43 48 —	Captain Purchas, in H.M.S. *Esk*, 1827.
Whydah, or Ajudah	6 19 30	2 5 0 —	
Appee	6 22 0	2 25 0 —	
Porto-Novo; Hill	6 20 0	2 34 0 —	
———Road	6 19 0	2 34 0 —	
Badagry; Mount	6 24 0	2 43 30 —	
———; Road	6 20 0	3 47 48 —	
Lagos River; Entrance	6 24 0	3 22 0 —	
———; End of the Sandy Beach	6 20 0	4 27 0 —	

COAST OF AFRICA—CONTINUED.

	LATITUDE.			LON. E.			AUTHORITIES.
	°	′	″	°	′	″	
Benin River; N.W. Point	5	43	0 N.	5	4	0	Captain Vidal.
Rio dos Esclavos	5	34	0 —	5	5	48	Captain Purchas
Terra Formosa; West point	4	28	0 —	5	41	30	Captain A. T. E. Vidal, in
————; Eastern point	4	19	24 —	5	54	33	H.M. sloop *Barracouta*, 1826.
River Nun or Quorra; the Bar (2 *fathoms*)....[11]	4	15	0 —	5	55	0	*(Longitude of the Bar of the Quorra, Captain William*
Rio Bento, or Second River	4	17	0 —	6	15	0	*Allen*, 1833.*)*
Rio St. Nicolas, or Third River	4	18	0 —	6	24	0	Captain Vidal, in the *Etna*, and Captain Purchas, in the *Esk*, 1857; and Captain Vidal and Boteler, 1826.
New Calabar River; Foche Point	4	22	40 —	7	0	0	
Bonny River; Rough Corner	4	23	40 —	7	7	0	
Old Calabar River; Tom Shot's Point, West of the Entrance	4	36	0	8	19	0	
Backasey Gap; East of the Entrance........	4	29	0 —	8	32	0	
Bimbia Isle	3	57	0 —	9	13	48	
Cape Camaroens	3	53	0 —	9	0	0	
Camaroens Mountain; peak	4	13	0 —	9	12	0	
Rumby Mountains; Highest peak	4	57	0 —	9	18	0	
Qua Mountain	5	15	0 —	8	51	0	
Corisco Island; N.W. Point	0	55	54 —	2	19	45	
Cape Esterias	0	37	48 —	9	21	0	
Point Clara	0	30	30 —	9	20	30	
Cape St. John	1	9	40 —	9	21	35	
Gaboon River; Round Corner	0	18	5 —	9	20	0	
Cape Lopez	0	36	12 S.	8	45	17	

AFRICAN ISLANDS.

	LATITUDE.			LON. E.			AUTHORITIES.
FERNANDO PO:—							
Clarence Peak	3	35	0 N.	8	46	30	Captain Vidal.
Cape Bullen; Northern Extremity	3	47	25 —	8	39	24	
Adelaide Islet	3	34	48 —	8	47	17	
Point William; Flagstaff	3	45	38 —	8	47	0	Captain W. F. Owen, in the *Eden*, 1827.
Cape Horatio; N.E. Extremity	3	46	15 —	8	54	24	
Cape Vidal; E. Extremity	3	39	18 —	8	56	18	
Cape Barrow; South Rock	3	11	30 —	8	40	0	
Cape Eden; S.W. Ex.	3	15	30 —	8	25	6	
Cape Badgley; West Ex.	3	19	42 —	8	24	42	
Charles' Folly; N.W. Ex.	3	26	48 —	8	27	42	
Goat Isle; Centre	3	31	0 —	8	32	48	
PRINCES' ISLAND; the Brothers near	1	23	0 —	7	19	48	Captains Purchas and Kelly.
ST. THOMAS'S ISLAND:—							
Cabrita Isle	0	27	0 —	6	45	0	
Anna de Chaves; Road	0	25	30 —	6	46	0	
Rolas' Isle (*On the Line*)	0	0	0 —	6	36	30	H.M.S. *North Star*.
ANNOBON; East Point ..	1	25	0 S.	5	42	43	Captain Purchas.

NOTES.

1. CAPE SPARTEL.—In the *Connaissance des Temps* this cape is stated to be in latitude 35° 48′ 40″, and longitude 5° 53′ 1″. In the Requisite Tables it is stated to be in lat. 35° 46′ 0″, lon. 5° 57′ 12″. The remarks of the late Mr. William Chapman, master of H.M.S. *Illustrious*, appear to confirm the longitude of Tofiño, from whom he differs only 40 seconds in latitude, which he represents as so much more to the southward. The observations of Captain Smyth give the lat. 35° 47′ 15″, and the lon. 5° 55′ 45″, by chronometer and lunars, as shewn in the table. The coast, from Cape Spartel to Cape Bojador, was surveyed in the *Etna* and *Raven*, under Lieutenants Arlett and Kellett, 1835, as afterwards noticed.

2. EMPIRE OF MAROCCO.—The points determined by Captain Washington we owe to an excellent paper, entitled "*Geographical, Notice of the Empire of Marocco; by Lieutenant Washington. R.N.*," given in the first volume of the "*Journal of the Royal Geographical Society*," 1831; a communication replete with interesting and useful information. Captain Washington is now the Hydrographer to the Navy.

3. CITY OF MAROCCO.—The scientific traveller, Don *Juan Badia y Leblich*, commonly called *Ali Bey*, from his observations in 1803-4, gave the centre of Marocco as in 31° 37′, and 7° 35′ 30″. On reference to the Astronomical Journal of Captain Washington, there appear upwards of 100 sights for determining the longitude of the city. Distances between moon and sun; moon and stars East and West of her; and altitudes of the moon when in the prime vertical,—the mean results of which give the longitude of a garden at the S.W. angle of the city: lon. 7° 36′ W., lat. 31° 37′ 20″; mean of about 20 mer. alts. of the sun. *Variation*, from numerous observations by Schmalcalder's compass, 20½° W.—*Geographical Journal*, vol. i. pp. 140, 141.

4. CAPE GEER., &c.—M. le Chevalier Jean Chas. de Borda was charged, in 1776, by Louis XVI., with a commission to the Canary Islands and the coast of Africa, for the express purpose of making observations, and determining the chief points of the Canary Islands, &c. He was furnished with timekeepers, by which he ascertained the positions, as they have appeared in different Charts and Tables. On this expedition, M. de Borda, in the ship *La Boussole*, was accompanied by the *Espiegle*, M. le Chastenet Puysegur, who afterwards composed the Pilot for St. Domingo; also by Captain Don Josef Varela, and another intelligent officer of the Spanish marine; all of whom assisted in the operations. The results proved to be numerous and important; and they served for the general rectification of the coast as far to the southward as Cape Verde.

But in the years 1817-18, Captain (afterwards Baron) Roussin was employed by the French Government in surveying the coast between Cape Bojador, in 26° 7′ N., and the Isles de Los, in 9½°; and this officer has given, most satisfactorily, many points not before ascertained.

Again, in 1820 and 1821, Captain William Fitzwilliam Owen, in H.M.S. *Leven*, was commissioned by the British Admiralty to examine and settle the coast from Cape Noon southward: and his observations have still further, and in a much more important degree, tended to perfect the hydrography of Western Africa. To Captain Owen's work, therefore, we refer most particularly in the Tables; and have only to add that there is a remarkable coincidence, in general, in the results of the two commanders; and that even in comparing either with those of M. de Borda, the differences, practically considered, are of little moment.

A survey of the Canary Islands, and the continental coast thence northward to Cape Spartel, was made by Lieutenants William Arlett and H. Kellett, commanders of the *Etna* and *Raven*, in 1835; the particulars of which are given in the "Journal of the Royal Geographical Society," vol. vi., 1836, and from these we derive the corrected positions given in the Table, as more fully shown hereafter.

5. CAPE BARBAS.—In the Admiralty translation of M. Roussin's Memoir (page 17,) the longitude of Cape Barbas is misprinted 17° 30′.—M. de Borda made it 16° 39′ 45″; Captain Owen, 16° 39′ 12″; as in the Table.

6.—CAPE CORVOEIRO.—We assume as Cape Corvoeiro a point in 21° 46′, according to M. Roussin, and not 21° 13′, as given by Captain Owen. The longitude, in the translation of M. Roussin's Memoir, is misprinted as 19° 14′ 55″, which is, we presume, the Paris longitude—16° 54′ 46″ from Greenwich.

7. PORTANDIK.—The two palm trees are the first seen in sailing hither from Cape Bojador. Portandik is supposed to have been situated about a mile to the southward of this spot, but not a vestige of it remained in 1818, when it was visited by Captain Roussin. It has recently been ceded to France, in exchange for Albreda, on the Gambia.—*See the description in* SECTION III. *hereafter.*

8. GOREE.—The position formerly given was 14° 40′ 10″ N., and 17° 24½′ W., from the observations of M. Fleurieu, 1769, and of M.M. de Verdun, Borda, and Pingré. Captain Boteler, in 1829, made it the same. The *Argo* frigate, Captain Hallowell, 1802, gave the lat. 14° 30′, and lon. 17° 24° 58″.

9. CAPE ST. MARY.—From observations in H.M.S. *Esk*, Captain Purchas, in 1826, the position of Cape St. Mary has been given at 13° 29′ N., and 16° 45′ 12″ W.; Bird Island, at 13° 40′ N., and 16° 54′ 12″ W. The results shew that the points lie at least as far to the West, as shewn by the Survey.

10. SIERRA LEONE, &c.—In preparing the former editions of this work, we collected a large number of observations, which had been made, from time to time on the coast of Guinea, &c., between Sierra Leone and Cape Lopez; they included those previously given by the officers of H.M. ships *Argo, Amelia, Inconstant, Tartar*, and others, and we finally appended to such as we selected for the tabular statement the following remarks:—"Although we have paid the utmost attention in the comparison of different results, charts, and descriptions as shewn in the Tables and Notes, we are by no means satisfied with the conclusions as to many points eastward of Cape Palmas and St. Andrew's Bay. Indeed, all that has yet been done by the naval officers, and others, prove only the necessity of a new series, in order to establish so much as may be correct, and to rectify so much as may not be so." Happily, such rectification has taken place, and many doubts, even on the most important points, have recently vanished.

We give a specimen, on the longitude of Cape Sierra Leone. Many years ago, the late Sir George Young gave the longitude of this cape as 12° 33′ 47″; the French Tables afterward, as 12° 34′; the Requisite Tables, 13° 9′ 17″; H.M.S. *Argo*, 1802, as 13° 12′; the *Inconstant*, 1816, the same; the *Amelia*, in 1812, 13° 17′ 30″; the *Leven*, (Captain Owen), in 1826, 13′ 18′ 0″; the *Eden*, (Captain Owen), in 1827, 13° 01′ 10″; Captain Sabine, Royal Artillery, in 1822, 13° 19′ 0″; and Captain Purchas, in 1827, 13° 19′ 12″. Hence we adopt Captain Owen's longitude as given in the Table. It may be added, that Lieutenant Raper assumes the North Battery to be in 13° 14′ 30″ or nearly as in the Table.

By 318 lunar distances (23 sets), taken in the West Bastion of Fort Thornton, at Freetown, Captain Sabine, in 1822, made the longitude of that spot 13° 15′ 11″ W.; and in 1827, Captain Owen in the *Eden*, made that of the Victualling Office 13° 14′ 30″ Latitude of the latter, 8° 30′ 6″; of Fort Thornton, by Captain Sabine, 8° 29′ 21″.

Fort Thornton stands on the highest ground in its own immediate neighbourhood, excepting a small hill on which a martello tower is built, at a distance rather exceeding a quarter of a mile. The situation of Freetown, however, may be more generally stated to be at the foot, on the northern side of the range of mountains, which, coming from the interior, finds here its termination in the sea, and gives the name to the cape, harbour, and colony of Sierra Leone: the general height of the range, so far as it has yet been explored, is from 2,000 to 3,000 feet. The principal geological feature in the neighbourhood of Sierra Leone, is a red granite, of easy and rapid decomposition."—*Captain Sabine's Notes.*)

COAST OF GUINEA, between CAPE THREE POINTS and CAPE LOPEZ, including the ISLANDS. Although we described this portion of coast in the "Directory for the Ethiopic or Southern Atlantic Ocean," we have considered it proper to continue the series of points in the Table; and for a description of the coast, and remarks upon the positions, we refer the reader to the above work.

11. River Quorra.—This important river is described in the Directory mentioned in the preceding note. In the beautiful Chart of it, by Captain William Allen, published in 1857, the East point of the entrance, formerly given by mistake in 6° 4′ E., is laid down in lat. 4° 20′ N., and lon. 5° 55′ E. The bar, with 2 to 4 fathoms over it, extends two leagues southward from the mouth of the river, which demonstrates the strength of the ebb tide. Within the bar, in an extent of 4 miles, the depths are 6 and 7 fathoms, but diminishing thence upward.

VARIATIONS OF THE COMPASS, 1861.

At Ceuta, it is 12° 50′; (in 1811, the variation was found to be 22½° W.) At Cape Spartel, 20°. Between Cape Spartel and Saffi Bay, it is, at present, from 20° to 20° 10′ W.; at Marocco, in 1804, it was found to be 20° 38′ 40″ W.; between Saffi Bay and the Canary Islands, it is now 20° 25′. In 1835, at Mogodor, it was 19½° W. it is now 20° 20′; and at Cape Nun, 20° 25′. Near Cintra Bay, in 23″ 5′; it was 19¾° in 1817: near Cape Blanco, it is 19° 20′; Bar of the Senegal and Goree, 19° 40′; Cape Roxo, 17° 20′; Bissao, and mouth of the Rio Grande, 19° 20′; Isles de Los, in 1856, 18°; at present. 19° 5′; Off Cape Palmas, in 1820, 18° 50′ (it is now 19° 50′); in the neighbourhood of Cape Mesurado, in 1839, 19° 30′; off Cape Three Points, and thence to Benin Bar, 20° W.; mouth of the Quorra, in 1833, as at present, 20° W.

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9. THE AZORES, OR WESTERN ISLANDS.

	LAT. N.			LON. W.			AUTHORITIES.
	°	′	″	°	′	″	
Formigas, or Ants:							
Formigao, or Hermigon; highest Rock	37	16	44	24	47	6	The Survey made by Capt. A. T. E. Vidal, 1842.
Dollabarats Shoal, 11 ft.	37	14	30	20	43	25	
Santa Maria, or St. Mary:							
Punto do Castello, or S.E. Point	36	5	30	25	1	30	
Villa do Porto	36	56	30	25	9	45	
Maldebarca Rock, off the N.W. Point ......[1]	36	59	31	25	12	3	
Pta. dos Matos	37	0	50	24	4	50	
San Miguel, or St. Michael's:							
Ferraria, or West Point	37	51	40	25	52	0	
City of Ponta Delgada; Castle..............	37	44	0	25	41	15	
Villa Franca; Island ..	37	27	0	25	42	0	
Pta. Retorta; S.W. Pt.	37	44	25	25	10	45	
Punta de la Marquesa, or East point ....[2]	37	48	15	25	8	25	
Pta. da Ajuda	37	51	50	25	19	30	
Morro da Ribeira Grande	37	50	32	25	29	40	
Porto Capellas; Morro	37	50	30	25	41	45	
Pta. de Bretanha......	37	54	40	25	47	35	
Terceira:							
Monte del Brasil, near Angra	38	38	33	27	14	10	
Praya; Pta. de Malmarenda	38	44	10	27	3	0	
Pta. de Serrata, or W.pt.	38	46	0	27	23	50	
St. George:							
Pta. del Topo, or Island off S.E. point	38	33	6	27	46	27	

THE AZORES, OR WESTERN ISLANDS—CONTINUED.

	LAT. N. ° ′ ″	LON. W. ° ′ ″	AUTHORITIES.
Pta. de Rosales, or N.W Point	38 45 5	28 20 15	The Survey by Captain A. T. E. Vidal, in 1842-44.
GRACIOSA:			
Fort at Praya	32 3 5	27 58 46	
Pta. de Fozo do Porto, or W. point	39 4 10	28 4 43	
PICO:			
The summit of the peak	38 25 0	28 28 12	
Pta. da Ilha or E. point	38 25 0	28 2 45	
Magdalena Rocks, off W. point	38 32 5	28 34 0	
FAYAL: The S.E. point, or Morro de N.S. de la Guia	38 31 20	28 38 5	
Caldeira; summit 3351 ft.	38 34 30	28 44 0	
Pta. da Negra; W. point	38 36 0	28 50 40	
FLORES: Sta. Cruz Fort[3]	39 27 3	31 8 37	
CORVO: the Southern point, or Pta. del Pesqueiro-alto	39 40 7	318 0	

NOTES.

1. AZORES.—The voyage of M. Fleurieu, in the *Isis* frigate, made in 1768-69, and published in 1773, furnished several observations of the points of the Azores, as shown by the marine clocks of M. Ferdinand Berthoud, andverified, in great measure, by more numerous observations of Don Vicente Tofiño, made in 1788. The difference in the results of these two observers was generally inconsiderable; so small, indeed, that it may rather be considered as an agreement.

M. Fleurieu ascertained the position of the Mount of Brasil, near Angra, in Terceira, to be 38° 38′ 37″ N., and 27° 12′ 27″ W. Tofiño's result was 38° 38′ 10,″ and 27° 14′ 40″; a remarkable coincidence, considering the distance of time at which the observations were made. The longitude of this spot was, therefore, assumed by the Spanish commander, as the meridian referred to from the points subsequently determined. The summit of the mount, as given by Captain FitzRoy, R.N., is in 38° 38′ 35, and 27° 12′ 54″.

Captain Alexander T. E. Vidal, R.N., who re-surveyed these islands, makes the Fort at Villa do Porto, in St. Mary's, in lat. 36° 56′ 30, and lon. 25° 9′ 45″ W.

2. ST. MICHAELS., &c.—In our former statements we noticed the erroneous positions of St. Michael's Terceira, &c., which had, from time to time, appeared in the *Requisite Tables* and *Connaissance des Tems*; but, as the doubts have vanished, it would be no longer useful to repeat those remarks. Captain FitzRoy gives St. Bras Castle, near Porta Delgada, as 37° 43′ 58′ and 25° 40′ 15″.

3 .FLORES AND CORVO.—The longitudes of these islands were given according to the results of Tofiño; they differ slightly from those of Captain Vidal as now stated. *Vide* the Chart of the Azores, Canary Islands, and opposite coasts, with the harbours, &c., constructed by the editor, and published by the proprietor, of this work.

VARIATIONS OF THE COMPASS.

At St. Michael's, in 1826, the variation was 24° 15′ W. At Flores, 19° W. Captain Livingston, by means of many observations, near Ponta Delgada, found it about 25° W., in 1818. This gentleman properly observes, that differences may be ascribed to the volcanic commotions and ferruginous nature of the country. See Note on the Variation at Tenerife, hereafter.

The present variation (1861), as estimated by Mr. F. J. Evans, R.N., is from 24° 50′ in the Southern Eastern part of the group, to 27° in the North-western portion. This variation is slightly *increasing*.

10. THE MADEIRA AND CANARY ISLANDS.

	LAT. N. ° ′ ″	LON. W. ° ′ ″	AUTHORITIES.
Madeira:			Captain Matt. Flinders, H.M. ship *Investigator*, 1801; Gen. Sir Thomas Brisbane, 1821.
Town of Funchal, British Consul's Garden ..[1]	32 38 22	16 54 45	
Camera de Lobos	32 38 35	16 59 0	
Punta del Parga, the West Point	32 48 7	17 16 20	
Tristao, or N.W. Point..	32 51 25	17 12 7	
S. Jorge point	35 49 40	16 54 40	Captain W. Fitzwilliam Owen, 1820, 1827.
Cape Garajao, or Brazen Head; S.E. extremity	32 37 18	16 51 42	
Pta. de S. Lourenzo, the East point..	32 43 34	16 40 12	
Pico Ruivo; summit, 6056 feet	35 45 0	16 57 0	
Porto Santo: Villa Baleira on the South side[2]	33 3 30	16 20 3	Captain A. T. E. Vidal, 1844.
Baixo Island, South point	32 59 10	16 18 50	
Dezertas:			
Chao Island; Sail Rock	32 35 45	16 33 0	
Bugio Island; Agulha point	32 24 0	16 28 20	
The **Salvages:**			
Middle of the Great Salvage ....[3]	30 8 30	15 55 36	
Lanzarote, or Lançerote:			
Allegranza Isle, off the North end	29 25 30	13 30 30	
Port de Naos..........	28 58 30	13 32 30	
Fuertaventura:			
Isle of Lobos, Pt. Martino...............	28 45 30	13 48 30	
Point Jandia, the S.W point	28 3 0	14 31 0	
Canaria, or **Grand Canary:**			
The Isleta, or N.E point	28 11 0	15 25 0	
Point Arguineguin, or South point	27 44 55	15 40 10	
Point Aldea, the West point	28 1 0	16 0 30	
Tenerife, or **Teneriffe:**			
Santa Cruz; Mole Lt.[4]	28 28 33	16 14 56	
Pico de Teide; summit	28 16 35	16 38 2	
Orotava (N.W. side) ..	28 25 0	16 33 0	
Pta de Anaga, E. point	28 33 50	16 6 0	
Pta. de la Rasca, S. point	28 0 30	16 41 0	
Gomera:			
The Port	28 8 0	17 5 55	
Pta. de Calera, W. point..	28 6 45	17 22 0	
Palma:			
Sta. Cruz, on the E. side	28 40 30	17 44 28	
Taxacorte, on the W. side	28 38 12	17 55 55	
Ferro:			
Port de Hierro	27 46 30	17 54 22	
Point Orchilla, S. W. Pt.	27 42 20	18 9 45	
Pta. de la Restinga, or S.Pt.	27 37 3	17 59 50	

NOTES.

1. **Funchal.**—The latitude of Funchal is well ascertained. The longitude was estimated by M. Bory, in 1772, at 16° 56′, as it has since stood in the French Tables. It is unnecessary to repeat the varying results of other observers, the differences having been decided by our respected countryman, Captain Flinders, from whose observations, in H.M. ship *Investigator*, 1801, the latitude of the road appeared to be 32° 37′ 44″, and the greatest longitude, by any of six timekeepers, 16° 54′ 26″.

His Excellency Sir Thomas Brisbane, on his voyage to New South Wales (1821), obtained his time at the house of Mr. J. W. Gordon, at Funchal, by four excellent chronometers, by which the mean longitude was concluded as 16° 54′ 36″. At the same time the latitude of the tower, on Mr. Gordon's house, was found to be 32° 38′ 19·7″, and that of the Loo Rock, 32° 37′ 53·8″. The longitude given by Sir Thomas Brisbane was confirmed by ten Admiralty chronometers, under the care of Dr. Tiarks, in 1823, which gave for the longitude of the British Consul's Garden, 16° 54′ 45″ (in time $1^h\ 7^m\ 39^s$), the position given in the Table.

Captain Fitzwilliam Owen, from observations in H.M. ship *Leven*, in 1820, gives the landing-place, near the Loo Castle, in 32° 37′ 42″ N., and 16° 55′ 30″ W.

Desertas.—Captain Flinders states the southern end of the Bujio to be in latitade 32° 24′ 20″, which differs less than a mile from its position as previously given on the charts; and he discovered a small ledge of rocks projecting from under the cliffs at the S.W. part of this island. Captain Owen gives the North end of the North Deserta in 32° 36′ 30″ N., and 16° 33′ W. The South end of the Southern Isle (*Bujio*) he gives in 32° 28′ 30″ N., and 31° 18′ W. It may probably be rather more eastward, but certainly not more West.

2. **Porto Santo.**—A plan of this island. from a survey by Lieutenant-Colonel Roberts and Captain Thomas Wolley, of H.M. ship *Arethusa* (1802), states, in general terms, the latitude of the town to be 33° 2′, and its longitude 16° 35′, which is only twenty minutes East of the meridian of Funchal. But, in the former edition of this work, upon a comparison of this statement with the different Tables and Charts, it was considered that the difference should be at least 37 minutes, and it was assumed in the Table. This has been in a measure confirmed by the recent observations of Captain Vidal, whose position is that given, the difference being 34′ 42′. See the Chart of the Azores and Canary Islands before mentioned. The Requisite Tables and *Connaissance des Tems* give the latitude of the middle of the isle 36° 5′, and the longitude 16° 14′ 51″, and 16° 17′ 34″. Captain Owen gives the governor's house in 33° 2′ 54″ N., and 16° 18′ 48″ W.

3. **The Salvages.**—The longitude of the Great Salvage, as furnished by five British East India Journals, differs from 15° 34′ to 16° 1′. The mean result of these is 15° 48′ W. Yet we have not deemed this evidence sufficient to cause a deviation from the position assigned in the Table.

M. La Pérouse has observed: "We were employed on the 18th of August, 1785, in taking observations off the Salvage, and I think its longitude may be fixed in 18° 13′, (15° 53′ from Greenwich), and its latitude 30° 8′ 15″."

Captain Wm. Mudge, R.N., who, with Captain Vidal, surveyed the Great Salvage in 1820, places its South side in 30° 7′ 39″ N., and 15° 56′ 18″ W.: and he says of it—"This Island is obviously of volcanic origin, and consists principally of a dark-coloured black rock, the detached parts of which, as well as the whole, exhibit strong marks of fixed magnetic polarity. Even the dust of the roads, and of the floors of the cottages, has the same character as the rock itself, and may be gathered up, like steel filings by means of a bar magnet.

"The compass was singularly deranged at the three stations taken on the survey, and the extreme difference in its variations amounted to about 72° at a less distance than a mile. At the first station, one morning, Mr. Durnford, one of the party, laid down his watch, and on returning to the same place again it was found that the watch had gained two hours in the interval, an acceleration due to the magnetic action of the rock upon the balance."

4. TENERIFE.—The position of Sta. Cruz in the Table is that given by Capt. Vidal in his completion of the survey of these islands (1844.) The previous observations have placed the longitude generally one or two minutes more, or to the westward of those in the Table.

M. La Pérouse says, "Several observations were made at Santa Cruz, in Tenerife, which we think may be fixed at 18° 36′ 30″ (16° 16′ 21″ from Greenwich), and 28° 27′ 30″ N." In 1817, the Baron Roussin, of the French Navy, placed the Mole Head of Sta. Cruz in 28° 27′ 58″ N., and 16° 19′ 0″ W.; and from this meridian he deduced, by chronometers, the longitudes of all the coast between Cape Boiador and the Isles de Los, which have already been described.

Captain Fitzwilliam Owen, from his observations in the *Leven*, 1820, gives the Mole Head in 28° 27′ 54″N., and 16° 15° 0″W. The Peak he gives in 22° 16′ 24″N., and 16° 39′ W.

The general mean of the longitude of the Mole of Santa Cruz, from the observations of Captains Pérouse, Bligh, Vancouver, and Krusenstern, of M. Quenot, and the Baron Alexander de Humboldt, is 16° 15′ 18″.

VARIATIONS OF THE COMPASS.—1861.

Between Porto Santo and Madeira, the mean variation is about 22°. In the road of Santa Cruz, Tenerife, it is rather less, if we may conclude that it has been correctly ascertained; but M. de Humboldt has noticed that the variation differs several degrees, according to the place where the observation is made, at the Mole, or at several points to the North, along the shore; and, he adds, we must not be surprised at these deviations in a place surrounded by volcanic rocks. "I remarked, with M. Gay Lussac, that, on the declivity of Vesuvius, and the inside of its crater, the intensity of its magnetic forces is modified by the proximity of the lavas."—(*Personal Narr.*, vol. i. p. 117.) Captain Owen gives the variation at Porto Santo at 23½° W. Mr. Evans estimates it at 22° W. in 1861. The same authority makes it about 21° at Tenerife, and 20° 30′ at Fuerteventura. It is slightly *decreasing*.

11. THE CAPE VERDE ISLANDS.

	LAT. N. ° ′ ″	LON W. ° ′ ″	AUTHORITIES.
SAL or SALT ISLAND [1]			The Survey of the Cape Verde Islands, by Lieutenants (afterwards Captains) Vidal and Mudge, R.N.; taken by order of the Lords Commissioners of the Admiralty, in the years 1819, 1820, and 1821, compared with the observations of Captains King, Foster, Owen, &c.
The North point	16 51 0	22 54 34	
The South point	16 34 0	22 56 4	
BONAVISTA:			
The N.W. point	16 13 20	22 55 44	
The N.E. point	16 11 0	22 42 34	
The New Town	16 7 0	22 55 34	
The South point	15 57 0	22 48 44	
Leton Rock	15 48 0	23 9 4	
MAYO, or ISLE of MAY: [2]			
The North Point	15 12 30	23 12 4	
English Road	15 7 30	23 13 4	
South point	15 6 40	23 10 4	
ISLAND of ST. IAGO:			
Bighude, or North point	15 19 30	23 45 34	
East point	15 0 30	23 25 56	
Porto Praya, Quail I. [3]	14 53 40	23 30 34	
S.W. point	14 58 30	23 44 56	
ISLAND of FOGO:			
North point	15 1 15	24 22 0	
Town of N.S. da Luz	14 53 0	24 31 0	
BRAVA:			
Road on the West side	14 48 0	24 43 34	

THE CAPE VERDE ISLANDS—CONTINUED.

	LAT. N. ° ′ ″	LON. W. ° ′ ″	AUTHORITIES.
ST. NICHOLAS:			
East Point	16 34 30	24 0 0	The Surveys by Lieuts. Vidal and Mudge, 1819-21.
North point	16 42 0	24 21 20	
West point	16 38 0	24 27 0	
South point	16 28 30	24 19 0	
RAZA: East point	16 38 0	24 38 30	
ST. LUCIA:			
East point	16 46 0	24 42 0	
North point	16 49 0	24 47 30	
ST. VINCENT:			
Porto Grande	16 54 0	25 1 0	
ST. ANTONIO: [4]			
North point	17 12 0	25 6 45	
West point	17 4 0	25 23 10	
South point	16 55 0	25 19 25	
East point	17 5 30	25 0 5	

NOTES.

1. SAL.—A particular description of Sal, and all the other islands, will be found in our Third Section, hereafter.

2.—MAYO.—In the course of the year 1819, while surveying the Island Mayo, Lieutenants Vidal and Mudge found the hills upon which they were carrying on their operations so strongly magnetic, that the needle belonging to the theodolite became wholly useless; the dip increasing so much that the needle could not traverse, in consequence of one end of it being drawn down to the face of the instrument, &c.

3. PORTO PRAYA.—The longitude of this place appears to be well determined; particular attention having been directed to it by many of our most skilful navigators. Captain FitzRoy places the West point or landing-place on Quail Island (called also Gun Point), at Porto Praya, in lon. 23° 30′ 0″ W. Captain P. P. King had made it 23° 30′ 17″; Captain Vidal, 23° 31′ 28″; and Captain Owen, 23° 31′ 3″; therefore 23° 30′ 34″, the longitude formerly assigned to it by Mr. Purdy. in previous editions of this work, cannot be far from the truth. This was deduced from the observations of Messrs. Fleurieu, Borda, Verdun, &c., of Mr. R. Keilor, Captains P. Heywood, Mortlock, &c.

4. ST. ANTONIO.—Admiral Von Krusenstern, in the relation of his voyage round the world, says, "On the 6th of November, (1803), at day-break, we perceived the island of St. Antonio, at the distance of from 25 to 28 miles. As the wind was moderate, I held directly to the westward, to keep still more away from the land, as calms are very frequent in the neighbourhood of lofty islands. At noon we had an observation in lat. 17° 55′. The S.W. point of the island bore, at the time, S. 24° E., distant about 45 miles. I now steered W.S.W., and as the wind freshened toward the evening, S.W. by W. The next day, at noon, the S.W. part of the Island of St. Antonio bore 86°, distant about 54 miles; and I again held S.S.W.

"The mean of a variety of lunar observations, taken this morning, made our longitude, reduced to mid-day, 26° 17′ 7″. By the watches it was 26° 24′ 20″. I reckoned the longitude of the S.W. point of St. Antonio, by Arnold's large timepiece, No. 128, the best of our chronometers, 25° 24′ 0″."—(*Mr. Hoppner's Translation*, p. 53.)

Captain Flinders, in the relation of his voyage (vol. i. p. 26), said that he found the variation near the western side of St. Antonio, on the evening of 14th August, 1801, before making the land, 13° 51′; and the next evening, 13° 3′, when 4 leagues to the westward. He had not an opportunity of making observations to determine the situation of the island, but, according to his estimation, it would appear to be even more to the *eastward* than the situation now assigned; as he supposes the high land near the S.W. point to be in 25° 12′ W.

Captain King made Terrafal Bay, at the S.W. end, by eleven chronometers, in lon. 25° 20′ 1″; Captain Owen made it 25° 21′ 42″, and Captain Foster, 25° 22′ 56″: therefore, from these it will be about 25° 21′ 3′ ″; and the West point, 25° 23′ 10″.

For further information, see the Chart of the Cape Verde Islands, published by the proprietor of this work; and see, also, the description of St. Antonio hereafter.

VARIATIONS OF THE COMPASS—1861.

In 1826, the variations of the compass near St. Antonio were found to be near 16°; at Porto Praya, St. Iago, 15° W. The *mean* variation allowed by Captains Vidal and Mudge, in 1819-21, is 14°. It is now (1861), 17° in the Western, and 18° W. in the Eastern portion of the group. It is increasing at the rate of 3′ per annum.

12. THE FÆROE ISLES, ICELAND, GREENLAND, LABRADOR, AND NEWFOUNDLAND.

	LAT. N. ° ′ ″	LON. W. ° ′ ″	AUTHORITIES.
THE FÆROE ISLANDS.			
Munken Islet	61 23 40	6 37 30	The Survey by CAPT. BORN, of the Danish Navy, 1790-5, published in 1806, subsequently corrected.
Suderö, Porkerji	61 31 32	6 42 0	
Sand ö; Village	61 52 30	6 46 0	
Waag ö; Sorwaag	62 5 0	7 12 30	
Myggenæs; West point ..	62 6 0	7 36 0	
Stromö; Thorshavn	62 2 40	6 43 0	
Oster ö; Rissing N. point	62 22 0	6 56 0	
Fuglö; East point	62 18 40	6 10 0	
ICELAND.			The DANISH Survey, 1845, &c.
Reikiavik	64 9 20	21 42 10	
Cape Reikianæs	63 48 35	22 42 0	
Fugle Skiærene; Grenaseer Huen	63 40 15	23 9 0	
Herdiservig; Strand church	63 50 0	21 38 0	
Skalholt	64 6 0	20 30 0	
Mount Hekla; summit ..	63 58 40	19 38 30	
Westmanöerne; Biarnereye church	63 26 0	20 15 0	
Portland; S. point of Iceland	63 23 45	19 6 0	
Oster Jökel	63 24 0	19 35 0	
Ingolfs Höfde	63 48 50	16 35 0	
Horne Fiord; Entrance ..	64 15 0	15 8 30	
Hvalsbak Islet	64 37 0	13 21 0	
Rode Fiord; Krosnæs....	65 1 30	13 32 50	
Hornnæs; East point of Iceland	65 10 50	13 28 0	
Langanæs; N.E. point ..	66 23 0	14 28 0	
Tiornæs	66 13 40	17 7 0	
Grimsey; church	66 33 30	18 0 0	
Holar church	65 45 30	19 5 0	
Skagen; Skagataa	66 8 0	20 3 30	

THE FÆROE ISLES ICELAND, GREENLAND, &c.—CONTINUED.

	LAT. N. °	′	″	LON. W. °	′	″	AUTHORITIES.
North Cape	66	29	0	22	25	30	The DANISH SURVEY, 1845.
Staalbierg Huk; W. point	65	30	25	24	30	15	
Ondverdarnæs	64	53	0	24	1	0	
Sneefields Jökel	64	48	0	23	43	30	
GREENLAND.							
Cape Danell [1]	65	37	0	36	10	0	The CHART of GREENLAND, published by authority at Copenhagen, in 1832, to illustrate the voyage of Captain Graah, &c., and which also exhibits Scoresby's Land to the N.E., and the coast to the N.W., from various authorities, up to the parallel of 73° N.
Dannebrogs Oe or Isle	65	18	0	38	30	0	
Cape Löwenorn	64	30	0	39	30	0	
Colberger Heide	64	8	0	40	7	0	
Cape Mosting	63	40	0	40	15	0	
Cape Juel	63	15	0	40	50	0	
Kinarbic	62	47	0	41	42	0	
Cape Bille	62	1	0	41	57	0	
Cape Tordenskiold	61	24	0	42	15	0	
Cape Discord	60	53	0	42	26	0	
Cape Valloe	60	38	0	42	40	0	
Statenhuk, otherwise Cape Farewell [1]	59	49	12	43	53	40	
Cape Christian	59	49	30	44	5	0	
Friedrichsthal	60	0	10	44	37	0	
Nennortalik; Commercial Establishment	60	7	45	45	16	0	
Julianeshaab	60	42	54	46	10	44	
Cape Thorvaldsen	60	44	0	47	56	0	
Cape Desolation	60	48	0	48	10	0	
Cape Absalon	61	3	0	48	23	0	
Frederikshaab	62	2	0	50	2	0	
Lichtenfels	63	5	0	51	31	0	
Fiskernæs	63	8	0	51	21	0	
Godthaab	64	10	5	51	42	15	
Holsteinborg	66	55	32	53	34	28	
LABRADOR.							
Button's Isles; Middle	60	35	0	65	20	0	Connaissance des Tems, &c.
Port Manvers; Entrance [2]	57	0	0	61	55	0	Captain T. Manby, R.N., 1808.
Nain, a Moravian Settlemt.	56	24	0	61	48	0	Inferred from Port Manvers.
Leveret Islet, at the Entrance of Netsbuktoke, or Sandwich Bay [3]	53	50	40	56	32	0	
Wolf Island; North End	53	45	0	55	37	0	The Admiralty Surveys, by Lieutenant Michael Lane, &c., to 1790.
Spotted Island; N.E. end	53	30	30	55	26	30	
Round Hill Island	53	25	20	55	21	0	
Hawke Island; S.E. point	53	4	20	55	26	0	
Cape St. Michael	52	47	0	55	27	0	
Cape St. Francis [4]	52	37	0	55	31	18	
Point Spear	52	32	0	55	28	18	
NEWFOUNDLAND.							The Survey by Captain Fredk. Bullock, R.N.
Belle-Isle; N.E. point	52	1	0	55	15	30	
——Lighthouse on S. pt.	51	53	0	55	22	18	
Cape St. Lewis; Small peninsula on S.E. point	52	21	16	55	38	28	

THE FÆROE ISLES, ICELAND, GREENLAND, &c.—Continued.

	Lat. N. °	′	″	Lon. W. °	′	″	Authorities.
Battle Islands; N.E. extreme of S.E. Island ..	52	15	36	55	32	23	
Henley Island; middle of North side............	52	0	0	55	50	23	
York Point; East extreme	51	57	53	55	52	33	
Red Bay; Harbour Island, S.E. point	51	43	47	56	25	53	
Loup Bay; Flagstaff at head of Bay	51	31	27	56	48	58	Captain (now Rear-Admiral) H. W. Bayfield.
Forteau Bay; S.W. extreme point	51	25	29	56	56	33	
Amour Point; Lighthouse	51	27	35	56	50	56	
Bradore Hills; N.W. hill, 1,264 ft., the Notre Dame of Cook and Lane	51	35	3	57	11	58	
——South Hill, 1,135 ft.	51	33	54	57	11	43	
——Middle, or N.E. hill	51	34	49	57	10	58	
Greenly Island............	51	23	11	57	10	43	The Admiralty Surveys, by Lieutenant (since Captain) Fred. Bullock, R.N., and his assistants, Messrs. T. Smith, &c., 1823, 1824, 1825, and 1826. The longitudes adjusted by the Observations of Captain H. W. Bayfield, &c.
Cape Norman ....[5]	51	38	5	55	53	28	
Cape Bauld	51	38	10	55	26	53	
Griguet Bay; East point..	51	32	30	55	27	50	
White Cape, near St. Lunaire Bay	51	30	25	55	27	53	
Needles Rocks, near Braha	51	26	5	55	29	5	
Bréhat or Braha Shoal (6 *ft.*)	51	25	40	55	26	20	
Cape St. Anthony	51	21	0	55	31	35	
Crémaillière Cove; Entrance, East point	51	18	30	55	6	50	
Goose Cape; S.E. point ..	51	17	20	55	37	40	
How Harbour; Entrance, West point	51	20	0	55	57	30	
Fishot Isles; Northern Isle	51	12	30	55	40	50	
Croque Harbour; Entrance	51	2	30	55	47	52	
Groais Isle; N.E. point ..	50	58	30	55	33	30	
Southern Belle-Isle; N.E. Point	50	48	0	55	29	0	
Rouge Isle; North point..	50	54	0	55	48	30	
Canada Bay; Entrance ..	50	42	30	56	8	30	
Hooping Harbour; Entr.	50	36	0	56	14	0	
Fourchet Harbour; Ent.	50	31	0	56	17	30	
Orange Bay; Entrance ..	50	22	0	56	27	30	
Little Harbour-deep Head	50	14	0	56	33	30	
Cat Head; Extremity....	50	7	0	55	40	50	
Coney Arm Head........	49	57	30	26	46	30	
Partridge Point	50	9	20	56	9	50	
Fleur de Lys Harbour; East Point	50	6	40	56	8	30	
St. Barbe, or Horse Isles; South-east point	50	11	0	55	43	0	
Paquet Harbour; Entrance	49	58	30	55	51	38	
La Scie Harbour; Entrance	49	58	0	54	36	50	
Promontory of St. John:							
North Bill............	49	59	30	55	31	20	
Middle Cape..........	49	57	30	55	29	20	
South Bill............	49	56	5	55	29	50	
St. John's Gull Isle	49	59	30	55	22	0	

Remarks.

By these excellent Surveys, a very important desideratum has been obtained; for before they were executed, the coasts which they display were comparatively unexplored, although frequented more or less by the fishers.—*British American Navigator.*

COASTS OF NEWFOUNDLAND—CONTINUED.

	LAT. N. ° ′ ″	LON. W. ° ′ ″
Bishop's Rock	49 55 30	55 27 30
Nippers' Isles; S.E. point	49 47 0	55 52 0
Cutwell Harbour; E. point	49 37 0	55 40 0
Triton Harbour; Entrance	49 33 0	55 37 0
Fortune Harbour; N.W. point	49 32 0	55 17 0
Toulinguet Harbour; N. Entrance	49 36 0	54 7 30
Change Isles; N.E. Islet	49 41 35	54 24 0
Fogo Harbour; Eastern Entrance	49 44 20	54 17 36
Cape Fogo; S.E. extremity	49 39 30	54 1 0
Offer Wadham Island; Lighthouse	49 36 0	53 46 0
Ireland Rk. (always breaks)	49 51 45	54 4 0
Inspector Rock (sometimes breaks)	49 47 0	54 6 40
Snap Rock, of 10 feet	49 54 0	53 43 43
Funk Island; Escape or East point	49 44 21	53 13 20
Green Island, in Rocky Bay	49 29 0	54 14 0
Ragged Point	49 30 0	54 0 0
Deadman's Point	49 22 18	53 43 30
Outer Cat Island	49 53 55	53 36 20
Freels' Gull Island ....[7]	49 19 6	53 26 58
Charge Rocks (6 feet)....	49 18 0	53 32 8
Stinking Islands	49 13 40	53 22 20
Fool's Island, off the N.W. Arm	49 9 15	53 36 30
Shoe Cove Point	49 4 40	53 57 30
Offer Gooseberry Island ..	48 58 20	53 30 0
Malone's Rock	48 53 30	53 27 40
Great Black Island; centre of	48 50 8	53 38 3
Little Denier Island	48 40 50	53 36 38
Western Head	48 37 15	53 27 48
Southern Head	48 37 15	53 21 48
Young Harry Reef	48 48 5	53 7 15
Cape Bonavista; Lighthouse	48 42 0	53 8 0
Bonavista Gull Island....	48 42 40	53 8 0
North Head Catalina	48 32 28	53 1 54
Catalina Harbour; Green Island Light	48 30 45	53 6 18
South Head, Catalina	48 27 38	53 6 40
Horse Chops	48 21 30	53 14 18
Entrance of Trinity Harbour	48 21 30	53 20 25
Bonaventure Head	48 16 30	53 23 5
Bacalieu Island; Light on North point	48 9 1	52 48 44
Harbour Grace; Light on Outer Island	47 42 40	53 9 20
Cape St. Francis	47 48 4	52 47 29
St. JOHN'S, Fort Townsend ....[8]	47 33 57	52 42 21

AUTHORITIES.

The Admiralty Surveyors, Messrs. George Holbrook and William Bullock, 1819 to 1826, adjusted by the Observations of [illegible] J. Jones, 1828, Admiral Bayfield, 1859, &c.

REMARKS.

In former editions the longitudes of the S.E. and South coasts were deduced from the observations and Surveys of Captain James Cook, Lieutenant M. Lane, Messrs. Cassini, Verdun, Borda Pingre, and Owen; and these were, generally, from 10 to 15 minutes *eastward* of those now given in the Table: but the longitude of the Burgeo Isles [*Eclipse I.*] *remains as given by Captain Cook;* and that of St. Pierre may, also, be considered as the same.

COASTS OF NEWFOUNDLAND—Continued.

	Lat. N. ° ′ ″	Lon. W. ° ′ ″	Authorities.
St. John's; Light on Fort Amherst, S. entrance ..	47 33 50	52 39 55	The Admiralty Surveyors, as before.
Cape Spear; Lighthouse	47 30 53	52 36 40	
Bull Head..............	47 18 1	52 44 33	
Cape Broyle, N. point of..	47 3 52	52 50 40	A Survey of *Port St. Pierre*, by Lieutenant Du Petit Thouars, gives the Government House, N.E. of the town, in 46° 46′ 30″ N., and 56° 9′ 45″ W. The French astronomers, Messrs. Verdun, Borda, and Pingre, in the voyage of *La Flore*, 1771, gave the town of St. Pierre in 46° 46′ 30″ N., and 56° 10′ W., and thus confirmed the previous determination of the Burgeo Islands, by Captain Cook, from a solar eclipse, in August, 1766.—*Phil. Trans.*, 1767.
Cape Ballard	46 46 46	52 56 57	
Cape Race; Lighthouse	46 39 12	53 2 43	
Virgin Rocks, on the Great Bank of Newfoundland	46 26 30	50 55 20	
Trepassey Harbour; Shingle Neck	46 43 32	53 22 3	
Cape Pine; Lighthouse ..	46 37 4	53 31 48	
St. Mary's Cape; Lighthouse	46 49 25	54 9 33	
Placentia Harbour	47 15 11	53 50 3	
Little Southern Harbour	47 43 32	53 49 38	
Extremity of Placentia Bay	47 49 46	53 52 14	
Bordeaux Harbour	47 45 28	52 53 30	
Great Burin Island; Light on Dodding Head	47 1 30	55 5 14	
Cape Chapeaurouge ..	46 54 19	55 19 20	
St. Pierre; Lighthouse on Galantry Head........	46 45 30	56 6 54	
Cape Miquelon..........	47 8 11	56 17 30	
Connaigre Shoal	47 23 57	55 57 19	
Pass Island	47 29 2	50 11 13	
Cape La Hune	47 31 55	56 50 23	
Outer Penguin Island	47 22 9	56 58 7	
Burgeo Islands; Eclipse Island	47 36 6	57 36 15	
Cape Ray; S. extreme [9]	47 37 2	59 18 8	Captain (now Rear-Admiral) H. W. Bayfield, 1827 to 1860. and Captain James Cook..
Cod Roy Isle; S. side	47 52 38	59 23 35	
Cape St. George	48 28 54	59 11 44	
Red Isle; S.E. point	48 33 50	52 13 26	
South Head of the Bay of Islands	49 6 12	58 20 50	
Cow Head..............	49 55 12	57 48 25	
Port Saunders; Entrance N.E. point	50 38 36	57 18 53	
Point Rich; West extremity	50 41 39	57 24 23	
Point Ferolle; Cove Point, N.E, extremity........	51 2 14	56 2 48	
Anchor Point	51 14 30	57 42 40	
Green Islet; N.E. Extremity	51 24 18	56 33 53	
Cape Norman	51 38 5	55 53 28	

NOTES.

1. Cape Farewell.—In the Maps and charts in general, the name of Cape Farewell is attached to the southern point of the continent of Greenland. In the Dutch charts, which have been republished in London, the same name is applied to an island, at the assumed distance of 45 leagues N.N.W. from that point. Hence, one point has frequently been mistaken for, or blended with another; and this affords,

therefore, one reason for the discordant accounts of longitude, &c. Such mistakes are not likely again to occur, as will be seen from the following statement.

In the first volume of the "Journal of the Royal Geographical Society" is given an account of *Discoveries on the Eastern Coast of Greenland*, by Captain Graah, of the Danish Royal Navy, in 1829, who proceeded along the coast from Staten Hook, to the parallel of 65½°, and who has disproved the existence of any ancient European colony upon it. In a single boat, amid difficulties almost insuperable, with only two Greenland men and four women, M. Graah reached an island, in latitude 65° 18'; longitude, *computed*, 38° 27'; he proceeded onward until stopped by an insurmountable barrier of ice, and was forced to return to the S.W,

All the coast appeared to be colder, more barren. and miserable, than the western coast. "It may be said to consist of one uninterrupted glacier, exhibiting only a few patches of vegetation, generally on the banks of the rivers, and elsewhere, often advancing into the sea and forming promontories of ice, which are passed with so much the more danger that they frequently fall in avalanches."

During the whole summer of 1829 there was not one day which could be called warm; and, before the 14th of June, the thermometer had never risen above 53°. At *Ekolumius* in lat, 63° 30', the vegetation appeared to be superior to that of any other part of the coast, even of *Julianeshaab*, on the S.W., reputed to be the most favored part of that coast. But the vegetation appears to consist only in a fine grass, which withers quickly when exposed to the warmth of the sun, and in some anti-scorbutic plants, as sorrel and scurvy grass, with one or two kinds of flowers, and low bushes of willow and birch, not exceeding two feet in growth.

The food of the natives is principally the dried flesh of the seal, with a little game and fish. Captain Graah makes mention of bears, hares, birds, and salmon; but he says that, "even at the latitude of 63° 36', reindeers, and hares are known only by name." The people, in their moral character, he describes as very estimable; "and the reported good nature of the husbands, the submission of their wives, the obedience of the children, and the mutual affection and confidence of the whole community, make it difficult to remember that they are pagans." It was the good faith, the hospitality, the kind and generous dispositions, of these children of nature, that enabled M. Graah to overcome the difficulties by which he was surrounded.

On the 3rd of November, 1831, Captain Graah returned to Copenhagen from a second voyage along the coast of Greenland, but without having passed much to the northward of his former limit. The Geographic Society of Paris subsequently presented their gold medal to the captain, accompanied by the diploma, for his persevering and indefatigable attempts in exploring this coast.

During his last stay, Captain Graah determined the longitudes of the two southern Danish settlements, *Julianeshaab* and *Nennortalic*, with great precision, by means of occultations of fixed stars, &c.; and we also gain, by his observations, the positions of *Cape Farewell*, never before ascertained, and *Cape Christian*, another promontory of the same island: Cape Farewell, lat. 59° 49' 12", lon. 43° 53' 40": Cape Christian, lat. 59° 42' 30", lon 44° 45' 0".

The eastern coast, is distinguished by the name of the late excellent *King Frederick VI.*

2. Port Manvers, formerly called Saltpetre Haven, was visited and explored by the *Thalia* and *Medusa* frigates, which wooded and watered here, in August, 1808. Of the mode in which the longitude was determined, we have not been informed. The coast, as well as that of Greenland, now appears more to the westward than it was formerly represented.

Of Port Manvers a particular plan is given on our Chart of the Northern Ocean. Without the entrance, on the East, are two groups of small isles, and near it is a cluster of dangerous rocks. The entrance itself is less than a mile broad, but the and within opens into a fine basin, on the shores of which are wood, water, and winged game, in abundance. At about 2 leagues, *true South*, from the entrance, is *Mount Thoresby*, 2,733 feet in height.

3. Sandwich Bay.—This fine harbour was surveyed by Lieutenant Michael Lane,

in 1771, but not the different entrances. The defect, was, however, remedied by Lieutenant Robert Pearce, of H.M.S. *Favourite*, in 1820. A range of mountains, called *Mealy Mountains*, stand on the N.W. side of the harbour, and, being 1,482 feet high, always covered with snow, may be seen from without Wolf Island, a distance of 17 leagues.

4. Cape St. Francis.—The coast in the vicinity of Cape St. Francis was surveyed by Mr. J. L. Roberts, of H.M.S. *Favourite*, in 1820. At half a mile W.S.W. from the cape is *St. Francis Harbour*; and at 1½ miles north-westward from the same is *Sealing* or *Seal Bight*. St. Francis Harbour is snug and secure, but very small, and generally filled with vessels, during the fishing season, as a considerable fishery is carried on in its vicinity. Sealing Bight is more commodious; and here water may be conveniently had, but no wood.

5. Cape Norman.—This cape is placed by Rear-Admiral Bayfield in 51° 37′ 57″ North, and 25° 53′ 28″, or 6′ 20″ to the West of the former surveys; and the longitudes of the whole of the N.E. coast, as far as Cape Freels, have been made in accordance with this.—*See Note* 8.

6. Cape Freels.—In the valuable survey northward of Cape Freels, by Lieut. Frederick Bullock, 1823-24, this cape is placed 5′ 10″ South of the same, as given in the survey southward, by Messrs. Holbrook and William Bullock, in 1817: to connect his with the southern parts, we have given the latter authority.

7. Cape Bonavista.—The assigned positions of this cape, is an evidence of the uncertainty which exists in the longitudes of this survey. The first sheet of the survey by Messrs. Holbrook and Bullock, made the longitude 52° 59′ 15″ In the re-issue, shortly afterwards, of the same sheet, it was shifted to longitude 53° 8′ 20″, or 8′ 35″ further west, nearly as it now stands.

8. St. John's—The longitudes of all the places on the eastern coast of Newfoundland are given *westward* of those assigned in the early editions of this work, and as also reported in the *British American Navigator*.

The longitude of St. John's, as deduced from the observations of Captain James Cook, Lieutenant Michael Lane, Messrs. Cassini, Verdun, Borda, Pingré, and Owen, would be generally from fifteen to ten minutes eastward of the longitude in the Table; Fort Amherst, at the entrance of the harbour, having been given in 52° 29′ W., or 13′ 45″ eastward of the later observations.

In the years 1828, 1829, and 1830, the officers of H.M.S. *Hussar*, under the orders of Rear-Admiral Sir Charles Ogle, made many observations in this part of the world; and the result given by Mr. John Jones, for the longitude of Fort Townsend, is 54° 45′ 22″ W., and latitude 47° 33′ 42″, and which position was recorded in the fort itself.

The last determination by Admiral Bayfield as given in the table, removes this longitude 3′ 8″ to the *eastward*. The coasts to the northward appear to have been been given much more to the *westward*. It is necessary to notice these discrepances here, although the amounts of differences as now settled, are not important to the general navigator.

9. Cape Ray, &c.—The South and West coasts of Newfoundland are still represented according to the surveys of the circumnavigator, Captain James Cook and Michael Lane, at the latter part of the last century. The original charts, published by Mr. Laurie's predecessors, are still in request, and it will be seen, upon comparison, that the positions given in Cook's first work are still found to be near the truth.

NEWFOUNDLAND.—The description of the coasts and harbours of this island with ample directions for the navigation, &c., will be found in the "*British American Navigator*," published by Mr. Laurie.

VARIATIONS OF THE COMPASS, 1861.

Iceland.—At the East end of Iceland, the present variation is 38° W.; at Ingolfs Hofde, 39° W.; at Portland, or the South Point, 41° W.; at Fugle Skiærene 41° 30′ W.; at Reikiavik, 43° 40′; at Staalbierg Huk, or the West point, 47°; at the North

Cape, 46° 30′ W. *Increasing* at the rate of 2′ 25″ per annum.

GREENLAND.—At Cape Farewell, at present it is about 52° 30′; at Cape Mosting, on the East coast, about 57° W.; at Nennortalic, on the South coast, about 53° 20′; at Frederikshaab, 59° W. These variations have *increased* about 2° 30′ since 1831.

NEWFOUNDLAND, *East Coast.*—Belle Isle, Lark Harbour, 37° 30′ W. (according to Mr. Evans, R.N., it is 39°); at Cape Norman, it is 38° W.; at the entrance of Canada Bay, 36° W.; St. Barbe, or Horse Isles, 35°; Cape St. John, 34° 50′ W.; Wadham Isles, 35° 0′; Cape Freels, 34° 30′ W.; Cape Bonavista, 33° 30′ W.; St. John's, 31° 30′ W.; Cape Race, 30° W.

South and West Coasts.—Cape Freels, 29° 50′ W.; Cape ChapeauRouge, 29° 40′ W. St. Pierre; 28° 25′ W.; Burgeo Islands, 29° 0′ W.; Cape Ray, 28° 0′ W.; (it was 27° 37′ in 1856); Cape St. George, 29° 0′ W.; Cow Head, 33° 32′ in 1859; Flower Cove, West entrance of Belle Isle Strait, 36° 52′ W. (in 1859.)

These variations are *increasing* at the rate of 7′ per annum in the southern, and 8′ to 10′ per annum in the northern parts of Newfoundland and Labrador.

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13. GULF AND RIVER OF ST. LAWRENCE, WITH CAPE BRETON ISLAND.

	LAT. N.	LON. W.	AUTHORITIES.
	° ′ ″	° ′ ″	
THE GULF. [1]			
ISLAND OF ST. PAUL. [2]			The Observations of Captain (since Rear-Admiral) Henry Wolsey Bayfield, F.R.A.S., of H.M. surveying vessel, *Gulnare*, 1827 to 1834.
Northern Ext- Lightho.	47 13 50	60 8 20	
Eastern side of Neck	47 13 9	60 8 30	
MAGDALEN ISLANDS. [3]			
Entry Isle; N.W. point ..	47 17 1	61 43 2	
Deadman Islet; W. point	47 16 3	62 12 28	
Amherst Harbour; Entr.	47 15 28	61 42 29	
Coffin's Island; N.E. point	47 17 30	61 23 0	
Northern Bird Islet......	47 51 2	61 9 18	
Bryon or Cross Isle; E. pt.	47 47 53	61 23 40	
ANTICOSTI. [4]			
East point; Extreme	49 8 17	61 40 0	
South point	49 3 35	62 15 33	
Heath point; Lighthouse	49 5 20	61 31 51	
S.W. point; Lighthouse..	49 23 45	63 35 49	
Cape Henry; S.E. Extr...	49 47 42	64 23 44	
West point; Extremity ..	49 52 12	64 33 8	
North point; Extremity..	49 57 32	63 9 0	
Observation Cape; W. side	49 38 51	62 41 27	
Bear Bay; Entrance of the River	49 30 22	62 24 32	
LABRADOR, &c. [5]			
Bradore Harbour; Flagstaff on Jones House ..	51 27 30	57 14 15	
Belles Amours point.; S.E. Extreme	51 26 34	57 25 53	

GULF AND RIVER OF ST. LAWRENCE, &c.—Continued.

	LAT. N.			LON. W.			AUTHORITIES.
	°	′	″	°	′	″	
Lion Island; Isthmus....	51	24	1	57	38	33	The Surveys by Admiral H.W. Bayfield, 1827-1860.
Mistanoque I.; E. point of Cove in N. side Island..	51	15	43	58	12	8	
Mecattina Harbour; S. point of Dead Cove....	50	46	44	58	59	23	
Grand Mecattina pt. Ex.	50	44	2	59	5	13	
Antrobus Point; North pt. of Island	50	33	12	59	16	48	
Hare Harbour; East side	50	36	24	59	17	23	
Wapitagun Harbour; East point of Islet	50	11	40	60	1	23	
Cape Whittle; South-west Extreme of Lake......	50	10	36	60	7	0	
Coacoacho Bay; S. point of Outer Islet	50	9	4	60	18	13	
Kegashka Bay; Islet at S. end of Beach	50	11	19	61	15	38	
Natashquan River; S. point of Entrance	50	6	57	61	47	58	
Little Natashquan Har.; N. pt. Islet at head of Bay	50	11	41	61	50	33	
Nabesippi River; S.E. of Entrance	50	13	52	62	13	0	
Appetetat Bay; E. point..	50	16	35	62	58	13	
Betcheween Harbour; S.E. point of Low Isle	50	14	13	63	10	32	
Clearwater Point; S. Ex.	50	12	27	63	27	6	
Mingan Harbr.; Sandy pt.	50	17	24	64	1	56	
Mingan Island; Summit..	50	12	48	64	7	31	
St. John River; E. point of Entrance	50	17	3	64	23	16	
Manitou Point; Extreme	50	17	34	65	14	8	
St. Charles Pt.; S. Extreme	50	15	17	65	48	48	
Moisie River; S.W. point of Entrance	50	11	16	66	4	38	
Carousel Island; S. Extreme	50	5	21	66	23	33	
Seven Islands Bay; Store House, East side	50	13	0	66	24	4	
St. Margaret's Bay; Exty.	50	2	25	66	44	43	
Cawee Islands; W. point of Little Island........	49	29	21	67	1	53	
Egg Islands; West pt. of North Island..........	49	38	13	67	10	6	
Trinity Bay; S.W. point	49	23	39	67	18	8	
Point de Monts; Lightho.	49	19	35	67	21	58	
———South extreme ..	49	18	41	67	23	18	
River St. Lawrence; N. Shore.							
Goodbout R; Trading post	49	18	25	67	36	4	
St. Nicolas Pt. S. Extreme	49	15	47	67	50	4	
Manicouagon Pt.; S.E. Ex.	49	6	5	68	11	55	
Bersimis River; S. point of Entrance	48	55	23	68	36	54	
Bersimis Point; S. extreme	48	53	57	68	38	29	

GULF AND RIVER OF ST. LAWRENCE—CONTINUED.

	LAT. N. °	′	″	LON. W. °	′	″	AUTHORITIES.
Jeremie; Trading Post ..	48	52	45	68	46	46	The Surveys by Admiral H.W. Bayfield, 1827-60.
Port Neuf; Church	48	37	17	69	5	53	
Tadousac (Saguenay River); Store on Beach.........	48	8	32	69	42	52	
Chicoutimi (Saguenay River; Trading Post	48	26	5	71	4	51	
Isle aux Coudres; West point of Laprairie Bay	47	24	40	70	24	52	
QUEBEC; N. Bastion [6]	46	49	0	71	12	49	
———; Wolf Monument	46	48	38	71	12	31	
———; Flagstaff, King's Bastion, Citadel	46	48	32	71	12	33	
RIVER ST. LAWRENCE; ABOVE QUEBEC.							
St. Jean des Chaillons; R. C. Steeple	46	33	23	72	7	6	
Cap Madeline; R.C. steeple	46	22	·6	72	30	3	
Three Rivers; E. steeple	46	20	43	72	32	10	
Point du Lac R. C. Steeple	46	17	21	72	41	20	
Sorel; Episcopal Church	46	2	42	73	6	50	
Repentigny; R.C. steeple	45	44	28	73	26	49	
MONTREAL; Gate Island N. end Lighthouse.....	45	30	22	73	33	5	
———; R. C. Cathedral [7]	45	30	24	73	33	18	
RIVER ST. LAWRENCE S. SHORE.							
Dauphin River; Orleans Isle, S.W. pt. of entrance	46	58	4	70	50	44	
Stone Pillar I. Lighthouse	47	12	25	70	21	39	
Kamouraska; N.E. pt. of Crow Island	47	35	9	69	52	39	
BrandyPots; S.pt.of S.Rk.	47	52	28	69	40	39	
Loup River; N. pt. of Ent.	47	50	57	69	33	41	
Red Island; Lighthouse ..	48	4	20	69	32	59	
Green Island; Lighthouse	48	3	17	69	25	6	
Razade Rocks; N. E. one	48	12	27	69	8	3	
Bicquette Island; Lightho.	48	25	18	68	53	3	
Bic I.; N.E. Ex. of S.E.Rf.	48	25	9	68	58	23	
Barnaby I., North-east pt.	38	29	35	68	31	56	
Camille Mt.; sumt. 2,036ft.	48	28	36	68	12	50	
Metis; Reef off Little Metis	48	41	10	68	1	34	
Matan R.; S.W. point. of Entrance	48	51	35	67	31	24	
Cape Chatte; Extreme ..	49	5	52	66	45	16	
Mt. Lewis R.; E. pt of Ent.	49	14	29	65	43	34	
Great Fox Bay; Centre of	48	59	57	64	22	55	
Cape Rozier; Lighthouse	48	51	37	64	12	3	
Cape Gaspé; Flower-pt. rk.	48	45	2	64	9	26	
NEW BRUNSWICK, &c.							
Cape Despair; Extreme..	48	25	22	64	8	32	

GULF AND RIVER OF ST. LAWRENCE, &c.—Continued.

	Lat. N. °	′	″	Lon. W. °	′	″	Authorities.
Macquereau Pt; N.E. Ex.	48	12	18	64	46	14	The Surveys by Admiral H.W. Bayfield, 1827-1860.
Port Daniel; N. side W. pt.	48	9	10	64	56	55	
Paspebiac; Episcopal Ch.	48	1	47	65	15	6	
Bonaventure Pt.; S. Extr.	48	0	17	65	26	26	
Carlton, or Tracadigash Point; N.W. Extreme..	48	5	9	66	7	10	
Dalhousie Island; E. point	48	4	16	66	21	26	
Black Rock; Station on ..	47	51	54	65	45	30	
Bathurst Har.; Carrou Pt.	47	39	19	65	36	59	
Mizzenette Point; Station	47	50	2	64	58	43	
Caraquette Island; S.E. extreme of Sandy Spit ..	47	49	19	64	51	45	
Shippigan Harbour; Fall's Wharf	47	44	52	64	42	12	
Miscou Island; Lighthouse	48	1	0	64	29	28	
Shippigan Gully; N. Ent.	47	43	24	64	39	36	
Miramichi; Bai du Vin Island, N.E. Extreme	47	6	19	65	4	21	
Escuminac Pt.; Lighthouse	47	4	32	64	47	17	
Richibucto River; N. beacon at Entrance	46	43	4	64	47	32	
Buctouche Riv.; Sta. at En.	46	26	55	64	37	45	
Cocagne Head; Ex. of Cliff	46	21	31	64	31	41	
Shediac; Episcopal Church	46	14	15	64	33	32	
Cape Tormentine; N.W. extreme of Joureman Is.	46	10	6	63	42	7	
Tignish Head, Bay Verte; Station	46	0	28	64	1	0	
Pugwash; Episcopal Ch.	45	51	14	63	30	18	
Amet Island; East Extreme	45	50	15	63	9	40	
Pictou Harbour; Lightho.	45	41	25	62	39	10	
Pictou Is.; Lightho. E. end	45	49	50	62	29	54	
Cape George; Station in Ballantine Cove	45	51	40	61	54	32	
Antigonish Har.; N. beacon	45	41	49	61	52	56	
Pomquet Island; S.E. Ex.	45	39	17	61	44	5	
Gut of Canso; Light N.Ent.	45	41	42	61	28	42	
PRINCE EDWARD ISLAND.							
North Point Extreme of Cliff	47	3	41	63	59	3	
W. Pt.; High Water Extr.	46	37	14	64	23	0	
Cape Egmont Stn. on Extr.	46	24	11	64	7	39	
Bedeque Harbour; Green's Wharf	46	23	32	63	47	10	
Cape Traverse; Ex. of Cliff	46	13	17	63	38	51	
St. Peter's Is.; Station S.W. Extreme	46	6	59	63	11	29	
Charlottetown; Flagstaff on Fort............[8]	46	13	55	63	7	7	
Prim Point Lighthouse ..	46	3	10	63	1	50	
Panmure Island; Lightho.	46	8	47	62	27	24	
E. Pt.; Stn. on ex. of cliff	46	27	15	61	57	42	
St. Peter's Harbour; Sand Hill, E. side of entrance	46	26	44	62	43	56	

GULF AND RIVER OF ST. LAWRENCE, &c. CONTINUED.

	LAT. N.			LON W.			AUTHORITIES.
	°	'	"	°	'	"	
Tracadie Harbour; Eastern point of Entrance	46	24	51	63	1	44	The Surveys by Admiral H.W. Bayfield, 1827-60. and Commander Olebar, R.N.
Grenville Harbour; High Sand Hill near Entrance	46	30	50	63	27	29	
Richmond Bay: Station on Royalty point	46	33	55	53	1	50	
Cascumpeque Har.; Light.	46	48	22	64	2	0	
Cape Kildare; Extreme ..	46	52	57	63	57	44	
CAPE BRETON ISLAND							
Bear Head; Extreme	45	33	5	61	17	5	
Plaster Cove; N. end of Bridge	45	38	56	61	23	36	
M' Keen Point; Extreme	45	38	51	61	23	54	
Port Hood; Harbour Lt. at South Entrance	46	0	0	61	31	40	
Sea Wolf Island; Lightho. on summit	46	21	30	61	15	33	
Chetican Point; S. extreme	46	36	22	61	2	58	
Cape St. Lawrence; N. ex.	47	2	54	60	35	36	
Cape North; N. extreme..	47	2	35	60	24	56	
Cape Egmont; E. extreme	46	51	1	60	18	3	
Inganish; Archibald point	46	41	31	60	21	18	
St. Anne Harbour; Beach Point	46	17	41	60	32	25	
Carey Point; W. side of entrance of Gt. Bras d'or	46	11	41	60	24	50	
Cunet Point; Extreme ..	46	20	32	60	17	16	
Sydney Harbour; Lighthouse on Flat Point	46	16	12	60	7	22	
Table Head; Extreme ..	46	13	14	59	57	4	
Flint Island; Lighthouse on North-east end	46	11	5	59	45	50	
Scatari Island; Lighthouse	46	2	13	59	40	18	
Menadou Harbour	46	0	29	59	49	58	
Cape Breton; Extreme ..	45	57	14	59	47	3	
Gabarus Bay; Church on Cape	45	42	7	60	5	3	
Louisburg; Lighthouse ..	45	54	34	59	57	15	
Michaux Point; Station on Extreme	45	34	11	60	41	0	
L'Ardoise; R. C. Church Steeple	45	36	45	60	45	59	
St. Peter Island; S.W. Ex.	45	35	54	60	48	39	
St. Peter Bay; Old Fort on West side of Haulover..	45	39	21	60	52	4	
MADAME ISLAND.							
Grande-digue Lennox Passage; Station	45	35	49	61	1	11	
Arichat Harbour; Jerseyman island, N. extreme	45	30	25	61	3	7	
——; Lightho. Marache Point	45	29	2	61	1	52	

NOTES.

1. GULF OF ST. LAWRENCE.—Among the difficulties of the navigation in the Gulf of St. Lawrence are the fogs and ices. In spring, the entrance and eastern parts of the gulf are frequently covered with ice, and vessels are sometimes beset for many days. Being unfitted for contending with this danger, they often suffer from it, and are occasionally lost; but all danger from ice, is far less than that which arises from the prevalence of fogs; these may occur at any time during the open or navigable season, but are most frequent in the early part of summer; they are rare, and never of long continuance, during westerly winds, but seldom fail to accompany an easterly wind of any strength or duration. This observation is, however, subject to restriction, according to locality or season. Thus winds between the South and West, which are usually clear weather winds above Anticosti, are frequently accompanied with fog in the eastern parts of the gulf. Winds between the South and East are almost always accompanied with rain and fog in every part. E.N.E. winds above Cape de Monts, at the mouth of the river, are often E.S.E. or S.E. winds in the gulf, being changed in direction by the high lands of the South coast, and have, therefore, in general the same foggy character. This is said of winds of considerable strength and duration, and which may extend over great distances. Moderate and partial fine weather winds may occur without fog at any season, and in any locality. In the early part of the navigable season, especially in the months of April and May, with clear weather, N.E. winds are of frequent occurrence, and they sometimes occur at other seasons, and in every part of the gulf and river.

The fogs sometimes last several days in succession, and to a vessel either running up or beating down, during their continuance, there is no safe guide but the constant use of the deep-sea lead, with a chart containing correct soundings.

The fogs which accompany easterly gales extend high up into the atmosphere, and cannot be looked over from any part of the rigging of a ship. They, however, are not so thick as those which occur in calms after a strong wind, and which are often so dense as to conceal a vessel within hail; whilst the former frequently admit the land or other objects to be distinguished at the distance of half a mile or more, in the day time.

The dense fogs which occur in calms, and even in very light winds, often extend only to small elevations above the sea; so that it sometimes happens, when objects are hidden at the distance of fifty yards from the deck, they can be plainly seen by a person 50 or 60 feet up the rigging. In the months of October and November, the fogs and rain that accompany easterly gales, are replaced by thick snow, which causes equal embarrassment to the navigator.—*Admiral Bayfield.*

2. The ISLAND of ST. PAUL lies N. 52° E., *true*, 10 miles from Cape North; it is about 1½ miles in length from North to South, and inclining to the eastward at the North end. Its average breadth is about a quarter of a mile. The margin is rocky and precipitous almost all round, indented on the North-east and North-west sides by two coves, in both of which afford shelter during the prevalence of certain winds. The cove on the N.W. affords a small and bold beach, about 150 feet long, where a landing may be effected, but generally with difficulty, by reason of the continual swell of the sea.

There is good anchorage all round the island, and close in-shore, which circumstance enables vessels to lie there with any winds, by shifting their stations as the wind and weather require. The current runs generally about 4 miles an hour, and nearly S.S.E.

St. Paul's has been noted for the great number of wrecks which have been found on its shores, arising from the frequent fogs and tempestuous weather, the uncertain currents, and abrupt nature of its coast, &c.: but on this island are now two lighthouses, one near its northern, and the other near its southern extremity; of which, one will always be open, unless to a vessel near the central rocks. The northern light, brilliant and fixed, is about 130 feet above the level of the sea; it can be seen to the southward on any bearing excepting between N. by E. and E. by N., when it is obscured by the hills to the southward of it. The southern light may be seen from the northward on any bearing except between S.S.E. and West., when it is obscured by the hills to the northward of it. Range of light from each tower, six leagues. Boats to render assistance, and guns for signals.

3. The MAGDALEN ISLANDS.—These islands have been surveyed by *Lieutenant P. E. Collins*, in 1833, and a beautiful chart of them has been published by the Admiralty. They form an irregular group, and are named respectively, *Entry Island, Amherst, Grindstone, Alright, Wolfe, Grosse*, and *Coffin Islands;* exclusive of *Bryon* or *Cross Island*, and the *Bird Islets*, which lie more to the North. Of these, *Amherst* is the most southern and principal island, but *Entry Island* is the highest, and is 580 feet above the sea; visible from 8 to 9 leagues off.

It often happens, from the prevalence of westerly gales, in the fall of the year, that ships bound to Quebec, after entering the gulf, have been driven out again, or they have contended until their crews were worn out, and have gone to the low ports for cargoes, when, by taking an anchorage, they would have secured their passage. These islands may be approached, generally, by the lead, to 7 fathoms of water.

Bryon or *Cross Island*.—The North side has steep cliffs of red sandstone, from which reefs extend 2 or 3 miles. Approach no nearer than in 8 fathoms. On the South side there is good shelter, with North and West winds, in 6 fathoms, sandy bottom, the East end of the island bearing E. by S., and the reef to the westward bearing West. In this road is a strong underset, which makes a ship at her anchors, roll heavily.

These islands are fully described in the *British American Navigator*, pp. 87—89.

4. ANTICOSTI.—This island, with one exception, has no bay or harbour capable of affording shelter to shipping in general: it is uncultivated; yet, rude and unhospitable as its aspect may be, it is not absolutely unprovided with the means of succouring the distress of such as suffer shipwreck on its coasts, there being government agents who reside upon it, (and, with the lighthouse keepers, are the sole inhabitants,) at different stations, all the year, furnished with provisions for the use of those who have the misfortune to need them. Boards are placed in different parts, describing the distance and direction to these friendly spots; these establishments were first made in the year 1809.

"One of these provision posts is at two leagues to the S.E. from the West end of the island, in Ellis's Cove or Grand Bay; the second at the lighthouse at the S.W. point; the third at Shallop Creek, otherwise called Jupiter River; and the fourth at the eastern lighthouse on Heath Point."

The South shore of the island is dangerous; but, to modify its character, *four* beacons have been erected—1. With a small triangular head, 40 feet high, on the South point. 2. At Pavillon River, large triangle, with cross over. 3. Six miles East of Salt Lake Bay, large triangular head. 4. On Cape St. Mary, with a cross (1851).

5. LABRADOR.—The Descriptions and Directions by Captain Bayfield, of this hitherto but little-known region, are given in the "British American Navigator," p. 91, &c.

6.—QUEBEC.—In the early editions of this work, the longitude of Quebec was stated to be 71° 10', "according to the observations of M. le Marquis de Lotbinière, M. Bédard, Director of the Seminary of St. Louis. and Captain Holland. M. Mechain computed the longitude to be 71° 10', by several eclipses of Jupiter's first satellite, observed by Messrs. Lotbinière and Holland; and the passage of Venus that Captain Holland observed in 1769. All the observations, made at different times, have given very coherent results."—Vide *American Trans.*, vol. i., &c.

The above passage, from "Analysis of a General Chart," &c., Paris, 1786, shows the position in which Quebec was laid down in the Charts; and it agreed with that given in the "Connaissance des Tems." But Quebec was afterwards exhibited considerably more to the eastward. Mr. Wright, in his chart of 1807, made it 70° 27'. The Requisite Tables, of 1802, gave latitude 46° 48' 38", longitude 71° 5' 22". Colonel Bouchette, in his work on Canada, 1815, gives 46° 48' 49 N., and 71° 11' W. In the years 1819, 1820, and 1821, the officers of H.M.S. *Newcastle*, provided with four chronometers, made many observations in the river; and these observations may be judged of by the longitude they placed Quebec in for three successive years, assuming Halifax as in 63° 33′ 40″; July 16th, 1819, 71° 12′ 48″; June 19th, 1820, 71° 13′ 14″; July 5th, 1821, 71° 12′ 25″. The greatest difference is 49″, and the mean of the whole is 1″ farther West than longitude given in 1819.

From these and other observations combined, the late Mr. Purdy placed Quebec in longitude 71° 13′, in the charts, &c., which he constructed, as they still remain.

When the charts of Captain H.W. Bayfield were published in 1837, they were based upon a longitude of 71° 16′ W. for Quebec. This has been shown to be in error nearly 3½ minutes of arc, by electric telegraphic signals transmitted between Quebec and Cambridge Observatory, in Massachusetts, by Lieut. E. D. Ashe, R.N., in September and October 1857.

The position of Cambridge, as will be seen in the Note on that longitude on a subsequent page, is definitely settled as 71° 7′ 58″·55, and the mean difference between that observatory and the Observatory in Mann's Bastion in the Citadel of Quebec, as determined by Lieutenant Ashe, is 0° 4′ 34″·17, which places Quebec in 71° 12′ 32″·72.

7. MONTREAL.—The longitude of Gate Island, opposite the Cathedral, and the Hotel Dieu, is given by Captain Bayfield in 73° 34′ 38″ (erroneously on Admiralty Charts, as 68° 54′ 38″).

Lieutenant Ashe, R.N., as stated above, in continuation of his work on electric time-signals, obtained the difference of longitude between Quebec and Viger Square, 630 feet west of Gate Island, on March 12th, 1857, as 2° 20′ 45″·5, which makes it in longitude 73° 33′ 18″·12, as shewn in the Table.

8. CHARLOTTETOWN and PRINCE EDWARD'S ISLAND.—The position of the flag-staff in the Fort of Charlottetown, has recently been given by Rear-Admiral Bayfield as 46° 13′ 55″, lon. 63° 7′ 23″ W. It had been before placed 3′ more to the West, but the exact difference of longitude between this point and Quebec, has lately been determined by the electric telegraph, as 8° 5′ 26″

VARIATIONS OF THE COMPASS.—1861.

There is no part of the world where the secular change in the magnetic variation is proceeding at a greater rate than in the vicinity of Labrador, and the N.E. portion of Newfoundland. This fact is very important in connexion with the fine surveys which have been made at periods of from 30 years since to the present time, inasmuch as the variations given at their completion, will vary from one-third to half a point from what it is at the present period.

At St. Paul's Island, it is about 26° 30′ W.; at the Magdalen Islands, 25° 16′ W.; East point of Anticosti, 27° 12′ (in 1852); at the West Point, 27° 0′ W.; at Wapitagun Harbour, in Labrador, 32° 17′ (in 1859); at Kegashka Bay, 31° 9′; at the Bay of Seven Islands, 25° 0′ W.; at Point de Monts, 24° 0′ W.

River St. Lawrence.—At the entrance of the Saguenay River, 19° 0′ W.; at Quebec, 15° 22′ W.; at Montreal, 10° 0′ W.

At Charlottetown, Prince Edward Island, 22° 50′ W.; Miscou Island, entrance of Chaleur Bay, 23° 10′ W.: at Sydney Harbour, Cape Breton Island, 24° 18′ W.; Louisbourg Harbour, 24° 21′ W.; at Gabarus Bay, 23° 40′ W.

These variations are now *increasing* at the rate of 5′ or 6′ per annum.

Mr, Bain, in his "*Essay on the Variation of the compass,*" noticed a frequent and remarkable aberration which has been found on approaching the vicinity of Cape Chatte. He says, "In the River of St. Lawrence, the change in the variation should be most particularly attended to, as it leads a ship, both in going up and coming down, on the coast most to be avoided." Mr. B. has shewn that, in coming down, in May, 1813, he found it necessary to steer a different course from the opposite one followed in going up, under very similar circumstances, a few days before. The difference exceeded a point. Both in going up and down, there was a breeze of 8 and 9 knots, weather uncommonly fine, and every circumstance extremely favourable for remarks

Subsequent to the above period, the *Zealous*, ship of war, had a very narrow escape in going up the river, the compasses in the binnacle, being so much affected by local attractions, that, had the fog not cleared away at the moment it did, the ship must have run on shore, not far from Cape Chatte, she being in 12 fathoms. But in a subsequent part of this work, will be found some remarks which demonstrate that this aberration only occurs when the vessel is close in shore.

14. NOVA SCOTIA, ETC.—(Southern Coasts.)

	LAT. N. ° ′ ″	LON. W. ° ′ ″	AUTHORITIES.
SABLE ISLAND: [1]			The Surveys by Admiral H.W. Bayfield, and Commanders Shortland and Orlebar, R.N., 1827-60.
West Flagstaff	43 26 24	60 8 15	
West extreme of Grassy Sand Hills	43 56 44	60 8 56	
East Extreme	43 58 57	59 45 58	
The MAINLAND: [2]			
Cranberry Is.; Lightho.	45 19 45	60 55 54	
Canso Harbour; Cutler Island, S.E. Extreme	45 20 42	60 59 27	
———; Steeple of Church	45 20 10	61 59 25	
White Head Island; Light.	45 11 58	61 8 27	
White Haven; Observation station in Marshall Cove	45 14 37	61 11 43	
Berry Head; Extreme ..	45 11 37	61 18 58	
Mew Harbour Head; Nob	45 9 7	61 28 21	
Harbour Island; N.E. Pt.	45 8 25	61 36 43	
Isaac Harbour; Red Head, summit	45 9 39	61 38 52	
Country Harbour; Station opposite Window Point	45 14 41	61 47 6	
Hollins Head; summit ..	45 4 19	61 44 57	
Wedge Island; Beacon ..	45 0 36	61 22 47	
St. Mary River; above Episcopal Church	45 6 12	61 58 7	
Liscomb Harbour; Spanish ship Point	45 0 28	62 1 8	
Mary Joseph Harbour; Lobster Point extreme ..	44 57 52	62 4 57	
Beaver Island; Lighthouse	44 49 33	62 20 38	
Salmon Riv.; W. of wharf	44 54 32	62 23 33	
Sheet Harbour; ½ mile N.W. from Watering Cove	44 54 11	62 30 37	
Taylor Head: summit....	44 47 24	62 33 8	
Pope Harbour; Harbour Island, N.E. Extreme ..	44 47 50	62 39 10	
Ship Harbour; Islet near Salmon Point	44 46 59	62 49 13	
Egg Island; Centre	44 39 55	62 52 9	
Jedore Harbour; Marsh Pt.	44 43 19	63 0 39	
Jedore Rock; Centre	44 39 49	63 0 57	
Jedore Head; Point	44 40 22	63 3 14	
Graham Head; summit ..	44 37 44	63 17 23	
Devil Island; Lighthouse	44 34 48	63 27 51	
Halifax Harbour; Lighthouse, Maugher Beach ..	44 36 6	63 32 18	

NOVA SCOTIA, &c.—CONTINUED.

	LAT. N. ° ′ ″	LON. W. ° ′ ″	AUTHORITIES.
Grahams Head; summit..	44 37 44	63 17 23	The surveys by Admiral Bayfield 1853.
Laurenceton Head; summit	44 38 34	63 21 35	
HALIFAX; Dockyard Observatory ....[3]	44 39 38	63 35 35	
Holderness Island, on the S.W. side of Margaret's Bay	44 34 20	63 58 48	
Green Island; off Mahone Bay	44 27 0	64 0 18	The survey made by Mr. Joseph F. W. Des Barres, 1775, with subsequent emendations.
Cross Island; off Lunenburg Harbour; Lighthouse..	44 20 0	64 7 0	
Cape Le Have; Ironbound Island; Lighthouse....	44 15 40	64 17 2	
Medway Head; Admiralty Head, Lighthouse......	44 8 0	64 34 32	
Coffin's Island Lighthouse, near Liverpool Harbour	44 3 0	64 36 32	
Mouton or Matoon Island	43 57 0	64 43 32	
Shelburne or Cape Roseway Lighthouse on Macnutt Island..............	43 37 31	65 17 2	
Baccaro Point; Light on East side of Port Latour	43 26 54	65 29 11	The surveys by Commander Shortland, R.N., Admiral Bayfield &c.
Brasil Rock	43 24 15	65 23 48	
Seal Island; Lighthouse; half mile from S. point	43 23 34	66 1 50	
Cape Fourchu, near Yarmouth; Lighthouse....	43 47 30	66 10 18	
Bryer's Island; Lighthouse	44 14 57	66 23 2	
Point Prim; Lightho. (Entrance of Annapolis Basin)	44 40 50	65 37 49	
Black Rock Point; Lightho.	45 10 48	64 48 30	
Horton Bluff; Lighthouse	45 6 15	64 2 30	
Partridge Island Light, in the Mines Channel	43 23 0	64 8 30	
Cape Chignecto	45 22 0	64 51 18	
NEW BRUNSWICK.			
Cape Enragé; Lighthouse	45 36 0	64 47 10	
Quako Head; Lighthouse	45 19 36	65 22 34	
Partridge Island; Lightho.	45 14 2	66 4 0	
CITY of ST. JOHN	45 15 30	66 4 18	Lieuts. Harding and Kortwright, R.N.
Point Lepreau; Lighthouse	45 3 50	66 27 33	

NOTES.

1. SABLE ISLAND.—On this island there is an establishment for the [illegible] of ship-wrecked mariners.—*Nova Scotia [illegible]* The establishment was founded [illegible] 1803, by the Provincial Legislature of Nova Scotia, at the recommendation of the late Sir John Wentworth, then Lieutenant-Governor; and has since proved the means of saving many lives. To the annual grant is now added an equal sum from the Imperial Government.

The house occupied by the superintendent stands on the North side, [illegible] 215 fathoms from the West end of the Grassy Sand Hills, in 1852. Near it is the *West* Flagstaff; the *East* Flagstaff is 2,280 fathoms from the North-east end of the Grassy Sand Hills, and the *middle* Flagstaff is on the South side of the Island. There are residents at each flagstaff to afford assistance. There are several fresh-water ponds, as shown on the particular chart; but, wherever the surface is moist, fresh water may be obtained by digging from 1 to 3 feet deep.

The Signals established, and used to communicate with the island, by any vessel visiting or passing, are explained in the *Colombian Navigator*, 1832, vol. i. p. xviii. The flag used on the island is red, white, and blue, horizontally. A gun fired, particularly in hazy weather, will draw the attention of the inhabitants.

2. NOVA SCOTIA.—The coasts of Nova Scotia have been heretofore laid down from the surveys of Mr. Des Barres, with emendations by Mr. A. Lockwood, R.N., and various corrections in position by Admiral Owen and others. Since the completion of the survey of the Canadian coasts, our Admiralty Surveyors, Admirals Bayfield and F. W. Owen, with Captains Shortland and Orlebar, have been proceeding with the re-examination of the S.E. shores of Nova Scotia, and those of part of the Bay of Fundy, the results of which, as far West as Halifax, as shewn in the table.

—We have noticed, in a former work, that the bulk and price of the showy work of M. Des Barres, never suffered it to come into general use; and, consequently, the new names which he assigned to different points and places have remained generally unknown. Mr. Lockwood says,—"The original names of the places are restored, by which only they are known to the inhabitants and fishermen. M. Des Barres, in attaching to them the names of noblemen, and men of power, has made his charts of less value; and, in one or two instances, has created serious blunders. Inquire of the people of Jedore for Port Egmont, or those of Sheet Harbour for Port North, they know them not; nor would they ever be induced to adopt them. Jestico, a harsh, unpleasant, and unmeaning name, is preferred to Port Hood, although the latter is more pleasing to the ear, and pronounced and recollected with ease: all attempts to change the rude Indian names for others of a finer texture have failed; even New Jerusalem and Acadia have expired." This complaint was also repeated by French authors. In the recent charts, however, the name Port Howe is made to supersede Raspberry Harbour.

3. HALIFAX.—In former editions of this work the following appears:—"The latitude of the Naval Yard of Halifax, from observations very carefully made by the officers of H.M.S. *Niemen*, in 1822, was 44° 39′ 37″. This was gained by eleven *meridian* altitudes with the artificial horizon, and several observations made on each side of noon at small intervals; the mean true altitudes being computed from the hour angles. The longitude, 63° 33′ 43″, was obtained as the mean result of more than 30 sets of lunar distances. We formerly gave the longitude of M. Des Barres, &c., as 63° 32′ 40″, and therefore presume that a statement of 63° 37′ 48″, which has lately appeared, is 4′ too far West."

Captain Bayfield, as above stated, assumed the longitude of the Dockyard, in his survey to be 63° 37′ 48″. The late Admiral W. F. Owen, in H.M.S. ship "Columbia," in 1844, made it 63° 35′ 28″ W. The late respected Lieut. Raper, takes it as a secondary meridian as 63° 37′ 26″, or, as Captain Bayfield.

Recent observations shew that M. Des Barres' longitude is as near the truth, accidentally perhaps, as that resulting from the refined operations of Admiral Bayfield, a mean between the two positions being that which must now be adopted.

In the determination of this, and of other longitudes, the Electric Telegraph has decided the question beyond controversy.

The difference of longitude between Cambridge Observatory, Massachusetts, and that of Halifax Dockyard, has been determined, electrically, by Professor Bond, and Captain Shortland, R.N., to be $0^h\ 30^m\ 9^s$ in time, or 7° 32′ 23″·45 in arc. This meridional difference applied to the determined longitude of Cambridge, as shewn in the note, or 71° 7′ 58″ 55, makes Halifax Dockyard Observatory to be in 63° 35′ 35″· W. of Greenwich.

4. SEAL ISLAND.—"M. Des Barres places the southernmost point of the southern Seal Isle in lat. 43° 25′ 25″, and lon. 66° 0′ 35″. Later charts have it in lat. 43° 26′ 35″; but our correspondent, Lieut. Hare, gave the latitude of the South point 43° 22′ 23″, or *four miles more to the southward.* This result, since confirmed, will account for so many ships having been yearly cast away, on coming out of the Bay of Fundy. A very strong in-draught, both on the ebb and flood, sets toward the isles, and in the vicinity, equal to 4 knots an hour, and *they should not be approached without a commanding breeze.*"

VARIATIONS OF THE COMPASS—1861.

At Sable Island, 21° 40′ W.; at Cape Canso, 22° 30′ W.; at Country Harbour' 21° 40′ W.; at Indian Bay, 20° 35′; Marie et Joseph Bay, 20″ 40′ W.; at Sheet Harbour, 20° 15′ W.; at Jedore Head, 20° 10′ W.; at Halifax, 19° 35′ W.; at Liverpool Bay, 18° 0′ W.; Cape Roseway, 17° 0′ W.; Cape Sable, 16° 6′ W.; Basin of Mines, 20° 0′ W.; St. John's, New Brunswick, 18° 5′ W.; Great Manan Island, 17° 0′ W.

15. THE UNITED STATES.

	LAT. N.			LON. W.			AUTHORITIES.
	°	′	″	°	′	″	
MAINE.							
Passamaquoddy Bay; Light on Quoddy Head	44	49	0	66	57	0	The surveys by S. Holland, Esq., with subsequent corrections.
Little River; Light at ent.	44	39	22	67	10	35	
Machias Seal Islands; Lightho. on E.one(Brit.)	44	30	0	67	5	30	
Machias Bay; Light on Libby Island..........	44	30	4	67	21	12	
Moose a-bec or Moose peak; Mistake Island Light ..	44	28	52	67	31	43	
Petit Manan; Lighthouse on S. end	44	22	0	67	52	0	
MOUNT DESERT ISLAND; Station at S.E. end							The TRIANGULATION made for the UNITED STATES' COAST Survey, under the superintendance of Professor A. D. BACHE.
Mount Desert Rock; Light.	43	59	30	68	4	41	
Isle au Haut; Light on Saddle Back Islet	41	1	47	68	3	49	
Matinicus Rock; Lightho.	43	51	15	68	47	58	
PENOBSCOT BAY; Ragged Mountain on W. side ..	44	12	44	69	9	12	
——; Owls Head Lightho.	44	6	10	69	0	59	
Manhegan Island; Lightho.	43	46	15	69	18	25	*** The Stations of the primary triangulation are distinguished by small CAPITALS.
CAPE SMALL; Station 5 miles North of Cape ..	43	46	42	69	50	54	
Portland Head; Lightho.	43	27	22	70	12	38	
Cape Elizabeth; E. Light	43	36	56	70	12	10	
FLETCHER'S NECK; Light on Wood Island	43	27	23	70	19	54	
Cape Porpoise Harbour; Light on Goat Island ..	43	20	0	70	28	14	
Cape Neddock; Station ..	43	10	1	70	36	7	
York Harbour; Light on Boon Island	43	7	15	70	28	44	
NEW HAMPSHIRE.							
Agamenticus Hill; station on summit	43	13	23	70	41	41	

THE UNITED STATES—CONTINUED.

	LAT. N.			LON. W.			AUTHORITIES.
	°	′	″	°	′	″	
Portsmouth Har.; Whales Back Light	43	3	30	70	42	3	The Great TRIANGULATION made for the UNITED STATES' COAST SURVEY, under the superintendance of Professor A.D. BACHE.
ISLES OF SHOALS; Station near Hog Island harbour	42	59	13	70	37	4	
——; White Is. Lightho.	42	59	0	70	37	39	
MASSACHUSETTS.							
Newbury Port; East Light on Plum Island........	42	48	25	70	49	15	
Cape Ann; N. Light on Thatcher Island	42	38	19	70	34	39	
——; Light on E. point ..	42	34	47	70	40	28	
Baker's Island; Lighthouse	42	32	10	70	47	25	
Marblehead; Light at Ent.	42	30	18	70	51	5	
Nahant; Hotel	42	25	7	70	54	34	
BOSTON; State House[1]	42	21	28	71	4	5	
——; Cunard Wharf; Flagstaff	42	21	48	71	2	40	
CAMBRIDGE Observatory Dome ....[2]	42	22	51	71	7	58	
Boston Bay; Light on Little Brewster Island	42	19	39	70	53	40	
——; Minot's Ledge; Light	42	16	9	70	45	48	
Scituate; Unitarian Church	42	11	59	70	45	36	
Plymouth Harbour; Pier Head	41	58	44	70	39	27	
Sandwich; Church Spire..	41	45	26	70	30	14	
Barnstaple; Beach Point Light................	41	43	19	70	17	7	
Billinsgate Point Lightho.	41	51	37	70	4	34	
Cape Cod; Provincetown, Orthodox Church Spire	42	3	2	70	11	31	
——; Race Point; Light.	42	3	42	70	14	51	
——; Highlands Lightho.	42	2	21	70	3	53	
——; Nausett centre Light	41	51	36	69	57	18	
Monomoy Island; Light at S. end	41	33	33	69	59	53	
Nantucket Island; CLIFF W. of Harbour........	41	17	33	70	7	7	
——; S. towered Church	41	16	54	70	6	11	
——; Light on Great or N.E. Point	41	23	22	70	2	59	
——; Sankaty Head Light	41	16	15	69	58	10	
——; Tuckanuck; Telegraph at W. end	41	18	12	70	15	13	
Davis South shoal, Light-vessel, about	40	56	30	69	52	0	
Muskeget Island; N.E. pt.	41	20	12	70	18	13	
Martha's Vineyard; Cape Poge Lighthouse	41	[illegible]	[illegible]	70	27	20	
——; Edgartown; Spire	41	[illegible]	[illegible]	70	31	20	
——; Holmes' Hole; spire	41	27	[illegible]	70	36	34	
——; West Chop, or North point Light	41	28	55	70	36	26	
——; INDIAN HILL on N.W. side	41	25	14	70	40	55	
——; Gay Head; Lightho.	41	20	[illegible]	70	50	23	

*** For the purposes of the Survey, the coast of the United States is divided into eleven sections, (nine of which are on the Atlantic Coast) in all of which the work is carried on simultaneously, the Survey being in different stages of progress in the several sections. These several sections are defined as follows:—Section I. From Passamaquoddy Bay to Point Judith. Section II. From Point Judith to Cape Henlopen. Section III. From Cape Henlopen to Cape Henry. Section IV. From Cape Henry to Cape Fear. Section V. From Cape Fear to the St. Mary's River. Section VI. From the St. Mary's River to St. Joseph's Bay. Section VII. From St Joseph's Bay to Mobile Bay. Section VIII. From Mobile Bay to Vermilion Bay. Section IX. From Vermilion Bay to the Rio Grando. Section X. Coast of California, San Diego Bay, to 42nd parallel. Section XI. Coast of Oregon, 42nd to 49th parallel. The Tables give the latitudes and longitudes of the trigonometrical points in each section. The manner in which these data have been obtained may be briefly explained here.

THE UNITED STATES—Continued.

	LAT. N.			LON. W.		
	°	′	″	°	′	″
No Man's Land; Station on centre	41	15	9	70	40	4
Cuttyhunk; Light on S.W. Point	41	24	50	70	57	15
Nashon Island; station	41	29	23	70	44	48
Nobska Lighthouse	41	30	55	70	39	36
Mattapoiset; Lt. on Ned's Point	41	39	1	70	48	1
New Bedford; Fort	41	37	25	70	54	25
Secounet Point, East Rock	41	27	2	71	11	53
Rhode Island.						
Newport; Spire	41	29	12	71	19	5
———; Beaver Tail Light	41	26	54	71	24	15
Quaker Hill, near N. end	41	34	55	71	15	31
Bristol; Court House	41	40	10	71	16	46
Providence; Unitarian Ch.	41	29	26	71	24	35
Point Judith; Lighthouse	41	21	28	71	29	10
Block Id.; Light on N. point	41	13	27	71	34	48
——; Beacon Hill at S. end	41	10	30	71	36	27
Watch Hill; Lighthouse	41	18	12	71	51	48
Connecticut and New York.						
Long Island Sound						
Montauk Point; Lightho.	41	4	13	71	51	42
Plum Id. Lighthouse	41	10	24	72	12	58
New London; Presbyterian Church spire	41	21	16	72	6	5
Connecticut River; Light on Saybrook Point	41	16	15	70	20	52
Falkner's Island Lightho.	41	12	41	72	39	30
Newhaven; Episcopal Ch.	41	18	11	72	55	49
———; Light on Five Mill Point.	41	14	54	72	54	51
Stratford Point; Light.	41	9	5	73	6	29
Throg's Neck; Lightho.	40	48	17	73	47	36
Lands Point Lighthouse	40	51	55	73	44	4
Eaton's Point; Lightho.	40	57	12	73	23	51
Old Field Pt., Lightho.	40	58	34	73	7	24
Horton's Point Lightho.	41	5	0	72	26	51
Long Island, South side; Shinnecoik Bay N. point	40	51	0	72	30	36
Fire Island; Lighthouse	40	37	53	73	12	51
NEW YORK; City Hall	40	42	43	74	0	39
———; Navy Yard Flagstaff [3]	40	42	2	73	59	6
New Jersey						
Sandy Hook; Lighthouse	40	27	39	74	0	24
Highlands of Navesink; Lighthouse	40	23	42	73	59	25
Barnegat Inlet; Lightho.	39	45	49	74	6	41
Little Egg Har.; Boarding House at North end of Tucker Island	39	30	48	74	18	12
Absecum Inlet; Light on South side	39	22	0	74	25	36
Cape May; New Lightho.	38	55	50	74	57	51

Authorities.

The Great Triangulation made for the United Sates' Coast Survey, under the superintendance of Professor A.D. Bache.

In each section a base line of from five to ten miles in length is measured with all possible accuracy. A series of triangles, deriving the length of their sides from this base, is then established along the coast, by the measurement of the angles between the intervisible stations. In this primary series the triangles are made as large as the nature of the country will permit, because the liability to error increases with the number of triangles.

On the bases furnished by the sides of the primary triangles, a secondary triangulation is next established extending along the coast, and over the smaller bays and sounds, and determining a large number of points at distances of a few miles apart.

The distances between the points thus determined, as given in the Tables, are liable to an average error of about one foot in six miles, until a final adjustment between the base lines shall have been made.

As, on the completion of the primary triangulation in each section, the several series form one connected chain, the different bases afford verifications of each other, and of the triangulation connecting them. The first three sections are thus connected at present.

THE UNITED STATES.—CONTINUED.

	LAT. N.			LON. W.			AUTHORITIES.
	°	'	"	°	'	"	
Delaware Bay and River; Egg Island Lighthouse	39	10	31	75	8	37	The Great TRIANGULATION made for the UNITED STATES' COAST SURVEY, under the superintendence of Professor A. D. BACHE.
Cohansey Lighthouse	39	20	18	75	21	45	
PHILADELPHIA; Girard College	39	58	23	75	10	30	
——; Navy Yard	39	55	47	75	8	50	
DELAWARE.							
Wilmington; Light at Christiania River......	39	43	15	75	31	32	
Bombay Hook; Lightho.	39	21	46	75	30	55	
Cape Henlopen; High Lighthouse	38	46	38	75	5	19	
Indian River; Salt Works	38	35	35	75	3	50	
VIRGINIA.							
Assateague Id.; Lightho. at South end..........	37	54	37	75	21	40	
Hog Island; Lighthouse at South end	37	23	18	75	42	12	
Cape Charles; Lighthouse	37	7	48	75	52	48	
Chesapeake Bay							
SANDY POINT; station on E. side	37	33	38	75	56	54	
TANGIER ISLAND; station on E. side	37	47	54	75	59	32	
Sharpe's Island; Lightho.	38	37	44	76	22	31	
Baltimore; Lazaretto..	39	15	39	76	35	14	
WASHINGTON; Capitol Dome	38	53	20	77	0	51	
——; National Observy.[4]	38	53	39	77	3	23	
Potomac River; Smith's Point Light	37	53	14	76	14	34	
Cape Henry; Lighthouse	36	55	29	76	0	48	
NORTH CAROLINA.							
Entrance to Pamlico Sound; Body Island Light	35	47	21	75	31	20	
Stevenson's Point; North side Albemarle Sound[5]	36	6	18	76	10	43	
Cape Hatteras; high Light.	35	15	11	75	30	33	
——; Extremity	35	14	50	75	30	40	
Ocracoke Inlet; Light on West end of Island	35	6	31	75	58	28	
Cape Lookout; Lighthouse	34	37	20	76	30	41	
——; Extremity	34	31	50	76	31	10	
Beaufort Inlet; S. Light near Fort Macon	34	41	43	76	40	0	
Bogue Inlet; Entr., about	34	38	0	77	6	0	
Cape Fear River; Light on Federal Point	33	58	4	77	54	53	
Cape Fear; Lighthouse on Bald Head...........	33	52	18	77	59	49	
——; South Extreme..	33	49	55	77	57	30	
Little River; Entrance	33	41	0	78	34	30	
SOUTH CAROLINA.							
George Town; Light at Entrance of Pedee River	33	13	31	79	6	44	

THE UNITED STATES.—CONTINUED.

	LAT. N. ° ′ ″	LON. W. ° ′ ″	AUTHORITIES.
Cape Romain; Light on Raccoon Key	33 1 4	79 17 5	The Great TRIANGULATION made for the UNITED STATES' COAST SURVEY, under the superintendence of Professor A.D. BACHE.
Bull's Bay; (Refuge harbour) Light at N. end of Bull's Island	32 55 42	79 30 33	
Charleston; Lighthouse on Morris Island, at W. Ent.	32 41 55	79 52 29	
——; St. Michael's Ch.[5]	32 46 33	79 55 38	
North Edisto River; East end of Base line 1¾ miles W. of Entrance	32 33 17	80 13 20	
St. Helena Sound; Light-ship at Entrance	32 24 44	80 21 31	
GEORGIA.			
Savannah River; Tybee Lighthouse	32 1 21	80 50 33	
Savannah; Exchange Spire	32 4 53	81 5 14	
Sapelo Bar; Blackbeard Island, East Point	31 30 10	81 16 0	
St. Simon's Sound; Lighthouse on N. side	31 3 46	81 32 29	
St. Andrew's Sound; Light on Little Cumberland Id.	30 53 32	81 32 25	
FLORIDA.			
St. Mary's River; Light on N. end of Amelia Island	30 39 26	81 30 54	
Fernandina; Railroad wharf	30 40 17	81 27 42	
St. John's River; Lighthouse [6]	30 21 42	81 27 30	
St. Augustine Inlet; Light on Anastasia Island	29 50 48	81 19 11	
Cape Canaveral; Light.	28 27 0	80 33 0	
Jupiter Inlet; Lighthouse	26 55 26	80 5 5	
Cape Florida; Lighthouse on Biscayne Key [7]	25 41 0	80 3 0	
Florida Reefs; Lighthouse near Coffin's Patches	24 37 46	81 6 43	
———; Sand Key Lightho.	24 26 30	81 51 12	
Key West; Lt. on S.W. pt.	24 32 32	81 49 20	
———; Tifts Observatory	24 33 31	81 47 0	
Marquesas; S.E. point	24 32 54	82 5 32	
Dry Tortugas; Lighthouse on Bush Key	24 37 20	82 53 40	
Cape Sable; Fort Poinsett	25 6 0	81 9 0	
Cape Romano	25 51 0	81 57 0	
Sanibel Island, East	26 27 30	82 10 0	
Tampa Bay; Egmont Key Lighthouse	27 36 0	82 45 45	
Anclote Keys; Inlet	28 17 0	82 54 0	
Cedar Keys; Lighthouse on Seahorse Key	29 5 45	83 4 50	
St. Marks Harbour Light.	30 4 24	84 10 37	
Dog Id.; Lt. near W. end	29 46 0	84 34 42	
Cape St. George; Lightho.	29 36 10	84 58 38	
Cape St. Blas; Lighthouse	29 41 41	85 24 34	
Pensacola Bay; Lighthouse	30 19 0	87 17 24	

THE UNITED STATES.—CONTINUED.

	LAT. N. °	′	″	LON. W. °	′	″	AUTHORITIES.
ALABAMA.							The Great TRIANGULATION made for the UNITED STATES' COAST SURVEY, under the superintendance of Professor A.D. BACHE.
Mobile Point; Fort Morgan ....[8]	30	13	48	88	0	25	
Dauphin Island; West end Station of base	30	14	27	88	13	53	
Mobile; Episcopal Spire..	30	41	26	88	1	29	
Horn Island; East Point..	30	13	21	88	30	58	
MISSISSIPPI & LOUISIANA.							
Ship Island; Lighthouse on W. point	30	12	55	88	57	1	
Chandeleur Island; Lighthouse on North Point ..	30	3	22	88	51	49	
Entrance of the Mississippi; Pass à Loutre Lighthouse	29	8	36	89	1	30	
——; S.W. Pass Lightho.	28	58	38	89	21	0	
NEW ORLEANS; City of ....[9]	29	57	30	90	2	18	
Timballier Bay; Lighthouse on W. side of Ent.	29	4	0	90	16	30	
Atchafalaya Bay; Point au Fer..................	29	19	30	91	33	0	
Sabine River; Lightho. on Brant Point	29	43	55	93	50	19	
TEXAS.							
Galveston Bay; Lighthouse on Bolivar Point	29	22	35	94	45	40	
Galveston; Court House..	29	18	14	94	46	33	
Matagorda Island; Lighthouse on E. Point......	28	20	58	96	23	57	
Aransas Pass; Lightho. on North side............	27	23	53	96	56	30	
Brazos Santiago; Lightho. on Isabel Point........	26	4	52	97	11	4	

NOTES.

GENERAL NOTE.—In the year 1807, the United States' Legislature determined upon the survey of the coast. This was not properly commenced until 1817, when some base lines were measured, and triangles taken. In 1832 the operations were resumed, under its original superintendent, Mr. *F. R. Hassler*.

In 1842, a plan was drawn up by Congress for its further organization, under which it has since continned under the able superintendance of *Professor A. D. Bache*. In the conduction of this extensive survey, every refinement and appliance to ensure accuracy is employed, and many new and important discoveries in geodetic science have been made.

The latitudes and longitudes of the points between Mount Desert Island, in Maine, and the Chesapeake, are connected together in the triangulation. South of this, the survey has only been carried on in detached portions, as stated in the respective notes, and their points given are dependent on the accuracy of the position of the primary station in each section..

As shown in the Note on page 65 the whole of the coasts of the United States, is divided into eleven sections, of which two are composed of the Pacific Coasts, and the geographic connexion between America and the rest of the world, is mainly dependant on the position of the Observatory of Cambridge near Boston.

The positions given are taken from a list of nearly 4,000 points, established in the course of the survey, as published in 1851-3, with a slight subsequent correction. But each place may now be taken by the mariner as absolutely accurate, as the amount of probable error is so small, as to be totally beyond his means of detecting. Therefore each lighthouse, cape, &c., will equally well serve to correct his reckoning, or rate his chronometer, as the primary observatory.

1. BOSTON.—Dr. Bowditch, from six astronomic observations, viz., two transits and four solar eclipses, made the longitude of Boston as $4^h\ 44'\ 16''.6$; and it was the opinion of Dr. Bowditch that this longitude was more accurately ascertained than that of any other place in the United States. The State of Massachusetts was surveyed trigonometrically, by Simeon Borden, and Robert Treat Payne, Esqrs., and the survey was based on the position of Boston State House. "From observations in 1829 and 1830," says Mr. Borden, "I made the longitude of the State House, as $4^h\ 44'\ 14''.6$"; and by the great solar eclipse, May 15th, 1836, $4^h\ 44'\ 19''.6$: mean of the whole, $71°\ 4'\ 13''.5$, or only 8" more than in the Table. The latitude deduced as $42°\ 21'\ 22''.7$, was from 636 observations.

2. Cambridge Observatory.—The longitude of the Observatory of Cambridge near Boston, is the primary meridian of the greater portion of N.W. America, inasmuch as the longitudes of most other places have been referred to it by triangulation, or by electric signal. Its relation to Greenwich has also employed years of assiduous labour and consummate skill, and may now be considered as entirely established, within probably an insignificant amount of error.

Prior to the year 1849, the astronomic observations systematically carried on there had resulted in a longitude assumed as $71°\ 8'\ 0''.0$ West of Greenwich. When the positions of the United States' Coast Survey stations were published in 1851, it was assumed as $71°\ 7'\ 22''.5$, from the following data:—Moon culminations at various observatories referred to Cambridge, $4^h\ 44^m\ 28^s.4$; by eclipses and occultations in the same manner, $4^h\ 44^m\ 29^s.6$, and by chronometric differences to that date $4^h\ 44^m\ 30^s.1$. This latter determination was afterwards assumed by Professor Bond to be very nearly the true longitude.

But in 1855, the chronometric operations were again resumed early in January, and the first meridional distance was carried by the steamer America, June 5th, and the last by the return of the Africa to Boston, October 26th, 1855. There were six voyages across the Atlantic, between Boston and Liverpool, and the total number of chronometers used was fifty two, and the final longitude determined is as follows:—

	h	'	"
Voyages from Liverpool to Cambridge	4	32	31.92
Voyages from Cambridge to Liverpool	4	32	31.75
Mean	4	32	31.84
Liverpool West of Greenwich		12	0.05
Resulting longitude	4	44	31.89 or

Cambridge $71°\ 7'\ 58''.55$ West of Greenwich, which is here assumed. This longitude which is $1''.79$ in excess of the longitude of 1851, is a very close approximation to that established by Dr. Bowditch and Mr. Borden for Boston as in the previous note, and is also nearly identical with that of New York, as obtained by Mr. Dents chronometers in 1839. For these reasons the result of 1855 has been preferred, and 36" has been added to the longitudes given in the extensive tables published by the United States' Coast Survey department in 1851, above alluded to.

The longitudes in Sections I, II, III, and V, of the United States' Survey, are dependant on this.

3. NEW YORK.—In the *Ladies and Gentleman's Diary*, or *United States' Al*

manac, for 1820, Mr. Nash, the Editor, having the reputation of an excellent observer, gives particulars of a great many meridian and circum-meridional observations taken at his school, Broadway, New York, from which he infers the latitude of No. 331, Broadway, as 40° 42′ 58″. The difference of latitude, trigonometrically found, between Mr. Nash's and the City Hall, was somewhat less than 1,300 feet, which, assumed as 13″, gives the latitude of the City Hall 42° 42′ 45″, *i. e.*, allowing 40° 42′ 58″. as the latitude of of No 331, Broadway. By observations of a solar eclipse, which Dr. Bowden observed at New York, he found the difference of longitude between Greenwich and Colombia College equal to 47° 0′ 45″W. On the 29th of May, 1818, at a few minutes past noon, the longitude of No. 331, Broadway, by the mean of three distances of the sun and moon, appeared to be 74° 0′ 42″, and Mr. Nash adds, "I am inclined for the present, to place the City Hall in 74° W."

By seventy lunar distances, forty of *Pollux* East, and thirty of *Aldebaran* West of the moon, in December, 1822, and January, 1823, *Captain Sabine* gave the longitude of the cupola of Colombia College, New York, as 74° 3′ 27″, and the latitude which he assigns to it is 40° 42′ 43″. Mr. De Witt, on his survey of the province, gave the longitude as 74° 3′.

The chronometers of Messrs. Arnold and Dent, however, appear to have decided the longitude of New York. Four of them were embarked in the *British Queen* steam-vessel, under the care of Captain Roberts, on her first voyage from England to America in July and August, 1839, and gained the longitude of the City Hall in New York, as 4^h 56′ 3″.35 (=74° 0′ 49″). A second experiment was made on the next voyage of the same vessel, in October and November of the same year, by another set of four chronometers, and by this the difference of longitude between the Observatory at Greenwich and the City Hall, New York, appeared to be 4^h 56′ 0.24″. Say 74° 0′ 10″. M. Daussy, the French Hydrographer, had previously given it in the *Connaissance des Tems* as 4^h 56′ 0″.72, or 74° 0′ 11″—(See *Athenæum*, Nos. 621 and 629, September and November, 1839.)

By the determination of the United Coast Survey, from data up to 1851, it was in longitude 74° 0′ 3″.09; but, by the subsequent correction of the Cambridge longitude as shewn above, it is in 74° 0′ 39″, as in the Table, very nearly identical with the determination of M. Daussy and Mr. Dent

4. WASHINGTON.—In our former editions, the Dome of the Capitol is placed in longitude 77° 0′ 20″, from the State Survey of 1816. This is shown to be nearly correct.

SEATON STATION in the City of Washington, is the point to which all telegraphic differences of longitude are referred, and which have now placed it in connexion with most of the important places on the coasts of North West America, and established beyond controversy, their true relative longitudes.

5. NORTH CAROLINA.—The longitudes of the coasts South of Cape Henry, at the Chesapeake, as far as Cape Fear, or Section IV, of the United States' Coast Survey, are dependant on that of Stevenson's Point, the West point of Little River, on the North side of Albemarle Sound. The Base line upon which the triangulation was established, was measured upon Body's Island, on the Coast of Pamlico Sound, and the South end of it is near the Lighthouse. The positions are given, subject to future corrections, both for the longitude of the primary point, and for that of the great triangles not yet obtained.

6. CHARLESTON.—The longitude of Charleston was obtained from Seaton Station, in Washington, by Electric Telegraph, in 1850, by Professor Walker and Lieutenant Gibbes. Section V. of the United States' Coast Survey system is thus connected with the rest of the series, but the triangulation has not yet been extended along the coasts of South Carolina. The longitude of Charleston Lighthouse now given is identical with that we assumed in former editions and in the *Colombian Navigator* vol. I., as obtained by Mr. James Elford, a mathematician of Charleston.

7. CAPE FLORIDA, &c.—In 1845, Captain Edward Barnett, R.N., made a running survey of the Coast of Florida and the adjacent banks. His longitudes

were found by eight chronometers by meridian distance from Havana, and in other portions of this region have been found very consistant. He places Cape Florida in longitude 80° 3° 0″ W. as shewn in the Table.

But the United States' Surveyors make this position a primary point for the longitudes in Section VI. of the Coast Survey, and they make it, according to their estimate of 1851, 80° 5′ 0″, and in 1859, 80° 9′ 29″, or 6½′ further West than Captain Barnett. Yet Sand Key is placed by the United States' authorities, in November, 1852, in 81° 52° 43″, while Captain Barnett's longitude is 81° 51′ 12″, a difference of only 1⅓′. We have adhered to the British authority, but it is necessary to point out the doubt which exists, which will be remedied when this part of the survey shall be brought into connexion with the remainder.

8. MOBILE. Fort Morgan, on Mobile Point, is made the primary station of Sections VIII and IX of the United States' Survey, or between it and the Mexican frontier. The triangulation is yet very incomplete.

9. NEW ORLEANS.—The position of New Orleans is given approximatively from the sketch published by the United States' Coast Survey. The triangulation was not entirely completed from Mobile.

The longitude of New Orleans is of some interest. The United States' Coast Survey has assumed a considerable degree of importance from its extent, and these results being extended to the other portions of the territory, render the consideration of a *primary* meridian for the western world one necessary to be determined in the early state of the operations.

The capitol of Washington would naturally appear to be the fittest starting point; but as the introduction of greater diversity in astronomic and other tables than at present exists is certainly not desirable, the United States' Survey Department commissioned Professor Bache to report on the subject. Impressed with the inconvenience attached to the introduction of a fresh mode of reckoning meridional distances, and at the same time to give due importance to the geodetical operations carried on in America quite independent of any in the eastern hemisphere, he recommended, if any transatlantic meridian were to be assumed as a primary, that that of *New Orleans* would be the fittest.

The progress of the survey having shown that New Orleans was in lon. 90° 0′ 0″, or nearly so, it became manifest that one objection to a new fractional element being introduced was in some degree removed if this were taken. With this view, if any meridian were to be assumed for the United States, that of 90° West of Greenwich, *wherever it may fall*, is the fittest. If in the course of the operations any correction be found necessary to this meridian, as marked in some part of New Orleans, let it be removed accordingly. Thus, the first meridian of the United States, would be one-fourth of the circumference, or six hours in time West of that of Greenwich.

VARIATIONS OF THE COMPASS—1861.

The question of Magnetic Variation or Declination, has received much attention from the Survey department under the superintendence of Professor Bache, who, with Mr. J. E. Hilgard, have reported on the subject.

The exact observations at present collected, have not been sufficient to establish the exact amount of secular change which is necessary to bring the observed result of former years in accordance with the existing Variation. As the amounts given in Professor Bache's and Mr. Hilgard's tables are for various epochs between 1844 and 1856, we have taken the secular change at the amounts estimated by Mr. F.J. Evans, R.N., in 1858, and added them to those quoted in the American list, to bring them down to the epoch 1861.

Near Great Manan Island, 17° 0′ W.; Mount Desert Island, 15° 0′ W.; West side of Penobscot Bay, 14° 5′ 3′ W.; Cape Small, Kennebec River, 12° 57′ W.; Portland, Maine, 12° 48′ W.; Fletcher's Neck, 12° 14′ W.; Isles of Shoals, off Portsmouth, 11° 45′ W.; Newbury Port, 11° 0′ W., Annis Squam, near Cape Ann, 12° 38′ W.; Marblehead, 12° 38′ W.; Boston, Harbour; 11° 0′ W.; Cape Cod; 11° 23′ W.; Nantucket Island, 10° 30′ W.; Martha's Vineyard, 10 6′ W.; Point Judith; Providence, Rhode Island, 10° 2′ W.

New London, Connecticut, 8° 49′ W.; New Haven, 7° 33′ W.; New York City, 7° 10′ W.; Sandy Hook, 6° 42′ W.; Girard College, Philadelphia, 5° 2′ W.; Little Egg Harbour, 5° 42′ W.; Cape May, Entrance to Delaware Bay, 4° 15′ W.; Cape Henlopen, 3° 57′ W.; Entrance to Chesapeake Bay, 2° 10′ W.; Washington City, 2° 0′ W.; (much affected by local attraction); Albemarle Sound, East part, 14° 5′ W. Pamlico Sound, 1° 0′ W.; Cape Hatteras, 1° 30′ W.

The line of *No Variation* intersects the coast to the Westward of Cape Lookout, in about longitude 76° 50′ W.

To the North-westward of this line, the *Westerly* Variation is *increasing* about 3′.5 per annum in the vicinity of Cape Hatteras; about 5′.0 per annum near New York, and 5′.3 per annum on the Coast of Maine.

The lines of *equal* variation run about N.W. and S.E. *true* on the Coast of Maine; N.W. by W. and S.E. by E. about New York, and N.N.W. and SS.E. on the Coast of Carolina and Georgia.

At Wilmington and Cape Fear the *Easterly* Variation is about 1° 0′; at Cape Romain, Cape Fear, 2° 0′ E.; Charleston, 2° 50′ E.; at Savannah, 3° 30′ E.; at Darien, 4° 0′ E.; St. Augustine, 4° 15′ E.; Capes Canaveral, and Florida, 4° 10′ and 4° 15′ E.; Cape Sable, Florida, 5° 0′ E.; Key West, 5° 30′ E.; Tampa Bay, 5° 7′ E.; Apalachuola Bay, 6° 0′ E.; Mobile, 7° 0′ E.; Mouths of the Mississippi, 7° 30′; New Orleans, 7° 45′ E.; Galveston, 9°. These variations are *increasing* at the rate of 0.5 per annum.

16. THE BERMUDA ISLANDS.

	LAT. N.			LON. W.			AUTHORITIES.
	°	′	″	°	′	″	
Ireland Island; Flagstaff [1]	32	19	30	64	51	40	
Wreck Hill .... [2]	32	16	45	64	54	40	
GIBB'S HILL LIGHTHOUSE, light revolving every minute, (362 feet) .. [3]	32	15	4	64	51	36	
Mount Langton; Signal Station North of the Town of Hamilton	32	18	30	64	48	12	
Castle Island; Entrance of Castle Harbour	32	21	0	64	40	30	The Trigonometrical Survey, by Captain Thomas Hurd, R.N., under the orders of the British Admiralty, between the years 1783 and 1797, adjusted by the observations of Captain Edward Barnett, R.N., 1846.
St. David's Head	32	22	50	64	38	45	
Fort Cunningham; at the Entrance of St. George's Harbour	32	23	13	64	39	37	
Mill's Breaker; Eastern Extremity of the Reef..	32	23	48	64	41	0	
North Rock; Northern limit of Reef	32	30	30	64	46	55	
Long Bar, N.W. end; the Western Extremity of the surrounding Reef ..	32	16	40	65	2	20	
S.W. Breaker; Southern Extremity of Reef	32	13	30	64	53	30	

NOTES.

1. Between the years 1783 and 1797, Captain T. Hurd, R.N., was employed in the survey of these beautiful islands, the outline of which survey is published by the British Admiralty. Captain Hurd deduced his longitudes from Wreck Hill, which, from its

position, as recently ascertained, may be taken as 4′ or 5′ E. of the correct longitude. In the chart of the Bermuda Islands, as published by Mr. Laurie, we have placed the islands in the longitudes, which, from the accuracy of Captain Barnett's observations, we may suppose to be finally settled.

IRELAND ISLAND.—The position of Bastion C, which serves as as a groundwork for the rest, was determined by meridian latitudes; and the longitude, we presume, is by chronometer, from the West Indies. The detail of these operations is given by Captain *Edward Barnett*, R.N., in the *Bermuda Royal Gazette*, August 25th, 1826.

2. WRECK HILL.—As we have mentioned, Captain Hurd considered this to be in lat. 32° 15′ 20″, and lon. 64° 50′; but, according to the corrected position of Ireland Island flagstaff, this is 1′ 25″ South, and 4° 40′ E. of its right place.

3. GIBB'S HILL LIGHTHOUSE.—The position of this was obtained by triangulation from Ireland Island; but, on applying these calculations to Captain Hurd's survey, we find some small discrepances; but as they are not of sufficient magnitude to affect navigation, we have not attempted to adjust them.

The lighthouse is an important structure, composed of iron, constructed in London, from the designs of Mr. Alexander Gordon, E.C., and erected under the superintendence of Mr. George Grove, in 1845. Its total height is 133 ft. 9 in., and the light was first shown May 1st, 1846. The tower is painted white, and in the day time will appear like a sail. The light revolves, and shows a bright glare every minute, but a fainter continuous light is visible within 15 or 20 miles off. It is 362 feet above the sea, and may be seen from a frigate's deck 7 or 8 leagues, but has been seen quite bright at 33 miles off. The light apparatus is dioptric, or from lenses of the first order. The light is intercepted between *N.* 43° 24′ *E. true*, or N.E. $\frac{1}{2}$ E. by compass, and N. 47° 34′ *E.*, *true*, N.E. by E. mag., and *N.* 57° 35′ *E.*, *true*, N.E. by E. $\frac{3}{4}$ E. mag., by the hills on the South side of the island.

Variation, 7° 1′ W.—October, 1845, and as at present.

17. THE BAHAMA AND PASSAGE ISLANDS.

	LAT. N.	LON. W.	AUTHORITIES.
	° ′ ″	° ′ ″	
LITTLE BAHAMA BANK.			
MATANILLA, or Maternillo Bank; N.W. end of [1]	27 23 0	76 8 0	Captain Edward Barnett,
Matanillo Shoal, 12 feet ..	27 22 0	79 4 0	R.N., 1846.
Outer part of the Western Reef	27 5 0	79 12 0	The Surveys of Mr. Anthony
Memory Rock	26 57 0	79 0 40	De Mayne, R.N.
Settlement Point; W. end of Grand Bahama Island	26 41 30	79 0 35	
S.E. pt. of Grand Bahama	26 20 0	78 41 30	
HOLE IN THE WALL; Lighthouse ....[2]	25 51 30	77 10 45	
N.E. Pt. of Abaco (*so called*)	26 30 0	76 57 0	
Elbow Reef; Outer Point	26 33 0	76 50 0	
GREAT BAHAMA BANK.			
THE SOUTHERN KAYS:			
The Brothers; East Rk.	22 3 30	75 44 0	The Observations of Captain
THE JUMENTOS:			Richard Owen, R.N., 1831-32.
Little Ragged Isle; Beacon	22 9 30	75 44 30	

THE BAHAMA AND PASSAGE ISLANDS—Continued.

	Lat. N. ° ' "	Lon. W. ° ' "
Ragged Island; Flagstaff	22 11 40	75 47 17
Racoon Kay; Beacon..	22 21 50	75 49 39
Channel Kay	22 32 15	75 52 50
Jamaica South Kay....	22 42 56	75 54 46
Man of War Kay; N.end	22 47 20	75 54 0
Flamingo Kay; Hill ..	22 52 0	75 53 6
Water Kay; S,W. point	22 58 0	75 45 3
Yuma or Long Island:		
Sonth Point of the Isle	22 50 0	74 52 0
Great Har.; Entrance ..	23 7 0	74 52 30
Michael Bank; 12 fathoms..............	23 9 15	74 45 30
Whale, or North point..	23 41 37	75 20 0
Exuma; the Beacon	23 31 53	75 49 21
Galliot Cut, on the Bank..	23 55 0	76 15 0
Eleuthera; S.E. Point ..	24 37 0	76 9 23
———; Govenor's Harb.	25 11 15	76 14 53
———; James' Cistern	25 21 0	76 23 0
———; Harbour Island	25 30 0	76 39 0
———; Egg Island Reef; Extremity ..[3]	25 34 0	76 55 30
The Isles, &c., on N.W.:		
Fleeming Channel; Beacon	25 16 45	76 55 3
Douglas Chan.; Entrance	25 7 30	77 2 45
Nassau, New Providence *Lighthouse* ....[4]	25 5 10	77 22 4
Joulter Kays; N. Exty...	25 19 30	78 8 30
Andros Isles: Morgan's Bluff, or N.E. Point....	25 10 24	78 1 30
High Kay, on the E. Coast	24 39 30	77 42 50
Golding Kay	24 13 40	77 37 20
Green Kay, in the Gulf	24 2 12	77 10 0
Berry Isles:		
S. Stirrup Kay; N.W. pt.	25 25 5	77 55 30
Great Stirrup Kay; E. Point	25 49 40	77 53 45
Holmes' Kay; Centre ..	25 37 40	77 44 0
Great Isaac; Lighthouse[5]	26 2 0	79 6 30
Western Side of the Great Bank:		
Moselle Bank; Bemini Isles	25 49 10	79 17 30
Gun Kay; Lighthouse[6]	25 34 35	79 18 50
Brown's Kay	25 23 40	79 13 0
South Riding Rock; Beacon	25 14 0	79 10 0
Orange Kays; Middle..	24 56 30	79 9 24
Southern Part of the Bank:		
Guincho, or Ginger Kay	22 45 0	78 8 0
Lobos, or Wolf Kay ..	22 22 50	77 36 0
Mucaras, or Diamond Point ....[7]	22 10 0	77 19 0
Cayo Verde, or Green Kay	22 1 40	75 10 0
Kay of St. Domingo [8]	21 42 20	75 44 45

Authorities.

The Observations of Captain Richard Owen, R.N., 1831-32.

Remarks.

A description of, and directions for, these isles and passages, according with the New Surveys, are given in the copious *Notes* prefixed to the second volume of the *Colombian Navigator*, edition of 1848, pages 212, 213.

The Surveys of Captain Richard Owen, Captain E. Barnett, Lieutenant T. Smith, R.N., &c., 1836—1842.

THE BAHAMA AND PASSAGE ISLANDS—Continued.

	LAT. N.			LON. W.			AUTHORITIES.
THE PASSAGE ISLANDS.	°	′	″	°	′	″	The Surveys of Captain Richard Owen, R.N., 1831-2.
Little St. Salvador; W. Point	24	36	22	75	58	0	
St. Salvador; Columbus or S.E, Point	24	8	30	75	16	48	
———; Hawk's Nest, or S.W. Point	24	8	50	75	32	30	
——; N.W. Point	24	41	10	75	45	30	
Conception Island; S. end	23	48	46	75	6	0	
Southampton Reef; Exty.	23	55	15	75	7	3	
Rum Kay; S.E. White Cliffs	23	38	40	74	47	20	
———; West End....[9]	23	39	0	74	56	35	
Watling's Island; Large White Rock at the N.end	24	10	15	74	28	30	
The S.W. Point	23	56	27	74	34	0	
Hinchinbroke Rock	23	56	40	74	28	33	
Samana or Atwood Kays:							
East Low Kay	23	5	0	73	36	43	
Westernmost Reef; Extremity	23	5	50	73	52	0	
Southern Reef	23	4	45	73	45	0	
Planas or Flat Kays; Centre	22	35	10	73	33	0	
Crooked Islands, &c.:							
The N.E. Breaker	22	43	30	73	47	0	
N.E. Reef; Extremity	22	47	0	73	49	45	
Mount Pisgah	22	44	10	74	7	33	
Bird Rock, off N.W. Pt.	22	51	0	74	22	15	
Fortune Isle, or Long Kay; S. Point	22	32	0	74	23	0	
Castle Isle........[10]	22	7	0	74	18	45	
Miraporvos: *							
North Rock	22	7	50	74	32	40	
South Kay; Sand-hills	22	5	0	74	32	15	
Hobart's Breaker's; S.E. End	21	58	30	74	27	30	
Diana, or Monkey Bank; Centre	22	31	0	74	47	30	
Mariguana, or Mayaguana; S.W. Point	22	21	45	73	9	30	
Eastern End of E. Reef	22	18	0	72	38	16	
The Caycos:							
Cape Comet, N.E. Pt.[11]	21	42	50	71	27	38	
Large House near the Booby Rocks	21	49	0	71	41	0	
The Three Maries	21	57	30	72	2	30	
West Caycos; South End	21	37	30	71	44	33	
Providenciales; N.W. pt.	21	52	40	72	20	3	
West, or Little Cayco; South Point	21	37	30	72	28	33	
West Sand Spit	21	22	0	72	5	0	
South Shoal	21	2	0	71	44	33	
Swimmer Shoal	21	5	15	71	29	0	
The Hogsties; N.W.Kay	21	41	30	73	50	0	

* The Miraporvos Bank and Kays were surveyed by Mr. De Mayne, in 1827. The Bank is eleven and a half miles in extent from S.S.E. to N.N.W., and the shoals upon it are very dangerous, particularly to those advancing from the S.E. With the wind blowing strong from the northward they break heavily, and at all times there is a heavy swell upon them. The current generally sets from the N.E. over the shoals at the rate of 1 mile an hour.

THE BAHAMA AND PASSAGE ISLANDS.—Continued.

	LAT. N. °	′	″	LON. W. °	′	″	AUTHORITIES.
GREAT INAGUA:							
The N.W. point....[12]	21	7	30	73	39	30	
Middle Point..........	21	1	45	73	41	0	
S.W. Point	20	55	0	73	39	3	
Mathew Town	20	58	0	73	39	30	
Lantern Head (82 *feet high*)	20	56	30	73	19	24	
S.E. Point............	20	57	45	73	9	48	
N.E. Point	21	20	30	72	59	30	
Little Inagua; East Point	21	29	15	72	55	33	
———; N.W. Point	21	30	40	73	4	33	
TURKS' ISLANDS:							
Edymion Reef	21	7	15	71	18	18	
Sand Kay; Centre	21	11	12	71	14	33	
Salt Kay; Centre	21	20	0	71	12	0	
Grand Kay; Roadsd.[13]	21	28	10	71	7	30	
Square Handkerchief; N.E. detached Breaker	21	6	30	70	27	20	
S.E. Extremity	20	47	30	70	27	0	
Western Extremity....	20	56	0	70	57	0	
SILVER KAY, or PLATE BANK:							
East End (10 *fathoms*)..	20	35	20	69	21	53	
S.E. Point............	20	13	0	62	35	48	
N.W. Point	20	55	0	69	56	13	
S.W. Point ......[14]	20	17	20	70	0	53	The Surveys of Mr. Anthony De Mayne, &c.
BAJO de NAVIDAD, or Ship Bank:							
Northern Extremity[15]	20	14	0	68	51	18	
Eastern	20	2	0	68	47	33	
South-West	19	51	50	68	58	16	

REMARKS.

TURKS' ISLAND PASSAGE.—Near the S.E. end or Elbow of the Caycos Bank, is a shoal in lat. 21° 4′, lon. 71° 31′ 32″, having over it, in some parts, only 5 feet of water, and lying with a bushy kay on the bank bearing N. by W. (by compass) 6 or 7 miles. Lat. by merid. alt.: lon. by two good chronometers, made by Barraud: one giving 71° 31′ 5″; the other, 71° 32′ 0″—*Edwd. Dunsterville H.M.S. Carnation.)*

NOTES.

1. MATANILLA BANK.—The Matanilla Bank, to the northward of the reef, is not represented in Mr. De Mayne's Chart, although given in that of the Spanish surveyors. It has been examined by Captain Edward Barnett, R.N., in 1846, and the positions corrected accordingly.—See, further, *Colombian Navigator*, 1848, vol ii. p. 203.

2. ABACO LIGHTHOUSE.—Of the light-tower near the South end of Abaco, or '*Hole in the Wall*,' the base is 80 feet above high water, and the tower is 85 feet high. It is painted red and white. The light revolves once in every minute, and may be seen in all directions, except where the high parts of the land intervene, and being 160 feet above the level of the sea, it will be visible in clear weather, at the distance of 15 miles, to an eye elevated 10 feet; 17 miles to one elevated 20 feet; 19 miles from 40 feet; and 21 miles from 80 feet.

During ordinary winds there is good anchorage in 10 and 11 fathoms, with the lighthouse bearing E. by N. about half a mile from shore. The edge of the bank, to the eastward of the lighthouse, is nearly 1¾ miles from shore, with 23 to 16 fathoms, extending out to the S.S.E. in a tongue of soundings, with quite clear ground.—"Colombian Navigator," vol. ii., pp. 199, 201.

3. EGG ISLAND REEF.—The *Lorton Rock* described in the *Colombian Navigator*, vol. ii., p. 162, *does not exist!* Captain Richard Owen has shown that the vessel

really struck on *Egg Island Reef*, just to the northward of Royal Island and not more than a mile from Goulding Kay.—For particulars, see "Colombian Navigator," vol. ii. p. 209.

4. Nassau.—The position appears to be finally settled as in the Table. The Spanish Surveyors gave the town as in 25° 4′ 33″ N., and 77° 19′ 30″ W. Mr. De Mayne as 25° 5′ 18″ N., and 77° 19′ W. The lighthouse, showing a harbour light, since improved, and similar to that on Abaco, is 70 feet above the level of the sea; it is on the West end of Hog Island, and therefore to be left on the port or North side, when entering into the harbour.

5. Great Isaac.—This islet is described in the *Colombian Navigator*, vol. ii. p. 217. It is moderately high, has several wells of fresh water, and abundance of large shell-fish. The Providence droggers water here. It is now remarkable for the very fine iron lighthouse erected on it in 1859; it is 145 feet high, painted in broad red and white bands, and shows a fine revolving light from reflectors every half minute.

6. Gun Kay.—The important lighthouse on this Kay shows a brilliant revolving light every minute all round the compass, at an elevation of 80 feet, visible 12 to 15 miles off.

7. Diamond Point of the Mucaras.—The Mucaras, Lavanderas, and Lobos, with the dangers on the bank in the vicinity, have been surveyed, with great care, by Captain *Edward Barnett*, whose positions are those given in the Table. This portion of the bank was formerly represented, as in the Spanish Charts, rather more to the South, and 6′ more to the East.

8. Kay of St. Domingo.—The southern part of the Great Bank, on which this kay is situate, is very dangerous by night. The kay had formerly the appearance of a sail, but, in 1835, the crew of the *Thunder* erected a beacon of stones, about 15 feet high, upon the centre of it; the other part of the kay is about 5 feet only above water. It is a rocky, arid spot, producing nothing but a little samphire and wild grass.—"Colombian Navigator," vol. ii. p. 214.

9. Rum Kay.—This island was formerly very erroneously represented on the charts, both as to magnitude and position. The white cliffs at the S.E. end are remarkable, and may be seen 6 leagues off.—See "Colombian Navigator", vol ii. p. 228.

10. Castle Isle.—The point appears to be finally settled. Former observations gave 22° 7′ 45″ N., and 74° 17′ 30″ W.

11. Caycos. Captain Livingstone's Remarks on the Northern Reefs of the Caycos, and the danger of approaching them without great caution, may be found in the "Colombian Navigator," vol. ii. p. 245. Captain Livingston says—"I am perfectly satisfied that any vessel shaping a course from off the rocks, to weather the N.W. point of the Caycos by any chart hitherto published, will infallibly get entangled among the reefs on the West side of the Watering Bay. When a vessel once gets embayed among them, it must be next to impossible to beat out; as the reefs extending from the land to the eastward, hook suddenly round, at their outer extremity, to the southward. Thus a vessel may be in blue and deep water while the hook of the reef is outside her. I have three times examined the appearance of these reefs from the mast-heads of different vessels, and each time they appeared to me more dangerous than they had previously done."—(*This was written in* 1848.)

12. Great Inagua.—This island has been surveyed by Lieutenant Lawrence, R.N.: Mathew Town, a new settlement, lies 3 miles northward of the S.W. point. On the South-east coast of Inagua are several detached coral reefs about, and at some distance from, the S.E. point. On one of these H.M.S. *Statira* was lost; and on another, if not the same, the bark *Emerald*, Captain Nockells, struck, at 5 p.m., 11th June, 1834, on her passage from Jamaica to London. The bark was on it for two hours, while the small islet off the S.E. point bore West, distant 4 miles, and the nearest shore was 5 miles off. The depth of water was about 18 feet. The captain observes that, as broken reefs may extend a long way out, vessels in passing should not advance within 10 miles of the shore. The *Emerald* was so much damaged that

it became necessary to abandon her; and on the next day, at seven p.m., her crew were saved in a Spanish schooner, bound for Philadelphia, being then, with 9 feet of water in her hold, in lat. 20° 36′, lon. 73° 10′, 24 miles to the southward of Inagua.

13. GRAND TURK.—An iron lighthouse, 400 yards within the North point.

14. SILVER KAY BANK.—It seems that the *Fletcher Reef*, said to have been discovered near the S.W. extremity of the *Silver Kay Bank*, in 1833, really exists on the S.W. part of that Bank, the true form of which has, for the first time, been ascertained by Captain Owen and assisting officers, as now exhibited on the charts. Its North-east side is extremely dangerous, having a cluster of rocky heads, extending 18 miles, and even with the water. There are also detached patches on the North and North-western parts.

15. The BAJO de NAVIDAD has been described as a fine clear bank of an oval form: its greatest length 22 miles North and South, and 11 in breadth; the least water on it 11 fathoms, which is on the South-east edge. The general depths 16 and 17 fathoms, very even bottom, coral and sand; the water being of a darkish hue, the bank is not easily distinguished.

VARIATIONS OF THE COMPASS.—1861.

The present variation at the head of the Matanilla Bank is about 4° E. At Nassau, in Providence Island, it was found, in 1836, to be 3½° E. At Gun Kay, on the western side of the Great Bank, 4° 30′ E.; at the Jumentos and Eleuthera, 3°; at the Crooked Islands and Watling's Island, nearly the same; at the Caycos it was 3° 10′; and at Turks' Islands, 2° 54′, 1836. There is but little secular change in the variation hereabouts, and therefore the amounts given above are still correct.

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18. CUBA, JAMAICA, ETC.

	LAT. N. ° ′ ″	LON. W. ° ′ ″	AUTHORITIES.
S·E. and EAST of CUBA.			Spanish Surveyors, &c.
Cape de Cruz	19 50 11	77 45 15	
Peak of Tarquino ....[1]	20 3 0	76 51 0	
ST. IAGO de CUBA, Morro at the ent.; *Lighthouse* [2]	19 57 29	75 58 48	
Port Guantanamo; Entr.	19 55 10	75 20 25	
——Escondido; East point	19 55 30	75 12 20	
——Baitiqueri; Entrance	20 1 0	75 1 10	
CAPE MAYSI, or MAIZE[3]	20 14 0	74 7 37	
Port Mata; Entrance	20 17 20	74 31 41	
——Baracoa; Entrance [4]	20 21 36	74 29 31	
——Maravi; Entrance ..	20 24 30	74 27 35	
——Navas; Entrance ..	20 29 35	74 29 50	
——Cayaguaneque; E. pt.	20 30 30	74 31 0	
——Taco; West Point ..	20 32 20	74 34 0	
——Jaragua; Entrance ..	20 32 40	74 36 40	
Punta de Guarico	20 39 0	74 40 45	
Port Cayo Moa; Kay; East Point...........	20 42 0	74 47 5	
——Yaguaneque; Entrance	20 41 50	74 58 5	
——Cananova; Entrance	20 42 0	75 0 25	
——Cebollas Entrance ..	20 42 20	75 2 35	
——Tanamo; Entrance ..	20 44 10	75 11 50	
——Cabonico; Entrance..	20 42 20	75 21 0	
——Nipe; Entrance	20 45 40	75 26 0	
——Banes; S.E. Point..	20 53 30	75 34 0	

CUBA, JAMAICA, &c.—Continued.

	Lat. N. ° ′ ″	Lon. W. ° ′ ″	Authorities.
Punta de Mulas	21 4 45	75 30 45	The Officers acting under the orders of the Spanish Government, for the purpose of ascertaining by chronometers, &c., the Positions of all the principal Points in the West Indies; with emendations, by Captain Foster, Captain R. Owen, &c. REMARKS. We have here given the situation of all the harbours in Cuba, which have been surveyed by the Spanish officers. The longitudes have been subsequently rectified: those of the North coast are more to the eastward, and agree with the large general Chart of the Bahama Old Channel, published by the Direccion Hidrografica of Madrid, and since in London. The greater part of the harbours are singularly formed, having a narrow entrance mostly bordered with a reef or shoal, but opening into a fine basin inward, which afford shelter from every wind. Of such are, St. Iago, Guantanamo, Escondido, Baitiqueri, Mata, and Baracoa; but the entrance of the latter is bold-to; again, Iaco, Yaguaneque, Cebollas, Tanamo, Cabonico and Livisa, Nipe, Banes, Naranjo, Vita, Jururu, Del Padre, Malagueta, Manati, Nuevitas, Havana, Mariel, Bahia-Honda, and Jagua.
Northern Kays and Coast of Cuba.			
Port Sama; Entrance....	21 5 45	75 53 15	
——Naranjo; Entrance ..	21 5 25	75 49 0	
——Vita; Entrance......	21 5 0	75 55 0	
——Bariay; Entrance ..	21 5 0	75 57 0	
——Jururu; Entrance....	21 5 0	75 58 10	
——Jibara; Entrance....	21 5 20	76 2 35	
——del Padre; Entrance	21 15 45	76 24 37	
——Malagueta; Entrance	21 17 0	76 29 28	
——Manati; Entrance ..	21 23 45	76 43 0	
——Nuevitas Grandes; Entrance	21 35 40	77 4 45	
Punta Maternillos ....[5]	21 40 0	77 8 0	
Cayo Romano; S.E. Pt.[6]	21 51 20	77 35 0	
Cayo Verde, or Green Kay	22 7 0	77 36 30	
Cayo Confites; North Pt.	22 12 25	77 37 50	
Double-Headed Shot; N.W. Kay ....[7]	23 56 28	80 27 38	
Cayo de Sal, or Salt Kay..	23 39 8	80 16 38	
Cayo Cruz del Padre......	23 17 20	80 53 15	
Matanzas; Castello de S. Severino	23 2 48	81 32 40	
————; Pan or Hill	23 1 39	81 40 20	
HAVANA, Morro; *Lighthouse* ....[8]	23 9 13	82 22 4	
————; Engineer's Post near the Steam Wharf	23 8 53	82 20 43	
Port del Mariel; Entrance	23 3 15	82 46 40	
Port Cavanas; Entrance	23 2 20	82 58 30	
Bahia Honda; Entrance..	23 0 45	83 12 30	
Guaijabon; Pan or Hill ..	22 49 0	83 23 20	The Spanish Surveyors, &c.
S.W. Coast of Cuba.			
Cape Antonio; *Roncali Lighthouse* ....[9]	21 51 40	84 58 0	Captain R. Owen, R.N.
Cape Corrientes ......[9]	21 45 20	84 31 3	
Llana or Mangrove Point	21 51 20	83 54 0	Lieut. J. Murray, R.N., 1858.
Isle of Pines; Cape Francé	21 36 30	83 13 30	
———; Extreme S. point	21 22 30	82 59 45	
———; Indian Riv. Entr.	21 42 30	83 1 20	
Bahia de Jagua, or Cienfuegos; *Lighthouse*....[10]	22 1 10	80 40 18	
Trinidad; City of......	21 42 0	80 3 25	The Spanish Surveyors, &c., as before.
Puerto Casilda; Entrance	21 38 15	80 2 30	
Cayo Blanco de Saza; W. Point	21 22 30	79 42 30	
————————; East Point	21 31 20	79 43 35	
Cape Larza de Tierra; East Point	21 31 30	79 40 20	
Cayo Breton; East Point	21 2 25	79 29 20	

CUBA, JAMAICA, &c.—Continued.

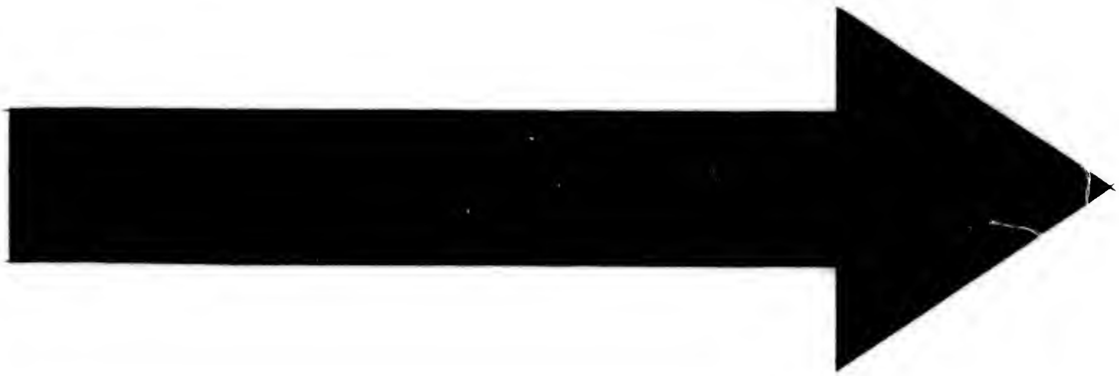
	Lat. N. ° ′ ″	Lon W. ° ′ ″	Authorities.
Boca Grande ; Entrance ..	20 58 0	79 23 45	
The Grand Cayman : S.W. Bay, Ft. George[11]	19 17 45	81 24 3	Latitude, Captain R. Owen, R.N. ; Longitude, Captain Barnett.
JAMAICA and Isles Adjacent. [12]			
Morant Kays; N.E. Kay..	17 26 30	75 55 0	
———— ; S.W. Kay..	17 23 45	75 58 0	
Morant, or East point of Jamaica; Lighthouse[12]	17 56 0	76 11 19	
Yallah's Point	17 51 45	76 36 30	
Plum Point	17 55 15	76 46 55	The mean of numerous Observations, taking into account those of Messrs. Leard, Robertson, De Mayne, and Dunsterville, of Mr. F. Owen, and Captain Edward Sabine ; adjusted by the meridian of Port Royal Dockyard, as ascertained by Captain Richard Owen, in 1830. —For particulars, see the "Colombian Navigator," vol. ii., page xviii., and the Chart of Jamaica, with its Harbours, published by Mr. Laurie.
Port Royal Dockyard ..	17 55 51	76 50 45	
Kingston ; Church	17 57 57	76 47 35	
Portland Point	17 43 50	77 7 24	
Portland Rock ......(13)	17 8 30	77 28 0	
Pedro Kays; N.E. Kay(14)	17 6 0	77 46 0	
Pedro Bluff	17 51 30	77 45 24	
Black River ; Entrance ..	18 1 10	77 53 15	
John's Point	18 11 30	78 17 30	
South Negril	18 15 45	78 25 30	
Montego Bay Point......	18 31 30	77 59 0	
Galina Point..........	18 27 30	76 58 0	
Annotta Bay ; the Town..	18 19 0	77 49 45	
Port Antonio ; Navy Id.	18 14 40	76 31 0	
Formigas ; N.E. Part	18 34 30	75 41 30	
———— ; S.E. Part	18 27 0	75 42 0	
———— ; S.W. Part	18 26 0	75 51 30	
Navaza ; Centre of the Isle	18 24 45	75 3 0	
BaxoNuevo; SandyKay(15)	15 53 0	78 38 30	The Survey of Captain Richard Owen, in 1835.
Serranilla ; S.W. Kay (16)	15 47 45	79 50 43	

NOTES.

CUBA in General.—It may be observed that the Coasts of Cuba, with some partial exceptions, has not been hydrographically surveyed, consequently that many of the positions given, especially on the South Coast, are not to be depended on. For example, the South Coast of the Isle of Pines, it is said, is shown too far to the northward on the Spanish Charts; while the coast about Puerto Casilda, and to the East of it, is 7 miles too far South. We are unable to state positively as to the relative correctness of the positions, and therefore they must be received with caution.

1. Peak of Tarquino.—We have given the Peak of Tarqnino according to Captain Bird Allen, who determined the position of the peak from the ship, by observation during three days' calm, after leaving Port Royal, as lat. 20° 3′, lon. 76° 51′, or 4½ minutes beyond that given by the Spanish authorities. The peak is about 5,500 feet high above the level of the sea.

2. St. Iago de Cuba.—Mr. Nicholls, Master of the *Sheerwater* brig of war, in 1819, communicated the situation of the Morro Castle of St. Iago, from observations made in that ship, as follows:—Latitude observed, 19° 57′ 50″: longitude by lunars, 76° 2′ 45″: by chronometer 76° 0′. The Spanish Chart of the harbour represents the Morro as in 76° 55′ 33″ W. In the last Chart it is given as 76° 0′.



A lighthouse has been erected on the table-land, about 309 feet to windward, or East of the Morro, to point out the entrance to the harbour, and prevent vessels running to leeward of it during the night. The light revolves in 1 minute at 223 feet, and is visible at 20 miles.

3. Cape Maysi.—Captain Foster places Cape Maize in 74° 5′ 18″, considering Chagres as 78° 57′ 19″. Captain Owen makes it 74° 8′ 0″. It may be observed that Captain Foster's longitudes appear to be about 3 minutes easterly (2′ 56″), and this correction applied to his positions will properly adjust them; this will place Cape Maysi, in accordance with Captain Owen's determination.

4. Port Baracoa.—Captain Foster found the difference of longitude between this and Cape Maysi to be 21′ 54″, which gives the position in the Table. The point of observation is the Fort of Point Barlovento, on the weather point of the harbour.

5. Nuevitas.—The channel into this harbour is to the S. by E., 4 miles from Point Maternillos. On Point Maternillos a lighthouse showing a revolving light at 170 feet above high water is constructed. It has "Colon" painted on it. Besides this there are lighthouses constructing at the *Cayo Paredon Grande, Cayo Lobos, and Cayo Confites.*

At Cardenas Bay, also on the North Coast of Cuba, there is a revolving light shown on Piedras Kay (lat. 23° 14′, lon. 81° 7′), and a red and white or revolving light on the Cayo de Aña.

6. Cayo Romano, &c.—In theyear 1781, M .le Marquis de Chabert, when proceeding from St. Domingo to the Chesapeake, had an opportunity of observing, by chronometers, the longitude of Cayo Romano, Port Matanzas, and the Pan of Matanzas; and his results were for the first, 77° 39′ 45″ W., and for the last, 81° 36′ 30″, being, in the mean, only 2 minutes to the westward of the late determinations.

7. Double-Headed Shot.—The position, according to the last edition of the Spanish Chart, of the Mexican Sea &c., edited by Admiral Don José de Espinosa, first Director of the Hydrographic Establishment at Madrid, is lat. 23° 26° 28″, lon. 83° 21′ 0″. In the first edition, published (by order of the Minister of Marine, Don Juan de Langara) in 1779, the N.W. Kay was represented in lat 23° 53′, lon. 80° 14′. Mr. De Mayne places the N.W. Kay in 23° 55′ N., and 80° 26′ W.

This is not the only variation to be found in the different editions of the Spanish Charts, even on points marked as determined; although the observations of the Spanish officers are generally admitted, by those who have given them an examination, to be excellent. It may not be superfluous here to notice, that the eastern extremity of Florida, in lat. 26° 35′, appeared in the first edition of these charts in 80° 5½′ W.; but, in the last edition, it is placed in 79° 54½′, or 11′ more to the eastward.

On the north-westernmost and highest of the narrow ridge of detached barren rocks, known as the Double-Headed Shot Kays, a lighthouse has been erected by the British Government, in lat. 23° 56′ 28″ N., lon. 80 27′ 38″. The light is fixed, and 100 feet above the sea; the tower being 54 feet high, it is visible from 14 to 20 miles, according to the height of the observer, in all directions, except S.S.W. ½ W., where, at 9 miles distant, it will be hidden by Water Kay.

8. Havana and Lighthouse.—The position formerly given was lat. 23° 8′ 18″ N., lon. 82° 22′ 4″ W. The longitude being the mean of twenty results from stars eclipsed by the moon, by Don Josef Joachim de Ferrer, 1808, 9, 10, 11, 12. This place, which is taken by Lieutenant Raper as a secondary meridian, is considered by him as in lon. 82° 21′ 57″ W. The difference, 17″, between this and Mr. Purdy's position, as given in our previous editions, is but trifling.

The *Lighthouse* on the Morro upon the eastern Point of the Harbour, exhibits a brilliant revolving light, which appears in its full lustre once in a minute. Although an inferior light, it may be distinctly seen, in clear weather, between 3½ and 4 leagues off.

9. Cape Antonio, Isle of Pines, &c.—On the 12th of August, 1817, Captain Livingston came to an anchor off Cape Antonio, in 7 fathoms; and by an excellent observation, found his latitude to be 21° 53′ 54″; this confirms that which has been

given by the Spanish officers. The longitude is well established between 84° 57′ and 84° 58′. The Baron von Humboldt gives 84° 57′; Captain Owen, 84° 58′; the Spanish officers had previously given it as 84° 57′ 30″, now confirmed.

A *lighthouse* called the *Roncali Tower*, and having that word painted on it, 117 feet in height, stands on the cape. It exhibits a brilliant revolving light every minute, at an elevation of 170 feet above high water, and is consequently visible at 14 miles distance. Is was first shown in 1850, and must prove exceedingly serviceable to navigation.

10. Jagua.—A lighthouse, showing a brilliant fixed light at 82 feet above high water, has been built (1850) on the East point of the entrance, Point Colorados. The tower is 45 feet high, and has "Villanueva" painted on it.

11. Grand Cayman.—The latitude of the S.W. Kay of the Grand Cayman, as observed by Captain Livingston, August 5th, 1817, appeared to be 19° 14′, not 19° 11′, the parallel formerly assigned: the longitude was communicated to us by the late Captain Hurd, as a determination to be relied on, and it appears to have been confirmed by Captain J.W. Monteith, as shown in the "Colombian Navigator," vol. ii. page 93.

The S.E. point, as communicated by Mr. Dunsterville, lies in lat 19° 16′ N., and lon. 81° 6′ 40″ W. The village on the West, formerly the *Hogsties*, is now called *Georgetown*, but the most populous village is *Boddentown*, on the South.

12. JAMAICA in general.—"In his outline of Jamaica, 1821, Mr. De Mayne gives Morant, or the eastern point, in longitude 76° 12′, and South Negril, or the western point, in 78° 25′ W. By reference to the Table it will be seen that we give the one in 76° 11′ 19″, and the other in 78° 25′ 30″.

"Mr. Leard, in his Survey of 1791, gave Morant Point in 76° 3′, and South Negril in 71° 33′; consequently he represented the island more than 15′ longer than it has since been exhibited; and there is reason for believing that the length is rather less than greater than that which we have given. The northern coast, it also appears, has been placed too far North from 1 to 2 miles. We have attempted to adjust these differences, still adhering to the *safe side*, on the New Chart of Jamaica and its Harbours, published by Mr. Laurie; and we give, with confidence, from several communications, Point Morant more, and South Negril less, to the West, than as shewn on former Charts."—*J. Purdy*.—See farther, the Note on Port Royal and Kingston, in vol. ii. of the "Colombian Navigator."

It may here be remarked, that Lieutenant Raper assumed Port Royal as 76° 50′ 54″, but considered that it was not satisfactorily settled. From subsequent calculations from data supplied by Commander Barnett's chronometric differences, he has arrived at the conclusion that it is 76° 51′ 47″, or 1′ more than his former longitude, or than that given in our Table; we have still adhered to the safe side.

Morant Point Lighthouse.—On November 1st, 1842, a bright light, revolving once in every minute has been shown from an iron light-tower on this point, at 103 feet above the level of the sea, and can be seen at 7 leagues. It is invisible to the eastward of N.E. by E. by compass.

This iron tower was made in London, in little more than two months, and weighs 100 tons; diameter at the base, 18½ feet; at the top, 11½ feet; iron 1 inch thick; the tower 105 feet high, 15 of which are sunk in the ground. Is is painted white.

13. Portland Rock.—The Portland Rock is a single Kay, 15 to 20 feet above the sea, and covered with small bushes. It has been variously represented in from latitude 17° 7½′ to 17° 13′, and from lon. 76° 32′ to 77° 31′. It Mr. De Mayne's Chart it appears in 17° 7½′ N., and 77° 29′ W. The position given in our Table cannot, we think, be far from the truth.—See "Colombian Navigator," vol. ii. p. 84.

The officers of H.M.S. *Winchester*, in 1834, by numerous altitudes, &c., gained the latitude of the rock as 17° 7′ 25″, and lon. 77° 27′ 4″.

14. Pedro Kays,—These Kays have been laid down from a late survey, as shown on the Chart of Jamaica; they are described in the "Colombian Navigator," vol. iii. page 246.

15. Baxo Nuevo.—According to the Spanish officers, 1804, the extent of this shoal is about 7 miles from North to South, and 14 miles from East to West. All the eastern part is a reef, very steep-to; but, on the West, the depth diminishes gradually. At 1½ miles from the northern extremity is the Sandy Kay, given in the Table. The Baxo del Comboy, which is represented on the charts to the E.S.E. of the New Shoal, has been particularly searched for, but could not be found.

The shoal was examined by H.M. surveying ship *Thunder*, March, 1835; the small kay, given in the Table was found to be 4 feet high, and a cable's length East and West, at 6 miles N.E. from the southern breakers; it presents no appearance of vegetation, and is composed of coarse coral, sand, and stones.—*Colombian Navigator*, vol. iii. p. 248.

16. Serranilla.—This bank, with its kays, formerly much misrepresented, lie between the parallels of 15° 35′ and 15° 55′ N., and the meridians of 79° 41′ and 80° 5′. On its eastern and southern sides are several kays and reefs. On the North-east side is a detached patch of rocks, on which the sea constantly breaks; it is just awash, but, in fine weather, a rock will show about 2 feet out of the water. Between it and the main bank is a safe passage, of not less than six fathoms, bordering close to the western side of the reef. In clear weather, by day, all the rocky patches are easily avoided, but it is very dangerous to approach by night.—*Colombian Navigator*, vol. iii. page 248.

VARIATIONS OF THE COMPASS—1861.

At the West end of Cuba, and about the Isles of Pines, the present variation is about 6° E. Near the East end, about 4 degrees. At the Grand Cayman, 5° 45′ E. At Port Royal, Jamaica, Mr. Leard in 1791, gave it as 6° 50′ E.; but there is reason to believe that, for a long time past, it has not exceeded 5°. In 1824, Mr. De Mayne gave it as 4° 40′ only. At Morant Point, 4° 40′ E. 1861. These variations are very slowly *decreasing*.

18. ST. DOMINGO OR HAYTI, PORTO-RICO, AND THE VIRGIN ISLANDS.

	LAT. N. ° ′ ″	LON. W. ° ′ ″	AUTHORITIES.
ST. DOMINGO.			
Isle of Mona; the Middle	18 6 0	67 49 0	
Hobero; Right Bank....	18 58 50	69 3 37	Sir Robert H. Schomburgk, F.R.G.S., 1852.
Punta Macao; ranchos ..	18 48 0	68 29 50	
Isle of Saona; Sandy beach near W. Point	18 10 18	68 46 53	
Boca de Quiabon, or Chaboni; Punta Barlovento	18 24 20	68 58 23	
Boca de la Romana; Commandant's house	18 27 32	68 58 37	
Macoris Point	18 25 50	69 19 25	
Isle of Santa Catalina; W. Point	18 19 0	69 2 0	
City of Santo Domingo; Cathedral, W. portal (1)	18 28 17	69 52 26	
——; Signal Tower on W. Point	18 28 22	69 52 10	
Baraona; Village in Neiba Bay	18 12 2	71 5 45	Captain Rich. Owen, R.N., and Edw. Dunsterville, Esq., R.N., 1826, 27, 32.
Alta-Vela, or the High Sail ....(2)	18 28 50	71 39 44	

ST. DOMINGO, PORTO-RICO, &c.—CONTINUED.

	LAT. N. ° ′ ″	LON. W. ° ′ ″	AUTHORITIES.
Cape Jacquemel, or Jacmel	18 10 20	72 33 15	
Pta. Ajugas, or False Cape	17 46 0	71 42 0	Captain R. OWEN, R.N., and Commander E. DUNSTERVILLE, R.N.
Frayle Rock	17 39 0	71 41 45	
Aquin Bay; the Diamond Rock	18 13 48	73 20 0	
St. Louis; the Old Fort ..	18 14 27	73 31 30	
Aux Cayes; the Town ..	18 11 10	73 44 0	
Isle à Vache; E. point....	18 4 0	73 44 30	
Point Abacou	18 1 0	73 46 0	
Point à Gravois	18 1 20	73 55 30	
Cape TIBURON; Extremity	18 22 0	74 27 32	
Irois Bay; House on the Beach..............	18 23 48	74 29 33	
Isle of Navaza; Middle ..	18 24 45	75 3 0	
Cape Dame Marie, or Donna Maria	18 36 30	74 27 13	
Port Jeremie............	18 38 0	74 6 0	
Pirogues, on the Rochelois Reef	18 37 20	73 12 0	
Hummock of Petit Gonave	18 26 51	72 53 39	
Isle of Gonave; West point	18 55 26	73 18 33	
PORT AU PRINCE; Fort Bigithon	18 32 12	72 22 25	
Arcadins ; Northernmost	18 48 0	72 38 0	
St. Marc, or St. Mark's pt.	19 2 10	72 51 0	
Port Piment	19 37 0	73 1 0	
St.NicholasMole,Ft.George	19 49 30	73 27 33	
Port à l' Ecu	19 55 10	73 5 30	
Port Paix; Carenage Point	19 58 0	72 48 45	
Tortue or Tortuga Isle; W. Point	20 8 20	72 57 30	
——— ————; East Point	20 1 0	72 36 0	
CITY of CAPE HAYTIEN; Watering Place	19 46 40	72 10 42	
The Grange Point	19 54 45	71 40 0	
Point Isabelica..........	19 58 40	71 6 30	
Isabella Bay; Islet......	19 53 50	71 4 7	
Port Plata; E. point	19 49 0	70 42 0	
Old Cape Français	19 40 30	69 55 0	The Observations of the Spanish Officers; particularly those of Captains Don Cosmé de Churruca, and Francisco Fidalgo, &c.
Cape Cabron	19 21 30	69 14 13	
Cape Samana	19 15 40	69 6 15	
Cape Raphael	19 2 0	68 53 30	
Cape Engaño	18 34 30	68 20 30	
Point Espada	18 19 48	68 30 0	
ISLAND of PORTO-RICO.			
Cape St. Juan, or N.E. Pt.	18 24 20	65 30 0	For some important remarks on the Navigation about Porto-Rico, with a Table of Observations on the Caribbee Island, &c., by *Captain Zarhtmann*, Hydrographer of the the Danish Royal Navy, see *Colombian Navigator*, vol. iii. pp. xix., xx.
MORRO CASTLE of ST. JUAN...............(3)	18 20 0	66 7 0	
Point Bruguen, or N.W. Point	18 31 18	67 7 0	
Isle Desecho, or Zacheo ..	18 23 48	67 27 40	
Aguadilla Town ...... (4)	18 25 10	67 7 17	

PORTO-RICO, VIRGIN ISLANDS, &c.—Continued.

	Lat. N. ° ′ ″	Lon. W. ° ′ ″	Authorities.
Point Algarroba	18 14 0	67 7 30	The Spanish Surveyors.
Puerto Guanica; East point	17 57 44	66 52 45	
Caxa de Muertos, or Coffin; S. W. Point	17 50 30	66 35 0	
The VIRGIN ISLANDS.			
Anegada; West point....	18 50 0	64 25 12	The Survey by Lieut. G.B. Lawrence, R.N., 1848.
———; East point....(5)	18 43 48	64 16 20	
Soldier, or North point ..	18 45 45	64 20 20	
———; Horse Shoe Reef; S.E. End	18 36 30	64 11 0	
Herman Reef, 16 feet; S. pt.	18 33 30	64 14 0	
Virgin Gorda; Pajaros, or East point	18 30 42	64 19 9	
Ginger Isle; Centre......	18 23 45	64 28 41	
Tortola; Road Town, Fort Burt	18 25 3	64 37 0	
St. John's; S.E. point....	18 19 0	64 44 20	
Sta. Monica Rock, (9 *feet*)	18 19 0	64 39 30	
St. Thomas Harbour; Fort Christian ......(6)	18 20 27	64 55 40	
The Bergantin or Carvel..	18 18 0	65 7 0	
St. Croix or Santa Cruz:			A communication made to Mr. Dunsterville, by Sir A. Lang, of St. Croix, Jan. 21, 1832.
Eastern Extremity of the Island ....(7)	17 45 30	64 34 0	
The Lang Observatory (8)	17 44 32	64 41 6	
Harbour of Christianstæd; Flagstaff of the Outer Point Battery, called *Fort Louisa Augusta* ....(9)	17 45 28	64 41 42	The general height of the tops of the hills in St. Croix is from 800 to 850 English feet above the level of the sea, excepting toward the northern side of the north-western district of the island, where they ascend higher, and the highest of which, called *Mount Eagle*, is 1,156 feet above the level of the sea. Its summit is in lat. 17° 45′ 52″, and lon. 64° 48′ 31″
Fort Christianswærn, in the Town of Christianstæd; Flagstaff	17 44 59	64 41 58	
Salt River Point .... (10)	17 47 12	64 44 45	
Hams or N.W. Bluff (11)	17 46 24	64 52 3	
Fort at Frederickstæd or West End; Flagstaff (12)	17 43 10	64 52 48	
Sandy Point; the S.W. Extremity of the Island (13)	17 40 30	64 53 48	
Buck Isle; East Extremity ....(14)	17 47 18	64 36 40	Along the greater part of the South side of the island a ledge of reefs lines the coast, at a distance from shore, in some places, of nearly 2 miles. There are few channels through these reefs, practicable for small vessels only.
———; North-West Extremity	17 47 30	64 37 37	
Its summit, about 350 feet above the level of the sea	17 47 15	64 37 3	

NOTES.

1. SANTO DOMINGO.—We previously gave the longitude of the City as 69° 58′, on the authority of the Spanish Officers, Captains Don L. Argedas, and J. A. Sartorio, who observed an eclipse here in 1780, with a subsequent correction of 1½′. This result was considered by the talented and energetic Sir Robert H. Schomburgk, F.R.G.S., on his appointment to the Dominican consulate in 1849, to be too far West, and he accordingly made many observations, and collected others of authenticity, and places it as stated in the Table. See *Naut. Mag.*, August, 1852, pp. 412, 418.

2. ALTA VELA, or the High Sail.—This is a high rocky islet, which serves as a general point of departure to all ships bound from the eastward to Jamaica, &c. It is peaked, and appears to the northward, at a distance, like a dome, emerging above a mist or fog.—See, further, the Book of Directions above mentioned.

On the authority of the respected and scientific Admiral Espinosa, of the Spanish Navy, we formerly gave Alta-Vela in lon. 71° 22′ W., instead of a more westerly position, which had previously been assigned: but it is now fully proved that this is wrong, and that the true longitude is about 71° 40′. Mr. Dunsterville, from the mean of observations in 1826 and 1829, made it 79° 39′ 25″ W. Captain R. Owen as in the Table, makes the summit in 71° 39′ 44″ W.

3. MORRO of ST. JUAN.—The Harbour of St. Juan, was surveyed by Don Cosme de Churruca, in 1794. The position given in the Table is from the statement of Don Josef Cerquero, director of the Royal Observatory in the Isle of Leon, near Cadiz. The particulars are given in the "Colombian Navigator," vol. ii. page xvii.; and the longitude, as there noticed, is considered as one of the best established in America.

4. AGUADILLA.—The situation of Aguadilla, as given by the Spanish Officers, is 18° 25′ 53″ N., and 67° 6′ 20″ W. Admiral Mackellar gives it as 18° 24′ 57″ N., and 67° 8′ 25″ W. In this, as in some other instances, the mean of the two is the position given in the Table.

5. ANEGADA, with its reefs, were surveyed by Mr. (since Sir) Robert Herman Schomburgk, the distinguished traveller, in 1832. We formerly enumerated, in the description of the Caribbean Isles, the number of wrecks that lay upon the reefs in 1811; and Sir R. Schomburgk has noticed that, between 1811, and 1832, twenty-one American, seventeen West-Indian, fifteen Spanish, nine British, two French, two Swedish, and one Portuguese were wrecked here; and this is attributed, chiefly to the insensible operation of the currents, as will be shown hereafter.

6. ST. THOMAS'S.—With the position of Fort Christian, as given in the Table, from a Danish Survey, compare the communication of Captain J. W. Monteath, "Colombian Navigator," vol. iii. note 3, p. xx. But upon this point, we have received the following communication from Major Sir Andrew Lang:—"The bearings of the flagstaff of *Cowel's Battery*, from my observatory (see note 8, hereafter), N. 21° 54′ 27″ W., from the true meridian, were determined by myself with a Troughton's altitude, azimuth, and transit circle. Notwithstanding the distance, (37½ miles), the flagstaff was distinctly seen with the telescope of the circle, and intersected with the vertical wire. Considering the latitude of the flagstaff, 18° 19′ 32″ N., which must be near it, then its longitude is as stated, 64° 55′ 45″ W., as deduced from my position; but I now strongly suspect that it is a little more to the North, say in 18° 19′ 45″; if so, its longitude, as deduced from my station, will be 64° 55′ 50″ W., and the latitude and longitude of Fort Christian would, on the same data, be lat. 18° 20′ 39″ N., longitude 64° 55′ 39″ W. (This is now confirmed). Fort Cowel is on the very top of an eminence (275 feet above the level of the sea) which rises at the southern extremity of a tongue of land which forms the western side of the entrance, as also the western shore of St. Thomas's Harbour."—Signed, *Andrew Lang*.

A *lighthouse* has been erected at Muhlenfeldt's Battery, on the East point of the entrance of the Harbour of St Thomas. The light is *red*, the lantern having red panes to S.E., S., and S.W., and is erected at 95 feet; first shown, August, 1844. To go clear West of the *Triangles*, the East angle of the lighthouse is brought to bear in a line, N. by W. ½ W., with the S.W. corner of a whitewashed kitchen, lying 67 feet North of the tower, and is visible by night from the reflection of the lamp; this will clear the Triangles by a cable's length; the more the kitchen is covered the greater the distance from these rocks.

At the king's wharf, in the town (West of Christiana Fort) a lamp with a red glass towards the harbour, will at the same time be seen West of Point Muhlenfeldt; this being free, ships safely bear away for the harbour.

Prince Rupert's Rock, near the middle of the entrance to the harbour, will always be kept whitewashed, and thereby be visible at night.

7. ST. CROIX.—Fully 9 nautic miles from the eastern extremity, N.E. by E. ½ E. (*true*), and about 11 miles E. by N. from the East point of Buck Island, commences the eastern extremity of an extensive bank or shoal, the northern limit of which rounds off from thence to the N.W., and soon after stretches westerly, inclining to the South of a westerly direction toward Buck Island Shoals and reefs, with which it may be considered as connected. The northern edge of the shoal is a coral ledge, several miles in extent, on which 5½ fathoms of water is the least depth yet found; the more common depths being 6, 6½ and 7 fathoms. The sea has been observed to break on the whole line of the northern edge, and to the very extremity of the bank, in an alarming manner, during a northerly ground swell in the winter months.

8. OBSERVATORY of SIR ANDREW LANG.—"The height of the observatory above the sea is 440 English feet. The latitude is true to within one second. The longitude is the result, I may say, of the labour of years, and the present assumption of 64° 41′ 0″ in arc, or 4^h 18′ 44″ in time, West from Greenwich, I consider to be determined with almost such absolute certainty, that I do not think the error in the determination can exceed four seconds in time, or one minute in arc, and I trust is less. On that datum the longitudes of the other stations are accurately determined. All the latitudes are certain to one or two seconds."—*Andr. Lang.*

[*From the observatory communication by signal, according to Captain Marryat's code, will be attended to. The observatory is situated about* 1 *mile to the E.S.E. of the town of Christianstæd. In clear weather the shoals are distinctly seen.—E. Dunsterville.*]

9. CHRISTIANSTÆD.—Nearly 1 mile due North from the entrance of the harbour of Christianstæd is the western extremity of a reef called the Scotch Reef, which stretches from thence, with its shoals, fully 1¼ miles to the E.N.E., rendering the approach to the harbour very dangerous to strangers.

10. SALT RIVER.—Salt River Point is comparatively a low point, and one of the most northerly in the island. About one fourth of a mile to the North of it is a dangerous sunken rock, called the White Horse, on which the sea generally breaks.

11. HAMS BLUFF, along its northern part, is bold-to.

12. FREDERICKSTÆD, or West-end Bay, is an extensive and beautiful bay, affording excellent and smooth anchorage, except where the wind has westing; but like all anchorages of that open kind, it then becomes dangerous.

13. SANDY POINT.—To the South of this low and deceiving point, at nearly a mile, there extends a dangerous reef to which a good berth should always be given.

14. BUCK ISLAND.—This island, except on its southern side, is surrounded with dangerous reefs and shoals, extending fully 1 mile to the W.N.W. of the N.W. point of the island; fully two miles to the eastward of its eastern extremity, ; and about 1 mile to the North of the island; forming, in the intervening bearings, a circuitous connexion of the greatest dangers, which all prudent persons will avoid approaching.

VARIATIONS OF THE COMPASS.—1861.

At the East end of Santo Domingo, it is about 2° 32′ E.; at the City of Santo Domingo, 3° 0′ E.; at the West end, 4° 0′ E. At Porto Rico, about 2° 0′ E.; about Tortola, 1° 30′ E.; at Anegada, about 1° 10′ E.

20. THE CARIBBEE AND LEEWARD ISLANDS.

	LAT. N. °	′	″	LON. W. °	′	″	AUTHORITIES.
CARIBBEE ISLANDS. [1]							Captain E. Barnett, R.N., Lieut. E. Lawrance, R.N., Mr. Parsons, R.N., &c.
Sombero ....[2]	18	35	45	63	27	45	
Dog Isle; Landing on S. side..................	18	16	15	63	16	10	
Anguilla; Custom House on North side	18	13	0	63	4	40	
ST. MARTIN'S; Philipsburgh, Fort William ..	18	1	25	63	4	24	
———; West Point	18	3	25	63	10	0	
Saba; the middle........	17	38	0	63	14	0	
St. Bartholomew; Fort Gustavia	17	53	50	62	51	30	
St. Eustatius; Orange Town	17	29	0	62	59	0	
ST. CHRISTOPHER'S; Basse-Terre ....[3]	17	18	0	62	42	30	
Nevis; Charlestown	17	8	50	62	36	50	
Redonda; the Pinnacle, 600 feet..............	16	55	0	63	19	0	
Montserrat; Plymouth on South side............	16	43	0	62	43	30	
Antigua; St. John's Road, Fort James ....[4]	17	6	40	61	51	21	
Ft. Byham on N.E. side	17	7	20	61	46	17	
Dockyard Flagstaff, English Harbour	17	0	0	61	45	42	
Desirade or Deseada; N.E. Point ....[5]	16	22	0	60	58	0	
GUADALOUPE; Basse-Terre [6]	15	59	30	61	45	38	
Marie-Galante	15	57	50	61	17	0	
The Saintes; St. Paul, Bolt Head, S.W. Point	15	51	20	61	37	30	
Aves Islet ....[7]	15	42	0	62	37	45	
Dominica; Rd. of Roseau[8]	15	18	30	61	25	15	
MARTINIQUE; Ft. Royal[9]	14	36	7	61	4	38	
St. Lucia; Pt. Moulacique or South Point	13	41	0	61	1	0	
St. Vincent; Kingston ..	13	12	0	61	15	0	
BARBADOS; Bridgetown; Fort Beckwith ....[10]	13	5	30	59	36	46	
Grenada; Fort St. George [11]	12	2	54	61	48	30	
Tobago; N.E. Point..[12]	11	20	13	60	32	30	
Scarborough Port; King George Fort	11	10	0	60	45	0	
———; S.W. End	11	7	35	60	51	30	
TRINIDAD: [13]							Captain E. Columbine, R.N. 1803.
Point Galera; N.E. Pt.	10	50	20	60	54	5	
Point Galeota; S.E. Pt.	10	9	30	60	58	20	
Boca de Navios, or Ship Channel............	10	41	45	61	45	30	
PORT SPAIN; Water Battery..............	10	38	42	61	31	45	
Testigos; Centre	11	23	15	63	5	50	
MARGARITA:							
Pampatar Castle	10	59	15	63	48	30	

THE CARIBBEE AND LEEWARD ISLANDS.—CONTINUED.

	LAT. N. ° ′ ″	LON. W. ° ′ ″	AUTHORITIES.
Margarita; North Point	11 10 30	63 53 30	The admirable Survey of the Coasts of Venezuela, &c., by Don Joáquin Francisco Fidalgo, and other Spanish Officers. Published by the '*Direccion Hidrografico*,' at Madrid, in 1816 and 1817. The longitudes adjusted.
Pta. de Arenas, or Sandy Point	10 59 0	64 24 30	
Blanquilla; North Point..	11 54 30	64 41 50	
Tortuga; East Point	10 54 45	65 13 50	
Orchilla; N.E. Breakers..	11 52 45	66 6 30	
Shoal of Two Fathoms ..	12 9 15	66 6 20	
Los Roques or Roccas:			
N.E. Islet	11 58 40	66 39 20	
Islas de Aves (*Birds' Is.*):			
Windward Isle	11 57 30	97 28 20	
Leeward Isle	11 59 30	67 42 35	
Buen-Ayre; N.E. Point..	12 14 0	68 18 30	
———; S. Point Light	12 2 30	68 22 30	
CURAÇAO; North Point .	12 24 0	69 9 0	
Bay of St. Anna; Entrance	12 6 20	68 55 43	
Little Curaçao; N. End ..	12 0 0	68 37 13	
Oruba; S.E. Point	12 23 45	69 57 30	

NOTES.

1. WINDWARD and LEEWARD ISLANDS.—Under the denomination of *Windward Islands*, the navigators of France and Spain include the whole range from the Virgins to Trinidad; and, under that of Leeward Islands, the range which exists between Trinidad and the Gulf of Maracaybo. This distinction is natural and proper, and we have adopted it, in preference to the former distinction in the English charts, which includes, under the name of Leeward Islands, those from Porto Rico to Dominica only; and, under that of Windward Islands, those from Martinique to Tobago.

The observations of the Spanish officers for determining the respective situations of the Caribbee Islands were very numerous and important, and our late charts have been regulated chiefly thereby. Some later corrections have, however, been made, particularly in the northern part of the range, and in the Virgin Isles.

2. SOMBRERO.—This solitary islet is a flat and rocky eminence, 2¼ miles in length, N.N.E. and S.S.W., without any hummock, having neither quadruped nor vegetable upon it, excepting grass, and that generally dry, with a few weeds, &c. It is even destitute of water. It has been surveyed by our Admiralty, but see '*Colombian Navigator*," vol. iii. p. 64.

3. ST. CHRISTOPHER'S.—In January, 1782, the Marquis de Chabert took nine meridian altitudes, whence he concluded the latitude to be nearly as in the Table. The longitude by his marine clocks, previously examined at Martinique, appeared as 62° 52′ 30″. Mr. Zahrtmann made the difference of longitude between it and St. Thomas's 2° 13′ 27″, or in 62° 42′ 13″ as in the Table.

4. ANTIGUA.—Our former position was a close approximation to that of Captain E. Barnett, R.N., whose fine survey of 1848, gives a perfect picture of the Island.

5. DESIRADE.—From observations made by the Chev. de Borda, he computed the latitude of the N.E. point as 16° 20′ 30.

Captain Monteith, in lat. 16° 58′, by three observations. Longitude of a ship by chronometer, 61° 9′ 45″; by lunars, 61° 14′ 38″; mean, 61° 12′ 12″. Bearing of Desirade, S. 5° E., distance, 36 miles, which gives 3′ of departure— lon· 3′ 5″. Hence longitude of the centre of Desirade, 61° 9′ 7″.

6. GUADALOUPE.—The latitude of Basse-Terre has been confirmed from observations of M. de Verdun, &c. The longitude (assuming Fort Royal, Martinique, as in 61° 9′) appeared to be 61° 48 15″; but if Martinique is 4° 50′ East of this, it will place

Guadaloupe in 61° 43′ 25″. The difference of longitude between Guadaloupe and St. Thomas (64° 55′ 40″) was found by Mr. Zahrtmann to be 3° 10′ 2″, and another measurement makes it 40° 35′ West of Guadaloupe; these combined will place it in 61° 44′ 16″, nearly as in the Table.

A lighthouse on *Terre de Bas Islet* (or Petite Terre) at the eastern extremity of the island of Guadaloupe, shows a fixed light at 108 feet above high water, and is visible in all directions for 5 leagues. A rock, called the *Baleine du Sud*, bears S. 19° W., 2,920 feet from the lighthouse. Ships coming from the eastward will find from 13 to 20 fathoms water, at the distance of 2 miles North or South of the light, and should not approach it nearer. M. Tondu, in 1783, concluded the longitude, by three immersions and two emersions of the first satellite of Jupiter, to be 61° 48′. The latitude of Pointe des Chateaux, the eastern point, was observed by M. de Borda as 16° 12′ 30″.

7. Aves Islet.—The position of this small kay was ascertained by Lieutenant Lawrance in 1850. It has been lately much visited for a stratum of guano which coverd it, and which was the subject of some dispute. When removed, it will probably leave the place but a bare reef.

8. Roseau.—The latitude of this place, according to the result of observations by Messrs. Verdun, &c., is 15° 18′ 23″. But the French officers have given the longitude 9½′ to the westward of that shown in the Table, which cannot be correct.

9. Martinique.—The latitude accords with that resulting from the observations of Messrs. Verdun, Borda, &c., who concluded the longitude as 61° 0′. Mr. Dunsterville gives the longitude of the Diamond Rock as 61° 6′.

In the Survey of Martinique, executed by order of the French Government in 1824 and 1825, as shown in third volume of the *Colombian Navigator*, the longitude of the flagstaff of Fort St. Louis, on which all the other longitudes depend, is assumed by M. Monnier as 61° 1′ 25″. This was arrived at by measurements from Rio Janeiro, &c., and is 3′ less than that now given. See Note 10, in that volume, page xxi, and the Table in page 91; which may be compared with the Notes hereto annexed.

The longitude in the Table is assumed from a mean of chronometric measurements by M. Zahrtmann and M. Lartigue, between this and the observatories of St. Croix and St. Thomas, positions which may be considered as finally determined. These differences of longitude are taken as 3° 36′ 58″ East of St. Croix, and 3° 51′ 7″ from St. Thomas.

10. Barbados.—The late Dr. Nevil Maskelyne communicated the latitude of St. Michael's Church, in Bridgetown, as 13° 5′ 30″. The longitude has since been given as 59° 43′ 40″ and 59° 41′ 15″. From four separate measurements of the meridional difference between Port Royal and Barbados, it may be taken as 17° 13′ 10″, which will give 59° 37′ 35″ as the longitude of Barbados.

In 1850, Lieutenant G. B. Lawrance, by a careful measurement from St. Thomas with 17 chronometers, made Fort Beckwith as in the Table, in longitude 59° 36′ 45″.6 W.

11. Grenada.—In 1779, M. de Chabert concluded the latitude of Fort St. George as 12° 2′ 54″, and its longitude 42½ West of Fort Royal, Martinique. This varies only 20″ from the statement in the Table. Captain G. Daniell, of H.M.S. *Victor*, in 1833, made the longitude 61° 48′ 90″. It was surveyed by Mr. James Young.

12. Tobago.—M. de Chabert. 1781, made the longitude of the *S.W. Point* 20′ to the the East of Fort Royal, Martinique: this places the point in only 60° 7½′ W. The position formerly given in the *Connaissance des Tems* was 11° 6′ N. and 60° 49′ W. The Baron Alex. de Humboldt, in his '*Personal Narrative*' (Engl. Transl.), gives it as 10° 20′ 13″ N., and 60° 27′ 30″ W. The latter is evidently a great error, as it would place Tobago directly East of the body of Trinidad. We presume that the N.E. end was intended, and that in 11° 20′ 13″ N., not 11° 10′ 13″, as given in the *Connaissance des Tems*. But if, upon conjecture, we take M. Humboldt's longitude thus, we shall place Tobago too far to the East: for it is allowed that the situation of Trinidad has been settled by the Spanish surveyors, and it is well known that the high land of

Trinidad is seen from the ships at anchor in Courland Bay, over the land of Sandy Point, which could not be the case if the former authorities were correct. See the Chart of the Coasts, &c., from Tobago to Barcelona, published by Mr. Laurie. Captain Daniell, in H.M.S. *Victor*, 1833, made the longitude of Great Courland Bay 60° 51′ 15″.

A *lighthouse* on Bacolet Point, at the Port of *Scarborough*, shows a brilliant fixed light at 126 feet; first shown August 1st, 1844. The Minister Rock bears E.S.E. from the light, distant 1¼ miles.

13. Port Spain in Trinidad.—Captain Foster (vol. ii. page 249) makes Fort St. Davids at Port Spain, 0h 52′ 0·8″ West of Parà, which we have placed in 48° 30′ 12″ (Ethiop Mem., page xxxiii.), therefore it will make it in 61° 30′ 24″. M. Zahrtmann states it to be 3° 10′ 12″ East of St. Croix—61° 30′ 48″; Captain Owen makes it 15° 19′ 0″ East of Port Royal, or 61° 31′ 45″, which is adopted by Lieutenant Raper; this is 2′ 30″ West of the position quoted in the former edition; it has, therefore been substracted from the longitude of Trinidad. The longitude, according to Lieutenant Lawrence, is 61° 31′ 0″.

Captain (now General) Edward Sabine R.A., has, from a great number of observations, given the position of the Protestant church in Port Spain, as 10° 38′ 56″ N., and 61° 35′ 0″ W. This new and beautiful church is said by Captain S. to be one of the many improvements and decorations for which Port Spain is indebted to its late governor, Sir Ralph Woodford, and which have rendered it one of the handsomest towns in the British colonies.

VARIATIONS OF THE COMPASS—1861.

In the channel between Porto-Rico and the Virgin Islands the variation is about 1° 40′ East; but on the East of Anegada it diminishes to 0° 40′ East. At Antigua and Guadaloupe it is 1° East; and nearly the same thence to Barbados. At Granada &c., 1° 30′ East; and Trinidad, 2° East. These *Easterly* variations are slowly *decreasing*.

21. THE COASTS OF GUYANA, COLOMBIA, ETC., TO THE MEXICAN SEA, INCLUSIVE.

	LAT. N. ° ′ ″	LON. W. ° ′ ″	AUTHORITIES.
Cape North	1 51 0	49 50 0?	M. De la Condamine and the French Engineers; including Lieutenant Roman Desfossés, who surveyed the "Iles du Salut" in 1834.
Mount Mayez, a landmark	3 5 0	50 55 0?	
Cape Orange	4 22 0	51 25 0?	
St. Luis of Oyapok; Fort	3 57 0	51 27 0?	
Cayenne [1]	4 56 15	52 14 36	
Isles du Salut; I. Royale	5 16 10	52 32 8	Capt. the Baron Roussin, 1820.
Riv. Marowyne; Dutch post	5 56 0	53 55 20	The Observations of Lieutenant Bisschop Greevelink, late of the Netherlandish Navy, in the brig *Echo*, 1833—37.
Post Orange [2]	6 1 0	54 33 0	
Mot Creek	6 1 30	54 37 41	
Cameron's Plantation	5 55 30	54 56 0	
Bram's Point, Surinam	5 56 20	55 9 48	
Paramaribo; Church	4 43 30	55 10 30	Sir R. Schomburgk.
River Corentyn; Nickerie Battery, on the East	5 57 33	56 52 24	The Topographical Surveys, adjusted by the longitude of Demerary, as given by Captain Owen, &c.
Mary's Hope, on the West	6 3 30	57 2 0	
Berbice; Crab Isle, light	6 24 30	47 22 0	
Corobana Point, Demerary; the Lighthouse	6 49 20	58 11 30	
River Essequibo; extremity of the Leguan Bank	7 0 20	58 18 0	Sir R. Schomburgk.

THE COASTS OF GUYANA, COLOMBIA, &c.—Continued.

	Lat. N. °	′	″	Lon W. °	′	″	Authorities.
Boca de Guayma	8	25	0	59	58	0	The Spanish Surveys of the Coasts of Venezuela, &c., by Don Joaquin Francisco Fidalgo, and other Spanish Officers. Published by the *Direccion Hidrografico*, at Madrid, in 1816 and 1817.
River Orinico:							
Punta or Point Barima	8	44	30	60	40	0	
Isle Cangrejos; N.E. pt.	8	51	0	60	22	0	
Trinidad. *See the preceding Section page* 89.							
Peñas Point	10	44	0	61	51	25	
Cape Three Points	10	45	15	62	40	15	
Cape Malapasqua	10	42	50	63	1	0	
Cumana, the City of ..[3]	10	27	37	64	10	28	
Fuerto de Mochima; Entrance	10	24	0	63	21	0	The whole of the Colombian coast, from the Island of Trinidad to Chagres has been so finely and accurately surveyed by Don Joaquin Fidalgo, and other Spanish officers, as to leave nothing more to wish for, so far as the survey extends; the South side of the *Gulf of Venezuela* only excepted. Some trifling variations in the longitudes have been made. See Notes.
Isla Borracha; N.E. point	10	19	40	64	44	46	
Barcelona, Moro of	10	13	15	64	43	45	
Piritu Isles; Centre......	10	9	0	64	56	0	
Isle Unare; Centre	10	5	15	65	15	25	
Cape Codera	10	35	54	66	6	0	
Chuspa; Point..........	10	39	30	66	20	0	
La Guayra; Road	10	37	0	66	56	0	
City of Caracas (*St. Iago de Leon*)..............	10	30	0	66	55	20	
Puerto de Turiamo	10	29	10	67	51	45	
Puerto Cabello; Ent.	10	29	45	68	2	0	
Punta Tucacas; South Kay	10	43	0	68	17	5	
Punta de San Juan	11	9	0	68	28	35	The Spanish Surveys of the Coasts of Venezuela, &c.
Punta del Ubero	11	19	30	68	47	15	
Punta del Manzanillo	11	31	15	69	22	5	
Vela de Coro............	11	26	30	69	40	5	
Cape S. Roman	12	11	0	70	6	35	
Punta de la Marcolla	12	5	0	70	19	20	
Santa Anna de Coro	11	24	0	69	47	50	
Fort or Castle of Zapara	10	58	30	71	38	30	
Maracaybo; Town	10	39	0	71	43	0	
Punta de Espada	12	4	0	71	9	50	
Bahia Honda; Entrance..	12	20	0	71	48	35	
Cape la Vela	12	11	0	72	13	35	
Rio de la Hacha; Town ..	11	33	30	72	56	55	
Cape S. Augustin	11	16	0	73	38	5	
Cape S. Juan de Guia	11	20	45	74	2	20	
Cape de la Ajuja	11	18	30	74	14	20	
Santa Marta........[4]	11	15	0	74	15	0	
Rio Magdalena:							
Boco de Rio Viejo	11	5	0	74	45	35	
Boco de Ceniza........	11	5	20	74	53	45	
Pueblo de Barranquillas	10	59	0	74	48	27	
Punta de Savanilla	11	2	0	75	0	25	
Morro Hermosa*	10	58	0	75	2	10	
Cascabel Rock	10	55	10	75	5	10	
Palmarita Shoal	10	51	45	75	16	25	
Punta de la Galera	10	47	0	75	26	30	
Punta de Canoas	10	34	15	75	33	0	
CARTAGENA; Popa ..	10	26	0	75	33	15	
Salmedina Bank (2 fms.)..	10	23	0	72	40	45	
Boco Chica; Entrance ..	10	19	30	75	36	17	
Islas del Rosario; larger I.	10	11	0	75	45	45	

Remarks.

* The Morro Hermosa, in lat. 10° 58′, is a hill which constitutes a useful landfall westward of the Magdalena, and is noticed as such in the *Colombian Navigator*, vol. iii.

There is said to be a rock, at five and a half miles to the W.S.W. of the Morro, in lon. 75° 10′, and, at about three and a half miles from the nearest land, not laid down on the Spanish Chart. It has 6 fathoms of water around it, with only 11 feet on its centre. The *Cascabel*, or *Cascavel*, lies within it, off the Rio Caimenes, at only half a league from shore, and cannot, therefore be the same.

THE COASTS OF COLOMBIA &c.—CONTINUED.

	LAT. N. ° ′ ″	LON. W. ° ′ ″	AUTHORITIES.
Islas de S. Bernardo; Tintipan or North I.	9 48 0	75 51 30	
Santiago de Tolu	2 30 45	75 36 50	
Puerto de Cispata; Ent.	2 25 0	75 48 5	
Isla Fuerte	9 23 30	76 11 15	
Punta Arenas; Entrance of G. of Darien	8 33 0	76 56 15	
Cape Tiburon	8 41 15	77 22 45	
Puerto Carreto	8 47 15	77 34 45	
Isla de Pinos; N. point of	9 1 30	77 46 0	
Puerto Escoces; site of Fort St. Andrew	8 51 0	77 38 16	
Caledonia Harbour; Scorpion Kay [5]	8 54 52	77 42 1	Mr. J. Parsons, R.N., 1854.
Cayo Ratones	2 23 0	78 16 15	Captain E. Barnett, 1840.
Punta S. Blas; E. Point	9 34 36	78 57 40	
Punta del Manzanillo	9 39 33	79 32 12	
PUERTO-VELO, or Porto-Bello; Town	9 32 30	79 39 12	
CHAGRES; St. Lorenzo Castle	9 19 39	80 0 15	
Escudo or Shield of Veragua; Centre	9 6 0	81 33 42	The Observations and surveys of Captain Richard Owen, in H.M.S. *Blossom* and *Thunder*, between 1828 and 1837.
Boca del Toro; Entrance	9 22 0	82 15 0	
Boca del Drago; Entrance	9 26 0	82 22 0	
Monkey Point	9 39 0	82 40 42	
Point Blanco	10 1 40	83 5 42	
S. JUAN de Nicaragua, or del Norte; Sandy Point	10 56 45	83 42 0	
ISLANDS, &c., in the Bay of GUATEMALA.			
Serranas; S.W. Kay	14 16 0	80 22 0	
Quito Sueno; S.E. Point	14 7 0	81 8 0	
Roncador Kay, on N.W. Reef	13 34 30	80 5 15	
Providence Island; Sta, Catarina	13 23 0	81 22 30	
St. Andrew's Centre	12 35 0	81 43 0	
Courtown, or E.S.E. Kays	12 24 15	81 28 0	
Albuquerque, or S.S.W. Kays	42 10 0	81 51 0	
MOSQUITIA or MOSQUI-SHORE.			
Blewfield Bluff	11 19 20	83 40 18	
Punta Gorda	11 28 0	83 47 0	
Parrot Isle (135 feet high)	11 30 38	83 42 30	
Man of War Kay; N.E. Kay	13 1 0	82 58 50	
Bragman Bluff; N. part	14 3 0	83 31 40	
Mosquito Kays; S.E. Kays	14 21 15	82 45 50	
CAPE GRACIAS a DIOS	14 59 30	83 12 0	
Carataska Lagoon; Ent.	15 23 40	83 43 0	
Point Patook	15 49 15	84 17 7	
Poyais Peak (3,500 feet)	15 48 0	84 53 30	
Cape Camaron; E. extrmty.	16 0 30	85 2 40	

REMARKS.

The whole of the coasts of the Bay of Honduras, from Cape Gracias a Dios to Cape Catoche, including the Isles and shoals between the Pedro Bank and Costa Rica, have been surveyed under the able direction of *Captain Owen;* Lieutenant now Captain *Bird Allen;* Lieutenant, now Captain *Edward Barnett;* Lieutenant *Jas. Cannon*, and other skilful officers of the British Navy. These important surveys were the means of correcting enormous errors in the representation of the Gulf of Honduras, and they have also given a true representation of the Rio and Golfo Dulce, the coasts of which were never before explored.—*Colombian Navigator*, vol. iii. p. 24.

THE COASTS OF COLOMBIA, &c.—CONTINUED.

	LAT. N. °	′	″	LON. W. °	′	″	AUTHORITIES.
Cape Honduras	16	1	30	85	59	30	
Bonacca; N. Extremity ..	16	30	0	85	47	37	The observations and Surveys of Captain Richard Owen, &c.
Ruatan; Port Royal	16	23	45	86	19	0	
Utila; highest hill (295 ft)	16	7	45	86	53	30	
Swan Islands; East Point	17	24	30	83	52	50	
Misteriosa Bank; N.E. part	18	56	15	83	41	38	
THE COAST continued:							
Peak of Congrehoy (7,500 feet)	15	38	55	86	54	0	
Cape Triumfo; Point	15	48	45	87	27	56	
Omoa; Low West Point..	15	47	10	88	4	40	
CAPE THREE POINTS; Ex.	15	47	45	88	38	50	
Rio Dulcé; Entrance	15	49	45	88	46	32	
Point Icacos	16	14	15	88	35	54	
Point Placentia	16	30	53	88	22	30	
Colson's Point; N.E. Extr.	17	4	15	88	15	0	
BALIZE; Fort Islet	17	29	20	88	11	30	
OUTER KAYS and REEFS:							
Glover's Reef; N.E. Extr.	16	55	0	87	43	50	
——————; S.W. Kay	16	42	20	87	50	57	
Half-Moon Kay; *Lightho.*	17	12	11	87	32	24	
North Kay on Lighthouse Reef	17	28	20	87	27	0	
Turneff; Kay Bokel	17	8	30	88	55	58	
———; Maugher Kay ..	17	36	15	87	46	40	
Rendezvous Kay	17	15	0	88	0	45	
English Kay; Flagstaff ..	17	19	25	88	0	20	
Goff's Kay.............	17	20	55	87	59	15	
St. George's Kay; Anchorage	17	33	15	88	4	54	
Northern Triangle; S. End	18	23	30	87	23	0	
——————; North Kay	18	45	0	87	19	0	
Shamrock Bay	19	17	30	87	28	0	
Ascension Bay	19	36	15	87	25	15	
Kilbride Cliffs; Stone Buildings	20	11	45	87	25	50	The Observations and surveys of Captain Richard Owen, &c.
Cosumel; South Point ..	20	16	0	86	59	39	
————; N.E. Point	20	35	30	86	44	34	
Mugere Isle; South Point	21	12	15	86	43	15	
Punta Brava...........	21	0	0	86	44	0	
CAPE CATOCHE	21	33	50	87	56	5	
Yalahau Spring	21	27	30	87	25	0	
Lagartos; Vigia	21	36	15	88	10	0	
Sisal Fort	21	10	6	90	2	47	
MonteNo-te-perderas; 80 ft.	21	10	0	90	5	30	
Jaina	20	5	0	90	30	10	The Surveys of Captain Edw Barnett, R.N., of H.M.S. *Thunder*, 1837.
CAMPECHÉ; Plaza	19	50	45	90	33	0	
Morros Point	22	45	0	90	40	15	
ALACRAN SHOAL; Whale Rock, N.W. End	23	27	0	89	48	0	
Port Alacran; Huts on Peres Island	22	23	6	89	42	50	
East Triangle; Beacon ..	20	54	54	92	13	21	
Arenas Kay	22	7	10	91	24	30	

REMARKS.

The town of Balize is the only regular establishment which the English settlers have formed in this country. It is immediately open to the sea; and though the situation is low, the groups of lofty cocoa-nut trees, with the thickly interspersed and lively foliage of the tamarind, contribute to give a very picturesque and pleasing effect to the dwellings of the inhabitants, independent of the advantage that is conferred by their grateful shade. The reefs and kays off the coast are those named *Glover's Reef*, the *Lighthouse Reef* and Kays, *Turneff*, or the Drowned Island, and the *Northern Triangle*. The Lighthouse Reef has been generally known under the name of the *Eastern Reef*; it is 8 leagues in extent from N.N.E. to S.S.W., and is steep-to, excepting the S.E. point, now distinguished by its lighthouse.

THE COASTS OF COLOMBIA, &c.—CONTINUED.

	LAT. N. ° ′ ″	LON. W. ° ′ ″	AUTHORITIES.
Javinal Point	19 12 0	90 53 0	The Spanish Surveys of the Mexican Sea, 1808—1814, with emendations by Admiral Mackellar, of the British Navy, and by the Baron Alex. von Humboldt, &c.
Punta de Xicalango	18 41 0	91 50 0	
Barra de S. Pedro	18 40 0	92 25 0	
Barra de Tabasco	18 34 30	92 35 0	
Barra d Chiltepeque	18 26 30	92 59 0	
Rio Tupilcho; Entrance of	18 26 0	93 21 0	
Barra de Goazacoalca	18 10 0	94 17 0	
La Barilla	18 10 0	94 30 0	
Punta de S. Juan	18 18 0	94 33 0	
Roca Partida, or *Cleft Rk.*	18 43 0	95 2 0	
BARRA de ALVARADO	18 45 0	95 42 0	
VERA CRUZ; *The Light-house*	19 12 15	96 7 12	
Xalapa	19 30 8	26 55 0	
Cofre de Perote	19 32 54	97 8 0	
Peak of Orizaba or Orizava	19 2 17	97 12 15	
Puebla de los Angeles	19 0 15	98 2 45	
Toluca	19 16 19	99 21 45	
Tescuco	19 30 40	98 51 15	
MEXICO	19 25 45	99 5 30	
Cape Roxo	21 16 0	97 18 0	
BARRA de TAMPICO	22 15 56	97 50 18	
Barra de Santander	23 46 0	98 2 0	
Boquillas Cerradas	25 0 0	97 45 0	
Rio Grande del Norte, or Rio Bravo, Mouth of; Boundary	25 56 0	97 11 30	

NOTES.

1. CAYENNE.—The situation of this town was given by M. De la Condamine, in 1774, from four eclipses of the first satellite of Jupiter, as in 52° 16′ 30″; but the longitude in the Table is inferred from Maranham: the difference of longitude between them having been ascertained by MM. Roussin and Lartigue.

2. COAST between the MAROWYNE and BRAM'S POINT.—To Lieutenant *B. Greevelink*, late of the Netherlandish Navy, the public is indebted for that valuable description of the coasts of Guyana and its several ports, which is in vol. iii. of the *Colom. Nav.*

3. CUMANA.—The Baron von Humboldt gives the longitude (as calculated by M. Oltmanns) as 64° 9′ 38″; the chronometric difference between it and St. Thomas, as ascertained by M. Zahrtmann, is 0° 44′ 18″, which makes it as in the table, 64° 10′ 28″.

4. SANTA MARTA.—The meridional distance between Port Royal and Santa Marta, by several measurements, is 2° 35° 45″, which gives the longitude in the table.

5. CALEDONIA HARBOUR.—The position of Scorpion Kay, in this harbour, was ascertained by Mr. Parsons, R.N., in H.M.S. Scorpion in 1854. It is important, as correcting the Spanish surveys of this coast, used in determining the practicability of forming a navigable canal between the Atlantic and Pacific Oceans.

VARIATIONS OF THE COMPASS.—1861.

According to the Chart of Lieutenant F.J. Evans, R.N., which, however differs in some respects from previous authorities, the line of *No Variation* passes within the coast of Guyana, from the entrance of the Amazons to near Cayenne.

The variation is thus at Cape North, about 0° 30′ *West*; at Surinam, about 1° 30′ *East*; at Demerara, &c., 2° 5′ East; Trinidad, 2° 30′ East; Caracas, 3° 50′ East; Curaçao, 4° 0′ East; Santa Marta, 5° 25′ East; Gulf of Darien, 6° 30′ East; Chagres, 6° 50′ E.; Cape Gracias a Dios, 6° 35′ East; Balize, 7° 20′ East; Vera Cruz; 8° 25′ East.

These variations appear to be very slowly *decreasing*.

SECTION II.

LIGHTHOUSES,

AND THEIR ILLUMINATION.

The Lighthouse Systems at present in operation on the shores of the Atlantic Ocean are well worthy of far greater attention than they generally receive, both for the regularity and perfection of their arrangements, and for the beautiful adaptations of science which they exhibit. A few remarks on their nature will therefore be an appropriate introduction to the lists and descriptions of the lights which follow.

It is of the utmost importance to the sailor, that one light should be readily and clearly distinguished from another; the melancholy effects or mistakes on this point are too familiar. Every means, therefore, of so distinguishing a light, should be made use of; and one point in furtherance of this, is the system employed in the illumination of the lighthouses, between the various methods of which it will be seen that there are some well-marked or minor features, which serve to give a distinctive character to lights which may have, otherwise, the same general appearance.

Lighthouses consist of two classes; those built on the land, which do not differ, in the principles of their construction, from ordinary buildings; and those erected on isolated rocks, such as the Eddystone, and that on the Héaux de Brehat, which have demanded the most refined judgment and skill to combat with the enormous force of the waves. Another description of erection consists of iron piles, either secured to the rocks, or on a large screw forced into the sand, which support the lighthouse. An example will be found in the Maplin Lighthouse, in the mouth of the Thames.

Light-vessels, employed where buildings have been hitherto impracticable, are of peculiar construction, and always painted *red*, with their name, in conspicuous white letters, on their sides, and carry at their mast-heads one or more skeleton balls, as described, which, in cases of the vessels driving, are lowered, in indication of such an occurrence. During fogs or snow storms, from each of these vessels is sounded at regular intervals a Chinese gong, the very peculiar and powerful sound emitted by which is not to be mistaken for anything else. Light-ships are very strongly moored, either with a single mushroom anchor, or with a span and bridle.

The *lamps* used for the illumination of lighthouses are upon the principle invented by Argand, about 1780. The smallest of them consists of a single cylindrical wick, of nearly an inch in diameter, and the air is made to ascend through the tube to the centre of the flame, by means of a glass chimney placed around it, and does not differ from that in universal use. This single wick lamp is used for the parabolic reflectors; and there are usually several of them in a lighthouse. Where a single and more powerful light is required, a lamp of more complicated construction, though of the seme principle, is employed. The largest has four concentric wicks, the outside or largest being 3½ inches in diameter, and the central or smallest five-sixths of an inch. From the great heat which this powerful lamp evolves during its burning, which is sufficient to char the wicks; the oil is made to flow copiously over them, so that the quantity supplied to them is about four times more than is consumed at the time. This is effected either by means of small pumps, moved by clockwork, or by springs or weights pressing on the reservoir, or by the pressure of condensed air. The lamp with four wicks is of the first order; for the second it has three wicks, for the third two, and the fourth one wick.

The oil now employed both in the English and French lighthouses is called colza oil, and is expresed from the seed of a species of rape or wild cabbage. Formerly the best sperm oil was used in the English lights till 1852.

The effect of a lamp in issuing rays, is to fill a sphere whose diameter is double that of the distance to which such a light can be seen. But as only those rays are serviceable which are visible in a horizontal or nearly horizontal direction, those which pass beyond these limits must be turned into it. To do this we have two alternatives,—one to reflect the light by polished mirrors, the other to refract it by glass lenses placed before the light.

When polished silver reflectors are used *behind* the light, it is called the *Catoptric* system, and is that most generally in use in England.

Where glass lenses are used *before* or around the light, it is called the *Dioptric* system, and is that most generally in use in France. Hence these two systems are frequently known by the names of the respective countries.

The *Catoptric* or reflecting system is dependent upon the peculiar properties of the parabolic curve, to which the reflectors are formed. The parabola is a conic section which has within it a point called the focus (which is the situation of the flame in the reflector), and if a line be drawn from the focus to any point on the parabolic curve, another line drawn from that point parallel to the axis of the parabola, will form an equal angle on either side of it. Now the reflector, composed of copper lined with silver, is formed by the section of the revolution of a parabola, and if a part of light from the focus be reflected from its polished surface, it is thrown off, or reflected in a direction perfectly parallel to its axis. The point of light in the focus thus sends forth a cylinder of light, whose diameter is equal to the double ordinate or opening or mouth of the reflector. Supposing, then, that we wished to produce a complete circle of light all around the hrizon, it is evident that it could not be done with any number of such instruments; there would be dark intervals between the direction of their axes, if they were placed in a circle. But here another circumstance occurs. The flame used is not a point of light, but is nearly an inch in diameter, and this subtends an angle at the vertex (or bottom of the reflector) of 14° 22′, in the reflectors ordinarily used in the Trinity House lights, which are 21 inches in diameter and 4 inches in focal length. Therefore, combined with other circumstances, about 15° or 17° of divergence may be considered effective, and it would take from 25 to 33 of such reflectors to make a complete circle of light.

The brilliancy of the ray from this reflector is considerably stronger in the direction of the axis, that is, when viewed directly in front, than it is for some distance on either side of that direction; and at great distances, in *fixed* lights, when you are in the direction *between* the axis of the adjoining reflectors, the light is frequently glimmering and feeble, but a small change in the position of the ship brings you again into the brighter beam of the reflector, one of which, it will be understood, is only in sight at a time. This is an important observation to the sailor, in distinguishing one fixed light from another, of different descriptions of apparatus.

When a revolving light is required, a number of these reflectors is fixed to the sides of a triangular or quadrangular iron frame, and the whole caused to revolve in regular periods, by means of clockwork. The reflectors on each side of the revolving frame, from four to eight in number, are thus successively directed to every point of the horison; and the combined result of their rays forms a flash of greater or less duration, according to the rapidity of their revolution.

From the amount of divergence the period during which such a light will remain visible is from 12 to 15 seconds, the light gradually increasing, and as gradually diminishing. And as the action of the reflector is only in the direction to which it is placed, the intervals between the flashes will be quite dark, for a shorter or longer period, according to the distance from which it is viewed, whether it is beyond that to which the unassisted flame will reach.

The light from a revolving catoptric or reflecting system is much brighter than from a fixed light on either principle, as you have the combined effect of several reflectors, each of which gives an equal amount of light, it is calculated, to 350 to 450 such lights without any reflectors.

In floating light-vessels the light is always shown from parabolic reflectors. These are smaller than those used in lighthouses, being 12 inches in diameter. For fixed lights, eight lamps and reflectors, each suspended on gimbals, or on ball and socket-joints, so that they always maintain their perpendicularity, notwithstanding the rolling of the vessel, are arranged in an octagonal lantern, which goes round the mast, and is hauled up to the mast-head when on service, and is let down on the deck during the day, or while the lamps are trimming. Revolving lights for floating light-vessels have four lamps, and similar reflectors, and the lantern revolves around the mast.

An apparatus for producing an *intermitting* light, of the only appearance to which such a term is applicable, is in use in three of the Scottish lighthouses, the invention of Mr. Robert Stevenson. It is an arrangement by means of which the light is suddenly obscured by an eclipser, and as suddenly appears again at its full brilliancy. This feature distinguishes it completely from revolving lights, which come gradually to their greatest brightness, and as gradually decrease, and this either from the reflecting or refracting apparatus.

There is yet another sort of reflector in use in France for harbour lights, called the Bordier Marcet apparatus, from its inventor, or the sideral lamp. It is used with a single lamp, and consists of a circular reflector, about 13½ inches diameter, formed by the revolution of a parabola around its focus in a horizontal plane; the centre of this is taken out to admit the lamp, which thus has all around it, above and below, a reflecting surface, which sends its upward and downward rays in a horizontal direction.

The lights in the ensuing list, which are upon the catoptric or reflecting system, are distinguished by this mark ●. Their magnitude, or order, is not indicated, as only one reflector is usually visible at a time; the class of the light is to be inferred from its importance.

The first notice we have of the use of parabolic reflectors is given by William Hutchinson, in his "Practical Seamanship," published in 1777, as having been used in the Liverpool lighthouses, erected in the year 1763. The formula for the parabolic curve now used was given by Captain Joseph Huddart.

The *Dioptric* or lenticular system is next to be considered, and depends for its action on the refracting properties of glass. In this the apparatus is placed before the flame, and derives its name, dioptric, from a Greek word, signifying anything looked through; or lenticular, from its being composed of lenses. Its principle may be thus explained:—

When a ray of light passes out of a rarer into a denser medium, as from air into glass or water, or *vice versâ*, it is refracted, or bent, out of its original direction. Of course, this new direction is dependent upon the direction in which it enters into, or emerges from, this second medium. This is familiarly explained in the burning-glass, in which it will be seen that a cylinder of parallel rays of the sun entering one side of the lens, are so deflected, that upon their issuing from it on the other, they form a *cone* of rays whose apex is at a certain distance, dependent on the curved side or sides of the lens, called the focal distance.

In the application of plano-convex lenses of 3 feet focus, to the controlling of two-fifths of the entire sphere of light, they must be 2 feet 6 inches in diameter, and if constructed of the usual form of smaller lenses, would be several inches in thickness in the middle. This would occasion serious inconveniences: a large portion of the light would be absorbed in its passage; there would be great difficulty in procuring such a mass of glass of anything approaching to uniform density, which is necessary to its proper action; and it would be also of very great weight, and consequently, be of difficult management.

To obviate these difficulties (for a burning-glass), it occurred to Sir David Brewster in 1811, and to M. Augustin Fresnel in 1819, that the same optical effects might be preserved if a large portion of the solid part of the lens were removed; because the refractive properties of the lens depend upon the relative direction of its surfaces. They therefore proposed the lens now in use for lighthouse purposes. It is called the polyzonal or annular lens, because it consists of a series of zones or rings, instead of being of one uniform curve or surface. It is a plano-convex lens, having the curved surface cut into rings, which are brought into one plane, and the relative direction of the outer curved surface to the inner flat one is preserved in the separate rings of which the lens is built. There is one great advantage in this method, that the lens may be built to any size, and yet not be thicker, and may be made square, so as to economize every portion of light which may be thrown on the zones of the breadth of their diameter. The dioptric system was perfected by the late M. Augustin Fresnel, the director of the French lights, and is sometimes called by his name.

For a *revolving* light of the first order, or largest size, eight of these lenses are formed into an octangular belt of 6 feet 0·5 inch in diameter, having the flame of the lamp in their common focus. Therefore as the action of these lenses is the reverse of that of the burning glass, by sending forth parallel rays of light, which enter the lens in the form of a cone from the focus within; this part of the apparatus will send forth eight beams of light in the direction of their axes, or the lines between the lamp and their centres; between these directions the light will not be seen. The apparatus being made to revolve, say, in eight minutes, by means of machinery, it follows that a bright beam, gradually increasing in intensity, and then diminishing, will be presented to the eye each time that one of these lenses passes before it, that is, once every minute.

The duration of these flashes is dependent on the power of divergence in the lens. If the light were a mathematical point, as supposed in the case of the reflector, the flash would last but a single instant, but the breadth of the flame being 3·39 inches, this, at the focal distance of 3 feet, subtends an angle of 5° 9′, and consequently the duration of the flash is while this angle is passing, or about seven seconds. These separate lenses form the principal or most powerful portion of a revolving dioptric light.

For a *fixed* light on the dioptric principle, another adaptation of it is used. As the object is now only to bend those rays, which would pass upwards or downwards into a horizontal direction, and not to interfere with the direction of those which pass laterally, the central portion of the apparaus is formed into a continuous belt, or rather series of belts, whose section is identical with that of the polyzonal lens. It will be evident that such an arragement distributes the light evenly all round the direction in which it is placed, and thus affords a means of distinction for the sailor, to discriminate such a fixed light from one on the catoptric or reflecting principle, when the light is not quite even all round, but is strongest when immediately in front of the reflector.

The central portions of the apparatus which we have been describing economise about two-fifths of the whole rays issuing from the central lamp, but does not affect those which pass above or below their action, and which would therefore be lost for useful effect without some additional controlling apparatus. This is of two kinds: either *reflecting*, being formed of numerous silvered glass mirrors, or else of *reflecting* and *refracting* glass prisms.

The upper series of this additional portion, in the original form of the larger apparatus, consists of a series of seven rings, covered with plates of looking-glass, which are inclined towards the flame at such an angle, that they reflect the light in a horizontal direction, and thus add their effect to the power of the central portion of the lenses. The same remarks apply to the lower series, or the four beneath the flame; and they may be considered, as each of the faces, forming a portion of the parabolic curve, whose focus is in the flame of the lamp. In a first order light apparatus on this system there are 264 separate mirrors in the 11 zones. But this portion of the apparatus is now in course of change for the following, in all the English and French lights.

In the earlier period of the introduction of the dioptric system, a more beautiful adaptation of science was alone used for the smaller apparatus, in the form of cata-dioptric or totally reflecting prismatic glass zones, above and below the principal lenses. It has been introduced into the largest apparatus, upon the suggestion of Mr. Alan Stevenson, the engineer of the Scottish lighthouses, and has most materially increased the efficiency of the whole system.

When a ray of light is thrown on a glass surface at a more acute angle than 41° 49′, instead of passing out again it is *totally reflected* from that point, and it is of no importance whether it is within the body of the glass or on its external surface. The prismatic zones are so arranged in the form of a cupola over the flame, that the upper and curved surfaces of each of them shall be at such an angle to the focal flame that the rays issuing from it shall, after being refracted from the under side, be received upon the inner surface of the upper side, be again refracted, and issue from the outer side in a perfectly horizontal direction.

This is one of the greatest refinements of practical science, and so perfectly does it fulfil its office, that the only loss of light is that which is absorbed by the glass of which the prisms are composed. These cata-dioptric zones are necessarily very much more costly than the ordinary catoptric or reflecting zones, but they increase the power of this part of the apparatus more than in a corresponding degree, though their general effects are not otherwise distinguishable from one another.

The distance to which the light from these zones is visible is about 10 or 8 sea miles, according as the apparatus is of the first or second order.

In a revolving lenticular light, therefore, the upper and lower portions of the apparatus, affording a constant and steady light, are visible in the intervals between the flashes from the central lenses, and this subordinate light will serve to fix the position of a light during such interval, if it is seen within the distance of 8 or 10 miles. This distinguishes a lenticular revolving light most clearly from one on the catoptric principle, or from parabolic reflectors, the intervals between the flashes of which are generally total beyond the distance of 2, 3, or 4 miles.

There is a more complicated system in use for dioptric revolving lights, which, although there is no example of them in the English Channel, as they are in use in the two finest lighthouses in the world, the Cordouan, at the mouth of the Gironde, and the new Skerryvore, off the West coast of Scotland, we will here describe. Instead of the bands of parabolic mirrors, or cata-dioptric zones, *above* the central and principal lenses, the apparatus is dia-catoptric, being composed of eight smaller lenses of 19½ inches of focal distance, inclining inwards towards the flame, and forming an octagonal frustrum of a cone of 50° inclination. These are surmounted by plane mirrors, placed so as to reflect horizontally the beams transferred by these lenses. This upper apparatus is fixed at an angle of 7° from that of the eight great vertical lenses. The whole of the apparatus is caused to revolve in eight minutes, and the following is its distant effect. Within 8 miles a constant steady light is seen from the lower zones, and once in every minute a small flash is seen for a few seconds, caused by the upper portion of the apparatus. Soon after this smaller flash, the principal lens gives the brightest beam, which may be seen more than 30 miles; this having passed, the smaller flash, after a period, succeeds, and thus in each minute a small and a large flash are visible.

Among the French system of lights is an apparatus which shows a fixed light varied by a bright flash at regular intervals. The apparatus consists of the ordinary fixed dioptric light with the refracting belt, which is composed of *horizontal* cylindrical elements. Round this central belt one or more panels of *vertically* cylindrical elements is made to revolve. This revolving panel causes the horizontally divergent beams to be parallelized in azimuth, and thus the appearance of the light from the entire apparatus will be a fixed light, then a short eclipse caused by the deflection of the section of light by the revolving panel, then the bright flash from the panel, then another short eclipse, and then the steady light again. The same appearance is also more effectually produced by constructing the apparatus of alternate segments of horizontal cylindrical elements and polyzonal lenses. Sometimes the flash is of a red colour, the revolving panel being stained for that purpose, as in the case of the new light on Chausey in the Channel Islands, and several others.

The only means of distinguishing one light from another is that of causing it to revolve or flash at different intervals, as is almost exclusively used in the French lights, or by means of colour, as is more in use in our own harbour and tide lights. The colour which alone seems adapted for this purpose is *red*, and this is applied to dioptric lamps by a cylinder of ruby-coloured glass, stained with a preparation of gold, placed around the lamp; or if to the ordinary reflector, a pane of this coloured glass is placed before the reflector. The use of colour is objectionable on the score of the greatly diminished power of such a light. In a bright light, revolving and showing alternate red flashes, these last will not be visible so far off as the bright light, and give the appearance of longer or unequal intervals in its appearance.

There is some waste of light in both the systems. In the catoptric it is that angle comprised between the angle formed by the lips of the reflector and the flame and the horizontal ray which strikes the outer edge of the reflector. That portion of the light which passes upwards is, of course, lost for useful effect: the other portions may be considered as serviceable. In the year 1849, Mr. Thomas Stevenson, son of Robert, brother of Alan Stevenson, proposed some arrangements which obviate this loss, upon what is termed the *holophotal system*.*

The ordinary paraboloidal reflector is rendered holophotal as follows:—A small portion of the back of the reflector is cut off; for this is substituted a portion of a *spherical* mirror of the same focus. In front of the flame a lens with three diacatoptric rings is added. The action of the spherical reflector is to return all the rays impinged on it back through the flame, and thus on to the posterior sides of the lens and diacatoptric rings. Therefore, all the rays which emerge from the lens, &c., will be horizontal, and the remainder, those impinging on the paraboloid, will also be reflected in the same direction. Peterhead light (1859) is on this principle. The Horsburgh Lighthouse, in the strait of Singapore, is fitted with 9 such holophotal reflectors; three on each face of a revolving frame, each side of which, it is said, gives as much light as five reflectors of the ordinary kind. This was completed in 1851. Another one, on a large scale, is at Hoy Sound, Orkney. A similar apparatus, a red light, was placed at Wick, in Caithness, in 1851.

Dioptric lights are divided into 4, or rather 6 orders, according to their magnitude:

1. The *first* order apparatus is 6 feet 0·5 inch in diameter, and is illuminated by a lamp with four wicks, of 3·39 inches, 2·52 inches, 1·69 inches, and ·83 inch diameter, respectively. It is indicated in the following list by the figure 1.

2. The *second* order apparatus is 4 feet 7·13 inches in diameter, and is illuminated by a lamp with three wicks of 2·6 inches, 1·8 inches, and ·9 inch in diameter, respectively, and is indicated by the figure 2.

3. The *third* order is subdivided into two sizes, larger and smaller. The first apparatus (grand modèle) is 3 feet 3·38 inches in diameter; and the second (petit modèle) 1 foot 7·69 inches in diameter. They are each illuminated by a lamp with two wicks, the larger of 1·61 and ·807 inches diameter respectively, and the smaller of 1·20 and ·589 inches in diameter. They are shown in the list by the figure 3. All the lights of this order in the English Channel are of the larger size.

4. The *fourth* order, or harbour light, is also subdivided into two sizes, the larger (grand modèle) 1 foot 2·77 inches in diameter, the smaller (petit modèle) 11·81 inches in diameter. They are illuminated by a single cylindrical wicked lamp of ·94 inch or ·85 inch in diameter. As the sub-division of this order is unnecessary to the sailor it is distinguished in the list by the figure 4.

In addition to the magnitude of the apparatus. the description of it will also serve usefully to distinguish one light from another. Therefore, the different systems em-

* "Holophotal:" from two Greek words, signifying "whole light."

ployed, as described in the foregoing paragraphs, are designated by the letters *a, b, c, d,* attached to the figures indicating their sizes, as follows:—

a. A *fixed* dioptric light apparatus, having a dioptric belt and cata-dioptric prismatic zones. This is the most perfect system for fixed light apparatus.

b. A *revolving* light apparatus, consisting of eight polyzonal lenses, surmounted by the cata-dioptric prisms. The appearance of this light, beyond the distance of 8 or 10 miles, according to the size of the apparatus, is that of a brilliant flash of 7 to 9 seconds' duration. Within that distance the fainter light between the flashes is visible.

c. A *fixed* light, varied by *flashes.* Its appearance, which distinguishes it from any other, upon close attention, is, 1st, the intensity and duration of the fixed light; and, 2nd, by the *short* duration of the eclipse which precedes and follows each brighter flash.

d. A *holophotal* apparatus, described as above.

The range (portée) of the different lights, as given in the table, represents this element very incompletely, inasmuch as the distance there given is dependent on the elevation of the light, and consequent distance of the horizon. The flashes of the principal revolving dioptric lights may be, and have been, seen 50 or 60 miles off, when they are above the horizon, and it may be taken for granted that, should the atmosphere be favourable, any of the larger lights may be seen from whatever distance they may be sought for from the greatest attainable elevation.

The height of the lights above the sea-level is given in the tables from the level of *high water at spring tides,* and consequently is their minimum height. This will cause the distance to which they are visible to be increased (with the exception of floating lights) when it is low water, by an amount equivalent to the depression of the sea surface at that period.

Atmospheric changes, of courses, have the most important effect on the range, visibility, and appearance of lights. In a very clear transparent atmosphere they will have nearly a white appearance; during foggy weather, particularly the dry haze sometimes predominant on soundings, they will have more or less of a yellow or reddish tinge.

Lights may be divided into three classes according to their nautical importance:—
1. *Coast lights,* those which serve for the mariner to recognise the land on approaching it, and are thus of the greatest power; they are marked in the following lists in capital letters, thus—USHANT, LIZARD, &c.

2. *Harbour and Leading Lights.*—These, of less importance than the former in the general system, are used to indicate a port or narrower channel. Some of these, though more limited in their immediate object, may be as important as the first class. Thus the Gull Stream light-vessel, though of limited approaches, is most useful in marking the centre of the Goodwin; it is therefore placed among the first class. The second class is shown in small capitals, as—Shoreham, Cherbourg, &c.

3. *Tide lights* show when a harbour has a certain depth of water and is accessible. They are frequently red, and, consequently, are of less power. They are marked in italics, as *Ramsgate, Boulogne,* &c.

Farther details are given and alluded to in our recent Work, "A Description and List of the Lighthouses of the World, 1861," to which the reader is referred.

EXPLANATION OF THE TABLES.

NAME AND CHARACTER OF LIGHT—First Column.

The principal coast lights are given in capitals, as N. FORELAND. Secondary lights in smaller capitals, as Shoreham Harbour. Tide lights in italics, as *Ramsgate*. The character of the light follows its name.

GEOGRAPHICAL POSITION—Second Column.

The latitudes and longitudes here given are presumed to be accurate, within less than 1′, for all the coasts of the Atlantic Ocean and its Seas. In other parts of the world it may vary somewhat more; but there is no great discrepancy, such as would lead to serious consequences, by taking any one of them as a point of departure.

DESCRIPTION OF THE LIGHT, &c.—Third Column.

In this, any peculiarity of the light, or period of a Tide light, is noticed; and also the direction of double lights. In many cases the bearing of two lights when in one will lead clear of a danger, as the S. Foreland in one, W. by N., clears S. end of the Goodwin, &c. Special directions will explain this.

DESCRIPTION OF APPARATUS—Fourth Column.

In this, the signs used to indicate the sort of light apparatus in use in each case:—

● signifies a catoptric, or reflector light. (See page 14, &c.)
1 a, 2, 3 d, &c., indicate dioptric, or lens lights, the figure showing the order or size, 1st, 2nd, 3rd, to 6th order. (See page 26.)
a, a fixed lenticular light. (Page 22.)
b, a revolving lenticular light. (Page 21.)
c, a fixed and flashing light. (Page 23.)
d, a holophotal light. (Page 25.)

These figures and letters will serve to explain the peculiarities of the Lenticular System, as in operation therein.

HEIGHT ABOVE HIGH WATER—Fifth Column.

This gives the height of the *flame* in feet above the highest tide level, consequently it is its minimum height, and is increased by the tidal range of the place. The height of the Lighthouse itself, from base to summit, is given sometimes in the third column.

VISIBLE IN MILES—Sixth Column.

This gives the minimum distance to which the light can be seen, in clear weather, from a height of 10 feet above the sea level. But in the case of the principal lights this but imperfectly represents their range, as they could be seen at any distance attainable by increased elevation. In the use of *coloured* lights this range is given according to their presumed power.

YEAR ESTABLISHED—Seventh Column.

The date of the first exhibition of the light is usually given; but its character, &c., may have been frequently changed in the interval.

LIGHTHOUSES.

ENGLAND. **Thames Mouth.**

Name and Character of Light.	Lat. N. Long. E. ° ′	Description, &c.	Description of Apparatus	Height above H. W.	Visible in Miles.	Year established.
RIVER THAMES Northfleet	......	*White* light in fairway; *red* over anchorage in Gravesend Reach and Broadness..............	●	..	..	1859
Hope Point Fort	......	A single lamp for Colliers......	..	..	..	1852
Mucking Flat, Pile Light House	......	Bright East of N.E. by E., *red* to W.; also *red* ray toward Blyth buoy, and *red* N. of fairway in Sea Reach.......	2a	40	11	1849
Chapman Head	......	Bright in fairway channel, *red* to N. A fog-bell	2a	40	11	1849
Southend Pier-head	......	*Red* fixed light................	..	..	..	1840
Sheerness ..	......	*Red* gas-light on Garrison Pt. ..	..	32	5	1869
NORE LIGHT-VESS. One br. rev. lt. ½ min.	51 29. 0 48.	In 3 fathoms at East end of the Nore Sand	●	38	10	1734
GIRDLER LT.-VESSEL One br. rev. lt. ½ min.	51 29. 1 7.	In 3½ fathoms W. Girdler Sand at W. entrance of Princes Chan.	●	38	10	1848
PRINCES CHANN. LT. VES. One *red* rev. lt. 20 secs.	......	In 3½ fms. N. side of Channel, between Girdler and Tongue Light-Vessels	●	38	10	1856
TONGUE LIGHT-VESSEL. Upp. br., low *red*, F. lts.	51 29. 1 19.	In 10 fathoms at E. Tongue Sand one *red* ball. Lights at unequal heights	●	38 14	10 ..	1848 ..
Herne Bay Pier	......	Fixed light at Pier-head	..	..	..	1857
Margate Pier One *red* fixed light	51 24. 1 23.	At West end of Pier, also a small light on Jarvis landing-place	●	85	10	1829
MOUSE LIGHT-VESSEL One bright fixed light	51 32. 1 0.	In 4 fathoms, at W. end of Sand	●	38	10	1838
MAPLIN PILE LIGHTHO. One *red* fixed light	51 35. 1 3.	Painted *red*, light not vis. over the sand; a bright ray to S. ½ W.	2a	36	10	1838
SWIN MIDDLE LT.-VESS. One br. rev. lt. 1 min.	51 39. 1 7.	In 4 fathoms at West end of Sand	●	38	10	1837
GUNFLEET PILE LT. HO. One *red* rev. lt. 2 min.	51 45.8 1 20.	On S.E. side of Sand; keep ½ mile off and do not pass to N.	●	41	9	1850
SUNK LIGHT-VESSEL. One bright fixed light	51 46.7 1 28.	In 10 fathoms in fairway of East Swin......................	●	37	10	1802
KENTISH KNOCK LT.-VES. One br. rev. lt., 1 min.	51 40.8 1 40.5	Has two *red* balls vertically. In 11 fms. on E. side of Sand ..	●	37	10	1840
GALLOPER LT.-VES. Two br. fixed lights	51 45. 1 56.	In 20 fms. on E. side of Sand; lights horizontal	●	36	10	1803

Name and Character of Light.	Lat. N. Long. E. ° ′	Description, &c.	Description of Apparatus	Height above H. W.	Visible in Miles.	Year established.
NORTH FORELAND One bright fixed light	51 22.5 1 26.8	White tower 78 ft. high. A strip of *red* lt. to E. end of Margate Sand	1a	184	19	1836
Ramsgate Tide Lights One *red*, two *green* lts.	51 20. 1 26.	While 10 feet. The low *green* lt. is changed to *red* with 10 feet. a *red* tide ball by day	4a	37	6	....
GOODWIN LT.-VESS. Three br. fixed lights	51 19. 1 35.	Off the N. end of the Goodwin Sands, in 9 fathoms	● ..	28 42	10	1793
GULL STREAM LT.V. One br. rev. lt., 20 secs.	51 17. 1 30.	On the W. edge of the Goodwin Sands, in 8½ fathoms	●	14	7	1809
SO. SANDHD. LT. VES. One bright fixed light	51 10. 1 28.	Off the S. end of the Goodwin Sands, in 13 fathoms	●	38	10	1832
SOUTH FORELAND Two br. fixed lights	51 8.4 1 22.4	In one W. by N., 1,347 feet apart	1a ●	372 275	25 22	1793 1842
DOVER One *green* light *Red Tide Lights* *Blue* light on Admiralty Pier	51 7. 1 19.	N. Pier: one *red* lt. while 7 feet. S. Pier: one *red* lt. while 7 to 10 ft.; two *red* lts. while 10 to 13 feet. The *green* light only toward the entrance	● ..	.. ..	.. ..	1842 1852
Folkestone Tide Light	51 5. 1 11.	One fixed *red* light, while 10 feet	●	36	6	1810
VARNE LT.-VESSEL One *red*, quick revol. lt.	50 56. 1 18.	In 16 fathoms at W. end of the Shoal	●	36	10	1860
DUNGENESS One bright fixed light	50 54.8 58.3	A *red* tower on the point. Fog bell	1a	92	14	1789
Rye Tide Lights Two bright fixed lts.	50 57. 0 44.	On N. side of the entrance while 10 ft.; in one N. by W. 540 feet apart	.. ..	26 16	4 3	....
HASTINGS One bright, one *red* lt.	50 52. 0 36.	In one, N.N.E., 508 feet apart, to direct the fishermen (September 29 and March 25)	.. ..	60 30	7 4	....
Eastbourne	50 45. 0 17.	A lamp in the fishing season	..	10	2	....
BEACHY HEAD A br. rev. light, 2 min.	50 44.2 0 12.9	A white lighthouse, 47 feet high, on summit of Belletout Cliff ..	●	285	22	1828
NEWHAVEN A br. fixed lt. & *Tide Lt.*	50 47. 0 4.	On the W. pier. The tide lt. *red* between 10 and 13 feet; bright above 13 feet..................	[illegible] ..	[illegible] [illegible]	3 [illegible]	....
	Lat. N. Long. W.					
BRIGHTON CH[illegible] PIER.	50 47. 0 4.	One *green* fixed light	..	35	10	1824
SHOREHAM [illegible] A br. fixed [illegible] *red* *Tide Light*	50 50. 0 15.	On central pier, bright *Tide* light while 11 feet, but *red* at H. W.	4a ..	42 23	10	1825
Littlehampton	50 48. 0 32.	A fixed *red* light on E. pier	●	30	9	1848

Name and Character of Light.	Lat. N. Long. W. ° ′	Description, &c.	Description of Apparatus.	Height above H. W.	Visible in Miles.	Year established.
OWERS LT.-VESSEL One bright fixed light	50 39.7 0 39.9	On the S.E. end of the Owers Shoal, in 19 fathoms	●	38	10	1788
Bembridge Lt.-Vessel Two bright fixed lights	50 41.7 1 1.7	Near the Nab Rock, off Bembridge Point, in 5 fathoms....	● ..	38 28	10 8	1812
ST. CATHERINE'S One brilliant fixed lt.	50 34.5 1 17.8	A handsome stone tower, 105 feet high	1a	178	18	1840
Warner Light-Vessel One br. rev. lt. 1 min.	50 43.8 1 4.	In 13 fathoms, on the Eastern part of the Shoal............	●	38	8	1854
Ryde Pier	......	A bright fixed light	5a	21	12	1852
Southsea Castle One *red* fixed light	50 46.6 1 5.2	A strong *red* light on Castle. Shows *green* from W. of the Spit Buoy....................	●	31	9	1822
Southampton Pier Two fixed *red* lights	50 53.7 1 24.4	In one, lead up the Channel. Also two *red* lts. at the Docks in one lead up	..	..	..	1841
Calshot Light-Vessel One bright revol. light 1 min.	50 48. 1 16.	Off Calshot Castle, in 8½ fathoms	●	32	9	1842
Yarmouth Castle One fixed light	......	*Red* light in centre leads in; bright or *green*, outside	..	12	..	1857
NEEDLES Outer Rock One fixed light	50 39.7 1 34.5	Shows Red (except between W. and W.N.W.), when it shows White. Shows White also to N.E. by E. ½ E. A faint lt. inside Warden Ledge Buoy. Fog bell.	1a	80	9	1859
Hurst Beach Two bright fixed lights	50 42.4 1 32.9	In one, N.E. by ½ E., 755 feet apart. Another light in the low lighthouse shows only up the Solent	● ●	66 29	12 9	1812 1786
Poole Two *red* lights	50 41. 1 58.	In one, N. ½ W.; 786 feet apart on N. side of entrance. Also four lights inside.............	● ..	37 16	6	1848
Swanage Pier	......	One fixed light intended	..	..	..	1861
Weymouth One *red* fixed light	50 37. 2 26.	On the S. pier head	..	23	21	1853
PORTLAND High lt., br. and fixed Low lt., br. and fixed	50 31.3 2 27.3	White towers, 32 and 86 ft. high near the Bill. In one, N.N.W. ¾ W., 1509 feet apart........	1a	222 145	19 16	1716 1789
Portland Breakwater One fixed *red* light	......	On the end of the Stage........	..	30	9	1851
Shambles Shoal Lt. Ves. One fixed light	......	On E. end of Shoal, in 15 fms.	●	38	10	1859
Lyme Regis Tide Lights One *red*, one *green* light	50 43.5 2 55.9	From half flood to half ebb. In one, N.W. ½ N., 825 ft. apart	.. ..	11 21	.. 4	1853

Name and Character of Light.	Lat. N. Long. W. ° ′	Description, &c.	Description of Apparatus	Height above H. W.	Visible in Miles.	Year established.
TEIGNMOUTH Two *red* fixed lights	50 33. 2 28.	One on a limestone tower on S.W. end of Denn; other on a house	●	31	61	1845
BRIXHAM One *red* fixed light	50 24. 3 30.	On an iron stand on the pier head ....—............	●	20	6	1839
Torquay Pier Head	50 27.5 3 31.	One fixed *red* light	..	15	5	1852
DARTMOUTH One *red* fixed light	50 20. 3 33.	W. side of entrance	●	80	10	1857
START POINT One brilliant revolving light, visible every minute	50 13.3 3 38.5	A white tower, 94 feet high. A fixed lt., 192 ft. high, is also vis. from tower, when it bears S. of W.S.W. A bell in fogs	1a	204	19	1836
PLYMOUTH BREAKWATER One bright and one *red* light	50 20.4 4 9.5	On W. end; bright to seaward, but *red* E. of N.E. ½ E. from it. A lower br. lt. is seen when the channel is open. A bell during fogs	2a ..	63 48	9	1844
PLYMOUTH HARBOUR One bright fixed light	50 22. 4 7.	A tower, 20 feet high, on the W. Barbican pier head..........	●	29	6	1822
EDDYSTONE One brilliant fixed lt.	50 10.8 4 15.9	An admirable *red* and *white* stone tower, 89 ft. above foundation on the rock, which covers 14 ft. at high water. Bell in fogs	2a	72	13	1759
FALMOUTH One rev. lt. in 20 secs.	50 8.6 4 59.5	A white tower, 62 feet high, on St. Anthony's Point	●	72	12	1835
LIZARD Two brilliant fixed lts.	49 57.6 5 2.1	Two white towers, each 61 feet high, W. ¾ N. and E. ¾ S., 223 feet apart, on the Lizard Cliff	● ●	229 232	20 20	1751
WOLF ROCK One light, proposed	49 56.7 5 48.2	(Proposed, on the rock.)	..	..	..	1861
Penzance Tide Light A fixed *red* light, while 15 ft. inside; *green* while less	50 7. 5 31.	A white building, 22 feet high, on the S. pier head. By day, a ball while 15 feet..........	5a	33	9	1855
LONGSHIPS One brilliant fixed lt.	50 4.1 5 54.7	A white square tower, 51 feet high	●	79	14	1795
SEV. STONES LT. VES. Two bright fixed lights	50 32. 6 7.3	On the E. side of the rocks, in 40 fathoms. Two *red* balls	●	20 38	10	1841
SCILLY One br. revol. lt. every minute	49 53.5 5 20.7	A white tower, 74 feet high, on the summit of St. Agnes' Island	●	138	16	1680
BISHOP ROCK One fixed bright light	49 52.5 6 26.6	On the S.W. rock. A noble stone tower, 147 feet high....	1a	110	16	1858

Name and Character of Light.	Lat. N. Long. W. ° ′	Description, &c.	Description of Apparatus	Height above H. W.	Visible in Miles.	Year established.
St. Ives Tide Light ...... One bright fixed light, while 10 feet	......	On the pier head. Lighted from 1st September to 30th April	●	23	7	1831
Hayle Tide Lights Two fixed bright lts.	......	N. 25° E. and S. 25° W., 207 ft. apart, while 12 feet water....	●	81 59	6	1840
GODREVY One flashing lt., 10 secs.	50 14. 5 24.	On the Island. A bell in fogs..	1c	120	15	1859
TREVOSE HEAD Two bright fixed lights	50 32.9 5 2.1	The lower light is 50 feet to seaward of the upper	1a 1a	204 129	20 17	1847
Bristol Channel.						
LUNDY ISLAND Upper lt., rev. in 2 min. Lower fixed light	50 10.0 4 40.3	In one tower, 96 feet high. Low light visible to W. between N.N.W. and W.S.W.	1b ●	540 470	31	1820
Bideford Harbour. Two bright fixed lts.	51 4. 4 12.	In one, S.E. ½ S., lead over bar; from ½ flood to ½ ebb. A *red* ball by day	●	86 40	14 11	1820
ILFRACOMBE One *red* fixed light	51 13. 4 7.	From the Lantern Hill (Michaelmas to Lady-day)	●	100	15	....
BURNHAM, or BRIDGEW. Upper light, intermitting Lower light, fixed	51 14.9 2 59.9	Upper tower white; lower with black streak, E. by S. ½ S., 1,500 feet apart. Upper light bright, 3½ min., obscured ½ min.	●	91 23	16 9	1832
AVON One bright fixed light	51 30.0 2 42.2	White tower, 65 feet, on the E. side. A *red* ray to N.W. ½ N.	2a	70	13	1840
ENGLISH AND WELSH GROUNDS LT.-VESSEL One br. rev. lt. 1 min.	51 26.5 2 58.	On S. side of Bristol Channel, in 5 fathoms; a *red* ball, gong, gun, &c.	●	38	10	1838
FLATHOLM One bright fixed light	51 22.5 3 7.	A white tower, 89 feet high, on the S. point	1a	156 ..	17 ..	1839 1839
USK RIVER One bright, one *red* lt.	51 32. 3 0.	W. side of entr., the *red* lt. 20 ft. below; *red* light also to N.E.	●	39	10	1821
CARDIFF	51 28. 3 10.	On the pier (intended)	●	..	..	1860
NASH POINT Two bright fixed lts.	51 24. 3 33.	White towers, 1,000 ft. apart, S.E. by E. ½ E., & N.W. by W. ½ W.	●	167 122	18 16	1832
SWANSEA HARBOUR *One red fixed light*	51 37. 3 56.	While 8 ft., black ball by day. Also two *red* or *green* lts. on new S. Docks	..	28	9	1803
MUMBLES One bright fixed light	51 34. 3 58.2	A white tower, 56 feet high, adjoining the Fort	●	114	15	1798
HELWICK LIGHT-VESSEL One br. rev. lt. 1 min.	51 31. 4 24.	In 16 fathoms, off the W. end of Sand, a *red* ball, gong, gun, &c.	●	38	10	1846
Llanelly Two fixed lights	51 40. 4 10.4	One on S. end of Breakwater, one on Whiteford Point, from ½ flood to ½ ebb	● ..	36 ..	7 ..	1850 1854

Name and Character of Light.	Lat. N. Long. W. ° ′	Description, &c.	Description of Apparatus	Height above H. W.	Visible in Miles.	Year established.
Pembrey Harbour One fixed light	51 41. 4 15.	While 10 feet water	●	35	9	....
Saunders foot, S. Pier	......	One *red* lt. or yell. ball while 8 ft.	..	15	..	....
Tenby Pier Head	......	One *red tide light*, for steamers, &c.	..	14	3	1856
CALDY ISLAND One bright fixed light	51 37.9 4 41.	A white tower, 56 feet high, S. part of Id.	●	210	19	1829
ST. ANN'S POINT. Two bright fixed lights	51 40.9 5 10.5	Two white towers, 75 and 39 ft. high, 610 ft. apart, N. by W. ½ W.	● 1a	192 159	10 17	1841
SMALLS One bright fixed light	51 43.2 5 40.1	Timber, painted *red*. A new granite tower, 141 ft. high, building, 1861, for a second light..	● 1a	70 125	13 16	1778 1861
Wales.						
S. BISHOP ROCK One br. rev. lt. 20 secs.	51 51. 5 25.	A white tower, 36 feet high....	1b	144	18	1839
CARDIGAN BAY LT.-VESS. One rev. *red* lt., 30 secs.	......	Between South Bishop and Bardsey Id. lighthouses..........	●	40	9	1860
Aberystwith	......	Two fixed lights occasionally ..				
BARDSEY ISLAND One bright fixed light	52 45. 4 47.9	A square white tower, 99 feet high	1a	129	17	1821
CAERNARVON One *red* and one bright fixed light	53 8. 4 24.7	*Red* light on Llanddwyn Point; bright light on pier head	●	50	5	1845 1858
SOUTH STACK ROCK One br. rev. lt. 2 min.	53 18.4 4 41.9	White tower, 84 feet. During fogs a rev. light is shown at 40 feet. Bell, gun, &c.	●	201	19	1809
HOLYHEAD HARBOUR One bright fixed light	53 18.8 4 37.1	On the old pier head; a *red* light also to N.N.E.; a bell and gun in fogs. Also two temporary *red* lights on jetty	●	44	11	1820
—— Breakwater Lt.-Ves.	......	One *red* lt. near E. end of works	●	20	4	1850
SKERRIES One bright fixed light	53 25.2 4 36.4	A white tower, 75 feet high, on the highest island	1a	117	15	1803
AMLWCH PORT	53 25. 4 20.	One br. light when practicable	●	28	9	1817
LYNUS or ELIAN PT. One intermitting light	53 25. 4 17.3	A white building, 36 foot high. Lt. vis. 8 secs.; eclipsed 2 secs.	●	128	16	1835
MENAI	53 18.9 4 2.3	One *red* fixed light on Trwyn-Du Point	1a	61	10	1837
AIR POINT One br. or *red* fixed lt.	53 21.4 3 19.2	A pile lighthouse; lt. is *red* only within Hoyle Sand; fog bell	●	42	9	1844
LIVERPOOL N.W.LT. SHIP Three br. fixed lights	53 27. 3 17.4	In 7½ fms. off the Horse and Helbre Channels; burns a *blue* lt. every 2 hours; a black ball. In fogs, a bell and gong alternately ..	●	36	10	1814

Name and Character of Light.	Lat. N. Long. W. ° ′	Description, &c.	Description of Apparatus	Height above H. W.	Visible in Miles.	Year established.
Hoylake Two br. fixed lights	53 23.7 3 10.7	In one, S.W. by S., 1,200 feet apart, near the Church	●	55 31	13 11	1763
BIDSTON One bright fixed light	53 24. 3 4.4	A stone tower, 68 feet high, on the hill	●	228	23	1771
Leasowe One bright fixed light	53 24.8 3 7.5	On the shore, between the Mersey and Dee	●	94	14	1763
BLACK ROCK One rev. lt. 1 minute br. twice; *red* once	53 26.6 3 2.	A white tower, 94 ft. high. Also a *fixed light*, while 11 ft., down Rock Channel and up Mersey	●	61	14	1830
Crosby Light-Vessel One yellow fixed light	......	In 44 feet off the N.E. elbow of the Burbo Bank; a *red* ball ..	●	29	8	1840
Formby Light-Vessel Two fixed lights	53 31.7 3 10.8	At the elbow of Crosby and Queen's Channels, in 25 feet	●	30 24	8	1834
Crosby Lighthouse One *red* fixed light	53 32.3 3 3.9	Near the Point	●	95	12	1856
Ribble River Upper, br.; lower, *red* lt.	53 44.6 3 1.1	In the same tower, on Stanner Point..........................	4a ..	72 35	12 9	1848
Lytham Harbour	53 44.2 2 58.5	One fixed light	●	..	..	....
Fleetwood Two bright fixed lights	53 55.6 3 0.4	N. and S., 850 feet apart; shown while 9 feet	● ..	90 30	13 9	1841
Wyre River One bright fixed light	53 57.2 3 1.8	A pile lighthouse, on N.E. of N. Wharf Bank; fog bell	..	30	10	1840
Lune River Two bright fixed lights	53 59. 2 53.	On Cockerham Point and Plover Scar Rock, while 8 feet water	● ●	54 20	9	1847
Clark Wharf Spit One fixed *red* light	54 1.3 3 0.	On red piles. A ball by day; a *green* light while 8 ft. Fog bell	●	30	6	1854
Poulton Pier	54 4.3 2 52.5	One fixed bright light	6a	48	8	1851
WALNEY ISLAND One br. rev. lt. 1 min. One *red* fixed light	54 2.9 3 10.6	On the S. point. In one, N.W. by W. ¾ W., 340 yards apart. A *red* lt. also on Railway Viaduct	●	70	13	1790
ST. BEES HEAD One bright fixed light	54 30.8 3 38.	A white tower, 43 feet high	●	333	23	1821
Whitehaven 1. One rev. lt., 2 min. 2. *Two fixed lights*	54 33.2 3 35.8	1. A white tower, 37 ft. high, on W. pier. 2. *Red* lt. on Old Quay while 9 feet. *Blue* lt. on N. pier	..	47	11	1823
Harrington Tide Light One fixed light	54 37. 3 34.	On the pier head, while 8 feet water. Red ball while 8 feet	●	44	11	1848
Workington Tide Lights Two fixed lights	54 39. 3 35.	On the ends of St. John's and Wooden piers, E. and W., 330 feet apart, while 8 feet water	..	53	11	1825

Name and Character of Light.	Lat. N. Long. W. ° ′	Description, &c.	Description of Apparatus	Height above H. W.	Visible in Miles.	Year established.
MARYPORT One br., one *tide light* One *green*, one *red* light	54 43. 3 30.3	Fixed lt. on Outer pier head. *Tide light*, while 8 ft., on Inner pier. *Red* lt. on Starboard side, and *green* lt. on North Tongue....	4a ..	51 ..	12 10	1796 1856
SOLWAY LIGHT-VESSEL One *red* light	54 48. 3 32.	In 4½ fms. in Robin Rigg Channel. Black ball; a bell in fogs....	●	25	6	1841
LEE SCAR One bright fixed light	54 51.8 3 24.7	On piles on the rocks. A bell in fogs	..	25	6	1841
SKINBURNESS One *red* light	54 52.5 3 23.	A white wooden building, 32 ft. high, on Silloth Point	..	40	9	1841
Carlisle Port Tide Light	......	A lamp on the pier head	..	..	..	1841
Isle of Man.						
POINT OF AYR A rev. lt., br. and *red*, 2 min.	54 24.9 4 22.	A stone tower, 90 feet high, ½ mile S.W. of the Point	●	103	15	1818
Peel Harbour	......	Bright lt. on E. side of entrance	..	21	8	1811
CALF OF MAN Two br. rev. lts., 2 min.	54 3. 4 50.	Two stone towers, 560 feet apart, N.E. ½ E., and S.W. ½ W. ..	● ..	375 282	25 23	1818
PORT ST. MARY	......	One bright light on pier head ..	●	25	9	1812
CASTLETOWN HARBOUR	......	One fixed lt. on New pier head	..	32	8	1849
DERBY HAVEN Two fixed lights	54 5. 4 36.	On Fort Island, and S.W. end of Breakwater	.. ..	50 14	6 2	1850
DOUGLAS One bright fixed light	54 9. 4 28.	A brown stone tower, 65 feet high, on Douglas Head	..	104	15	1832
DOUGLAS HARBOUR	......	One fixed lt. on the N. pier head	..	34	6	1796
RAMSEY HARBOUR	......	One fixed *red* lt. on S. pier head	●	28	10	1845
BAHAMA BANK L.V. Two bright fixed lights	54 20. 4 12.	In 11 fathoms, on the S.E. part of the Bank	● ..	20 33	10	1848

Name and Character of Light.	Lat. N. Long. E. ° ′	Description, &c.	Description of Apparatus	Height above H. W.	Visible in Miles.	Year established.
HARWICH Two fixed lts.; in one N.W. by N.	51 56.6 1 17.4	A lower *red* lt. in high tower vis. S. of entrance, becomes white in fairway (see Directions).	●	69 25	13 10	1818
DOVERCOURT Two lighthouses	......	Building on the extreme point, to supersede present Harwich lts.	..	..	..	1861
Landguard Fort	......	A *red* light outside, white within the entrance	6a	..	..	1848
CORK LIGHT-VESSEL One br. rev. lt. ½ min.	51 56. 1 23.	In 4 fathoms, near the Cork Ledge	●	38	10	1840
SHIPWASH LT.-VESSEL One bright fixed light	52 1.5 1 38.	In 9½ fathoms, off N.E. end of the Sand	●	38	10	1837
ORFORDNESS Two bright fixed lights	52 5.6 1 35.2	Towers *red;* in one S.W. by W. and N.E. by E., 1439 yards apart. High light to South...	1a ●	83 63	14 13	1792
Pakefield	.. :..	*Red* light; only shows to S. ¾ E.	●	68	9	1832
LOWESTOFT Two bright fixed lights	52 29.2 1 45.5	Towers white; in one N. ½ E. and S. ½ W., 1013 yards apart. High light to North	● ●	119 45	16 11	1609
STANFORD LIGHT-VESSEL Two bright fixed lights	52 29. 1 47.2	Near Mid channel in 6 fathoms; lights horizontal; two *red* balls	●	23	9	1802
ST. NICHOLAS GAT LT.-V. One bright, one *red* lt.	52 35.5 1 47.	In 6 fms. at N. end of Kettle Bottom Sd.; one *red* ball; lts. at unequal heights	a ●	40 12	10 4	1827
Yarmouth or *Gorleston* One *red* fixed light	52 34.4 1 44.3	A *red* flag by day, and the light shown during the flood tide ..	●	..	2	1852
COCKLE LIGHT VESSEL One brt. rev. lt. 1 min.	52 41.5 1 47.	In 6½ fathoms at E. side of N. entrance of Cockle Gat	●	36	10	1844
WINTERTON NESS One bright fixed light	52 43. 1 41.5	An octangular *red* tower 61 feet high	●	52	14	1790
NEWARP LIGHT-VESSEL Three br. fixed lights	52 45. 1 53.	Lts. triangular. In 19 fms. at N. end of Sand. Three *red* balls	●	38 28	10	1791
HASBOROUGH Two bright fixed lights	52 49. 1 32.	In one N.W. ½ W. (½ mile apart) leading lts. for Hasboro' Gat	●	137 100	17 15	1791
HASBOROUGH LT.-VESSEL Two bright fixed lights	52 58. 1 36.	In 15 fathoms near N. end of Sand; lights horizontal......	●	38	10	1832
LEMAN & OWER LT.-VES. Upper revol. 1 min., low fixed light	53 8.6 2 1.	In 16 fms. between the Sands; lts. at unequal heights; two *red* balls	●	38 27	10	1840
CROMER One br. revol. 1 min.	52 55.4 1 19.1	Near the Cliff, a white tower 59 feet high	●	274	23	1719 1833
HUNSTANTON One bright fixed light	52 56.9 0 29.8	The light is *red* to S.E. by E. ½ E. over the Roaring Middle Sand	2a	109	16	1665

Name and Character of Light.	Lat. N. Long. E. ° '	Description, &c.	Description of Apparatus	Height above H. W.	Visible in Miles.	Year established.
LYNN WELL LT.-VESSEL One quick revol. light	53 1.7 0 25.	In 27 fathoms off the hook of the Long Sand	●	34	10	1828
DUDGEON LIGHT-VES. One bright fixed light	52 15. 0 56.	In 9 fathoms near S. side of the Shoal	●	38	10	1736
SPURN LIGHT-VESSEL One br. rev. lt. ½ min.	53 34. 0 13.	In 9 fathoms off the Point.......	●	38	10	1820
SPURN POINT Two bright fixed lights	53 34.7 0 7.2	In one N.W. ½ N. (158 yards apart). The low light to N.W.	1a 4a	93 54	15 12	1776 1851
RIVER HUMBER						
Bull Sand Lt.-Vessel	......	One bright fixed lt. off Spurn Pt.	●	21	10	1832
	W. Lon.					
Stallingborough Ferry	......	One bright fixed lt. to W.S.W.	●	..	..	1849
Killingholm Three br. fixed lts.	53 39. 0 12.	Lights in one N.W. lead up the river, and when S. by W. lead down	●	68 36	11	1836 1852
Paull.	......	One bright fixed light	●	36	7	1836
Hebbles Light Vessel One *red fixed light*	53 44. 0 16.	In 5 fms. on S. side of Channel, near Hull	●	16	5	1839
Bridlington One bright fixed light	54 5.2 0 11.7	On the North Pier-head while 9 feet water..................	..	24	8	1852
FLAMBORO' HEAD One revol. light, 2 min. bright, bright and *red* alternately	54 6.9 0 4.8	A white tower 87 feet high. Bearing N.N.E. clears N. end of Smithic..................	●	214	20	1806
Scarborough Tide Light One fixed light, *red* to seaward	54 17. 0 23.	While 10 feet water; on Vincent Pier. A ball by day........	..	58	13	1806
HIGH WHITBY Two bright fixed lights	54 28.7 0 34.2	In one S. by E. ¾ E. (258 yards apart). A *red* light from N. tower over the Scar	1a	240 ea.	23	1858
WHITBY HARBOUR *One green tide light* One *red* or green light	54 30. 0 37.	*Green* tide light on W. Pier from 2 hours flood to 2 hours ebb. E. Pier light *red* to S. but *green* to N. of Rock buoy..........	● ●	83 54	13 10	1831 1855
TEES BAY						
BRAN SAND High br., low *red* lt.	54 38. 1 13.	Wooden towers shifted occasionally. In one lead over the bar	●	53 38	11 10	1839
Care Sand Lt.-Vess.	......	One fixed light. There are 8 small lights up the Tees	●	20	7	1836
SEATON High br., low *red* lt.	54 40. 1 12.	In one N.W. by W. (118 yards apart).	●	89 34	13	1839
HARTLEPOOL High bright, *low red tide light*	54 41.8 1 10.4	On the Heugh. The *red* tide lt. from half flood to half ebb....	1a 4a	84 62	15 4	1847

Name and Character of Light.	Lat. N. Long. E. ° ′	Description, &c.	Description of Apparatus.	Height above H. W.	Visible in Miles.	Year established.
Hartlepool Old Harbour	……	*Red* light on Pier, two *red* lights on Quay …………………		..	..	1836
—— *West Harbour*	……	*Green* lt. on N. Pier, two *red* lts. in one lead in while 10 ft. water	..	..	..	1855
SEAHAM Upper bright fixed lt., low *red* rev. lt. ½ min.	……	In one stone tower 58 feet high on Red Acre Point…………	5a 6	94 49	14 11	1848 1857
Seaham Harbour	……	*Red* tide light, when practicable	●	..	..	1846
SUNDERLAND One bright, one *red* lt. on N. Pier, *one bright tide light* on S. Pier	54 55.1 1 21.6	*Tide light* from ½ flood to ½ ebb, a *green* light below it shows danger ……………… …	3a 5a	73 58	14 4	1802 1857
TYNEMOUTH One br. rev. lt. 1 min.	55 1.1 1 24.9	A square white tower 79 ft. high, near Priory Ruins in the Castle	●	154	18	1802
Tyne Tide Lights	55 0. 1 26.	At N. Shields, from ½ flood to ½ ebb; in one W. by N., 240 yards apart ………………	●	123 77	16 13	1808
Blyth, two bright Tide Lts.	……	While 8 ft. water; in one N. by W. ½ W. ………………	●	11	48	1783
COQUET ISLAND One bright fixed light	55 22. 1 32.	A *red* ray toward Hanxley Pt. buoy, and *red* over the Boulmer Rocks …………………	1a	83	14	1841
Warkworth red Tide Lt.	……	While 10 ft. water. On S. Pier	..	..	1	1848
FARN ISLAND Upper light rev. ½ min., lower fixed	55 36.9 1 58.9	Two white towers in one N. by W. ½ W., 187 yards apart ..	●	87 45	15 12	1776
LONGSTONE One br. rev. lt. ½ min.	55 39. 1 37.	Red tower on the Rock ………	●	75	14	1826
BERWICK ON TWEED Upper br., *lower red lt.*	55 45.9 1 58.9	Low *red* lt. while 10 feet on Bar. On the Pier-head …………	●	44 28	11 8	..

Name and Character of Light.	Lat. N. Long. W. ° ′	Description, &c.	Description of Apparatus	Height above H. W.	Visible in Miles.	Year established.
Eyemouth	......	One *red* fixed light	..	..	..	1857
ST. ABB'S HEAD One bright fixed light	55 55. 2 8.	Building (1860)	1a	..	..	1860
DUNBAR *Old Harbour* ——— *Victoria Harbour*	56 0. 2 30.7	One fixed br. light at each, from July to October	..	..	..	1857
INCHKEITH One br. rev. lt. 1 min.	56 2. 3 8.	A white tower, 45 feet high	2b	220	18	1804
FISHERROW One fixed light	......	On the pier head; all night, except in moonlight	●	20	5	1839
Leith *Red* light on E. pier *White* light on W. pier	55 59. 3 10.	A *green* lt. under the *white* one on W. pier while 8 ft.; the *green* changed to *red* when Dock gates are open	5a	28	10	1829
Newhaven	......	One bright light on the pier	..	20	5	
GRANTON	......	One *red* light on pier head	..	33	6	1845
GRANGEMOUTH One fixed light	......	At the entrance of the River Carron	●	33	10	1847
INVERKEITHING	......	Two *red* lights on W. Quay	..	..	..	1856
Burntisland East Pier ——— *Ferry Pier* A fixed light on each	56 4. 3 14.	Also a small *red* lt. at Newhalls, and a *white* one at Queensferry, for passage boats only	..	13 28	8 ..	1845 1853
KIRKCALDY One fixed light	56 7. 3 9.	On E. pier head. *Red* to seaward; *white* when Harbour is open	..	29	8	
Buckhaven	......	A *white* light on E. pier head	a	17	9	1854
ST. MONAN One *red*, and one br. lt.	56 12.5 3 46.3	One on pier head; the other on a house	..	20	..	1855
PITTENWEEM Three fixed *red* lights	56 13. 2 43.5	Two on pier head, and one on a building. Not lighted between May 15 and July 15. In bad weather a br. gas lt., 50 feet high, vis. 7 miles, is shown while 6 feet	.. ..	25 72	6 6	1853
ANSTRUTHER One *red* and one *green* lt.	56 13.3 2 41.8	N.E. ½ N. and S.W. ½ S. from each other. Aug. to April	..	20	4	1848
CELLARDYKE One fixed *red* light	......	On a house, in W. of Harbour; only while boats are out	......	......	......	......
ISLE OF MAY Two brilliant fixed lts.	56 11.1 2 33.3	On the summit of the island, N.E. side; N.N.E. ½ E., and S.S.W. ½ W., 750 feet apart	1a ●	240 110	21 15	1816 1844
BELL ROCK One rev. light, bright and *red* alternately, every 2 minutes	56 26.1 2 23.1	A tower, 117 feet high; on the Bell Rock, at 10 feet below high water. A bell is sounded every half minute in fogs	●	90	14	1811
ST. ANDREW'S Two fixed lights	56 20. 2 47.	On the pier head, and a turret in Cathedral wall	● 5a	30 100	6 5	1825 1849

Name and Character of Light.	Lat. N. Long. W. ° ′	Description, &c.	Description of Apparatus	Height above H. W.	Visible in Miles	Year established.
BUDDONNESS or TAY Two brilliant fixed lts.	56 28.1 2 44.9	The lts. in one, N.N.W. ¾ W., and S.S.E. ¾ E., 374 yards apart, lead into the Tay	● ●	71 45	10 8	1820
PORT ON CRAIG Two fixed lights	56 27. 2 49.	Leading lts. up the Tay. W.N.W. Northerly, and S.S.E. Southerly, 1,700 yards apart. A bell in fogs	● ●	80 35	16 11	1820 1845
NEWPORT Two fixed lights	56 26. 2 57.	On the W. Ferry pier, N.N.E. and S.S.W., 63 yards apart ..	●	10 16	7 8	....
DUNDEE HARBOUR Two fixed *red* lights	......	On Mid. and E. piers, N.W. ¾ W., and S.E. ¾ E., 130 yards apart	●	10 12	7	1827
ARBROATH One *red* fixed light	56 33. 2 35.	On the N. pier, when vessels enter. An occasional *bright flash* is a warning to keep off.	●	24	8	1826
MONTROSE Two fixed *red* lights	56 42. 2 27.	On the N. side of entrance, N.W. by W. ½ W., and S.E. by E. ½ E., 303 yds. apart	●	60 35	10 11	1818
STONEHAVEN One br., one *red* fixed lt.	56 58. 2 12.	W. by N. ½ N., and E. by S. ½ S.; on the inner side of Harbour	●	18 24	6	1839
GIRDLENESS Two bright fixed lights	57 8.2 2 3.	In one tower	1a ●	185 115	19 16	1833
Aberdeen One bright fixed light Two *red* (or *green*) fixed lights	57 8.5 2 4.1	On N. pier head, from half flood to high water. When entrance is safe the two lts. are *red:* when ships cannot enter, *green*	.. .. ..	40 47 30	8 3	1842
BUCHANNESS One flashing lt., 5 secs.	57 28.2 1 46.1	A stone tower, on the Ness	●	130	16	1827
PETERHEAD One br., and one *red* lt.	57 30. 1 46.	*White* on elbow of W. Pier in S. Harbour; and *red*, on W. Pier, in N. Harbour..............	a a	24 26	10 10	1834 1849
FRASERBURGH Two fixed *red* lights	57 41.5 2 0.	On pier head, and Middle Pier; S.E. by E., and N.W. by W., 228 ft. apart, from July to April	..	36	5	1841
KINNAIRD HEAD One bright fixed light	57 42. 2 1.	A stone tower, 76 feet high, on the Head	1a	120	15	1851
MACDUFF One *red* fixed light	57 40. 2 30.	On the W. pier head	●	25	6	1829
BANFF Two *white*, one *red*, lts.	57 40. 2 31.	One *white* light on N. pier head, and one high *white* lt., with lower *red* lt. in the upper part of the New Harbour	..	28	8	1851
Elgin and Lossiemouth	......	One *green* light on S. pier head..	..	30	..	1858
COVESEA SKERRIES One rev. lt. 1 min.	57 43.2 3 20.3	On Craig Head. It is *red* from S. E. by E. ½ E., to S.E. ½ S. The rest is bright	1b	160	18	1846

Name and Character of Light.	Lat. N. Long. W. ° ′	Description, &c.	Description of Apparatus	Height above H. W.	Visible in Miles.	Year established.
CHANONRY POINT A bright fixed light	57 34.5 4 5.	A tower, 42 feet high, on the Point	4a	40	11	1846
CROMARTY POINT One *red* fixed light	57 41. 4 2.	A tower, 42 feet high, on the Point	4a	50	9	1846
TARBET NESS One *interm.* lt., 3 min.	57 51. 3 48.	Bright 2½ min., eclipsed ½ min.; within Moray Frith it is visible always	●	175	18	1830
Little Ferry Two fixed *white* lights	57 56. 4 0.	Two Lanterns; one on Point; N.W. ½ N., and S.E. ½ S., 150 feet apart	.. ..	19 14	4 3	....
Latheronwheel One fixed *white* light	58 16.1 3 22.9	On S. Head, at the end of fishing season	..	..	..	1852
WICK or PULTENEY TOWN One *red* light	58 26. 3 5.	On the N. pier head, during July and August	a	35	8	1851
NOSS HEAD One rev. lt. half min.	58 28.6 3 3.1	From N.E. ¾ N. to W.N.W. the lt. is *red*; the rest, to seaward, is bright	1b	175	20	1849
DUNNET HEAD One bright fixed light	58 40.3 3 22.3	A stone tower on the northernmost point of Scotland	1a	346	23	1831
PENTLAND SKER. Two bright fixed lights	58 41.4 2 55.4	Two stone towers, 118 and 88 ft. high, N.N.E. and S.S.W., 100 feet apart	1a ..	170 140	18 16	1794
HOLBURN One fixed light	58 37.5 3 31.8	Building on the Head	..	..	..	1860
Orkney Islands.						
CANTICK One br. rev. lt., 1 min.	......	A white tower, 73 ft. high, on the Head, Hoy Id.	2b	116	16	1858
HOY SOUND High lt., *red* or *white* Low light, bright	58 56.1 3 16.5	The low lt. (br.) is on N.W. Pt. The high lt. is *red* toward Hoy Sound; *white* between S.S.E. and W.S.W. The towers stand S.E. ½ E., and N.W. ½ W., 2,237 yards apart	● a	115 55	10 7	1851 1851
KIRKWALL One bright fixed light	58 59.2 2 57.5	On the pier head, from August to April	●	20	9	1854
START POINT One fixed bright light	59 16.6 2 22.4	A stone tower, on E. Point of Sanda Island	4a	100	15	1806
N. RONALDSHA One br. flash. lt. 10 secs.	59 23.2 2 23.6	A brick tower, 139 feet high, on N. Point	a	140	18	1854
Shetland Islands.						
SUMBURGH HEAD One bright fixed light	59 51. 1 16.	A stone tower, 55 feet high, on the S. Point of Zetland	●	300	22	1812
BRESSAY One rev. *red* and *white* lt., 1 min.	60 6.1 1 7.5	Tower, 58 feet high, on E. side of entrance to Lerwick	2b	105	15	1858

Name and Character of Light.	Lat. N. Long. W. ° ′	Description, &c.	Description of Apparatus	Height above H. W.	Visible in Miles.	Year established.
WHALSEY SKER. One br. rev. lt., 1 min.	60 25.4 0 44.	A white tower, 98 feet high, on Bound Skerry	1b	145	18	1854
NORTH UNST One bright or *red* lt.	60 51.3 0 53.	*Red* between S.S.E. ½ E., and S.E. by E. ½ E. A white tower on N. part of Island	1a	235	21	1854
Cape Wrath One revol. lt., 2 min.	58 37.5 5 0.	*White* and *red* alternately	●	400	23	1828
S. Rona One flash lt., 12 secs.	57 32. 5 58.	N.E. Point of Island	2o	222	20	1857
Kyle Akin, Loch Alsh One bright fixed light	57 16.5 5 45.	S.W. Point of Gillean Island	..	53	11	1857
Oronsay Island One bright fixed light	57 9. 5 47.	S.E. part of Sleat Sound	..	58	12	1857
Hebrides Islands.						
Butt of Lewis	58 31. 6 16.	Building on N. Point	..	..	..	1860
Stornoway One fixed, 1 rev. light	58 11.5 6 22.1	200 yards apart; rev. every ½ min., on Arnish Point	.. 2b	27 56	2 12	 1852
Monach or Hyskeir	57 31.6 7 41.6	Building on W. Island	1a	..	..	1860
GLASS ISLAND One fixed bright light	57 52. 6 33.	N.E. Point of Island, Harris Isles	1a	130	17	1789
Ustrenish One bright or *red* lt.	57 15. 7 10.	E. side of S. Uist. *Red* vis. between S.S.W. and N.E. by the S. & E.	1a	176	18	1857
BARRA HEAD One intermitting light	56 48. 7 38.	Vis. 2½ min. and dark ½ min. On top of Bernera Island	●	680	33	1833
SKERRYVORE One rev. light, 1 min.	56 19.3 7 6.5	On the Rock	1o	150	18	1844
ARDNAMURCHAN One fixed bright light	56 43.6 6 13.5	On the Point	1a	180	18	1849
Sound of Mull One fixed light	56 38. 6 4.	*Red* lt. N. to Sea; *green*, towards Rocks; *white*, towards Mull Sd.	..	55	12	1857
LISMORE One fixed bright light	56 27.3 5 36.3	On Musdile Island	●	103	15	1833
LOCH EIL One fixed bright light	......	On Corran Point. Lt. is *red* between N.E. by E., and S.W. by W. ¾ W.	..	36	10	1860
Oban	......	A Lantern on the Pier	..	..	..	1858
Phladda Island	56 19.0 5 39.5	One fixed br. lt., shows *red* from N.	..	42	11	1860
Crinan Canal	......	One *red* light on E. side	..	25	4	1851

Name and Character of Light.	Lat. N. Long. W. ° ′	Description, &c.	Description of Apparatus	Height above H. W.	Visible in Miles	Year established.
Iron Rock or Sgeir Maoile	55 52.5 5 50.	Proposed, on the Rock	..	..	..	1860
Islay Sd. Rhu Val One fixed *red* or *white* light	55 56.1 6 7.5	N. Point of Islay Island	2a	147	15	1859
Islay Sd. M'Arthur's Head	55 45.8 6 2.8	Building	..	..	..	1860
RHYNNS OF ISLAY One flash. lt., 5 secs.	55 40.3 6 30.	Oversay Island, off S. W. Point of Islay	●	150	17	1825
Port Ellen One fixed bright light	55 36. 6 12.	On Carraig Fadda Point, W. entrance	..	45	11	1853
MULL OF CANTYRE One fixed bright light	55 19. 5 49.	S.W. Headland of Cantyre	●	297	22	1787
SANDA ISLAND One fixed *red* light	55 16.5 5 34.9	On the Ship Rock	1a	165	15	1850
Davar Island One br. rev. lt., ½ min.	55 25.7 5 32.2	Stone tower, 65 feet high, on E. part	2b	120	17	1854
Campbellton	......	On Old pier head. *Red*, when bearing N.W.	..	18	2	....
Ardrishaig	......	A fixed *white* light on Pier head	..	25	4	1850
PLADDA Two fixed bright lts.	55 26.0 5 7.1	One 52 ft. above the other. On Id. off S.E. Pt. of Arran Id.	.. ●	130 77	17 14	1790
CLYDE RIVER						
Cumbrae One fixed bright lt.	55 43.3 4 58.	W. side of Little Cumbrae Id.	●	115	15	1793
Toward One br. rev. lt., 1 m.	55 51.7 4 59.2	On the Point	●	55	11	1812
Cloch One fixed bright lt.	55 56.6 4 52.6	On the Point	●	76	..	1797
Greenock Two *red*, and 1 *white* light	55 57. 4 45.	The *red* lts., 1 mile N.N.W. of Custom House, 140 yds. apart, W.S.W. ¾ W., and E.N.E. ¾ E. The *white* light in front of Custom House	.. ..	40 26	.. 4	1834 1829
Port Glasgow	......	One fixed *red* light on W. Quay	..	18	3	....
Cardross One fixed *red* light	......	On the Pillar Bank	..	22	4	1849
Bowling Bay	......	Small lt. at Firth of Clyde Canal	..	12	2	1849
Donald's Quay	......	A *red* light, 200 feet from end	..	26	..	1849
Broomielaw	......	A Bude light	..	..	..	1844
Auchenlech	......	A *white* lt., ¾ m. above Pt. Glasgow	..	..	..	....
Garmoyle Light	......	A floating lt., 3 miles above Pt. Glasgow	..	..	..	....
Dickies Light	......	A *white* lt., 1 mile above Dumbarton	..	..	..	....

Name and Character of Light.	Lat. N. Long. W. ° ′	Description, &c.	Description of Apparatus	Height above H.W.	Visible in Miles.	Year established.
Ardrossan	55 38.4 4 49.5	One *red* light on Breakwater ..	a	25	5	1856
Saltcoats	55 37.9 4 47.4	Bright bull's eye in *red* glass plate, on Pier	..	26	6	1840
TROON HARBOUR One br. revol. and 1 fixed *red* light	55 33. 4 41.	Revolves 40 *secs.* bright, 20 secs. hidden. N.E. ½ N., and S.W. ½ S., 350 yards apart	.. ..	35 35	9 6	1827 1848
AYR HARBOUR Two white, 1 *red tide*, fixed lights	55 28.3 4 38.4	A *red* and a br. lt. in one building. S.E. by E. ½ E., and N.W. by W. ½ W., 283 yards apart. *Red* light while 8 feet on Bar	.. .. ..	12 35 53	4 10	1790 1826
LOCH RYAN One fixed bright light	54 57.7 5 2.0	On Cairn Ryan Point	4a	46	10	1847
CORSEWALL One *red* and *white* rev. 2 min.	55 0.5 5 9.5	A white tower, 110 ft. high, on W. side of entrance to Loch Ryan	●	112	15	1817
Port Patrick One fixed bright light	54 50.3 5 7.0	S.E. angle of Harbour	..	37	8	1856
MULL of GALLOWAY One intermitting br. lt.	54 38.1 4 51.3	On S. Point. Visible, 2½ min.; invisible, ½ min.	●	325	23	1830
LITTLE ROSS One flash. light, 5 secs.	54 46. 4 5.	On the Island	1o	175	18	1843
SOUTHERNESS One fixed bright light	54 52.4 3 35.5	On the Point	..	50	11	1805
Annan River One fixed *white* light	54 57.7 3 16.	On Annan Foot, from half flood to half ebb	..	..	..	1841

Name and Character of Light.	Lat. N. Long. W. ° ′	Description, &c.	Description of Apparatus.	Height above H. W.	Visible in Miles.	Year established.
FASTNET. One rev. light, 2 min.	51 23.3 9 36.4	On the summit of the Rock	1b	148	18	1854
KINSALE One bright or *red* light, and one bright light	51 41.8 8 15.2	The lt. on S. Point of Old Head is *red* over the Horse Rock, and br. to seaward. Br. lt. on Ft. Charles, E. side of Harbour..	1a ●	236 98	21 14	1853 1804
CORK HARBOUR, or QUEENSTOWN						
ROCHE POINT One *red* or br. lt.	51 47.6 8 15.2	*Red* to Seaward; br. towards the Harbour. (Revolv. in 1861?).	●	92	4	1817
SPIT BANK One *red* light	51 50.7 8 16.4	Off Queenstown, on piles, in 9 ft. water, on E. elbow of Bank..	4a	32	8	1853
MEELOUGH SPIT One *red* light	......	On piles, 100 ft. from the Channel	a	25	3	....
BALLYCOTTIN Flashing light, 10 secs.	51 49.5 7 59.	On the Outer Island	1c	195	18	1850
YOUGHAL One bright light	51 56.5 7 50.5	On W. side of entrance........	3a	78	6	1852
MINEHEAD Interm. light, 1 min.	51 59.5 7 35.1	On S. side of Head. Br. 50 secs.; suddenly dark, 10 secs.	1a	285	21	1850
DUNGARVAN *Red, green*, and br. lt.	52 4.4 7 33.1	On Ballinacourty Pt. *Red* over Carrickapane Rock; *green*, over Rocks from Ballinacourty Pt.; and bright in other directions	3a	52	10	1858
WATERFORD HOOK TOWER One bright light	52 7.4 6 55.9	E. side of entrance. Fog bells	●	152	16	1859
DUNMORE PIER HEAD One *red* light	52 9. 6 59.5	W. side of entrance. It is bright N. of Pier..................	..	..	..	....
DUNCANNON FORT Two fixed lights	52 13.2 6 56.	In one tower. The lower is a *tide light*	●	53	10	1803
DUNCANNON N. One fixed light	......	Half mile N.N.E. ¾ E. of the Fort	●	128	16	1838
SALTEES LT. VESS. Two fixed bright lights	52 2.4 6 38.2	In 32 fathoms, off Coningbeg Rock	●	38 28	10	1824
TUSKAR *Red* and br. rev. light	52 12.1 6 12.3	A flash of 10 secs. every 2 min.; bright, br. and *red* alternately	●	101	15	1815
East Coast.						
BLACKWATER BANK LT. VESS. One fixed light	52 29.5 6 7.	In 10 fathoms, on N.E. part of Bank	●	33	9	1860
ARKLOW LT. VESS. One br. rev. lt., 1 min.	52 42. 6 0.	In 22 fathoms, on S. end of Bank	●	39	10	1860
WICKLOW Two fixed br. lights	52 57.8 6 0.1	In one, N.W. by W. ¾ W., 180 yards apart	●	250 121	21 16	1860 1818

Name and Character of Light.	Lat. N. Long. W. ° ′	Description, &c.	Description of Apparatus	Height above H. W.	Visible in Miles.	Year established.
DUBLIN BAY KISH LT. VESS. Three bright lights	53 19. 5 56.3	In 10 fms., off N. of Kish Bank. The lts. are set triangularly ..	●	38 20	10	1811
Kingstown E. Pier One rev. lt., ½ min.	53 18. 6 9.	*White* and *red* light alternately. A fog bell.................	●	41	9	1822
Kingstown W. Pier One fixed *red* light	......	....	●	36	2	1845
POOLBEG Two bright lights	53 20.5 6 9.3	At Mouth of R. Liffy. *Lower lt.* from half flood to half ebb ..	●	68	12	1768
BAILEY One bright light	53 21.7 6 3.3	On S.E. point of Howth Penins. A fog bell..................	●	134	15	1813
Howth E. Pier One *red* light	53 24. 6 4.	On Pier Head	●	43	11	1818
BALBRIGGAN One bright light	53 36.8 6 11.	On Pier, S. of entrance	●	42	10	1769
ROCKABILL One br. and *red* flash. lt.	53 35.7 6 0.5	Flash every 12 secs.; bright seaward, *red* to Westward	1b	148	18	1860
DROGHEDA Three fixed br. lights	52 43. 6 15.	On Sandhills, S. of R. Boyne. Changeable, as sandbanks shift	●	..	6	1842
DUNDALK One flash. lt., 15 secs.	53 58.7 6 18.	*Red* towards W. side of Dundalk Bay. *White* to seaward	4b	38	9	1855
CARLINGFORD HAULBOWLINE ROCK Two bright lights	54 1. 6 5.	In same tower. *Lower lt.* from half flood to half ebb. Fog bell	●	101	15	1823
GREENORE POINT	......	One revolving light., 45 secs.	●	29	9	1830
DUNDRUM BAY One intermit. *red* light	54 13.1 5 40.	On St. John's Pt. *Red* 45 secs., dark 15 secs.	1b	62	12	1844 1860
Ardglass Harbour	......	One fixed *red* light	●	18	6	1851
SOUTH ROCK One rev. br. lt., 1½ m.	54 23.9 5 25.1	A white tower, 60 feet high, on the Rock	●	52	12	1797
Donaghadee Pier Head One *red* or br. fixed lt.	54 38.6 5 32.	*Red* to seaward; bright towards Harbour and Belfast Bay	●	56	12	1826
COPELAND One fixed bright light	54 41.7 5 32.	A white tower, 52 feet high, on Small Copeland Island	●	131	16	1796
BELFAST BAY One *red* lt., and others	54 39. 5 53.	*Red* lt. on Hollywood Bank; *green* lt. also on the Bank; 3 more *green* lts. towards Belfast; and a *red* lt. S.W. of Stone Beacon	5a ●	27	5	1848
Larne Lough	......	One bright light on Farres Point	●	42	11	1839
MAIDENS Two fixed bright lts.	54 55.8 5 45.	Towers white, with red belt. In one, N.W. by W., 640 yds. apart	●	94 84	14 13	1828
RATHLIN One interm., 1 fixed lt.	55 18.2 6 10.7	Upper lt. intermt., br. 50 secs.; dark 10 secs. Lower lt. fixed. *Red* lt. over Carrickvanan Rock	1b	243 182	21	1856

Name and Character of Light.	Lat. N. Long. W. ° ′	Description, &c.	Description of Apparatus	Height above H. W.	Visible in Miles.	Year established.
LOUGH FOYLE Inishowen Two fixed bright lts.	53 13.6 6 55.6	On Dunagree Point. In one, E. and W., 153 yards apart	●	67	13	1837
Red Castle One fixed bright lt.	......	On piles, on outer edge of Ridge Shoal....................	..	25	..	1852
White Castle One fixed bright lt.	......	On piles, E. side of Channel....	..	26	..	1848
Ture One fixed bright lt.	......	On piles, S.E. side of Channel ..	..	25	..	1850
Cunnyberry One fixed bright lt.	......	On piles, N.W. side of Channel	..	25	..	1848
Culmore Point	......	A Lantern on a Mast...........	..	45	..	1848
Culkeeragh	......	Bright light E. side of entrance	..	50	..	1851
Boom Hall	......	One fixed *red* light	..	12	..	1859
Ross Bay Lt. Vessel	......	One fixed bright light	..	20	..	1859
Rock Mill	......	One fixed *red* lt., near the Mill	..	15	..	1859
INNISTRAHUL One br. rev. lt., 2½ min.	55 25.9 7 13.6	A white tower, 41 feet high. On N.E. part of Island	●	181	16	1812
LOUGH SWILLY One *red* or bright light	56 16.6 7 37.9	On Fannet Point; *red* seaward, bright towards the Lough	●	90	14	1816
TORY ISLAND One fixed bright light	55 16.4 8 15.	On the N.W. Point of Island ..	1a	125	16	1832
Aranmore Island One flashing br. light	55 0.9 8 33.6	Building (1861) on N.W. Point	2b	..	..	....
RATHLIN-O-BIRNE One flash. lt., 20 secs.	54 39.8 8 49.9	*Red* towards Mainland and Sound. To be a fixed light after Aranmore is lighted	2b	116	16	1856
KILLYBEGS St. John's Point	54 34.1 8 27.6	One fixed bright light	●	98	14	1831
Rotten Island	......	One fixed bright light	●	66	12	1838
SLIGO Black Rock	54 18. 8 37.	One fixed bright light in the Bay	●	79	13	1835
Oyster Island	......	Two fixed br. lts., in 1 S.S.E. ¾ E.	●	40	11	1837
Broadhaven One br. or *red* fixed lt.	54 16. 9 53.	On Gubacashel Pt. *White* to seaward; *red* towards W. side of Harbour	3a	87	12	1855
EAGLE ROCK Two bright fixed lights	54 17. 10 6.	3 miles from Erris Hd. In one E. by N., and W. by S., 132 yards apart	●	220	20	....
BLACK ROCK One light intended	54 4. 10 19.	Building (1861)................	..	..	..	....

Name and Character of Light.	Lat. N. Long. W. ° ′	Description, &c.	Description of Apparatus	Height above H. W.	Visible in Miles.	Year established.
CLEW BAY CLARE ISLAND	53 49.5 9 59.	One fixed bright light on N. Point	●	341	27	1806
INISHGORT ISLAND	53 49.6 9 40.2	One fixed bright light	●	36	10	1827
SLYNE HEAD One rev. *red* and bright light, 2 min., and 1 fixed bright light	53 23.9 10 14.	N. light rev., with one *red* and two br. faces; the rev. and fixed lts. in one N. ¾ E. and S. ¾ W., 142 yards apart	●	126 115	15 14	1836
GALWAY BAY ERRAGH ISLAND One rev. bright light	53 8.9 9 51.5	On W. Point. Bright flash every 3 min.	1b	115	16	1857
INISHEIR One bright or *red* lt.	53 2.7 9 31.5	*Red* in direction of Finnis Rock	1a	110	15	....
Mutton Island One fixed bright lt.	53 15.2 9 3.1	On centre of Island, off Galway	..	33	10	1817
SHANNON, RIVER LOOPHEAD One fixed bright lt.	52 13.6 9 55.9	500 yards from extremity of Head	1a	277	22	1858
KILCRADAN One bright or *red* lt.	52 34.8 9 42.6	On the Point. *Red* to seaward; bright to River	●	133	16	1824
Tarbut One bright fixed lt.	52 35.5 9 21.8	On the Rock	●	58	13	1834
Beeves One bright or *red* lt.	52 39. 9 1.3	Red to N. of Rock	3a	40	10	1854
TRALEE One bright or *red* light	52 16.3 9 53.2	On Little Samphire Id. *Red* lt. seaward fr. W.N.W. to N. ½ E.	4a	56	9	1850
VALENTIA One fixed bright light	51 56. 10 19.3	On Cromwell's Fort	●	54	12	1841
SKELLIGS Two fixed bright lights	51 46.2 10 32.7	On highest Rock, 7½ miles from shore. One lt. will be discontinued when Calf R. is lighted	●	372 175	25 18	1826
CALF ROCK One light	51 34.2 10 15.	Building (1861).	..	..	..	....
BANTRY BAY One fixed bright light	51 39.2 9 44.8	E. entrance to Bearhaven	●	55	12	1847
CROOKHAVEN One bright or *red* light	51 28.6 9 42.6	On Rock Island Pt. *Red* across Rocks to Shuk Head	●	67	13	1860

Name and Character of Light.	Lat. N. Long. E. ° ′	Description, &c.	Description of Apparatus	Height above H. W.	Visible in Miles.	Year established.
WHITE SEA.						
JIJGINSK One fixed bright light	65 12.2 36 51.	On the N. height of Island	..	140	17	1842
MOUDIUGA One fixed bright light	64 55.5 40 16.	On a sandy Hillock on the Id., at entrance of R. Dvina	..	140	16	....
MORJOVETS One fixed bright light	66 45.7 42 30.	540 yards in shore of N.W. Point of Island	..	150	14	1842
ORLOV One fixed bright light	67 11.2 41 20.5	N.E. Point of C. Orlov, 1,200 yards from Beach	..	222	17	1842
NORWAY.		**West Coast.**				
Hokkingon, Malang Fiord	69 36. 17 50.5	N. side of Hokking Id. From Aug. 15 to May 1	4a	66	14	1859
Andenæs One fixed and flash. lt.	69 19.5 16 9.	From Aug. 15 to May 1. Flash every 3 min.	2d	143	20	1859
Klopen, or Gloppen One fixed bright light	67 53.5 13 4.5	Sörvaagen, S. of entrance. From Sept. 1 to April 14..........	6a	134	11	1857
LOFOTEN ISLANDS Svinö One fixed *red* light	68 3. 13 34.5	Near Balstad. September 1 to April 14	●	196	11	1857
HENNINGSVÆR One fixed & flash. lt.	68 8.5 14 14.5	Quitverden. Flash every 3 min. August 15 to May 1	●	113	16	1857
Kjeöen, or Kie I., S. Point One fixed bright light	68 13.2 14 37.	Svolvær. September 1 to April 14	●	54	4	1856
Sjaaholmen One fixed bright light	68 9.5 14 41.5	Skraaven's Harbour. Sept. 1 to April 14	..	31	4	1856
Stamsund One fixed bright light	68 7.2 13 53.	Tornholm, S. Point. Sept. 1 to April 14	..	56	7	1859
Hammerfest One fixed bright light	70 40.2 23 40.	Extremity of Fuglenæs Island. Aug. 25 to April 20	6a	30	11	1859
Vaag, or N. Hellig Vær One fixed bright light	67 26. 14 1.7	N.E. Point of Island. Aug. 15 to May 1	6a	45	12	1859
PRÆSTÖ, Folden Fiord One fixed bright light	64 43.4 10 46.1	On the Islet. August 1 to May 16	6a	36	12	1841
VILLA One fixed and flash. lt.	64 32.7 10 41.7	On the Island. A flash every 4 min. August 1 to May 16	2d	127	20	1859
Munk Holm One fixed bright lt.	63 27.2 10 24.8	On the Fortress. August 1 to May 16	6a	44	10	1840
Agdenäs One fixed bright lt.	63 38.2 9 49.5	On the Point. August 1 to May 16	..	116	9	1831
Torningen One fixed bright light	63 29.6 9 9.	On the Island. August 1 to May 16	6a	100	12	1849

Name and Character of Light.	Lat. N. Long. E. ° ′	Description, &c.	Description of Apparatus	Height above H. W.	Visible in Miles.	Year established.
TRONDHJEM One fixed bright light	63 18.7 8 13.4	On the Ringholm Rock, half mile from E. Pt. of Eddo. Aug. 1 to May 16	5a	51	14	1849
Leervig One fixed bright light	63 6.5 7 42.	On N. side of Island. Aug. 1 to May 16	..	..	..	1833
CHRISTIANSUND One fixed bright light	63 7.3 7 38.2	On Stavnæs, N.E. Point of Averö. Aug. 1 to May 16	5a	65	12	1842
QVITHOLM One fixed and flash. lt.	63 2.2 7 12.5	On N.W. Pt. of Id. A flash of 12 secs. every minute. Aug. 1 to May 16	2d	134	19	1842
Walderhoug One fixed bright light	62 30.1 6 7.4	On S. Pt. of Walderö. Aug. 1 to May 16	..	41	4	1860
Lepso Reef Lt. Vessel One fixed bright light	62 35.5 6 14.5	In 3 fms. on S.E. part of Reef. Aug. 1 to May 16	..	25	4	1858
Hogsten One fixed and flash. lt	62 28. 6 1.5	Flash every 3 min. On S.E. of Godö Id., Bred Sound. Aug. 1 to May 16	4d	41	12	....
RONDÖ One fixed bright light	62 25. 5 35.1	W. Pt. of Id., Bred Sd., Aug. 1 to May 16	..	161	22	1858
HELLESÖ ISLAND One fixed and flash. lt.	60 45. 4 43.1	Flash 12 secs. every min.; at 8 m. dist. dark between flashes	2d	154	19	1855
SKÆLLANGER One fixed bright light	60 36.5 4 57.3	N.W. side of Holsenö Id. July 15 to May 16	5a	58	13	1853
Bergen One fixed bright light	60 24. 5 18.7	On Nordnæs Point. Aug. 15 to April 30	..	41	4	1839
Leeröen Island One fixed bright light	60 14. 5 11.	W. side of Island. July 15 to May 16	..	57	4	1855
Piir Holm One fixed bright light	60 5.2 5 12.3	Bagholm Sound. July 15 to May 16	..	..	4	1849
Öxhammer One fixed bright light	59 59.2 5 14.	E. side of Selbö. July 15 to May 16	..	..	4	1860
SLOTTERÖ, SELBÖ FIORD. One fixed bright lt.	59 54.5 5 5.	On the Island. South entrance	2a	152	18	1859
Folgeröen One fixed bright light	59 48. 5 20.	On Island at Stoksund. July 15 to May 16	..	51	4	1855
Midtholmen One fixed bright light	59 42. 5 24.7	Mosterhavn. July 15 to May 16	..	39	4	1855
Langevaad One fixed bright light	59 37. 5 16.	Lille Blegan. E. side of Bommelö Id. July 15 to May 16	..	16	3	1855
Espevär One fixed bright light	59 35.1 5 10.1	S. entrance of Harbour. Oct. 1 to April 1	..	..	4	1849
Ryvarden One fixed bright light	59 31.7 5 14.7	On Point leading into Bommel Fiord. July 15 to May 16	..	..	4	1849

Name and Character of Light.	Lat. N. Long. E. ° ′	Description, &c.	Description of Apparatus	Height above H. W.	Visible in Miles.	Year established.
Gitterö One fixed bright light	59 26. 5 8.5	Removed from Gletta. Vis. from N. to S.W. ½ W., by the E. ..	..	..	4	1860
SÄRHOUG One fixed bright light	59 25.2 5 15.5	On Rock at N. entrance	5a	72	12	1846
Höievarde One fixed bright light	59 19.5 5 20.3	E. side of Karmö	..	65	6	1858
UDSIRE Two fixed bright lights	59 19.6 4 51.1	W. side of Id. N.W. and S.E. 220 yards apart	2a	255	21	1844
Bukke Sund One fixed bright light	59 13.2 5 29.	E. side of Bukken Island. Oct. 1 to April 1	..	..	4	1849
Fieldo Island	......	One fixed br. lt. Oct. 1 to April 1	..	..	4	1849
Skude Ness Havn	......	One fixed br. lt. Oct. 1 to April 1	..	..	4	1849
Skude Ness One fixed bright light	59 9.2 5 17.	S.E. Point of Karmö. Oct. 1 to April 1	..	77	6	1840
Tunge Ness One fixed bright light	59 2. 5 36.7	October 1 to March 31	..	25	6	1840
HVIDINGSÖ One fixed and flash. lt.	59 4. 5 23.1	Fixed lt. 2m. 55 secs.; then short eclipse; then br. flash 10 to 15 secs.; then eclipse. Only flashes seen 16 m. dist. Revs. in 4 m.	2d	149	21	1853
LILLE FRISTEEN One fixed *red* light	58 49.5 5 30.7	On the Island	4a	68	12	1859
EGERÖ						
GRUNDSUND HOLM One fixed br. light	58 27.8 5 53.1	On N.W. Point	5a	43	11	1855
W. POINT OF ISLAND One fixed br. light	58 26. 5 52.2	....	1a	154	24	1854
VIBBERODDEN One fixed br. light	58 25.3 5 59.6	S.E. Point of Vibber Odde	5a	73	12	1855
VARNÄS One fixed bright light	58 10.6 6 37.3	S. Point of entrance to Lister Fiord	..	90	12	1836
LISTER Three fixed br. lights	58 6.5 6 34.2	Three white towers built in a triangle, on W. Pt. of Lister Land	2a	130	19	1853
NAZE OF NORWAY or LINDESNÆS One fixed & flash. lt.	57 59. 7 3.	White and red tower, 33 ft. high, on the Cape. Flash of 12 secs. every minute	1d	164	24	1853
ODDERÖ ISLAND One fixed *red* light	58 8.2 8 0.5	In Christiansand Fiord, on S.W. Point of Island	..	27	10	1832
OXÖ ISLAND One fixed bright light	58 4.4 8 3.6	Round white tower on S. of Id., entrance of Christiansand Fiord	2a	139	19	1853
ÄRENDAL One fixed bright light	58 26.3 8 47.4	Yellow building on Sandvig Pt., W. side of Channel..........	6a	43	11	1844

Name and Character of Light.	Lat. N. Long. E. ° ′	Description, &c.	Description of Apparatus	Height above H. W.	Visible in Miles.	Year established.
TORUNGEN IDS. Two fixed bright lights	58 24.1 8 47.7	On Outer Torungen, and Inner Torungen, N.N.E. 1,200 yds. apart	2a	134	20	1844
Stangholms Island One fixed *red* light	58 42.7 9 15.	Yellow building on E. Point ..	5a	34	10	1855
JOMFRULAND One fixed and flash. lt.	58 52.2 9 36.3	White tower, 86 ft. high, on a low Island. Flash every ½ min. Dark between flashes at 8 m.	2d	134	20	1839
LANGÖTANGEN One fixed bright light	58 59.7 9 45.8	Yellow tower on S. Point of Langö Island	6a	41	11	1839
Frederiksværn One fixed *green* light	58 59.5 10 4.5	Staværnsö, S. Pt., E. side of Channel. July 15 to June 1	..	101	8	1855
CHRISTIANIA FIORD.						
FÆRDER One fixed bright lt.	59 2. 10 32.1	Red tower, 134 ft. high, with white belt, on Lit. Færder. Fog bell	1a	154	24	1857
TORGAUTEN ISLAND One fixed bright lt.	59 9.5 10 50.3	On S. Point	..	37	12	1859
FULEHUK ISLAND One fixed & flash. lt.	59 11. 10 36.7	White ower, 41 feet high. Flash every 3 minutes	4d	57	14	1850
Torgersö Island One fixed bright lt.	59 15.5 10 30.9	On N.W. Point. July 15 to June 1	..	10	3	1851
Moss Havn One fixed *red* light	59 26.4 10 39.8	E. side of Canal. October 1 to March 31	..	10	3	1857
BASTÖ ISLAND One fixed bright lt.	59 23.3 10 33.	Yellow building on N. E. Point	6a	38	12	1848
Röd Point One fixed bright lt.	59 31.9 10 26.3	E. side of entrance to Drams Fiord. July 15 to May 31 ..	..	35	6	1840
Filtvedt One fixed bright lt.	59 34.7 10 37.7	On W. shore. July 15 to May 31	..	24	6	1840
Steilene Island	......	One fixed light. July 31 to May 31	6a	22	6	1837
Heg Holm	......	One fixed light on N. Pt. July 15 to May 15	6a	23	4	1826

Name and Character of Light.	Lat. N. Long. E. ° ′	Description, &c.	Description of Apparatus	Height above H. W.	Visible in Miles.	Year established.
SKAGEN, or SCAW One fixed bright light	57 44.1 10 37.9	Ice signals shown. Red ball on the Old Lt. H. if the Læsö Lt. Vessel is not at her station ..	1a	144	15	1858
HANSTHOLM .. One rev. br. lt. ½ min.	57 6.8 8 36.2	N.W. Point of Jutland	..	218	18	1843
AGGER CHAN. LT. VESSEL One fixed bright light	56 45.5 8 10.5	Within the Channel. Nov. 15 to March 20................	6a	30	10	1860
SYLT Two fixed lights One fixed and flash. light ...	55 3.5 8 24.	Two fixed lts. (the Western *reddish*) on List or N. end of Id. S.E. by E. ¾ E., 2,910 yards apart. The fixed lt. will flash every 4 m., in village of Kamp, and changes to *red* when over the Bar....................	4a	63 72 205	10 13 20	1852
Dagebüll Two fixed bright lts.	54 43.7 8 41.3	On the Dyke	..	..	5	1854
Fohr Island Two fixed bright lts.	54 41.5 8 34.3	Wyk Harbour. In one lead in	..	..	5	1852
AMRUM ISLAND. One rev. br. lt., ½ min.	54 38.5 8 22.5	On the Island	..	140	14	1853
EIDER LT. VESSEL One fixed bright light	54 10.7 8 34.6	In 4½ fms. at Mouth of River. Has two masts and flag......	..	34	10	1805
River Elbe.						
I. Outer Light Vessel Three fixed br. lts.	54 0.1 8 18.2	In 11 fms. Three Masts; a light on each, and *red* flag at Main	..	..	3	....
Loots Galliote Lt. Ves. One fixed bright lt.	......	Pilot Vessel, 1¾ miles from Outer Vessel	..	..	..	....
II. Middle Light Vessel Two fixed lights	......	Three Masts; blue and white flag at Main. ¾ m. from Pilot Vess.	.. ..	31 18	3	1839
III. Inner Light Vessel	......	One fixed br. lt. Three Masts; *red* flag, with wh. square at M.	..	29	..	1857
NEUWERK Two fixed bright lts.	53 55. 8 30.	On Id. at entrance to River. S. by E. ½ E., 685 yards apart ..	.. ..	120 60	15 12	1814 1815
Kugel Baak One fixed bright light	53 53.5 8 41.7	Shows inside the Beacon, from N.W. ¾ N., and N.W.	..	..	..	1853
CUXHAVEN One fixed and flash. lt.	53 52.3 8 43.	Brick tower, 66 ft. high, W. side of entrance. It is a fixed lt. up the River	..	80	12	1853
Bösch One fixed bright light	53 53.7 9 15.	On E. side, when River is free from ice	..	..	..	....
Storens One fixed *red* light	53 50. 9 24.3	N. Pier, at entrance of River Stor	..	32	6	1805
Glückstadt One fixed *red* light	53 47.1 9 24.5	On N. Pier	..	24	8	1846

Name and Character of Light.	Lat. N. Long. E. ° ′	Description, &c.	Description of Apparatus	Height above H. W.	Visible in Miles.	Year established.
Lühe Light Vessel	……	In 10 feet. Fixed bright light	..	..	..	….
Schulau Light Vessel	……	In 2½ fathoms. *Red* light……	..	..	..	….
HELIGOLAND One fixed bright light	54 10.8 7 53.1	(British). A circular white tower, 60 feet high, on W. side ….	..	221	20	1811
HANOVER.						
WESER RIVER.						
WESER LIGHT VESSEL One fixed bright lt.	53 49. 8 8.3	At entrance in 8 fms. Two Masts and ball at the Fore ………	..	30	3	1818
HOHE WEG FLAT One fixed bright lt. One fixed *red* and br. light	53 42.8 8 14.9	In one tower. Lower lt. from N. by W. ½ W., to E. by S.: it shows *red* to the Dwasgatt ..	2a	112 44	15 7	1856 1857
Bremerhaven One br., one *red* lt.	……	Bright light at 10 feet at new Harb.; *red* lt. on old Port Mole	..	..	10	….
Heppens	……	A small light near new Harbour	..	..	..	….
WANGEROOG One rev. br. lt., 2 min.	53 47.4 7 54.2	E. of Island; tower white, 60 feet high; a beacon to E. by N.	..	100	12	1856
BORKUM ISLAND One fixed bright light	53 35.5 6 40.4	A red brick tower, 110 ft. high, at entrance of River Ems ….	2a	142	18	1817
EMS RIVER One fixed bright light	53 20.3 7 3.	On the Dyke of the Knock, at entrance ………………	6a	29	8	1856
NETHERLANDS.						
ZUIDER ZEE.						
HARLINGEN One fixed bright lt.	53 10.6 5 25.	On Rampart………………	..	56	10	….
STAVOREN One fixed bright lt.	52 25.2 5 21.6	N.W. of side of Harbour ……	..	39	10	….
URK ISLAND One rev. br. lt. 2½ m.	52 39.7 5 35.8	On the S.W. Point……………	4b	69	10	….
SCHOKLAND ISLAND One fixed bright lt.	52 37.2 5 46.7	On S. Point of the Island ……	..	34	8	….
HOEK, near Amsterdam One fixed bright lt.	52 22.3 5 1.1	At the angle of the River Y….	..	51	10	….
MARKEN ISLAND	……	One fixed br. lt. on S.E. Point..	..	52	10	….
GELDERSCHE HOEK One fixed bright lt.	52 44.6 5 17.2	A stone tower on the Dyke ….	..	55	10	….
Wieringen Two fixed bright lts.	52 53.4 4 56.3	On W. of Id., N. and S., 448 yards apart ……………	..	39 16	6 4	…. ….

There are also small Harbour lights in the Zuider Zee at Workum, Hindelopen, De Lemme, Blokzyl, Genemuiden, Kampen, Elburg, Harderwyk, Nykerk, Muiden, Edam, Hoorn, Enkhuisen, Medembik, &c.

Name and Character of Light.	Lat. N. Long. E. ° ′	Description, &c.	Description of Apparatus	Height above H. W.	Visible in Miles.	Year established.
SCHIERMONNIKOOG Two fixed bright lts.	53 28.8 6 10.	On the North side of the Id., S.E. by S., 1,102 yds. apart ..	15	147 139	15	1854
TERSCHELLING One rev. br. lt., 1 min.	53 21.7 5 13.1	On the Brandaris tower, near the W. end of Island	2b	177	20	....
VLIELAND One fixed bright light	53 17.8 5 3.8	....	..	151	12	....
NIEUWE DIEP One fixed bright light One fixed *red* light	52 58. 4 47.	On the Weirhoofd, N.E., 51 yds. apart	.. ..	29 35	8 8	1843 1843
KYKDUIN One fixed bright light	52 57.1 4 43.5	On the Fort on the high white Sandhill	.. 1a	.. 161	.. 20	1822 1853
EGMOND-AAN-ZEE Two fixed bright lts.	52 37.2 4 37.6	S.S.E. ¾ E., 408 yds. apart. N. Lighthouse, called Van Speyk's Tower	3a	120 126	16 18	1834
Zandvoort One fixed light	52 22.5 4 31.5	N. of Village, a coal fire? for fishermen	..	56	4	....
Noordwijk-aan-Zee One fixed bright light	52 14.6 4 25.9	For fishermen. On a scaffold ..	..	66	5	....
Katwijk-aan-Zee	......	Light for fishing boats	..	82	6	....
SCHEVENINGEN One fixed bright light	52 6.3 4 16.3	A stone tower, S. of town; half mile S.W. of Church	3a	95	16	1850
VOORNE ISLAND.						
Brielle Harbour	......	Fixed bright light on E. Mole ..	..	16	4	1858
Steenen Baak	......	One fixed bright light	..	..	..	....
Oostvoorne One br. and one *red* fixed light	51 54.8 4 4.5	Half mile W. of Village; S.E. ½ S., 457 yards apart	..	59	7 8	1857
HELLEVOETSLUIS One fixed bright lt.	51 49.2 4 7.9	W. end of Harbour	●	46	8	1858
GOEREE ISLAND.						
Middelharnis	......	Fixed bright Harbour light	..	..	..	1857
GOEDEREEDE or GOEREE One fixed light	51 49.1 3 58.8	On Church tower. *Red* towards E.N.E. to N.E. by E........	2a	148	18	1856
Kwaden Hoek	......	One fixed bright light	..	..	..	1857
Steenen Baak	......	*Red* lt. to W., on N. side of Id.	..	98	10	1858
SCHOUWEN ISLAND.						
Ossenhoek	......	One fixed bright light	..	23	8	1859
BROUWERS HAVN. Two fixed br. lights	51 44.5 3 47.5	At Renesse, on N. side of Id., E.S.E. ½ E., 800 yards apart	3a 4a	148 82	16 12	1848
Verklikker, or guide lt.	......	N.W. of Id., to show Anchorage	..	55	6	....

Name and Character of Light.	Lat. N. Long. E. ° ′	Description, &c.	Description of Apparatus	Height above H. W.	Visible in Miles.	Year established.
SCHOUWEN One rev. bright lt.	51 42.5 3 41.8	A fine tower, 166 ft. high, on W. end of Id. Bright 25 secs. every 1½ min.	1b	171	20	1744 1840
WALCHEREN ID.						
Sloe	……	Light S. of Middelburg Harbour	..	33	3	….
VEERE One fixed bright lt.	51 32.9 3 40.5	S. side of entrance	4a	38	10	1847
WEST CAPPEL One fixed bright lt.	51 31.8 3 27.1	On old Church Tower	●	144	15	1818
FLUSHING One fixed bright lt.	51 26.4 3 34.7	On Westhaven Bastion	..	49	10	….
S. BEVELAND ID.						
BORSSELEN	51 25. 3 44.	One fixed bright light	4a	35	9	1847
Baths One fixed bright lt.	51 23.7 4 12.8	S.E. of Fort	..	32	5	….
Goes Harbour One fixed bright lt.	51 32.8 3 55.8	On N. side of entrance	..	31	5	….
TER NEUSE, AXEL ID. One fixed bright light	51 20.5 3 50.	On W. Jetty	..	43	10	1845
THOLEN ISLAND.						
Gorishoek One fixed bright lt.	51 31.6 4 4.8	N. of Ferry	..	35	4	….
Stavenisse	……	Bright lt. at E. Angle of Haven	..	27	5	….
ZIERIKZEE Two fixed bright lights	51 37.9 3 55.4	One at S. Angle, near Zierikzee; the other on W. Haven Heads	..	31 43	4 6	….
ZIJPE Two fixed bright lts.	51 39.3 4 6.3	One on Outer Dyke of Stooff Polder; the other on Land side of Dyke	..	31 39	5	….
Ooltgensplaat One fixed bright light	51 40.9 4 22.2	End of Harbour Dam, River Volgerak	..	15	6	….
WILLEMSTAD One fixed bright light	51 41.8 4 26.7	In front of Bastion	..	41	10	….
Strijen-Sas One fixed bright light	51 42.7 4 35.6	W. Heads of Outer Haven	..	48	6	….
DORDSCHE KIL One fixed bright light	51 43.4 4 37.5	W. extremity of Dordt Channel	..	48	10	….
Krab	……	In Old Maas. One bright light	..	31	2	….
MAAS RIVER	……	Small Harbour lights at Schiedam, Pernis, and Vlaardingen	..	..	..	….

Name and Character of Light.	Lat. N. Long. E. ° ′	Description, &c.	Description of Apparatus	Height above H. W.	Visible in Miles.	Year established.
NORTH HINDER LT. VESSEL One fixed br. light	51 36.7 2 34.6	In 14 fathoms, on the E. side ..	●	40	11	1858
PAARDE MARKT LT. VES. One fixed *red* light	51 23.7 3 20.	S.W. part of Bank	●	..	..	1849
Heyst .... One fixed bright light	51 20. 3 14.	N. of Town	..	48	8	1842
Blankenberg .... One fixed bright light	51 18.9 3 8.	In small Fort	..	44	6	1839
OSTENDE .. .... One fixed bright lt.	51 14.4 2 55.9	Tower, 170 feet high, 820 yards E. by N. of old light	1a	189	20	1860
E. Pier	......	*Red* light, while 8 to 14 ft., and bright lt., while 14 ft., on Bar	.. ..	25 40	6 7	1849
W. Pier	......	*Green* light all night	..	25	7	....
Nieuport Tide Light One fixed bright light	51 8.4 2 43.	E. side of Port, from half flood to half ebb	..	32	6	1825

Name and Character of Light.	Lat. N. Long. E. ° ′	Description, &c.	Description of Apparatus.	Height above H. W.	Visible in Miles.	Year established.
DUNKERQUE ...... One rev. br. lt. 1 min.	51 3. 2 22.	Brick tower, 180 ft. high, on Pier Head	1b	194	24	....
DUNKERQUE PORT One bright and one *red* fixed light	......	Bright lt. on Heuguenar Tower; *red* light on W. Mole Head ..	5a ●	85 23	9 3	1845 ....
GRAVELINES Three fixed br. lights	51 0.3 2 6.5	One lt. on Fort Philippe; 2 lts., 65 yds. apart, on S.W. Mole of Fort Philippe	3a ●	95 20	15 6	1843 1854
WALDE POINT One fixed and flash. lt.	50 59.7 1 55.1	Br. lt., with *red* flash every 20 secs.; no eclipse	..	34	10	1859
CALAIS One fixed and flash. lt.	50 57.7 1 51.1	Fixed lt., with flash every 4 min.; in tower, 167 ft. high, on Old Fortifications	1d	190	20	1848
CALAIS HARBOUR Two lts. and one *Tide lt.*	......	*Red* lt. on W. Jetty; *green* lt., in fair weather, on E. Jetty; and br. *tide light* on Fort Rouge while 8 feet	● 6a	16 33	2 9	1842 ....
CAPE GRISNEZ One rev. br. lt., ½ min.	50 52.2 1 35.1	Tower, 46 feet high, ½ mile S. of Cape. Eclipses not total at 12m.	1b	194	22	1842
Boulogne Two fixed bright lts., and one fixed *red* lt.	50 43.9 1 35.1	Two br. lts. in one tower; higher lt. while 9½ ft.: lower lt., from high water to 9 ft. ebb. *Red* lt. on N.E. Jetty while 9½ feet ..	6a ●	43 33 46	9 4	1835
ALPRECK POINT One fixed and flash. lt.	50 41.9 1 33.7	A br. lt., with *red* flash every 2 min. Tower, 33 ft. high, 2½ miles S.W. of Boulogne	4d	161	12	1842
ÉTAPLES or CANCHE RIVER Two fixed br. lts.	50 31.4 1 35.5	At Touquet, S. side of Mouth of River, in towers 171 ft. high, N.N.E. and S.S.W., 273 yards apart	1a	174	20	1852
Lornel Point	......	One fixed lt. on N. side of Mouth	●	52	6	....
PT. HAUT-BANC OF BERCK One fixed bright light	50 24. 1 33.5	N. side of Mouth of l'Authie River	4a	66	10	1836
SOMME RIVER.						
Crotoy One fixed bright lt.	50 12.9 1 37.3	On N. side of entrance. *Tide light* while 3 feet	●	..	4	1851
Hourdel Point One fixed bright lt.	50 12.9 1 33.9	On S. side of entrance. *Tide light* while 2 feet	●	..	4	1852
CAYEUX One fixed and flash. lt.	50 11.7 1 30.7	On S. side of entrance. Fixed light, with flash every 4 min.	3d	92	15	1835
Cayeux One fixed bright lt.	......	812 yards S.W. of Cayeux light, from 3½ hours flood to 1½ ebb.	●	..	..	1856
Treport One fixed bright light	50 3.9 1 22.1	*Tide light* on W. Mole, while 6½ feet in the Channel.........	5a	36	10	....

Name and Character of Light.	Lat. N. Long. E. ° ′	Description, &c.	Description of Apparatus	Height above H. W.	Visible in Miles.	Year established.
Dieppe, W. Mole One fixed bright lt.	49 56. 1 5.2	*Tide light* while 10½ feet	..	39	10	....
E. Mole Three fixed br. lts.	......	On a Mast. Lowest lt. all night; highest light from 2½ hours before to 2 hours after high water; middle lt. from 2 hours before until high water	●	23 31 27	4	....
AILLY POINT One rev. br. lt. 1 min.	49 55.1 0 57.5	Tower, 66 ft. high, on the Point. Eclipses not total at 10 miles	1b	305	27	....
St. Valery-en-Caux One br. 1 *red* fixed lt.	49 52.1 0 42.7	*Bright tide light* on W. Jetty while 8½ feet. *Red* lt. on E. Jetty	● ..	29 24	6 3	1857 1857
FÉCAMP One fixed bright light	49 46.1 0 22.3	On Fagnet Point, above the chalk cliff. Sometimes obscured by fog	1a	426	18	1836
Fécamp Harbour	......	Fixed and flash. *Red tide light* on N. Jetty while 10 ft. Fixed *red* light on S. end of Jetty......	5a	39 29	10 3	....
RIVER SEINE.						
LA HÈVE Two fixed bright lts.	49 30.7 0 4.3	Two towers, 66 ft. high, on the Cape, S.W. ¼ S., 69 yds. apart	1a	397	20	....
HAVRE One fixed bright lt.	49 29. 0 6.3	On N.W. Jetty. An Orange lt. also on S.E. Pier, vis. 1 mile; and a Lantern, with coloured glasses, on the Quay	5a	39	10	1843
HOC One fixed bright lt.	49 28.8 0 11.2	On Point, N. Bank of River Seine.......................	5a	39	10	....
Hode Point	......	One bright light on the Point ..	●	..	8	1847
Tancarville	......	One bright light on the Point ..	●	..	8	1847
Villequier	......	One br. lt. 1 m. W. of Vatteville Church	●	..	3	....
Caudebecquet	......	One br. lt. ¾ m. E. of Caudebec Church	●	..	3	....
Neuville	......	One br. lt. 1¾ m. below Vatteville Church	●	..	3	....
Vaquerie	......	One br. lt. 1¼ m. above Aizier Church	●	..	3	....
Aizier	......	One bright lt. near the Church	●	..	4	....
Courval	......	One br. lt. 2¾ m. above Quillebœuf light	●	..	3	....
Gros-Heurt	......	One br. light ¼ m. above Point Quillebœuf	●	..	3	....
Quillebœuf One fixed bright lt.	49 28.4 0 31.6	N. end of Quay, S. Bank	5a	33	10	....
La Roque	......	One bright light on the Point ..	●	..	8	....
Berville	......	One bright light N. of Church..	●	..	8	....

Name and Character of Light.	Lat. N. Long. E. Long. W. ° ′	Description, &c.	Description of Apparatus	Height above H. W.	Visible in Miles.	Year established.
FATOUVILLE One fixed and flash. light	49 24.9 0 19.4	Tower, 105 feet high, on the Heights. Br. light, with *red* flash, every 3 minutes	1d	420	20	1850
HONFLEUR Two fixed br. lights	49 25.5 0 13.6	On Hospital Jetty, N.W. end of Tower; and *Tide light* on E. Jetty, while 6½ feet	3a 5a	82 29	15 6	1857 1843
TOUQUES RIVER Two fixed bright lights	49 21.7 0 4.5	W. side, 153 yds. apart. *Lower lt.* while 7 feet on Bar. In one lead in	● ●	33 20	6 6	....
L'ORNE RIVER Two fixed bright lts. One fixed *red* light	Long. W. 49 16.6 0 15.6	Br. lts. on Church and Redoubt of Oyestreham, W. side of entr. *Red Tide lt.* on N. end of W. Jetty, 3 hours before and after high water	5a ● ●	92 39 ..	10 4 2	 1855
Courseulles One fixed bright light	49 20.3 0 27.5	On W. Jetty Head	●	30	6	1857
POINTE DE VER One fixed and flash. lt.	49 20.5 0 31.2	800 yards from the shore. Fixed light, with flash every 4 min.	3d	138	15	....
PORT-EN-BESSIN Two fixed bright lights	49 21.1 0 45.6	N.E. by E. and S.W. by W., 79 yards apart. *High tide lt.* while 12 feet on Bar	5a 5a	131 92	8 6	1854
Grandcamp One fixed bright light	49 23.4 1 2.6	875 yards West of Church	●	26	3	1836
PORT D'ISIGNY Two fixed bright lights	49 19.3 1 6.7	N. by E. ¼ E. and S. by W. ¼ W., 306 yards apart	5a	46 28	10 8	1852
ST. MARCOUF One fixed bright light	49 29.9 1 8.9	On the Fort, E. of Sand-fly Island	5a	56	10	1840
MORSALINE One fixed bright light	49 34.3 1 19.4	On the Mound. Much higher than La Hougue light	5a	282	10	1836
LA HOUGUE One fixed bright light	49 34.3 1 16.4	At S. end of Fort	5a	36	10	1836
SAIRE POINT One fixed bright light	49 36.4 1 13.9	On Reville Redoubt	5a	36	10	1836
BARFLEUR One rev. br. lt. ½ m., & Two fixed bright lts.	49 41.9 1 16.	Rev. lt. on the Cape. Bright lts. on S. side of entrance, S.W. by W. ¼ W., and N.E. by E. ¼ E., 309 yards apart	1b 6a 6a	236 23 43	22 8 9	1836 ....
LEVI CAPE One fixed and flash. lt.	49 41.8 1 28.5	Tower, 103 feet high. Lt. br., with *red* flash every 3 min. ..	4d	115	12	1858
CHERBOURG						
Port de Commerce	......	*Red* light on E. Jetty	4a	33	3	1839
PELÉE ISLAND One fixed bright lt.	49 40.3 1 34.9	On Fort Impérial	5a	85	10	....
LA DIGUE One fixed & flash. lt. One fixed *green* light One *red* light	49 40.1 1 37.2	Bright fixed, with flash every 3 min., on Central Fort. *Green* light on Eastern Head. Temporary *red* light on W. Head	5d ● ●	60 .. 39	10 2 10	1839 1853 1853

Name and Character of Light.	Lat. N. Long. W. ° ′	Description, &c.	Description of Apparatus.	Height above H. W.	Visible in Miles.	Year established.
QUERQUEVILLE FORT One fixed bright lt.	49 40.3 1 49.1	On the Guard-house	5a	50	10	....
CAPE DE LA HAGUE One fixed bright light	49 43.4 1 57.3	On the top of Gros du Ras Rock, half mile from Cape	1a	157	18	1837
CASKETS Three rev. br. lights, ... 20 secs.	49 43.4 2 22.5	(British). Placed triangularly on the highest Rock, E. ½ N., 62 yards; S.W. ½ W., 46 yards; and N.W. ¾ W., 24 yds. apart	● ..	113 ..	15 ..	1723 1855
HANOIS or HANOVEAUX ROCKS .... One light building	49 25.8 2 43.3	(British). Building	..	..	..	1861
GUERNSEY One fixed bright light	49 27. 2 33.	(British). On St. Pierre, S. Pier Head	●	40	11	1832
JERSEY						
VERCLUT BREAKWATER One fixed bright lt.	49 13.3 2 1.2	(British). On the Outer end, in St. Catherine's Bay	5a	60	11	1857
ST. HELIER One fixed bright lt.; One fixed *red* lt.; and One fixed blue light	49 10.5 2 7.3	Bright light on Victoria or S. Pier; *red* light on Albert or N. Pier; *blue* light on Old N. Pier.....................	● ● ..	31 15 17	6 3 3	1858 1859 1856
Gouray Pier Head	......	One fixed bright light	..	..	..	1857
Dielette One fixed br. and *red* lt.	49 33.1 1 51.7	On Jetty Head. *Red* lt. at head of Harbour. N.W. and S.E., 169 yards apart	.. ..	23 75	5 9	1858
CAPE CARTERET One rev. br. lt., ½ min.	49 22.4 1 48.5	Tower, 49 feet high, on Cape ..	2b	262	18	....
Portbail Two fixed *red* lights	49 20. 1 43.	On Church Tower and Point Dune, S.W. ½ S., 953 yds. apart	..	..	..	1859
Sénéquet	49 5.5 1 39.8	Building, 1861	..	..	..	....
RÉGNEVILLE One fixed bright light	49 0.5 1 34.9	On Agon Point	5a	33	10	1856
CHAUSEY ISLANDS One fixed and flash. lt.	48 52.2 1 49.4	On S.E. Point. A br. lt., with *red* flash every 4 min.........	3d	121	15	1847
GRANVILLE One fixed bright lt., & One fixed *red* light	48 50.1 1 36.9	Bright lt. on Granville *Rock*, or Cape Lihou. *Red* lt. on Mole Head, W. side of entrance ..	3a ●	154 26	15 3	1839 ....
ST. MALO One fixed bright light	48 39. 2 1.7	On the new Mole des Noires ..	5a	33	10	1842
CAPE FREHEL One rev. br. lt., ½ min.	48 41.1 2 19.2	Tower, 72 feet high, on the Cape	1b	259	22	....
LÉGUE PORT One fixed bright light	48 32.2 2 43.2	On Point Aigle	5a	40	10	1857
ILES SAINT QUAY One fixed bright light	48 40. 2 48.6	On Harbour Island	5a	49	10	1850

Name and Character of Light.	Lat. N. Long. W. ° ′	Description, &c.	Description of Apparatus	Height above H.W.	Visible in Miles.	Year established.
BINIC PORT One fixed bright light	48 36.1 2 49.	On Penthièvre Mole	5a	36	10	1854
Portrieux ..One fixed *red* light	48 38.8 2 49.5	On end of Pier	●	29	3	1853
BRÉHAT ISLE ..Two fixed *red* lights	48 51.9 2 59.3	On Paon Rock and Rosedo Hill, W. ¾ S., and E. ¾ N., ¼ mile apart	5a	67 90	6 8	1860
HÉAUX DE BRÉHAT ..One fixed bright light	48 54.5 3 5.3	N.E. side of Rocks............	1a	148	18	1835
SEPT ILES One fixed and flash. lt.	48 52.7 3 29.5	Tower, 52 feet high, on E. end of Ile aux Moines. Fixed, with flash every 3 min.	3d	184	15	1835
TRÉGUIER RIVER One fixed *red* lt., and One fixed bright light	......	Proposed (1861). *Red* lt. on Mill of St. Antoine, and br. lt. on Harbour Mill	..	..	..	....
PERROS BAY						
Nantouar Bridge One fixed bright lt.	48 48.1 3 23.9	On S.E. shore of Bay..........	..	33	10	1860
Kerjean	......	Fixed br. light, 750 yds. S.E. of Nantouar Light	..	253	14	1860
Pigeon House	......	Bright light on S. shore of Bay	..	89	12	1860
Kerprigent One fixed bright lt.	48 46.7 3 28.4	Near the Mill, 3,133 yards S.W. of Pigeon House Light	..	259	14	1860
Ploumanac'h Port One fixed *red* light	48 50.3 3 29.1	On the Point	..	69	5	1860
MORLAIX						
ILE NOIRE One fixed & flash. lt.	48 40.4 3 52.6	Fixed light, with flash every 2 minutes.....................	5d	46	10	....
TOUR LA LANDE One fixed bright lt.	48 38.2 3 53.2	(There is also a small *red* lt. on the Château du Taureau for the anchorage.)	5a	285	12	....
Jardin or Louet Id.	......	One fixed light building, 1861 ..	..	..	..	....
ILE DE BAS One rev. br. lt., 1 min.	48 44.7 4 1.7	Tower, 131 feet high, on W. part	1b	233	24	1836
ILE VIERGE One fixed and flash. lt.	48 38.4 4 34.2	On E. Point. Br. fixed lt., with *red* flash every 4 min.	3d	108	15	1845
ABERVRAC'H 1. One bright and 1 *green* light; also 2. One *red* and 1 br. light	48 35.7 4 33.5	1. Br. lt. at Head of St. Antoine Creek, and *green* lt. on E. of Palue Beach. 2. *Red* lt. on Plouguerneau Steeple, and br. lt. on Ile Vrac'h, E. side of entrance	● ● 6a ●	49 29 226 59	4 3 10 4	1845 1845
OUESSANT, or USHANT One fixed bright lt.	48 28.5 5 3.5	N.E. Point of Id. A second lt. on S.W. Point is proposed (1861).	1a	272	18	....
CONQUET PORT One fixed bright light	48 21.7 4 47.5	On Kermorvan Point	4a	72	12	1849

Name and Character of Light.	Lat. N. Long. W. ° ′	Description, &c.	Description of Apparatus	Height above H. W.	Visible in Miles.	Year established.
ST. MATHIEU One rev. br. lt. ½ min.	48 19.8 4 46.4	Tower, 82 feet high on the Point	2b	177	18	1835
BREST						
Minou Point One fixed bright lt.	48 20.2 4 37·	Tower, 79 feet high, on the Point..........................	3a	105	15	....
Portzic Point One fixed and flash. light	48 21.5 4 32.2	Tower, 108 feet high, 4 miles E. ½ S. of Minou Light. Flash every 3 min.	2d	184	18	....
Camaret Bay	......	Light building (1861) on E. Co.	..	..	..	....
Toulinguet Point One fixed *red* light	48 16.8 4 37.9	S.W. side of entrance	4a	161	10	1849
Douarnenez Bay One fixed bright light	48 6.2 4 21.5	On Tristan Ile................	4a	114	10	1857
ILE DE SEIN One fixed and flash lt.	48 2.7 4 52.	N. Point of Id. Fixed lt., with flash every 4 min.	1d	148	20	1843
BEC DU RAZ One fixed bright light	48 2.4 4 44.	Tower, 49 feet high on the highest part	1a	259	18	1843
Audierne Port One fixed *red* lt., and One fixed bright light	48 0.6 4 32.5	*Red* lt. on Raoulic Point; br. lt. near Capuchin Garden; N.E. ½ N., and S.W. ½ S., 1,203 yards apart	● 5a	36 69	6 12	1856
PENMARC'H POINT One rev. br. lt. 1 min.	47 47.9 4 22.4	On the Point, on the Church of St. Pierre..................	1b	135	22	....
Loctudy	....	Building (1861) on Pont l'Abbé	..	..	..	....
Odet River One fixed *red* light, and One bright light	47 52.3 4 6.8	On Coq Point, N. ¾ E., and S. ¾ W., 291 yds. apart. In one lead in	●	33 56	7 9	1848
PENFRET One fixed and flash lt.	47 43.3 3 57.3	N. Point of Id. Fixed lt., with flash every 4 min.	3d	118	15	1838
Concarneau Two fixed bright lights	47 52.2 3 55.2	On Croix Battery, and between Concarneau and Beuzec, in one, N.E. ½ E., 2,052 yds. apart	6a	46 177	9 12	1849
Lanriec	......	*Red* lt. on E. of Concarneau Port	●	135	9	1857
Douelan Port	......	Two lts. building E. & W. of entr.	..	..	..	1861
ILE DE GROIX One fixed br. lt., and One fixed and flash. lt.	47 38.9 3 30.7	Fixed lt. on N.W. part; the other on Fort, on E. part. Br. lt., with *red* flash every 3 min. ..	1a 5d	194 171	18 10	....
L'Orient 1. Two fixed br. lights 2. Two fixed br. lights	47 44.9 3 20.8	1. One lt. on Church Tower, the other at Lapeyrière, N. 83° E., 1,826 yards apart. 2. Two lts. in Port Louis, E. side, E. ½ N., and W. ½ S., 481 yards apart	6a 6a	62 20 39 62	12 8 10 12	1850 1850 1854
Etel River One fixed *red* light	47 38.7 3 12.9	At entrance of River	6a	20	3	1850

Name and Character of Light.	Lat. N. Long. W. ° ′	Description, &c.	Description of Apparatus	Height above H. W.	Visible in Miles.	Year established.
BELLE ILE						
Sauzon Port .... One fixed *red* light	47 22.4 3 13.2	On the end of Mole	4a	28	..	1859
Palais Port One fixed br. light...	47 20.9 3 9.3	Mole Head, S. side of entrance	6a	30	9	1836
GOULFAR BAY .... One rev. br. lt., 1 m.	47 18.7 3 13.5	Tower, 151 feet high, on S.W. of Island	1b	276	27	1836
Hœdic Id. ...One fixed bright light	47 20.5 2 52.	Tower, 39 feet high, 600 yds. W. from E. Point of Island......	5a	85	10	1836
QUIBERON BAY						
La Teignouse .... One fixed and flash. light	47 27.4 3 2.8	On the Rock, S.E. of Quiberon Peninsula. Fixed light, with flash every 3 min.	4d	59	12	....
...Haliguen One fixed bright lt.	47 29.2 3 5.9	Tower, on N. Jetty	4a	40	9	1856
...La Crac'h One *red* and 1 br. lt.	47 34.1 3 0.4	On left Bank of River, N. by E. and S. by W., 574 yds. apart	6a	29 69	9	1856
Navalo Port One fixed bright lt.	47 32.9 2 54.	On the S. Point of entrance to Morbihan	5a	72	10	1840
Penlan Point One fixed bright light	47 31. 2 30.2	On the Point	5a	52	10	....
LE FOUR One rev. br. lt., ½ min.	47 17.9 2 37.9	A round stone Tower on the Rock	2b	79	18	1822
Croisic Port Two fixed bright lts.	47 18. 2 30.9	Near the Church, N. and S., 50 yards apart	6a ..	13 33	6	1838 ....
LOIRE RIVER						
Point l'Eve One fixed *red* light	47 14.5 2 16.1	Marks the channel to the town of St. Martin	6a	102	6	1850
Aiguillon Tower	......	One fixed bright light	3a	112	12	....
Commerce Tower	......	One fixed and flash. lt., flash 2 m.	3d	128	14	....
St. Nazaire	......	One fixed br. light, on Mole Head	6a	26	8	1836
Paimbœuf Port One fixed bright lt.	47 17.4 2 2.	End of Mole	6a	26	8	1856
Pierre à l'Œil	......	One fixed light proposed (1861).	..	..	..	....
St. Nicholas I.	......	*Red* light proposed (1861).	..	..	..	....
Mindine Tower	......	One fixed light proposed (1861).	..	..	..	....
Pornic Port One fixed bright light	47 6.6 2 7.	On Noveillard Point	6a	59	9	1846
PILIER ID. One fixed and flash. lt.	47 2.6 2 21.7	On N.W. Point. Flash every 4 min.	2d	105	18	....
ILE D'YEU, near N. Point, One fixed bright lt.	46 43.1 2 23.	Tower, 108 feet high, on Mound. From N. Point 1,660 yards ..	1a	177	18	....

Name and Character of Light.	Lat. N. Long. W. ° ′	Description, &c.	Description of Apparatus	Height above H. W.	Visible in Miles.	Year established.
BRETON PORT Three fixed br. lts.	46 43.6 2 21.	One on Outer Jetty, N. side of entrance; one (proposed, 1861) on Point Corbeaux; and one at Head of Harbour	6a .. 5a	23 .. 49	8 .. 10	.... 1860 ....
St. Gilles-sur-Vie One fixed *red* light	46 41.6 1 56.9	N. side of Jetty	5a	30	6	1852
LA CHAUME One fixed bright light	46 29.7 1 47.4	Tower, 85 feet high, on W. side of entrance to Olonne.........	4a	118	12	....
Sables d'Olonne	......	Fixed br. lt., E. side of entrance	5a	23	8	....
BARGES D'OLONNE	......	Flashing light, building (1861).	..	..	..	....
Roche Bonne Lt. Vessel	......	Proposed (1861)................	..	..	..	....
PERTUIS BRETON						
GROUIN DU COU POINT One fixed bright lt.	46 20.8 1 28.3	N., 32° E., 7 miles from the Tour des Baleines	5a	59	10	....
AIGUILLON POINT One fixed bright lt.	46 16.3 1 12.8	Bearing S. by E., leads on to Mid. Channel	5a	33	10	....
ILE DE RÉ						
BALEINES One rev. br. lt., ½ m.	46 14.7 1 33.8	On N.W. Point. Flashes of unequal brilliancy	1b	164	22	1854
HAUT-BANC DU NORD One fixed br. lt.	46 15.8 1 35.20	On the Shoal	3a	72	15	1854
St. Martin Port One fixed bright lt.	46 12.4 1 21.9	On Demi-Bastion, E. of entrance	5a	52	6	....
Port de la Flotte One fixed bright lt.	46 11.3 1 19.4	On the Mole	6a	30	9	1849
CHAUVEAU POINT One fixed bright lt.	46 8. 1 16.5	S.E. Point of Island	5a	72	14	1842
Rochelle Harbour One bright and one *red* fixed light	46 9.4 1 9.3	Upper br. lt. on E. Quay; lower lt. *red*, W. ½ S., and E. ½ N., 257 yards apart	5a	59 46	10 8	1852
ILE D'AIX One fixed bright light	46 0.6 1 10.8	On Fort at S. Point of Island ..	5a	56	10	....
ILE D'OLÉRON						
CHASSIRON One fixed bright lt.	46 2.8 1 24.7	Tower, 141 feet high, N.W. Point of Island	1a	141	18	1836
La Pérotine One fixed bright lt.	45 58.2 1 13.9	End of Jetty	..	38	4	1859
Château Port Two fixed br. lts.	45 53. 1 11.2	Building, 1861. When in one will lead in	..	..	..	....
RIVER GIRONDE						
CORDOUAN One rev. br. lt., 1 m.	45 35.2 1 10.5	A handsome structure on the Rock....................	1b	207	27	1727 1854

Name and Character of Light.	Lat. N. Long. W. ° ′	Description, &c.	Description of Apparatus	Height above H. W.	Visible in Miles.	Year established.
RIVER GIRONDE						
COUBRE POINT One fixed bright lt.	45 41.5 1 15.4	Tower, 100 feet high, on N. point of River, N. point of entrance	3a	121	5	1860
Falaise and Terre Nègre One *red* & 1 br. lt.	45 38.9 1 6.9	*Red* light at Falaise, 600 yards from bright light on Terre Nègre Tower	5a 4a	46 118	7 12	1852 1842
Pontaillac One rev. *red* and br. light	45 38.2 1 3.7	Wooden Tower, 105 ft. high, on the Table land. *Red* and *white* alternately, for 20 secs.......	3b	177	15	1856
Royan	......	Bright light on Jetty..........	●	36	6	....
St. George One fixed *red* light	45 36. 1 0.6	On East bank of River	..	44	7	1860
Suzac One fixed *red* light	45 35.4 0 58.9	On the Sandhills at Suzac on East bank.................	..	121	12	1860
De Grave One fixed bright lt.	45 34.3 1 3.4	On the Point	a	85	15	1828 1860
Tallais Bank Light Vessel	45 30.7 0 59.1	One fixed bright light, in four fathoms, on W. side	5a	33	9	1845
Tour de By Lt. Vessel One fixed bright lt.	45 27.6 0 45.3	On West Bank of River	5a	33	10	1860
Mapon Light Vessel	45 17.6 0 45.9	On West Bank of River	5a	33	10	1860
Ile de Patiras One fixed bright lt.	45 12.4 0 42.	On the North part of the Island	..	43	12	1860
Trompeloup	......	Fixed lt., on old Chapel, on W. Bank..........................	..	..	15	1860
Richard	......	Fixed *red* lt., on W. side of River	4a	56	8	1845
Gaet	......	Fixed *red* light................	..	..	..	....
Pauillac	45 11.9 0 44.9	Two small lts, on landing-place	..	..	..	....
Blaye	......	E. side of River. Light at landing-place	..	..	..	....
Hourtin	......	Two lights, proposed (1861)....	..	..	..	....
ARCACHON BASIN One fixed bright light	44 38.7 1 15.1	On Ferret Cape, N. side of entrance	1a	167	18	1840
CONTIS One rev. *red* and br. lt.	44 4. 1 20.	Proposed (1861)..............	..	..	..	....
Adour River One fixed bright light	43 31.8 1 31.5	On Jetty, S. side of entrance ..	..	38	6	1860
BIARRITZ One rev. br. lt. ½ min.	43 29.6 1 33.6	Tower, 144 feet high, on Point St. Martin	1b	240	22	....
Socoa Port One fixed bright light	43 23.7 1 41.1	W. Point of St. Jean de Luz Bay	5a	115	10	....

Name and Character of Light.	Lat. N. Long. W. ° ′	Description, &c.	Description of Apparatus.	Height above H. W.	Visible in Miles.	Year established.
Fuenterradia One fixed bright light	43 23.6 1 47.7	On Cape la Higuera, W. side of Bidasoa River	5a	285	7	1855
Pasages Port One fixed bright light	43 20.3 1 56.5	Cape la Plata, near W. entrance	4a	486	14	1855
SAN SEBASTIAN One fixed and flash. lt.	43 19.4 2 0.4	Mount Igueldo, W. side. Flash every 2 min.	3d	431	15	1855
MACHICHACO CAPE One fixed and flash. lt.	43 28. 2 49.4	Bright fixed light, with flash every 4 min.	1d	260	18	1852
BILBAO One fixed bright light	43 22.6 3 4.	Fort, on Point Gales, W. side of entrance	4a	380	10	1852
Santona	43 27.5 3 16.7	Building (1861)	..	..	..	....
Castro Urdiales One fixed and flash. lt.	43 24.2 3 16.1	On Castle. Bright light, with *red* flash every 3 min.	5d	131	7	1853
SANTANDER Mouro Island	......	One fixed bright light	5a	141	12	1860
CAPE MAYOR One rev. br. lt., 1 min.	43 30.3 3 47.1	1½ miles from Port entrance	2b	298	24	1839
Llanes	43 27. 4 39.	Light building (1861)	..	..	..	....
Rivadesella	43 31. 5 0.	Building (1861)	3a	..	..	....
Gijon	43 35.3 5 38.	Near Sta. Catalina Hermitage	4a	167	10	1855
PENAS CAPE One rev. br. lt. ½ min.	43 42.3 5 49.8	On the Cape	1b	338	21	1853
Aviles	43 38. 5 50.7	Building (1861)	..	..	..	....
Cudillero One fixed bright light	43 36.2 6 9.1	Revallera Point	5a	94	10	1858
CAPE BUSTO One fixed and flash lt.	43 36.2 6 28.8	Bright, with *red* flash every 2 min.	3d	307	12	1858
ORRIO DE TAPIA ID. One fixed and flash. lt.	43 35.6 6 58.4	Fixed, with flash every 2 min.	3d	93	15	1859
Pancha Island One fixed bright light	43 34.7 7 4.2	Near Ribadeo	5a	79	9	1859
CAPE ESTACA One rev. br. lt., 1 min.	43 47.5 7 33.4	....	1b	307	20	1850
CAPE PRIOR One fixed bright light	43 33.7 8 19.9	On N. part of the Cape	3a	448	15	1854
Cape Priorino One fixed and flash. lt.	43 27.8 8 20.5	Bright fixed, with *red* flash every 2 min.	4d	92	11	1854
CORUNNA One fixed and flash. lt.	43 23. 8 24.1	On Tower of Hercules. Fixed, with flash every 3 min.	3d	331	12	1847

Name and Character of Light.	Lat. N. Long. W. ° ′	Description, &c.	Description of Apparatus	Height above H.W.	Visible in Miles.	Year established.
Corunna, St. Antonio Cas.	……	Fixed light, building (1861) ….	6a	..	..	….
CISARGAS ISLANDS One fixed and flash. lt.	43 21.8 8 50.2	On Isla Mayor, N. Peak. Fixed br. lt., with *red* flash every 4 m.	4d	358	11	1853
CAPE VILLANOS One fixed bright light	43 9.8 9 12.9	Camarinas ………………	4a	225	10	1854
CAPE FINISTERRE One rev. br. lt., ½ min.	42 52.6 9 15.4	S. Point of the Cape ………	1b	468	20	1853
CAPE CÉ One *red* fixed light	42 54.8 9 10.1	Octagonal Tower, 25 feet high, on the Cape ……………	5a	82	8	1860
CAPE CORROBEDO One fixed bright light	42 34.6 9 4.8	On the Cape ……………	3a	103	12	1853
SALVORA ISLAND One fixed and flash lt.	42 27.8 9 0.4	S. Point. Bright, with *red* flash every 2 min……………	4d	82	10	1853
AROSA ISLAND One fixed bright light	42 34.1 8 52.	On the N.W., or Caballo Point	4a	38	18	1851
BAYONA or CIES ID. One rev. br. lt., 1 min.	42 12.4 8 54.1	Mount Faro, Middle Island ….	2b	595	20	1853
VIGO One fixed and flash. lt.	42 15.1 8 41.	On Castle of La Guia, 1½ m. N.E. of Vigo. Flash every 3 min.	4d	102	10	1844
PORTUGAL.						
Pavoa de Varzim	……	Fishing lts., 15 m. N. of Oporto	..	..	..	1857
OPORTO One rev. br. lt., 6 min.	41 9.1 8 37.2	At Nossa Senhora da Luz. (Bad light.) ………………	●	220	20	1834
CAPE MONDEGO One fixed bright light	40 12. 8 55.2	………………………	●	330	20	1837
BERLENGAS One rev. br. lt., 3 min.	39 25. 9 31.2	Square tower, 100 feet high, on Great Berlenga Island ……	●	365	25	1848
CAPE CARVOEIRO One fixed bright light	39 21.1 9 24.3	Tower, 94 feet high, on highest part …………………	●	182	15	1790
CAPE ROCA One rev. br. and *red* light, 1½ min.	38 46.5 9 30.	Light *red* and white alternately. Round tower, 52 ft. high, ½ mile N.E. of Cape ………	●	598	21	1772
RIVER TAGUS						
GUIA One fixed bright lt.	38 41. 9 27.2	Square tower, 96 feet high, at Nossa Senhora da Guia……	●	207	12	1771
SAN JULIAN One fixed bright lt.	38 39.7 9 20.	Square tower, 120 feet high, in the Fort ………………	●	128	12	1848
BUGIO One rev. br. lt., 1½ m.	38 39. 9 18.1	Tower of Lorenzo, 70 feet high	●	110	16	1775
Belem One fixed *red* light	38 40.8 9 17.6	In Fort, near Castle ………	●	38	6	1847
CAPE ESPICHEL One fixed bright light	38 24.9 9 13.	Square tower, 100 feet high, on the Cape ………………	1a	627	25	1848

Name and Character of Light.	Lat. N. Long. W. ° ′	Description, &c.	Description of Apparatus.	Height above H. W.	Visible in Miles.	Year established.
Setuval, or St. Ubes .... One fixed bright light	38 31.1 8 53.	On Fort, at W. entrance of Harbour	●	490	6	1775
CAPE ST. VINCENT One rev. br. lt., 2 min.	37 3. 9 0.	On the Convent	●	220	20	1846
CAPE SANTA MARIA One fixed bright light	36 56. 7 46.	On the Cape	●	109	15	1850
SPAIN.			South Coast.			
GUADIANA RIVER Four fixed lights	37 11. 7 18.	Building, 1861, at Ayamonte. Two lts. at River Mouth; and two on Christiana or Higuerita Id., E. side of entrance	..	..	..	....
ODIEL RIVER						
Huelva Two fixed br. lts.	37 13.4 6 51.6	On the Bar. In one lead over the Bar	●	..	3	1853
Cartaya	......	Fixed lt. in River, building (1861)	3a	..	..	....
GUADALQUIVIR R.						
Chipiona	......	Temporary lt. on Church Tower	5a	72	8	1855
Espiritu Santo	......	Fixed *red* light	..	..	..	1854
Malandar Point One fixed bright lt.	36 46.3 6 21.9	....	..	36	6	1854
Salmedina Rocks	36 44. 6 27.	Fixed bright lt. building (1861)	..	..	..	....
Bonanza	......	Fixed bright light	..	52	7	1854
CADIZ One rev. lt., 1 min.	36 31.2 6 18.9	W. Tower of San Sebastian, 127 feet. Br. & *red* flash alternately	1b	146	20	1855
CAPE TRAFALGAR	36 10. 6 1.	Building on the Cape (1861)....	..	..	..	....
TARIFA One fixed bright light	36 0. 5 36.6	On the Island, S. of town	1a	132	20	1813 1855
Algeciras One fixed *green* light	36 7.3 5 26.1	Isla Verde, not shown from N. to W.	..	46	5	1850
GIBRALTAR						
EUROPA POINT One fixed bright lt.	36 6. 5 21.	On Victoria Tower, 60 feet high	1a	150	15	1840
Old Mole, S.	......	*Green* to N.; br. to W.; *red* to S.	..	..	..	1857
New Mole Head	......	*Red* light at end of works	..	..	..	....
Ragged Staff	......	*Green* light at landing place	..	..	..	....
Old Mole Head, N.	......	Fixed *red* light	..	..	..	1850
MAROCCO						
CEUTA One rev. bright lt.	35 53.7 5 17.5	Tower, 88 ft. high, on Mosqueros Hill, Almina Point..........	1b	483	23	1855

Name and Character of Light.	Lat. N. Long. W. ° ′	Description, &c.	Description of Apparatus	Height above H. W.	Visible in Miles.	Year established.
BELLE ISLE One fixed bright light	51 53. 55 22.3	White tower, 62 feet high, on S. Point of Id., Straits of Belle Isle. Gun in fogs	1a	470	28	1858
AMOUR POINT One fixed bright light	51 27.6 56 50.9	White tower, 109 feet high, on the Pt., S.E. side of Forteau Bay. Whistle or gun in fogs	2a	155	18	1858
OFFER WADHAM ISLAND One fixed bright light	49 36. 53 46.	Circular brick Tower, on the Island	a	96	12	1858
CAPE BONAVISTA One rev. lt., br. and *red* alternately, 2 min.	48 42. 53 8.	Tower, 36 feet high, striped *red* and *white* vertically, on Cape. (Lt. apparatus from Bell Rock, E. of Scotland.)	●	150	30	1843
GREEN ISLAND One fixed bright light	48 30.7 53 6.3	S. side of Catalina Harbour, in Trinity Bay	●	86	15	1857
BACALHAO, or BACCALIEU ID. One rev. br. lt., 20 s.	48 9. 52 48.7	On N. end of Island. Holophotal apparatus	1b	[illegible]	30	1858
HARBOUR GRACE One fixed bright light Two fixed lts. on Beach beacon	47 42.7 53 9.3	One light on Id. at entrance, 4 miles from the town. 2 lts., 11 yds. apart, on Point of Beach Entrance	● ●	150 50	20 10	1836 1853
ST. JOHN'S One fixed bright light	47 33.8 52 39.9	On Fort Amherst, S. entrance of Harbour. Gun in fog	4a	110	12	1852
CAPE SPEAR One rev. br. lt., 1 min.	47 30.9 52 36.7	Square tower, 38 ft. high, striped *red* and *white* horizontally, on Cape	●	275	30	1835
CAPE RACE One fixed bright light	46 39.2 53 2.6	Tower on Cape, with S.E. side striped *red* and *white* vertically	..	180	17	1856
CAPE PINE One rev. br. lt., ½ min.	46 37.1 53 31.8	Round iron tower, 56 feet high, with *red* and *white* bands, on the Cape	●	314	30	1851
CAPE ST. MARY One rev. lt., br. and *red* alternately, 1 min.	46 49.4 54 9.5	Light building (1861)	1b	..	..	....
GREAT BURIN ID. One rev. br. lt., 20 secs.	47 1.5 55 5.	On Dodding Head	2b	410	30	1858
ST. PIERRE ID. Two fixed bright lights	46 45.5 56 6.9	(French). One on Galantry Hd.; the other on Canon Point, St. Pierre Harb., from May to Decr.	2a ●	210 ..	18 3	....

Gulf of St. Lawrence.

Name and Character of Light.	Lat. N. Long. W.	Description, &c.	Description of Apparatus	Height above H. W.	Visible in Miles.	Year established.
ST. PAUL ID. One fixed br. lt., N. end One br. rev. lt. 1 min., on S.W. Point	47 13.8 60 8.3	Fixed lt., on a Rock; revol. light on S.W. Point. At the latter a fog bell and gun	.. ..	144 140	20 20	1839 1831
MAGDALEN IDS.	47 50.9 61 9.2	Light on Bird Rocks, proposed (1861)	..	..	..	....

Name and Character of Light.	Lat. N. Long. W. ° ′	Description, &c.	Description of Apparatus	Height above H. W.	Visible in Miles.	Year established.
CAPE ROZIER One fixed bright light	48 51.6 64 12.	White tower, 112 feet high, on the Cape	1a	136	20	1858
ANTICOSTI ID.						
HEATH POINT One fixed bright lt.	49 5.3 61 41.8	Grey conical tower, 90 ft. high; from April to December......	●	110	15	1831
S.W. POINT One rev. br. lt., 1 m.	49 23.7 63 35.8	Conical grey tower, 75 feet high	●	100	15	1831
W. POINT One fixed bright lt.	49 52.5 64 32.	Round white tower, 109 feet high	2a	112	15	1858
POINT DE MONTS One fixed bright light	49 19.6 67 22.	Round white tower, 75 feet high, 1½ mile N.E. of Point	..	100	15	1830

River St. Lawrence.

Name and Character of Light.	Lat. N. Long. W. ° ′	Description, &c.	Description of Apparatus	Height above H. W.	Visible in Miles.	Year established.
FATHER POINT One fixed *red* light	48 31.4 68 27.4	Rimousky. From April 10 to December 10	..	43	10	1859
BICQUETTE ID. One rev. br. lt., 2 min.	48 25.2 68 53.5	On W. Point. Hour gun, during fogs and snow	..	112	15	1844
RED ISLET BANK One fixed *red* light	48 4.3 69 33.1	On S.W. Point	..	75	12	1848
GREEN ISLAND One fixed bright light	48 3.3 69 25.2	On N. Point. From April 15 to December 10	..	60	13	1809
STH. TRAVERSE LT. VESS. Two fixed bright lts.	47 22.2 70 15.1	N.E. part of St. Rocque Shoals	..	..	9	1830
STONE PILLAR One rev. br. lt., 1½ min.	47 12.4 70 21.8	100 yards from S. Point of Islet. From April 15 to December 15	..	68	13	1843

Note.—The Lights on the upper part of the River St. Lawrence, and those on the Great American Lakes are omitted, as not being of service to oversea vessels.

Name and Character of Light.	Lat. N. Long. W. ° ′	Description, &c.	Description of Apparatus	Height above H. W.	Visible in Miles.	Year established.
NEW BRUNSWICK.						
MISCOU ISLAND One fixed *red* light	48 1. 64 29.5	White tower, on Birch Point ..	..	79	12	1856
MIRAMACHI BAY One fixed bright lt.	47 4.5 64 47.6	White tower, on Escumenac Point	●	70	14	1841
Shediac One fixed light	46 14.6 64 31.5	A lantern, on Chene Wharf, in the Summer.................	..	15	6	1860
NOVA SCOTIA.						
PICTOU HARBOUR One fixed br. lt., and one *red* light	45 41.4 62 39.5	Tower, str. red and white, vertical. S. Point of entrance. Lower light *red*	●	65	11	1834
PICTOU ISLAND One fixed bright lt.	45 49.8 62 30.2	White tower, on E. Point......	..	52	12	1853
CANSO GUT						
N. ENTRANCE One fixed bright lt.	45 41.7 61 28.9	White tower, on W. side, 120 yards in shore	●	110	18	18[illegible]
S. ENTRANCE Two fixed bright lts.	45 31.5 61 14.6	Tower white, with black diamond, on Eddy Point, 8 yds. apart	..	25	8	1851
Prince Edward Island.						
Bedeque Harbour One fixed bright light	46 23.5 63 47.5	A lantern, on Green's Wharf, when practicable	..	15	7	1856
Charlotte Town One fixed bright light	46 11.6 63 7.4	Blockhouse Pt., W. side of entrance to Harbour	..	35	9	1856
HILLSBORO' BAY One fixed bright light	46 3.2 63 2.1	White brick tower, on Prim Pt., S.E. of Bay	●	68	13	1845
CARDIGAN BAY One fixed bright light	46 8.8 62 27.7	On Panmure Head, S. entrance of Georgetown Harbour	●	89	14	1853
Richmond Bay One fixed bright light	46 34.7 63 42.8	On Bill Hook, or Fishing Id., N. entrance	..	20	8	1856
Cascumpeque One fixed bright light	46 48.4 62 2.1	White tower, on Sandy Island, on N. side	●	32	8	1856
Breton Island.						
PORT HOOD One fixed br. or *red* lt.	46 0. 61 31.6	White tower, S. entrance. Light *red* to N., and br. to S.	..	54	10	1854

Note.—The lighthouses of Nova Scotia and New Brunswick, where necessary, are painted with black or red stripes, &c., to distinguish the towers from the land; as, after the snow is gone off the land, the accumulations against the fences, which generally run at right angles to the coast, and which continue for some time after it has disappeared from the fields themselves, have exactly the appearance of a white tower, and frequently mislead even those acquainted with the coasts.

Name and Character of Light.	Lat. N. Long. W. ° ′	Description, &c.	Description of Apparatus	Height above H. W.	Visible in Miles.	Year established.
SEA WOLF, or MARGARIE ISLAND One fixed bright lt.	46 21.5 61 15.5	White tower, on Summit, or Middle of Island...........	..	298	21	1854
SYDNEY One fixed bright light	46 16.2 60 7.3	Tower, red and white, vert. Flat Point, E. side of Spanish Bay	●	70	14	1832
FLINT ISLAND One revolving light	46 11. 59 45.8	Flash every 15 secs.	..	65	12	1856
SCATARI ID. One rev. bright light	46 2.2 59 40.3	White tower, on Trap Rock, N.E. Pt. Bright, 1 min.; dark, ½ m.	●	90	15	1839
LOUISBURG One fixed bright light	45 54.6 59 57.2	Tower, wh., with bl. vert. stripe on S.E. Point of entrance	..	85	16	1842
NOVA SCOTIA.						
Guysboro Harbour One fixed bright light	45 22.8 61 29.1	W. side of entrance; near Peart Point, Chedabuctoo Bay	●	80	8	1846
Arichat Harbour One fixed bright light	45 29. 61 1.8	Tower, white, S. entrance; on Marache Pt., Madame Island	..	34	8	1851
CAPE CANSO Two fixed bright lts.	45 19.8 60 55.4	In one tower; str. red and white horiz.: on N. part of Cranberry Island	●	75 40	15 9	1815
WHITE HEAD ID. Revolving lt., 20 secs.	45 12. 61 8.	White tower, on S.W. extremity	..	55	11	1853
BEAVER IDS. One rev. br. lt., 2 min.	44 49.6 62 20.2	Tower, white, with 2 black balls, on S.E. part of E. Beaver, or William Island	●	70	12	1846
HALIFAX						
Devil Island One fixed red light	44 34.8 63 27.9	Tower, red, with white belt, at E. entrance	..	45	8	1852
Sherbrook Tower One fixed bright light	44 36.6 63 31.9	Tower, white, with red roof, on Mauger Beach, E. side of entr.	..	58	10	1815
SAMBRO ID. One fixed bright light	44 26.2 63 33.6	White tower, on middle of Id.	..	115	20	1758
MALAGUASH, or LUNENBURG BAY One rev. light, 1 min. One fixed bright light	44 20. 64 7.	Tower, red. Upper lt. br. 45 secs., dark 15 secs.; 33 feet above lower light	●	90 56	14 8	1832
CAPE LE HEVE One rev. lt., ½ min.	44 15.7 64 16.5	White tower, on S. side of Ironbound Island	..	70	13	1855
METWAY, or MEDWAY HEAD One fixed bright lt.	44 6. 64 34.	Tower, white, with black square, on W. side of entrance	..	44	10	1851
LIVERPOOL BAY						
COFFIN ISLAND One rev. br. lt., 2m.	44 3. 64 36.	Tower, striped red and white horizontally, on S. Point	..	80	16	1812
Fort Point One fixed bright lt.	44 3.7 64 39.	White tower, on Fort Point....	..	30	7	1855

Name and Character of Light.	Lat. N. Long. W. ° ′	Description, &c.	Description of Apparatus	Height above H. W.	Visible in Miles.	Year established.
RUGGED ISLAND HARB. One fixed bright light	43 36. 65 6.	White tower, on the Gull Rock	..	51	10	1858
SHELBURNE .. Two fixed bright lts.	43 37.5 65 16.5	Tower, striped bl. and wh. vertically, on Cape Roseway, Macnut Id. Lts. vert., 38 ft. apart	.. ..	100 62	18 10	1858
PORT LATOUR One rev. lt., 40 secs.	43 26.9 65 28.7	Tower, white, with black ball, on Baccaro Point, E. side	..	49	12	1850
Pubnico Harbour One fixed *red* light	43 35.7 65 47.	White tower, on Beach Point, S.E. side of entrance	..	28	8	1854
Bay of Fundy.						
SEAL ISLAND One fixed bright light	43 23.6 66 1.3	White tower, ½ mile inland of S. Point	●	98	18	1830
YARMOUTH, or CAPE FOURCHU One rev. br. lt., 1½ m.	43 47.5 66 9.8	Tower, striped red and white vertically, on S. Point of E. Cape	●	117	20	1839
BRYER ISLAND One fixed bright light	44 14.9 66 23.5	White tower, on W. Point	●	66	15	1832
PETER ISLAND Two fixed bright lights	44 15.5 66 20.9	White tower, S. entrance to Grand Passage. Lts. horizontal	..	40	10	1850
DIGBY, or ANNAPOLIS	44 40.8 66 47.3	Tower, striped vertically, on S. Point of entrance	●	76	13	1817
Marshall Cove, or Port Williams One fix. br. (or *green*) lt.	44 56.8 65 16.	Appears *green* within four miles	..	..	5	1859
Margaretville One fixed br. (or *red*) lt.	45 3. 65 4.	Appears *red* within four miles ..	..	..	5	1859
BLACK ROCK POINT One fixed bright light	45 10.8 64 48.	White tower, on S. Shore......	..	45	12	1848
HORTON One fixed bright light	45 6.3 64 2.	White tower, on the Bluff	..	95	20	1851
BASON OF MINES One fixed bright light	45 18.3 63 46.9	White tower, on Burnt Coat Head	..	75	13	1859
Parsborough One fixed bright light	45 23. 64 8.	White tower, on Partridge Id., on W. side of River	..	30	9	1852
APPLE RIVER Two fixed bright lts.	45 26. 64 50.	White tower, on Cape Capstan. Horizontal lights, 24 ft. apart	..	40	10	1848
GRINDSTONE ISLAND One fixed bright light	45 43.2 64 37.4	White tower, on W. part of Island	..	60	12	1859

Name and Character of Light.	Lat. N. Long. W. ° ′	Description, &c.	Description of Apparatus	Height above H. W.	Visible in Miles.	Year established.
CAPE ENRAGÉ One fixed bright light	45 36. 64 46.7	Square white tower, on the Cape	●	151	15	1840
QUACO One rev. br. lt., 20 secs.	45 19.6 65 31.9	Tower, red and white horizontal bands, on Rock off the Head	..	70	15	1848
ST. JOHN'S HARB.						
PARTRIDGE ISLAND One fixed bright lt.	45 14. 66 3.5	Tower, striped vertically red and white. Steam whistle every min. in fogs. Bell buoy near	●	119	20	1832
Beacon Tower One fixed bright light	......	Striped vertically, white and red	●	35	10	1828
LEPREAU Two fixed bright lights	45 3.8 66 27.1	Tower, striped horizontally, red and white lts. vert., 28 ft. apart	..	81 53	15	1831
CAMPOBELLO ID. One fixed bright light	44 57.7 66 53.9	Tower, white, with red cross, on N. Point	●	64	15	1829
PORT ST. ANDREW One fixed bright light	45 4.2 67 4.	N. Point of entrance	..	35	10	1833
GREAT MANAN ID. One fixed bright light	44 45.7 66 44.	Swallow's Tail, N.E. part, building, 1861	..	148	17	....
MACHIAS ISLANDS Two fixed bright lights	44 30. 67 5.5	On E. Id. Gun in fogs. Lts. E.S.E. and W.N.W., 55 yards apart	..	58 54	15	1832
GANNET ROCK One rev. light, 20 secs.	44 30.7 66 46.8	Tower, half blk. half wh., vertic., on S. part. Flash every 20 secs.	..	66	12	1831

Name and Character of Light.	Lat. N. Long. W. ° ′	Description, &c.	Description of Apparatus	Height above H. W.	Visible in Miles.	Year established.
WEST QUODDY HEAD One fixed bright lt.	44 49. 66 57.	Near East Port, S. side. Fog bell	3a	133	17	1808
LITTLE RIVER One fixed and flash lt.	44 39.4 67 10.6	On Island, at entrance. Flash every 1½ min.	5d	40	12	1855
Round Island	......	In Machias Bay. Proposed (1861)	..	..	..	....
LIBBY ISLAND One fixed bright light	44 34.1 67 21.2	In Machias Bay. Grey tower, 35 feet high. Fog bell	4a	52	13	1856
MOOSE PEAK One rev. br. lt., 30 s.	44 28.9 67 31.7	White tower, 40 feet high, on Mistake Island	2b	65	14	1856
NASHES ISLAND One fixed & flash. *red* lt.	44 28.7 67 44.5	E. side of Pleasant River	4d	47	12	1858
NARRAGUAGUS One fixed bright light	44 29.4 67 49.5	Red tower, 29 feet high, on S.E. Point of Pond Island	5a	45	12	1856
PETIT MANAN One fixed and flash. lt.	44 22. 67 52.	Grey tower, 109 feet high, on S. end of Island	2d	125	17	1855
WINTER HARBOUR One fixed bright light	44 21.8 68 5.6	On S. Point of Mark Island. Frenchman Bay	5a	37	11	1856
MOUNT DESERT One fixed bright light	43 59.5 68 4.7	Grey tower, 60 feet high, on the Rock. Fog bell	3a	75	14	1857
BAKER'S ISLAND One fixed and flash. lt.	44 15.7 68 14.2	Off Mount Desert Id., Frenchman's Bay. Flash every 1½ m.	4d	105	17	1855
BEAR ISLAND One fixed bright light	44 19. 68 17.5	Cranberry Islands	5a	97	15	1856
BASS HARBOUR HEAD One fixed and flash. *red* light	44 16.5 68 23.6	E. side	..	56	13	1858
Spoon Island	......	Isle au Haut Bay. Building, 1861	..	..	..	....
PENOBSCOT BAY						
FLY, or GREEN ID. One fixed bright lt.	44 15.8 68 27.7	Edgemoggin Reach. On S.E. Point	4a	26	9	1856
SADDLEBACK LEDGE One fixed bright lt.	41 1.8 68 43.8	S.W. end of Isle au Haut Island	5a	51	13	1856
HERON NECK One fixed and flash. *red* light	44 2.2 68 51.	S. Point of Green Island	5d	92	10	1853
Widow Island	......	Proposed (1861)	..	..	..	....
DEER ISLAND One fixed bright lt.	44 9.2 68 41.5	Mark Island, Isle au Haut Bay	4a	52	12	1857
EAGLE ISLAND One fixed bright lt.	44 13.2 68 45.	On Point of Island, Isle au Haut Bay	4a	106	16	1837
Pumpkin Island One fixed bright lt.	44 19. 68 45.	Guide to Buck Harbour	5a	27	9	1854

Name and Character of Light.	Lat. N. Long. W. ° ′	Description, &c.	Description of Apparatus	Height above H. W.	Visible in Miles.	Year established.
PENOBSCOT BAY						
MATINICUS ROCK Two fixed br. lts.	43 51.2 68 48.	N.N.W. and S.S.E., 60 yards apart. Fog bell	3a	85 90	16	1857
WHITEHEAD ISLAND One fixed bright lt.	44 0.3 69 6.	Fog bell	3a	70	13	1856
OWL'S HEAD One fixed bright lt.	44 6.2 69 1.	W. entrance. Fog bell	4a	100	16	1856
BROWN'S HEAD One fixed bright lt.	44 6.5 68 54.	S. Head of Fox Island	5a	39	12	1856
NEGRO ISLAND One fixed bright lt.	44 11.7 69 0.4	S. side of entrance to Camden Harbour	4a	52	12	1856
GRINDELS POINT One fixed bright lt.	44 16. 68 53.3	N. side of Gilkey Harbour, Long Island	5a	39	11	1856
DICE'S HEAD One fixed bright lt.	44 23.4 68 48.3	Near Castine, W. side of entrance	4a	130	17	1858
FORT POINT One fixed bright lt.	44 28.3 68 48.7	Entrance of Penobscot River	4a	103	16	1857
TENANT HARBOUR One rev. br. lt., 1 min.	43 58.7 69 10.7	N.E. side of S. Island	5a	66	13	1857
MARSHALL'S POINT One fixed bright light	43 55.6 69 14.7	Entrance to Herring-gut Harb.	5a	31	10	1857
MANHEIGIN ISLAND One rev. br. lt., 1 min.	43 46.3 69 18.4	Fog bell, on Manana Island	2a	175	19	1856
FRANKLIN ISLAND One fixed and flash. lt.	43 55. 69 23.3	N. end of Island, W. of entrance to St. George's River	4d	54	12	1855
PENMAQUID POINT One fixed bright light	43 50.4 69 28.5	S.W. entrance to Bristol Bay	4a	75	14	1857
BURNT ISLAND One fixed br. light	43 49. 69 37.[illegible]	W. side of Townsend Harbour	4a	61	13	1858
HENDRICK'S HEAD One rev. br. lt., ½ min.	43 5[illegible].2 69 40.5	E. side of Sheepscot River	4b	40	12	1851
POND ISLAND One fixed bright light	43 44.1 69 46.	W. entrance of Kennebec River. Fog bell	5a	54	13	1855
SEGUIN ISLAND One fixed bright light	43 42.4 69 45.2	Off Kennebec River. Fog bell	1a	180	20	1857
PORTLAND, or CASCO BAY						
C. ELIZABETH One rev. br. lt., 1 m. One fixed br. light	43 33.9 70 11.7	300 yards apart. Fog bell	2b ..	143 143	17	1858
PORTLAND HARBOUR One fixed br. light	43 37.4 70 12.6	On the Head, S. side. Fog bell	4a	81	14	1855
Breakwater	......	*Red* light on N.E. part	6a	23	8	1855
WOOD ISLAND One rev. *red* lt., 1 min.	43 27.4 70 19.4	Near Saco Harbour	4b	62	13	1858

Name and Character of Light.	Lat. N. Long. W. ° ′	Description, &c.	Description of Apparatus	Height above H. W.	Visible in Miles.	Year established.
GOAT ISLAND One fixed bright light	43 20. 70 28.2	N. side; Mouth of Cape Porpoise Harbour	5a	38	11	1833 857
BOON ISLAND One fixed bright light	43 7.3 70 28.7	W. part; off York Harbour	2a	133	17	1812 1854
NEW HAMPSHIRE.						
WHALE'S BACK One fixed and flash lt.	43 3.5 70 42.1	N.E. side of Portsmouth Harbour. Flash every 1½ min. ..	4d	58	12	1829 1855
PORTSMOUTH One fixed bright light	43 4.2 70 42.8	S.W. side of Inner entrance of Harbour	4a	70	14	1804 1854
WHITE ISLAND One rev. br. lt., ½ min.	42 58. 70 38.2	S.W. Id. of Isle of Shoals......	2b	87	15	1821 1858
MASSACHUSETTS.						
NEWBURY PORT Two fixed bright lts.	42 48.4 70 49.3	S. side of entrance to Port, Merrimack River, 167 yds. apart	5a	54 20	13 5	1809 1857
IPSWICH HARBOUR One fixed & flash lt., & One fixed bright light	42 41.1 70 46.2	Flash every 1½ min. Lts. E. ½ S., and W. ½ N., 173 yds. apart	5d 6a	40 20	12	1837 1856
Wigwam Point One fixed bright light	42 39.7 70 41.2	E. of entrance to Annisquam Harbour	5a	50	12	1801 1857
Straitsmouth Harbour One fixed bright light	42 39.7 70 35.5	On Island, N. of Cape Ann	6a	33	11	1850 1857
CAPE ANN Two fixed bright lights	42 38.3 70 34.6	On Thatcher's Id., N. by E. ¾ E., & S. by W. ¾ W., 298 yds. apart	.. ..	98 98	16 16	1841 1849
GLOUCESTER HARBOUR One fixed bright light	42 34.6 70 40.1	On the Point, E. side. Fog bell	4a	60	13	1837 1857
TEN POUND ISLAND One fixed bright light	42 36.1 70 40.2	Gloucester, or Cape Ann Harbour	6a	49	12	1831 1856
BAKER'S ISLAND Two fixed bright lights	42 3[illegible].2 70 47.5	S. side of N.E. entrance to Salem Harb. 13 yds. apart. Fog bell	4a	87 64	15 13	1707 1857
MARBLEHEAD HARBOUR One fixed bright light	42 30.3 70 51.1	S. side of entrance	6a	43	12	1835 1856
Egg Rock One fixed *red* light	42 26. 70 54.1	Off Nahant	5a	87	8	1856
BOSTON BAY						
OUTER MINOTS LEDGE One fixed br. lt.	42 16.1 70 45.8	Grey granite tower, on Cohasset Rocks	2a	84	14	1800
BREWSTER ID. One flash. br. lt., ½ m.	42 19.6 70 53.7	N. entrance of Harbour	2c	90	15	1784 1859
W. end of Spit	......	One fixed *red* light	6a	35	7	1856
LONG ISLAND HD. One fixed bright light	42 19.8 70 57.7	N.E. end of Island	4a	80	15	1819 1855

Name and Character of Light.	Lat. N. Long. W. ° ′	Description, &c.	Description of Apparatus	Height above H. W.	Visible in Miles.	Year established.
SCITUATE One fixed bright light	42 12.2 70 43.3	On Cedar Point, N. of entrance	4a	49	12	1812 1855
CAPE COD BAY						
PLYMOUTH Two fixed bright lts.	42 0.2 70 36.3	Gurnet Point, N. side of Harb. N.W. and S.E., 10 yds. apart	6a	98	15	1769 1856
RACE POINT One fixed & flash. lt.	42 3.7 70 14.8	N.W. Point of Cape Cod. Flash every 1½ min. Fog bell	[illegible]	85	[illegible]	1816 1855
LONG POINT One fixed bright lt.	42 1.9 70 10.3	On Shoal, S.W. entrance to Provincetown Harbour	5a	28	11	1826 1856
Mayo's Beach One fixed bright lt.	41 55.8 70 2.2	Head of Wellfleet Bay	6a	26	6	1838 1858
BILLINGSGATE ISLAND One fixed bright lt.	41 51.6 70 4.9	N. side of entrance to Wellfleet	4a	40	12	1822 1858
SANDY NECK One fixed bright lt.	41 43.3 70 17.1	W. side of entrance to Barnstaple	4a	33	11	1836 1857
CAPE COD HIGHLANDS One fixed bright light	42 2.3 70 3.9	Cape Truro	1a	195	20	1797 1857
NAUSET BEACH Three fixed bright lts.	41 51.6 69 57.3	At Eastham, E. of Cape Cod; N. and S., 50 yds. apart	6a	93	10	1837 1856
CHATHAM HARB. Two fixed bright lights	41 40.3 69 57.2	W. Side; N. and S., 23 yards apart	4a	70	14	1808 1857
MONOMOY POINT One fixed bright light	41 33.6 69 59.8	Cape Malabar, S. end of Cape Cod	4a	33	11	1823 1857
POLLOCK RIP LT. VESS.	......	One fixed br. lt., off Chatham ..	●	45	12	1849
SHOVELFUL LIGHT VESS. One fixed bright light	41 34. 69 57.6	2½ miles S.S.W. ¾ W., from Monomoy Point	●	40	11	1852
HANDKERCHIEF LT. VESS. One fixed bright light	......	In 5½ fms., 1½ min. from S. part of Shoal	●	40	10	1855
Bass River One fixed bright light	41 39.1 70 8.3	N. of Vineyard Sound	5a	40	8	1854
BISHOP AND CLERKS SHOAL One rev. br. lt., ½ m.	41 34.3 70 15.9	N. part. Fog bell	4b	59	14	1858
SUCCONNESSET SHOAL LT. VESSEL One fixed bright lt.	......	In 6 fms. Between Succonnesset and Eldridge Shoals. Fog bell and horn	●	40	10	1854
NANTUCKET One fixed bright light	41 23.4 70 3.	White tower, on N.E. Point of Island	3a	70	14	1769 1857
SANKATY HEAD One fixed and flash. light	41 17. 69 58.2	Tower, wh., red, wh., on E. part of Nantucket Island. Flash of 10 secs. every min..........	[illegible]	150	20	1849
SOUTH SHOAL LT. VESSEL Two fixed bright lts.	40 [illegible] 69 [illegible]	In 14 fms. 2 miles S. of S[illegible] Fog bell, horn, and gun	[illegible]	44	12	1856

Name and Character of Light.	Lat. N. Long. W. ° ′	Description, &c.	Description of Apparatus	Height above H. W.	Visible in Miles.	Year established.
VINEYARD SOUND						
GAYHEAD One flash. br. light	41 20.9 70 50.4	W. Point, Martha's Vineyard Sound. Flash every 10 secs.	1o	170	20	1856
Hyannis Harbour One fixed bright lt.	41 38. 70 18.6	Inside the Harbour	6a	36	8	1856
Tuckanuck Shoal Lt. Vessel One fixed bright lt.	41 26.7 70 17.1	In 8 fms. On Cross Rip, N.W. of Nantucket. Fog bell, and horn	●	39	7	1828 1855
Nantucket Cliff Two fixed bright lts.	......	On the Beach, N.W. of Harb., N.W. and S.E., 100 yds. apart	..	8 10	4	1838 1856
BRANT One fixed bright lt.	41 17.4 70 5.8	Red tower, on the Point	4a	46	11	1794 1856
Nantucket Harbour One fixed bright lt.	41 16.4 70 5.	From a window, on S.E. side ..	..	24	5	1820 1856
CAPE POGE One fixed bright lt.	41 25.2 70 27.3	N.E. Point of Martha's Vineyard Sound	4a	55	13	1801 1857
EDGARTOWN One fixed bright lt.	41 23.4 70 30.4	W. side of entrance to Harbour	4a	37	12	1828 1856
HOLMES HOLE One fixed bright lt.	41 28.9 70 36.4	W. Chop of Harbour	4a	60	13	1817 1857
NOBSQUE POINT One fixed br. light	41 30.9 70 40.5	E.S.E. of entrance to Wood's Hole Harbour	5a	80	13	1828 1856
TARPAULIN COVE One fixed br. light	41 28.1 70 45.7	W. side......................	5a	80	13	1817 1856
VINEYARD SOUND LT. VESSEL Two fixed br. lts.	41 22. 70 57.6	In 13½ fathoms, near Sow and Pigs Rocks	●	34 23	9	1847 1855
BUZZARD'S BAY						
CUTTYHUNK One fixed bright lt.	41 24.8 70 57.3	S.W. Point of Island	5a	42	12	1823 1857
DUMPLING ROCK One fixed bright lt.	41 32.3 70 55.5	Off Round Hill	5a	42	12	1828 1857
CLARK'S POINT One fixed bright lt.	41 35.5 70 54.3	W. side of entrance to New Bedford Harbour	5a	57	12	1800 1856
Palmer's Island One fixed bright lt.	41 37.6 70 54.8	N.E. end, in New Bedford	5a	32	9	1849 1856
NED'S POINT One fixed br. light	41 39. 70 48.	N. side of Mattapoisett Harbour	6a	43	11	1849 1856
BIRD ISLAND One rev. br. lt., 1½ m.	41 40.1 70 43.3	E. side of entrance to Sippican Harbour	5b	35	10	1819 1857
WING'S NECK One fixed bright lt.	......	Head of Buzzard's Bay, in Sandwich	5a	44	10	1849 1856
Point of Rocks	......	Building (1861) on W. side of entrance to Westport Harb...	..	..	..	....

Name and Character of Light.	Lat. N. Long. W. ° ′	Description, &c.	Description of Apparatus	Height above H. W.	Visible in Miles.	Year established.
RHODE ISLAND.						
BRENTON'S REEF LIGHT VESSEL Two fixed bright lts.	......	In 13 fms., E. side of entrance to Newport	●	50 40	12	1853
BEAVER TAIL One fixed bright light	41 26.9 71 24.3	S. Pt. of Connecticut Id., entrance to Newport Harbour ..	3a	96	15	1793 1856
LIME ROCK One fixed bright light	......	S. side of Newport Harbour....	6a	30	11	1854
NARRAGANSETT BAY						
GOAT ISLAND One fixed bright lt.	41 29.6 71 19.9	On Breakwater, Newport Harbour	4a	33	11	1823 1857
DUTCH ISLAND One fixed bright lt.	41 29.8 71 24.5	S. end	4a	56	14	1826 1857
POPLAR POINT One fixed bright lt.	41 34.2 71 26.5	Near Wickford	5a	51	12	1831 1855
PRUDENCE ISLAND One fixed bright lt.	41 36.4 71 18.3	East side, on Sandy Point......	5a	30	10	1852
Bristol Ferry One fixed bright lt.	41 38.7 71 15.	N. side of entrance to Mount Hope Bay	6a	35	10	1855
WARWICK One fixed bright lt.	41 40. 71 22.9	S. end of Neck	4a	54	14	1826 1856
NAYAT POINT One fixed bright lt.	41 43.5 71 20.5	Entrance to Providence River ..	4a	31	12	1828 1856
POINT JUDITH One rev. lt., 15 secs.	41 21.5 71 29.2	S. extremity of Narragansett Shore	4a	67	14	1810 1857
BLOCK ISLAND One fixed bright light	41 13.4 71 34.8	N. Point of entrance to Long Island Sound	4a	65	14	1829 1857
WATCH HILL One fixed bright light	41 18.2 71 51.8	3 miles S.E. of Stonington	4a	62	14	1808 1857
CONNECTICUT.						
LONG ISLAND SOUND						
STONINGTON One fixed bright lt.	41 19.6 71 54.6	E. side of entrance	6a	50	12	1823 1855
EEL GRASS LT. VESSEL One fixed bright lt.	41 18.4 71 57.3	On the Shoal	●	32	10	1835 1857
MORGAN POINT One fixed bright lt.	41 18.9 71 59.7	N. side of Fisher's Island Sound	6a	44	11	1831 1855
N. DUMPLING ISLAND One fixed *red* light	41 16. 72 3.6	Fisher's Island Sound. Fog bell	6a	70	12	1868 1855
NEW LONDON One fixed bright lt.	41 19. 72 5.7	W. side of entrance to River Thames. Fog whistle	4a	86	14	1800 1857
BARTLET'S REEF LT. VS. Two fixed bright lts.	41 16. 72 11.6	On Reef, off New London......	●	25 35	10	1846 1857

Name and Character of Light.	Lat. N. Long. W. ° ′	Description, &c.	Description of Apparatus	Height above H. W.	Visible in Miles.	Year established.
LONG ISLAND SOUND						
LITTLE GULL ID. One fixed bright lt.	41 12.3 72 6.7	S. side of Long Island Sound. Fog bell	3a	74	13	1806 1857
Gardiner's Island	......	Fixed bright light, on N. Point	6a	29	6	1855
PLUM ISLAND One rev. br. lt., ½ m.	41 10.4 72 13.6	W. end; N.E. extremity of Long Island	4a	63	12	1827 1856
Cedar Island One fixed bright lt.	41 2.4 72 15.9	Sag Harbour, Long Island	6a	34	10	1839 1855
SAYBROOK POINT One fixed bright lt.	41 16.3 72 21.5	W. side of Mouth of Connecticut River	4a	80	13	1803 1857
Calves' Island One fixed bright lt.	......	2 miles below Essex Town, E. side	6a	..	3	1856
Brockways Reach	......	Fixed br. lt., 2 m. above Essex Tn.	6a	..	3	1856
Devil's Wharf	......	Fixed br. lt., 4 m. above Essex Tn.	6a	..	3	1856
CORNFIELD PT. LT. VES. One fixed bright lt.	41 13.5 72 23.4	In 7½ fms., on middle of S. side of Long Sand Shoal	●	40	10	1856
HORTON'S POINT One fixed bright lt.	41 5. 72 27.3	On the Point	3a	110	18	1857
FAULKNER ID. One fixed & flash. lt.	41 12.7 72 39.5	Off Guilford Harbour. Flash every 1½ min.	4d	98	15	1801 1856
NEW HAVEN HAR. One fixed bright lt.	41 15.9 72 54.5	On Five Mile Point, E. side of entrance	4a	93	15	1805 1855
STRATFORD POINT One rev. br. lt., ½ m.	41 9.1 73 6.5	W. entrance to River..........	4b	53	12	18[illegible] 18[illegible]
STRATFORD PT. LT. VES. Two fixed bright lts.	41 4. 73 4.6	In 11 fms., on Middle Ground..	●	32 40	10	1837 1855
Bridgeport One fixed *red* light	41 10.5 73 11.7	2 miles S.W. by W. of town....	6a	23	6	1851 1854
OLD FIELD POINT One fixed bright lt.	40 58.6 73 7.4	S. side of Long Island Sound ..	4a	67	13	1823 1855
BLACK ROCK HARB. One fixed bright lt.	41 8.5 73 13.2	On Fairweather Island	5a	52	12	1808 1854
EATON'S NECK One fixed bright lt.	40 57.2 73 24.3	E. side of entrance to Huntington Bay	3a	138	[illegible]	[illegible]8 1857
LLOYD'S HARBOUR One fixed bright lt.	40 54.8 73 26.2	N. side	5a	48	10	1857
NORWALK ISLAND One rev. *red* and br. lt., 1½ min.	41 2.9 73 25.4	W. end; at W. entrance of Norwalk River	4b	40	11	1826 1857
GREAT CAPTA[illegible] One fixed b[illegible] lt.	40 58.9 73 37.7	Near Greenwich Point	4a	62	12	1829 1858
EXECUTION ROCKS One fixed bright lt.	40 52. 73 44.5	Off Sands Point. Fog bell	4a	54	12	1848 1856

Name and Character of Light.	Lat. N. Long. W. ° ′	Description, &c.	Description of Apparatus	Height above H. W.	Visible in Miles.	Year established.
LONG ISLAND SOUND						
SANDS POINT One rev. br. lt., ½ m.	40 51.9 73 44.1	E. entrance to Cow Bay	4b	53	15	1809 1856
THROGG'S NECK One fixed bright lt.	40 48.3 73 47.6	S.W. Point; at N.W. of entrance to East River	6a	66	10	1826 1855
NEW YORK AND NEW JERSEY						
MONTAUK POINT One fixed and flash. lt.	41 4.2 71 51.7	E. end of Long Island. Flash every 2 min.................	1d	160	20	1795 1860
GREAT WEST, or SHINNECOCK, BAY One fixed bright lt.	40 51. 72 30.	N. side; tower, 150 ft. high, on Pondquogue Point..........	1a	160	20	1857
FIRE ISLAND One rev. br. lt, 1 min.	40 37.9 73 13.3	S. side of Long Island. Yellow tower, 150 feet high	1b	166	22	1826 1858
NEW YORK BAY						
SANDY HOOK LT.V. Two fixed bright lts.	40 28. 73 52.	6 miles from Sandy Hook and Navesink lights	●	45	10	1823 1854
HIGHLANDS OF NAVESINK One fixed br. lt., and One rev. br. lt., ½ m.	40 23.7 73 59.4	S. of Sandy Hook, 100 yards apart	1 2b	248	21	1828 1840
SANDY HOOK Three fixed br. lts.	40 27.6 74 0.4	S. entrance to New York Harb. E. lt. is N. by W. ¾ mile, and W. lt. N.W. ½ m., from main lt.	3a 5a 6a	90 35 35	15 10 10	1762 1857
MAIN CHANNEL Two fixed bright lts.	40 25.2 74 4.	One near the Beach, the other on Chapel Hill, half mile apart ..	2a 3a	60 224	12	1856
GEDNEY'S CHANNEL Two fixed bright lts.	40 27. 74 8.2	Near Point Comfort	2a 3a	40 76	12 14	1856
SWASH CHANNEL Two fixed bright lts.	40 33.7 74 6.6	On Staten Id.; near Elm Tree Station, and New Dorp	2a 3a	59 189	14	1856
PRINCES BAY One fixed & flash lt.	40 30.4 74 13.	S.E. end of Staten Id. Flash every 2 min.	3d	106	16	1828 1857
FORT TOMPKINS One fixed bright lt.	40 3[illegible] 74 4.4	On Staten Island, W. side of Narrows	4a	89	15	1839 1855
ROBBINS REEF One fixed bright lt.	40 39.4 74 4.2	N.W. part of New York Harbour. Fog bell	4a	66	13	1839 1855
NEWARK BAY						
BERGEN POINT One fixed bright lt.	......	On a Reef, at entrance to Newark Bay. Fog bell	6a	40	10	1849 1853
Corner Stake	......	Fixed br. lt., opposite Eliz. Port	6a	..	..	1857
Passaic River	......	Fixed br. lt., at Mouth of River	6a	40	10	1849
Elbow	......	Fixed br. lt., ½ m. N. of Passaic Lt.	6a	..	..	1854

Name and Character of Light.	Lat. N. Long. W. ° ′	Description, &c.	Description of Apparatus	Height above H. W.	Visible in Miles.	Year established.
NEW JERSEY.						
BARNEGAT SHOALS One rev. br. lt., 10 secs.	39 45.8 74 6.7	Red and white tower, 159 feet high; S. side of Inlet........	1b	165	22	1831 1858
ABSECOM One fixed bright light	39 22. 74 25.6	Tower, 150 feet high, on S. side of Inlet..................	1a	167	22	1856
CAPE MAY LT. VES. Two fixed bright lts.	38 53.5 74 39.5	In 12 fathoms, on Five-Fathom Bank, 16 miles from C. May..	●	45 40	10	1839 1855
CAPE MAY One fixed and flash. br. light, 1½ min.	38 55.8 74 57.8	N. side Delaware Bay. (A tower, 150 ft. high, with 1a rev. br. lt. 1 m., is to replace the present)	1d	84	14	1823 1858
CAPE HENLOPEN Two fixed bright lights	38 46.6 75 5.4	S. side Delaware Bay. Lower lt. ¾ mile N.W. of Higher	1a 4a	180 33	20 10	1792 1855
DELAWARE BAY AND RIVER						
BREAKWATER One fixed & flash. lt.	38 47.9 75 6.1	Flash every 45 secs. Fog bell	4d.	47	10	1849 1855
BRANDYWINE SHOAL One fixed bright lt.	38 59. 75 7.3	Iron screw pile tower. Fog bell	3a	46	13	1850 1857
Maurice River	......	Fixed br. lt., S.W. of Haystack Id.	6a	45	10	1849
EGG ISLAND One fixed bright lt.	39 10.5 75 8.6	N. side of Bay................	5a	45	11	1837 1856
UPPER MIDDLE SHOAL, or CROSS LEDGE, LT. VESSEL	......	One fixed br. lt., W. side of main Ship Channel. Fog bell and horn	●	39	9	1845 1854
MAHON RIVER One fixed bright lt.	39 10.3 75 23.7	S. side of Bay	5a	30	9	1831 1855
COHANZEY One fixed bright lt.	39 20.3 75 21.7	W. side of Creek, N. side of Bay	5a	46	11	1838 1855
BOMBAY HOOK One fixed bright lt.	39 21.8 75 30.9	N.W. end	4a	46	11	1831 1855
REEDY ISLAND One fixed bright lt.	39 30. 75 34.4	S. Point. Fog bell	4a	55	12	1839 1855
CHRISTIANA RIVER One fixed bright lt.	39 43.3 75 31.4	At Wilmington, N. side........	4a	48	11	1835 1855
Fort Miffin	......	Fixed br. lt., on Pier. Fog bell	6a	28	7	1849
VIRGINIA.						
FENWICK ISLAND One fixed and flash. lt.	38 27. 75 4.1	White brick tower, fixed lt., with flash every 2 min.	3d	86	15	1858
ASSATEAGUE ID. One fixed bright light	37 54.6 75 21.7	Between Chesapeake and Delaware Bays, 2 m. from S.W. Pt.	3a	80	14	1833 1856
HOG ISLAND One fixed bright light	37 23.3 75 42.2	W. Point	4a	60	13	1852 1855

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Name and Character of Light.	Lat. N. Long. W. ° ′	Description, &c.	Description of Apparatus	Height above H. W.	Visible in Miles.	Year established.
CHESAPEAKE BAY						
CAPE CHARLES One rev. br. lt., 1 m.	37 7.8 75 52.8	N.E. of Smith Id., N. entrance. (A new tower, 150 ft. high, building.)	1b	69	14	1827 1858
CAPE HENRY One fixed br. light	36 55.5 76 0.8	S. side of entrance	2a	129	17	1791 1857
HAMPTON ROADS WILLOUGHBY SPIT LT. VESSEL Two fixed br. lts.	......	S. of entrance to Hampton Roads	●	48 35	11	1847 1857
OLD PT. COMFORT Two fixed br. lts.	37 0. 76 18.7	One on N. side of entrance to James' River; the other on S.W. Point	4a 6a	48 21	11 5	1802 1855
CRANEY ISLAND SHOAL One fixed bright lt.	......	W. side of entrance to Elizabeth River, near Norfolk. Fog bell and horn	5a	52	12	1820 1859
Naval Hospital	......	Fixed bright light, on the Wharf	6a	..	6	1857
JAMES RIVER						
White Shoal	......	Fixed br. lt., below Sandy Point	6a	27	9	1854
Point of Shoals	......	Fixed bright light, on the Shoal	6a	27	9	1854
Deep Water Shoals	......	Fixed bright light, on the Shoal	6a	27	9	1854
Jordan's Point	......	Fixed bright light	6a	35	10	1854
CHERRYSTONE INLET One fixed bright lt.	37 15.5 76 3.	W. side of entrance	4a	36	10	1859
BACK RIVER One rev. br. lt., ½ m.	37 5. 76 21.	S. side of entrance	4b	35	10	1829 1854
York Spit Lt. Vessel	......	Fixed br. lt., in 4 fms., off Spit	●	40	9	1855
NEW POINT COMFORT One fixed bright lt.	37 18. 76 17.1	N. side of Mobjack Bay	4a	60	13	1804 1855
WOLFTRAP SHOALS LT. VESSEL Two fixed br. lts.	......	E. side of Shoal, between York and Rappahannock Rivers	●	30 38	10	1821 1854
Stingray Point One fixed bright lt.	37 33.6 76 14.7	S. side of Rappahannock River	6a	36	7	1859
WINDMILL PT. LT. VES. One fixed bright lt.	......	S.E. part of Shoal, N. side of Rappahannock River	●	34	10	1834 1854
WATTS ISLAND One fixed & flash lt.	37 46.9 75 53.8	S. end; E. entrance to Tangier Sound	5d	46	12	1833 1857
MARYLAND.						
JANE ISLAND LT. VES. One fixed bright lt.	......	Off end of Bar, Tangier Sound	●	30	10	1853

Name and Character of Light.	Lat. N. Long. W. ° ′	Description, &c.	Description of Apparatus	Height above H. W.	Visible in Miles.	Year established.
CHESAPEAKE BAY AND RIVERS						
SMITH PT. LIGHT VES. Two fixed bright lts.	......	S.E. entrance of Potomac River	●	35 39	10	1821 1857
FOG POINT One fixed bright lt.	38 2.7 75 2.8	Smith Island, entrance of Potomac River	5a	30	10	1827 1855
CLAY ISLAND One fixed bright lt.	38 13.9 75 58.1	Entrance of Nanticoke River	6a	36	10	1832 1855
LOOKOUT POINT One fixed bright lt.	38 2.3 76 19.6	N. side of entrance to Potomac River	4a	37	10	1831 1857
HOOPER'S STRAITS LT. VESSEL One fixed br. lt.	......	S. of Hooper's Island..........	●	34	10	1827 1856
COVE POINT One fixed & flash. lt.	38 23.1 76 23.2	4 miles N. of Patuxent River. Flash every 1½ min.	4d	46	11	1828 1857
SHARP ISLAND One fixed bright lt.	38 37.7 76 22.5	N. Point; entrance of Choptank River......................	5a	41	10	1838 1855
THOMAS POINT One fixed bright lt.	38 54.4 76 27.6	4 miles S. of entrance to Annapolis	4a	63	12	1825 1857
GREENBURY POINT One fixed bright lt.	38 58.5 76 26.9	N. side of Annapolis Harbour ..	6a	50	11	1848 1855
SANDY POINT One fixed & flash. lt.	......	Flash every 1½ min. Appears as fixed lt. only within 10 miles	5d	50	12	1858
PATAPSCO RIVER						
SEVEN FOOT KNOLL One fixed br. light	39 9.3 76 23.9	Entrance to Patapsco River	4a	43	11	1855
NORTH POINT Two fixed br. lts.	39 11.6 76 26.2	N. side of entrance............	6a	33 42	10 11	1824 1856
FORT CARROLL One fixed br. light	39 11.8 76 26.6	On the Fort. Fog bell........	3a	37	10	1854
LAZARETTO POINT One fixed br. light	39 15.6 76 34.6	N side of Baltimore Harbour ..	4a	35	10	1831 1855
POOLE ISLAND One fixed br. light	39 17.4 76 15.7	Off Gunpowder River. Fog bell	4a	35	10	1825 1855
SUSQUEHANNA R.						
TURKEY POINT One fixed br. light	39 26.9 76 0.2	N. side of entrance to Elk and Susquehanna Rivers	4a	65	12	1833 1855
FISHING BATTERY One fixed br. light	39 29.6 76 4.6	On the Battery	6a	36	10	1853
HAVRE DE GRACE One fixed br. light	39 32.4 76 4.8	Concord Point, entrance of Susquehanna River	6a	40	10	1825 1857
POTOMAC RIVER						
PINEY POINT One fixed br. light	38 7.6 76 32.5	E. side, about 14 miles N.W. of Mouth	5a	35	10	1836 1856

Name and Character of Light.	Lat. N. Long. W. ° ′	Description, &c.	Description of Apparatus	Height above H. W.	Visible in Miles.	Year established.
POTOMAC RIVER						
Blakistone Island One fixed br. light	38 11.3 76 43.	Entrance of Clement Bay	4a	46	11	1851 1856
Lower Cedar Pt. Lt. Vessel One fixed br. lt.	......	Between Cedar and Yates Points	●	22	8	1825
Upper Cedar Pt. Lt. Vessel One fixed br. lt.	......	Off the Point, opposite Tobacco River	●	28	10	1851 1856
Fort Washington	......	Fixed bright light, on the Wharf	6a	..	6	1857
Jones Point One fixed br. light	38 47.5 77 3.2	Near Alexandria..............	5a	35	10	1855
Bowler Rock Lt. Vessel	......	Fixed bright light	●	..	5	1835
NORTH CAROLINA.						
BODY'S ISLAND One rev. br. lt., 1½ min.	35 47.3 75 31.3	1½ mile S. of new Inlet	3b	90	15	1857
CAPE HATTERAS One flash. br. lt., 15 s., and one fixed br. lt.	35 15.2 75 30.5	Flash. light, 2 miles N. of high water; fixed light, 500 yards from Point	1o 3a	150 25	20 6	1798 1857
PAMLICO SOUND						
OCRACOKE ID. One fixed bright lt.	35 6.5 75 58.5	W. end........................	4a	75	15	1823 1854
Royal Shoal Lt. Ves.	......	One fixed br. lt., on S.W. Point	●	43	11	1826
Royal Shoal	......	Fixed and flash. lt., on N.W. Pt.	4d	33	11	1857
Harbour Id. Lt. Ves.	......	Br. lt. on Bar, between Pamlico and Core Sds.	●	34	10	1836
Brant Id. Shoal Lt. V.	......	Br. light, S. part of Pamlico Sd.	●	45	11	1851
Neuse R. Lt. Vessel	......	Bright light, off Marsh Point ..	●	38	11	1828
Pamlico Point One fixed bright lt.	35 19.4 76 31.3	S. side of Pamlico River	5a	37	11	1828 1856
Long Shoal Lt. Ves.	......	Fixed br. lt., on E. Point. Bell, &c.	●	46	11	1854
Roanoke Marshes One fixed bright lt.	......	Pile lighthouse, between Pamlico and Croatan Sounds. Fog horn	4a	33	11	1825 1857
Roanoke Id. Lt. Ves. One fixed bright lt.	......	Between Pamlico and Albemarle Sounds. Fog bell and horn..	●	31	10	1835 1854
Wade Point One fixed bright light	......	White Pile lighthouse, on end of Shoal, W. side of Pasquotank R., Albemarle Sound	5a	31	10	1855
Roanake River Lt. Ves.	......	Fixed bright lt., near entrance..	●	41	11	1835
CAPE LOOKOUT One fixed bright light	34 37.3 76 30.7	Red tower, 96 feet high, near the end of Cape	1o	156	22	1812 1859

D, &c.

Visible in Miles.	Year established.
11	1851 1856
8	1825
10	1851 1856
6	1857
10	1855
5	1835
15	1857
20 6	1798 1857
15	1823 1854
11	1826
11	1857
10	1836
11	1851
11	1828
11	1828 1856
11	1854
11	1825 1857
10	1835 1854
10	1855
11	1835
22	1812 1859

Name and Character of Light.	Lat. N. Long. W. ° ′	Description, &c.	Description of Apparatus	Height above H. W.	Visible in Miles.	Year established.
BOGUE BANKS Two fixed bright lts.	34 41.7 76 40.	Beaufort Harbour, near Fort Macon. In one, N.W. ½ W., and S.E. ½ E., ½ mile apart ..	4a 6a	50 30	13 10	1855
FRYINGPAN SHOALS LT. V. Two fixed bright lights	33 35. 77 50.	In 10 fathoms, 1 mile from Outer Shoal	●	40	12	1854
CAPE FEAR One fixed bright light	33 52.3 77 59.8	White tower, 92 feet high, on Bald Head, E. side of Cape Fear River, 4 m. from Cape ..	3a	107	16	1818 1855
FEDERAL POINT One fixed bright light	33 58.1 77 54.9	N. side of Inlet, N. of entrance of Cape Fear River..........	4a	46	12	1816 1855
CAPE FEAR RIVER						
OAK ISLAND Two fixed bright lts.	33 53.3 78 1.6	3 m. below Wilmington, N. ½ E., and S. ½ W., 267 yards apart	5a	37 27	9	1849 1855
PRICE'S CREEK Two fixed bright lts.	33 56.1 77 59.2	Entrance of Creek, W. bank of River......................	6a	25 35	9	1850
HORSE-SHOE LT. V. One fixed bright lt.	33 56.3 77 55.4	Between New Inlet and Price's Creek	●	43	16	1851
Campbell's, or Big. Id. One fixed bright lt.	34 6.9 77 56.	On S.W. corner	6a	25	9	1849 1855
Orton's Point One fixed bright lt.	34 3.4 77 56.2	W. Bank of River	6a	25	9	1849 1855
Upper Jetty Range Two fixed bright lts.	34 12.8 77 56.3	E. side of River, 3 miles below Wilmington, 267 yards apart	6a	42 65	8	1855

SOUTH CAROLINA.

Name and Character of Light.	Lat. N. Long. W. ° ′	Description, &c.	Description of Apparatus	Height above H. W.	Visible in Miles.	Year established.
GEORGETOWN One fixed bright light	33 13.5 79 6.7	White tower, 82 ft. high, at E. entrance to Pedee River	4a	85	14	1801 1854
Fort Point	......	Fixed bright light	5a	34	9	1858
CAPE ROMAIN One rev. br. lt., 1 min.	33 1.1 79 17.1	Raccoon Key. Striped red and white tower, 150 feet high ..	1b	150	23	1827 1857
BULL'S BAY One fixed bright light	32 55.7 79 30.5	White brick house, N. end of Island	4a	35	11	1852
RATTLESNAKE SHOALS LT. VESSEL Two fixed bright lts.	32 44.1 79 43.6	In 6 fathoms. Opposite N. end of Sullivan Island. Fog horn and bell	●	44	12	1854
CHARLESTON Two fixed bright lights	32 41.9 79 52.5	One on Id., W. of Ship Channel; the other in front of main lt.	2a 4a	133 50	20 10	1830 1857
CHARLESTON HARB.						
MORRIS ISLAND	......	Two fixed br. lts., 300 yds. apart	4a	55 40	10	1837
SULLIVAN Two fixed br. lts.	32 46.9 79 51.3	E. end of Battery on Island....	4a	45 50	10	1848 1857
FORT SUMTER	......	One fixed bright light	5a	57	10	1855
Castle Pinckney	......	One fixed *red* light	5a	50	10	1855
Battery Beacon	......	Gas light on E. end of Battery	..	45	..	1857

Name and Character of Light.	Lat. N. Long. W. ° ′	Description, &c.	Description of Apparatus	Height above H. W.	Visible in Miles.	Year established.
HUNTING ISLAND One rev. br. lt. ½ min., & One fixed bright light	32 24.5 80 24.5	On N. Point; and on W. side of entrance to St. Helena Island	2b 6a	108 39	17 ..	1859
Cambahee Bank Lt. Vess.	......	Intended, 1861	..	..	..	....
CALIBOGUE LT. VESSEL	......	Fixed br. lt., in 4½ fms., in Sound	●	30	10	1855
GEORGIA.						
MARTIN'S INDUSTRY LT. VESSEL Two fixed bright lts.	32 5.5 80 35.2	15 miles E. of Tybee Light. Fog horn and bell	●	44	12	1839 1855
TYBEE ISLAND Two fixed bright lts.	32 1.3 80 50.5	N.E. end, S. side of entrance to Savannah River; beacon lt. on Pt. of Tybee Id., ¾ mile E. of main light	2a 4a	108 62	16 12	1793 1856
SAVANNAH RIVER						
TYBEE KNOLL LT. VES.	......	Fixed bright light, N. of Id. Bell and horn	●	40	10	1848 1857
Cockspur Island One fixed bright lt.	32 1. 80 52.8	On a Knoll, E. end	6a	25	9	1849 1856
Oyster Beds	......	Fixed *red* lt., opp. Cockspur Id.	6a	35	9	1849 1856
Fig Island One fixed bright lt.	32 5. 81 3.6	On E. end, in Savannah River. Fog bell	6a	26	9	1848 1856
The Bay	......	Gas light, in Savannah city	..	77	9	1858
SAPELO ISLAND One fixed and flash. lt., One fixed bright light	31 21.5 81 24.	Tower, striped red and wh.; flash every 40 secs. S. end of Id.; N. side of Doboy Sound. Fixed light in front of former	4d 6a	74 50	14 11	1820 1854 1858
WOLF ISLAND Two fixed bright lights	31 18.2 81 20.3	Near N. end	6a	25 15	9	1822 1856
ST. SIMON ISLAND One fixed bright light	31 3.8 81 32.5	S. end, on N. side of St. Simon's Sound	3a	80	14	1811 1856
LITTLE CUMBERLAND ISLAND One fixed bright lt.	30 53.9 81 32.4	S. side of entrance to St. Andrew Sound, and Santilla River ..	3a	70	14	1838 1856
FLORIDA.						
AMELIA ISLAND 1. One rev. br. lt., 1½ m., and 1 fixed bright lt. 2. Two fixed bright lts.	30 39.4 81 30.9	1. Rev. lt., with fixed lt. in front of it, on N. end, and S. side of entrance to St. Mary's River. 2. Two fixed lts. on N. side of Id., leading into Fernandina Harbour	3b 6a	104 .. 60 35	17 6 12 9	1838 1856 1858
ST. JOHN'S RIVER One fixed bright light	30 21.7 81 27.5	S. side of entrance	3a	75	14	1829 1859
Dame's Point Lt. Vessel	......	Small lt. off Point, St. John's R.	a	..	5	1857

Name and Character of Light.	Lat. N. Long. W. ° ′	Description, &c.	Description of Apparatus	Height above H. W.	Visible in Miles.	Year established.
ST. AUGUSTINE One fixed and flash lt.	29 50.8 81 19.2	N. end of Anastasia Id., S. entrance to St. Augustine. Flash every 1½ min.	4d	68	14	1823 1854
CAPE CANAVERAL One rev. br. lt., 1 min.	28 27. 80 33.	White tower, 55 feet high, on N.E. part	..	65	14	1847
JUPITER INLET One fixed & flash. br. lt.	26 55.4 80 5.1	Tower, 10 feet high. Fixed lt., with flash every ½ min.	1d	146	18	1860
CAPE FLORIDA One fixed bright light	25 41. 80 3.	White tower, 96 feet high, on S. Point of Key Biscayne	2a	100	18	1825 1856
CARYSFORT One rev. br. lt., ½ min.	25 13.3 80 6.2	Dark tower, 112 feet high, on the Reef	1b	106	18	1852 1857
DRY BANK One fixed bright light	24 37.6 81 6.7	Red pile lt. ho., 149 ft. high, near Coffin Patches and Sombrero Key	1a	144	18	1857
SAND KEY One fixed and flash. lt.	24 26.5 81 51.2	Flash every 2 min. Dark tower, 121 ft. high, 7½ miles S.W. of Key West Lt.	1d	110	18	1826 1853
KEY WEST						
S.W. Point of Island One fixed bright lt.	24 33. 81 49.3	White tower, 50 feet high	3a	50	13	1825 1858
N.W. Passage One fixed bright lt.	24 37.1 81 55.2	On iron screw Piles, in 6 feet	4a	40	12	1838 1854
DRY TORTUGAS						
LOGGERHEAD KEY One fixed bright lt.	24 37.3 82 55.2	Round tower, 150 feet high, on centre of W. Key	1a	152	20	1858
GARDEN, or BUSH KEY One fixed bright lt.	27 37.3 82 53.7	On Jefferson Fort	4a	70	14	1825 1858
EGMONT One fixed bright lt.	27 36. 82 45.7	Entrance of Tampa Bay, on the Key	4a	45	12	1848 1857
CEDAR KEYS One fixed and flash. lt.	29 5.7 83 4.8	Flash every min. On E. Mound of Seahorse Key	4d	75	16	1854
ST. MARK'S HARBOUR One fixed bright light	30 4.4 84 10.6	E. side of entrance	4a	73	14	1829 1856
DOG ISLAND One rev. br. lt., 1 min.	29 46. 84 34.7	White tower, 44 ft. high, on E. side of Middle entrance to St. George's Sound	4b	48	13	1838 1856
CAPE ST. GEORGE One fixed bright light	29 36.2 84 58.6	White tower, 70 feet high, on the Cape	3a	77	15	1847 1857
CAPE ST. BLAS One rev. br. lt., 1½ m.	29 41.7 85 24.6	White tower, 50 feet high, 2 miles from S. Point of Cape	3b	96	16	1847 1858
PENSACOLA One rev. br. lt., 1 min.	30 19. 87 17.4	White tower, 160 ft. high, on S. side of entrance to Bay, near Barancas	1b	210	21	1824 1858

Name and Character of Light.	Lat. N. Long. W. ° ′	Description, &c.	Description of Apparatus	Height above H. W.	Visible in Miles.	Year established.
ALABAMA.						
SAND ISLAND 1. One fixed br. light 2. One *red* and br. fixed light	30 11.3 88 2.	1. Brick tower, 150 ft. high, 3 m. S.S.W. of Mobile Pt. 2. Beacon lts.; *red* lt. on E. Point, br. lt. on S. Point of Sand Id. Lighthouse, with red vertical stripe	1a ..	152 20	19 9	1838 1858 1854
MOBILE BAY						
MOBILE POINT 1. One fixed br. lt. 2. One fixed & flash. *red* light, and 1 fixed br. light	30 13.8 88 0.5	1. White tower, 53 feet high, on E. side of entrance to Bay. 2. Beacon lights	4a ..	58 20	13 9	1821 1858 1854
CHOCTAW POINT One fixed bright lt.	30 40.2 88 2.	White tower, 43 feet high, a little S. of Mobile city............	4a	45	11	1831 1857
Choctaw Pass	......	Two small beacon lights	..	15	3	1855
MISSISSIPPI AND LOUISIANA.						
MISSISSIPPI SD.						
ROUND ISLAND One fixed br. light	30 17.5 88 34.2	Off Pascagoula Bay	4a	51	12	1833 1856
E. PASCAGOULA R. One fixed br. light	30 21. 88 33.1	At Pascagoula................	5a	..	10	1854
SHIP ISLAND One fixed br. light	30 12.9 88 57.	On W. end	4a	51	13	1853
BILOXI One fixed br. light	30 23.7 88 53.2	W. entrance to Bay	4a	62	13	1848 1856
CAT ISLAND One fixed br. light	30 13.9 89 8.7	W. Point	4a	39	12	1831 1857
PASS CHRISTIAN One fixed br. light	30 18.9 89 14.	6½ miles N.W. of Cat Island Light	4a	42	12	1831 1857
MERRILL SHELL BK. One fixed br. light	30 14.3 89 13.9	A pile lighthouse, between Cat Island and Grand Island	4a	45	11	1860
St. Joseph's Island	......	Building, 1861	..	..	..	....
PROCTORSVILLE One fixed br. light	29 52.2 89 39.4	Lake Borgne	6a	39	10	1850
LAKE PONTCHARTRAIN						
PLEASANTONS ISLAND One fixed bright lt.	......	E. entrance of Lake, near Pearl River....................	4a	60	13	1838 1857
RIGOLETS One fixed bright lt.	30 9.4 89 38.1	E. entrance of Lake	5a	30	10	1855
BON FOUCA One fixed bright lt.	30 2.3 90 2.8	Near Mouth of Bay on Bon Fouca	5a	39	11	1843 1857
PORT PONTCHARTRAIN One fixed & flash. lt.	......	Near E. end of Railroad. Flash every 1½ min.	5d	35	10	1838 1855

Name and Character of Light.	Lat. N. Long. W. ° ′	Description, &c.	Description of Apparatus	Height above H. W.	Visible in Miles.	Year established.
LAKE PONTCHARTRAIN						
BAYOU ST. JOHN One fixed bright lt.	30 2. 90 4.	5 miles N. of New Orleans	6a	39	10	1811 1855
New Canal	......	Fixed bright light, at entrance..	5a	33	10	1838
Tchefuncta River	......	Fixed br. lt., near Madisonville	5a	38	11	1837
PASS MANCHAC One fixed bright lt.	30 17.8 90 12.7	S. side, between Maurepas and Pontchartrain Lakes	4a	45	10	1838 1857
CHANDELEUR ID. One fixed bright light	30 3.4 88 51.8	White tower, 50 feet high, on N. end	4a	50	13	1848 1855
MOUTHS OF MISSISSIPPI						
PASS À L'OUTRE One fixed bright lt.	29 8.6 89 1.5	Black tower, 69 ft. high, on Middle Ground Id., N. side of entrance	3a	77	15	1855 1858
GORDON ISLAND One rev. br. lt., 1½ m.	28 59.7 89 7.4	S. Point of Id. South Pass, S.W. side	3b	60	13	1831 1858
Deer Island One fixed bright lt.	......	At junction of S.W. and N.E. Passes	6a	..	5	1855
SOUTH WEST PASS One fixed bright lt.	28 58.5 89 21.	White tower, 68 ft. high, on W. side of entrance of River	3a	70	15	1831 1858
TIMBALLIER BAY One fixed bright light	29 4. 90 16.5	W. side, Grand Pass	4a	60	13	1858
SHIP ISLAND SHOAL One fixed and flash. lt.	28 55.1 90 55.9	Brown pile lighthouse. Fixed lt., with flash every ½ min.	2d	110	17	1860
S.W. REEF One fixed *red* light	29 25. 91 30.	On the Reef....................	4a	49	12	1859
SHELL KEYS One fixed bright light	29 20. 91 49.	Pile lighthouse, 81 feet high, on S. extremity................	3a	71	13	1859
SABINE PASS One fixed and flash. lt.	29 43.9 93 50.3	White tower, 75 feet high, on Brant Point, E. side of River. Flash every 1½ min.	3d	85	16	1856

TEXAS.

Name and Character of Light.	Lat. N. Long. W. ° ′	Description, &c.	Description of Apparatus	Height above H. W.	Visible in Miles.	Year established.
GALVESTON BAY						
BOLIVAR POINT One fixed bright lt.	29 22.6 94 45.7	Red tower, 89 feet high, N. side of entrance to Galveston Harb.	3a	100	16	1852 1858
Galveston	......	2 fixed br. lts., in range of Chan.	6a	..	10	1860
Galveston Beacons	......	2 fixed bright lts., in the city ..	6a	44	..	1856
Half-moon Shoal One fixed bright lt.	......	Between Pelican Id. and Dollar Point. Fog bell.............	6a	35	10	1854
Red Fish Bar	......	Fixed bright light. Fog bell ..	6a	35	10	1854
Clopper's Bar	......	Fixed bright light. Fog bell ..	6a	35	10	1854

Name and Character of Light.	Lat. N. Long. W. ° ′	Description, &c.	Description of Apparatus	Height above H. W.	Visible in Miles.	Year established.
MATAGORDA BAY						
MATAGORDA ID. One rev. br. lt., 1½ m.	28 21. 96 23.9	Tower, with bands, 79 feet high, on E. Point	3b	96	16	1852 1858
Siluria	......	Fixed bright light, on N. side	6a	33	6	1858
Half-moon Reef	......	Fixed br. lt., on E. end. Fog horn	6a	40	6	1858
Swash	......	Fixed br. lt., opp. Alligator Hd.	5a	38	6	1858
ARANSAS PASS One fixed bright light	27 53.4 96 56.5	Brown tower, 55 feet high, on Low Island, on N. side	4a	60	13	1856
BRAZOS SANTIAGO						
PADRE ISLAND One fixed bright lt.	26 6. 97 12.	S. Point, N. side of entrance	5a	35	10	1852
ISABEL POINT One fixed & flash. lt.	26 4.9 97 11.1	Flash every min. White tower, 57 feet high, on the Point	3d	82	16	1852 1857
Rio Grande	......	Building, 1861	..	..	..	....

Name and Character of Light.	Lat. N. Long. W. ° ′	Description, &c.	Description of Apparatus	Height above H. W.	Visible in Miles.	Year established.
ABACO One rev. br. lt., 1 min.	25 51.5 77 10.7	(British). White and red tower, 85 feet high, on S.E. Point, or Hole in the Wall	..	160	16	1848
NASSAU HARBOUR One fixed bright light	25 5.6 77 22.	(British). Stone tower, 58 feet high, on W. Point of Hog Id.	..	68	10	1847
GREAT ISAAC One rev. br. lt., ½ min.	6 2. 79 6.5	(British). Red and white tower, 145 feet high, on Island	●	158	16	1859
GUN KAY One rev. br. lt., 1½ m.	25 34.6 79 18.8	(British). Tower, 70 feet high, near S. Point	..	80	12	1836
KAY SAL BANK One fixed bright light	23 56. 80 28.5	(British). White and red tower, 58 feet high, on N. Elbow Kay	..	96	14	1839
KAY LOBOS One fixed bright light	22 22.8 77 35.8	(British). Red and white iron tower, 150 feet high, on Kay	1a	146	16	1860
TURKS ISLAND One fixed and flash. lt.	21 31. 71 7.7	(British). White tower, 60 feet high, 400 yards from N. end. Flash every ½ min..........	..	103	15	1852
CUBA (Spanish).						
ST. IAGO DE CUBA One rev. br. lt., 1 m.	19 57.5 75 58.8	E. side of Morro Castle	4b	223	20	1842
CRUZ CAPE One fixed bright lt.	19 50.2 77 45.3	Building, 1861	2a	106	15	....
JAGUA, XAGUA, or CIENFUEGOS HARB. One rev. br. light	22 1.2 80 40.3	Colorado Point, E. of entrance..	3b	81	14	1851
Batabano One fixed br. light	22 41.4 82 18.	Lantern, on a Mast.............	..	31	3	1847
ISLE OF PINES One rev. bright light	21 26. 83 6.	Proposed, 1861, on Cape Pepe ..	2b	111	16	....
SAN ANTONIO One rev. br. lt., 1 m.	21 51.8 85 1.3	Roncali Tower, 117 feet high, on the Cape	2b	107	20	1850
JUSTIAS One fixed & flash. lt.	22 43.3 84 6.5	Proposed, 1861, on the Kay	2d	129	16	....
GOBERNADORA One rev. bright light	23 0. 83 13.2	Proposed, 1861, on the Point ..	2b	111	15	....
HAVANA One fixed & flash. lt.	23 9.3 82 22.1	On Morro Castle, E. entrance. Flash every ½ min..........	1d	144	21	1847
Port Santa Cruz	......	Fixed bright light	..	..	7	1858
GUANOS One rev. br. lt., 1 m.	23 9. 81 42.	Proposed, 1861, on the Point ..	3b	92	..	....

Note.—The latitudes and longitudes on the Coast of Cuba are uncertain, probably to a considerable amount.

Name and Character of Light.	Lat. N. Long. W. ° ′	Description, &c.	Description of Apparatus	Height above H. W.	Visible in Miles.	Year established.
CARDENAS BAY One fixed & flash. lt. One fixed *red* & br. lt.	23 14.4 81 7.5	Flash. lt., red flash ev ry ½ min., on Piedras Kay. Fixed red and br. lt. on Anas Kay	4d	66 48	15 9	1857 1846
BAHIA DE CADIZ One rev. br. lt., 1 m.	23 13. 80 30.	Proposed, 1861, iron tower, 169 feet high, on the Kay	1b	175	20	....
Anguila One fixed & flash. lt.	23 29. 79 32.	Proposed, 1861, on S.E. Kay ..	4d	..	8	....
KAY PAREDONE GRANDE One fixed & flash. lt.	22 29.4 78 9.7	Iron tower, 128 feet high, on N. part. Flash every min.	1d	159	20	1859
NUEVITAS HARB. One rev. br. [illegible], 1 m.	21 39.6 77 10.9	Colon tower, 170 feet high, on Maternillos Point	1b	174	23	1849
LUCREZIA One rev. bright lt.	21 10. 75 38.	Building, 1861, on the Point ..	1b	112	15	....
CAPE MAYSI .... One fixed bright lt.	20 16. 74 7.	Building, 1861. [There is a temporary lt. at 53 ft., vis. 10 m.]	2a	124	15	....
JAMAICA (English).						
MORANT POINT One rev. br. lt., 1 m.	17 56. 76 11.2	White tower, 96 feet high......	..	115	15	1842
PLUM POINT One fixed *red* or br. lt.	17 55.7 76 47.	Red between W.N.W. ½ N. & N. ½ E. Br. from N. ½ E. to S.E.	..	68	12	1854
Fort Augusta One fixed *red* or br. lt.	17 57. 76 53.	Red to E.; bright to S. & W. ..	..	40	..	....
SANTO DOMINGO One fixed bright light	18 28.1 69 52.5	Tower, 100 feet high, on San Jose Fort	..	113	9	18[illegible]
PUERTO RICO One rev. br. lt., 2 min.	18 29. 66 7.1	Fort San Juan, on the Morro ..	2b	171	20	1846
SANTA CRUZ, or ST. CROIX ISLAND One fixed bright lt.	17 42.7 64 52.7	(Danish).	..	..	4	1857
ST. THOMAS One fixed bright light	18 19.4 64 55.1	(Danish). E. entrance, on Mohlenfels Point	..	95	12	1844
SOMBRERO	18 35.8 63 27.7	(British). Proposed, 1861, on the Island	..	..	..	....
ST. CHRISTOPHER One fixed bright light	17 18. 62 42.5	(British). On the Beach, at Basse Terre	..	37	12	1846
Montserrat	16 43. 62 12.	(British). 2 fixed br. lights for Mail Steamers, on the Beach at Plymouth	..	..	..	....
Antigua Two fixed br. lights, & One *red* light	17 0. 61 45.7	(British). Fixed triangularly, upper lt. red, for Mail Steamers	..	62	8	1843

Name and Character of Light.	Lat. N. Long. W. ° ′	Description, &c.	Description of Apparatus	Height above H. W.	Visible in Miles.	Year established.
GUADALOUPE (French).						
Moule de Port One fixed bright lt.	16 23.7 61 [illegible]	[Position uncertain].	..	..	7	1858
Pointe à Pitre	......	Lantern, S. of town	..	..	..	....
Muron Islet	......	Lantern	..	..	..	....
Grozier Islet	16 14.1 61 24.7	One fixed bright light	..	..	..	....
PETITE TERRE One fixed br. light	16 10.5 61 4.9	Tower, 75 feet high	3a	108	15	....
Dominica	15 18. 61 25.	(British). Light on Fort Young flagstaff....................	..	..	..	....
MARTINIQUE One fixed *red*, & 1 br. lt.	14 36.1 61 4.6	(French). Red lt. on Pointe de Nègres, in Fort. Br. light in Fort Royal, S.W. part	..	62 131	11 6	1855 ....
ST. LUCIA Three fixed bright lts.	14 0. 61 5.	(British). 2 lts. on Tapion Battery, S. entr. of Castries Harb.; 1 light on Wharf. For Mail Steamers	..	80	3	1843 1850
St. Vincent One fixed bright light	13 13. 61 15.	(British). On Fort Charlotte, for Mail Steamers	..	640	6	1858
TRINIDAD One fixed bright light	10 38.7 61 31.9	(British). In Port Espana, on the Jetty	..	50	5	1841
TOBAGO One fixed bright light	11 10. 60 44.	(British). Scarborough, on Bacolet, or Red Point..........	..	128	12	1842
BARBADOS (British).						
Carlisle Bay One fixed br. or *red* lt.	13 4. 59 37.2	Bright to S. of E.; *red* to N. of E.	..	34	5	1855
S. POINT One rev. br. lt., 1 m.	13 2.7 59 33.5	Red and white striped tower, 90 feet high	..	145	18	1852

GUAYANA.

Name and Character of Light.	Lat. N. Long. W. ° ′	Description, &c.	Description of Apparatus	Height above H. W.	Visible in Miles.	Year established.
Cayenne One fixed bright light	4 56.2 52 14.8	(French). On Infantry Barracks	..	69	8	1850
SURINAM LIGHT VESSEL One fixed bright light	6 4. 55 9.5	(Dutch). In 4 fathoms, off Bram Point....................	..	30	7	1858
BERBICE HARBOUR LT. VESSEL One fixed bright light	6 19.3 57 22.5	(British). Near E. Point of entrance	..	..	15	1850
DEMERARA (British).						
LIGHT VESSEL One fixed bright lt.	6 55.5 58 1.5	In 4 fms., 10 miles N.N.E. ½ E. from River entrance	..	..	12	1844
E. SIDE One fixed bright lt.	6 49.3 58 11.5	Red and white tower, 100 ft. high, on E. side of River entrance..	..	103	14	1829

Name and Character of Light.	Lat. N. Long. W. ° ′	Description, &c.	Description of Apparatus	Height above H. W.	Visible in Miles.	Year established.
TIERRA FIRME Orinoco River Lt. Vessel	8 37. 60 42.	Sunk in 1859. Not likely to be replaced	..	..	..	....
Puerto Cabello	10 29. 68 0.	(Venezuelan). Proposed, 1861	..	..	..	....
Tucacas One fixed bright light	10 47. 68 24.	(Venezuelan). Brava Point	..	30	9	....
BUEN AYRE One fixed bright light	12 2.5 68 23.5	(Dutch). Lacre Point, S. Point	●	85	12	....
LITTLE CURAÇOA ISLAND One fixed bright light	11 58. 68 44.	(Dutch). On S. side	●	62	10	1850
Great Curaçoa Island One fixed bright light	12 6. 68 59.	(Dutch). St. Ann Harbour, on Rif Fort	..	..	..	1850
Rio de la Hacha One fixed bright light	11 33. 72 59.	(New Granada). On the Church	..	69	6	1857
LIMON, or NAVY BAY, One fixed bright light	9 23.8 79 53.	(New Granada). N.W. part of Manzanillo Island	..	60	10	1852
HALF-MOON KAY One fixed bright light	17 12.3 87 32.4	(British). On S.E. Point	..	88	18	1848
Belize Three fixed bright lts.	17 19.6 88 4.	(British). S. side, on English Kay	..	95 75	3	1846
TURNEFF KAYS Three fixed bright lts.	17 36. 87 46.	(British). Fixed triangularly, on Mauger Kay, N.W. Point	..	95 75	13	1846
GULF OF MEXICO						
SISAL One fixed bright light	21 10. 90 3.	(Mexican). On the Castle	..	60	10	1852
Terminos de Laguna One fixed bright light	18 38.5 91 54.	(Mexican). In Indian village	..	75	..	1856
Coatzacoalcos River One fixed bright light	18 12. 94 17.	(Mexican). [Temporary light is shown while lighthouse is building, 1861.]	..	..	..	....
VERA CRUZ One rev. bright light	19 12.3 96 7.2	(Mexican). Fort San Juan de Ulloa	..	80	15	....
Tampico	22 15. 97 46.	(Mexican). Small light on N. Point, for Mail Steamers	..	..	..	....

Name and Character of Light.	Lat. N. Long. W. ° ′	Description, &c.	Description of Apparatus	Height above H. W.	Visible in Miles.	Year established.
Senegal One fixed bright light	16 0.8 16 31.	(French). Ile de St. Louis	..	..	6	....
Gorée Island One fixed bright light	14 39.9 17 24.8	(French). In the Fort	..	..	6	....
SIERRA LEONE One fixed bright light	8 30. 13 18.5	(British). White tower, 69 feet high, on the C[illegible]e. Gr[illegible] lt. at landi[illegible] p[illegible]	..	96	18	1849
MONROVIA One fixed bright light	6 19. 10 50.	(Liberian). [illegible]ed [illegible] feet high, on C[illegible]	..	240	15	1855
CAPE PALMAS One fixed bright light	4 22.1 7 44.3	(Liberian). T[illegible] high, on the Cape	..	110	13	....
CAPE COAST CASTLE One fixed bright light	5 6.3 1 13.9	(British). White tower, 46 feet high, in Fort William	..	192	20	1847

ATLANTIC ISLANDS.

Name and Character of Light.	Lat. N. Long. W.	Description, &c.	Description of Apparatus	Height above H. W.	Visible in Miles.	Year established.
BERMUDAS. One rev. br. lt., 1 min.	32 15.1 64 51.6	A white iron tower, 106 ft. high, on Gibbs Hill, on S. side. Seen all round, except between S. 48° W., and S. 52° W.; and also S. 53° W. to S. 62° W. ..	●	362	24	1846
CANARY ISLES.						
Santa Cruz One fixed bright light	28 28.6 16 14.9	(Spanish). Teneriffe Island; on Mole Head	..	36	5	1857
Anaga	27 35.2 16 5.7	Teneriffe Island. Proposed light on the Islet, 1860	..	..	..	....
Grand Canary Island One fixed bright light	28 7.1 15 24.8	On the Mole, Palma town......	..	..	..	1859
AZORES, or WESTERN ISLANDS.						
St. Michael Proposed fixed light	37 44. 24 41.2	(Portuguese). At Santa Clara Fort. Punto Delgada	..	..	..	....

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SECTION III.

GENERAL OBSERVATIONS ON THE WINDS, TIDES, AND CURRENTS; AND ON THE DIFFERENT PASSAGES OVER THE NORTH ATLANTIC OCEAN.

1.—OF THE WINDS.

GENERAL REMARKS.—(1.) The study of the winds is the most important branch of Marine Meteorology. It has ever been a favourite subject for speculation, but man's finite powers and limited views have hitherto failed to give us a complete and satisfactory view, in all respects, of that vast system of aerial circulation by which this globe is made fit for an habitation. Within the last ten years, however, the subject has assumed a new form, and more definite results have been arrived at; so that much that was before difficult to be understood, is now made perfectly demonstrable. Still, however, doubts may be permitted as to whether the data hitherto collected and arranged are of that exact nature which will allow those certain deductions necessary for a scientific axiom, and therefore, even now, we are not in a position to assert that the circulation of the atmosphere is carried on in all particulars under the systems which are now recognized as correct.

But as the sailor deals not with speculation, but applies the facts of nature to his use, the mode in which the whole mass of the atmosphere is interchanged and mingled is important to him only as a field of observation which he enjoys with the rest of mankind. The present object being practical utility, the theory of the winds will be very briefly alluded to here, leaving the reader to those numerous and voluminous works now extant on these subjects for a more full elucidation of them.

(2.) As a broad and primary principle, it may be affirmed, the complete circulation of the atmosphere, by which any particle of the air has in its course, passed over every portion of the earth's surface, is demonstrated by the fact that the air is composed of precisely the same elementary constituents in every part of the world. This fact was experimentally demonstrated by the French Academy of Sciences many years since, who had bottles of air most carefully collected in all regions and submitted to the most rigid analysis, which failed to discover any difference whatever. It is manifest in a natural sense also, by its supporting animal and vegetable life universally in the same manner. If it were not so, the air over a special region would, in the course of ages, have become subject to the emanations and influences of the earth it covered. The same remark holds good also with the water of the ocean, equally universal in its definite characteristics, and from the same cause, as will be shown hereafter. The manner in which this is carried on is still involved in some mystery.

(3.) In the year 1686, Edmund Halley* proposed the Theory of the Trade Winds and Monsoons, which is now generally received as an approximation to the true solution. He afterwards altered his views, which were revised and extended by George Hadley in 1735.† The following is a brief summary of them:—

* Philosophical Transactions, xvi. 153. † Ibid., 1735, p. 58.

(4.) The sun is constantly vertical over some part of the earth between the tropics, and this zone is consequently maintained at a much higher temperature than the regions nearer the Poles. This heat on the earth's surface is imparted to the air, which is, therefore, displaced and buoyed up from the surface, and the colder, and therefore heavier, air from without glides in, on both sides, along the surface; while the displaced air, thus raised above its due level, and unsustained by any lateral pressure, flows over, as it were, and forms an upper current in the contrary direction, or towards the Poles; which being cooled in its course, and also sucked down to supply the deficiency in the extra-tropical regions, keeps up thus a continual circulation.

Since the Equator revolves much more rapidly than the portions nearer the Poles, it follows, that a mass of air flowing towards the Equator must be deficient in rotary velocity, and, therefore, unable to keep up with the speed of the new surface over which it is brought. Hence these currents from the North and South must, as they glide along the surface, at the same time lag or hang back, and *drag upon* it in the direction *opposite* to the earth's rotation, *i.e.*, from East to West. Thus, from simple northerly and southerly winds, they become permanent *north-easterly* and *south-easterly winds*.

The lengths of the diurnal circles increase very slowly near to the Equator, and for several degrees on each side of it hardly change at all. It follows from this, then, that as these winds approach the Equator, their easterly tendency must diminish; and at the Equator must be expected to lose their easterly character altogether. And not only this; but the northern and southern currents, here meeting and opposing, will mutually destroy each other, leaving only the actions of local causes, which may lie in one region in one way, and in another a different one.

The result of this, then, is the production of two great tropical belts of north-easterly and south-easterly winds, while the winds in the equatorial belt which separates the two former should be free from any steady prevalence of an easterly character, and should also be comparatively calm. All these consequences are agreeable to observed fact, and constitute the system of the regular *trade winds*.

(5.) The constant friction of the earth upon the air near the Equator, it may be objected, would, by degrees, destroy the rotation of the whole mass; but it is compensated in this manner. The heated equatorial air, rising and flowing off toward the Poles, carries with it a rotatory velocity much greater than that of the surface over which it passes in its northward and southward progress. Hence it will gain more and more on the surface of the earth, and assume more and more a *westerly* relative direction; and when, at length, it necessarily returns to the surface in its circulation, which it must do, more or less, in all its course, it will act on it by its friction as a powerful S.W. wind in the northern hemisphere, and a N.W. wind in the southern, and thus restore the equilibrium. This is the origin of the S.W. and westerly gales so prevalent in our latitudes, and of the almost universal westerly winds in the North Atlantic.*

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* *Sir John Herschel* gives the following note in his work, upon the origin of storms, which, as it is most feasible, we give here; it must be observed, that it was written before the views and observations of Reid, Redfield, and others, had been published. We shall advert to it hereafter.

"It seems worth inquiry, whether hurricanes in tropical climates may not arise from portions of the upper currents prematurely diverted downwards before their relative velocity has been sufficiently reduced by friction on, and gradually mixing with, the lower strata; and so dashing upon the earth with that tremendous velocity, which gives them their destructive character, and of which hardly any rational account has yet been given. Their course, generally speaking, is in opposition to the regular trade wind, as it ought to be, in conformity with this idea.—(*Young's Lectures*, i. 704.) But it by no means follows, that this must always be the case. In general, a rapid transfer, either way, in latitude, of any mass of air which local or temporary causes might carry *above the immediate reach of the friction of the earth's surface*, would give a fearful exaggeration to its velocity. Wherever such a mass would strike the earth, a hurricane might arise; and should two such masses encounter in mid-air, a tornado of any degree of intensity on record might easily result from their combination."—*Astronomy*, p. 132. The more recent views of Sir John Herschel will be found in their place hereafter.

(6.) Now it will be seen, that by this theory the trade winds *meet* near the Equator, leaving a belt of calms of various breadth between them. According to Commander Maury, the winds here being neutralized rise up and cross each other; the wind brought by the S.E. trade passing over N.E. trade as a S.W. upper current; and, having passed the calms or variables of the Tropic of Cancer, it appears as the ordinary anti-trade or S.W. prevalent wind. The chief physical fact upon which this theory is based is the red dust, found frequently to fall on vessels near the Cape Verdes, and in the Mediterranean, where it is called sirocco dust (as coming from the South). This red dust was found by Ehrenberg to consist of microscopic infusoria and organisations, whose habitat, *as far as was known*, is in South America. But this argument may be demurred to from the limited extent this dust falls upon compared with the vast area from which it is said to be derived.

(7.) There is another great difficulty in the reception of this theory, in the great breadth, in some parts, of that intervening band of calms that these supposed currents are to cross each other. In the eastern part of the Atlantic, it is from 300 to 600 miles in breadth. If this great interchange of directions were continually going on with such a vast amount of atmosphere, we may safely conclude that the lower strata would not be characterized by the calms or "doldrums" they are known by.

(8.) The more reasonable argument, in the present state of our knowledge, is, that the trade winds reaching this belt of calm, by far the greater part of this indraught will rise on its own side, and revert towards the pole of its own denomination in a precisely opposite direction to that by which it arrived. In the parts of the equatorial regions, where this intervening calm belt is much narrower, as on the East coast of America, this crossing may take place, and the upper currents pass on towards the poles of *contrary* names. At all events, this view of the circulation of the atmosphere will satisfy our first proposition,—that every particle of air has been so commingled with the rest that it produces the universality of character which is demonstrated to exist. These theories are practically unimportant to the sailor in his profession, but are highly interesting* to him as a subject of observation and reflection.

It has been held by many that the solar heat, combined with the revolution of the earth, is sufficient to account for the general phenomena of the winds; but there are still some difficulties in the way of accounting for some of the periodical winds which are found to recur with great regularity. This has been reasoned for by Mr. Hopkins, who argues that the Trade wind at times blows towards areas of great condensations; in other words, that a great rain-fall occasions a corresponding indraught†. Another agent in giving the easterly direction to the Trade winds, suggested by Commander Maury to be Magnetism; but this subject, of the magnetism of the air and the influence of the solar heat on it, is as yet hidden too much in obscurity to draw any certain deductions therefrom.

(9.) There is one feature of the atmosphere which has been involved in some obscurity, or, at least, has been the subject of controversy. It is the condition of *aqueous vapour*, at all times present in the air. It is a very important question, as upon this water-bearing property of the air, evaporation, condensation, and rain depend, and consequently climate and fertility to the earth. The doubts may be briefly stated. The eminent chemist, Dalton, demonstrated that one gas (and aqueous vapour is such) could permeate or exist in connexion with another gas without displacing its bulk, and that water was thus diffused through the atmosphere without increasing its volume. Therefore, in estimating the height of the barometer, account must be taken of the amount (or weight), and elasticity (or tension) of the vapour, and *subtracted* from the height of the mercury, to give the true weight of the dry air. With a dew point temperature of 87° 35′ the pressure of moisture is equal

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* See further on these subjects, Maury's "Physical Geography of the Sea, 1860," pp. 149, 175. Sir John F. W. Herschel, Ency. Brit., 1859, xviii. 577. Captain Basil Hall, "Fragments of Voyages and Travels," 2nd series, i. 162.

† Mr. Hopkins: "The atmospheric changes that produce Rain and Wind;" also see Journal R. Geog. Soc. 1856, pp. 158, et seq. See also D. Vaughan, U.S., in Brit. Association Report, 1860, p. 41.

to the weight of 1.26 inches of mercury, and must be *subtracted* from the height shown by the barometer, as above stated. This is the view held by Dalton, Ure, Regnault, Daniell, Sir Henry James, &c.

In opposition to this, Professor Patton, of Bombay, maintained that moisture did *displace* an equal or equivalent volume of air, and that therefore it was only the difference of their amount which should be applied as a correction, and he estimated the amount of vapour above stated to be equal to a pressure of only 0.518 of an inch of mercury. But the first theory is thought to be the most feasible.*

(10.) Leaving the field of conjecture, we come to the actual condition of the atmosphere which covers the North Atlantic Ocean in particular, and generally the whole earth. Its elevation or weight is ascertained by the barometer, as is well known. According to the decrease in the height of the mercury on ascending to great elevation, it is calculated that at 15 miles the air is rarefied to about 25,000 times, and at 80 or 90 a perfect vacuum exists. It presses with a mean force 14.73 lbs. per square inch, and forms one 1,125,000th part of the mass of the whole earth. The Trade winds do not reach more than to 3 miles in height, and it is probable that all the phenomena of clouds and vapours occur beneath the height of 4 to 5 miles.

(11.) If the surface of the earth were evenly covered with land or water, or a combination of both, the phenomena of the Trade and Anti-Trade winds would form symetrical zones around the globe; but the relative proportions are very different in the two hemispheres, being 100 land to 150 water in the northern, and 100 to 628 in the southern.† There is a still greater contrast, if we take the horizon of London as a great circle dividing the earth into two hemispheres. It will be then seen, that London is in the centre of that half which includes all the land, except Australia; and the other half all the water of our globe. From this cause the line of meeting between the N.E. and S.E. Trades is in all seasons *northward* of the Equator in the Atlantic; and, from the land influences on the Trade winds to the N.E. of Africa, there is a wide space of calms, or doldrums, whose base lies against that continent, and its apex stretching toward the coast of Brazil, as is readily seen by the illustration of the Trade winds diagram, which will explain far better this peculiarity than a verbal description.

(12.) The *force* with which the wind blows is the chief consideration of the sailor, in connexion with the study of the subject. This force is readily measured in a fixed observatory, or on board a ship at anchor; but not so when she is under sail, as it is manifest that she is then apparently feeling less wind than is actually blowing, from being drifted before it. We have had some singular accounts of some of the fine clipper ships scudding at an immense rate before a gale which has been marked as of no extraordinary violence, while other ships, dull sailors, have been dismasted or disabled by the fury of the same gale, from their not being able to bear away before its great velocity. Therefore the *recorded* force of the winds met with at sea should be subject to this qualification,—what are the sailing powers of the ship which has recorded them. We have no *standard* of sea-rates for the wind as yet. Perhaps it would add to the value of such observations if the sailing powers of all ships engaged in adding to our knowledge were tested when both close hauled and running free upon a wind of known velocity.

In former times the vague terms of breeze, gale, hurricane, &c. sufficed to describe the relative character of the wind. The late Sir Francis Beaufort devised a system of simple notation which more exactly defined these forces, and which is now in universal use at sea. The figures prefixed indicate the estimated character of the wind:—

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* See "Abstracts of Meteorological Observations by the Royal Engineers, 1853, 4," by Sir Henry James, R.E., F.R.S.

† The dry land, as far as it is known, is estimated to occupy 49,806,000 square statute miles. If this is increased to 51 millions for the unknown polar regions, it will allow 146 millions of square miles to be covered by the ocean.—*Sir J. Herschel.*

(*Beaufort Notation.*)

0 Calm.	6 Top gallant sails over single reefs.	10 Close reefed main top sail and reefed fore sail.
1 Steerage way.	7 Two reefs in topsails.	11 Storm stay sails.
2 Clean-full from 1 to 2 knots.	8 Three reefs in top sails.	12 Hurricane.
3 Ditto 3 to 4 knots.	9 Close reefed top sails and courses.	From 2 to 9 being supposed* "close hauled."
4 Ditto 5 to 6 knots.		
5 With royals ("close hauled").		

(13.) The *wind over the land* is found to be generally of much less force and velocity than at sea, so that the Beaufort notation was found inconvenient for land purposes; Mr. Glaisher, therefore, has proposed another notation for this use, which is now adopted at Greenwich, Liverpool, and indeed at most of the principal observatories. It divides the force into the numbers 1 to 6, which have been proportioned to the Beaufort scale as follows:—

(*Glaisher Notation.*)

1. Moderate (Beaufort scale..	1—2)	4. Heavy ..(Beaufort scale....	7—8)
2. Fresh....(————..	3—4)	5. Violent....(————..	9-10)
3. Strong ..(————..	5—6)	6. Tremendous(————..	11-12)

(14.) The actual force and velocity of the wind has been calculated by Sir W. Snow Harris, by an improvement of Lind's Anemometer, by which he found air moving 20 feet in a second presses on 1 square foot with a force of about 13 oz. avoirdupoise, or at 50 feet per second it would support a column of water 1 inch high, the pressure force increasing very nearly with the square of the velocity. With these data the table on the following page has been calculated:—

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* In addition to the *figures*, showing the force of the wind, the state of the weather is to be understood by *letters*, as follows:—

Letters indicating the state of the Weather (*Beaufort Notation*).

b Blue Sky.	m Misty (hazy).	u Ugly (threatening) appearance of Weather.
c Clouds (detached).	o Overcast.	v Visibility. Objects at a distance unusually visible.
d Drizzling Rain.	p Passing Showers.	w Wet (Dew).
f Foggy.	q Squally.	
g Gloom.	r Rain.	
h Hail.	s Snow.	
l Lightning.	t Thunder.	

NOTE.—A bar (—) or dot (.) under any letter augments its signication:—thus $\underline{f}$ very foggy, $\underline{r}$ heavy rain, $\underset{\cdot}{\underline{r}}$ heavy and continuing rain, &c., &c.

TABLE, *showing the Force and Velocity of the Wind from light Airs to heavy Gales, and Tempests.*

Pressure in lbs. on Square Foot.	Velocity. Feet per Second.	Velocity. Miles per Hour.	Popular Descriptions.
0·002	1	0·68	Gentle airs (unappreciable by gauge). (*Beaufort scale*, 1).
0·004	1·47	1	
0·019	3	2	Light airs (just appreciable by gauge); would fill the lightest sail of a yacht (2).
0·032	3·9	2·66	
0·043	4·5	3	
0·065	5·28	3·6	Light breezes; such as would fill the lightest sails of a large ship (3).
0·071	5·87	4	
0·090	6.6	4·5	
0·100	6·98	4·75	
0·112	7·34	5	
0·130	7·89	5·38	
0·162	8·8	6	
0·228	10·4	7	
0·260	11	7·6	
0·291	11·8	8	Moderate breezes, in which ships can carry all sail (4).
0·364	13·2	9	
0·390	13·6	9·27	
0·452	14·7	10	
0·521	15·8	10·77	
0.551	16·2	11	
0·650	17·66	12	
0·780	19·3	13	Fresh breezes,—topgallant sails and royals (5).
0·830	20·	13·6	
0·884	20·6	14	
0·910	20·9	14·25	
1·042	22	15	
1·170	23·6	16	
1·250	24·2	16·5	
1·302	25	17	Fresh winds; reefs (6).
1·470	26·5	18	
1·563	27·39	18·67	Strong winds; treble reefed topsails (7).
1·630	28	19	
1·790	29·35	20	
2·084	31·15	21·47	Gales; close reefed topsails and reefed courses (8).
2·600	35·32	24	
3·126	38·73	26·40	Strong gales; close reefed topsails, and stay sails (9).
3·647	41·83	28·52	
4·168	44·83	30·56	
4·689	47·44	32·34	
5·200	50	34	
7·800	61·18	41	Heavy gales and storms (10).
10·400	70·72	48·2	
13·000	79·07	53·91	
20·800	100	68·18	Very heavy gales; great storms; tempests (11).
26·000	111·74	76·18	
31·200	122·62	83·6	
41·600	141·30	90·34	Tornadoes; cyclones; hurricanes (12).
52·000	157·98	107·7	
62·400	173·06	120	

There is no doubt that these figures may be open to some doubt, as the subject is a difficult one, and they are given independent of the different forces exerted by aqueous vapour and by air. Sir Henry James has also given a table, more complicated, but which does not very materially differ from the above, which will suffice for the sailor's use.

(15.) In estimating the *diminishing* pressure on the barometer during the progress of a gale, it is rather difficult to understand how the force which must, in some degree, *compress* the air, and therefore make it more dense and heavy, besides the idea that such a force may tend to heap up the atmosphere in some part of the area, can show a *less* weight of air. There is one view which has not been made prominent,—that the *horizontal* force exerted by the progress of the wind may lessen its downward vertical force or pressure in the same way that a railway train in quick motion does not deflect a bridge as the same train would do if going slower; or as a skater can pass swiftly over ice that would infallibly break with his weight when quiescent; or as the apparently anomalous loss of gravity in the gyroscope when in motion. However, these considerations have no effect on the phenomena of a falling barometer with a rising wind.

(16.) The *alternation of the sea and land breezes* in warm latitutes is an important feature in coast navigation. Its cause is generally well understood. It is owing to the different powers of radiation and absorption of heat possessed by land and water. So that, generally, when the day temperature is highest on the land, the strongest will be the alternating breezes. During the day the radiation of the sun's heat on the land causes the air to expand and rise from the surface, and then the sea air rushes in to fill the void. It frequently occurs that the surface of the soil will show a temperature of 120° under the meridian sun, and sinks to 50° or 60° during the night; while the sea, rarely having a higher temperature than 80°, and, from being a bad radiator, fluctuates but very little, it follows that it is alternately warmer and colder than the land, and hence the phenomena in question. The minimum temperature of the 24 hours being a little before sunrise, and the maximum about 2 p.m., the change of these breezes occurs generally at some little time after those hours.

(17.) The wind decidedly veers round the compass according to the sun's motion, *i.e.*, from N. through N.E., E., S.E. to S., and so on, often making a complete circuit in that direction, or more than one in succession, (perhaps occupying many days in so doing,) but it rarely veers, and very rarely or never makes a complete circuit in the contrary direction. This has been shown by Professor Dove to be the direct consequence of the rotation of the earth; and, although the observation was recorded by Lord Bacon in 1600, it is now known as *Dove's Law of Gyration*.*

(18.) Professor Coffin, from his elaborate discussions, thinks himself authorized to lay down, as a general description of the winds of the northern hemisphere,—1st. That from high northern latitudes the winds proceed in a southerly direction, but veer towards the west as they approach a limit ranging from about lat. 56° on the western continent to about lat. 68° on the eastern, where they become irregular and disappear. The area of this zone is about 11,800,000 square miles. 2nd. That further south there is a belt of westerly winds, less than 2,000 miles in breadth entirely encircling the earth; the westerly direction being clearly defined in the middle of the belt, but gradually disappearing as we approach the limits on either side. The area of this zone is estimated to be about 25,870,000 square miles. 3rd. That south of the zone last named the mean direction of the wind is easterly. This area is estimated to contain 60,760,000 square miles.† Professor Dové contends that there are but two Systems, the 1st and 3rd of the foregoing.‡

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* When speaking of the wind veering *with* the sun, of course the shifting of the cyclonic winds in the northern hemisphere is not included.

† "Winds of the Northern Hemisphere;" by Professor Coffin, A.M. Pennsylvania, U.S. "Smithsonian Contributions to Knowledge," vol. vi. 1854.

‡ See Report, Brit. Asso., 1845. See also Professor Mitchell in American Journal of Science and Arts, vol. xix. p. 254. A great amount of information will be found on the

(19.) The *wind regions* of the North Atlantic may be thus defined:—To the north of the Tropic of Cancer are the *Anti-Trades*,* *or Passage Winds*, which, though variable, have a general N.E. tendency. South of these is a belt of calms and variable winds, distinguished by a high barometer, called by Commander Maury the "*Calms of Cancer*," known to sailors as the "horse latitudes." This belt varies between 30° and 35° north, according to the season. South of this, and extending to about 8° to 5° north, but varying in its southern as in its northern limits, is the great region of the *N.E. Trades*. In the space between the Equator and this region of Trades are the "*Doldrums*," or calms, of the Equator; and upon the African coast there is a regular alternation of the winds, similar to the Monsoons in other parts. Each of these regions will be treated of separately.

(20.) In the spaces which separate these wind systems those hurricanes, tornados, typhoons, or cyclones occur, which are caused by the action of currents of air moving in opposite directions; their phenomena are farther controlled by the influence of the land they approach or pass over. This important branch of the present subject is fully considered hereafter, but the occurrence of storms is an exceptional case in the vast system of of atmospheric circulation we have been considering.

THE TRADE WIND.

(21.) The region of the Trade winds occupies nearly one-half of the entire surface of the globe. From their constancy and regularity, they form by far the most important part of the circulatory system of the atmosphere, although generally their strength is inferior to many of those smaller but compensating currents which are experienced in extra-tropical regions.

(22.) The source from which the ensuing *statistics* of the various winds described, is the extensive collection of observations recorded in the *Pilot Charts* of Lieut. M. F. Maury, U.S.N., published in 1849. This immense mass of figures has been analyzed and placed in a graphic form by the Meteorological Department of the Board of Trade, under the direction of Rear-Adml. FitzRoy (Aug. 1855). It has also been done by the Royal Netherlandish Meteorological Institute, which has been foremost in advancing the good cause of this investigation. On our Chart of the North Atlantic Ocean, in four sheets, to which this Work especially refers, these wind records are also arranged in a simple and comprehensive graphic form. The observations on the Trade winds of the globe, collected in Maury's Chart, amount to 1,159,353; for those of the North Atlantic, 220,000.

(23.) The **North-east Trade Wind** blows over the tropical region between lat. 36° N. and the Equator, seldom, however, reaching these extremes. When uninterrupted by gales or hurricanes, caused by the disturbing influences of land or rain, it is a fair weather region that procured for it the term of "The Lady's Gulf" by the old Spaniards. From the difference 0.055 inches in the observed mean barometric pressure by the Dutch in the N.E. and S.E. Trades, between the parallels of 5° and 20°, which is 29.968 inches for the former and 30.023 for the latter, it is inferred by Capt. Maury that the greater pressure in the S.E. Trades indicates a greater

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general subject in the works of Kämtz and Romme, who have also laboriously studied and generalised the phenomena of the winds, and to whose labours much that is here said is owing. But by far the largest collection of observations, arranged in order, is contained in Capt. Maury's "Pilot Charts," before alluded to, which are well known to all sailors.

* This term, Anti-Trades, is adopted by Sir John Herschel: it is expressive and appropriate. By others they have been named *Counter-Trades*, which designation may more exactly define the upper currents *over* the Trade Winds. They have also been vaguely called "The Variables," a term which is best confined to the characteristic of the belts of calm or shifting winds about the Tropics.

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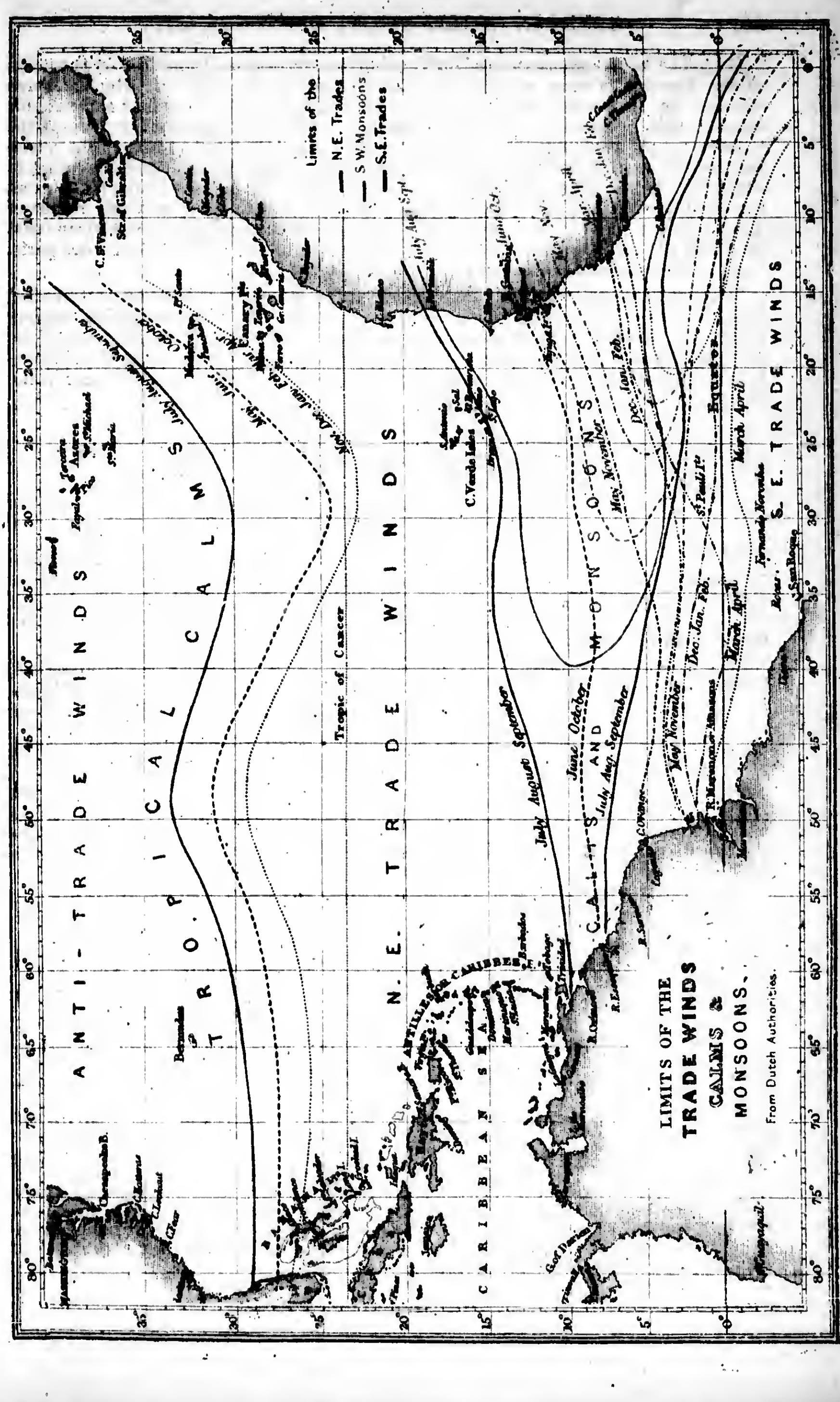

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force and velocity* than the N.E. Trades. This, as investigated by Commander Maury, has been indicated by the rate of vessels daily passing through them. He has compared the sailings of 2,235 vessels, and finds that the homeward bound vessels cross the Trades of the North Atlantic with the wind abeam at an average rate of 5.6 knots per hour, and across the Trades of the South Atlantic at an average of 6 knots. As the latter is with the wind generally dead aft, he argues that this rate would be increased 2 or 2½ knots with the wind on the beam, and make the difference still more evident. The comparative duration of each of these winds in the Atlantic is thus given by Capt. Maury:—

Between Latitudes.	N.E. Trades.		S.E. Trades.	
	Mean Direction.	Annual Duration.	Mean Direction.	Annual Duration.
0° and 5°	N. 48° E.	76 days	E. 34° S.	308 days.
5 10	N. 46 E.	118 „	E. 41 S.	329 „
10 15	N. 47 E.	208 „	E. 37 S.	305 „
15 20	N. 46 E.	197 „	E. 34 S.	253 „
20 25	N. 43 E.	167 „	E. 34 S.	163 „
Means	N. 46 E.	153 days	E. 36 S.	272 days.†

(24.) The N.E., like the S.E., Trade wind, blows over a wider area in the eastern part of the Atlantic than on the American side, as at the meridian of 10° W. they extend from 35° or 38° N. to 25° or 28° S.; while on the American side the N. limits is 28° or 30° N. to 23° or 25° S.: but on the Eastern side the intervening space of calms is much wider. The extent and limits will be best comprehended by an inspection of the diagrams adjoining, which are formed from the tabular statements drawn up by Commander Maury and by the Dutch Meteorological Institute. They will explain better the various lines and fluctuations than would be done by a long series of words.

(25.) The *Northern limit* of the N.E. Trade wind, as will be seen, extends on the eastern side of the Atlantic, that is off the coast of Africa, to lat. 35° as a mean, in August and September, being then at its greatest northern extent; but it is frequently encountered when in lat. 38°, or sometimes even at 40°. To the westward of the meridian of 30° the northern edge seldom extends northward of 33° or 34°, while toward the Bahamas the northern limit is 30° N. This extreme northern declination appears to be attained in August and September, as has been said above, when following the sun in its southward course it reaches its southern limits in March or April. In January its mean limit on the eastern side is about the Canaries; over the eastern half of the Atlantic in about 25° N.; in the centre about 22° N., and on the Bahamas it seldom vibrates to any great extent throughout the year.

* It is generally argued, that less barometric pressure indicates increased force of wind, and not the reverse, as is here argued; but from the following note it will be seen that these pressures are more nearly alike than is stated above.

† As this table is founded on the assumption that the Equator is the division between the two wind systems, instead of the parallels of 5° to 9° N., as is really the case, it cannot be taken as a fair comparison of their relative duration. If the parallel of 5° N. be taken as a division, the mean barometric pressure in the N.E. Trades is 30.057 in., and in the S.E. Trades 30.034 in., making the latter the least. If the winds recorded between 0° and 5° N. be added to the S.E. Trades, it will give a mean duration of 239 days, and make the N.E. Trades 230 days.

(26.) The extent of variation between the northern edge of the Trade winds when first encountered, as shown by Maury's Trade Wind Charts, seems to be as much as 10 degrees of latitude,—a wide range of probability,—and in many cases there appears from these Charts to be as much chance of meeting them in one latitude as another. Of course this is taking into account the belt of calms and variable winds usually (but not always) found on the edge of the Trades, which will be spoken of presently.

(27). The *Southern edge of the N.E. Trade* wind is limited in the eastern part by that broad region so embarassing to the sailor known as the "doldrums," or especially during the northern summer months by a set of winds blowing towards the coast of Africa, known of old as the West African S.W. Monsoon. This wedge-shaped area, whose apex reaches in July to 40° or 45° W., extends on the African coast at that period from 50° N. to 16° or 17° N. To the west of this there is still a belt of almost constant rain, "under the equatorial cloud ring," which, however, is much narrower, and, perhaps, at times may not be encountered, called the Equatorial calms. The Trade wind is at its southerly limit in March and April, reaching in mid ocean sometimes to 3° S., but seldom so far as 3° N. on the E. side. It remains there for two or three months, and then advances northward till August and September, when it is seldom found south of the parallel of 9° N.; indeed this parallel may be taken as the mean limit of the N.E. Trades. This northern division of the Trade wind is owing to the unequal distribution of land in the two hemispheres (11).

The following useful Table is that drawn up by the late Capt. Horsburgh, as the limits usually found in the track generally pursued by the East Indiamen :—

TABLE, *showing the Equinoctial Limits of the N.E. and S.E. Trade Winds, between the Meridians of* 18 *and* 26 *degrees West.*

N.E. TRADE WIND.			S.E. TRADE WIND.		INTERVAL BETWEEN.
CEASES.	General Extremes.	Probable Mean.	General Extremes.	Probable Mean.	Mean Breadth.
In January at......	3° to 10° N.	5° N.	0½° to 4° N.	2¾° N.	2¼ degrees.
February	2 to 10 N.	4 —	0½ to 3 —	1¼ —	3½ „
March	2 to 8 —	4¾ —	0½ to 2½ —	1¼ —	3¾ „
April	2½ to 9 —	5 —	0 to 2½ —	1¼ —	3¾ „
May	4 to 10 —	6½ —	0 to 4 —	3½ —	4 „
June	6½ to 13 —	8½ —	0 to 5 —	3 —	5½ „
July	6½ to 14 —	11 —	1 to 6 —	3½ —	7½ „
August	11 to 15 —	13 —	1 to 5 —	3¼ —	9¾ „
September	9 to 14 —	11½ —	1 to 5 —	3 —	8½ „
October	7½ to 14 —	10 —	1 to 5 —	3 —	7 „
November	6 to 11 —	8 —	1 to 5 —	3 —	4½ „
December	3 to 7 —	5½ —	1 to 4½ —	3¼ —	2¼ „

(28.) The *direction of the N.E. Trade wind* is an important nautical consideration. Its mean direction in the circuit of the earth is estimated at N. 47° E., but it varies considerably under the influence of the land, and especially so in the N. Atlantic. As mentioned above, the Trade wind blows much more from the northward to the eastward of long 25°,—that is, within 400 or 500 miles of the African coast,—than it does in the open ocean. Between the Canaries and Cape Verdes, during the northern summer months, it blows from N.N.E. and N.E. for 55 days out of every 100.

During the winter months, from January to March, the wind in the neighbourhood of Cape Verde draws very much toward the land, or from N.W. and W. This point will be more discussed in a later part of this Work.

(29.) In order more fully to exemplify the duration and direction of the Trade wind the adjoining diagrams have been selected from the Chart of the North Atlantic

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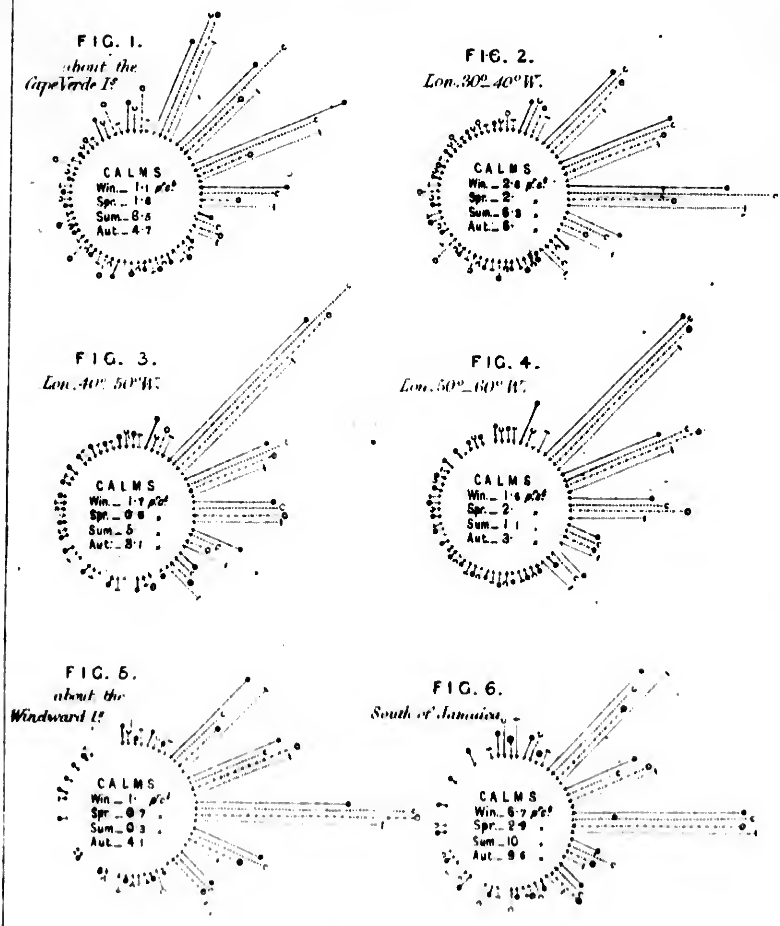
Diagrams illustrating the direction of

THE N.E. TRADE WIND,

between Latitudes 10° & 20° N.



The arrows represent winds blowing toward the centre

Winter: Jan. Feb. Mar. — Spring: Apr. May June — Summer: July Aug. Sep. — Autumn: Oct. Nov. Dec.

The length of the arrows is proportionate to the frequency of that wind

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Ocean. They will show the particulars of the wind between the parallels of 10° and 20° N.; that is, in the main strength of the N.E. Trades. They have been adapted from Maury's Pilot Charts, as appeared before (22), and will show the per centage of winds from any quarter in each of the four *calendar* seasons; and also the amount per cent. of calms encountered. The plate will explain the different arrows, indicating the seasons, which are supposed to represent winds blowing *toward* the centre of the circle, because the winds take their name from the quarter *from* whence they come. Their length is proportioned to the duration or frequency, according to the scale attached; so that by applying the compasses to any one of the arrows it will give, according to the scale, the amount of wind *per cent.* for that direction. These arrows are given for 16 points of the compass, omitting the "by" points; and in each season these arrows altogether make up the length of 3 inches, that of the scale given.* In the centre of each diagram is given the amount per cent. of *calms* encountered in the respective seasons. As the *force* of the winds is not given in the Pilot Charts this register of the calms is the more important, as it is the only scale we can apply to the force of this wind; as, by analogy, we may argue that where calms predominate there also do light and baffling winds, and the reverse.

(30.) An analysis of the wind-roses in Capt. Maury's Chart, from which these diagrams are constructed, will give the following figures as the prevalence and direction of the winds along the main strength of the N.E. Trades in the N. Atlantic. It must be premised, however, that these figures, as well as the data from which they are derived, will give only a general view of the phenomena likely to be encountered, and the *chances* per cent. that a ship will have of meeting with similar winds or calms. The figures in these columns give the number of days (or observations) the wind blows in *each hundred*, from the respective directions :—

Fig. 1.—*In the neighbourhood of the Cape Verde Islands.*

	Between N. & E.	E. & S.	S.&W.	W.&N	Mean.	Frequent.	Calms.
Winter	73	12	10	7	N.E.	E.N.E.	1.1
Spring	76	18	4	2	N.E.	N.E., N.N.E.	1.8
Summer	70	14	4	12	N.N.E.	N.N.E.	8.5
Autumn	63	22	6	9	N.E.	E.N.E.	4.7

Fig. 2.—*Between Lats.* 10° *and* 20° *N., and Longs.* 30° *and* 40° *W.*

Winter	45	41	2	2	E. by N. ½ N.	East	2.5
Spring	48	48	2	2	E.N.E.	East	2.
Summer	48	32	12	8	E.N.E.	N.E. to E.	6.3
Autumn	32	51	9	8	E. by N.	East	5.

* There is one remark which it is necessary to make here respecting these wind observations (220,000 in number). They have been taken from a vast quantity of different log-books, whose remarks are not made with that definite accuracy necessary for scientific precision. A slight inspection of the figures given on the diagram, or of the Board of Trade Charts, will show that in these data the direction of the wind is loosely and indefinitely given throughout. Thus, a wind between N. and E. is set down as a N.E. wind, &c., &c., and not so often as a N.N.E. or E.N.E. as must really occur. Consequently, the arrows representing those principal or cardinal points are longer than they ought to be, and the intermediate ones shorter; in fact, they form a zig-zag or irregular curve around the centre: whereas it is manifest that this curve should be somewhat symmetrical, and that the wind blows from the intermediate points in some regular ratio to those on either side of it. Until we get more exact records added together in great numbers, as has been done in the Pilot Charts with these imperfect logs, it is plainly futile to draw any precise or refined conclusions from their teaching. This is not said to underrate their value. To the sailor, who only requires a generally exact knowledge of the subject, they teach as much almost as he requires to know as to the direction of the wind. The *force* is still a desideratum.

Fig. 3.—Between Lats. 10° and 20° N., and Longs. 40° and 50°. W.

	Between N. & E.	E. & S.	S.&W.	W.&N	Mean.	Frequent.	Calms.
Winter	60	26	8	6	N.E. ½ E.	N.E.	1.7
Spring	70	25	0	5	N.E. by E.	N.E.	0.6
Summer	63	29	4	4	N.E.byE.¾E.	N.E.	5.
Autumn	50	34	4	2	N.E. ½ E.	N.E.	3.1

Fig. 4.—Between Lats. 10° and 20° N., and Longs. 50° and 60° W.

Winter	66	22	7	5	N.E. by E.	N.E.	1.6
Spring	65	30	2	3	N.E.byE.½E.	N.E.	2.
Autumn	63	31	4	2	E.N.E.	N.E., E.N.E.	1.1
Summer	59	29	2	0	N.E.byE.¾E.	N.E.	3.

Fig. 5.—In the East part of the Caribbean Sea, near the Windward Isles.

Winter	42	46	0	2	E. by N. ½ N.	East.	1.
Spring	35	63	2	0	E. ½ N.	,,	0.7
Summer	33	61	3	3	East.	,,	0.3
Autumn	44	51	2	3	E. by N.	,,	4.1

Fig. 6.—In the West part of the Caribbean Sea, South of Jamaica, &c.

Winter	47	42	6	5	E. by N.	N.E., E.	6.7
Spring	42	50	8	0	E. by N.	E.	2.9
Summer	44	56	0	0	E.N.E.	E.	10.
Autumn	54	43	3	0	E.N.E.	N.E., E.	9.6

(31.) In examining the figures in these tables, and the illustrative diagrams, it will be seen by Fig. 1, that the wind about the Cape Verde Islands, or that part of the Atlantic most frequently crossed by vessels from Europe, that the mean direction of the Trade wind is to the northward of N.E.; and further, that calms and light airs are more prevalent than farther to the westward, especially in the summer and autumn months, July to December, in the former season. It has always been held that the wind draws more to the eastward as you get to the westward of the usual crossing of the Equator, and this an inspection of Fig. 2 will verify, when it is seen that the mean direction is South of E.N.E., and that the calms, taking the year round, are less frequent.

Whether the Cape Verde Archipelago has an influence in thus causing the Trade to assume a more easterly direction to the westward cannot very well be determined; but it is certain that this E.N.E. direction is not maintained between longitude 40° and the West Indies, as Figs. 3 and 4 show that winds hold persistently to the N.E., or a little to the S. of it, although winds to the northward of N.E. are very rare. It is probable, also, that the winds recorded from the other directions are exceptional.

The easterly direction of the Trade wind in the Caribbean Sea will be readily noticed. It will be further remarked on in the observations on the winds of the West Indies hereafter.

(32.) The calendar seasons of northern latitudes are here taken as the quarters of the year. In the American Charts these seasons are made to include the month before the usual reckoning: thus, Winter begins with December; Spring, with March, &c. Perhaps the latter mode of division would be rather more applicable to the tropical phenomena than that here chosen, because it appears that the changes in the inter tropical seasons (to which, however, the terms Winter, Spring, &c., are not applicable) seem rather to coincide with the American calculation. But as these changes are certainly not simultaneous in the northern latitudes, and, as including such a difference would involve some confusion, the ordinary terms used to designate European seasons is here adhered to as being readily comprehended and sufficiently exact.

(33.) The following summary of Trade winds was given by Commander Maury in connexion with his "Wind and Current Chart":—

"There is a marked difference in the prevailing direction of the wind, not only according to the season of the year, but also according to different parts of the ocean, including even those parts which are between the same parallels of latitude, but in different longitudes.

"As a general rule it may be remarked, 1st, that in the North Atlantic the nearer to the coast of Africa and the Equator, the more the so-called N.E. Trade winds haul to the South.

"2nd. That to the West of lon. 45°, between 20° and 30° N., the N.E. Trades blow much more steadily in May, June, July, and September, than they do the rest of the year; and that during the other months, particularly in March, they blow between these parallels nearly alike from all points of the compass.

"3rd. That between lat. 15° and 20° N. they are most variable; West of lon. 35° in the months of September, October, and November; while to the East of 30°, between the parallels, they are most variable in February, March, April, and October.

"4th. That between lat. 10° and 15° to the West of 35°, they are steadily between E.N.E. and S.E., except in July, August, September, October, and November, when they are more variable, being most variable in the three montes first named. To the East of 35° W., between these parallels, they may be said to lose their trade character during the months of July, August, September, and October, particularly in August and September, when they blow nearly alike from the four quarters. Calms, too, are more frequent here in these months.

"5th. That between the Equator and 10° N., to the East of lon. 30°, the winds assume a new feature. It may be said, almost literally, that in this part of the ocean they uniformly blow, when they blow at all, during the months of July, August, and September, from some point between S.E. and W. They blow most between S. and W.S.W., and very rarely from any point between N. and E.S.E. To the West of this meridian, during the same months, they blow most between S.E. and N.E., inclining more and more to the North as you go West. These are the months in which the winds vary most in this part of the ocean."

To the foregoing general remarks the following, respecting particular localities within the scope of the Trade wind, are added. Further application of them will occur in the Instructions for making passages, &c.

(34.) **WINDS ON THE ATLANTIC ISLES.**—The winds upon and near the different islands in the Atlantic Ocean are very variable and uncertain, especially where the land is high and irregular. In general, regular sea and land breezes alternately prevail; the sea-breeze by day and the land-breeze by night, as the land is alternately heated and cooled: but the direction of these breezes is varied by the quality and figure of the land, and other local circumstances. If the land be very high, it generally intercepts the prevailing wind, and so affects the air as to produce, on the lee-side, either a calm, a gentle breeze in an opposite direction, or a kind of eddy, which is sometimes very troublesome to shipping. Such is the case under the western part of Madeira, and to leeward of the Canary Islands; the Grand Canary being so high as to stop the current of the N.E. wind, which prevails there; and on the eastern side there is a calm, or a gentle breeze from S.W.

The calms and eddy winds, occasioned by the figure and height of the Canaries, extend from 10 to 30 leagues beyond them to the S.W., according to the height of the respective islands. The boundary of the calms may be seen: for, within them, the water is smooth; without them is the regular undulation of the sea, caused by the general wind; and, at the edge of them, the winds, by setting in opposite directions, produce a breaking of the waves, with a foam, like the billows on a rocky shoal, just beneath the surface of the ocean.

From a consideration of the particulars now described, the cause of those copious dews which fall in the night, on the islands, &c., situated within the tropics, will be apparent. For, as the great power of the sun by day causes an extraordinary evaporation of the ocean, so, in the night, the exhalation, ceasing to retain the same degree of levity acquired from the heat of the sun, becomes, by the absence of the power which produced it, so dense and heavy as again to fall back to the earth. The air, at the same time, cooling, by the same cause, is also affected by the descending moisture, and thus acquires an additional tendency to increase the land-breeze.

(35.) **WEST INDIES** IN GENERAL.—The following description of the winds prevailing over these regions, in the different seasons, has been extracted chiefly from Captain Livingston's translation of the *Derrotero de las Antillas*, or Spanish Directory for the West Indies, now included in the *Colombian Navigator*.

On the eastern coasts of America, and among its islands, the course of the general easterly or Trade-wind is uninterrupted, though subject to some modifications in direction and force. At a short distance from the land the sea-breeze calms at night, and is replaced by the land-breeze: this variation happens every day, unless a strong wind prevails from the northward or southward; the first of these being experienced from *October* to *May*, and the second in *July*, *August*, and *September*.

The general easterly wind, of the tropical regions, is felt on the coast of Guyana and on the coasts of the Colombian and Mexican Seas, but with variations which may be denominated *diurnal* and *annual*. The diurnal period is that which the *sea-breeze* causes, and which strikes the coast usually at an angle of two points, less or more according to the locality and other circumstances; and then the *land-wind*, which, coming from the interior, always blows off shore. The sea-breeze comes on at about nine or ten in the forenoon, and continues while the sun is above the horizon, increasing its force as that luminary augments its altitude, and diminishing in a similar proportion, as the sun's altitude decreases. Thus, when the sun is on the meridian, the sea-breeze is at the maximum of its strength; and at the time that the sun reaches the horizon this breeze has, perceptibly, ceased. The land-breeze commences before midnight, and continues until the rising of the sun; sometimes longer. A space of some hours intervenes between the land-breeze ceasing and the sea-breeze coming on, during which there is a perfect calm.

The *annual period* of the Trade-wind here is produced by the proximity or distance of the sun, which occasions the only two seasons known in the tropics, the *rainy* and the *dry* seasons. The first is when the sun is in the tropic of Cancer, and heavy rains with loud thunder are prevalent. In this season the wind is generally to the southward of East, but interrupted by frequent calms, yet it occasionally blows with force, and obscures the atmosphere.

When the sun removes to the tropic of Capricorn the dry season commences, and then the Trade-wind, which is steady at N.E., is cool and agreeable. At this season, N. and N.W. winds are sometimes found, blowing with much force; and, indeed, in some degree, they regularly alternate with the general wind, as they are more frequent in November and December than in February and March.

In the change of the seasons there is a remarkable difference: for in April and May no change is experienced in the atmosphere, and the weather is, in general, beautifully fine; but in August, September, and October, there are usually calms, or very light winds: and dreadful hurricanes, in these months, sometimes render the navigation perilous. From these perils, however, are generally exempted the Island Trinidad, the coasts of Colombia (late Terra Firma), the Bays of Darien and Honduras, and the Bight of Vera Cruz, which the hurricanes seldom reach. In the space of sea between the greater Antillas* and the coast of Colombia, the general N.E. or Trade-wind regularly prevails; but near the shore local peculiarities are found.

(36.) It has been remarked, by *Captain F. Chamier*, of the British Navy, that "about BARBADOS and the WINDWARD ISLANDS, from Tobago to Barbuda, the wind will be found to veer more to the northward in the early part of the year, than in the months of June, July, and August. In the more northerly islands, as Dominica, Montserrat, Antigua, Nevis, &c., the wind, in the evenings of January, February, and March, veers round to about N. or N.N.E.; blows fresh in squalls; and, from the extensive space of ocean over which it travels, becomes cool and very refreshing. The thermometer, even in English Harbour, Antigua, in the above months, at eight o'clock p.m., I never saw above 76°. In this season of the year the sickness of the hot months is no longer experienced; the general lassitude of the mornings and noons of July and August seems forgotten; and no man who visited these islands during the first three months of the year would believe that the change of seventy or eighty days could make such an amazing difference in the look, as well as in the energy, of the inhabitants of the Windward Islands. In the change of seasons, from wet to dry, a great difference is experienced in the winds. In April and May the atmosphere is, in general, clear, and fine weather prevails; but in August, September, and October, calms, or very light winds, are not uncommon, and strong hurricanes blow in these months.

At the GREATER ANTILLAS the sea-breeze constantly prevails by day, and the land-breeze by night. These land breezes are the freshest which are known, and assist much in getting to the eastward or remounting to windward, which, without them, would be almost impossible. At the Lesser Antillas, as Dominica, Martinique, St. Lucia, &c., there are no land-breezes.

(37.) **JAMAICA.**—At JAMAICA the air is, in most places, hot and unfavourable to European constitutions; but the cool sea-breezes, which set in every morning, render the air more tolerable: and that upon the high grounds is temperate, pure, and cooling. It lightens almost every night, but without much thunder: nevertheless, when the latter happens, it is very terrible, and roars tremendously.

On the northern side of the island the sea-breeze from the south-eastward comes on in the morning and gradually increases until noon, when it is strongest: at two or three in the afternoon its force diminishes; and, in general, it entirely ceased by five o'clock. About eight in the evening the land-breeze begins: this breeze extends to the distance of four leagues to the southward from the island. It increases until midnight, and ceases at about four in the morning.

The sea and land-breezes are more regular than otherwise from the latter part of January until May. In the middle of May the sea-breeze generally prevails for several days and nights, especially about the time of full and change of the moon; and thus they continue throughout June and part of July; from that time the sea-breeze diminishes, varies, and veers round to S. by W., or S.S.W., with frequent calms. August, September, and October, are the hurricane months, in which there generally are strong gales of wind, with much rain.

In December, January and February, when the North winds predominate, their force checks the sea-breeze. The southern coast is that which, of course, is least exposed to these winds, being sheltered, in a great measure, by the mountains. When combined with the land-breeze they render the air very cold and unhealthy.

During the months of July and August the sea-breeze about the island generally blows impetulously, and in frequent squalls. At this season vessels bound hence to Europe would have the most advantageous passage through the Strait and Stream of Florida; but in October northerly winds frequently extend over all the Bahamas, Cuba, and, for some time, on the North side of Jamaica; but the current of air is forced upward by the mountains of the latter, and its strength is spent in the heights. In seasons when it is more impetuous, it rushes through the windings and defiles of

* Cuba, Jamaica, Hayti, and Porto-Rico.

the mountains upon the northern coast, particularly in the neighbourhood of Kingston, and has been known to continue for some days.

During the winter, the land-breeze is more general off the shores than in summer: it sometimes continues throughout the day as well as night; and westerly winds prevail over all the space between Jamaica and Cuba, and even to the Island of Hayti or St. Domingo. They have been experienced from Port-Royal, through the Windward Channel; but this is not generally the case.

In November, southerly winds prevail on the South side of the island, and have been known to extend from the Mosquito shore, whence vessels have arrived in five or six days that might, at other times, have been as many weeks, when beating against the sea-breeze. The southerly winds are generally faint; nor do they come upon the land until it be heated by the sun, and are often expelled by a fresh land-breeze soon after mid-day, which abates in a few hours.

The return of the sea-breeze, falling sooner or later in Autumn, is gradual: first approaching at the East end, then advancing a little; and, in some years, it reaches Morant Point fourteen or twenty days before it is felt above Kingston. It also blows for a week or two later on the East end of the island than at Kingston; and has been known, in some years, to prevail there in the day time during the whole time it was unfelt at the foomer place.

(38.) **The Bahama Islands** are all within the influence of the Trade-winds. Their lowness, of course, exempts them from the regular land wind, but in the summer season a light breeze frequently comes from the Florida shore in the night, and reaches the western side of the Little Bahama bank, but no farther. At this period the wind generally prevails to the southward of East, and the more so as their north-west extreme is approached; the weather is then very variable, and squalls rush down with great violence, accompanied with heavy rains and an oppressive atmosphere. They are within the zone of hurricanes, and a year seldom passes without their being visited by a heavy gale at least, from the S.E., which inflicts serious damage both on shore and at sea.

In the winter months, from about November to the middle of March, the Trade wind is frequently interrupted by N.W. and North winds. In December and January this may be expected almost weekly. Previously to this change the wind will draw round to the South and S.W. About 24 hours after, or less, dark masses of clouds will be seen rising from the westward, and in a short time the wind will rush down suddenly from that quarter with the force of a double or triple-reefed top-sail breeze. It will soon veer round to the N.W. and North with clear weather, and remain between these points two or three days. It will then haul gradually to the N.E., perhaps with increased force, accompanied by heavy squalls, and wear itself out at East in the course of a few days. The barometer is scarcely any guide.

(39.) Among the local winds are to be ranked the BAYAMOS, violent gusts which blow from the land on the South side of Cuba, and are so termed from being felt more severely off the Bight of *Bayamo* or *Buena Esperanza*, than off any other part of the coast.

When heavy and dense clouds gather over the mountains, a Bayamo blast may be expected: after this, the surest prognostic is the thunder, which invariably precedes the gust: it is, therefore, advisable to take in all sail with the greatest expedition, so soon as the first or most distant clap of thunder is heard, the wind following it almost immediately. Fortunately, however, these dreadful squalls are of short duration; but, as a repetition of them frequently occurs at intervals of half an hour or an hour, great attention is necessary, especially during the night, to prevent the ship's being unprepared; as it is almost certain, that, if she were overtaken by one of these squalls whilst under sail, she would either upset or lose her masts.

These sudden tempests are attended with sheet and forked lightning, vivid in the extreme; and the flashes, following each other in quick succession, have the momentary effect of illuminating every object, and leave behind them a sort of blue indescribable appearance; the sea is whitened with foam, and the rain falls in torrents, surpassing any, perhaps, witnessed in other regions; for it appears as if the clouds had opened their store of waters to deluge the earth: in fact, we cannot better describe the extreme heaviness of the shower, than by giving the sailor's observation on it, namely, that it "comes down by buckets full." The Bayamo squall, however, although the most awful of any in the Caribbean Sea, and creating much anxiety to those exposed to his fury, is grand and sublime.*—*Lieutenant Evans*, "Revision of Geographic Terms," p. 107.

(40.) On the COASTS of GUYANA, the *Derrotero* again continues, there are no land-breezes, nor more wind than is generally experienced between the tropics. In January, February, and March, the winds here blow from North to E.N.E., and the weather is clear. In April, May, and June, the winds are from E. to S.E. In July, August, and September, there are calms, with tornadoes from South and S.W.; and in October, November, and December, there are continued rains, while the sky is, in general, obscured by clouds. In the dry season, which is from January to June, the heat is very great; and in the wet season, from August to November, rains and thunder are constant and violent.

On the COASTS of CUMANA and CARACCAS, to Cape la Vela, the breeze follows the regular course; but from that cape to Cape San Blas the general wind alters its direction; for it blows from N.E. or N.N.E., excepting in the months of March, April, May, and June, when it comes to E.N.E., and is then so uncommonly strong as to render it necessary for vessels to lie-to. These gales, which are well known to mariners, extend from about mid-channel to within 2 or 3 leagues of the coast, where they become weak, especially at night. On this coast, about the BAY of NICARAGUA, are westerly winds, which the pilots of that country call *Vendavales* (rainy winds), in the months from July to December; but these winds never pass the parallel of 13° N., nor do they blow constantly, but alternate with the sea-breeze.

Upon the MOSQUITO SHORE, HONDURAS, and EASTERN COAST of YUCATAN, the general winds or breezes prevail in February, March, April, and May; but, during the first two of these months, they are occasionally interrupted by *Norths*. In June, July, and August, the winds here are from the eastward and westward of South, with tornadoes and calms. In September, October, November, December, and January, they are from the northward or southward of West, with frequent gales from W.S.W., and North.

On the NORTHERN and WESTERN COASTS of YUCATAN, between Cape Catoche and Point Piedras or Desconocida, and thence to Campeche, there is no other than the N.E. or general wind, interrupted by hard Norths in the season of them; and, about the end of April, tornadoes commence from N.E. to S.E. These tornadoes generally form in the afternoon; continue about an hour; and, by nightfall, the serenity of the atmosphere is re-established. The season of the tornadoes continues until September, and in all the time there are sea-breezes upon the coast, which blow from N.N.W. to N.E. It has been remarked that, as the breeze is more fresh, the more fierce is the tornado, especially from June to September. The sea-breezes come on at about eleven of the day; and at night the wind gets round to E.N.E., E.S.E., or S.E., so that it may be, in some degree, considered as a land-breeze.

On the COAST of the MEXICAN SEA, from VERA CRUZ to TAMPICO, the breeze from E.S.E. and East prevails in April, May, June, and July; and at night the land-breeze comes off from South to S.W.: but if the land-breeze is from the N.W., with rain, the wind, on the day following, will be from North, N.N.E., or N.E., particularly in August and September: these winds are denominated, in the country, *Vientos*

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* The winds on the S. coast of Cuba, when the Trade is not blowing steadily, have a remarkable rotary motion following the course of the sun, according to Dove's Law of Gyration (17). Thus, in the evening, the wind comes off the land about North; by daylight it will be N.E.; at 8 a.m. E.N.E.; at noon E.S.E.; at 2 p.m. South; at 4 p.m. S.W.; in which quarter it generally dies away into a calm until the land-wind comes off again. By a knowledge of this a vessel may creep fast to windward during the calm months of May, June, and August, and frequently at other seasons. The Trade is found to be unsteady, especially in the night.

de Cabeza o Vendavales (head winds or rainy winds); they are not strong, nor do they raise the sea: with them, therefore, a vessel may take an anchorage as well as with the general breeze; but they impede getting out, for which the land-breeze is required. The *Vientos de Cabeza*, or head-winds, reach to about 20 or 30 leagues from the coast, at which distance are found those at East and E.S.E.

(41.) From the middle of September until the month of March caution is necessary in making VERA CRUZ, for the Norths are then very heavy. The narrowness of this harbour, the obstruction formed by the shoals at its entrance, and the slender shelter it affords from the Norths, render an attempt to make it, during one of them, extremely dangerous, for it will be impossible to take the anchorage. The following description of the winds here has been written by Don Bernardo de Orta, a captain in the Spanish Navy, who has been captain of the port, and who surveyed it.

Although in the Mexican Sea it cannot be said that there is any other constant wind than the general breeze of this region, yet, from September to March, the North winds interrupt the general course, and, in some degree, divide the year into two seasons, *wet* and *dry*, or of the *Breezes* and *Norths:* the first, in which the breezes are settled, is from March to September; and the second, in which the Norths blow, is from September to March. For greater clearness, we shall explain each separately.

(42.) **The Norths.** — The first of the Norths is regularly felt in the month of September; but, in this month and the following one, October, the Norths do not blow with much force. Sometimes it happens that they do not appear; but, in that case, the breeze is interrupted by heavy rains and tornadoes. In November the Norths are established, blow with much strength, and continue a length of time, during December, January, and February. In these months, after they begin, they increase fast; and in four hours, or a little more, attain their utmost strength, with which they continue blowing for forty-eight hours; but afterward, though they do not cease for some days, they are moderate. In these months the Norths are obscure and north-westerly, and they come on so frequently that there is, in general, not more than four or six days between them. In March and April they are neither so frequent, nor last so long, and are clearer, but yet they are more fierce for the first twenty-four hours, and have less north-westing. In the interval before November, in which, as we have said, the *Norths* are established, the weather is beautiful, and the general breeze blows with great regularity by day; the land-breeze as regularly by night.

There are various signs by which the coming on of a *North* may be foreseen: such are, the wind steady at South; the moisture of the walls, and of the pavements of the houses and streets; seeing clearly the Peak of Orizaba and the Mountains of Perote and Villa Rica, with the cloud on those of St. Martin, having folds like a white sheet; the increase of heat and of dew; and a thick fog, or low scud, flying with velocity to the southward: but the most certain of all is the barometer; for this instrument, in the time of the Norths at Vera Cruz, does not vary more, between its highest and lowest range, than 0·8; that is to say, it does not rise higher than 30·6 inches, nor fall lower than 29·8 inches. The descent of the mercury predicts the Norths; but they do not begin to blow the moment it sinks, which it always does a short time before the North comes on: at these times lightnings appear on the horizon, especially from N.W. to N.E.; the sea sparkles; cobwebs are seen on the rigging, if by day: with such warnings trust not to the weather, for a North will infallibly come on.

This wind generally moderates at the setting of the sun; that is, it does not retain the same strength which it had from nine in the morning to three in the afternoon, unless it commence in the evening or at night, for then it may increase. Sometimes it happens that, after dark, or a little before midnight, it is found to be the land-wind, from the northward and westward; in which case, should it get round to the southward of West, the North will be at an end, and the general breeze will, to a certainty, come on at its regular hour: but, if that does not happen at the rising of the sun, or afterward, and at the turn of the tide, it will return to blow from the North, with the same violence as on the day before, and then it is called a *Norte de Marea*, or *Tide North*.

The Norths also sometimes conclude by taking to the northward and eastward, which is more certain; for if the wind in the evening gets to N.E., although the sky remain covered the day following, but by night the land-breeze has been from the northward and westward, the regular breeze will surely ensue in the evening, good weather succeeding and continuing for four or six days; the latter period being the longest that it will last to, in the season of the Norths: but, if the wind retrograde from N.E. to N.N.E. or North, the weather will be still unsettled.

Examples are not wanting of Norths happening in May, June, July, and August, at which times they are most furious, and are called *Nortes del Hueso Colorado;* the more moderate are called *Chocolateros*, but these are rather uncommon.*

(43.) The *Wet Season*, or *Season of the Breezes*, is from March to September; the breezes at the end of March, and through the whole month of April, as already explained, are, from time to time, interrupted by Norths, and are from E.S.E., very fresh; the sky sometimes clear, at other times obscure. At times these touch from S.E., and continue all night, without giving place to the land-breeze, which prevails, in general, every night, excepting when the North wind is on. The land-breeze is freshest when the rains have begun.

After the sun passes the zenith of Vera Cruz, and until he returns to it, that is, from the 16th of May to the 27th of July, the breezes are of the lightest description, almost calms, with much mist or haze, and slight tornadoes. After that time the pleasant breezes from N.W. to N.E. sometimes remain fixed.

From the 27th of July to the middle of October, when the Norths become established, the tornadoes are fierce, with heavy rains, thunder, and lightning: those which bring the heaviest winds are from the East, but they are also those of the shortest duration.

In the Season of the Breezes the total variation of the barometer is 0·4; the greatest ascent of the mercury is to 30·36 inches, and its greatest decent to 29·96 inches. The thermometer in July rises to 87°, and does not fall to 82½°: in December it rises to 80½°, but never falls below 66½°. This, it must be understood, was ascertained in the shade, the instrument being placed in one of the coolest and best ventilated halls in the castle.

In the months of August and September, rarely a year passes without hurricanes near Florida and the Northern Antillas; but to Vera Cruz, or any part of the coast thence to Campeché, they never arrive; all that is felt being the heavy sea, which has arisen in the higher latitudes. Hurricanes begin to the northward and eastward; and, although they do not always go round the same way, yet, in general, they next go to the southward and eastward, with thick squally weather and rain.

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* From the late Lieut. *John Evans* (a), R.N. (a gentleman to whom we were indebted for many valuable communications), we received the following description of a *North* in the Mexican Sea, which occurred in March, 1828:—

"We had observed, during our run over the Catoche Bank, a very extraordinary white hazy-like appearance, very distinct from the common fog, haze, or mist; this was seen principally in the northern quarter, and attracted much notice; the air, at the same time, 'breathing gently at South,' and the sympiesometer falling unusually low, gave us strong indications of an approaching *North.* On the 15th there appeared on the sky only a few small *cumuli* and dark *strati;* in the morning the air was very light from the South, and was so warm, or rather hot and oppressive, that, like the *sirocco*, it affected the breathing of some of us. At ten a.m. it changed to the N.E. with fine weather, the wind gradually freshening: at sunset the *cumuli* changed into dark *nimbus*, of a deep purple, edged with a bronze colour: from these clouds proceeded squalls with rain, the wind veering from N.E. to N.N.W., after which it cleared up, the clouds all dispersed, and at eight p.m. a fresh North came on, with a rapidly rising sea (which a short time before had been perfectly calm and smooth). The sympiesometer fell to 29.80, which was lower than it had ever done before. It blew a gale all night, with a heavy sea; no clouds; the stars bright and large. The same white hazy-like appearance took place before the North set in. Early in the morning of the 16th the wind died away suddenly, almost to a calm; and at eight a.m. became a moderate breeze."

From TAMPICO to the BAY of SAN BERNARDO, breezes, from the southward and eastwa[illegible] steady and pleasant from April to August; but, in the remaining months [illegible] is much exposed to gales from East and E.S.E., which blow, without intermission for two or three days, before a North comes on. In about latitude 26°, there are land breezes, in the summer, which blow from midnight until nine in the forenoon.

(44.) **GULF of MEXICO, North Coast.**—A series of observations on the winds and tides were made by the officers of the U.S. Coast Survey, between June, 1847, and July, 1852. The force and direction of the wind were noted at three Stations: at Galveston in Texas, lat. 29° 18′ N.; long. 94° 46′ W.: at Fort Morgan, Mobile Bay, about the middle of the North coast, in lat. 30° 13′ N.; long. 88° 0′ W.: and at Key West, one of the Florida Keys, in lat. 24° 38′; long. 84° 48′ W. These observations, however, have the same imperfection as that noticed in the note (*) on page 187,—that the winds are not recorded equally for all points of the compass. However, the following general remarks are useful and interesting as derived from these observations, and are arranged in the form of diagrams, which need not be repeated here.

(a) Winds from some northern quarter prevail from September until February, both inclusive, and southwardly winds from March to August, inclusive. Winds from the eastward prevail throughout the year, except at Fort Morgan in May, June, July, and August, when the sea-breeze is from the south-west. In the whole year the winds from the same quarter north and south balance each other nearly, while the eastwardly wind greatly predominates over the westwardly.

(b) As remarked in my former paper, the months may be classed, according to the prevailing winds, into the following classes:—The winter, consisting of December and January; the spring, of March and April; the summer, of May, June, and July; of preparation for change, August; the autumn, of September, October, and November.

The winter and summer types are extremely distinct. At Key West, in December and January, north-east and north are the prevailing winds; at Fort Morgan, north, east-south-east and east; at Galveston, north and north-west, then east-north-east and south-east. I suppose the general course of the north-east Trade wind to be disturbed by local action at Fort Morgan and Galveston, the local position of greatest warmth being the Gulf.

The summer type, May, June, and July, gives south-east as the prevailing wind at Key West; the south-east, south, and south-west (sea-breeze) at Fort Morgan; the south, south-east, and east at Galveston, blowing towards the land.

August resembles July, with the appearance of winds which prevail in the autumn.

In September, October, and November, at Key West, east-north-east prevail; at Fort Morgan, north, north-east, east; and at Galveston, north, north-east, east, and north-west.

In March and April, the spring period, south-east, south-south-east, and east winds prevail at Key West; north, south-south-east, and east-south-east at Fort Morgan; and north, south-east, and south at Galveston.

February resembles January with a preparation for the spring period, and like August, it is characterized at Fort Morgan and Galveston by a general diminution in the quantity of wind.

January presents the full winter type of the winds on the Gulf, and June and July the full summer type. The changes are quite gradual and tolerably regular from one extreme to the other.

(c) The following deductions are made from these observations in regard to the least and greatest quantities of wind in the principal directions in different portions of the year.

The north wind is a minimum at the three places in July, and a maximum in January. It is a very remarkable feature at all three places in January. The north-west almost dies out at all three from May to September, first gaining strength at Galveston, in October, and reaching its maximum in all the places in December. Its quantity at Key West and Fort Morgan is small when at the maximum.

The northers and north-westers both appear in force in April, at Galveston. There is very little west wind at either place, but more at Fort Morgan than either of the others, and chiefly during the months of June and July.

South-west wind is of rare occurrence except at Fort Morgan, where it constitutes the sea-breeze of summer, and reaches its maximum in June and July, suddenly diminishing in September.

There is but little south wind at Key West; at Fort Morgan it increases in amount in the spring and is the greatest in June. It is decidedly a marked feature as one of the prevailing spring winds at Galveston, reaching its maximum in May and becoming quite small in August, re-appearing in the winter, and rapidly increasing in March.

The north-east wind is a minimum at the three places in July and August; is largest in quantity in September, October, November, and December, at Key West; in September and October at Fort Morgan; and in September, December, and January at Galveston. The sudden increase of this wind in September, after its small quantity in August, is remarkable at all three places.

The winds intermediate between north-east and south-east occur during the changes from north-east to south-east, and it would be of little value to refer to the greatest and least quantities.

The south-east wind is a minimum in December and January at Key West; in January and February at Fort Morgan; in December and January at Galveston. It is a maximum at Key West in July, but, being replaced during the summer to a great extent by the sea-breeze (S.W.) at Fort Morgan, makes its maximum in November, and at Galveston in May, doubtless from the disturbing effect of the land; it is again large in July. This is the sea-breeze of Key West, and, as well as the south wind, that of Galveston.

(d) The movement of the prevailing wind at Key West, where the disturbing causes of the land are the least, is very instructive.

The prevailing wind in April, May, June, and July is the south-east, hauling to the eastward in August, and becoming east-south-east. In September and October it passes further north to east-north-east, and in November and December becomes north-east; in January it reaches north; returning southward in February, it is north-north-east, in March east, and reaches the south-east in April. The local action is thus seen to prevail for the greater part of the year over the general. For the whole year the south-east wind exceeds any other from an eastwardly point.

The eastwardly wind at Fort Morgan reaches no further south than east-south-east, in the spring and summer. In September the prevailing wind is north-east, passing to east-north-east in October, and back to east-south-east in the winter and spring The general tendency for the year is then east-south-east.

The changes at Galveston resemble those at Key West, the general absence of east-north-east and east-south-east winds being due to defects in the observations.

In the Strait of Florida the breezes are the prevailing winds, but they are interrupted by Norths in the winter, and by calms in the summer. Although the northern limit of this channel is within the boundary of the Trade-wind, it is necessary to remember that, in winter, or from November to April, the variable winds from the southward and eastward, and southward and westward, are met with in lat. 27°, and even before: and in summer, from May until September, the winds in the whole channel are variable from the southward and eastward, and southward and westward.

EQUATORIAL CALMS AND WINDS.

(45.) The N.E. and S.E. Trade, blowing toward each other, meet and are neutralized near the Equator (6.) This neutral line of calms and varying winds is sometimes known by the name of the "*Doldrums*," an uncouth term, which, we think, has had unmerited authority given to it of late. It is, perhaps, a corruption of the Spanish *doloroso*, or old Portuguese *dolorio*, "tormenting."

Commander Maury says, "It has a mean average breadth (around the globe) of about six degrees of latitude. In this region, the air which is brought to the Equator by the north-east and south-east trades ascends. This belt of calms always separates these two trade wind zone, and travels up and down with them. If we liken this belt of equatorial calms to an immense atmospherical trough, extending, as it does, entirely around the earth; and if we liken the N.E. and S.E. trade winds to two streams discharging themselves into it, we shall see that we have two currents perpetually running in at the bottom, and that therefore we must have as much air as the two currents bring in at the bottom to flow out of the top. What flows out at the top is carried back north and south by these upper currents (6.), which are thus proved to exist and to flow counter to the trade winds." *

This belt of calms follows the sun in his annual course, though the limits do not range so much in latitude as the sun does in declination, and, generally, they pass from one extreme of latitude to the other in about three months. The whole system of wind and calm belts move northward from the latter part of May till some time in August: they then remain almost stationary till the approach of winter, when they commence to go southward, and proceed in that direction from December till February or March.

"The great '*sun swing*' of this calm belt," says Capt. Maury, "is annual in its occurrence; it marks the seasons and divides the year into wet and dry for all those places that are within the arc of its majestic sweep. But there are other subordinate and minor influences which are continually taking place in the atmosphere, and which are also calculated to alter the place of this calm belt, and to produce changes in the thermal status of the air which the Trade winds move. These are, unusually severe winters or hot summers; remarkable spells of weather, such as long continuous rains or draughts over areas of considerable extent. Either within or near the Trade-wind belts it is tremblingly alive to all such influences, and they keep it in continual agitation; accordingly we find that such is its state, that, within certain boundaries, it is continually changing place and limits. This fact is abundantly proved by the speed of ships, whose log-books show that it is by no means a rare occurrence for one vessel, after she has been dallying in the Doldrums for days in the vain effort to cross that calm belt, to see another coming up to her, 'hand over fist,' with fair winds, and crossing the belt after a delay in it of only a few hours instead of days." †

(46.) These remarks of Capt. Maury, coupled with the experience of most sailors who cross the line, will demonstrate that the limits of this calm belt cannot be very exactly defined, and it is only the doctrine of chances that can determine whether any particular ship will lose the trades and encounter these doldrums. On page 186 (27), is given the table drawn up by Capt. Horsburgh as the probable equinoctial limits of the N.E. and S.E. Trades, and consequently of the intervening belt of calms. This applies to that part of them, between 18° and 26° W., which was usually traversed by the East India Company's ships; but, as a more westerly crossing is now advocated by many, the following approximate estimate of the breadth of this calm belt is derived from Maury's Trade Wind Chart, and given by Dr. Van Galen: ‡ —

* "Sailing Directions, 1858," vol. i. p. 40.
† "Physical Geography of the Sea, 1860," p. 358.
‡ "Zeil, Wind en Stroomkaarten Toegelicht," door Dr. P. van Galen. Rotterdam, 1859.

TABLE *of the Average Extent of the Equinoctial Calms.*

Month	Limits.	50° to 45° W.	45° to 40° W.	40° to 35° W.	35° to 30° W.	30° to 25° W.	25° to 20° W.	20° to 15° W.
Jan.	N.	3° N.	3° N.	2° N.	2° N.	3° N.	3° N.	6° N.
	S.	–	3	2	2	0	1	1
Feb.	N.	3	3	2	1	3	4	6
	S.	–	3	2	1	1 S.	0	0
March.	N.	3	2	0	1	2 N.	4	5
	S.	–	2	0	0	2 S.	1 S.	0
April.	N.	3	2	1 S.	1	2 N.	3 N.	6
	S.	–	2	0	0	2 S.	1 S.	0
May.	N.	4	4	3 N.	3	4 N.	5 N.	6
	S.	–	4	1	1	1 S.	0	1
June.	N.	6	6	6	8	9 N.	8	9
	S.	–	4	1	2	0	1	1
July.	N.	8	9	9	11	11	12	–
	S.	–	5	3	4	2	2	1
Aug.	N.	11	12	12	12	12	13	–
	S.	8	6	4	4	2	2	1
Sept.	N.	11	12	12	10	12	12	–
	S.	8	6	5	4	2	1	1
Oct.	N.	10	10	10	10	10	11	–
	S.	7	6	5	4	2	1	1
Nov.	N.	6	6	6	6	6	8	10
	S.	6	6	5	3	2	1	1
Dec.	N.	2	4	4	3	4	5	7
	S.	–	4	4	3	1	2	1

This table will show that, during the winter months, and in the western part of the ocean, the limits of the Trade winds (which is that given in the table) approximate, and leave no interval of calm. In the northern summer months, however, the calm belt is much more distinctly marked, although its mean breadth is not one-third or one-half what it is in the eastern side. This fact is also graphically explained by the diagram facing page 185. As was said before on page 186 (26.), the limits of the Trades vary to the extent of 10° of latitude, and therefore the figures given above can only be taken as a possible approximation.

There is one remark, which it may be as well to urge here: that, as this belt of calms runs east and west, the navigator will clear them soonest by making a direct *Southern* or *Northern* course, as far as possible, as he thus runs directly across them; by beating too much East or West he is retarding himself in their direction.

(47.) The Trade winds are essentially *evaporating* winds. From their high temperature, in passing over a large extent of ocean, they become loaded with aqueous vapour, which becomes evident when they meet and neutralize each other in this zone of equatorial calms.

The result is the formation of the "*cloud ring*" of Capt. Maury, which he likens to the rings of Saturn or the belts of Jupiter. Under this oppressive and constant companion of the equatorial calm the rain falls in torrents, and by the progress of the sun in the ecliptic it causes the phenomena of the tropical seasons, divided, as is well known, into the wet and dry. A consideration of the chart and the shifting of this belt will explain how it is that some places have two rainy seasons and others only one, by the passing of this cloud ring over them.

"It is broader than the belt of calms out of which it arises. As the air, with its vapours, rises up in this calm belt and ascends, these vapours are condensed into clouds, and this condensation is followed by a turgid intumescence which causes the clouds to overflow the calm belt as it veers both to the north and to the south. The air, flowing off in the same direction, assumes the character of winds that form the upper currents that are counter (5.) to the Trade winds. These currents carry the clouds still farther to the north and south, and thus make the cloud ring broader. At least, we infer such to be the case, for the rains are found to extend out on to the Trade winds, and often to a considerable distance north and south of the calm belt."

(47.) This oppressive region, most tedious to navigators, is, however, not at all times subject to this great amount of deposition, which has procured for it the appellation of "*The Rains;*" and especially during the winter months, when its extent is more limited, it may be crossed without encountering either those torrents of rain, or almost unbearable calms. This compensating belt to the evaporation of the trades of course is subject to squalls, and especially to thunder-storms, the natural result of the conflicting elements. Altogether, its effect on the health and spirits, its enervating influences, its oppressive and damp heat, make it one of the most unpleasant parts of the globe. *

Winds on the African Coast.

(48.) The influence of the land upon the Trade winds, and the intervening calms, is very powerful on the eastern side of the Atlantic; and the peculiar configuration of the coast of Guinea, trending as it does along the very axis or line of division of the northern and southern wind systems, causes a different set of phenomena to arise. During that part of the year when the sun is in the southern hemisphere, the Trades and calms follow the normal or usual course, as it is then exerting its maximum force on the sea with its low absorptive and radiative powers; but when, during the northern summer, it is raising the temperature of the land of the Guinea coast, a new phase arises from the heated atmosphere over the land drawing the wind towards it, and instead of a S.E. or N.E. wind we have a South and S.W. wind occurring with great regularity. Major Rennell says, "in the space lengthwise, between Cape Verde and Cape Mesurado, and in certain places to the extent of 70 leagues off shore, (50 off Sierra Leone,) a regular change of winds and currents takes place, according to the seasons: that is to say, a N.E. or North wind and S.E. current, from September to June; and in the rest of the year, S.W. wind and N.E. or northerly currents, in effect a *monsoon;* and this extends, in respect of the *wind*, nearly through the whole space between the two continents. †

* Attention to personal cleanliness is very important during the detention caused by these calms. Dampier gives a quaint description of the ill effects of his men not drying their clothes and lying down on their hammocks while wet, which caused all to become offensive and open to attacks of disease. Capt. Maury says, "The emigrant ships from Europe to Australia have to cross it. They are often baffled in it for two or three weeks; then the children and passengers who are delicate in health suffer most. It is a frightful grave-yard on the wayside to that golden land."

† The existence and character of this S.W. African monsoon was thus early recognized and named (at the latter end of last century). The term "*newly-discovered*" monsoons, given to them by our American friends, is therefore not quite applicable.

(49.) In Dampier's Discourse on the Trade Winds, and his illustrative Chart (1697), we find a solution of the origin of these S.W. winds, which is that still held to be most feasible. It is, that they are derived from the S.E. Trades, and not from a diversion of the N.E. Trades. This also has been suggested in the "Mercantile Marine Magazine" of 1856,* the data being derived from Maury's Charts. "An important element in determining the reality or otherwise of this suggestion is the position of the calms. Are they interposed between the N.E. trade and monsoon, or between the monsoon and S.E. trade? But this consideration may not have great weight in this region of calms, and besides the probability of this origin is increased by the data for the direction of the S.E. trade, which is shown not to blow with regularity to the east of a line joining Cape Palmas and Angola.

(50.) There is another conclusive evidence of the westerly extension of these monsoons in the *easterly* current that is met with almost constantly during the seasons of their prevalence. These are very persistent as far as longitude 40° W., and are times encountered as far north as lat. 16°; but more usually between 6° and 11° N. This origin of the anomalous Guinea current was indicated in our Chart of the Atlantic, published in 1858. A similar current is shown to exist in the Pacific Ocean west of Panama Bay. This feature will be farther dilated on when we come to the Section on Currents.

(51.) These South, S.S.W. and S.W. winds prevail, according to Maury's Pilot Charts, chiefly during the months of July, August, September, and October, and are then felt as far to the westward as 35° or 40° W., between the parallels of 5° and 8° N. In the western tract of this area they diminish in frequency as the sun proceeds to the S., and are scarcely felt in the North Atlantic during the months of December, January, and February. The chances of encountering this adverse wind must have an important bearing on the choice of a route for crossing the Equator during these months. Between December and April, which is the season most visited by calms, the wind has still a southern tendency; but during the season of the monsoon the calms are at a minimum near the coast. It is difficult to explain in words the relative duration, force, or frequency of, the winds in this changeable locality, without an appeal to the Chart. The reader is referred to that facing page 185, and to the Chart of the North Atlantic, in 4 sheets, before alluded to.

(52.) **Winds and Seasons.**—The following remarks, by the late *Capt. Midgley*, who had great experience on the African coast, will be found of service in explaining the character of the wind and seasons:—

I will here offer a few remarks on the general variable winds and weather which prevail between the parallels of 4° and 10° N., and the meridians of 18° and 25° West, or between the N.E. and S.E. trade winds.

The winds generally incline from the southward, between the trades, and few vessels pass from one trade wind to the other without meeting with very unpleasant weather, in the shape of calms, light baffling winds, squalls, and rain, particularly when the sun is much to the northward.

In June, July, and August, heavy squalls seem to prevail from the S.W., with a great deal of rain, and the wind often blows hard from this quarter for several hours together, and then falls calm, leaving a heavy and confused short sea, which cause a vessel to labour and strain more than she would do in a gale of wind.

When the sun is far to the southward, the weather is comparatively fine, with light southerly and S.E. winds, occasionally, however, interrupted by squalls and rain; and the calms are of shorter duration, owing, probably, to the limited breadth of the space between the trade winds at this season.

In this part of the ocean, when much lightning is seen in a heavy dense cloud, in any quarter of the compass, the wind may be expected to come out suddenly from that

* Mer. Mar. Mag., Feb. 1856, p. 47.

quarter, especially if there is any rain, even though the wind may be blowing at the same time with moderate force from an opposite quarter.

Forked or chain lightning is the almost sure forerunner of a heavy squall; it is a monitor whose warning should not be neglected.*

Whenever there is much lightning, and the wind is unsteady and baffling about, prepare for a change. A heavy dense cloud, having a squally appearance, may rise and pass slowly over the vessel directly to leeward, with perhaps little or no increase of wind; and when the danger may be supposed over, the vessel is suddenly taken aback with a smart squall. This, I presume, arises from the cloud which has just gone over the ship, being opposed in its progress to leeward by a stronger current of air from the opposite quarter. On this account, when clouds are in motion from opposite quarters of the compass, a better look-out, if possible, should be kept to leeward than to windward.

Keeping a good look-out upon the surface of the water is an excellent method of judging of the force of wind in an approaching squall; but on account of the heavy rain which invariably accompanies the squalls alluded to, very little sound judgment can be exercised with respect to their strength; they are generally, however, tolerably heavy, and require sail to be considerably reduced.

In June, July, and August, the weather is very wet and squally. Sometimes dense masses of clouds are seen in rapid motion from the S.E., southward, and S.W. quarters of the horizon: these clouds have a bulky and confused appearance, as if tumbling or rolling over each other; are of a dirty, dark drab colour, with ragged edges, and inky-looking small clouds flying about the edges of them. In their approach towards the zenith they gradually appear to unite and form the apex of an angle, and thus united blow with incredible violence from the S.W. quarter (veering about two or three points or more) for upwards of two hours, during which time the rain descends in torrents, perhaps accompanied by a waterspout or whirlwind.

Ships should be well prepared for these dangerous visitors; for they come with a similar violence to the arched white squall of the West Indies. I have experienced two squalls of the above description (both in the month of July), and in one of them lost a good fore-topsail, after the reef tackles, &c., were hauled out snug, and the ship had been for some time running directly before the wind. Upon both occasions my barometer fell three-tenths of an inch very suddenly, which enabled me to take in sail in time; for the squalls did not look particularly alarming until about eight or ten minutes before they reached the ship.

To the inexperienced in this part of the ocean, I would beg to remark, that *much* sheet lightning is always suspicious, and forked or chain lightning universally so; and the latter is, in some degree, indicative of a change, as well as of an increase of wind.

After the wind has blown steadily, with fine weather for a few hours, and it then begins to be variable, and fly suddenly about, squalls and rain may be expected.

The moon has great influence on the weather; for it is mostly squally and unsettled, with much rain, about the full and change.

I perfectly agree with Captain Cheveley, that the month of July is, perhaps, the worst in the year for making southing between the trades. I have made two homeward passages in July between the meridians of 22° and 26° West, and met upon each occasion with the same weather as described by that gentleman; namely, strong S.W. winds, hard squalls, and torrents of rain, with a heavy short sea, and northerly currents.

(53.) *Between Cape Blanco and the entrance of the River Gambia*, during the months of November, December, January, February, and March, the winds from the

* In those parts of the North Atlantic Ocean which are not in the general influence of the trades, I have very frequently remarked that lightning is indicative of a change of wind.

East and N.E. are prevalent. In this time the nights are cool; but scarcely has the sun arisen above the horizon, when the air becomes dry and parching. Nevertheless, these five months are the winter in this part of Africa, and this is the most healthy season. Between the Gambia and Cape Palmas the inland winds, during the same season, are variable.

In June, July, August, September, and October, the country situated between Cape Verga and Cape Mount is much exposed to hurricanes or tornadoes. These, however, do not occur in any part of the coast northward of Cape Verga.

From the 20th degree of North latitude to the environs of the line, the months of July, August, September, and October, are those of the rainy season, when the atmosphere emits its waters to the earth; the only difference is, twenty days sooner or later in the arrival of these torrents. During the other eight months in the year there does not fall a single drop of water.

Between the CAPE VERDE ISLANDS, and in their neighbourhood, southerly and S.W. winds generally blow in July, August, September, and October. These islands, when the sun is in their zenith, are generally surrounded by thick fogs.

From SIERRA LEONE to CAPE PALMAS the ordinary course of the winds on the coast is from W.N.W., and beyond Cape Palmas, from W.S.W. to S.W. and S.S.W.

Although, in the Gulf of Guinea, the wind blows generally from the southward, and S.S.W. toward the coast, they take, in South latitude, a more westerly direction near the land, and then prevail from S.W. and W.S.W. between Cape Lopez and Benguela. But they veer proportionally more southerly as the distance increases from the coast.

WINDWARD COAST, &c.—The name of *Windward Coast* has been given by our navigators to the whole of that coast which extends from Cape Mount to the River Assinee, where the Gold Coast commences: it includes the three particular coasts called, 1st, Grain, or Pepper Coast; 2nd, Ivory, or Teeth Coast; 3rd, the Coast of Adou, or Quaqua.

From January until May the weather here, along-shore, is commonly fair and clear, with cooling breezes, and gentle southerly winds. But, about the middle of May, South and S.E. winds begin, accompanied not only wish hurricanes and stormy gusts, but also with thunder, lightning, and great rains, which continue, more or less, until the conclusion of the year.

On the Gold Coast, from Assinee to the River Volta, the wind, in January, begins to blow from the S.W. quarter, and becomes stronger in February, bringing with it sometimes rain, and sometimes a hurricane. About the end of March, and beginning of April, those heavy tempests, called by the Portuguese *tornadoes*, arise, accompanied with a deluge of rain, thunder, and lightning; these continue to the end of May, and are announced by the darkness of the sky in the S.E.

During the rainy season, that is, in May and July, little or no land-winds are felt; but, from the sea, it blows from the S.W. and W.S.W., making a very great swell, which continues even in August, although the rains begin to cease in that month.

The weather becomes fair in September, and the air clear, with gentle South winds; and this continues till January, the hottest days being in December.

(54.) **The HARMATTAN.**—On the Gold Coast, as well as the windward coast, an easterly wind, called the *Harmattan*, prevails during the months of December, January, and February. This wind comes on indiscriminately, at any hour of the day, at any time of the tide, at any period of the moon, and continues sometimes only a day or two, sometimes five or six days, and it has been known to last fifteen or sixteen days. There are generally three or four returns of it in every season; it blows with a moderate force, not quite so strong as the sea-breeze, which every day sets in, during the fair season, from the West, W.S.W., and S.W.; but somewhat stronger than the land-wind, at night, from the North and N.N.W. In the "Philosophical Transactions," vol. lxxi., for the year 1781, an account of the *Harmattan* was first given by *Matthew Dobson*, M.D., F.R.S., from the inquiries and observations of *Mr. Norris*, of which the following is the substance:—

On that part of the coast of Africa which lies between Cape Verde and Cape Lopez, a singular periodical easterly wind, named, by the natives, the *Harmattan*, prevails during the months of December, January, and February. Cape Lopez lies to the southward of the line. At the Isles de Los, which lie to the northward of Sierra Leone, this wind blows from the S.S.E.; on the Gold Coast, from the N.E.; and at Cape Lopez and the River Gaboon, from the N.N.E.

The Harmattan comes on as above described. A fog or haze always accompanies it, and the gloom is sometimes so great as to render near objects obscure. The sun is thus concealed the greatest part of the day, and appears only a few hours about noon, and then of a mild red colour. At 2 or 3 miles from shore the fog is not so thick as on the beach; and, at 4 or 5 leagues distance, it is entirely lost, though the Harmattan is felt for 10 or 12 leagues, and blows fresh enough to alter the course of the current.

Extreme dryness is a property of this wind. No dew falls during its continuance, nor is there the least appearance of moisture in the atmosphere. All vegetables are much injured, and many destroyed. The seams in the sides and decks of ships become very leaky, though the planks are 2 to 3 inches thick. Iron-bound casks require the hoops to be frequently driven tighter, and a cask of rum or brandy can scarcely be preserved; for unless kept constantly moistened the hoops fly off. The Harmattan has, likewise, very disagreeable effects on the skin, lips, and nose, which become sore.

The effects of the Harmattan in evaporation are great; as will appear by the following comparative statement:—At Liverpool, the annual evaporation is about 36 inches; at Whydah, 64 inches; but, under the influence of the Harmattan, at the rate of 133 inches.

This wind, though so prejudicial to vegetable life, is highly conducive to health; so that fluxes, fevers, small-pox, &c., generally disappear in spite of the doctor; and it contributes to the cure of ulcers and cutaneous eruptions. The baneful effects which have been said to arise from the prevalence of this wind proceed from the periodical rains, which fall in March, April, &c., and are ushered in by the tornadoes from the N.E. and E.N.E., accompanied with violent thunder and lightning, and very heavy showers. The earth, drenched by these showers, and acted upon by an intense solar heat, so soon as the storm is over, sends forth such noisome vapours as are the occasion of putrid fevers and other diseases.

On this coast, from the middle of February to the first week in March, a wind up the coast, from S.S.W. to S.S.E., prevails for about three weeks. The tornado season is part of March, all April, and the greater part of May, about twelve weeks. The rainy season is from the latter end of May, all June, and to about the 20th of July, about eight weeks. Hence, high wind, and squally, with very heavy rains, to the middle of August, about three weeks. The rain ceases, and then, for the first three weeks in September, the weather is foggy and close, without any breeze. From this time, for about six weeks, the wind blows fresh down the coast; the tornadoes and southerly wind then succeed, with some rain, generally called the *latter rains*, about four weeks, to the beginning of December, when the Harmattan season commences.

(55.) *Remarks by Baron Roussin.—Cape Bojador to the Isles de Los.*—On the whole extent of the African coast there are but two seasons; namely, the Rainy and Dry Seasons. The division of the two is connected with the periods when the sun crosses from one hemisphere to the other, and is modified as he advances to, or recedes from the Equator.

The Rainy Season commences at each place on the coast to the northward of the Equator, at the time when the sun passes the zenith of that place in his course to the northward. It is, usually, during the month preceding this event, that the change of weather takes place. It may, therefore, be calculated, that, at the Isles de Los, the first point exposed to the rainy season, and which lie in 9½° N., the first violent squalls do not occur before the 10th or 15th of May: their arrival seems to be affected by the moon; for they almost always commence, and are most violent, on the days of the new and full.

The Rainy Season ends in very violent squalls with intervals of calm, of which there are at least two, and frequently more, during the twenty-four hours; and we remarked, that they generally happen on the rising or setting of the sun or moon. In the country, these squalls are generally called *Tornadoes;* but, according to the best information, the tornado, properly speaking, is to be met with only to the southward of Cape Verga. They generally begin to form themselves in the N.E. or E.N.E. quarter of the horizon, which seems completely on fire during an hour or more. The storm then gradually shifts round to E. and E.S.E., becoming darker in the horizon. Having arrived at S.E., it attains its full vigour, when thunder and lightning become incessant. A moment of absolute calm then takes place, which is caused by the obstruction which the usual winds from the N.W. meet with from this immense mass of clouds. Shortly after, a small arch is formed at the horizon, which increases and rises rapidly. The more defined the edge of this arch appears, the more violent will be the storm, as it is a proof that the column of air has divided much heavier clouds, and is more confined. When the summit of this arch has attained an altitude of about 45°, the hurricane bursts forth, and torrents of rain immediately follow. The crisis of its greatest violence generally lasts from 15' to 20'; it afterwards gradually becomes weaker; and finally nothing remains but rain, attended with very little wind. It then shifts round from S.E. to W.S.W., then to the quarter from which the usual winds blow, to exhaust itself to the northward in another squall from the S.E.

The Rainy Season, at any place, continues from four to six months, according to its proximity to the Equator, and the tornadoes continue to decrease, both in frequency and violence, during the two latter months of the season. In ten days or a fortnight after the sun has passed the zenith of any place on his way to the South, it is considered as free from bad weather. On the 15th of November a gun is fired at Goree, which announces the return of the fine season.

The squalls here spoken of, and the winds which proceed or follow them, generally occupying so very small a portion of the year, may be considered as momentary convulsions in a state of climate almost unchangeable; a sky nearly always serene, and generally clear.

On the greater part of the African coast, from Cape Bojador to the Isles de Los, regular winds blow, and no rain ever falls during eight months. The prevailing winds in this country blow from N.E. to N.W.; it may, therefore, be said, that they follow the direction of the coast from North to South, and that they seldom vary from the limits here assigned.

The Dry Season commences in the latter part of October at Senegal; a little later at Goree; and at each intermediate place toward the Equator it becomes gradually later. It is not till the beginning of December that its return is observed in the parallel of the Isles de Los.

(56.) *Remarks on the Harmattan, by Baron Roussin.*—Although the winds from N.E. to N.W. prevail on the N.W. coast of Africa during the dry season, that is, from November to May, they are, nevertheless, occasionally interrupted between the 1st of December and the 1st of February by the land-wind, which blows from E.N.E. to E.S.E., and sometimes with violence.

It is this wind which the inhabitants of the country call the *Harmattan.* It comes on at different periods in the above interval, and blows during one, two, and sometimes five or six successive days. This continuance, however, is rare, as it is generally interrupted by the sea-breezes, which commence about noon, after a calm of one or two hours. These alternate land and sea-breezes generally last till the end of February, when the usual winds entirely prevail. The Harmattan, which passes over the most arid country of the globe, is of an extremely dry nature, and would probably become insupportable, were it not frequently allayed by the sea-breezes above mentioned. Notwithstanding the salutary effect of these breezes, the drought is astonishing, so long as the Harmattan lasts. Mankind are inconvenienced; vegetables suffer so much as to be nearly killed; the sun loses its brilliance, and is only to be seen when near noon; the sand, brought with it from the desert, pervades the atmosphere, and prevents objects from being distinguished at the distance of a quarter of a mile. Nevertheless, the effect of the Harmattan is not really injurious to health; it is remarked, that it even purifies the atmosphere, by destroying the noxious vapours with which it is replete on the conclusion of the rainy season. It is usually on the return of the Harmattan, that recovery commences from disorders which are incident to the climate.

The fog which accompanies the Harmattan loses nothing of its density when 3 leagues out at sea. On the edge of the Bank of Arguin, which is 10 leagues from the land, it prevented our distinguishing the horizon during three successive days. This state of the atmosphere is not permanent, but varies with the winds which produce it; and, in general, independent of the Harmattan, the African coast, from Cape Bojador to Cape Verde, is continually covered, during the whole dry season, with a white mist, which is seen from the sea much sooner than the land, of which it is a sure indication. This mist, which is nothing but sand, the extreme fineness of which allows of its being supported by the least agitated air, is particularly remarkable on that part of the desert between the parallel of 22° and Senegal. We have seen it at the distance of 5 leagues, when the coast could scarcely be seen at 3 leagues. This dust, alluded to on page 179, is farther remarked on at the end of this Volume.

(57.) *Remarks, by Capt. T. Boteler, of H.M.S. Hecla,* 1829.—The HARMATTAN SEASON sets in with November, or about a month earlier than off the Gambia, and prevails through December and part of January, but not quite constantly; for occasional intervals of clear weather, accompanied by the refreshing sea-breeze from the N.W., sometimes afford a respite to its oppressive effects. Nor does the Harmattan blow uniformly, either in the same direction, or with the same strength; for it ranges through eight points of the compass, from N.N.E. to E.S.E.; and, however fiery at the commencement, declines, after the first month, to a comparatively light breeze.

The PECULIAR HAZE which more or less envelopes the coast of Africa at all times, is at its maximum during the influence of the Harmattan; and, though partially dispersed by the tornadoes and the rainy season, returns with increased density when they cease. Strangers should, therefore, be on their guard when estimating their distance from the land, as the deceptive effect of this haze makes it appear much farther off than it really is; for the contrast which the coast present to the eye, in different states of the atmosphere, is very great. In clear weather the view of the fertile shelving hills in the Isles de Los, the stupendous features of the distant mountains, the plains covered with trees, and the beautiful little Island of Matacong (described hereafter), are highly interesting; while, in hazy weather, nothing is visible but a low mangrove coast, enveloped in mist, with an indistinct opening of a river here or there, or perhaps a column of smoke rising from a native village.

The RAINY SEASON continues for four months, from May to September; but the *tornadoes*, which invariably accompany its commencement and termination, generally cease between those periods. They blow from the E.S.E., and with great fury; but they seldom last more than three hours. The prevalent winds, during the rest of the rainy season, are from southward and westward, and are usually so light as to give way in the afternoon to the N.W. sea-breeze.

Winds and Calms on the Tropic.

(58.) Between the N.E. trades, and the westerly winds which prevail more or less to the northward of them, there is a belt of variable and light winds, which have, perhaps somewhat vaguely, been called the *Calms of Cancer,*—a term which will not express its characteristics.

It is called, also, the *Horse Latitudes,* from the fact that vessels in former years, employed in carrying horses to the West Indies, were frequently obliged to throw them overboard during the embarrassment caused by the continual changes, sudden gusts and calms, rains, thunder and lightning, which are general in it (19., p. 184).

(59.) This zone is caused by the uniting, or interchanging, of those upper but contrary currents which pass northwards over the N.E. trades in consequence of the heat acquired under the tropical sun having reached the northern extreme of this superheating influence. They here meet the currents passing southwards to feed the trades from the polar regions, and thus pressing against them cause the high barometer peculiar to this belt, standing as it does at a higher level than either to the north or south of it. Capt. Maury infers that the mean height of the mercury in this belt is 30·21 in., and at the Equator at 29·93 in. Admiral FitzRoy states the mean height of the barometer in the latitude of England to be 29·95′. This greater height of the mercury, showing increased pressure, will be an index to the sailor that he has reached this intervening belt between the Passage and Trade winds.

From the lower part of this zone pass out two currents of air, one to feed the N.E. Trades, as before described, and the other to form the Anti-Trades, or Passage winds; and it is fed by the polar and tropical counter currents which flow over these different wind systems.

(60.) The mean latitude of this belt is from 30° to 35° N., but varying with the motion of the sun in the ecliptic, as explained in (25.) on p. 185. In fact, the northern edge of the Trade wind may be taken as the axis over which this belt moves, sometimes of great breadth, as 10°; at others not felt at all. The mean position of these tropical calms, &c., will be best comprehended by an inspection of the diagram facing p. 185. As is well known, this belt is the line upon which the dreaded cyclones turn; they pass to the W.N.W., to the south of it; and to the E.N.E., to the north of it; showing the origin of the struggle between the polar and tropical currents, which is evident in their tremendous phenomena.

(61.) As was said in (26.), p. 186, the range over which the northern limits of the N.E. trade is met with seems to be, from Maury's Chart, about 10°; but as this chart is apparently not quite perfect, or, at least, is not derived from sufficient data to pronounce absolutely upon, it may be said that the mean position of the tropical calms in the various seasons of the year cannot with certainty be predicted; but as it does not offer the same obstacles to navigation as those of the equatorial regions, it is of less importance to the sailor, who, by his usual sagacity and prudence, may guard against the squalls, thunder-storms, and calms which characterize it.

(62.) To the westward of the meridian of 50° W.,—that is, the western half of the N.E. trade in the North Atlantic,—the trade is very light during the months of September and October; perhaps at other times of the summer and autumn. They will be most felt between the parallels of 15° and 25°; but not with any certainty near the American coast. This region may therefore be added to the tropical calms during these months.

As examples of the winds, as observed upon the lands lying in this belt, we select the remarks upon the Bermudas:—

(63.) **BERMUDAS.**—The winter, or cold season, at Bermudas, is the most agreeable, and lasts from November to March,—the mean temperature being 60°: the predominant winds are then from the westward; if to the northward of this, fine, hard weather, with a clear sky, accompanies them. This is the favourable time for refitting ship, painting, &c. The close of this is often a very fine, bright day, with little wind and partial calms, when the wind is certain of going round to the S.W.; the weather becoming hazy, damp, subject to heavy rains and gales. The thermometer immediately attains 60° to 70°. These alternate north-westerly and south-westerly winds prevail through nine months of the year, the wind remaining at no other point for any length of time. This change is exhibited by a difference of 14° in the temperature. At this season, it seems advisable for ships bound to the southward to wait and take the first set-in of the north-westerly winds. In most cases, it will ensure a quick run to the Variables, and often to the Trades.—*Mr. H. Davy.*

In the latter part of February spring commences, and the weather usually continues mild, with refreshing showers of rain and gentle breezes from the South and West, until the end of May. In June the summer sets in, and the weather becomes hot. Calms now succeed to the gentle breezes of May; the air is sultry and oppressive, and long droughts are common, which are often broken up by heavy thunderstorms. In September the weather changes its character, and becomes again mild and agreeable.

The dew-point in Bermuda usually ranges high. The climate, being therefore moist, is favourable to vegetation at all seasons, except during the droughts of summer, and the storms of winter.

Hurricanes and tempests are very frequent, as is to be expected from the proximity of the isles to the variable limit of the Trade and other prevailing winds. Few autumns pass without hurricanes of more or less violence.

The Bermuda Squalls are sudden and violent tempests, occurring particularly in the winter season.

According to the observations registered at Her Majesty's Dockyard, in 1853, 4, the easterly winds, or those to the E. of N. or S., prevailed for a mean of 139 days, and westerly winds for 186 days; the remainder being made up of calms and variable winds.*

THE ANTI-TRADES, or PASSAGE WINDS.

(64.) In a previous page, 184 (19.), the reason is given for applying the term *Anti-Trades* to the variable, but westerly, winds which prevail to the northward of the Tropic of Cancer. In the consideration of these winds, which only extend over an area, compared to that of the Trade winds, as 5 is to 12, (thus showing their vastly inferior importance in the atmospheric economy,) it will be found that it is impossible to accurately define their direction and character at any particular season. The great difference which exists between the winds and seasons of different years, which, however, when combined with a series, show a well marked and consistent average, will demonstrate that it is only the doctrine of chances which can determine whether a single ship will encounter a particular wind at a particular time and place. Therefore this Section will be less definite in its teachings than that on the Trade winds.

(65.) The most accurate and extensive observations, — extensive because continuous,—which have been made upon the direction and force of the wind in these latitudes, are those made upon *land*, and especially by self-registering instruments, which have been in operation for a series of years, which give absolutely the quantity and path of the wind passing over the observatory during their operation. But, as will be shown presently, these observations, however excellent, are fallacious; they do not give the *correct* normal direction of the wind, but that of the wind under the powerful influence of the adjacent land and its configurations. In future years this may be obviated by the erection of these anemometers on isolated spots, as has been done at Bermuda, in our latitudes, as at St. Kilda, or any other position distant from any great mass of land.†

(66.) The *westerly* predominance of Anti-Trades will be more manifest from an

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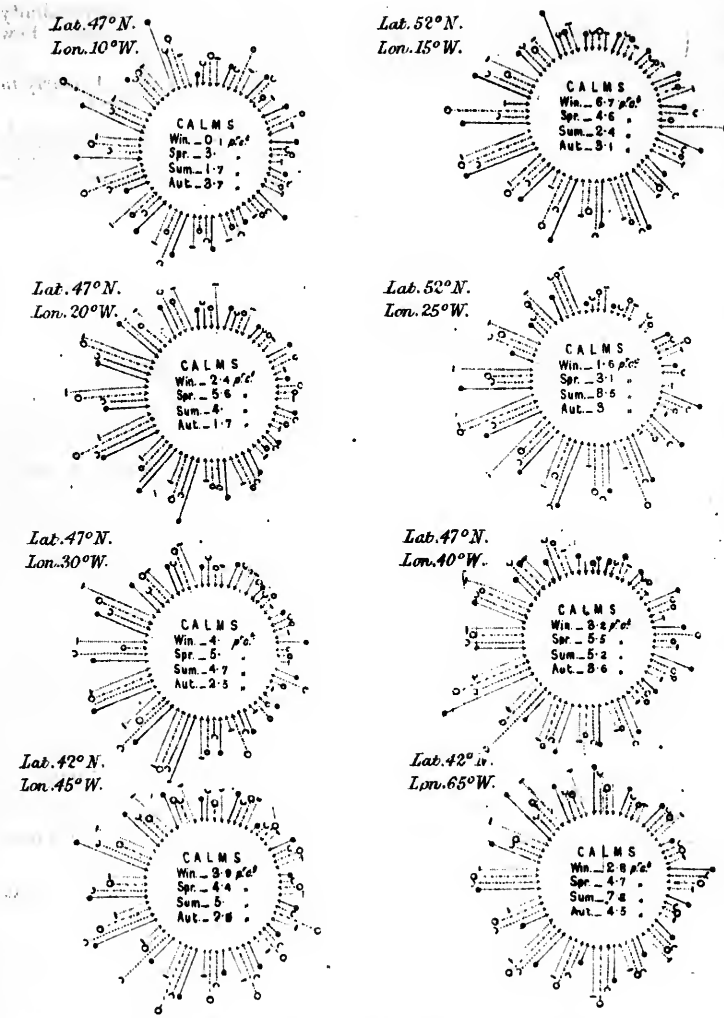
* The tables are given in Admiral FitzRoy's First Number of "Meteorological Papers—Board of Trade," 1857.

† On page 180 (12.), the question of force, as encountered by ships in *motion*, is alluded to as not giving a correct estimate, as it ought to be the real amount without the effect of the ship's driving before it. The land observations also are modified by the above-mentioned influence. A plan has been proposed by Professor Piazzi Smith, in conjunction with Capt. H. Toynbee, to have the wind recorded from the *mast-head*, as the only part of a ship not affected by the eddies from her sails: the direction and force to be communicated electrically to the cabin and there recorded. See "Report, Brit. Association, 1855," p. 45.

Diagrams illustrating the directions of

ANTI-TRADES OR PASSAGE WINDS.



The arrows represent winds *blowing toward the centre*

Winter {Jan. Feb. Mar. *Spring* {Apr. May June *Summer* {July Aug. Sep. *Autumn* {Oct. Nov. Dec.

The length of the arrows is proportionate to the frequency of that wind.

5 10 20 30 40 50 60 70 80 90 100

R H Laurie London

face p. 209.

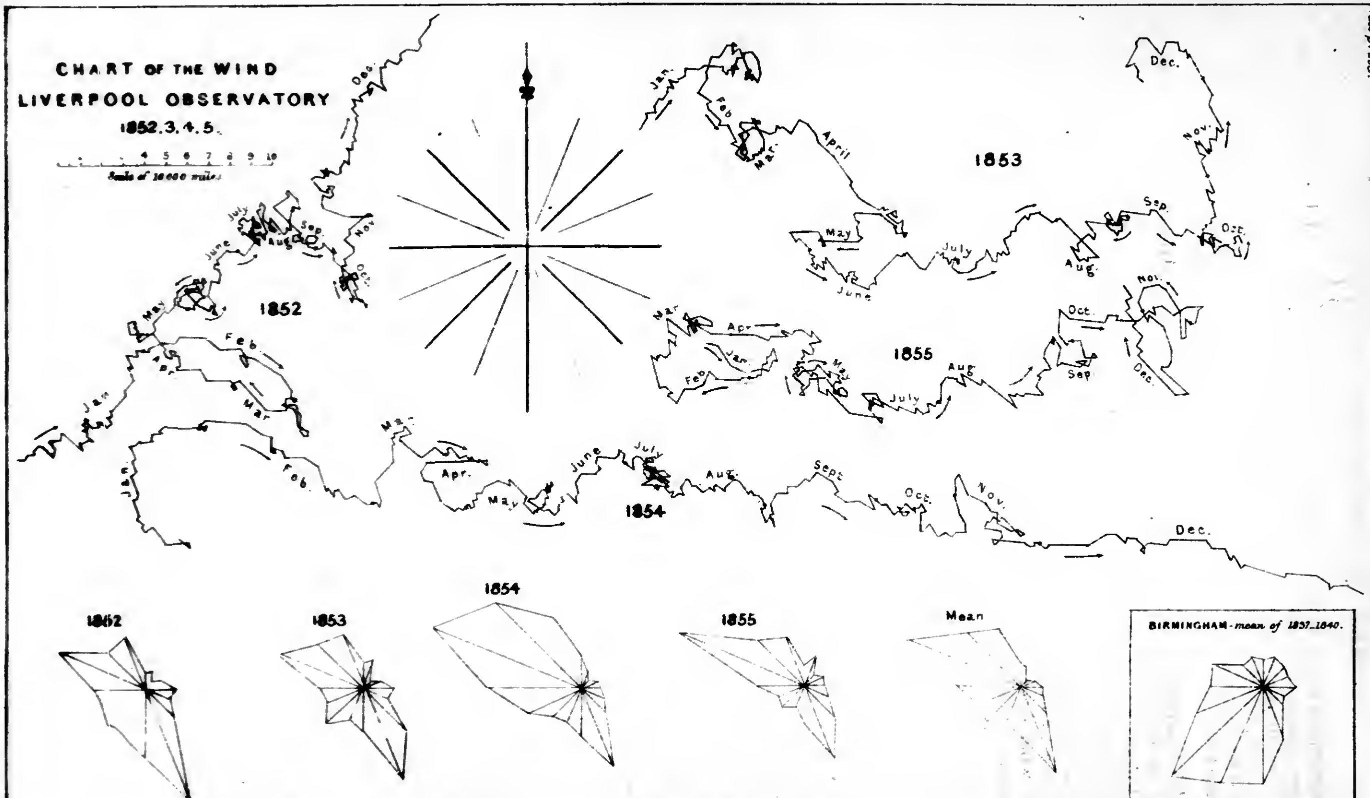


CHART OF THE WIND
LIVERPOOL OBSERVATORY
1852.3.4.5.
Scale of 10000 miles
1852
1853
1854
1855
Jan.
Feb.
Mar.
Apr.
April
May
June
July
Aug.
Sep.
Sept.
Oct.
Nov.
Dec.
1852
1853
1854
1855
Mean
BIRMINGHAM - mean of 1837-1840.

examination of the quantity (or force) of the winds, rather than its prevalence, from those quarters; so that mere *numerical* preponderance gives an imperfect notion of the real proportion of westerly or easterly winds. Thus, as has been before remarked on p. 187, the Pilot Charts of Capt. Maury, though the result of vast labour and of the first importance as one grand repertory of facts, are deficient in this respect. A perfect Wind Chart is yet to be constructed.

(67.) **Liverpool.**—At the Liverpool Observatory, an anemometer, the invention of Mr. A. Follett Osler, F.R.S., registered the force, or rather the motion and direction of the air, for the years 1852, 3, 4, and 5; and the lines thus drawn by the machine itself are reduced on the diagram shown. The lines represent the actual direction and distance, according to scale, travelled by the wind over the instrument. Upon looking at these lines, except the general tendency to the eastward, there is no similarity between the years; yet, by taking the absolute motion throughout the year of the wind from any quarter, and forming a single diagram, there is seen to be a remarkable identity in them all.

Thus, the main direction of the wind in 1854, was rather to the southward of *West;* in 1852, it was to N.W.; and in the other two years, although to the West, yet the wind was very devious.

Notwithstanding the wide difference in the line formed in these different years, yet, if the whole amount of wind in each year is arranged graphically for each point of the compass, they are very similar to each other, showing that a fixed law prevails; which is still more evident if the duration of their prevalence were taken instead of their quantity or velocity. This is shown on the wind-stars on the diagram.

These diagrams will demonstrate the uncertainty there is in predicting from past experience what will be the character of the wind at any time, and at the same time will show that the mean of the chances will be contracted within very narrow limits.

(68.) The total amount of the *horizontal motion* of the air at Liverpool, as registered by the anemometer, is also exceedingly alike in different years, as is shown by these figures:—

	Wind in Miles.	Calms.	Rain.	Duration.
1852	114,276	19 hours.	31·59 inches.	683 hours.
1853	105,989	27 „	22·47 „	625 „
1854	128,283	4 „	22·11 „	537 „
1855	103,405	12 „	22·57 „	540 „
Mean.	112,989	15·5 „	24·69 „	597 „ or 24 days 21 hours.

The *seasons* have an influence in the velocity of the wind; thus these observations show, that in *Winter* (Dec. to Feb.), the mean rate is 15·6 miles per hour; *Spring* (March to May), 12·1 miles per hour; *Summer* (June to Aug.), 11·8 miles per hour; and *Autumn* (Sept. to Nov.), 11·5 miles per hour. The day winds are stronger than at night: thus, at midnight, it travels 11·2 miles per hour; 6 a.m., 11·8 miles per hour; 9 a.m., 12·9 miles; noon, 15·2 miles; 3 p.m., 14·6 miles; 6 p.m.. 12·7 miles; and 9 p.m., 11·6 miles per hour.

Direction.	Miles per Hour.
N.N.E.	6.2
N.E.	6·6
E.N.E.	7·8
E.	11·0
E.S.E.	9·6
S.E.	11·6
S.S.E.	11·4
S.	10·3
S.S.W.	11·8
S.W.	16·7
W.S.W.	15·5
W.	18·9
W.N.W.	19·0
N.W.	17·4
N.N.W.	12·7
N.	7.8

But the more important general deduction to be derived from these observations is the fact, as before alluded to (67.), that all winds having a *westerly* bearing travel very much the fastest; those from south to east proceed at a much slower rate: while such as come from the north and east average but little more than a third of the rate of the westerly winds. All this is made clear by a glance at the adjoining column of figures, which gives the mean rate in miles per hour of the winds from the various directions; and will show further, that the wind-roses and figures of Maury's and other charts do not give an accurate knowledge of this zone of winds, as the westerly winds, though by them made greatly to predominate; do not show the *actual amount* of those winds by, perhaps, one-half or two-thirds their real quantity. All the strongest gales recorded in those years come from western quarters.

(69.) Notwithstanding that the results shown by the Liverpool anemometer are of the utmost value, and great labour and skill have been exercised in reducing them to a comprehensive form by Mr. Hartnup, the able superintendent; yet they contain evidence of the interference of land influences, as alluded to in (65.), on page 208. By his last dissertations,* as here shown, the winds from N.N.W. and S.S.E. were most prevalent, whereas the prevalent direction in England is from the west, with the polar current from the N.E.; showing that the form of the valley of the Mersey has much to do with diverting the normal direction of the wind. Still these observations, as before stated, are most instructive and important.

(70.) There is one remark respecting *land* observations, which is important:—"All the synoptic charts hitherto advanced at the Board of Trade exhibit a marked *diminution of force* on land compared with that on the sea coast. Indeed, the coast itself offers similar evidence in its stunted, sloping trees, and comparative barrenness." † The trees in many localities form excellent wind-vanes, as, by their growth, they show exactly the direction from whence the most powerful and persistent winds come.

It would seem, also, that the land has a tendency to draw the wind towards it, so as in some measure to make it appear that the prevalent direction is more across the line of direction of that coast than is really the case. Looking at the simultaneous observations now daily collected and published for a great extent of coast, this is very apparent. All these arguments tend to lessen the value, in some degree, of those extended and accurate records of the winds on land. The mean direction of the wind, derived from land observations, however, as given by Kämtz and Dove, is as follows:—

England	S. 65° W.	Denmark	S. 62° W.
France and Holland	S. 88° W.	Sweden	S. 77° W.
Germany	S. 76° W.	N. part of United States	S. 86° W.

(71.) **English Channel.**—The following are the results of fifteen consecutive years' observations upon the wind taken by M. *Nell de Bréauté*, at the Chapelle, near Dieppe, at an elevation of 410 feet above the sea:—

* "Report, British Association, 1856," p. 137, &c.; and also "Report of the Direction and Strength of the Wind at the Liverpool Observatory, 1852—1857." It is from these sources that the above facts and figures are derived.

† Third Number, Meteor. Papers, by Admiral FitzRoy, 1858, p. 99.

Direction of the Wind.	Mean number of Days.	Maximum.	Minimum.
South.	37	In 1828— 54 days.	1820 and 1825—28 days.
S.W.	93	1823—121 „	1831—67 „
West.	48	1830— 72 „	1829—31 „
N.W.	52	1825— 72 „	1832—38 „
North.	36	1819— 56 „	1821—21 „
N.E.	41	1826— 54 „	1828—22 „
East.	23	1820— 41 „	1821—12 „
S.E.	31	1818— 46 „	1827—19 „
	Total, 361 Days.		

From this table the following conclusions may be drawn:—

In the 365 days of the year there are about 361 of wind, and 4 or 5 of dead calm.

If the horizon is divided into four equal parts, there will be

135 days with the wind between South and West,*
94 „ „ between West and North,
71 „ „ between North and East,
61 „ „ between East and South.

And consequently there are:—

The maximum of winds between South and West takes place in	November and December.
The minimum „ „	May and June.
The maximum of winds between West and North takes place in	July and August.
The minimum „ „	October and December.
The maximum of winds between North and East takes place in	May and June.
The minimum „ „	October and November.
The maximum of winds between East and South takes place in	December and June.
The minimum „ „	June and July.

Moderate winds from North and N.E. are those which bring fine weather. In summer the N.E. wind blows more particularly in the afternoon; in the morning the wind is S.E., a slight breeze, and towards noon it changes quickly to N.E.; then it freshens, and towards the evening it sinks; at night it is calm, and the coolness condenses the vapours. When this condensation does not take place, it is a sign of a change of wind.

Dead calms are of rare occurrence, and do not last long, except during summer. When they occur in winter, it is regarded as the precursor of bad weather. It is always, in reality, an indication of a change in the direction of the wind.

(72.) The foregoing remarks will be ample for the purpose of giving the sailor an idea of the relative duration, force, and direction of the wind in that part of the Atlantic. Reverting to the observation made on page 209, it may be re-stated, that from the variable nature of its changes and the great difference that is found to occur between one period and another, yet when these are combined in a long series of observations there is great similarity, yet it cannot be predicted or asserted with certainty that a particular wind will occur at a certain time; but what has been said will show what the *chances* are of such wind occurring. For the further service of the mariner, in foretelling what weather is approaching, he is referred to Admiral FitzRoy's "Barometer Manual."

(73.) In the open ocean, between Europe and America, we have only the numerical

* Upon comparing this direction of W. to S. with the Liverpool observations, as given in the diagrams, &c., on p. 209, the disturbing action of the land will be evident.

results collected in Capt. Maury's Pilot Charts, as a source from whence to deduce any exact system. These, as the foregoing remarks will show, are in some degree fallacious, in not giving the force or quantity of wind, as well as its frequency, in any direction,—a very important consideration to the sailor in making use of "these brave west winds." However, they are very valuable in enabling him to form a conclusion as to the *chances* he may have of meeting with any wind.

The diagrams adjoining have been drawn up from the Pilot Charts in the same manner as those given on page 187, to illustrate the Trade winds. They are selected from those parts of the ocean most generally traversed by ships crossing it in the strength of these westerly winds. Their localities are shown by the latitude and longitude assigned to such diagram, which thus represents the wind in the region for 150 miles around that position. But, as will be seen at a glance, there is a great similarity in the general features of them all.

The principle upon which these wind-roses are constructed is explained on page 187 (29.); and the six examples there given are analyzed in that page. The remark in the note (*) should be particularly attended to in connexion with the observations on these Anti-Trade winds, as it is clearly futile to endeavour to lay down any *refined* rule for their practical application. As there certainly is a doubt as to the accuracy of the recorded direction of the wind to the extent of two points,—to lay down rules for sailing over any area with a course limited to a few degrees, certainly appears to be a needless refinement with such data to argue upon.

(74.) In comparing these observations, recorded by Mr. Osler's self-registering wind-guage at Liverpool, as shown in page 209, with the second diagram adjoining,—that for lat. 52° N., long. 15° W., or off the West coast of Ireland, where we might expect to find some degree of similarity, there appears to be scarcely any accordance at first sight. But upon referring to the evidence of the greater force of the *westerly* winds over the easterly, as shown by the figures (68.) p. 210, we arrive at a reason why this apparent discrepancy exists. If the arrows on the west (or windward) side of these diagrams were enlarged in proportion to the relative *force*, and the easterly arrows diminished in like manner, there would be a much nearer approximation. This comparison will demonstrate how the direction of the valley of the Mersey, and the line of docks and walls at Liverpool around the Observatory, have diverted the true direction of the winds. For the purpose of still further exemplifying this, the mean of the observations recorded at Birmingham for 4 years, by another anemometer of Mr. Osler's, is given. Although this is inland, and necessarily subject to land influences, the south-westerly preponderance is most clearly marked, and would probably be much more like those in open ocean could the latter be registered by similar means.

The diagrams, as we give them, or the figures in Maury's Chart, must be studied should any greater exactness in the relative duration of any wind be required than can be acquired at a cursory glance; and in the former case, as was before explained, the length of the award applied to the scale at the bottom of the plate will give the exact ratio *per cent.* of the wind represented by that arrow.

One general remark only need be given: it is, that about the Azores the greatest irregularity in the direction of the wind appears to occur in these latitudes; during the summer months the wind is frequently from northern quarters, driving before it the cooler water from the polar regions, and thus abnormally reducing the temperature. Besides this, there appears to be a conflict between this southern and western tendency, and the Trade which is established to the west of them.

(75.) **AMERICA.**—GULF AND RIVER OF ST. LAWRENCE.—Rear-Admiral Bayfield states that, during the navigable season, the prevailing winds are either directly up or directly down the estuary of St. Lawrence, following the course of the chains of high lands on either side of the great valley of the river. Thus a S.E. wind in the gulf becomes E.S.E. between Anticosti and the South coast, E.N.E. above Point de Monts, and N.E. above Green Island. The westerly winds do not appear to be so much guided in direction by the high lands, excepting along the South coast, where a W.S.W. wind at the Isle Bic has been seen to become West, W.N.W., and N.W., on running down along the high and curved South coast, until it became a N.N.W. wind at Cape Gaspé. These winds frequently blow strong for three or four days in succession: the westerly winds being almost always accompanied with fine, dry, clear, and sunny weather; the easterly winds as frequently with the contrary, cold, wet, and foggy. In the spring the easterly winds prevail most, frequently blowing for several weeks in succession. As the summer advances, the westerly winds become more frequent, and the S.W. wind may be said to be the prevailing wind in summer, in all parts of the river and gulf. Light South winds take place occasionally; but North winds are not common in summer, although they sometimes occur. Steady North winds do not blow frequently before September, excepting for a few hours at a time, when they generally succeed easterly winds which have died away to a calm, forming the commencement of strong winds, and usually veering to the S.W. The N.W. wind is dry, with bright clear sky, flying clouds, and showers. After the autumnal equinox, winds to the northward of West become more common, and are then often strong, steady winds of considerable duration. In the months of October and November the N.W. wind frequently blows with great violence, in heavy squalls, with passing showers of hail and snow, and attended with sharp frost.

Thunder-storms are not uncommon in July and August; they seldom last above an hour or two, but the wind proceeding from them is, in general, violent and sudden, particularly when near the mountainous part of the coast; sail should, therefore, be fully and quickly reduced on their approach.

Strong winds seldom veer from one quarter of the compass to another directly or nearly contrary; in general, they die away by degrees to a calm, and are succeeded by a wind in the opposite direction. It is not here meant, that they may not veer to the amount of several points. N.W. winds seldom veer round by North and N.E. to East and S.E.; but they do frequently, by degrees, to the S.W., after becoming moderate. S.W. winds seldom veer by the N.W. and North to the eastward, but sometimes by the South to S.E. and East. Easterly winds generally decrease to a calm, succeeded by a wind from the opposite direction.

In the fine weather westerly winds of summer a fresh top-gallant breeze will often decrease to a light breeze or calm at night, and spring up again from the same quarter on the following morning: under these circumstances only may a land-breeze off the North coast be called for. The same has been observed of the South coast also, but not so decidedly, nor extending so far off shore. Admiral Bayfield adds, "I have occasionally carried the North land-wind nearly over to the South coast just before daylight; but have never observed the South land-wind extend more than 5 or 6 miles off, and that very rarely. Under the same circumstances, that is, with a fine weather westerly wind going down with the sun, a S.W. land-breeze will frequently be found blowing off the North coast of Anticosti at night and during the early part of the morning. If, however, the weather be not settled fair, and the wind does not fall with the sun, it will usually prove worse than useless to run a vessel close in shore at night in the hope of a breeze off the land. Such is the usual course of the winds in common seasons, in which a very heavy gale of wind will probably not be experienced from May to October, although close-reefed top-sail breezes are usually common enough. Occasionally, however, there are years, the character of which is decidedly stormy. Gales of wind, of considerable strength, then follow each other in quick succession, and from opposite quarters.

Nova-Scotia.—The prevailing winds on all the coast are from W.S.W. to S.W., nearly as steady as *trade winds*; excepting that, during the summer months, they are rather more southerly, accompanied with but little intermission by fog, which requires a north-westerly wind to disperse it. It is, therefore, recommended not to leave an anchorage without making arrangements for reaching another before dark, or the appearance of a fog coming on, which, with a S.W. wind, is so sudden, that you are unawares enveloped in it; nor to keep at sea during the night, if it can be avoided. Whenever the wind blows directly off the land the fog is soon dispersed.

Sable Island.—In the spring and summer months dense fogs or rain almost always accompany all winds from the sea, from E.N.E., round south, to W.S.W. In winter, the rain is frequently replaced by snow. During the autumnal and winter months, winds from between North and West become more frequent, and, being off the land, are always accompanied with clear weather.

Strong gales of wind do not often occur in May, June, or July; but, after the middle of August, they are often of great strength, and it becomes the more necessary to attend carefully to the indications of the barometer. Strong winds from East, round South, to W.S.W., are always accompanied by a falling barometer. When, therefore, these winds begin to abate, and the barometer at the same time ceases to fall, a change of wind, more or less sudden, to the opposite direction may be expected, with a rising barometer and fine weather; and if it be winter, with intense frost, coating the vessel, her sails and rigging, with ice.

Again, a high barometer, stationary or beginning to fall, indicates that a S.E. or S.W. wind, with accompanying rain and fog, is not far distant; and if, at the same time, there be a bank of clouds rising above the north-western horizon, the indication is certain.

SOUTH CAROLINA, &c.—About this coast, if the wind blows hard from the N.E. quarter, without rain, it commonly continues so for some time, perhaps three or four days; but, if such winds are attended with rain, they generally shift to the East, E.S.E., and S.E. S.E. winds blow right in on the coast; but they seldom blow dry, or continue long: in six, eight, or ten hours after their commencement, the sky begins to look dirty, which soon produces rain. When it comes to blow and rain very hard, you may be sure the wind will fly round to the N.W. quarter, and blow hard for twenty or thirty hours, with a clear sky.

N.W. winds are always attended with clear weather; they sometimes blow very hard, but seldom for longer than thirty hours. The most lasting winds are those which blow from the S.S.W. and W.N.W., and from the North to the E.N.E. The weather is most settled when the wind is any of these quarters.

In summer time, thunder-gusts are very common on this coast; they always come from the N.W. quarter, and are sometimes so heavy that no canvas can withstand their fury: they come on so suddenly, that the greatest precaution is necessary to guard against the effects of their violence.

HURRICANES.

(76.) Among the most extraordinary phenomena of nature, may be classed those tremendous meteors, the hurricanes and tornadoes of the tropical regions. Until within a recent period they were very imperfectly understood, and were only regarded as terrible convulsions of the aerial system, when all order seemed to be broken up. But these, like many other apparent anomalies in nature, have been found reducible to system; and their various seemingly capricious motions all subject to general rules, which, in this case, have been aptly denominated "*The Law of Storms.*"

The discussions on the *progressive* nature of hurricanes appear to have originated in a paper, entitled, "Remarks on the Prevailing Storms of the Atlantic Coast of the North American States, by William C. Redfield, of the City of New York;" which has proved to be a very important and valuable addition to nautical literature. The subject, adopting the "Redfield Theory," has since been amplified and illustrated by the late Lieutenant-Colonel (afterwards Sir) William Reid, R.E. and C.B., Governor of the Bermudas and of Malta, in his beautiful volume, bearing for the title, "An Attempt to Develop the Law of Storms by means of Facts, arranged according to Place and Time, and hence to point out a Cause for the Variable Winds, with a view to practical use in Navigation," &c. As connected with this subject, the names of REDFIELD and REID will be imperishable.*

We say that the discussion appears to have originated in the before-mentioned works; but, without deciding on the claims of priority, it must be mentioned that, besides the names of Reid and Redfield, those of Mr. Piddington, at Calcutta; Dr. Thom, in the Indian Ocean; of Mr. Espy, in America, and of Professor Dové, at Berlin, must be enrolled with them, as the primary instigators of the inquiry into the origin and nature of storms.

There are various names applied to these storms: Revolving storms, Hurricanes, Tornadoes (Spanish and expressive "turned"), Cyclones, Typhoons, &c.; but all are meant to describe the same thing.

In the foregoing remarks on the winds, on pages 178, 179, the general theory of atmospheric circulation is described; and in (19.) and (20.), page 184, is a *resumé* of the whole, which will show the localities in which these phenomena occur. The subject is also illustrated by the plate at the commencement of this Volume.

(77.) Although the "Law of Storms" is now fully recognized, yet opinion is still divided as to the real character and condition of these remarkable meteors. Reid, Redfield, and others, contend that they are real vortices—currents of air *revolving* round a progressing centre; others, as Thom, contend that the wind blows in *spirals* around this centre; Espy, that the wind blows *toward* the centre: others, again, consider that *vertical* motion of the air will explain many of the phenomena. It is also argued, that, instead of a circle, the form of the storm is elongated, ellipsoidal, or even straight, moving broadside onwards. Jinman considers that, as the air is blowing away from one area another current necessarily blows towards and into that area, causing the peculiar features of these hurricanes. It would be out of place, and far too discursive for this Work, to discuss these various propositions. They may readily be found in the numerous works extant.

One remark may suffice. Is it not possible, nay, probable, that each of these theories may be correct as to individual cyclones, which may be (and are) of such varied character as not to be reducible in all cases to a fixed rule? However, it is certain that in many examples the true revolving storm is the proper appellation, and the rules now applied will give the means of avoiding their fury.

In our description of the Winds, &c., page 184, we gave the theory that has been universally received as the cause of the Trade-winds and their attendant phenomena in the general atmospheric currents.

(78.) From all the investigations on the subject, the following conclusions have been arrived at. The hurricane, or rotary storm, commences within the tropics, on either side of the Equator; *those in North latitude, the motion of the revolving circle is from right to left, past the North, or against the sun:* while the storm progresses to the W.N.W., N.W., North; forming a cycloidal curve in about 30° N. lat., and runs off to the N.E.

South of the Equator, or in the southern hemisphere, *this rule is reversed, the storm revolving from left to right*, and passing onwards in a S.W., and finally in a S.E. course.

The diameter of these circular vortices varies from 40 to 50 or even 1,000 miles, probably increasing in size in their onward progress. Their rate of travelling varies from 3 to 50 miles per hour.

There are numerous minor peculiarities connected with these CYCLONES, which will

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* "My attention was first directed to the subject from my having been employed at Barbadoes in re-establishing the Government buildings blown down in the hurricane of 1831; when, from the violence of the wind, 1,477 persons lost their lives in the short space of seven hours. I was induced to search everywhere for accounts of previous storms, in the hope of learning something of their causes and mode of action."—*Reid*, "*Law of Storms*," p. 1. This work is illustrated with ten large charts, besides other engravings.

be gathered from the subsequent remarks. But the great point with the mariner is to avoid their fury, and, having ascertained their character and his relative position on the meteor, to make the best course for getting away from it. Colonel Sir William Reid's "Law," is simple, and will be best given in his own words.

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In these tempests, when a vessel is lying-to, and the wind veers by the ship's head, she is in danger of getting stern-way, even when no sail is set; for in a hurricane the wind's force upon the masts and yards alone will produce this effect should the wind veer ahead, and it is supposed that vessels have often foundered from this cause.

When the wind veers aft, as it is called, or by the stern, this danger is avoided, and a ship then comes up to the wind, instead of having to break off from it.

If great storms obey fixed laws, and the explanation of them in this Work be the true one, then the rule for laying a ship to follows like the corollary of a problem already solved. In order to define the two sides of a storm, that side will be called the right-hand semicircle which is on the right of a storm's course, as we look in the direction in which it is moving, just as we speak of the right bank of a river.

The rule for laying a ship to will be, *when in the right-hand semicircle to heave-to on the starboard tack, and when in the left-hand semicircle to heave-to on the port tack in both hemispheres.**

(81.) Mr. Redfield says:—"At stations within the tropics, the changes of wind, during the passage of the hurricane, are sometimes known to *exceed* those which pertain to the passage of a regular circuit of wind; these changes sometimes running through the entire circuit of the compass, and even more. Again, they have been known to shift *backward and forward*, in alternate and fitful changes, when near the crisis of the storm. These phenomena, so far from disproving the rotative character of these gales, only prove something more, and afford, at least, probable evidence in support of one or both of the following positions, viz.:—1. That high land and other obstructions often produce sudden and fitful gusts and changes in these violent winds. 2. That, in accordance with our observations of minor vortices, the axis of rotation is often impelled, excentrically, around a smaller circuit, in the interior of the advancing storm.

"In the northern intertropical latitudes the recession or departure of the south-eastern limb of the storm appears to be followed, not unfrequently, by strong squalls or gusts from S.E., this being the true course of the general trade-wind that determines the track of the storm. These gusts, or squalls, if mistaken for the regular action of the hurricane, may occasion erroneous deductions in regard to the course of the storm.

"At stations apparently within the regular track of the storm, there will sometimes be an absence of violent wind; or the violence will pertain to only one of the phases, which the storm presents, in its regular course over such locality.

"Some storms are interrupted in their development by the near approach of another storm. Care must be taken, therefore, not to mistake the N.E. wind of a storm whose north-western limb is thus intercepted by a bordering storm, and which hence is sometimes followed by the natural current of air from the S.W. quarter, for the changes that pertain to the centre of the gale."

Mr. Redfield says, in conclusion, "That courses and developments of the storms which pass over the Island of Great Britain are believed to be more complex than on the shores of the United States. It is not improbable that the course of many European storms is in a south-eastern direction. A comparison of marine reports has shown me that, while a storm was blowing at West or W.S.W. in the English

* "An Attempt to Develop the Law of Storms," 3rd edition, 1850, p. 509; and "The Progress, &c., of the Law of Storms and of Variable Winds," 1849, p. 25.

Channel, it was blowing S.E. at Elsinore; at N.E. on the East coast of Scotland; and at North and N.W. in the Irish Channel; thus exhibiting, plainly, a rotation to the left: but it is on careful investigations, hereafter to be made, that we must rely for a proper development of the system of European storms." *

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Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
0	1	2	0	0	4	15	36	25	27	1	2	113

I consider the hurricane season proper commences with the full moon in August and does not end till the full moon in October, and that the third day after the first quarter of the moon is the most dangerous time of the month, but, of course as I have only been navigating in these waters forty eight years, I can't be supposed to know much about it.

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One great advantage in the Aneroid barometer is, that its variations occur simultaneously with their causes. In the mercurial barometer, the friction of the mercury on the tube, and other reasons, concur to make the column rise or fall at some time after the change has occurred. In this the Aneroid barometer possesses great advantage, and it has another very great claim to notice,—that it clearly shows very minute changes, which the oscillation or pumping motion of the mercury in bad weather will not allow to be estimated.

(84.) The main object of the navigator, when assailed by a hurricane, should be to keep his vessel *clear of the centre of rotation*, as there the strength of the wind concentrates, sudden shifts take place, and heavy and confused seas break. It is obvious, that the nearer the vortex is approached the quicker the shift of wind will be, and *vice versâ.*

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(83.) The **Barometer** will be found an unerring indicator of the approach of these meteors, provided proper attention be paid to its monitions. As a general law, the following will be its usual vibrations:—Just previous to the commencement of the hurricane, the mercury will suddenly rise above its ordinary level; † soon after it will begin to fall, and the wind probably rises, showing that the storm has begun. The mercurial column then begins to descend, rapidly at first, and then more slowly, till the centre of the hurricane has passed over, when it begins gradually to rise, and the reverse of the commencement ensues; it attains a higher level, and then as suddenly falls to the mean height. This is supposing the whole of the meteor to pass over, and the centre to be crossed; the mercury showing the quantity of atmosphere above. Upon a little consideration, it will be evident that the form of the upper surface of the revolving storm, or the section of the vortex, is described by the variations in the barometric column. It by no means follows that, practically, this will always be found: a ship may only skirt the exterior of the storm, and, consequently, the mercury will only rise, or oscillate, according to the relative position of the hurricane and the ship, but it may be taken as an indication, when the barometer begins slowly to rise after being depressed, that the greatest danger has passed over, or that the ship is steering away from it. Therefore, should there be any sudden change in the barometer, either rising or falling, its indications should never be neglected, especially during the period, and in the regions, subject to these storms. ‡ The barometer sometimes sinks *two inches* during the progress of a hurricane.—(See *Reid*, pp. 268, 271.)

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The *centre of the storm* is most likely to be different at various times: but it is certain that, in some cases, a certain interval occurs, and this of considerable extent; while in others it has been thought that there is no calm or open space free from its impetuosity. At all events, it must naturally be supposed, that the nearer the proximity of the centre the greater must be the danger from the force of the wind, and its more quickly shifting its direction.

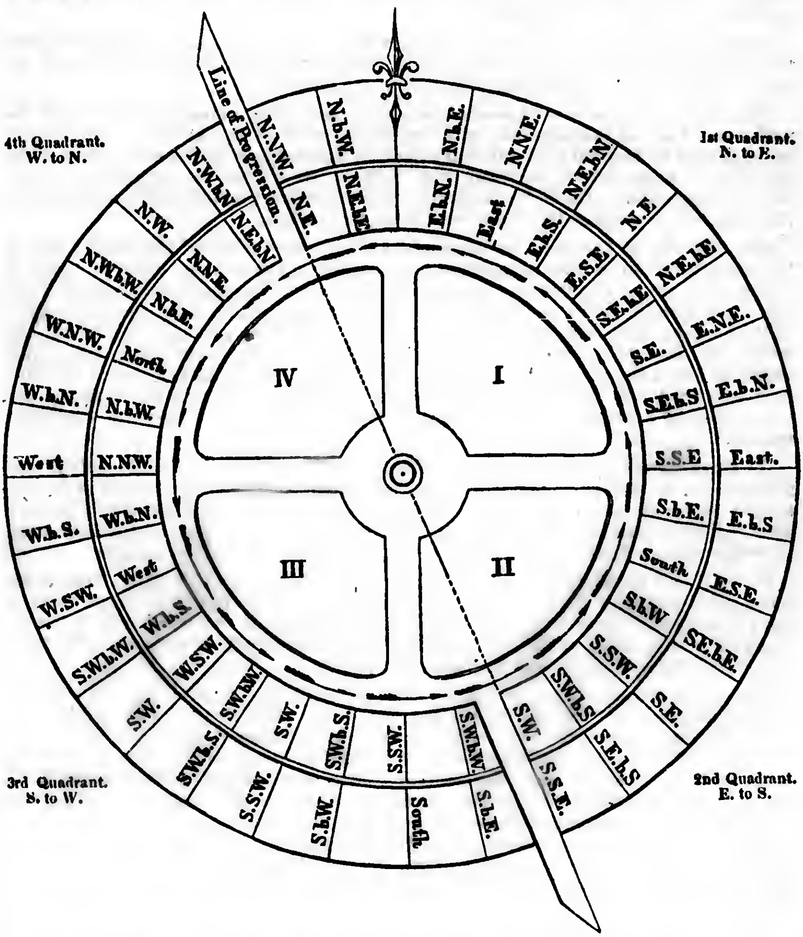
Lieutenant Evans remarks that, "When fairly under the dominion or power of the storm, and in any part of the area, except in the immediate vicinage of the centre of rotation, a ship will not be liable to be taken aback; because, if scudding, she would not intersect the wind; and if she be lying-to, it will either break her off or draw aft gradually, according to the tack she is on: but the case may be different under certain circumstances. Most ships are dismasted at the *crisis;* that is to say, at the time the wind *blows strongest*, which is always on the nearest approach from the centre to any given position. The point at which the wind of the hurricane *commences*, if observed, will make known to the observer the verge under which he is placed.

(85.) *Prognostics.*—With that threatening aspect of the sky which generally precedes all storms,—such as the greasy halo round the sun or moon, the rolled and tufted forms of the clouds, with their lurid streaks of light and extraordinary colours, and the heavy bank clinging to the horizon with its darting forks and threads of pale lightning,—every seaman is acquainted. The best and surest of all warnings will, however, be found in that invaluable and seldom-failing monitor, the *barometer;* the language of which, in the torid zone, is unmistakeable, because there it is usually so tranquil and undisturbed. When any such warning symptoms are observed in *any* quarter of the world it may be supposed that no time will be lost in making all due preparation, and especially if to such menacing appearances be added the confused and troubled agitation of the sea which often precedes these revolving storms, and always shows that they are at no great distance. But if these combined prognostics should occur within the limits of *those regions* in which these cyclones occur, let the seaman immediately consider the possibility, at least, of his being about to encounter a storm of that revolving type of which we have been treating.*

(86.) Acting under this anticipation, his first care should be to discover the position of the storm with respect to the vessel, or, in other words, to ascertain its bearing. Fortunately this is a problem of extreme facility, for, as we have already stated, it is one of the remarkable laws of these storms that in opposite hemispheres they revolve in opposite directions—in *North* latitudes *against* the course of the sun, that is to say, from *right to left*, or in a direction contrary to the movement of the hands of a watch, and in *South* latitudes from *left to right;* and, secondly, it is known that, no matter how great or how little may be the size of the storm-field, the wind continually blows in a circular course round and round a centre or vortex. It therefore necessarily and demonstratively follows that this centre must always be at right angles to that circular course; or, in other words, that the bearing of the centre lies 8 points of the compass from the direction of the wind. Now, these two considerations are quite enough for our purpose, for they enable us to answer the question instantly and certainly by the following general rule:—

* Although it is true that the prognostics of a common coming storm are, in general, sufficiently plain to be understood by a spectator, from the angry appearance of the firmament, yet it is also true that there is no particular indication in any one quarter of the horizon sufficiently marked, like the space occupied by the *Black squall* panoply of the Caribbean Sea;—so that an acute seaman shall say, "thence will the blast come." On the contrary, the clouds gather together (we speak from experience) in dense masses, of a cinereous hue, in every direction, until the whole canopy of heaven is overspread, and the gloom at last becomes so intense that, even at mid-day, to speak within bounds, beyond a quarter of a mile no object can be even indistinctly seen. There are, however, some degrees of variation in the intensity of the obscurity; but we all know that the measure of distance by the eye upon such an exciting occasion is not likely to be very exact; at one period in a hurricane, just as the ship was dismasted, at the *crisis*, near noon, we could not clearly distinguish the end of the bowsprit from the quarter-deck.—*Lieutenant Evans.*

(87.) **Rule.**—Look to the wind's eye,—set its bearing by the compass,—take the 8th point to the **RIGHT** thereof—and that will be the bearing of the centre of the storm if in north latitude; or, if in south latitude, the 8th point to the **LEFT** of the direction of the wind. For example: suppose the vessel to be in 14° N. latitude, the wind from E.S.E., and the barometer and sky indicating a coming gale,—then, look at the compass, take the 8th point to the right of E.S.E., and S.S.W. will infallibly be the bearing of the brewing storm, *if it be* of a revolving type. Or, under similar appearances of the weather in 14° S. latitude, with the wind S.W., take 8 points to the left of S.W., and S.E. will consequently be the direction of the centre of the impending gale. In the former case, the vessel will be on the northern edge of the storm-field; and in the latter, she will be somewhere in its north-western segment.



(88.) In order to simplify this subject, and render it perfectly clear, a copy of the figure annexed (obligingly communicated to Mr. Purdy by the late Lieutenant Evans, who wrote on this subject under the name of "Stormy Jack"), may be drawn on thick paper or card-board. The outer circle to be *fixed*, representing the points of the horizon; the inner circle, with index, to be moveable, and attached, with a button in the centre, so as to revolve on the outer or under circle: thus the inner circle may represent the *phases of the wind*, as it gyrates round a centre; the arrows showing the revolution of the aerial current from right to left. The moveable circle is subdivided into four quadrants, for the purpose of facilitating the mode of operation.

Here (says Lieutenant Evans) it will be obvious that, if a vessel be caught under the N.N.W. verge of the hurricane, the wind, as shown by the arrow annexed to that point, will be, apparently, from E.N.E., and the changes will be seen as they occur progressively. On the N.E. verge of the hurricane the wind will appear to come from the S.E. On the North verge the wind will be East; and if on the West, it will be northerly, as shown in the figure.

The subject, when considered, will be readily understood: only bearing in mind that the shifts of wind will appear, *in most cases*, to be from left to right, *while the general wind is actually pursuing quite a contrary direction.*

(89.) *To use the instrument*, formed as above, place the moveable circle upon the under one, East, in juxtaposition with the North point of the horizon. The vessel's position may be marked as a stationary spot on the outer or under circle—say under the N.N.W. verge, where the wind is at E.N.E.; then move the upper circle in the line of progression to the N.W., which is the general line pursued, and the changes of the wind will be seen as they occur on the object marked.

The direction of the wind is independent of the progression of the storm; and as the current of air, whilst sweeping round the centre, pursues one unvaried path, it follows that, under every point of the horizon, there will be experienced a wind blowing at right angles to it, unchangeable in its direction; thus, under the *North* point of the horizon, there will be an East wind; under the *South* point, a West wind; and under the *East* point, a South wind. So that, were the storm stationary, a ship scudding round the entire circle, from any given position, would experience the wind from every point of the compass, in regular succession; but this, as the fact is, can very rarely, if ever, happen, on account of the progressive movement of the entire meteor.

As these storms do not pursue a uniform velocity, the rate of their actual progression can be arrived at only after they have ceased to act on any two or more stationary spots; or upon two ships, by noting the exact time each experienced the first shock of the hurricane, and also the time of its departure, respectively. Some cause or causes operate to accelerate the rate at one time, and retard it at another.

On reference to the preceding diagram, it will be seen, that if a ship first encounters a hurricane with the wind at E.N.E., she will be under the N.W. verge; and as the progression is (generally) to the N.W., the changes of the wind will be to the eastward, going round to the S.E. and South, and ending with it at about S.W. by S. *Apparently* these changes will be from right to left.

It becomes necessary here to observe, that, although the general medium course of the hurricane in the West Indies has been found to be N.W., yet in two or three instances we have reason for believing that either a deviation in particular parts of its course, or otherwise a vibration of oscillation of the entire meteor, has taken place. Any deviation, however, from the general course pursued by the storm to the N.W. can easily be detected, from the veering of the wind; as that ought to be regular, when the progressive path of the storm is regular, except at or near the vortex. For instance, if the hurricane commences at E.N.E., and the wind does not follow the regular successive changes, as noted above, we may be assured that the storm is not pursuing a course to the N.W.; and the true line of progression may be ascertained by the circle, so as to gain the corresponding points of change to those which occur.

Again, if the storm commences at North, the wind ought to veer (under the same progressive direction of N.W.) to the N.W., West, and end with it about W. by S. or W.S.W. But if, after the wind has got to West, the storm should end with it at South (as it did at Antigua in 1804), we shall be assured that a deviation had taken place at the westward in the progression, or otherwise a vibration or oscillation to the southward.

The uncertainty of these aberrations should not deter the navigator from placing confidence in the general remarks here given, as these (based on Mr. Redfield's theory) have been arrived at from experience, from facts which are incontrovertible, and from a careful study of the subject; and besides, should these variations not happen, and to a certainty they do not always occur (at least on the ocean), he may benefit by them; whilst, under a case of their occurrence, no rules can possibly be given for his guidance; he must place his vessel in the best position his judgment points out, and passively await the result.

We shall now endeavour to explain, in the plainest manner we can, the operation of the wind, and its effects on a vessel in each of the quadrants, when the progression is to the N.W.

(90.) *First, or N.E. Quadrant.*—Wind from South to East. The changes of wind, if a vessel be lying-to, will *appear* to take place from *left* to *right* throughout: as the wind will *seem* to draw round them from the eastward toward the South, although it is in fact proceeding the contrary way, or from right to left.

The navigator's attention is particularly directed to this apparent paradox; for, whilst he notes the wind down in his journal as veering with the sun, it is all the time, as remarked before, going the contrary way! The delusion is occasioned by the progression of the hurricane to the N.W., which, by receding from the vessel's position, has the effect of bringing up the more southerly *phases* of the wind in succession, and, consequently, imparting to these an *apparent* contrary direction to that which the whole current of air is actually pursuing. This deceptory process is somewhat similar to the well-known astronomical illusion every day before our eyes: we allude to the apparent course of the great luminary. Not only can we imagine, from the evidence of our sense of seeing (not at all times to be depended upon), that the sun is moving from East to West, but, in common *parlance*, such idea is invariably expressed; yet everybody knows that this is only apparent, and that the delusion is occasioned by the diurnal rotation of the earth round its axis from West to East.

This point, however, once clearly understood, will no longer perplex us; and the best mode to adopt, in order to avoid being puzzled, is, to use the moveable circle with the *phases* of the wind marked on the rim, placing it over the fixed circle with the points of the horizon marked to represent the ocean.

We now proceed with the first quadrant. If a ship scuds to the northward, the direction of the alterations of the wind will in a great measure depend upon her velocity, as she is crossing obliquely the course of the progression: if she keeps pace with the *northerly* advance of the storm, the wind will remain the same; if she exceeds it, the wind will draw round to the eastward; and if the progression outstrips her, the changes will be to the southward. In either of the latter cases the variations will be few, in all probability; and the westerly progress may be expected to cause the ship to be speedily thrown out of the circle of operations.

A ship is likely to enter this quadrant only under the northern verge from the North to the N.E. point: if she happens to be standing to the southward, within the limits of the trade-wind, she will be liable to be taken aback; but if standing to the northward, of course she will not.

(91.) *Second, or S.E. Quadrant.*—Wind from West to South. A ship lying-to, with the wind from any point between South and S.W., the shifts will be from the southward toward the West, *apparently* from left to right. If the wind be between the S.W. and West, there will be few if any changes, as the ship will be near the posterior line of the progression; what changes may happen will probably be from West towards the South. The vessel will soon be clear of the commotion. It seems pretty evident that a vessel will not, in the first instance, be liable to fall under the S.E. verge in this quadrant, for this reason—that she cannot overtake the hurricane, as its velocity, in all probability, at any time would exceed her rate of sailing. She may, however, just touch literally about the southern verge, where she would get the wind from the West. To enter this quadrant, therefore, a ship must pass through some other.

(93.) *Third, or S.W. Quadrant.*—Wind from North to West. A ship lying-to, the wind from the northward (as the storm progresses) will draw round to the westward, from right to left, truly as apparently so.

As a ship scuds to the southward and eastward, the wind will draw round in the same manner as mentioned above. It appears obvious, that a vessel falling into the storm, under any point in this quadrant, would merely feel the "*brush*," but she will be liable to be taken aback if standing to the northward or north-eastward on first entering the scene of operation, supposing her to be within the limits of the trade-wind.

(94.) *Fourth, or N.W. Quadrant.*—Wind from East to North. If a ship lies-to with the wind at any point between East and N.E., it will *appear* to draw round from left to right, or from N.E. by E. to East. If she lies-to with the wind between N.E. and North, the shifts will be from right to left, or from N.E. by N. to North. Under the N.W. verge (where the wind is at N.E.), a ship, being there in the line of the anterior progression, will drift, probably, into or very near to the centre of the circle, which, on account of the sudden shifting of the wind there, should, if possible, be avoided, as there the greatest danger may correctly be considered as existing.

If a ship scuds, under the same circumstances of winds, the changes will appear the same as above given; but slower in the first instance, and quicker in the second, for these reasons: that in the one case, the points of change are receding from her as she advances; and in the other, they draw toward her approach, her velocity through the water accelerating the alterations; and this difference is occasioned by the progression to the N.W.

Within the limits of the trade-wind, if a ship be standing to the southward, she will not be liable to be taken aback, or striking the storm in this quadrant, but she would be so if steering to the northward.

It should be constantly held in remembrance, that, under all circumstances, the wind remains the same; or, in other words, that under any given point of the horizon, the wind will be found to blow from a particular direction unchangeable, so that there is actually no shifting; the changes observable being occasioned by the progression of the storm to the N.W., and the movements of a vessel.

From this peculiar character of the tempest, the course which a ship will pursue through the circle of operations, as also the successive changes of the wind, as these appear to take place, become an easy problem to solve, after having noted the point from which the first wind or the first shift, is felt, *provided* no divergency in the course, or vibratory motion of the meteor, takes place.

Although a ship in most cases, we imagine, may be more likely to fall into the circle of operations under the north-western verge of the storm than in any other part, as that is the anterior advancing section, no general rules can be laid down for the guidance of the mariner for placing his ship in such a position so as to ensure her not being taken aback when the storm shall be first felt, because until that moment arrives, when the direction of the first blast is to become his "polar star," he cannot, with unerring certainty, anticipate his position with respect to the particular verge of the hurricane that is approaching him.

Under such unavoidable circumstances, he must use his best judgment in preparation for meeting the worst, and be ready to lay his vessel to, or to scud, according to the direction of the wind first experienced. To be quite sure of what he is about to do, perhaps the safest plan would be to wait until the first *shift* takes place after the commencement of the storm; by which measure, his position would be confirmed, a point of material consequence to arrive at.

Every experienced seaman, after having given the theory his best attention, and made himself familiar with the whole working of the wonderful meteor, will of course follow the dictates of his own mature judgment, upon an occasion that will assuredly call forth the full exercise of it. Without, therefore, presuming or desiring to obtrude upon him the manner we ourselves should act under a case of such uncertainty, which would demand all the resources of mind of the individual commander, for the first time placed in such a dilemma, we shall nevertheless offer it here a mere illustration.

Let us, then, suppose that we are steering to the northward in our ship, within the limits of the trade-wind (call it E.N.E.), and that certain prognostics appear, which our judgment informs us forbode a storm. If it happens to be the hurricane season, we are bound by prudence to prepare the ship for encountering a tempest of that nature, even though appearances may induce us to think that such would not eventually happen; for, whether a mere common gale or a hurricane should follow, every sensible person will admit that, during that season, it is the wisest, as it is the safest plan, to be prepared to meet the worst that may happen under such appearances. It must be recollected, that nature herself proclaims the warning, and her admonitions are not to be disregarded with impunity.

Without loss of time, we make the ship snug, hatches battened down, &c. This done, we should bring her to the wind on the starboard tack, with her head to the northward, with a fore and a mizen storm stay-sail. We cannot, as we said before, anticipate under what verge of the storm we shall enter, but we shall have done all that prudence can dictate, by lying-to *without square sails*, and of course making our minds up to have the fore-and-afters blown to shreds by the new wind, come from whatsoever quarter it may. In this position we must wait patiently until the first shift of wind takes place. If this should be from E.N.E. to E. by N. and East, we should make ourselves easy in the position obtained, with reference to the particular verge of the storm, as well as in that we had placed the ship; having the assurance (from the shift of wind) that the anterior verge which had struck us, would be now running away at the rate of from 15 to 20 miles an hour, whilst our drift to the westward would not exceed 3½ miles in the same time; so that every point that the wind drew round toward the South, would tell as plainly as if a map of the whole operations were suspended in the heavens overhead, for our consolation, that our exit from the commotion was rapidly drawing nearer and nearer; and that, if the ship proved equal to contend with the *crisis*, and no vibration occurred, we should escape the centre.

This may sound, in the style of the celebrated Francis Moore, of predicting memory, very like "taking a peep into futurity." We are not, however, studying the doctrine of probabilities. As far as we at present know of the matter, and (thanks to Mr. Redfield) we have gained a pretty general insight into it, there appears but two circumstances at all likely to upset our calculations and foresight of what is to happen, and there are, as intimated before, a divergency in the line of progression, or a vibration of the entire meteor; and here we are taught, that, with all the wide and searching capacity of our minds, there is a point beyond which it is not permitted man to peer. We have been allowed, however, to glean enough of the economy of this wonderful phenomenon, to excite our unfeigned gratitude to HIM "who rules the whirlwind and the storm." We proceed:—

On the other hand, if the shift of wind was to the N.E., or even a point on either side, we should immediately know that we were in the "very jaws of the lion;" and to escape being overwhelmed in the vortex we must run for it.* On this occasion, every moment is of importance, when we bear in mind that we are now in the path which the centre will follow. To the S.W., therefore, we start away, not without an impressive dread, as the wind comes veering round and round toward the North, of a too close approximation to the vortex, toward which curve the ship makes inclines. If we could tell the exact diameter of the hurricane, and its precise rate of progression, we could calculate pretty accurately whether, and at what distance, we should

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* When the line of progression is to the W.N.W. (a direction which some of the most southern storms have pursued), it would be wrong to scud with the wind at N.E.; but when at N.N.E., it would be proper to do so.

pass the centre; but as these data can never be obtained, we have nothing otherwise than *prudence*, to gude us in this particular case, the most perilous that can occur.

There is a very nice point to be determined upon at this juncture, and one, although there will be but a few minutes for decision, that should not be rashly settled; a sort of choice between the scalping-knife and the tomahawk—a very forlorn hope, take which measure you please; it is this: to scud under square sail, or to run with bare poles? Now, however desirable it is that top-sail should be carried in a storm where the waves rise to a great height, and break in heavy surf, and a ship's way is lessened as she drops into the trough, to prevent her from being pooped, yet, we say, although it should be practicable to set a close-reefed main-topsail, the propriety of so doing is questionable until the wind has drawn round to the westward of North (and then it might as well be left alone), for not before that will the dreaded centre have been passed; and as there can be no certainty of a ship's safety until that "consummation" has been accomplished, the chance of being taken aback with square sail deserves the most serious consideration of the commander. The danger in both cases is imminent; but, in determining for ourselves, we should run with bare poles, until finally thrown out of the storm. Indeed, after all the judgment, care, anxiety, and apprehension which may be displayed and felt on so trying an occasion, our approximation, notwithstanding the vessel's *dash* of 12 or 13 knots, may be so near the vortex as that every stick shall be blown out of her. And we impressively declare our conviction, that hitherto the majority, if not all, the vessels that have been lost in hurricanes and typhoons, have foundered by falling into the centre with square sail set whilst scudding. On lying-to, no sail would stand the disruptive puffs for five seconds!

We have ourselves, in utter ignorance of the operations as they occur, and are here stated, been scudding in a frigate, partly dismasted, with reefed *main-sail* (the only sail available), before the furious blast of a hurricane, after the wind had veered to the S.W. As it happened, we had fortunately dropped into the second quadrant, and were drawing near our exit, but we knew nothing of that; and if it had happened in the fourth quadrant, and we had got into the centre, there is no doubt but that the ship must have foundered! But to proceed:—

No other resource is available to us under such circumstances as described above; and no other alternative remains except the desperate one of heaving-to, defying the fury of the storm, and taking the chance of being thrown directly into the centre of commotion; where, if the ship should not founder, she would, there is scarcely a doubt, lose her masts, and be otherwise completely assailed at all points by the raging elements!

The N.W. verge of the hurricane, whilst it advances in that direction, is the "very head and front" of the danger, the nucleus of which follows, in a direct line, the advance of that point. The consequences, be they the foundering of the ship, or the loss of her masts, &c., are inevitable, if prompt and active measures are not taken to get out of that position.

Should the wind, at first, keep steady at E.N.E. for some time, which it would do (if the storm is of great extent) when a ship enters under the N.N.W. verge, the navigator may be a little puzzled how to act, as anticipating a shift, to determine his position; he need be under no apprehension; the shift will come in due time (according to the extent of the circumference) from the E. by N., and so gradually round (but quickening as he approaches the centre) to the southward: he may, however, expect to loose some of his spars when the *crisis* arrives.

We have dwelt longer upon the action of the wind in the fourth or N.W. quadrant, because under this anterior verge the greatest peril may follow; and we may now be permitted to express a hope that mariners may derive some little advantage from the perusal of this paper, as the writer has devoted his best attention to the subject with the sole view of rendering them, as brother sailors, a service.

JOHN EVANS.

(95.) We will close this portion of our remarks with some general observations on the subject by *Captain Richard Leighton,* of Montrose, to whose kindness and talent we are indebted for numerous additions to hydrography:—

"1st. Outward-bound ships. As the S.E. storm-wind is generally nearly directly in front of the storm, on meeting with that wind and a falling barometer, &c., you should bear off freely to the north-westward, that is, nearly at right angles with the route of the gale, and all that you run that way will increase your distance from the centre when it passes you; whilst, if you run westward, you will pass so near to the centre that you will be taken aback by the wind flying into the north-westward; the object is to skirt the gale, and haul more westerly as the wind veers to the eastward.

"2nd. When the wind is to the southward of S.E., it appears that you must pass through the right-hand semicircle, and should haul to and hold all the southern that you can; lay down the bearing and distance of the centre, and as soon as practicable, by a second bearing and distance, estimate the route of the gale and its progress.

"3rd. Estimate your distance, and the course that you are likely to make, clear of leeway, and some veering in the wind, and this will give you an idea at what distance you are likely to pass the centre, and what is likely to occur. Knowledge is power. Most carry sail long enough, but many don't set it *soon enough.*

"4th. The farther the wind is to the southward, the nearer you must pass to the centre, and as the wind veers and breaks her off, she will lay in the trough of the sea, and is most likely to get damage that way, so that if the wind gets loose, it is time to be upon the right tack (that is, the starboard tack, with westerly winds, in the Atlantic, being in the right-hand semicircle). Every one knows best what his own ship will bear, and what she will perform; however, if you *will go ahead* till the last minute, when the *barometer stops falling,* it is *high time* to have her round upon the right tack, as there is generally a tremendous gust shortly after the barometer stops falling: or, when she has made a slight rise, and the ship should be upon the starboard tack, that she may *come up* and bow the sea when she takes it.

"5th. To wait for 'the lull,' or the 'sky to the westward lighting up, to indicate the shift,' will often be *too late.*

"6th. Eight miles per hour, I think, is a fair medium for the rate of progress of rotatory gales in the Atlantic and Southern Indian Oceans. The regular West India cyclone travels generally much quicker, and some Mauritius cyclones have a very slow movement; that which the *Charles Heddle* scudded three and a half times round, only progressed about 2½ miles per hour.—*At Sea, August,* 1851.—R. LEIGHTON."

(96.) **EXAMPLES.**—To illustrate the preceding remarks and directions, accounts of a series of revolving storms is given. They are illustrated by the map before alluded to at the commencement of the work.

Routes on the Chart—No. I. Trinidad to Yucatan, over the middle of the Caribbean Sea, June 23 to 28, 1831.

No. II. Barbadoes to the Mississippi, August 10 to 17, 1831.

No. III. Guadaloupe to the Bank of Newfoundland, August 17 to 29, 1827.

No. IV. Guadaloupe and Antigua to Charlestown, and thence to the Bay of Fundy, September 3 to 10, 1804.

No. V. Antigua, passing over Cuba, to the coast of Texas, August 12 to 18, 1835.

No. VI. Barbuda to Charlestown, and thence to the Bank of Newfoundland, August 12 to 19, 1830.

No. VII. From the intersection of 20° North and 60° West (N.E. of Barbuda), passing to the West of Bermuda, and thence N.E. to the parallel of 42½°, September 29 to October 2, 1830.

No. VIII. From the parallel of 22° (North of Porto-Rico) to Cape Hatteras, to the coast of Maine, September 1 to 5, 1821.

No. IX. From near the same spot as No. VIII., on a similar route, but more to the eastward, August 22 to 27, 1830.

No. X. From the parallel of 30° North, on the East side of the Florida Stream, to Cape Sable of Nova Scotia, January 13 to 16, 1831.

No. XI. Inland storm, over the lakes, and thence to the Gulf of St. Lawrence, November 10 to 12, 1835.

The route designated as No. I. is that of the hurricane which visited the Islands of Trinidad, Tobago, and Grenada, on the 23rd of June, 1831. Pursuing its course through the Caribbean Sea, it was subsequently encountered by H.M. schooner *Minx*, and other vessels, and its swell was thrown with great force upon the south-eastern shores of Jamaica on the 25th, while passing that island, where the wind at this time was light from the northward. After sweeping through the Caribbean Sea, the hurricane entered upon the coast of Yucatan, on the night of the 27th, having moved over the entire route from Trinidad to the western shore of the Bay of Honduras, in a little more than 100 hours, a distance of nearly 1700 miles, equal to 17 miles an hour.

Track No. II. is that of the hurricane which desolated Barbados in the night of the 10th of August, 1831; and which passed Porto-Rico on the 12th; Aux Cayes, in Hayti, and S. Iago de Cuba, on the 13th; Matanzas on the 14th; was encountered off the Tortugas on the 15th; in the Mexican Sea on the 16th, and was at Mobile, Pensaccla, and New Orleans on the 17th; a distance of 2,000 miles in about 150 hours, exceeding 13½ miles an hour. Its course, until it crossed the tropic of Cancer, was nearly W.N.W. Mr. Redfield adds—"in pursuing its northern course, after leaving the ocean level, it must have encountered the mountain region of the Alleganies, and was perhaps disorganized by the resistance opposed by these elevations. It appears, however, to have caused heavy rains in a large extent of country north-eastward of the Mexican Sea."

Track No. III. is that of the destructiue hurricane which swept over the Windward Islands, 17th August, 1827; visited St. Martin and St. Thomas on the 18th; passed the N.E. coast of Hayti on the 19th; Turks' Islands, on the 20th; the Bahamas on the 21st and 22nd; was encountered on the coast of Florida and South Carolina on the 23rd and 24th; off Cape Hatteras on the 25th; off the Delaware on the 26th; off Nantucket on the 27th, and off Sable Isle and Bank on the 28th. Its ascertained course and progess were nearly 3,000 miles in about eleven days; or at the average rate of about 11 miles an hour. The direction of its route, before crossing the tropic, nearly N. 61° W., and in lat. 40°, while moving eastward, N. 58° E.

Track No. IV. An extensive hurricane of September, 1804, which swept over the Windward Islands on the 3rd of that month; the Virgin Islands and Porto-Rico on the 4th; Turks' Islands on the 5th; the Bahamas and the Strait of Florida on the 6th; the coast of Georgia and the Carolinas on the 7th; Chesapeake and Delaware, with the continuous portions of Virginia, Maryland, and New Jersey, on the 8th; and the States of Massachusets, New Hampshire, and Maine, on the 9th; being on the high lands of New Hampshire a violent snow-storm. The destructive action of this storm was widely extended on both sides of the track indicated upon the chart, and the same fact pertains in a greater or less degree to the other storms herein mentioned. It appears to have passed from Martiuique and the other Windward Islands to Boston, by the usual curvilinear route, in about six days; a distance of more than 2,200 miles, at an average progress of about 15½ miles an hour.

Track No. V. The route of the hurricane which ravaged Antigua, Nevis, and St. Kitt's, in the afternoon and night of August 12th, 1835; St. Thomas, St. Croix, and Porto-Rico, on the 13th; Hayti and Turks' Islands on the 14th; the vicinity of Matanzas and Havana on the 15th; was encountered off the Tortugas, on the Bank of Florida, on the 16th; in lat. 27° 21′, long. 94°, and other points on the 17th and 18th; and at Matamoras, near the Mexican shore, lat. 26° 4′, on the 18th, where it was most violent during the succeeding night. It also passed over Galveston Bay, in Texas, and there blew with violence from the S.E.; while at the mouths of the Mississippi and along the northern shores of the gulf, the gale was not felt. This storm is remarkable, as moving more directly and farther to the West, than is usual for storms which pass near the West Indian Islands, it having reached the Mexican shores before commencing its sweep to the northward. Course, about N. 73° W.: progress more than 2,200 miles in six days; nearly equal to 15½ miles an hour.

Track No. VI. The memorable gale of August, 1830, described hereafter, which, passing close by the Windward Islands, visited St. Thomas on the 12th was near Turks' Islands on the 13th; at the Bahamas on the 14th; eastern coast of Florida on the 15th; coasts of Georgia and the Carolinas on the 16th; off Virginia, Maryland, New Jersey, and New York on the 17th, off George's Bank and Cape Sable on the 18th; and over the Newfoundland Bank on the 19th; having occupied about seven days in its ascertained course from near the Windward Islands, a distance of more than 3,000 miles; the rate of its progress being equal to 18 miles an hour. If, adds Mr. Redfield, we suppose the actual velocity of the wind, in its rotary movement, to be five times greater than this rate of progress, which is not beyond the known velocity of such winds, it will be found equal, in this period, to a rectilinear course of 15,000 miles. The same remark applies, in substance, to all the storms which are now passing under review.

Track No. VII. was encountered to the northward of the Caribbee Islands on the 22th of September, 1830; its route was to the eastward of all those previously described, and was found on the Grand Bank of Newfoundland, October 2, having caused great damage and destruction, on its widely-extended track, to the many vessels which fell in its way. The ascertained route may be estimated at 1,800 miles, and the average progress 25 miles an hour.

Track No. VIII., experienced in September, 1821, as more fully shown hereafter. This hurricane was extremely violent; it was encountered to the north-eastward of Turks' Islands, on the 1st of the month; to the northward of the Bahamas and near the latitude of 30° on the 2nd; on the coast of the Carolinas early in the morning of the 3rd; and from thence, in the course of that day, along the coast of New York and Long Island; and it is represented to have continued its course across the States of Connecticut, Massachusets, New Hampshire, and Maine. The diameter of the storm appears to have exceeded 100 miles; its ascertained route and progress about 1,800 miles in sixty hours, equal to 30 miles an hour.

A similar but less violent storm swept along the same portion of the coast of the United States on the 28th of April, 1835.

Track No. IX. The route of a violent and extensive hurricane, which was encountered to the northward of Turks' Islands, August the 22nd, 1830; northward of the Bahamas on the 23rd; and off the coast of the United States on the 24th, 25th, and 26th of the same month. It produced much damage, but scarcely reached the American shores. Its duration was about forty hours, and progress more tardy than some others.

Track No. X. A violent hurricane and snow-storm, which swept along the American coast from the parallel of 30° North, on the 5th and 6th of December, 1830. This track corresponds to another storm of similar character, which swept along the coast on the 13th, 14th, and 15th of January, 1831. These violent winter storms exhibited nearly the same phases of wind and general characteristics as those which appear in the summer and autumn.

Track No. XI. The violent inland storm which passed over the Lakes Erie and Ontario on the 11th of November, 1835. This storm was very extensive, spreading from the sea-coast of Virginia into the Canadas, to a limit unknown. The anterior portion of this gale was but moderately felt, and its access was noted chiefly by the direction of the wind and the great fall of the barometer; the violence of the storm being exhibited chiefly by the posterior and colder portion of the gale, as is common with extensive overland storms. The regular progression of the storm, in an easterly direction, was established by facts collected by Mr. Redfield, from the borders of Lake Michigan to the Gulf of St. Lawrence and the coasts of New England and Nova Scotia.

In perusing the descriptions above, it is to be noted that the lines on the Chart representing the routes, are given by Mr. Redfield as but approximations to the centre of the track or course of the several storms; and the gales are to be considered as extending their rotative circuit from 50 to 300 miles or more, on each side of the delineations; the superficial extent of the storm being estimated both by actual information and by its duration at any point near the central portion of its route, as compared with its average rate of progress.

The circular figure which appears upon the Chart, on Tracks Nos. I., V., and VII., will serve, in some degree, to illustrate the course of the wind in the various portions of the superficies covered by the storm, and also to explain the changes in the direction of the wind, which occur successively at various points, during the regular progress of the gale.

(97.) HURRICANES of 1780.—From want of adequate information on the subject, it was formerly assumed that the memorable hurricane of the year 1780, which dispersed and destroyed nearly all the British fleet in the West Indies, took its course from W.N.W. to E.S.E.; but from authentic documents, acquired by Colonel Reid, it has been shown that two great storms occurred nearly at the same time, and these have been frequently confounded together, and considered but as one. The first destroyed the town of Savanna-la-Mar, on the 3rd of October, 1780. The second, and by far the greater one, passed over Barbadoes on the 10th and 11th of the same month, as will be shown hereafter.

The first or *Savanna Hurricane* appears to have progressed from the S.E. to the western part of Jamaica, and thence passed in a N.N.E. direction over Cuba, the Great Bahama Bank, and Island of St. Salvador, continuing nearly in the same direction to the parallel of 35° N., in long. 69° W., whereabout its ravages probably ceased. Between the 5th and 7th of October, it annoyed the squadron under Rear-Admiral Rowley, between the parallels of 28° and 29½°, long. 72½° to 75°,* previous to which, at half-past five in the morning of the 4th, the *Phœnix* frigate, under Sir Hyde Parker, was driven on shore and wrecked at about 3 leagues to the eastward of Cape Cruz, Cuba. At eleven p.m. of the 2nd, the ship was off Port Antonio, Jamaica, when the wind began to blow, with a stormy appearance to the eastward, and she then close-reefed her topsails. At eight a.m. of the 3rd, the wind was E.N.E., with occasional heavy squalls; and Sir Hyde remarked that the *weather had the same appearance as he had observed in the commencement of a hurricane in the East Indies.* He then ordered the topsails to be taken in, and wore the ship, in order to keep mid-channel between Jamaica and Cuba.

At two p.m. the *Phœnix* lay-to, with a storm mizen staysail, and her head to the northward. When night set in, the storm increased with great violence. At midnight the wind was S.E., and the ship drawing upon Cuba, the captain proposed to wear her, but no canvas could withstand the wind at this time, and under the direction of the first lieutenant, Archer, she was wore by sending 200 of the crew into the fore-rigging. When about to cut away the masts, the ship took the ground, and if she had not been driven on shore she must have foundered. All the ship's company were saved, excepting twenty, most of whom were lost with the main-mast, and washed overboard.

Of the ships in Rear-Admiral Rowley's squadron, above mentioned, on the 6th and 7th of October, the *Hector*, *Berwick*, *Bristol*, *Trident*, and *Ruby*, were disabled, and mostly dismasted. They had been sent by the Admiral, Sir Peter Parker, to convoy a fleet part of the way to Europe, and had subsequently the misfortune, in the same month, to meet the great hurricane, next described.

The Savanna hurricane seems to have originated within the Caribbean Sea, and not to have passed over the Eastern Antillas, nor touched on the continental coast to the southward. The *Scarborough* frigate, which was lying a few days before in

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* Marked * in the Chart.

Montego Bay, was lost, and it is supposed that she foundered near the western end of Jamaica.*

The Great Hurricane, which commenced at Barbadoes on the *10th of October*, 1780,† with preceded in the evening of the 9th by weather remarkably calm, but the sky surprisingly red and fiery, and during the night much rain fell. The storm approached from the S.E., and the ships of the squadron stationed here experienced the hurricane, each in turn, according to the place she was in. A letter from Dr. Blane, dated from the *Sandwich*, Sir Geo. Rodney's flag-ship, stated that it was not previously apprehended that there would be anything more than such a gale as they experience, from time to time, at that season; but, on the evening of the 10th, the wind rose to such a degree of violence as clearly to amount to what is called a *hurricane*. At eight p.m. it began to make impression on all the houses, by tearing off the roofs, and overthrowing some of the walls. As the inhabitants had never been accustomed to such a convulsion of nature, they remained for some time in security, but they now began to began to be in the utmost consternation. * * * * It was thought to be at its greatest height at midnight, and did not abate considerably until eight next morning. During all this time, most of the inhabitants had deserted their houses, to avoid being buried in the ruins; and every age, sex, and condition, were exposed in the fields to the impetuous wind, incessant torrents of rain, and the terrors of thunder and lightning. Many were overwhelmed in the ruins, either by clinging for shelter too long in the buildings, or attempting to save whas was valuable, or by unavoidable accidents in the fall of walls, roofs, and furniture, the materials of which were projected to great distances. Even the bodies of men and cattle were lifted off and carried above the ground. From an estimate of the number of deaths reported to the governor, they amounted to more than 3,000. All the fruits of the earth were destroyed; most of the trees torn up by the roots, and many of them stripped of their bark. The sea rose so high as to destroy the fort, carrying the great guns many yards from the platform, and demolishing the houses near the beach. A ship was driven on shore against one of the buildings of the naval hospital, which, by this shock, and by the impetuosity of the wind and sea, was entirely destroyed and swept away. * * * * The mole-head was swept away; and ridges of coral rock were thrown up to above the surface of the water: but the harbour and roadstead were, upon the whole, improved, having deepened in some places six feet, in others many fathoms. The crust of coral, which had been the work of ages, leaving a soft oozy bottom, and many shells and fish were found ashore which had been previously unknown.

The hurricane passed, in succession, over the Islands of St. Vincent, St. Lucia, Martinique, and Dominica, and included within its area those of Guadaloupe, St. Christopher, St. Eustatius, &c. At St. Vincent, every building was blown down, and the town destroyed. At St. Lucia, which was near the centre of the hurricane, all the barracks and other buildings were blown down and the ships driven to sea. At Martinique, likewise, all the ships that had brought troops and provisions were blown off the island. On the 12th, four ships with their crews foundered in Fort Royal Bay. The other ships were blown out of the roads. In the town of St. Pierre, on the N.W. coast, every house was blown down, and more than 1,000 people perished. At Fort Royal, the cathedral, seven churches, other religious edifices, many public buildings, and 1,400 houses, were blown down, as was the hospital of Notre Dame, in which 1,600 sick and wounded, the greatest part of whom were buried in the ruins. The number of persons who perished in Martinique is said to have been 9,000. Dominica likewise suffered greatly, and Guadaloupe was within the northern verge of the hurricane.

At *St. Eustatius*, although not far within the N.E. verge, the loss was very great.

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* Colonel Reid, "Law of Storms," pp. 276—278, and Chart ix. The colonel, as in other cases, adds copious details, which plainly show where the hurricane did not operate, either to the East or to the West.

† The track of this hurricane is shown on the Chart commencing between No. i. and ii.

On the 10th of October, at eleven a.m., the sky on a sudden blackened all round; it looked as dismal as night, attended with the most violent rains, thunder, lightning, and wind. In the afternoon the gale increased; seven ships were driven on shore near the North point, dashed to pieces on the rocks, and their crews perished. Nineteen vessels cut their cables and went to sea. In the night every house to the northward and southward was blown down, or washed away with the inhabitants into the sea, a few only escaping. The houses to the East and West were not so much hurt till the afternoon of the 11th, when the wind, on a sudden, shifted to the eastward; and at night it blew with redoubled fury, and swept away every house; but the forts, barracks, hospital, cathedral, and four churches, remained. Here between 4,000 and 5,000 persons are supposed to have lost their lives.

Advancing north-westward, the centre of the hurricane on the 14th had reached to the Mona Passage, on the West of Porto-Rico. Here the *Ulysses* and *Pomona*, with a fleet under their convoy, suffered greatly, and here the *Deal Castle* frigate was wrecked. Another frigate, the *Diamond*, fell within the western verge of the storm on the 15th, but happily escaped by passing Alto-Vela, on the South side of Hayti. Above the parallel of 20° the *Stirling Castle*, 64, was lost on the Silver Kay Bank, and most of her crew perished. On the 18th we find, in about 22½ N., and 69° W., the *Trident*, *Ruby*, *Bristol*, *Hector*, and *Grafton*, men-of-war, on the S.W. verge of the storm. The ship last mentioned, on the 16th, at noon, was in lat. 26½°, long. (by estimation) 71° 30′; heavy gales and cloudy weather; lying-to under trysails; the gales split the sails to ribands. On the 18th, lying-to; strong gales and heavy squalls.—17th to 18th, carried rapidly to the south-eastward, when the *Trident*, *Ruby*, and *Hector*, came in sight as above. At eleven a.m. spoke the latter, in great distress.

The *Ruby*, *Trident*, and *Bristol*, on the 15th, were as high as 27½ N., and they, too, from the western border of the hurricane, were driven to the southward, until they joined company.

Here the detail becomes imperfect, until we reach the Bermudas; but to the N.E. of these isles we find the *Berwick*, 74, on the 19th, which had fallen, on the 17th, within the border of the hurricane from a position to the W.N.W., near the latitude of 35°. This ship had previously been one of Rear-Admiral Rowley's squadron; she was proceeding to England under jury-masts, and had reached to the North of the latitude of the Bermudas when the hurricane overtook her. On the 16th, at eleven a.m., during calm, there was a great swell from the eastward. On the 17th, at one p.m., she was taken aback; wore ship and handed topsails: at three, squally, with rain; loosed the topsails; six to eight, wind E. by N., fresh gales. On the 18th, winds variable from the eastward, E. by N. to E.S.E.; after midnight, strong gales and heavy squalls. At noon, by estimation, Bermudas S. 53° E. 31 leagues.—19th, at one a.m., weather moderate, and the ship proceeded on her course.

On the 18th about fifty vessels were driven on shore at Bermuda.

We have been the more particular in giving these details, from having formerly been misled by imperfect data. In the delineation of the "Great Hurricane," given by Colonel Reid, he first assumes a circle having a radius of about 170 miles, which gradually expands, on its N.W., North, and N.E. course, to 270, with, we may presume, a diminished and proportionate momentum, on the parallel of Bermuda. The colonel observes that, on reading the logs and the various accounts of this hurricane, and comparing the different reports of the wind, it will be found that no storm yet described, more strongly than this proves the rotatory nature of hurricanes.

(98.) *Trinidad, June*, 1831.—(*No. I. on the Chart.*)—It will not readily be forgotten that, on the 23rd of June, 1831, Trinidad, in the parallel of 10½° N., experienced one of the most awful storms of wind and rain ever remembered by the oldest inhabitant. The gale commenced at five o'clock on Thursday morning, and continued till eleven; the wind, after shifting from East, North, West, and South, finally settled at S.W., and blew without intermission until three in the afternoon. Eleven or twelve vessels were driven on shore, and several of them severely damaged.

It was subsequently stated that the hurricane was felt at all the southern islands, where the loss it occasioned was very great. Such a storm had not happened at Granada since the year 1780; the devastation was extensive and dreadful; and the loss in that colony was estimated at £80,000. Its course to Yucatan is described hereafter.

(99.) *Barbadoes, August*, 1831.—(*No. II. on the Chart.*)—In the night following the 10th of August, one of the most devastating hurricanes that had ever been experienced visited Barbadoes. Not a single house was left uninjured, and the greater part were levelled with the ground. On the 11th it passed over the Islands of St. Vincent and St. Lucia, extending a portion of its influence to Martinique and islands to the N.W., and to Granada on the South, but exhibiting its principal violence between 12¼° and 14° N., or the parallels of Barbadoes and Martinique. On the 12th it arrived on the southern coast of Porto-Rico; from the 12th to the 13th it swept over the South side of Hayti, and extended its influence as far southward as Jamaica. On the 13th it raged on the eastern portion of Cuba, sweeping in its course over large districts. The town of Aux Cayes, in Hayti, was almost destroyed by its force, and that of S. Iago de Cuba was very much damaged. On the 14th it was at Havanna, and toward the West end of Cuba. On the 15th it proceeded north-westward, and on the 16th and 17th it arrived on the northern shores of the Mexican Sea, in about the 30th degree of latitude, raging simultaneously at Pensacola, Mobile, and New Orleans, where its effects were continued till the 18th. At New Orleans, on the 17th, it came on in dreadful gales, from N.E. to S.E., accompanied with torrents of rain. Almost all the shipping in the river were driven on shore, and very few of the smaller craft escaped total wreck. The back part of the city was completely inundated. The sugar-canes, above and below the city, were laid flat, and the loss was enormous. The gale was felt at Natchez, 300 miles up the river; and hereabout it spent itself in heavy rains, after having occupied a period of six days in the cycloidal course from Barbadoes.

At most of the islands, during the hurricane, the winds in the earlier part of the storm were from a northern quarter, and in its later periods from a southern quarter, of the horizon; from which it results, that the gyratory action was from *right* to *left*, as in the storms which pass to the northward of the great islands, and along the western coast of the ocean.

The distance passed over by the storm, in its passage from Barbadoes to New Orleans, is equal to 2,100 nautic miles. The average rate about 14 miles an hour.

The details of the storm in August, 1831, as it affected *Barbadoes*, *St. Vincent*, and *St. Lucia*, were given in the *Times* newspaper of the 10th of October, in the same year. In the despatch of his Excellency *Sir James Lyon*, governor of Barbadoes, it is noticed that, on the evening of the 10th, the sun set on a landscape of the greatest beauty and fertility, and rose on the following morning over an utter desolation and a waste. The prospect at daybreak on the 11th was that of January in Europe—every tree, if not entirely rooted up, was deprived of its foliage, and of many of its branches; every house within view was levelled with the ground, or materially damaged; and every hour brought intelligence of the most lamentable accidents and of very many shocking deaths.

The evening of the 10th was not remarkable for any peculiarity of appearance; but in the night it began to rain, accompanied with flashes of lightning and high wind, which appeared to come from the North and East; toward midnight the wind increased, and was more to the westward and S.W.; the rain fell in torrents, and the lightning was vivid in the extreme; at one o'clock the hurricane had commenced, and from two until daybreak it is impossible to convey any idea of the violence of the storm; no language can sufficiently express its horrors. The noise of the wind, the peals of thunder, and the rapidly repeated flashes of lightning (more like sheets of fire), and the impenetrable darkness which succeeded them, the crash of walls, roofs, and beams, were all mixed in appalling confusion, and every house shook to its foundation.

The tempest did not entirely cease, nor the atmosphere clear up, until about nine o'clock in the morning of the 11th, when many families were found to be buried in the ruins; and the few ships in Carlisle Bay were driven high on the strand.

At an early hour on the morning of the 12th, the storm commenced from the northward on *St. Vincent*, but was not much felt at Kingstown and the shipping on the West until about half-past eight, when its violent effects were excessively destructive. Every vessel at the anchorage, with the exception of one, was cast on shore, and every plantation sustained damage, more or less, by the total destruction of crops and provisions, buildings, works, and negro-houses.

St. Lucia, it appears, did not suffer so much as St. Vincent; but even here the destruction was immense. In the night of Wednesday, the 10th, the same night on which the hurricane commenced at Barbadoes, the sky had a very heavy, lowering appearance; and early on the next morning, with the wind at North, it began to blow very fresh, which continued increasing, accompanied with rain, until five o'clock; and by seven, or half-past seven, the prognostics of a hurricane appeared; by a little after eight the harbour presented a most awful appearance, the sea ran mountains high, and broke on the South side with the utmost violence, and the vessels in the anchorage became ungovernable. In this condition the town was situated from half-past eight to twelve o'clock, when the wind, which had prevailed in frequent and violent gusts, became more moderate, and before two o'clock it was comparatively calm. During the continuance of the storm it rained unceasingly, but not violently, and the wind seemed to vary very little from its ordinary direction.

(100.) HURRICANE OF 1830.—The storm which passed the city of New York, on the 17*th of August*, 1830, was there, and along all the coast northward of Cape Hatteras, considered as a *north-east storm*.—(*See Chart, Route VI.*)

It appears that this commenced at the Island of St. Thomas, in the West Indies, on the night between the 12th and 13th of August. On its progress, in the afternoon of the 14th, it commenced at the Bahama Islands, and continued during the succeeding night, the wind almost round the compass during the existence of the storm. On the 15th, in the Florida Channel, its effects were very disastrous. Without the strait, in lat 26° 51′, lon. 79° 40′, the gale was severe from N.N.E. to S.W. Late on the same day, off St. Augustin, it was equally so. At 20 miles North of St. Mary's, from eight p.m. on the 15th, to two a.m. on the 16th, it was from an eastern quarter, then changed to S.W.

Off Tybee and at Savanna, on the night of the 15th, it changed to N.W. at nine a.m. on the 16th, and blew till twelve. On the 18th, at Charleston, the gale was from S.E. and East, till four p.m.; then N.E. and round to N.W. At Wilmington (N. Carol.) the storm was from the East, and veered subsequently to the West. In the vicinity of Cape Hatteras, at sea, the storm was very heavy from S.E., and shifted to N.W.

Early in the morning of the 17th, the gale was felt severely in the Chesapeake, from the N.E. Off the capes of Virginia, on the 17th, lat. 36° 20′, lon. 74° 2′, "a perfect hurricane," from South to S.S.E., from five a.m. to two p.m., then shifted to N.W.

Off Cape May, lat. 32°, lon. 74° 15′, in the afternoon of the 17th, a heavy gale from E.N.E. Coast of New Jersey, same afternoon, heavy at N.E. Again, in lat. 39°, lon. 73°, at E.N.E. In the same latitude, lon. 70° 30′, a "tremendous gale," commencing at S.S.E., and veering to North.

Afternoon and evening of the 17th, at New York and in Long Island Sound, gale at N.N.E. and N.E. Off Nantucket Shoals, at eight p.m., severe at N.E. by E. In the night of the 17th, off Nantucket, and in the Gulf Stream, lat 38° 15′, lon. 67° 30′, "tremendous," commencing at South, and veering, with increasing severity, to S.W., West, and N.W. Peninsula of Cape Cod, in the night between the 17th and 18th, severe at N.E.; 18th, at Salem and Newbury, heavy gale from N.E. In lat. 39° 51′, lon. 69°, severe from S.E., suddenly shifting to North. In lat. 41° 20′, lon. 60° 25′, "tremendous hurricane," from N.N.E.

Off Sable Island, in the night of the 18th, lat. 43°, lon. 59½°, "tremendous heavy gale," from South and S.W. to West and N.W. In lat. 43°, lon. 58°, a severe gale from the South; the manner of change not reported.

This remarkable storm appears to have passed over the whole route above described in about six days, at an average of about 16 miles an hour; the duration of its most violent portion, at the several points over which it passed, may be stated at from seven to twelve hours; and the width of its track is supposed to have been from 150 to 200 miles.

"On the western part of the Atlantic Ocean, between the parallel of New York and the northern limit of the trade-wind, the prevailing winds, for a considerable period, both previously and subsequently to the occurrence of this storm, were south-westerly, or from the southern quarter; and over the whole breadth of the Atlantic, on the route frequented by ships in the European trade, fresh south-western or westerly winds also prevailed at the same period, for many weeks. These facts are well established by numerous marine journals, which have been consulted in relation to this subject.

Of the vorticular or rotative character of the storm, striking evidence has been afforded by the journals of two ships, the *Britannia* and the *Illinois*, both bound from America to Europe; the particulars of which are fully given in the Exposition by Mr. Redfield.

(101.) *In about a week after the storm last described*, another occurred, which passed New York on the 26th and 27th of August, and which was, also, on this coast, a N.E. storm, of about three days' duration. From the eastward of the Bahamas it appears to have passed northwardly between the Florida Stream and the Bermudas; and touching the American shore near Cape Hatteras, raged with great fury for about forty hours at each locality, as it swept the great central curve of the coast; and passing from thence, continued its course over George's Bank, in a north-easterly direction. It was evidently of greater compass, and slower progress, than the preceding storm, as is proved by a collation of the various reports of mariners; and its long duration, and its effects were almost equally violent.

The next remarkable series of hurricanes appear to have originated in the vicinity of the Windward Islands, near the close of September, 1830, and which, passing westward of the Bermudas, on a course nearly North, assumed thence a more easterly course, toward the southern edge of the Grand Bank of Newfoundland.—(*See the Chart, Route VII.*)

This storm was very disastrous. In lat. 20½°, lon. 63°, it commenced, on September 22, at one p.m., and continued till half-past six p.m., from N.E. and S.W. alternately. On the same day it passed through lat. 22° 46′, lon. 65°. At night, on the 30th, in lat. 26° 7′, lon. 66½°, "very heavy," for five hours and a half. On the 1st of October it arrived at lat. 30° 38′, lon. 63°; severe at S.E., shifted to N.W.: thence it was found in lat. 33°, lon. 66½°; lat. 34° 9′, lon. 66° 12′: lat. 35°, lon. 68°; lat. 38°, lon. 63°; lat. 38½°, lon. 57°; lat. 40°, lon. 61°; lat. 40° 25′, lon. 58° 24′; lat. 41°, lon. 55°, and very severe. By an average estimate of rates and distances, it appears to have proceeded at the rate of about 27 miles an hour.

The extensive hurricane of 1804, which swept over most of the Windward Islands in the West Indies, commenced at Martinique, on the 3rd of September, reached Savanna on the 7th, Boston on the 9th, and became a *snow-storm* on its arrival in the interior of New Hampshire.

The great gale of 1815 commenced at St. Bartholomew's on the 11th of September, and reached Rhode Island on the morning of the 23rd, where it was awfully destructive from the S.E., while in the south-eastern parts of Massachusetts, it was then blowing at South; at New London from East to S.E.; and at New York from North to N.N.W.

(102.) *A S. E. storm, in September*, 1821—(*see Chart, Track VIII.*)—was experienced in the central parts of Connecticut, commenced blowing violently from E.S.E. and S.E., at about six p.m. on the 3rd of September, having been preceded by a fresh wind from the southern quarter, and flying clouds. It continued blowing in heavy gusts, and with increasing fury, till about ten p.m., when the wind suddenly subsided. A calm or *lull*, of perhaps fifteen minutes' duration, ensued, but was terminated by a violent gust from the N.W., which continued till about eleven p.m., and then gradually abated. Much damage was sustained, and fruit-trees, corn, &c., were uniformly prostrated toward the N.W.

At New York the same storm was experienced, with at least equal violence, about three hours earlier than in Connecticut, but blowing from a more eastern quarter. In the north-eastern parts of Massachusets it was experienced some hours later; and at Providence, in Rhode Island, the storm was felt in the south-eastern quarter, but not severely; as was, also, the case in the south-eastern parts of Connecticut. In the N.W. portions of the latter state, and the adjacent towns of Massachusets, the gale blew with its chief violence from the N.W. quarter, and the trees and corn were uniformly prostrated toward the S.E.

At New York the gale was from N.E. to East, and commenced blowing with violence at five p.m., continued with great fury for three hours, and then changed to West. More damage was sustained in two hours than was ever before witnessed in the city, the wind increasing during the afternoon, and *at sunset was a hurricane.* At the time of *low water* the wharfs were overflowed, the water having risen 13 feet in an hour. Previous to setting in of the gale, the wind was from South to S.E., but changed to the N.E. at the commencement of the storm, and blew with great fury till evening, and then shifted to the westward.

ON MAKING USE OF HURRICANES.

(103.) It has been proposed by Mr. Piddington to make use of these storms, by taking advantage of the favourable wind which some portions of their circumference offer for expediting the voyage. This has also been proposed by Sir W. Reid, in his "Law of Storms." Mr. Piddington has given rules for this, in the regions he has made more particularly his study—the Indian and China Seas; but here the hurricanes do not appear to travel at so great a speed as those of the Atlantic.

In order to benefit by the hurricane, several conditions are necessary; and it need not be again insisted on, that any error or ignorance of the centre of rotation may be fatal. Of course the first consideration is, in what part of the circumference is the ship, and in what bearing is its centre?—then, at what rate, and in what direction, is it travelling?—and is it so violent that the ship cannot weather it? All these things must be weighed well by the mariner, before he endeavours to lay his ship on that tack which will appear the best to forward his voyage. Should the storm be advancing in the same direction as his course, and the position of the ship be upon the anterior verge, should it travel at a rate above that which he can keep up with it, it is evident that it will pass over him, and the consequences need not be remarked upon. Should the vessel be upon the posterior verge of the hurricane, it will, if travelling at 20 or 30 miles an hour, soon leave it, and then no advantage can follow.

Thus, to "make use of a hurricane," several conditions are absolutely necessary: these are—"1. The ship must get into the storm precisely where the wind blows fair for prosecution of the voyage—which is quite a matter of chance. 2. If she happen to do so, she must, to derive benefit, regulate her speed exactly to that of the meteor. Can she do that at pleasure? There would be no difficulty in ascertaining the fact of her preserving her station, or not, by the wind remaining steady, or veering; but there is a necessity that would bind her, and which cannot be evaded with impunity when a high sea follows;—she must carry a certain proportion of sail to prevent her from being pooped. Now this sail may give her a greater velocity than the meteor at the time: hence she would run ahead of it. Again, the rate of the meteor may be greater than her utmost speed; hence she would be ejected."*

* "Nautical Magazine," 1843, p. 301.

WATERSPOUTS.

(104.) The well-known phenomenon, called a WATERSPOUT, which is frequently seen on the Atlantic, proceeding from black dense clouds, always appears in warm weather, generally in calms, or with little wind; but they have been seen during a fresh gale. It has been shown, by the celebrated Dr. Franklin, and other writers, that a whirlwind on land, and a waterspout at sea, arise from the same general causes, and may be considered as one and the same. At sea they are commonly harmless, unless ships happen to be immediately under them; but if, in the progressive motion of the whirl, it passes from the sea over the land, and there suddenly breaks, violent and mischievous torrents are the consequence. At sea, after the spout breaks, the water descends in the form of very heavy rain. In the vicinity of a spout, the wind commonly flies round in sudden gusts; and all ships should therefore take in their square sails.

That a waterspout and whirlwind are identical, has been amply demonstrated by those who have seen this meteor pass from the sea to land, and the contrary. They have both a progressive as well as circular motion; they usually appear after calms and great heats, and mostly happen in the warmer latitudes.

(105.) Marine waterspouts, therefore, are caused by the action of atmospheric currents. Malté-Brun thus describes them:—"Underneath a dense cloud, the sea became agitated with violent commotions, the waves dart rapidly toward the centre of the agitated mass of water, on arriving at which they are dispersed into aqueous vapours, and rise whirling round, in a spiral direction, toward the cloud. This conical ascending column is met by another descending column, which leans toward the water, and joins with it. In many cases the marine column is from 50 to 80 fathoms in diameter near its base. Both columns, however, diminish toward the middle, where they unite; so that here they do not extend more than 3 to 4 feet in diameter. The entire column presents itself in the shape of a hollow cylinder, or tube of glass, empty within. It glides over the sea without any wind being felt; indeed, several have been seen at once following different directions. When the cloud and the marine base of the waterspout move with unequal velocities, the lower cone is often seen to incline sideways, or even to bend, and finally to burst in pieces. A noise is then heard, like the noise of a cataract falling in a deep valley: lightning frequently issues from the very bosom of the waterspout, particularly when it breaks; but no thunder is ever heard."

In order to prevent the danger which a vessel would be exposed to by coming in contact with these tremendous colums, it is the practice to discharge upon them a cannon-ball, which, passing through them, causes them to burst, and consequently removes all chances injury connected with them. This phenomenon is accounted for in the following manner:—Two winds meet—a vortex ensues: any cloud which happens to lie between them is condensed into a conical form, and turned round with great velocity; this whirling motion drives from the centre of the cloud all the particles contained in it; a vacuum is thereby produced, and water, or any other body lying beneath this vacuum, is carried into it upon the usual and well-known principle. The cannon-ball, breaking this cylinder, which is always partly hollow, causes it to fall to pieces, in the same manner as a touch upon the surface of a bubble reduces the resplendent mass to a drop of common water.

(106.) The following description of a WATERSPOUT, seen during a fresh gale upon the coast of North America, was written by the late Mr. Murdo Downie.

"Upon the forenoon of the 9th of October, 1795, while cruising in his Majesty's ships *Resolution*, of 74 guns (then bearing the flag of the late Admiral Murray), in company with H.M.S. *Africa*, of 64 guns, commanded by the late Admiral, then Captain, Home, in lat. 32°, and long. 66¼° W., having the wind at N.N.W. blowing a fresh gale, and the ship steering by the wind East for the Islands of Bermudas, we were surprised with a waterspout, formed in an instant, directly to leeward, at about 2 miles, or little more, distant. Both the *Africa* and we fired several 18-pound shot at it, which fell a little short; and, although some of the shot fell very near, yet they had no visible effect upon it. Its appearance was that of a long slender pillar, with the upper end spreading into a large dense cloud, of which it seemed to form a part, and the lower end reached to within about 20 or 30 feet of the sea, where it was obscured from the sight by the water's being violently thrown up and agitated, so as to resemble a number of fountains or water-engines playing perpendicularly round the lower end of the spout. The pillar became more transparent in proportion as it decreased in size from the cloud downward, until at the lower end, where it was almost perfectly so; and a small column, of an equal diameter, and more transparent than the rest, appeared up through the middle, so that about the lower end it resembled an empty glass tube in appearance; from thence the transparent column in the middle became gradually obscured, the higher up, by the opacity of the outside, until it altogether disappeared near the cloud. The spout appeared at its full size, or nearly so, when first seen, and began to decrease shortly after, and turning gradually smaller, it in a short time vanished in a slight shower.

"We were too intently gazing at this extraordinary phenomenon to mark the exact time it lasted, but supposed it to continue ten or fifteen minutes; and its distance from the ship was pretty accurately ascertained by the shot fired at it nearly reaching; but what appeared most remarkable was, that, although the wind blew so strong a gale, that the ship could carry only reefed topsails (from which the velocity of the wind cannot be estimated at less than 30 or 40 miles an hour), yet the waterspout seemed to move but very little from the place where it was first seen. The ship was going at the rate of 5½ miles an hour, and increasing her distance from the spout; yet, after continuing the above-mentioned time, it was considerably within the verge of the visible horizon, as seen from the quarter-deck, when it vanished (as upon the quarter-deck the eye was elevated 23 feet above the surface of the sea, the horizon would therefore be seen about 6 miles distant): now, allowing the ship to have increased her distance from the spot half a mile during its continuance, and that it vanished a mile within the verge of the visible horizon, which, together with 2 miles it was distant when first seen, will make in all 3½ miles, which, taken from 6 miles (the distance of the visible horizon), leaves 2½ miles for the spout to move in ten minutes; whereas the wind must have gone at least 5 miles in that time, and consequently 2½ miles faster than the waterspout. Indeed it is very probable the waterspout did not move so much, in proportion to the wind, as the above calculation gives the least difference between their motions that could have been allowed from the observations: the intention of this calculation being principally to prove that the waterspout in some measure resisted the force of the wind.

"I have always observed, that waterspouts, lightning, and other electrical phenomena, are far less frequent toward the middle of the ocean than they are upon the land, or near it; and when they happen upon the sea, the cloud that contains them is generally observed to have come from off the land; from which reason we find that electrical phenomena are more frequent, and are found to reach to a greater distance, upon the sea bordering the East coast of North America, than upon that bordering the West coast of Europe; because of the prevailing westerly winds carrying the clouds charged with electric fluid off the land upon the sea near the American coast; whereas upon the European coast these winds confine the clouds upon the land. It is also a known fact, that within the limits of the N.E. trade-winds, and half-way between the Cape Verde and Windward West India Islands, more especially in the latitude of these islands, scarcely any of these electrical appearances ever happen; whereas upon the shores of Africa and America, in the same climate, they frequently rage with great fury."

(108.) *Description of Waterspouts by the late Mr. George Maxwell.*—There can be no doubt that waterpouts have, in most cases, been accompanied with electrical phenomena; and it is equally certain that the spiral and ascending motion of the water has been produced by a gyratory movement in the air, arising from the meeting of two opposite winds. Mr. Maxwell had opportunities, during several voyages to the Congo, of frequently witnessing this interesting phenomenon; and in a drawing, from which the subjoined figure has been made, he has represented the different states of a waterspout, as they most commonly occur.

At their first formation, Mr. Maxwell says, they appear as at A, where the black cloud drops from a level surface into a conical form, before the disturbance at the surface of the sea, as shown at D, is observed. The effect produced at D is like that of a smoking furnace. The black conical cloud now continues to descend, as shown at B, till it almost reaches the surface of the sea, and the smoke-like appearance rises higher and higher, till it forms an union with the cloud from which the spout appears to be suspended. In this condition it is said to put on its most terrific appearance to the mariners who have the misfortune to be in its neighbourhood. When the spot begins to disperse, it assumes the appearance shown at C. The black cloud generally draws itself up in a ragged form, but leaves a thin transparent tube, C E, which reaches the water, where the smoke-like commotion still prevails. Mr. Maxwell observed, at this time, in the upper part of the tube, a very curious motion.

This singular fact, of the existence of a transparent tube, confirms a description, by Mr. Alexander Stewart, of waterspouts which he saw in the Mediterranean, in 1701. "It was observable of all of them, but chiefly of the large pillar, that toward the end it *began to appear* like a hollow canal, only black in the borders, but white in the middle; and though at first it was altogether black and opaque, yet one could very *distinctly perceive the sea-water to fly up along the middle of this canal as smoke does up a chimney*, and that with great swiftness, and a very perceptible motion; and then, soon after, the spout or canal burst in the middle, and disappeared by little and little; the boiling up and the pillar-like form of the sea-water continuing always the last, even for some considerable time after the spout disappeared, and perhaps till the spout appeared again, or re-formed itself, which it commonly did in the same place as before, breaking and forming itself again several times in a quarter or half an hour."—"Phil. Trans., 1702."

Captain (now Admiral) William H. Smyth, in his interesting volume on Sicily and the Sicilian Islans, has noticed, that "waterspouts and various singular meteoric phenomena occur in that neighbourhood. Among the latter, on a warm, cloudy, and hazy day, the 14th of March, 1814, it began to rain in large drops, that appeared muddy, and they deposited a very minute sand of a yellowish red colour. The wind, on the day before, had been blowing strongly from the S.S.W. to the N.E.; and, during the time the rain fell, was from the S.W., which leads to the supposition that it was transported from the deserts of Africa."—This remark accords with a number of others on the sand from the *Sahara* or *Desert*, which is carried by the wind over the Atlantic, to an almost incredible distance from the western coast.*

(108.) To the preceding descriptions we now annex another, as given by the Honourable Captain Napier, R.N., F.R.S.E., in 1814.

"On the 6th of September, 1814, in lat. 30° 47′ N., and long. 62° 40′ W.,† at half-past one p.m., the wind being variable between W.N. W. and N.N.E., the ship steering S.E., an extraordinary sort of whirlwind was observed to form about 3 cables' length from the starboard bow of H.M.S. *Erne*. It carried the water up along with it in a cylindrical form, in diameter, to appearance, like that of a water-butt, gradually rising in height, increasing in bulk, advancing in a southerly direction, and, when at the distance of a mile from the ship, it continued stationary, for several minutes, boiling and foaming at the base, discharging an immense column of water, with a rushing or hissing noise, into the overhanging clouds; turning itself with a quick spiral motion, constantly bending and straightening, according as it was affected by the variable winds, which now prevailed from all points of the compass. It next returned to the northward, in direct opposition to the then prevailing wind, and right upon the ship's starboard beam, whose course was altered to East, in hopes of letting it pass astern. Its approach, however, was so rapid, that we were obliged to resort to the usual expedient of a broadside, for the purpose of averting any danger that might be apprehended; when, after firing several shots, and one, in particular, having passed right through it, at the distance of one-third from its base, it appeared for a minute as if cut horizontally in two parts, the divisions waving to and fro in different directions, as agitated by opposite winds, till they again joined for a time, and at last dissipated in an immense dark cloud or shower of rain.

"The near edge showered in large heavy drops on the ship's deck, until the cloud was quite exhausted.

"At the time of its being separated by the effect of the shot, or more probably by the agitation occasioned in the air by the discharge of several guns, its base was considerably within half a mile of the ship, covering a portion of the surface of the water at least half a furlong, or 300 feet in diameter, from one extreme circumference of ebullition to the other; and the neck of the cloud into which it discharged itself appeared to have an altitude of 40° of the quadrant, while the cloud itself extended overhead, and all around, to a very considerable distance.

"Allowing, then, from the ship, a base of little more than one-third of a nautic mile, say 2,050 feet, and an angle of 40° to the top of the neck, we shall then have, for the perpendicular height of the spout, about 1,720 feet, or very nearly one-third of a statute mile. A little before it burst, two other waterspouts, of an inferior size, were observed to the southward, but their continuance was of short duration.

"When danger was no longer to be apprehended, I observed the brometer, and found it at 30·1 inches, with the surface of the mercury very convex; an appearance which it had not assumed when at the same height at noon, about two hours before; the thermometer stood at 82°, having risen 1° since that time.

"During the continuance of the waterspout, and the subsequent rain, which might be a little more than half an hour, the wind blew from all points of the compass at

* Colonel Reid has given, in his "Law of Storms," a chapter (xi.) on "Waterspouts and the Smaller Whirlwinds," with several beautiful figures of the same, which have been repeated in the "Nautical Magazine," of July, 1830.

† About 45 leagues S.E. from the Bermudas.—Ed.

different times, generally shifting at opposite points, never longer than a fresh breeze for a moment, but in most instances quite light. It was unattended with any thunder or lightning, and the water that fell from the cloud was perfectly fresh.

"Having witnessed this extraordinary phenomenon, I endeavoured to ascertain its cause.*

"Although this phenomenon was rather terrific in appearance, yet I am not inclined to think it would have been attended with any serious calamity to the ship, had even the whole quantity fallen on board, allowing the loftier sails to have been taken in, the hatches battened down, and scuppers open. The cylinder or spout coming in contact with the masts and rigging, would naturally be destroyed; and the air rushing in, instantaneously, to restore the equilibrium, the torrent would thus be checked in its fall to the mere weight or force of a tropical descent. I have heard many reports of ravages committed by these aqueous meteors, but never yet met a person who had actually witnessed or experienced any such distressing effects."

II.—OF THE TIDES.

(109.) As introductory to a General Table of the Tides, we shall give a few passages from *M. Malté-Brun*, explanatory of the subject; and also the results of the recent extensive observations and profound researches of *Professor Whewell* and *Sir John Lubbock*.

The water of the sea yields to the slightest impression; and, although its density and weight combine to retain it in a constant equilibrium, it is agitated to a certain depth by rapid and varied motions. These motions may be classed according to the manner in which the particles move, and according to the nature of the agents which cause the motion.

Three kinds of motion may be distinguished in the sea, considered in reference to their causes. The TIDES are *sidereal motions*, because they depend upon the influence of the heavenly bodies. *General Currents*, and the greatest number of *Particular Currents*, have their causes in the very element that is agitated by them; these, then, are *motions of the sea itself*. The third kind comprehends *atmospheric motions*, produced by the action of the winds.

The TIDES are regular and periodical oscillations, which the seas undergo from the attraction of the celestial bodies, principally those of the moon and sun.

(110.) *Action of the Moon.*—Let us first consider the single action of the moon upon the sea; supposing that luminary to be in the plane of the Equator. It is evident that, if the moon exerted upon all the particles of the sea an equal attraction, and parallel to the earth's centre of gravity, the entire system of the globe, and of the waters which cover it, would be influenced by a common motion, and their relative equilibrium would not suffer any change. The equilibrium is disturbed only by the difference between the attractions which the moon exerts, and the inequality of their directions. Some parts of the globe are are *directly* attracted by the moon; others only obliquely. The former are in conjunction with the moon; and a line drawn from the centre of the two planets would pass through their zenith. The latter are in quadrature with the moon—that is to say, a line drawn from the terrestrial centre to their zenith would make an angle of 90° with the line which connects the centres of the two planets. The attracting force acting obliquely is decomposed by the obliquity of its angle of incidence: thus the parts in conjunction being more

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* See "Edinburgh Phil. Journal," vol. vi. p. 97.

strongly attracted than those in quadrature, the weight of their particles is diminished. It is necessary, then, to there being an equilibrium in all parts of the sea, that the waters should rise under the moon, in order that the excess of weight of the particles in quadrature, above those in conjunction, may be compensated by the greater height of the latter.

The waters, however, rise, not only on the side where the attracting planet is, but also, on the opposite side; because, if the planet attract the superior waters more than it attracts the centre of the earth, it also attracts this centre more than it attracts the inferior waters in the opposite hemisphere. These waters will then approach less toward the attracting planet, than the centre of the earth approaches to it. They will remain as far off, from and behind the centre, as the superior waters advance from it on the side of the moon.

Two promontories, or eminences of water, will therefore be formed by the action of the moon upon the earth;—one on the side toward the moon; the other on the side opposite to it; which gives the sea an appearance of an elongated spheroid, whose great axis will pass through the centre of the moon and of the earth. It is *high tide* under the moon and in the opposite point at 180 degrees of distance; consequently, in the two intermediate points, or at 90 degrees of distance from the moon, the tide will be *low*.

The earth, by its rotatory motion, successively presents to the moon, in the space of twenty-four hours, all its meridians, which, consequently, are found by turns, and at an interval of six hours, sometimes under under the moon, and sometimes at a distance of 90 degrees from it; hence it follows that, during the time which passes between the departure of the moon from one meridian, and its return to the same meridian, that is, in the space of a lunar day, which exceeds the solar day by about fifty minutes and a half, the waters of the sea will ebb twice, and flow twice, in every part of the earth, although in a manner almost insensible in those places which are distant from the path or orbit of the moon.

(111.) *Action of the Sun.*—If we now imagine the sun to be in the plane of the Equator, it is evident that, as its action is similar to that of the moon, it should excite in the ocean an agitation similar to the lunar tides. Thus the sea would ebb twice and flow twice during a solar day; but, on account of the immense distance from the sun, those solar tides will be much smaller than those which result from the action of the moon.

On account of the inequality which exists between the solar and lunar days, the action of the sun will sometimes change the position of the lunar tides, and at other times will unite its influence with that of the moon. In the syzigies, or conjunctions, the action of the moon concurs with that of the sun to raise the waters. This is the reason why the highest tides happen at new and full moon; or when the moon is in its first or third quarters. In the quadratures, the waters of the sea are depressed by the action of the sun, at the same point where the action of the moon raises them, and reciprocally. Thus the tides of the quadratures ought to be less.

The height of the tidal wave produced by the moon is as that produced by the sun as 100 to 38, when combined, of course, they produce the spring tide, as above stated; opposed, they make neaps, the range of them being as 138 to 62, or nearly as 7 to 3. Newton (from the Severn tides) made it 4·48 to 1, which is far too large. Laplace from the Brest observations, makes it 2·90 to 1, and Sir John Lubbock and Dr. Whewell about 2·66 to 1. Of course, these relations are very much controlled in action by the configuration of the coast or channel.

(112.) What we have already explained regards the position of the sun and moon in the Equator. Let us now consider these heavenly bodies in their various declinations, and we shall see the elevation vary in the inverse ratio of the cube of the distance of the water.

Without entering into details, which would require mathematical demonstrations, we shall remark only, that the proximity of the sun and moon seems to be the cause to which we must refer the extraordinary equinoctial tides, which happen most frequently; the one before the *vernal equinox*, and the other after the *autumnal*; that is, both of them at the time when the sun, passing through the meridional signs, is nearest us. But this does not happen every year, because there are sometimes variations produced by the situation of the orbit of the moon, and by the distance of the syzigies from the equinoxes.

(113.) This, then, is the general *theory* of the tides, and from these observations their general laws may be inferred; but it has been reserved for later times to pursue the inquiry into detail, and to develop the minor effects which modify, and in some places totally change, the character of the tides. It is chiefly to the Rev. *Dr. Whewell*, now Master of Trinity College, Cambridge, and to *Sir John Lubbock*, that our present knowledge of the tide laws is owing, and from their observations we will give some extracts.

(114.) In the Rev. Dr. Whewell's papers on the subject of the Tides, he commences:—"Ever since the time of NEWTON, his explanation of the general phenomena of the tides, by means of the action of the moon and the sun, has been assented to by all philosophers who have given their attention to the subject. But, even up to the present day, this general explanation has not been pursued into its results in detail, so as to show its bearing on the special phenomena of particular places,—to connect the actual tides of all the different parts of the world,—and to account for their seeming anomalies. With regard to this alone, of all the consequences of the law of universal gravitation, the task of bringing the developed theory into comparison with multiplied and extensive observation is still incomplete; we might say, is still to be begun."*

(115.) *The Tidal Wave.*—The tidal wave is not owing to the transfer of the body of water, which would be a current, but to an *elevation* of its surface. This motion is, as readily conceived, compatible with immense velocity; and it may be taken as a rule, that the broader the wave, the greater will be its velocity. If the earth were in equilibrium, and its surface entirely covered with water, and under the influence of the moon's attraction, it would assume the form of an ellipsoid, having the semi-axis directed towards the moon longer by about 58 inches than that transverse to it; that is, the water would become higher by that amount. This is merely adduced to show what may be the amount of the luni-tidal wave, without entering into any other considerations.

(116.) *Velocity of the Tidal Wave.*—As the whole of the tidal wave must circulate around the globe in twenty-four hours nearly, the velocity must be very great; but it is greatly modified. In the middle of the Atlantic it would appear to travel at the rate of about 700 miles an hour, but on the coast it is widely different; hence its velocity along the eastern coast of England varies from 35 miles to 160 miles per hour.

In the open ocean, where nothing intervenes to obstruct the course of the tidal wave, it travels probably with regularity; and it may be presumed that its height is also inconsiderable. But when this wave, from an open ocean, approaches a narrow channel, such as the Bristol or English Channel—from being hemmed in, as it were, it forms a *tide-current*. Now, along the centre of such a channel the tidal wave would travel with much greater speed than on the sides. Hence the distances at which the hour-marks representing high water will be wide apart in the centre, and transverse to its general direction; while, on the shores, the direction of the wave would be altered, and it will approach parallel to the shore; hence the hour-marks will be close together, and parallel to the general direction of the main tide-current.

The tide-wave, advancing through the contracting channel, towards the end becomes of great height, and, as at Bristol, and in the Bay of Fundy, sometimes rises to the enormous height of 50 or 70 feet: just in the same manner that the surf runs up a shelving beach.

The variation in the height of the tide (as is found to be the case in some parts of

* 'Essay towards a First Approximation to a Map of Cotidal Lines;' Philosophical Transactions of the Royal Society, 1833, p. 147.

the coast of France), between places near each other, and having high water at the same time, is to be accounted for by the convex form of the tidal wave.

In some parts of the world, as in Australia, Kamtschatka, &c., the tides offer very singular anomalies. At Adelaide, in South Australia, it is high water only once in the twenty-four hours, and that during the night. This arises from what are called *interferences*, whereby two distinct sets of tidal waves, in their combination, produce apparent rest.*

(117.) One of the most important circumstances of this subject is, that, in an open channel, the *flood current* (the current which runs till high water) will continue running for three hours afterwards, or till *half ebb;* and the ebb current, which then begins, will run after low water till half flood. The time of slack water is intermediate between the times of high water and low water. In proportion as the channel is obstructed at the further end, the flood current runs for a shorter time after flood; and in a closed creek, the flood current ends at high water.†

Another error to correct is this:—"That the time of the change of current, or the *time of slack water*, as it may be termed, *never* coincides with the *time of high water*, except close in-shore, and within its influence; the interval is generally considerable. Great confusion has arisen from these two times not being properly distinguishdd."—'Phil. Trans.,' 1833, p. 162.

(118.) *The Establishment of the Port.*—The vulgar establishment of the port is the interval of time by which the time of high water follows the moon's transit *on the day of the new and full moon.*' This is, corrected, the *mean* value of the interval, freed from the semi-menstrual inequality. Its value at the London Docks is one hour twenty-six minutes, by the mean of all the observations.—'Phil. Trans.,' 134, p. 19.

The Corrected Establishment.—The mean luni-tidal interval, or *corrected establishment* of each place, differs from the vulgar establishment, or time of high water for new and full moon; for the time of high water at syzigy is affected by the semi-menstrual inequality belonging to the moon's position one or two day's earlier, and is therefore later by about thirty minutes than the mean interval would give it.‡

(119.) *The Semi-monthly Inequality.*—The interval of tide and moon's transit is affected by a considerable inequality, which goes through its period *twice* in the space of one month; it may be considered as depending upon the moon's distance from the sun in right ascension, or, which is the same thing, on the solar time of the moon's transit. The difference of the greatest and least intervals at London is one hour twenty-eight minutes.§

(120.) *The Age of the Tide.*—The tide does not depend upon the passage of the moon upon that particular day or hour, but from some previous transit; hence the tide is observed to take place at London at two o'clock on the days of new and full moon; therefore, as the tide of London is found to be determined by the position of the sun and moon upon two days and a half before it occurs, one hour twenty-six minutes is the *corrected establishment* for London, as stated above.¶

(121.) *Difference of the Two Diurnal Tides.*—It has been remarked in various places by separate observers, that the evening tide is higher than the morning tide in one part of the year, and lower at another. This is thus explained by Newton. From the vernal to the autumnal equinox, the sun has North declination; and as the moon's orbit is never much inclined to the sun's, a line drawn from the earth's centre to the moon would meet the earth's surface, on the side towards the sun, in North latitude. Now, such a line is the axis of the tide-spheroid, supposing the tide to be always under the moon; and the tide taking place when the moon in the meridian is higher, as the place is nearer to the vertices or points where the axis of the tide-spheroid meets the earth's surface. Hence, in this case, the tides which occur on the side of

* "Phil. Trans.," 1833, p. 154.
† "Phil. Trans.," 1833, p. 215.
‡ "Phil. Trans." (Whewell), 1836, p. 292.
§ "Phil. Trans.," 1834, p. 19.
¶ "Phil. Trans.," 1831, p. 163.

the earth next the sun, or the day tides, would be larger for a place in North latitude than the tides on the opposite side. For a similar reason, the night tides would be higher in winter.

(122.) *Height of Mean Water.*—The mean between high and low water is found to be constant and permanent, however much may be the difference of high and low water. It has been found, from a great number of observations on the South coast of England, not to vary more than 2 or 3 inches; therefore all heights ought to be referred to the *mean* level of the sea, instead of the vague and uncertain data of high or low water.*

The refined surveying operations which have of late been completed have demonstrated one singular fact, which could only have been elicited in the laborious and exact processes carried on during the Ordnance Survey. It is, that the *mean level* of the sea, as we assume it, is *not a level*, from whatever cause it may arise, and it is difficult to assign one. It is found that the *mean* level of the sea around Ireland is lower on the South than it is on the North coast. Taking Courtown in Wicklow as the standard—a spot remarkable as the node or axis of the great tidal wave of the St. George's Channel, and when there is little or no rise or fall, that at Ballycastle on the North, the mean sea level is higher by 0·881 foot, and lower on the South at Castle Townsend by 0·938 foot than it does at Courtown. Thus the mean level is nearly 1 foot 10 inches higher on the North than it is on the South of Ireland. Of course this fact has no bearing upon the seaman's application of tidal phenomena, but is curious.

(123.) It has been fonnd that a low barometer causes a higher tide and the reverse. This element, in the disturbance of the regular tides, the effects of atmospheric pressure, has been estimated by different observers, and its amount has been ascertained with considerable accuracy. Thus, at Liverpool, there is a difference in the *height* of high water of 10·1 inches for a variation of 0.91 in the barometer; and at London it has been calculated by Mr. Dession that the water rises 6·3 inches for ·90 depression of the barometer. M. Daussy has ascertained that, at Brest, the ocean rises ·223 metre, or 8·78 inches, for a depression of ·0158 metre, or ·622 inch in the barometer.† These results are nearly identical with those ascertained by Sir James Ross in the Arctic regions in 1848 by means of the steady level of the winter ice. These refinements in tidal calculations are, perhaps, of little value for the practical mariner when at sea; they may be useful in entering a dock; but they are of the utmost service in generalising the phenomena of the tides, upon which so little, it may be said, is known that may be applied.

(124.) The foregoing are the principal effects of the causes which produce the tides, in reference to their rise and fall. There is another branch of the subject, however, which is of great importance to the navigator; that is, the currents formed by the alternate elevation and depression of the ocean. As before mentioned, in the open sea it may be considered that there is no tidal current, and that the tidal wave is propagated without any actual displacement in the particles of the water. But when this wave approaches the coast, the case is widely different, and the wave must necessarily form a current, sometimes flowing in one direction, and at others in the opposite one. This variation in the progress of the flood and ebb-tide wave must vary with every locality, and is influenced by the particular configuration of the coasts, &c., by which it passes. The question of the form and transmission of waves is so complicated, and involving mathematical analysis of so high an order, that it cannot be usefully dwelt on here.

Upon the direction in which the great tidal wave is propagated, we at present have much to learn. It has been supposed by Sir J. Lubbock, that it travels from the Cape of Good Hope to Gibraltar in twelve hours; from Gibraltar to Edinburgh in about twelve hours; and from Edinburgh to London in about twelve hours,‡ which is in accordance with Bernouilli's theory. Passing north-eastward from the South

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* "Phil. Trans.," 1839, p. 154.
† "Phil. Trans.," 1836, pp. 220, 221; and "Conn. des Tems.," 1834.
‡ "Phil. Trans.," 1836, p. 218.

Atlantic, it strikes the south-west shores of Great Britain and Ireland, and becomes divided by these lands; one portion of the great wave passes northward to the west of Ireland, a portion of it enters by the North Channel, and meets a large portion from the south which has passed up the St. George's Channel; another passes up the English Channel passing on to the North Sea along the Dutch and German coasts, and with another portion of the western branch which enters the North Sea between Norway and Scotland, causes a circulation of tides which is still involved in some obscurity, but which is discussed elsewhere; the remainder passes north-eastward along the Norway coast on to the Polar basin. Along the American coast the great wave passes from south to north, making high water at a later hour continually, and entering the various bays and outlets in the same manner. It may at once be mentioned that in low latitudes the rise and fall of the tide is very inconsiderable, and therefore comparatively unimportant.

(125.) In 1834, from the recommendation of the Rev. Professor Whewell, a series of tide observations were made, during a fortnight, in the month of June, at the coast-guard stations in Great Britain and Ireland; and in the following year a much much more extensive series was taken simultaneously between the 8th and 28th of June. "The chain of places of observation extended from the mouth of the Mississippi round the Kays of Florida, along the coast of North America, as far as Nova Scotia; and from the Straits of Gibraltar along the shores of Europe, to the North Cape of Norway. The number of places of observation was twenty-eight in America, seven in Spain, seven in Portugal, sixteen in France, five in Belgium, eighteen in the Netherlands, twenty-four in Denmark, and twenty-four in Norway; and observations were made by the coast-guard of this country at 318 places in England and Scotland, and at 219 places in Ireland." This large number of observations was also undertaken at the instigation of Professor Whewell, and their reduction was made by Mr. Dessiou and assistants, under his directions. The details and results are given in the "Philosophical Transactions," 1836, p. 289, *et seq.*

These observations have given us a far greater insight into the nature of the tidal progress than was had heretofore. A still more refined series was carried on for the English Channel by Adm. Beechey as heretofore shown.

(126.) In the ensuing tide table for the North Atlantic the *vulgar* establishment (118) is given as the tidal hour at full and change, except in some cases, which are noticed as being the *corrected* establishment of the port. These figures are taken chiefly from the Government Nautical Surveys and the special observations which have been made in various places. They are given, also, in the Admiralty Tide Tables for 1860.

The height of the tide is here quoted as the *range*—that is, the difference of level between high and low water both as springs and neaps; so that the figures giving neaps do not represent the amount above the low water spring tides, but the higher level generally of one-fourth of the difference of range.

Attached to the table are some brief remarks on peculiarities of the tidal phenomena, in the form of notes.

TIDE TABLE.

The Figures in Brackets (1.) refer to the subjoined Notes.

England—Thames and South Coast.

Place.	High Water, Full and Change.	Range. Sps.	Range. Nps.
	h. m.	ft.	ft.
London Bridge (1.)	2 7	19¼	14¼
London Docks	1 57	19½	
Gravesend	1 10	17½	
Nore	12 30	15½	11½
Margate	11 40	15½	10½
Ramsgate	11 44	15	9
Deal	11 15	16	
Dover (2.)	11 12	18¾	11
Folkstone	11 7	20	13
Dungeness	10 45	21¾	17
Rye Bay	11 20	22	12½
Hastings	10 53	24	13
Beachy Head	11 20	20	10
Newhaven	11 51	20	10
Shoreham	11 34	18	10
Littlehampton	11 36	16	7½
Selsea Bill	11 45	16½	8½
Portsmouth Dock Yard	11 41	12½	6½
Southampton (3.)	10 30 / 12 45	13	6½
West Cowes	10 45	12½	6½
Hurst, Camber	10 0 / 12 0	7½	4
Needles Point	9 46	7½	3
Christchurch	9 0 / 11 30	5	
Poole	9 10 / 12 45	6½	3
Portland Breakwater	7 1	6¾	2¼
Bridport	6 5	11¼	4½
Exmouth	6 21	12¼	5¼
Torbay	6 0	13½	6½
Dartmouth	6 16	14	6
Devonport Dock Yard	5 43	15½	7½
Plymouth Breakwater	5 37	15½	7½
Fowey	5 14	15	7½
Falmouth	4 57	16	8
Lizard	5 0	14½	7
Penzance	4 30	16	8
Scilly Isles	4 30	20	10

England and Wales, West Coast.

Place.	High Water, Full and Change.	Range. Sps.	Range. Nps.
	h. m.	ft.	ft.
St. Ives	4 44	21	9¾
Padstow	5 13	20½	12¾
Lundy Island (4.)	5 15	27	13
Barnstaple (Bar)	5 30	19	9
Bideford	6 7	16	8
Ilfracombe	5 42	27¼	14½
Bridgewater Bar	6 50	35	18
Portishead	7 16	41¼	21½
Bristol (King Road)	6 56	44	22
Chepstow	7 30	50?	
Newport	7 10?	24?	
Cardiff	6 59	38	21
Swansea	5 56	30	15
Llanelly Bar	6 16	28	14
Tenby	6 0	27	13
Milford Haven (entrance)	5 52	22	
Pembroke Dk. Yard	6 12	21	10
Cardigan (5.)	7 1	14	
Aberystwyth	7 31	13½	6½
Bardsey Island	7 40	15	
Caernarvon	9 33	13¾	7¾
Holyhead	10 11	16	8½
Beaumaris	10 32	21½	11¾
Chester	10 30	26	
Liverpool	11 23	26	14½
Formby Point	10 35	28	
Ribble Lighthouse	10 51	24	10
Fleetwood	11 11 / 11 12	27 / 26¼	15 / 14½
Lancaster	11 16	8½	
Poulton-le-Sands	11 26	27¼	16
Piel Harbour (Pier)	11 5	28	14
Whitehaven	11 14	23¼	12¾
Workington	11 4	20	10
Maryport	11 3	18	8
Southerness	11 20	28	
Annan Foot	11 56	20	8
Port Carlisle	12 10	20?	8?

Isle of Man.

Place.	High Water, Full and Change.	Range. Sps.	Range. Nps.
Douglas	11 12	20¾	11¾
Ramsey	11 15	19½	12½

Place.	High Water, Full and Change.		Range. Sps.	Range. Nps.
	h.	m.	ft.	ft.
Peel	11	8	16¼	9
Calf Sound	11	17	16¼	9¼
Port, St. Mary	11	10	20	12
Castletown	11	10	20	12
Scotland, West Coast.				
Kircudbright	11	10	23	
Troon	11	50	10	5
Port Patrick	11	10	15	9
Loch Ryan	11	12	11	
Campbellton	11	45	8½	4
Ayr	11	50	8¾	5
Ardrossan	11	45	10	6
Largs	11	50	10	
Greenock	0	8	9¾	6½
Port Glasgow	0	18	9	
Dumbarton	0	40	9	
Glasgow	1	25	2	
Burnt Isles, Kyles of Bute	11	50	10	6
Ardrishaig, Loch Fyne	11	53	9	6
Gigha Sound	2	22	4	1
Jura, E. Coast	4	56	3½	1¼
Easdale Sound	5	25	10–12	
Crinan	4	49	6	1¾
Loch Aline	5	33	13¾	7
Oban	5	45	12	7
Loch Eil	5	15	13	5
Tobermory, Mull	5	36	13	5½
Portree, I. of Skye	6	32	15	6½
Kyle Akin	6	16	15	7½
Ullapool, Loch Broom	6	40	14½	6½
Poolewe, Loch Ewe	6	20	14½	6½
Berneray, Island of Harris	6	11	13	5
Stornoway	6	46	13	5¾
Cape Wrath	7	30	15½	
Thurso	8	28	14¾	6
Stroma, S. side	9	47	9	4
Swona, E. side	10	24		
„ W. side	9	35		
Great Skerry, East side	11	4	9¼	3
Orkneys.				
Stromness	9	0	10	5
Kirkwall	10	9	10	5
Deer Sound	10	30	10	5

Place.	High Water, Full and Change.		Range. Sps.	Range. Nps.
	h.	m.	ft.	ft.
Widewall	9	3	10	5
Otterswick	9	13	11	5½
Shetland Isles.				
Balta	9	45	6	3
Lerwick	10	30	6	2
Scalloway	9	30	5¾	3½
Sumburgh Head	9	45		
Fair Isle	11	0	5	1
Scotland, East Coast.				
Duncansby Ness	10	14	10	4
Wick	11	22	9¾	5
Cromarty	11	56	14	8
Inverness	12	18	12	7
Peterhead	0	34	10¾	5¾
Aberdeen	1	0	12	8
Montrose	1	25	13	7
Arbroath	1	35	14	8
Tay Bar	2	6	16	12
Dundee	2	32	4½	7¾
Leith	2	17	16½	9
Dunbar	2	8	15½	7
England, East Coast.				
Berwick	2	18	15	8
Tyne River Bar	3	20	14¾	8
„ Newcastle	4	23	10½	
Sunderland	3	22	14½	7¾
Tees River, Bar	3	45	15	
Whitby	5	45	15	
Scarborough	4	11	15¾	8½
Flamborough Head	4	30	16	8
Humber River, Spurn Point	5	26	18¾	10¾
„ Hull	6	29	20¾	11¾
Lynn Deep, Sand	6	0	23	23
Cromer	7	0	14¾	7½
Yarmouth Haven	9	15	6	2
Lowestoft	9	56	6½	4
Orfordness	11	15	8	5
Woodbridge Haven Bar	11	45	12	6
Harwich Harbour	12	6	11½	8
Orwell River, Ipswich	12	35	13½	
Gunfleet Sand, N.E. end	11	40	12	4

Place.	High Water, Full and Change.	Range. Sps.	Nps.
	h. m.	ft.	ft.
Ireland, South and East Coasts.			
Cape Clear	4 0	9	
Baltimore	4 23	10	6
Kinsale	4 43	11½	6¾
Queenstown	5 1	11¾	7
Ballycotton	4 54	12	7¼
Youghal	5 14	12¾	7¼
Ballinacourty, Dungarvan	5 12	12½	6¾
Waterford (Duncannon Fort) ..	5 20	12½	7
Wexford (6.)	7 21	5	2¼
Arklow	8 45	4	2
Wicklow	10 29	9	4
Dalkey Island	10 45	13	9
Kingstown	11 10	11	6½
Dublin Bar	11 12	13	7
Harbour	11 9	12	7
Balbriggan	10 40	11	
Dundalk	11 0	17	10
Carlingford, Bar ..	10 40	17	9
Ardglass	11 0	16	8
Strangford, Bar ..	10 30	15	8
„ Portaferry	12 0	14	9
Ireland, North and West Coasts.			
Donaghadee	11 13	11¼	7
Belfast	10 43	9½	6¼
Lough Larne	10 30	10	6
Tor Point	9 40	9	4½
Ballycastle Bay ..	6 8	4	
Port Rush	6 8	5¼	2
Coleraine	6 24	6¼	2
Londonderry	8 1	7¾	3¾
Rathmullen, Lough Swilly	5 42	12½	5¼
Sheephaven	5 25	12	5¾
Gweedore Bay	5 32	11	5
Inishkeel	5 10	11	4½
Killibegs	5 31	11½	4¾
Ballyshannon (Bar)	5 30	10	4
Sligo Bay	5 11	11¼	5¼
Killala Bay	5 22	10¼	5¾
Broadhaven Harbour	5 0	10½	5
Achillbeg	5 14	10¾	6¼
Westport	4 57	12¾	6
Inishbofin	4 34	12¾	7
Roundstone	4 28	13½	6¼
Greatman Bay....	4 39	15½	7½
Killeany, Arran Is.	4 28	13½	6½

Place.	High Water, Full and Change.	Range. Sps.	Nps.
	h. m.	ft.	ft.
Galway	4 35	14¾	7
Liscanor Bay	4 23	13¼	6¼
River Shannon, Limerick	6 20	17	9¾
„ Foynes Isd.	5 35	15½	8
„ Talbert ..	4 57	14½	7
„ Kilbaha ..	4 16	13	6½
Valentia Harbour	3 42	11	5½
Kenmare River, (West Cove)....	3 52	10	5
Bantry Harbour ..	3 47	10	5¼
Castletown, Bearhaven	4 14	9¾	5¼
Black Ball Harbour	3 40	9½	5¼
Dunmanus Harbour	3 57	9½	5
Crookhaven	4 9	9¾	6
Skull	4 2	9¾	5½
Cape Clear	4 0	9	
Norway.			
Lofoten Islands ..	12 0	9	6
Væro	12 0	9	6
Træ Islands	11 45	7	
Romdals Islands ..	10 45	6	
Bergen	1 30	4	
North Sea, East Coast.			
Skagen or the Skaw	5 56	1	
Blaavand Point ..	1 44	5	
Hierting	2 45	5	
Eider, Tonning ..	2 1	9	
Elbe, Hamburg ..	5 29	6½	
„ Cuxhaven ..	1 8	10	
„ Entrance....	12 0	11	
Helgoland	11 33	9	5
Weser, outer light vessel	11 30		
Ems (outer buoy)	10 0	9	
Ameland Gat	9 0	7	
Terschelling (West)	8 40	6	4
Amsterdam	3 0	18	
Nieuwediep	7 27	4	3
Texel (outside shls.)	6 30	4	3
Brielle	3 0	5	
Hellevoetsluis	2 30	8	4
Flushing	1 20	15	
Ostend	12 25	19	11
Nieuport	12 18	16	12
France, North Coast.			
Dunkerque	12 8	16¾	12
Gravelines	12 0	19	11

Place.	High Water, Full and Change.	Range. Sps.	Range. Nps.
	h. m.	ft.	ft.
Calais	11 49	19½	11¾
Cape Grisnez	11 27	21	12
Boulogne	11 25	25	14
Cayeux	11 6	27	15½
Dieppe	10 44	23	13
Fécamp	9 51	22	12½
Havre	9 29	23	11
Honfleur	8 51	17	9
Cherbourg	7 49	17	8
Alderney	6 46	17	8
Guernsey	6 30	25	14
Goury	7 6	22	13
Jersey, St. Aubin	6 21	32	14
Carteret	6 25	31	14
St. Germain	6 20	42	16
Régneville	6 20	35	17
Granville	6 13	37	17
Ile de Chausey	6 9	35	17
Cancale	6 20	37	17
Les Minquiers	6 6	35	17
St. Malo	6 5	35	17
Bréhat	5 51	31	16
Héaux Lights	5 45	31	16
Tréguier	5 32	25	12
Ploumanach	5 15	24	12
Morlaix Road	4 53	24	12
Isle de Bas	4 49	23	11
Abervrac'h	4 14	22	10
Ushant (7.)	3 32	19¼	8¼

France, West Coast.

Place.	High Water, Full and Change.	Range. Sps.	Range. Nps.
Brest	3 47	19	8¾
Isle de Sein	3 21	17½	7¼
Concarneau	3 12	13	6¼
Prt. Louis, L'Orient	3 11	13	6
St. Nazaire	3 40	15¼	7¼
Ile de Noirmoutier	3 2	16	7
Ile d'Oleron	3 50	19	
Bordeaux	6 50	14	11¼
Cordouan Lt. house	3 37	13¾	7¼
Arcachon	4 37	11¾	7¼
Boucaut, Adour R.	3 39	8¾	5
Bayonne	3 45	12	6

Spain and Portugal.

Place.	High Water, Full and Change.	Range. Sps.	Range. Nps.
Port Passage	3 0	12	6
Bilbao	3 20	9	
Santander	3 30	15	9
Corunna	3 0	15	
Cape Finisterre	3 0		
Oporto	2 30	10	
Peniche	1 54		
Lisbon Bar	2 30	16	
Setubal	2 30	8	
Lagos	2 7	13	
Cadiz	1 45	9½	
Gibraltar, old Mole (8)	2 20	3½	
Malaga	12 0	3	

Atlantic Isles.

Place.	High Water, Full and Change.	Range. Sps.	Range. Nps.
Funchal Bay, Madeira	12 48	7	
St. Michael, Azores	12 30	6	
Terceira „	12 32	4½	
Fayal „	11 45	4	
Bermudas, Ireland Island Dock Yard	7 4	4	
Porto Praya	6 0?	5	
Sal, Cape Verde Is.	7 45	5	
Puerto de la Luz, Gran Canaria	12 52	10	

Africa.

Place.	High Water, Full and Change.	Range. Sps.	Range. Nps.
Ceuta (9.)	1 10		
Tangier	1 42		
Mogador	2 0	10	
Cape Bojador	12 0		
Cape Blanco	11 46	6	
Portendik	10 0	6	
Senegal	10 30		
Cape Verde	7 45	3	
River Gambia	8 10	6–9	
Bijouga Ids., Orango Channel	10 0	11	
River Nunez	10 0	15	8
Isles do Los	6 35	13	
Mellacorce R.	7 40	11	
Scarcies Rivers	7 10	10	
Sierra Leone	7 55	8	
Banana Islands	8 15	9	
Gallinas River	6 45	4	
Monrovia	6 0	6	
Cape Palmas	4 30	4	
Grand Lahou	4 20	4	
Cape Three Points	4 0	4	
St. George d'Elmina	4 30	6	
Cape Coast Castle	4 30	6	
River Lagos	6 0	2	
„ Forçado	4 22	5	
„ Benin	4 15	7	

Place.	High Water. Full and Change.	Range. Sps.	Range. Nps.
	h. m.	ft.	ft.
Niger, Nun (entrance	4 8	6	
Bonny and New Calabar Rivers..	5 0	9	
Cameroons River ..		6	
Fernando Po	4 0	7	
Princes Id.	3 45	4½	
St. Thomas Id. ..	3 25	4½	
Anno Bom Id. ..	3 45	5	

Newfoundland (10).

Place.	h. m.	Sps.	Nps.
Little Mecattina ..	10 30	5	
New and Old Ferolle	11 45		
Bays of St. Genevieve and St. Barbe	11 30		
Isle Verte, or Green Island..	9 0		
Bay of Pistolet ..	6 45	5	
Croque Harbour ..	6 30	6½	
Triton Harbour in Notre Dame Bay	6 0	6	
St. John's........	7 30	5–7	
Placentia Harbour	9 15	8	
St. Pierre and Miquelon	9 3	6–7	
Between Cape Chapeau Rouge and Cape Ray generally	9 0	7–8	
Beyond Cape Ray, northward, the tide is inconsiderable.			

Labrador and Gulf St. Lawrence.

Place.	h. m.	Sps.	Nps.
St. Lewis Cape ..	6 30		
Chateau Bay	7 35	3½	1
Red Bay	7 45	3½	1½
Bradore Bay	8 45	4	2
Belles Amours Bay	9 0	4½	2½
Kegashka Bay ..	10 45	5	3
Clearwater Point	11 30	5	3
Mingan Harbour..	1 16	7	4
Bay of Seven Islands	1 40	9	5
Anticosti Island, West Point	2 0	6	4
Point de Monts ..	12 0	12	
Cape Chatte	12 0	13	

Place.	High Water, Full and Change.	Range. Sps.	Range. Nps.
	h. m.	ft.	ft.
St. Nicholas Harbour	1 55	12	7
Bersimis River ..	2 0	12	7
Bic Island	2 15	14	8½
Saguenay, Tadousac	2 45	16	9½

River St. Lawrence (11).

Place.	h. m.	Sps.	Nps.
Green Island	2 45	16	9½
Brandy Pots	3 0	17	10
Isle aux Coudres ..	4 25	17	10
Pillars	5 0	17	10
Quebec	6 38	18	13

Gulf St. Lawrence.

Place.	h. m.	Sps.	Nps.
Magdalen Islands	8 20	3	2
Gaspé Basin......	1 50	5	3
Point Macquereau	2 0	5	3
Campbell Town, Ristigouche R. ..	4 0	10	7
Miramichi Bar ..	5 0	5	3
Richibucto River	3 30	4	2½
Point Escumenac	4 10	4	2½

Prince Edward Island.

Place.	h. m.	Sps.	Nps.
Cardigan Bay	8 40	5	3½
Hillsborough Bay	10 45	9½	7
Bedeque Harbour	10 15	7	5
Cascumpeque Hr.	5 40	3	2
Tracadie	7 0	3½	2

Cape Breton Island.

Place.	h. m.	Sps.	Nps.
Sydney Harbour ..	9 0	5	4
St. Anne Bay	8 34	6	3

New Brunswick and Nova Scotia.

Place.	h. m.	Sps.	Nps.
Shediac Harbour	{ 1 0 / 8 0 }	4	2
Bay Verte	9 0	9	5
Pictou Harbour ..	10 0	6	4
Gut of Canso	9 15	4	2
Canso Harbour ..	7 48	6½	4½
Harbour Island ..	7 40	6½	4½
Ship Harbour	7 54	6½	4½
Jedore Harbour ..	7 45	6½	4½
Halifax Harbour ..	7 49	6	4½
Sable Island, S. side	8 30	7	
„ N. side	10 30	7	
Shelburne	8 30	8	

Place.	High Water, Full and Change.	Range. Sps.	Range. Nps.
	h. m.	ft.	ft.
Bay of Fundy, Nova Scotia.			
E. side, Cape Sable Island	8 0	7	4
Cape Sable	8 30	9	4½
Cape Sable, Seal Island	9 0	12	6
Pubnico	9 3	12½	5½
Tusket River	9 33	13	7
Jebogue	9 47	16½	6⅓
Yarmouth	10 11	16½	8¼
Cape St. Mary ..	10 30	19	9¾
West Port, Grand Passage	10 47	21⅓	10
Sandy Cove, East	10 39	22¼	12
Annapolis	11 0	30?	
Gulliver Hole	10 51	26	13½
Digby Gut	11 2	28½	16⅓
Young Cove Point	11 14	32	18⅓
Port George......	11 22	34	19⅓
Isle Haute	11 27	35½	20
Black Rock Lighthouse	11 36	37½	21
Spencer Anchorage	11 50	40¼	22
Parsborough West Bay, Basin of Mines	12 4	45¼	25
Horton, do.	12 5	50	27¼
Bay of Fundy, New Brunswick.			
Cumberland Basin, Sackville	11 48	50	24
Cape Chignecto(12)	11 0	32	
Quaco	11 31	32	18
St. John	11 24	26⅓	12⅓
Campobello	11 20	25	12
West Quoddy	11 3	22⅓	10¾
Passamaquoddy ..	11 30	25	
Grand Harbour, Grand Manan ..	11 1	17¾	11½
Machias, Seal Islands	10 58	13	10
United States.—Portland to New York.			
Mount Desert Island (13)	11 10	13	
Portland*	11 25	10	7⅓?
Portsmouth*......	11 28	9¾	7¼?
Newburyport*	11 22	9	6½
Salem*	11 13	10½	7½
Marblehead	11 30	12	
Boston Light*	11 12	11	8?
Boston (Charleston Yard)*	11 27	11¼	8?
Plymouth	11 30	11	
Barnstable	11 0	9	
Cape Cod	11 30	13	
Monomy Point....	11 30	6	
St. George Shoals	10 30	7	
Nantucket (14)....	12 24	3⅓	2⅓
Edgartown*	12 16	2¼	1½
Holmes Hole*	11 43	1¾	1½
Gay Head	7 37	7	
Tarpaulin Cove* ..	8 4	2⅓	2
Bird Island Light*	7 59	5¼	3½
New Bedford, entrance*	7 57	4⅓	2½
Newport*	7 45	4¼	3
Point Judith*	7 32	3¾	2¼
Montauk Point* ..	8 10	2¼	1½
Sandy Hook*	7 29	5⅓	4
New York*	8 13	5¼	3¾
Long Island Sound.			
Throgs Neck*	11 20	9¼	6
Sands Point*	11 13	9	6⅓
Oyster Bay*	11 7	9½	5¼
Bridgeport*	11 11	8	4¾
New Haven*	11 16	6⅓	5?
New London*	9 28	3	2?
Stonington*	9 7	3⅓	2
Watch Hill*	9 0	3	2⅓
Delaware Bay and River.			
Philadelphia*	1 18	7	5
New Castle*	11 53	7	6½?
Mahons River* ..	9 52	7	5
Cape Henlopen ..	8 0	3–4	
Higbees, Cape May*	8 33	6¼	4
Delaware Breakwater*	8 0	4⅓	3
Chesapeake Bay and Rivers.			
Richmond*	4 28		
James River*	2 14		

* From the Report of the U. S. Coast Survey, the times of High Water being the Corrected and not the Vulgar Establishment.

Place.	High Water, Full and Change.	Range. Sps.	Range. Nps.
	h. m.	ft.	ft.
Baltimore*	6 33	1½	1
Cape Henry	7 40	4	
Annapolis*	4 38	1	¾
Point Lookout* ..	12 58	2	¾
Cape Charles	7 45	5	
Old Point Comfort*	8 17	3.	2
United States.—North Carolina to Texas.			
Hatteras Inlet* ..	7 4	2¼	1¾
Cape Hatteras	9 0	5	
Ocracocke Inlet ..	9 0		
Beaufort*	7 26	3¼	2¼?
Smithville*	7 19	5½	3¾
Cape Fear........	7 0	7	
Georgetown	7 0	4	
Charleston*	7 13	6¼	4½?
Savannah*	3 13	7½	5½?
Cape Florida*	8 31	1½	1¼
Sand Cay*	8 40	2	½
Cay West*	9 25	2⅓	⅓
Tampa Bay*......	11 21	1¼	1
Pensacola		2	
Mobile		2	
Mississippi S. W. pass		1½	
Galveston		4	
Gulf of Mexico.			
Vera Cruz		2	
Triangles		1½	

Place.	High Water, Full and Change.	Range. Sps.	Range. Nps.
	h. m.	ft.	ft.
Campeche	1 42	2½	1½
Cape Catoche	9 30	1	
Cozumel	8 30	1½	
Royal Harbour, Ruatan	7 45	3½	
Cape Gracias Harb.	10 30	2	
Man of War Cay ..	8 10	2	
Blewfields	1 50	4	
Greytown	9 0	1¼	
West India Islands.			
Havana, Cuba		3	
Cape Haytien, St. Domingo	6 0	3	
Gun Cay	8 30	3	
Abaco	8 0	3	
Nassau, New Providence	7 30	3–4	
Guinchos Kay	7 40	3	
Clarence Harbour, Long Island	8 30	4	2½
Exuma	7 20	2½	
Crooked Island....	7 0	2½	
Inagua	8 0	3⅓	2
San Juan, Porto Rico	8 2	1½	
Christianstad, Santa Cruz	7 30	⅔	⅓
Anegada	8 30	1⅓	

REMARKS ON THE TIDE TABLE.

(1.) River Thames.—During strong north-westerly gales, the tide marks high water earlier in the River Thames than otherwise, and does not give so much water, whilst the ebb tide runs out later, and marks lower; but, upon the gales abating and the weather moderating, the tides put in and rise much higher, whilst they also run longer before high water is marked, and with more velocity of current, nor do they run out so long or so low.

(2.) English Channel.—The tides of the English Channel were but imperfectly understood till Rear Admiral Beechey, R.N., investigated a mass of observations which had been made about the year 1847, and which demonstrated that there was a great resemblance in the characteristics of the tidal phenomena of the English and

* From the Report of the U. S. Coast Survey, the times of High Water being Corrected and not the Vulgar Establishment.

Irish Channels,* and this investigation led to a more extensive series of observations throughout the English Channel, which were also discussed by Admiral Beechey. From his valuable contribution to science and the mariner in the "Philosophical Transactions" for 1851,* we make the following extract:—

Instead of the progressive changes of stream turning progressively later as the tide advances up the strait, they cease at a certain point, which is in the English Channel, between the Start and Gulf of St. Malo; and in the North Sea, between the Texel and the Estuary of Lynn; and between these spots there is a tide peculiar to the Channel, quite distinct from that of the seas on either side of it, which are alwaya running in contrary directions.

When these streams meet, the tide is ever varying in its direction, according as the strength of one stream prevails over that of the other, giving to the water a rotatory motion, without scarcely an interval of slack water; while in the space between them the tide sets steadily *towards* Dover, while the water is *rising* there, and *away* from it while it is *falling* at that place. This "*true Channel stream*" is about 180 miles in extent in either direction, from the point of union of the tides in the Strait of Dover to the region of rotatory tides off Lynn, and off the Start and St. Malo.

As the true Channel streams are always running in opposite courses, there is necessarily a point where they meet and separate, and this occurs in the strait of Dover. But *in this strait* the stream, although it first obeys one tide and then another, does not slack with the Channel streams, but is found to be still running at high and low water on the shore, at which times those streams are at rest, so that the Strait of Dover never has slack water throughout its whole extent at any time. I have in consequence called this an *intermediate* tide.

The limits of neither of the streams appear to be stationary, but *range to and fro* as the tide rises and falls *at Dover*, travelling to the *eastward* on *both sides*, and at high and low water suddenly shifting 60 miles to the westward to recommence their easterly course with the next tide; and although so far apart, they possess the remarkable peculiarity of shifting together; so that the Channel streams preserve, as nearly as possible, the same relative dimensions.

In the Strait of Dover this line of meeting and of separation oscillates between Beachy Head and the North Foreland, a distance of about 60 miles. When the water on the shore at Dover begins to *fall*, a *separation* of the Channel streams begins off Beachy Head. As the fall continues, this line creeps to the eastward; at two hours after high water it has reached Hastings; at three hours, Rye; and thus it travels on until at low water by the shore it has arrived nearly at the North Foreland on one side of the strait, and at Dunkirk on the other. At this time the *Channel streams* on both sides slack, but in that portion which I call the *intermediate* stream, in the Strait of Dover, the water is still running to the westward; and when the new *Channel* streams make, as the water rises on the shore, this *intermediate* portion is found to unite with, or to oppose, one or the other of these streams, according as it was before the reverse; so that, as before mentioned, the line of meeting at low water appears off Beachey Head to recommence its easterly course. This *intermediate* stream forms a remarkable feature in the tidal system of the Channel; it is well established, as the line of meeting and of separation occupies a very limited space, and it seems to be entirely due to the contracted form of the Channel in this immediate locality preventing the free escape of the water.

Captain Bullock, in order to test the point of separation, anchored two vessels a mile apart between Beachy Head and Dungeness; and found both vessels at the same time to ride with their heads in opposite directions in obedience to the streams, which were then running oppposite ways.

The *Channel Stream*, which I have described as running between the intermediate stream and the rotatory or mixed streams at the outer extremities of the Channel, pursues a steady course along the main trunk of the Strait, slacking only towards

* Phil. Trans., 1848, pp. 105—116; and 1851, pp. 718, et seq.

high and low water at Dover, when it is preparing to invert its course; and, contrary to the generally received opinion of a *progressive slack water* in a strait having a progressive establishment, this stream has the peculiarity of slacking throughout its whole extent at *nearly the same time;* and this time, as was anticipated in my former paper (" Phil. Trans.," 1848), corresponds nearly with the time of high and low water on the shore at Dover, the site of the combined wave, and the *virtual head of the tide.*

A simple rule thus suffices to guide the sailor up the main Channel stream. It is that *the stream runs toward Dover while the water is rising there, and away from it while falling.* The tidal hours for Dover, therefore, answer for the whole of the Channel.

(3.) SOUTHAMPTON, &c.—This port has the singular advantage of having two high waters, which adds not a little to its dock facilities. The same phenomena is also found at other places within the Isle of Wight, and is owing to the Channel tide passing round either end of the Isle of Wight, and arriving at the point at different times.

It will be observed that at Poole the rise and fall is insignificant, while on the opposite side of the Channel we have the gigantic tides of the Bay of St. Malo, a similar feature to that which is found in the St. George's Channel.

(4.) BRISTOL CHANNEL.—The tides of the Bristol Channel are remarkable for their magnitude and rapidity. There are few places in the world where they are exceeded. The Bay of Fundy, Nova Scotia, and the Bay of Mont St. Michel, on the French coast, are somewhat analogous. The effect of these rushing waters is to alter the channels and shift the banks in the upper portion of the Bristol Channel in a most extraordinary manner. Some idea is given in our Directions for the Bristol Channel, page 24.

Without the Bristol Channel spring tides rise from 22 to 24 and 26 feet; but as that channel narrows, or contracts in its breadth, the velocity and vertical rise increase in proportion; and so much that, in King Road, it rises to the height of 8 fathoms.* Between Nash Point and Bridgewater Bay, past Hurlstone Point, &c., the tide sets with great velocity over the Culver Sand, into Bridgewater Bay and River. Through Caldy Sound, the stream from Caermarthen Bay makes westward nearly two hours before the *flood* has done running without the island; and the stream makes eastward through the Sound, as well as between the Helwick Sand and Worm's Head, nearly two hours before the channel ebb ceases.

At Lundy Island ordinary spring tides rise 27 feet, equinoctial springs 31 feet, and neaps 13 feet. *In Barnstaple Bay,* ordinary springs rise 25 feet, equinoctial 28 feet, and neaps 15 feet. In this bay, at from two to three miles from shore, a gentle stream sets to the eastward, from the time of low water to four hours' flood, and then to the westward until low water again. In mid-channel between this bay and Lundy Island, the streams of flood and ebb set tide and tide each way, according to the time of flowing on the shore, at the rate of three miles an hour on springs and two upon the neaps, allowing half an hour slacking and veering out.

It should be understood that, within the range of Swansea Bay and its offing at about five miles west of the Skarweathers, the first quarter-flood sets directly toward them; after which and until half-flood, it sweeps one mile outside, nearing the west end of the Nash Sands; and ultimately setting, till high water, S.S.E. by compass, which points well outside of all. It averages a rate of 4 and 5 knots on springs, and 3 upon neaps, and changes exactly at the same time that it ceases to rise on the shore; but slack water always lasts half an hour.

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* Capt. And. Livingston, of Liverpool, a gentleman to whom we have been much indebted for many valuable and useful communications, has informed us that he actually measured fully 50 feet rise of water, in November, 1813, at King's Road, in a spring tide. At Chepstow, above, on the opposite side, the vertical rise of a spring tide is not uncommonly 60 feet, and even 72 feet.

It has been observed, that over the shoals, and through the different channels, the velocity of the tides is greatly increased, and there is reason for believing that on springs the rate is nearly six knots.

There is always a strong tide under these shoals, which is, of course, increased or decreased according to the vertical rise. This is of consequence when working up near them, as some advantage may, in the daytime, be taken of it, by keeping on the proper side. Its influence will be manifest to any vessel thus situated, as she would nearly make her course good when under their lee, but swept away furiously on opening the different passages. Should it be desirable to have the true tide it will therefore be requisite to keep on the north or south side of all the shoals, according to the ebb or flood.

(5.) St. George's Channel.—Much that has been said of the English Channel tides is applicable to those of the St. George's Channel.

In the St. George's or Irish Channel, experiments have shown that, notwithstanding the variety of times of high water throughout the Channel, the turn of the stream over all that part which may be called the fair navigable portion of the Channel is nearly simultaneous; that the northern and southern streams in both channels commence and end in all parts (practically speaking) at nearly the same time; and that that time happens to correspond nearly with the time of high and low water on the shore at *the entrance* of Liverpool and of Morecambe Bay,* a spot remarkable as being the point where the opposite tides, coming round the extremities of Ireland, terminate. So that it is necessary only to know the times of high and low water at either of these places to determine the hour when the stream of either *tide will commence or terminate in any part of the Channel.* For this purpose the Liverpool tide table may be used, subtracting 16′ from the times there given, in consequence of the Canning Dock being later in its high water than the point which is considered as the head of the tide.

The tide from the Atlantic enters the Irish Channel by two channels; of which Carnsore Point, the S.E. point of Ireland, and St. David's Head, the S.W. point of Wales, are the limits of the southern one; and Rathlin and the Mull of Cantyre the boundaries of the northern.

The *central portion of the stream* of flood, or *ingoing* stream runs nearly in a line from a point midway between the Tuskar and the Bishops, to a position 16 miles due west of Holyhead; beyond which it begins to expand eastward and westward; but its main body preserves its direction straight forward towards the Calf of Man and on towards Maughold Head. Here it is arrested by the flood or southern stream from the North Channel coming round the Point of Ayr, and is first turned round to the eastward by it, and then goes on with it at an easy rate direct for Morecambe Bay; thus changing its direction nearly eight points.

The *outer portions* of the stream are necessarily deflected from the course of the great body of the water by the impediments of banks on the Irish side of the Channel, and by the tortuous form of the coast on the Welsh. The eastern portion rushes with great rapidity between the Smalls, Grassholm, and Milford Haven towards the Bishops, which it passes at a rate of between 4 and 5 knots; sets sharply round those rocks in an E.N.E. direction, right over the Bass Bank, and into Cardigan Bay; makes the circuit of that bay, and sets out again towards Bardsey, at the other extremity of it; the stream still continuing outside towards the South Stack, which it rounds, setting towards the Skerries at a rate of upwards of 4 knots; and, finally, turns sharp round those rocks for Liverpool and Morecambe Bay; completing in its way the high water in the Menai, and filling the Dee, the Mersey, and the Ribble.

The *western portion of the stream*, after passing the Saltees, runs nearly in the direction of the Tuskar, sets sharply round it, and then takes a N.E. ½ N. direction,

* The entrances of Liverpool and of Morecambe Bay (Pile Lighthouse, Fleetwood) are, as before stated, 16 minutes earlier in their times of high water than those given for Liverpool in the tide tables.

setting fairly along the coast, but over the banks skirting the shore; so that vessels tacking near the inner edge of the sands on the flood, and on the outer edge on the ebb, have been carried upon them and lost, especially upon the Arklow and Codling Banks. Abreast of the Arklow is situated that remarkable spot in the Irish Channel, where the tide scarcely rises or falls. The stream, notwithstanding, sweeps past it at the rate of 4 knots at the springs, and reaches the parallel of Wicklow Head. Here it encounters an extensive projection of the Codling Bank; and while the outer portion takes the circuit of the bank, the inner stream sweeps over it, occasioning an overfall and strong rippling all round the edge, by which the bank may generally be discovered. Beyond this point the streams unite and flow on towards Howth and Lambay, growing gradually weaker as they proceed, until they ultimately expend themselves in a large space of still water situated between the Isle of Man and Carlingford. There we have not been able to detect any stream; for there another remarkable phenomenon occurs—the water rising and falling, without having any perceptible stream. This space of still water is marked by a bottom of blue mud. Such is the course of the flowing water at the Southern Channel.

In the North Channel the stream enters between the Mull of Cantyre and Rathlin Island simultaneously with that passing the Tuskar into the Southern Channel, but flows in the contrary direction. It runs at the rate of 3 knots at the springs, increasing to 5 knots near the Mull, and to 4 near Tor Point on the opposite side of the channel. The main body sweeps to the S. by E. taking nearly the general direction of the channel, but pressing more heavily on the Wigtonshire coast.

The *central portion* midway between the Mull of Galloway and the Copeland Islands presses on towards the northern half of the Isle of Man; and while one portion of it flows towards the Point of Ayr, the other makes for Contrary Head, and is there turned back to the N.E. at a right angle nearly to its early course. Passing Jurby Point, it re-unites with the other portion of the stream, and they jointly rush with a rapidity of from 4 to 5 knots round the Point of Ayr, and directly across all the banks lying off there, and catching up the stream from the South Channel off Maughold Head, they hurry on together towards that great point of union, Morecambe Bay. This bay, the grand receptacle of the streams from both channels, is notorious for its huge banks of sand, and also remarkable for a deep channel scoured out by the stream, and known as the Lune Deep, which is the great beacon to all vessels bound to that place.

Such is a general description of the streams in the Irish Channel, which are produced by the flowing of the water, or which, for the purpose of distinction, we may designate the *ingoing streams*.

The ebbing or *outgoing streams* do not materially differ from the reverse of those, except that in the southern channel they press rather more over towards the Irish coast.

(6.) THE NORTH SEA.—The complicated tidal system of the North Sea was first developed by the Rev. Dr. Whewell in 1833, and although there may be some difference of opinion upon various points urged by the author in the "Philos. Trans." for that year, still the main features seem to be established. The the following is the abstract:—"It appears that we may best combine all the facts into a consistent scheme by dividing the German Ocean into *two rotary systems* of tide waves; one occupying the space from Norfolk and Holland to Norway; and the other the space between the Netherlands and England. In the former space the cotidal lines, or those on which the tides are at the same time, revolve around a point where there is *no tide;* for it is clear that at a point where all the tidal lines meet, it is high water at all hours, that is, the tide vanishes. In the latter space we may suppose similarly a tideless centre, about which the cotidal lines revolve."

A further collection of exact observations having been made in 1850-51, and discussed by Admiral Beechey, as before alluded to in the English Channel, a still further insight has been given, and the following summary was drawn up by Mr. Jno. Murray, C.E., 1861:—

"The great stream of flood from the Atlantic, after traversing the western coast of Scotland, approaches the Orkney and Shetland Isles from the north-west, passing eastward through these groups, and after combining with the stream through the Pentland Frith, ran southward along the east coast of Caithness. The same great stream of flood also reaches the coast of Norway, and in latitude 62° separated, one branch running to the north, and the other south. The latter stream impinges upon Kinnaird Head and Rattray Point, throwing a branch into the Moray Frith. The eastern branch of this stream continues its course southward, until checked by St. Andrew's Bay and the shoals off the coast of Fife, passing from thence into the Friths of Tay and Forth. In consequence of the Bell Rock, and other patches north of it, the stream of flood is divided; and as the flood in the deep water is pressed forward with greater velocity than the streams which traverses the more shallow water of the coast, the main stream arrives sooner, and splits off Dunbar and St. Abb's Head, entering the Frith of Forth in a north-westerly direction, and penetrating a considerable distance within it, before the other streams which run parallel with the coast. Southward from St. Abb's Head the stream of flood is uninterrupted, until it encountered the projecting coast from Redcar eastward; and the tidal waters are in consequence heaped up in Tees Bay. This stream continues its course, and off Whitby joins the main stream coming due south from the deep water. The united streams continues their course to Flamborough Head, sending a branch suddenly round this point to the westward, which sweeps Bridlington Bay and the low coast of Holderness. Another branch makes for the mouth of the Humber; but the main stream takes a south-easterly direction, and as the depth of the sea is reduced, by an extensive shoal off the coast of Norfolk, the stream of flood is forced forward, scooping out in its passage the Inner Silver Pit. From thence it runs into Lynn Deeps and fills the Great Wash. Another branch was scoopt out the channels called the Coal and Sole Pits, and continues its course between numerous long narrow banks, which much retards the velocity of the tidal stream. The stream. The stream of flood off Yarmouth resumes its southerly course, hugging the coasts of Suffolk and Essex, until it fell into the estuary of the Thames.

Returning now to the great flood stream off Flamborough Head, the main set ran almost due east between the shoal ground off the coast of Norfolk, and the Outer Well Bank, scouring out a channel called the Outer Silver Pit, between it and the shoals. Continuing onwards to the Texel, it threw off a branch southward, which made for the mouth of the Thames and the Schelde; and this current met with the flood issuing through the Straits of Dover, the one neutralizing the other. Observations made by the late Capt. Hewett, R.N., in lat. 52° 27′ 30″ N., long. 3° 14′ 30″ E., showed, as had been previously pointed out by the Rev. Dr. Whewell, that no rise and fall of the tide could exist in that part of the North Sea; and that, therefore, the surface between the two opposite coasts must assume a convex form at low water by the shores, and a concave one at high water. The great stream of flood made for the mouths of the Weser and the Elbe, sweeping the coast of Friesland, and being forced in a northerly direction along the coast of Denmark, it impinged on an extensive reef off the extreme point of Jutland, which altered its course. It then took the name of an ebb-tide, and after uniting with the constant outset from the Baltic, ran in a north-easterly direction, meeting the flood entering the North Sea between Norway and Scotland, to renew the race it had just run.

(7.) Bay of Biscay.—On the coasts of the bay, the tidal wave advancing from the westward, makes high water almost at the same hour all around its shores; and the range also does not vary greatly.

(8.) Strait of Gibraltar.—In the middle of the Strait of Gibraltar, the *current mostly* and generally sets to the East: but, on each side, the flood tide sets to the westward. On the European side, West of the Isle of Tarifa, it is high water at eleven o'clock, but the stream without continues to run until two o'clock. On the opposite shore of Africa, is is high water at ten o'clock, and the stream without continues to run until one o'clock: after which periods it changes on either side, and runs eastward with the general current. Near the shores are many changes, counter-currents, and whirl-pools, caused by, and varying with, the winds.

(9.) Africa.—The currents on the African coast (hereafter explained) render the given times of high water uncertain.

Between Cape Cantin and Cape Blanco they are strong, and set as shown on the Chart.

In the road without the Senegal, the current sets chiefly to the S.W. From the bar, strong freshes come down after the rains, and a powerful current of fresh water sets from the river to some distance out to sea.

In the Bay of Yoff, to the N.E. of Cape Verde, the currents set rapidly, and sometimes in very dangerous whirls.

At the mouth of the Gambia the greatest rise in the dry season is not more than 6 feet. Here the tide continues to run on the surface for an hour and a half after it ceases flowing on the shore.

The level of the sea, in the vicinity of Cape Coast Castle, is higher, by at least 6 feet, in the rainy season (which is the season of the strong S.W. and southerly winds, between April and September), than in the more serene weather of the dry season.

In the rainy season, or S.W. monsoon, trunks of trees are frequently carried on shore, and found at 6 or 8 feet above the level of the sea, of the other season; and the tides *ebb* and *flow* regularly in the several rivers; but, in the dry season, the same rivers run ebb constantly; the level of the sea being then too low to allow the tide-waters to enter the mouths of the rivers.

Some Remarks on the tides about Cape Blanco, the Channels of the Bissagos, &c., are given in the Description of the Coast hereafter.

(10.) Newfoundland.—On all the coasts of Newfoundland the tides are very irregular; being greatly influenced by the prevailing wind. On all the eastern coast they have nearly the same rising; springs about 6 feet; neaps 4. At the entrance of St. John's they set in a bore.

Between Cape La Hune and Cape Ray the flood sets to the westward in the offing, very irregularly, but generally two or three hours after high water on shore. See more particularly our "British American Navigator, &c." published by Mr. Laurie.

(11.) River St. Lawrence.—At 3 leagues below *Tadousac*, or the *Saguenay*, is the eddy of the flood, and the stream on the surface always sets thence downward. Off Tadousac, the tide ebbs six hours eight minutes. Both streams here run three-quarters of an hour after high and low water. At Green Island, it ebbs six hours twenty-four minutes, and flows six hours.

At the Isle aux Coudres, it ebbs six hours twenty minutes, and flows six hours. Here the ebb stream continues an hour and a quarter after low water, and the flood three-quarters of an hour after high water. Within the Pillars, off St. Jean, the tide ebbs six hours fifty minutes, and flows five hours twenty-five minutes. Both streams continue to run an hour after high and low water by the shore, but they are influenced in duration by strong winds.

At the Isle of Orleans, the stream ebbs seven hours, and flows five hours twenty minutes. At Quebec, it flows four hours forty-five minutes only, but an hour longer as above.

From Green Island to Quebec the tides rise irregularly, but vary considerably. From Coudre to Quebec the water falls 4 feet before the tide makes down. At the Isle of Coudre, in spring tides, the ebb runs at the rate of 2 knots. The next strongest ebb is between Apple and Basque Isles; the ebb of the River Saguenay uniting here, it runs full 7 knots in spring tides; yet, although the ebb is so strong, the flood is scarcely perceptible; and below the Isle of Bic, there is no appearance of a flood tide.

(12.) Bay of Fundy.—Off Cape Sable the tide runs at the rate of 3, and sometimes 4, miles an hour; and in the Bay of Fundy the tides are very rapid. Cape D'Or and Cape Chignecto are high lands, with very steep cliffs, and deep water close under them. The same kind of shore continues to the head of Chignecto Bay, where very extensive flats of mud and quicksand are left to dry at low water. Here the

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tides come in a bore, rushing in with great rdpidity: they are known to flow at the equinoxes from 60 to 70 feet perpendicular; and it is remarkable that, at the same time, they rise in the Bay Verte, on the northern side of the isthmus, only 8 feet.

(13.) MOUNT DESERT ROCK.—At Mount Desert Rock the stream of flood divides to run eastward and westward. With the Skuttock Hills about N.N.E., and within 4 or 5 leagues of those of Mount Desert, the flood stream sets E.N.E., and the ebb, W.S.W.; but, at the distance of 9 or 10 leagues from the land, the current, in general, sets to the S.W. and more westward. From the Mount Desert Rock to the Fox Islands, at the entrance of the Bay of Penobscot, the flood stream sets W.S.W. along shore; but it, nevertheless, runs up to the northward into Isle Haute Bay, &c.

(14.) NANTUCKET, &c.—Off this this island and its vicinity is that remarkable, but dangerous collection of shoals, which are so well known to all who navigate these waters. Their form and situation, and also the peculiarities of the Cape Cod peninsula lead to the inference that there is some singular effects of the tides and currents hereabout to which these peculiarities are owing. This subject has been partially investigated by the United States Coast Survey, but a complete report has not yet been issued.

"The region about Nantucket and Martha's Vineyard is the dividing space between the cotidal hours of xii. and xv., and in this locality the combination of two apparently distinct tide-waves is observed. This combination presents the most singular forms, giving at times four high tides in one day near the junction of Nantucket and Martha's Vineyard Sounds, and distorting the tide-wave generally, not only in these sounds, but also on the open sea coast of Nantucket and Martha's Vineyard Islands, and in Mustkeget Channel.

"The great disturbance of the ocean level thus prodnced gives rise to those remarkable currents so peculiar to this neighbourhood, and so disastrous to commerce."

(15.) FLORIDA, &c.—Near Kay West, on the Florida Reef, the tides are, in some measure, regular within the reef: the flood setting to the westward, and the ebb contrary. To the westward, between the Tortugas and Cayo Marques, the flood sets variably through to the northward, and ebbs to the E.S.E.

It is remarkable that, on the South side of these kays, the flood comes from the south-eastward; but on the North side of them, all the way from Kay West, the flood runs to the eastward, along the edge of the bank, and to the southward, through the little channels, in order to fill up the intermediate bays and lagoons, with the assistance of the flood from the southward.

Westward of Kay West there is a general current to the south-westward, along the reef, and to some distance to the South side of it.

In Chatham Bay it runs tide and half-tide; viz., three hours flood, then three hours ebb: next, nine hours flood, &c. Here, in some places, it is a mere fall; but in some of the channels it is as much as four men can do to stem the current with a boat.

During a S.E. gale or storm the water in the bays and rivers of West Florida has been known to rise 7 feet perpendicular, and vessels of burden have been driven in, among the pine trees, at some distance from shore.

From Cape Roman, northward and westward, the tide seems to ebb and flow only once in the twenty-four hours; but it is irregular, and much governed by the winds. Yet the effects in a dry season are very perceptible in the rivers at a distance from the sea.

(16.) BAHAMAS, &c.—Although, at the Bahamas, the rise and fall are inconsiderable, the tide of flood sets an indraught on the northern part of the Little Bahama Bank from every point of the compass, which renders an approach very dangerous. The tide sets with some force directly on and off the western side of the Grand Bank of Bahama; particularly at the full and change of the moon. High water at half-past seven or thereabout. Rise, 3 to 4 feet. On the Middle Ground of this bank the tides set in every direction.

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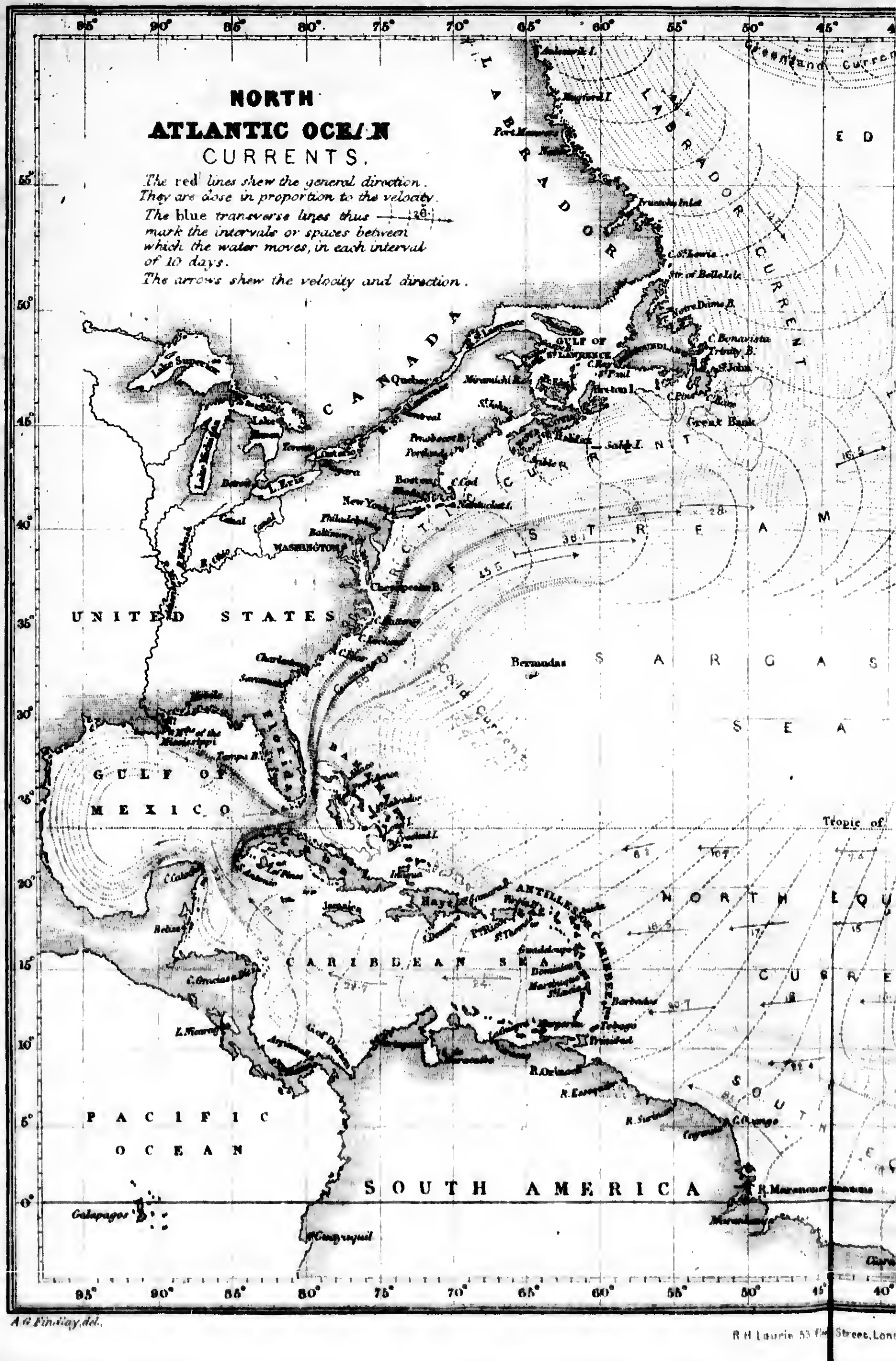
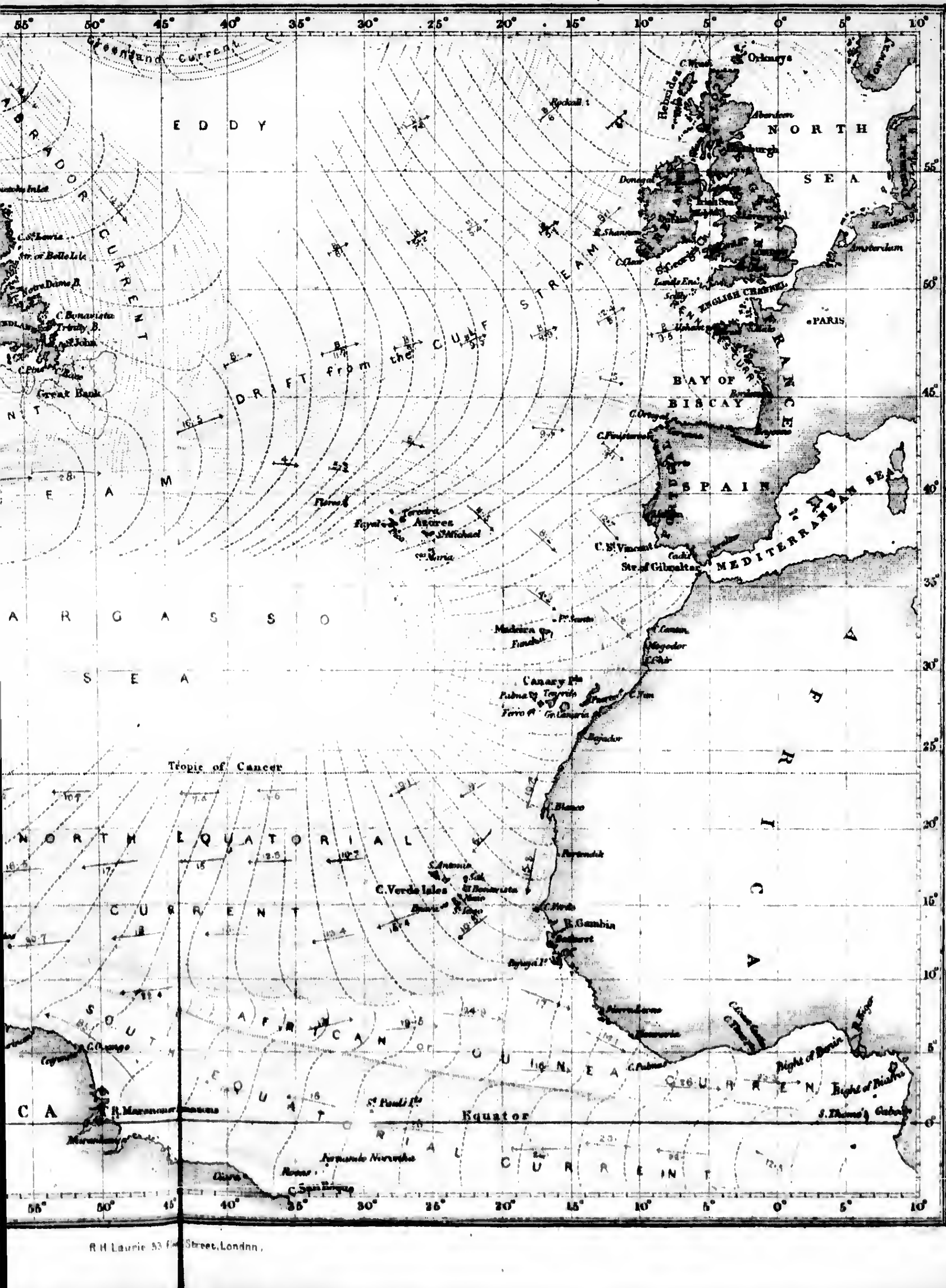


A G Findlay, del.

R H Laurie 53 Fleet Street, London



R.H. Laurie 53 Fleet Street, London.

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In Providence N.W. Channel the current runs generally to the eastward, about 2 miles an hour.

Near Egg Island, to the N.W. of Eleuthera, it is, however, uncertain, and great attention should be paid to the lead. In the passage within Egg Island the tide runs at the rate of 4 miles, and rises above 4 feet; the flood setting eastward, and strongly over the reefs.

About the Berry Islands and Providence the water rises 2 feet higher when the sun comes to the northward of the line, than it does when the sun is to the southward, and its strength is in a similar proportion. Here and at the Bemini Isles the flood sets to the N.E.

III.—OF THE CURRENTS.

(127.) **GENERAL REMARKS.**—A CURRENT is at present to be understood to be a stream on, or a particular set in the direction of, the surface of the sea, occasioned by winds and other impulses, exclusive of (but which *may be influenced by*) the causes of the tides. It is an observation of *Dampier*, that CURRENTS are scarcely ever felt but at sea, and TIDES but upon the coasts; and it is certainly an established fact that *currents* prevail mostly in those parts where the tides are weak and scarcely perceptible, or where the sea, apparently little influenced by the causes of the tides, is disposed to a quiescent state. This will be obvious by an attentive consideration of the following descriptions. The necessity of attention to the silent, imperceptible, and therefore dangerous operation of currents, will be equally apparent.

(128.) The usual method of estimating the existence, direction, and velocity of a current, as is well known, is the comparison between the observed position of a ship and that obtained by dead-reckoning. It may be as well to observe in the outset, that this only method of observations involves some amount of fallacy, as a current will be the general receiver of all errors or imperfections of observation, and beyond doubt the strength of currents has been frequently exaggerated from this very cause. Now, as the latitude is attained far more easily and accurately than the longitude, it follows that this exaggeration has been chiefly shown in those currents supposed to move to east and west. Still, by combining a large number of observations, we may safely conclude that they will neutralize each others errors, and afford something like an accurate conclusion.

(129.) We have an excellent respository of a vast number of current observations in the elaborate charts of Major Rennell, still the great mine for facts in surface current theory. Commander Maury's charts likewise afford a great addition to our stock of knowledge. This is also increased by numerous detached observations scattered through many works. All these, as far as attainable, have all been integrated at a great expenditure of labour, in the Chart of the North Atlantic Ocean, which this work particularly elucidates. In pursuing these calculations it was found that in many localities the currents were represented as most devious and erratic, frequently of great strength, and yet on a mean, showing that there was no continued set of the waters in any special direction. The diagrams of the direction of the wind at the Liverpool Observatory, page 209, in their more complicated parts, give a good notion of their motions, as their paths, when traced, resemble each other much. In other parts, as in the great Equatorial Current, the motion, as estimated, is remarkably uniform, and this demonstrates that these observations generally are entitled to confidence.

(130.) In founding any theories of circulation or movement of the ocean waters upon the basis of these, acknowledged to be, imperfect observations, it may be objected that many of them are now old, and therefore still less trustworthy. To this it may be replied, that they were mostly taken in *wooden* ships by careful navigators in an age when great pains was taken with the dead-reckoning. A doubt may very fairly be expressed whether the observations of an equal number of modern ships would give as trustworthy results. Modern speed, less attention to D.R., more refined astronomy superseding it, and, above all, the greater quantity of iron in modern ships, which acting on the compass, will inevitably tend to invalidate the most carefully kept log, will all tend to give confidence in these old observations.

(131.) **Bottles.**—It has been a well-known practice for many years to send these floating messengers as indicators of currents. In 1843, Captain A. B. Becher, R.N., drew up a very interesting chart of the North Atlantic with the points of "despatch and arrival" of a very large number of these current bottles. The practice and the accuracy of the teaching of these bottles led to a long controversy, which however certainly did not tend to overturn their authority, so it need not be longer adverted to here than to say that the principal objection to them was, that they were rather impelled by the prevailing wind than drifted in the current. But this is also a demonstration of what can be otherwise proved, that the wind and surface currents of the Atlantic and other oceans obey the same law, and move very much in the same circuits. These bottles, then, will form an important part of the subsequent demonstrations of the direction and rate of currents. The chart of Captain Becher's alluded to, bears intrinsic evidence of its trustworthy character, as in each region the bottles obey precisely the law which would, *à priori*, be laid down for them.

Further speculations as to the causes of the currents, and the general view of their circulation and character, is reserved for the end of this section.

(132.) It may be observed that this section deals chiefly with the *surface currents* of the Atlantic, as that is the only feature which affects navigation. But this superficial action is not the only point to be considered in relation to ocean currents, as it will not explain many phenomena known to exist, and the few experiments and facts we have of the movement and condition of the lower strata of the ocean do not as yet afford us the means of judging accurately of what is the real system of circulation.

(133.) That the water of the ocean does circulate over and intermingle with every portion of the water-surface of the globe is certain. Its composition and character is everywhere, in every region, exactly the same. This universality of character can only be accounted for by inferring that the ocean-waters are continually being intermingled, as is the case with the atmosphere, as before described (2.) page 177.

It may be objected that the specific gravity of the *surface* water varies considerably in different regions, and that is therefore an argument against this intermingling of the sea waters. But it will be found that there are local causes which affect the saltness of the surface-water. In the Arctic regions, where it is frequently found of great density or increased saltness, it is doubtless caused by the formation of ice subtracting the fresh water from the surface. Again, in the equatorial regions, it is usually found of low specific gravity, or containing less salt, which may also be accounted for by the great rain-fall which, by intermingling the light fresh water with the surface, lowers its density. Very much speculation has been used on this variation in the surface density and on its dynamic effects, in producing currents and other phenomena.

But it is deferentially urged against this reasoning, that almost all the experiments upon the density made upon the water at any considerable depth (above 20 or 30 fathoms) show a remarkable uniformity in the density in all regions (1·0027), as will be shown in a later part of this book, and that, therefore, the real character of sea water, *below* local influences, is everywhere nearly the same.

(134.) But we have a remarkable proof, lately obtained, that not only the upper strata, but also the whole ocean to its bed is of one universal character. During the voyage of H.M.S. *Bulldog*, in the summer of 1860, for the purpose of obtaining the deep sea soundings between England and Labrador, for the electric telegraph cable, when nearly midway between Ireland and Greenland, they brought up from the depth of 1,260 fathoms, that is nearly $1\frac{1}{2}$ statute mile, several *live starfish*, which had clasped their slender arms round that part of the sounding line which lay on the bottom. Now, as the process of winding this line in would occupy upwards of an hour, and these delicate animals having passed through all the strata still *attached* and *alive*, it follows that had the water varied in character even in a slight degree, that they would have loosened their hold and have died.

Besides this, immense quantities of microscopic animals have been brought up from their *living* places at greater depths, disproving the idea that these minute creatures had lived on the surface, and when dead had sunk to the bottom. All this goes to prove that sea water is everwhere and at all depths alike.

It is needless to pursue this subject farther now. It will be found more amplified hereafter, when the question of the depth of the Atlantic is discussed. It is only here cited in order that should the mariner in the course of his voyage be able, from his observations, to add to the knowledge of this interesting but new subject, it will afford him great interest, and be beneficial to the rest of the world.

(135.) The subject of the *temperature* of the ocean will be treated of specially at the end of the work. It is of importance in some localities, as it will indicate the changing from one current to another, as from the Gulf Stream into the cold Arctic current within it, or the reverse. It was formerly thought that a decrease of temperature was a sure indication of approaching shoal water, and its study was therefore inculcated as a precautionary measure. This point, however, has been shown to be, in general, fallacious. It arose from the fact that vessels crossing the Gulf Stream, on attaining soundings on the American coast, experienced a very sudden decrease of heat in the water. This is now accounted for in a very different way, therefore this topic is not of so much importance in the practice of navigation as was formerly thought.

(136.) Of Currents there are two distinctions:—1. The *Drift Current:* 2. The *Stream Current.*

The Drift or Drift Current is the mere effect of a *constant* or *very prevalent* wind on the surface water, impelling it to leeward until it meets with some obstacle which stops it, and occasions an accumulation and consequent *stream* of current. It matters not whether the obstacle be *land*, or *banks*, or a *stream of current* already formed. The drift current is generally shallow, and at a mean, perhaps, of no more than half a mile an hour, when the wind is constant and a good breeze. Such a current, from a predominance of westerly winds, occupies the northern region of the Atlantic, from the N.W. and West to the E.N.E. and S.E.; and such, likewise, is the central portion of the ocean under the influence of the trade wind.

The Stream Current is formed by the accumulated waters of a *drift current.* It is more limited, but it may be of any bulk, or depth, or velocity. Of such is the temporary stream setting at times from the Bay of Biscay to the West of Ireland; and of such is the *Florida* or *Gulf Stream*, setting from the Mexican Sea to the Banks of Newfoundland, and terminating to the West of the Azores.

In some parts the current is compounded of *drift* and *stream;* for a *stream*, already formed, may pass through the region of a prevalent wind, in a direction according with that of its *drift* current, and receive an acceleration of motion from it accordingly. Of such is the Equatorial Current, which will be presently noticed.

(137.) Of the currents and regions of the Atlantic, the first in order, from the Land's End of England, is Rennell's Current, a temporary but extensive stream, which sets at times from the Bay of Biscay to the westward and N.W., athwart the entrance of the English Channel, and to the westward of Cape Clear.

Second.—The Easterly and S.E. Drift Currents to the coasts of Europe and Africa, and southerly to the Coast of Guinea.

Third.—The African or Guinea Current, an Easterly stream across the Atlantic between 5° and 8° N., and continuing along the coast of Africa, into the Bights of Benin and Biafra, with a westerly outset from the same.

Fourth.—The SARGASSO SEA or central area, between the Azores, Canaries, and Bermudas, &c., in which it seems that there is no particular current, and is covered with the well-known Sargasso or Gulf Weed.

Fifth.—The EQUATORIAL CURRENTS, the vast streams caused by the trade winds. That of the N.E. Trade running from between the tropic and Cape Verde, on the eastern side, towards the Carribee Islands, having a general westward tendency, and that from the S.E. Trade, which is usually found to the N. of the equator, passing strongly to the westward, south of the counter or easterly current, number thr.e above, and then strongly to the W.N.W. along the Colombian coast, joining the N.E. Trade current in the Caribbean Sea.

Sixth.—The CURRENTS of the COLOMBIAN or CARIBBEAN SEA, and the MEXICAN STREAM, a continuation of the Great Equatorial Streams into the Mexican Sea, from the south-eastward and eastward.

Seventh.—The FLORIDA or GULF STREAM, an outset from the Mexican Sea, setting thence to the north-eastward, through the Strait of Florida, and thence eastward toward the Newfoundland Bank and Azores, &c.

Eighth.—The ARCTIC or LABRADOR CURRENT, passing southwards from Davis Strait down the coast of Labrador, round Newfoundland, and thence south-westward past Nova Scotia and the coast of the United States inside the Gulf Stream.

In explaining this subject, we shall endeavour, in the first place to establish the facts which prove the existence of these currents, and then attempt to deduce the causes, according to the given description.

1.—OF RENNELL'S CURRENT; OR THE CURRENT ATHWART THE ENTRANCE OF THE ENGLISH CHANNEL.

(138.) This current, which is occasionally of considerable breadth and strength, frequently sets athwart the entrance of the channel to the N.W. and W.N.W. at some distance to the westward of the Isles of Ushant and Scilly. As it apparently depends on temporary circumstances, it is considered as a temporary stream; and, although a certain quantity of northerly indraught is always to be allowed for, with the tide of flood, on approaching the Scilly Islands, the current, unless with particular winds on the ocean, will be scarcely, if at all, perceptible.

The general causes of currents, so far as they depend upon the state of the winds, &c., are generally known to seamen; and that a long-continued wind, in one particular direction, will either produce a stream where no obstruction exists, or causes an accumulation of the water against an opposing coast, until a reverberation takes place, needs no demonstration. The latter appears to be the case in the present instance. A long and continual prevalence of westerly and south-westerly winds, in combination with a current that commonly sets into the southern part of the Bay of Biscay, occasions an accumulation of water in the Bay, which seeks a an escape, by setting to the N.W. or W.N.W., within the limits described by the half-arrows in the accompany Chart.

It would be very difficult to understand how that the great preponderance of winds from the westward of North and South, which prevail in the latitudes of Cape Finisterre, should not have some effect in forcing the water toward the coast; and if so, what can become of it, unless it forms some current, which we should very naturally expect to find would follow the trend of the coast against which it is propelled.

That such a current does actually prevail is too well known to be longer doubted. Mr. KELLY, the author of a treatise on Navigation, in two volumes, published in 1733, has given a particular instance of it;* by which he shows that a ship becalmed

* See Vol. i. p. 434.

with her sails furled for forty-eight hours, was in that time carried by the current 46 miles to the northward; and we have many subsequent examples of vessels which have been set, by the course of the stream, to the northward, or upon the rocks, of Scilly. But the writer to whom we are more particularly indebted for an elucidation of the subject, is the late Major RENNELL,* who has given an illustration of it, which places it beyond all controversy; and from whose paper, published in the "Philosophical Transactions" of the year 1793, we extract the following observations:—

"In crossing the eastern part of the Atlantic, the *Hector*, East India ship, Captain Williams, in 1778, encountered, between the parallels of 42° and 49°, very strong westerly gales; but particularly between the 16th and 24th of January, when, at intervals, it blew with uncommon violence. It varied two or more points, both to the North and S.W., but blew longest from the northern point; and extended, as subsequently appeared, from the coast of Nova Scotia to that of Spain.

"Within 60 or 70 leagues of the meridian of Scilly, on the 30th of January, between the parallels of 49° and 50°, the effect of the current was first experienced, which set the ship to the North of her intended parallel, by nearly half a degree, in the interval between two observations of latitude; namely, in two days. The wind,

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* From the name of this gentleman, the current is now generally denominated RENNELL'S CURRENT.

The currents of the ocean appear to have attracted the attention of Major Rennell at an early period, and they continued to occupy the attention until the last ebb of his honourable life. The results have appeared before the world in five large charts, with a descriptive volume, dedicated to his late Majesty, William the Fourth, under the editorship of Mr. Jno. Purdy, the original author of this volume.

The Major's first Chart and Remarks on the Agulhas or South African Current appeared in the year 1778, and the important tract on the Scilly or 'thwart Channel Current, in the year 1793. In the mean time, and subsequently, some cursory remarks on the same subject were introduced in the "Illustration of the Geography of Herodotus," the Philosophical Journals, &c. In or about the year 1810, on th suggestion of a friend (Mr. Purdy), who expressed a wish to see all his writings on this subject combined and republished, he commenced his *Current Charts of the Atlantic Ocean*, and collected from the journals of his numerous friends a gleaning of information which, at length, from repeated accumulations, presented a most beautiful and singular instance of successful perseverance, on a subject never before attempted upon a plan so comprehensive. To an ordinary mind such a topic would have been regarded as dull, uninviting, and *impracticable;* by the author it was appreciated according to its importance and usefulness to mankind, and he treated it accordingly. He had long lamented the general ignorance prevalent on this subject, and which had, from time to time, produced so much loss of life and treasure, especially in relation to his native country. It is true that, in later times, practice and experience have taught the mariner, in many cases, how to shape his course to the best advantage; but still he was deficient in *theory*, and knew not the *rationale*, the *why and wherefore*, of the courses which he adopted, and the variations which might be most advantageously made in his outward or homeward passages, according to the fluctuations of season and circumstances. Such knowledge is now, in a great measure, supplied.

Among the names of the contributors to the work on the currents, that of *General Edward Sabine* is conspicuous; and were any apology required for the undertaking, his words might be quoted with propriety. In the year 1825, this gentleman published his *Account of Experiments to determine the Figure of the Earth by means of a Pendulum vibrating Seconds in different Latitudes, as well as on various Subjects of Philosophical Enquiry;* and in that volume he has given his testimonial of the necessity of the "Investigations in the following terms.

"On a general review of the currents particularized on the *Pheasant's* progress (in 1822) in her voyage, commencing at Sierra Leone and terminating at New York, it was found that she was indebted to their aid, on the balance of the whole account, and in the direction of her course from port to port, not less than ***sixteen hundred geographic miles***, the whole distance being nine thousand; affording a very striking exemplification of the importance of a correct knowledge of the currents of the ocean to persons engaged in its navigation: and consequently of the value of the information in the acquisition and arrangement of which Major Rennell has passed the latter years of his most useful life."

ever afterward, prevented the ship from regaining the parallel; for although the northern set was trifling, from the 31st until she arrived near Scilly, yet the wind, being scant and light, never enabled her to overcome the tendency of the current. It is also to be observed, that the direction of the current was much more westerly than northerly; the ship crossed it on so very oblique a course as to be in it a long time, and was driven, as it appears, nearly 30 leagues to the West by it; having soundings in 73 fathoms, in the latitude of Scilly, and afterwards ran 150 miles by the log, directly East, before she reached the length of the islands: running, in effect, 120 miles, and shallowed the water only 9 fathoms.

"The current was not only sensible by the observations of latitude, but by ripplings on the surface of the water, and by the direction of the lead line. In consequence of all, the ship was driven to the North of Scilly, and barely able to lay a course through the passage between those islands and the Land's End.

"There being no timekeeper on board, the longitude was uncertain; but it was concluded that the current, at times, extends to 60 leagues West of Scilly, and runs close to the West of the islands. The breadth of the stream, where the *Hector* crossed over it, was supposed to be about 30 leagues.

"A journal of the *Atlas*, East India ship, Captain Cooper, furnishes much clearer proofs, both of the existence of the current, and the rate of its motion. This ship, outward bound, in January, 1787, had advanced 55 leagues to the westward of Ushant, when violent gales began at South, and for four days continued between that point and W. by S.; during which time the ship was lying-to, with her head to N.W. On the 5th day the wind abated, but was S.W.; stormy weather then ensued for nine days, the wind blowing from all points between South and S.S.W., but chiefly, and most violently, from W.S.W. and S.W; and when the ship then proceeded southward on her voyage, she was, by the reckoning, only $2\frac{1}{4}$ degrees of longitude West of Cape Finisterre; but, by timekeepers, more than *four degrees and a half.*

"On the day the gales commenced, the reckoning was within fourteen minutes of that by the timekeepers; the latter being more westerly, owing to the current. On the third day after, the difference was about twenty-four minutes, when the ship was 25 leagues S.W. from Scilly, in soundings of 70 fathoms. The ship, in lon. 8° 28′, had entered into the stream; and, its course being opposite to that of the *Hector*, it facilitated her progress, and carried her clear of the S.W. coast of Ireland.

"After this, in the course of fifty-one hours, the ship had set two whole degrees to the westward of her reckoning; and in the forty-five hours following, she had a farther set of twenty-three minutes; so that, in four days only, she had been carried by the current no less than 2 degrees and 23 minutes; and, since the gale began, 2° 32′ of lon., or 93 nautic miles.

"It consequently appears, that the *Atlas* experienced a westerly current, from about 24 leagues W.S.W. of Scilly, to near 4 degrees of longitude West of the meridian of Cape Clear, where its effect was imperceptible. It may, therefore, be inferred, that the stream goes off to the N.W. in the parallel of 51°; between long. 14° and 15°, and the S.W. coast of Ireland.

"No northern set is indicated in the journal of the *Atlas*. This would have been remarkable, had the weather permitted nice attention to the reckoning; but it is to be remarked, that observations on the latitude were not regularly made; and besides, that the great distance of 36 miles was allowed for only twenty hours' drift to the N.W., when the ship was lying-to.

"From the nature of this current it must be obvious that its velocity will always be proportionate with the strength and direction of the wind, by which its direction will also be regulated, and that the middle of the stream will preserve its original course in a greater degree than its borders. The direction of this appears to be N.W. by W., the eastern border more North; and the western more West; so that the northern current is stronger close to the West of Scilly than more to the westward.

"From the foregoing observations may be deduced the following inferences:—

"1st. That ships, which cross the current obliquely, steering a true E. by S. course or more southerly, will continue longer in it, and be more affected by it, than those which steer more directly across it. In crossing it with light winds, the effect will be the same. Allowance must be made for the more northerly direction of the eastern edge of the current.

"2nd. That, after a continuance of westerly gales, even should a good observation of latitude be made, it would be imprudent to run eastward from the Atlantic during a long night. For a ship might remain in the current so long as to be drifted from a parallel, deemed a very safe one, to that of the Rocks of Scilly. It is, therefore, recommended, that vessels, at such times, should keep, at the highest, 48° 45′, because in 49° 30′ the whole effect of the current may be experienced in the worst situation. But from the current in 48° 45′, a southerly wind will set the ship into the Channel. In time of peace, coming from the Atlantic, it would be still better to make Ushant.

"3rd. That ships, bound to the westward from the Channel, with a south-westerly wind, so that it may appear indifferent which tack they go on, should prefer the *port* tack, as they will then have the benefit of the current."

In a SUPPLEMENTARY PAPER *on the* EFFECTS *of* WESTERLY WINDS *in* RAISING *the* LEVEL *of the* ENGLISH CHANNEL, *dated* 22*nd June*, 1809, *Major Rennell has stated:—*

(139.) "In the *Observations on a Current that often prevails to the Westward of Scilly*, which I had the honour to lay before the Royal Society many years ago, I slightly mentioned, as connected with the same subject, the effects of strong westerly winds in *raising* the level of the British Channel; and the escape of the superincumbent waters, through the Strait of Dover, into the *then* lower level of the North Sea.

"The recent loss of the *Britannia*, East India ship, Captain Birch, on the Goodwin Sands, has impressed this fact more strongly on my mind; as I have no doubt that her loss was occasioned by a current, produced by the running off of the accumulated waters; a violent gale from the westward then prevailing. The circumstances under which she was lost were generally these:—

"In January last she sailed from the anchorage between Dover and the South Foreland (on her way to Portsmouth), and was soon after assailed by a violent gale between the West and S.W. The thick weather preventing a view of the *lights*, the pilot was left entirely to the reckoning and the lead; and when it was concluded that the ship was quite clear of the Goodwin, she struck on the north-eastern extremity of the southernmost of those sands; and this difference between the reckoning (after due allowance being made for the tides) and the actual position I conclude was owing to the northerly stream of current, which caught the ship, when she *drifted* to the *back* or *eastern side* of the Goodwin.

"The fact of the high level of the Channel, during strong winds, between the West and S.W., cannot be doubted; because the increased height of the tides in the southern ports, at such times, is obvious to every discerning eye. Indeed, the form of the upper part of the Channel, in particular, is such as to receive and retain, for a time, the principal part of the water forced in, as may be seen by the Chart; and as a part of this water is continually escaping by the Strait of Dover, it will produce a current, which must greatly disturb the reckonings of such ships as navigate the Strait, when thick weather prevents the land, or the lights of the Forelands and the North Goodwin, from being seen.

"I observe, in a new publication of Messrs. Laurie and Whittle, entitled *Sailing Directions, &c., of the English Channel*, that, throughout the channel, it is admitted by the experienced persons whom they quote, that strong S.W. winds 'cause the flood tide to run an hour, or more, longer than at common times; or, in other words, that a *current overcomes the ebb tide a full hour;* not to mention how much it may accelerate the one, and retard the other, during the remainder of the time.

"It is evident that the direction of the current under under consideration will be influenced by the form and position of the opposite shores at the entrance of the strait; and, as these are materially different, so must the direction of the stream be within the influence of each side respectively. For instance, on the English side, the

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current, having taken the direction of the shore between *Dungeness* and the *South Foreland*, will *set* generally to the N.E., through *that* side of the strait.—(See the Chart.) But, on the French side, circumstances must be very different; for the shore of *Boulogne*, trending almost due North, will give the current a like direction, since it cannot turn sharp round the point of *Grisnez*, to the north-eastward, but must preserve a great proportion of its northerly course, until it mixes with the waters of the North Sea; and it may be remarked, that the *Britannia*, when driven to the eastward of the Goodwin, would fall into this very line of current.

"There is another circumstance to be taken into the account, which is, that the *shore of Boulogne*, presenting a direct obstacle to the water impelled by the westerly winds, will occasion a higher level of the sea there than elsewhere; and, of course, a stronger line of the current toward the Goodwin.—(See the Chart.)

"It must, therefore, be inferred, that a ship passing the Strait of Dover, at the back of the Goodwin Sands, during the prevalence of strong West or S.W. winds, will be carried many miles to the northward of her reckoning; and, if compelled to depend on it, may be subject to great hazard, from the Goodwin.

"It will be understood, of course, that although the stream of current alone has been considered here (in order to simplify the subject), yet that, in the application of these remarks, the regular tides must also be taken into the account. But, from my ignorance of their detail, I can say no more than that I conceive the great body of the tide from the Channel must be subject to much the same laws as the current itself. The opposite tide will, doubtless, occasion various inflections of the current, as it blends itself with it; or may absolutely suspend it; and the subject can never be perfectly understood without a particular attention to the velocity and direction of the tides in moderate weather, to serve as a good ground work."

FURTHER OBSERVATIONS ON RENNELL'S CURRENT.

(140.) After the publication of the first paper on the current of the Channel, and the supplementary paper immediately preceding, Major Rennell published some further important observations upon it, which were read before the Royal Society, April 13, 1813, and from which we have the following extracts:—

"During the interval of twenty-one years, since the Society did me the honour to receive my *Observations on the Current to the Westward of Scilly*, more facts relating to that current have been collected, as well as observations on its effects, in different parts of its course, between Cape Finisterre and Scilly; the whole tending to confirmation of the general system set forth in 1793; and, in one instance, affording perhaps a clearer proof of the strength of the stream, in respect to its *northerly* direction, than any of those adduced on the former occasion.

"In pursuing the detail of these facts and observations, I shall begin the neighbourhood of Cape Finisterre, and proceed with the course of the current, along the Bay of Biscay; and thence across the mouth of the English Channel to Scilly, and the entrance of St. George's Channel.

"The first three facts regard the current from the open sea, setting into the South side of the Bay of Biscay, and along the North coast of Spain; which current has been supposed in the former paper to be occasioned by the prevalent westerly winds, which force the water near the shore *into the bay*, and along the southern coast of it. The water so displaced would be followed, of course, by the adjacent water *behind* it, in the open sea; and so on successively, to a certain extent. This cause must surely be referred to as the origin of the Scilly Current.

"I. The first case is that of the *Earl Cornwallis*, East India ship. The circumstance occurred on her outward passage; she was well provided with timekeepers, as most of the India ships are.

"On the 12th of March, 1791, between the parallels of 43° and 44°, and at 3° 45′ of longitude West of Cape Finisterre (about 53 leagues), this ship experienced an easterly current, equal to 26 marine miles. Her position being directly opposite to the line of the southern coast of the Bay of Biscay, it is a fair conclusion, that the current was occasioned by the cause above mentioned, or, as seamen call it, the *indraught* of the bay; which, it appears, extends to at least 53 leagues from the shore. And as the rate, in this place, extends one mile per hour, it may be supposed that the effect extends to a still greater distance.

"It may here be remarked that the same ship, in coming out of the *chops* of the Channel a few days before, was *set* 24 miles to the westward, 15 to the northward, in the course of twenty-four hours; that is, 38 miles, in a direction of N.W. by W. This may be supposed to be the same stream of current in its course from the *bay* toward Scilly.

"II. The second fact is that of the *drift of a bottle*, which was thrown out of a Danish ship (I believe sent on discovery), since the publication of the former paper.

"The bottle was thrown out in lat. $44\frac{1}{2}°$, long. 12° West from Greenwich, that is, about 48 miles to the N.E. of the *Cornwallis's* station, at the time she began to feel the current, on the 11th of March. It was taken up by a sentinel on duty, near Cape Ortegal, and, as was supposed, at the moment of its driving into the surf. If this was really the fact, the bottle, according to the date of the letter contained in it, must have been carried, at the rate of half a mile per hour, in the direction of about E. by S. $\frac{1}{2}$ S.; the distance was about 64 leagues.

"The report of this circumstance was transmitted, by the French Consul at Corunna, to the Academy of Sciences at Paris.

"It may be observed that the drift of the bottle was much to the *South* of East, whereas that of the *Cornwallis* was East; that is, both pointed toward Cape Ortegal or its vicinity: as if the main stream of the current was concentrated there.

"With respect to the velocity of the current in the present case, all, of course, depends on the time of the arrival of the bottle at the shore. It might have been thrown up long before it was seen, and washed off again by the tide, or surge, of the sea. The *direction*, the most important point, cannot be questioned.

"III. The third fact is very simple, and perfectly conclusive. Off Cape Ortegal, at a considerable offing, Admiral Knight found the current, at the rate of one mile per hour, setting to the E.S.E.; that is, nearly *along shore*.

"The reader will immediately perceive that these three facts converge, as it were, to one point; that is, in the proof that the waters of the Atlantic flow into the Bay of Biscay, along the North coast of Spain.

"It would seem that the north-westerly current, by Scilly, did not, at least in many cases, balance the easterly current round Cape Ortegal and the land of Finisterre.* The loss of his Majesty's frigate *Apollo*, with most of her convoy, may surely be attributed to the operation of this current. Captain (afterwards Commissioner) Wallace assured me, that after having made as he supposed, ample allowance for clearing Finisterre, yet, in the night, he had a very narrow escape from shipwreck. Very many others have been brought into the same kind of danger; so that the land of Finisterre, were it not discernible at a considerable distance, and its offing clear of rocks and shallows, and, moreover, situated in a finer climate, would prove a kind of Scilly to mariners.

"I have not been able to obtain any proofs on record concerning the course of the current *round* the Bay of Biscay. I formerly collected some information from a French commander respecting it. He said, that the setting of the current along the

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* Nor, admitting an equal rate, in both places, could it well be. For the current enters the Bay of Biscay, in an *East* direction, but goes off from it *N.W.*; so that, if a ship was carried 50 miles to the N.W. from Ushant, she would only have made about 35 westing; but, in the other case, she would be carried the *whole* 50 eastward, toward the Bay and Cape *Finisterre*.

coast of France, to the North and N.W., was a fact well understood; and even acted on by many in the choice of the *tack*, on which the current gave the greatest advantage, with dead winds.

"One circumstance, and that a very striking one, in respect to this particular, is that the soundings in the Bay of Biscay show little or no *muddy bottom* to the *southward* of the *Gironde* River; but everywhere to the *northward.* This seems to show that the mud of the *Gironde, Charente, Loire,* &c., &c., is all carried to the northward; and by what cause but a northerly current? Had the motion of the sea been variable, the mud would surely have been distributed to the South, as well as to the South, of the mouth of the Gironde. The alluvial *embouchures* of the rivers in general here, and the positions of the banks formed by them, in the sea, point to the North or N.W.; apparently the effect of the same sea-current.*

"IV. In continuation of this current along the Bay of Biscay, I shall next mention that Captain (afterward Admiral) John Payne assured me, that, being in H.M.S. *Russell,* in a severe gale of wind at S.W., and with the ledge of rocks called the *Saintes,* not far to leeward, he was under apprehensions for the safety of the ship during the whole night, but, to his surprise, found himself carried clear of the danger by a current, which set the ship, in all, about 70 miles to the N.W.

"V. The flowing of the tides, on the West of Scilly, cannot well be accounted for, on any other supposition, than that the flood is prolonged by a southerly current. The flood tide is known to run nine hours to the northward; but the ebb, in the opposite direction, only three hours. This particular had not come to my knowledge when the paper of 1793 was written.

"VI. Our navigators, in earlier times, appear to have entered the English Channel on a more southerly parallel than they have done in later times. For, although they might have been ignorant of the real cause of their disturbance in their course, yet many of them believed that there was an *indraught,* as they called it, into the St. George's Channel; so that one effect of the current, that is, the *northern set,* had not passed unobserved, although the *cause* was not understood; nor, of course, could it be known when to expect. But I have also heard it remarked by sea-officers as long ago as I can remember, that 'it was unaccountable what should occasion their *running down so much distance,* in coming in with the land from the westward.' I never heard, however, that there was any suspicion of a current setting westward.

"The idea of a northern *indraught* into St. George's Channel (but which applies equally to the current West of Scilly) is clearly set forth in a publication by Captain Joseph Mead, in 1757; but which came to my knowledge only very lately, by the favour of Mr. Purdy. Captain Mead first relates the case of the ship *Hope,* of Liverpool, bound from the coast of Guinea to that port, in November, 1735. (Preface, p. iii.)

"'Having had a good observation, by which they found they had the Irish Channel open, the wind continued to blow strong from between the South and West, but mostly from the former. Having no other observation [of latitude] for six days, in which time they carried sail constantly, they by reckoning expected to fall in with Cape Clear; but in the following night they fell in with the *Blasquets.*' These islands and rocks are situated in lat. 52° 10', or about 48 miles to the North, and one degree of longitude to the westward of Cape Clear.

"Again (page 10) he says, that the Bristol merchant-ships, which fall in with Cape Clear, on their homeward passage [from the West Indies, &c.], shape their course

* From a view of the Chart of Soundings between Spain and Ireland, one might be led to suppose that the deep water and steep shore along the North Coast of Spain had been *partly* occasioned by the water driven in from the Atlantic, in westerly storms, along that coast; and which had gradually worn away the matter *there,* and deposited it on the bank which extends from Bayonne to the westward of Ireland. For the bank seems to expand, as it goes northward, in like manner as the current; and the water is shallower than might be expected, in proportion to the depths farther in.

from thence, with a large wind, to the high land near *Padstow;* which is the land they choose to make to lead them to the entrance of the Bristol Channel. That, in estimating this course, they allowed 4 or 5 degrees in the bearing, to compensate for the indraught int2 St. George's Channel. This angle would give about 13 or 14 nautic miles; and is probably what they found by experience to be the general amount of the *northern set.*

" He goes on to say that, in like manner, the safety of ships, after they come into soundings, until they reach Scilly, depended on their making *no less allowance* than Bristol men do in the other Channel. For, says he, ' experience informs me that, from the commencement of soundings, in lat. 49° 30′ N., to the length of Scilly, in *fair weather*, I had found the northern indraught to be 6 or 8 miles in the twenty-hours.' "

Here, then, the fact of the *northern set* is a second time recognised, though without any suspicion, any more than before, of there being a *westerly set* also.

Here it may be proper to state, what appears to me to be a very important fact; although perhaps not connected with the current in question, but materially affecting the safety of the navigation between the English Channel and Dublin. It was communicated to the author by Captain Evans, a gentleman who superintends the harbour-works at Holyhead, and who has had much experience in the navigation of the Irish Sea.

" All navigators (says he) in their voyage from the Land's End to Dublin, find themselves more or less carried to the eastward, while running up St. George's Channel; which is the cause of so many vessels finding themselves in Cardigan Bay; where in tempestuous weather and westerly winds many have been lost.* And this he justly supposes to be occasioned by a current setting to the north-eastward."

From subsequent communications, it has been shown that the water sets into the Bay of Biscay from the N.W. as well as the West, at times as high as the parallel of 47°; and it is supposed that a *whirl* is sometimes formed by the outer part of the water; that the bay discharges to the N.W., turning to the west, and round the South and S.E., while the inner part shoots to the N.W. and W.N.W. Hence it may be concluded that, when the volume of water received, and, of course, the velocity, is very great, the whirl to the left or West is farther removed to the N.W., and the contrary.

Of this current Captain Livingston says:—" I have seen, in a late magazine, some one alleging that Rennell's Current, athwart the channel, is imaginary. I know the contrary from experience, and perfectly remember, that in 1813, while master of the *Lark* sloop, I was set one day twenty-four minutes North of dead reckoning, equal to one mile an hour, but can say nothing as to the westing. On coming lately from Bordeaux, 1819, we were set by it seventeen minutes North in twenty-four hours; but, as a passenger, I had, at this time, no opportunity of keeping a reckoning."

On the 13th July, 1826, the ship *Carshalton Park*, Captain J. S. Park, entered upon the Bank of Soundings on the parallel of 49°, and between the meridians of 11° and 9° W., *Rennell's Current* was then found to be setting with dangerous strength. The ship crossed it rapidly; running all the time at the rate of 7 knots, but was swept 14 or 15 miles to the N.W. by W. It had been previously ascertained that no current existed, nor was any found eastward of 9° W. The wind was between S.W. and N.W., flying about in squalls.

At nine a.m., on the 14th, Captain Park made the Lizard, bearing N.E., and had the satisfaction to find his chronometer perfectly correct.

(141.) FURTHER DEMONSTRATION.—To the preceding development, by Major Rennell, we may with propriety add a notice of the loss of *La Jeune Emma*, of Cherbourg, commanded by Chaccelot de Chatillon, in the night of November 28, 1828; an

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* A light-vessel lately placed here, it is hoped, will avert this mischief.

extraordinary and memorable instance of the operation of the current. This vessel, of about 400 tons, from Martinique, was bound to Havre de Grace, with colonial produce. She had, in her passage, encountered several severe gales (we presume from the S.W.) and had shipped two heavy seas. On advancing toward the English Channel, the weather was hazy, and thus continued for *several days*, so that no observation could be taken, and the reckoning consequently became erroneous. At length a lighthouse was seen, supposed by the captain to be that of *Ushant*, and a course was shaped accordingly; but this unhappily brought the vessel to the *Cefn Sidan Sands*, within the *Bar of Caermarthen Harbour*, and the next day became a total wreck. The captain and passengers were drowned, and from a crew of nineteen only six were saved.

The narrative states that there is not, perhaps, a beach of this kingdom, where there is a more furious sea running, during the prevalence of south-westerly winds, than Cefn Sidan Sands, nor any which has proved more eminently disastrous to those who have been so unfortunate as to have been driven on them.

The event proved that the lighthouse, which had previously been supposed to be that of *Ushant*, on the French coast, was really that of *Lundy Island*, in the Bristol Channel; The latitude of Lundy Lighthouse is 51° 10′; that of Ushant 48° 28′. The difference of latitude between the two is, therefore, 2° 42′, or 102 miles; a difference surely too great to have been effected by merely ordinary circumstances, but which may, in the absence of positive information, be assumed as a presumptive proof of the operation and strength of *Rennell's Current*. This case is not cited as exhibiting any circumstances which proper precaution could not have avoided, but is here quoted from a multitude of others where the error is on the same side, and all of which tend to confirm the previous remarks.

EXPERIMENTS ON THE CURRENT.

(142.) Inset into the Bay of Biscay.—A bottle from the *Lady Louisa*, bound to St. Michael's, in lat. 45°, long. 13° 45′, 2nd February, 1830, found on the coast of Lit, in the province of Bayonne, 14th of October, in the same year.

Channel Soundings into the Bay.—Bottle from the brig *Hope*, from Havannah, 31st March, 1838, in lat. 50° 10′, long. 9° 43′; wind *strong from the eastward* for three days; found on the 1st of June, 1838, on the coast of Rochefort; having probably been first impelled to the S.W. by the ebb tide and prevalent wind, and thence following the general inset to the South and East.

Query.—"Why should the sea be higher, or more dangerous, in the Bay of Biscay than it is in the middle of the Atlantic or elsewhere? Is it really so? are questions often asked.

"I believe that there is a shorter, higher, and consequently worse sea, in and near the Bay of Biscay, than is often found in other places, and attribute it to the effect of immense Atlantic waves rolling into a deep bight, where they close upon each other, and receive vibratory undulations from each shore; augmented, perhaps, by the peculiar formation of the bottom of that bay, the variation in depth, and the effects of currents, which, when running over uneven ground, or against the wind, alone cause a heavy swell; a striking exemplification of which may be seen on the Bank of Agulhas, near the Cape of Good Hope."—*Captain FitzRoy*, vol. ii. p. 45.

From Channel Soundings to the West of Scotland.—A bottle thrown from the ship *Duke of Marlborough*, Captain Jeffery, by Mr. George Thom, near the Sole Bank, in lat. 43° 38′, long. 9° W.; found on the shore of Carsaig, near the middle of the South side of the Island Mull, 14th April, 1821, and made known by Mr. Hector Maclean. At the time this bottle was thrown into the sea, the ship was on its passage to London from the Cape of Good Hope, and an allowance was made for current to the N.W. of 12 miles to the twenty-four hours. From the spot in which it was dropped, it seems unquestionable that the bottle was carried by the current to the West and North of Ireland, and thence between Ila and Mull, to the place in which it was found. It has, therefore, well answered Mr. Thom's purpose of *confirming Rennell's Current.*

BAY of BISCAY to the NORTH of SCOTLAND.—A bottle, enclosing a song composed on board, from the *Great Western* steamer, on her voyage to New York, at midnight of September 10, 1838, in lat. 48° 3′ N., long. 9° 52′ W.; picked up by Captain Thornton, of the *Ceres*, in passing through the Pentland Frith, on the 16th of the same month. It must, therefore, have drifted to the north-westward and northward, off the western coast of Ireland, and thence to the N.E. and East, by the general drift from the Greenland Seas.

ST. GEORGE'S CHANNEL.—A bottle from the ship *Osprey*, of Glasgow, Alexander M'Gill, master, which sailed from Greenock. This bottle (No. 310.) was thrown into the sea 1st March, 1822, on the ship's return from Calcutta, in lat. 49° 54′ N., and long. 12° 20′ W. It was found on the shore, upon the South side of Milford Haven, on the 6th of the following month, April.

EASTERLY CURRENT TO BRISTOL CHANNEL.—A bottle from the brig *Albert*, R. L. Robertson, master, lat. 47° 20′ N., long. 22° W., 24th January, 1822, on the passage from Virginia to England, the wind then about W.N.W., and had so prevailed for two or three days. Found in Rockham Bay, about 4 miles West from Ilfracombe, 29th July, 1822, and attested by the agents to Lloyd's.

BAY OF BISCAY, NORTH SIDE.—A bottle from the ship *Graham Moore*, 6th of July, 1821, in lat. 47° 47′ N., long. 7° 51′ W.; found, 15th of September, 1821, on the coast of St. Jean de Mont, arrondissement of Sables d'Olonne, department of La Vendée; and made known by the *Journal de Paris*. This bottle was impelled in an E.S.E. direction, the *north-westerly* current not then prevailing, and was within the influence of the *tide*.

By Captain Livingston's Journal, 28th November, 1820, "It appears that in twenty-four hours, ending at noon of yesterday (on the passage from Gibraltar), we made about 15 miles *North* by current; and in twenty-four hours, ending at noon this day, about 13 North; and in the two days rather more than 20′ E. Therefore about N. 40½′ E. 37 miles in the forty-eight hours."

INSET TO, AND OUTSET FROM, THE BAY OF BISCAY.—A bottle from the *Iris*, Captain Skinner, in lat. 47°, long. 21°, 9th September, 1802; found at the Isle of Skye (lat. 57° 15′, long. 6° 20′), 22nd February, 1803. (Probably carried into the bay on an eastern direction, subsequently northward by Rennell's Current, and thence by the eastern drift to Scotland.)

The ship *Jessie*, Bevan, master, left London for the Bahamas, about the 13th of November, 1833. She was struck by lightning and abandoned by her crew, in lat. 45°, long. 14°, and on the 5th of February, 1834, drove on the *Isle Groix*, near L'Orient, and was immediately dashed to pieces.

INSET; BAY OF BISCAY.—A bottle from the *Carshalton Park*, Lieutenant J. Steele Park, 27th July, 1827, in lat. 48° 39′, long. 10° 21′; taken up, 21st Debember, 1827, on the shore of Pembron Road, near the Loire, in the Bay of Biscay, lat. 47° 19′, long. 2° 30′ W.

A bottle from H.M.S. *Arrow*, in lat. 48° 30′, long. 9° 25′, 14th July, 1838; wind from S.W. for five days, a fresh gale, and then S.W. Another bottle from the *Maitland*, transport, in lat. 49° 5′, long. 18° 19′, 10th March, 1838. Both found, on the 25th of February, 1839, on the shore of Arcachon, in the bay, lat. about 44° 40′ N.

A metal cylinder, cast from H.M.S. *Chanticleer*, Captain H. T. Austin, 3rd of May, 1831, in lat. 44° 38½′, long. 11° 4′ W.; found near Vivero, on the North coast of Spain, 12th of September following, at about 150 miles from the spot where it was dropped into the sea.

A bottle from the bark *Mary*, of London, Abyah Locke, master, 12th of April, 1832, in lat. 48° 30′, long. 16° 56′; found on the coast of Jart, lat. 36° 25′, 4th March, 1833.

Another bottle, from the same vessel, 1th April, 1832, in lat. 46° 15′, long. 17° 58′; found near Cape Feret, 44° 38′, 21st February, 1833.

A bottle thrown over from the *Wellington*, August 23rd, 1837, in lat. 45° 10′ N., long. 12° 58′ W.; thrown on the South coast of the Isle of Ré, probably about the end of February, 1838; found March 2nd, 1838.

TIDE WATER ON SOUNDINGS.—A bottle from the bark *Wallace*, of Alloa, bound to Van Diemen's Land, 12th of April, 1835, in lat. 52° 13′, long. 15°. Picked up at 5 miles from Ushant, 21st of August. 1835.

A bottle from the *Kent*, troop-ship, in lat. 50° 20′, long. 19° 0′ W., August 19th, 1836. Picked up near Cape Blancnez, a few miles from Boulogne, December 20th, in the same year.

BAY OF BISCAY, SOUTH SIDE.—A bottle from the schooner *Morning Star*, of Liverpool, Captain Andrew Livingston, 7th of October, 1821, lat. 42° 45′ 39″ N., long. 13° 3′ 21″ W. Found about 29 miles to the northward of Bayonne, in the arrondissement de Dux, lat. 43° 58′ N., long. 1° 20′ W., and made known by the direction of the Minister of the Marine and Colonies of France in the *Moniteur* of, January 24, 1822.

One of the most singular routes of the kind that we have met with was a bottle covered with barnacles, picked up at the Mizen Head, on the S.W. of Ireland, Oct. 19, 1837. Its enclosed note stated that it was dropped off Cape Horn, from the *Salem*, R. Crukers, master, of the United States, in lat. 53° 3′ S., and long. 67° 5′ West, on the 24th of June, 1830.

(143.) The daily rate of the inset into the Bay of Biscay, as estimated from the drift of the bottles quoted in Captain Becher's Chart (131), is as follows:—The numbers refer to the Bottle Chart in the "Nautical Magazine for November, 1852—No. 2 (drifted 250 miles), 4·8 miles per day; No. 3 (230 m.), 3·3 m.; No 3*a*, (270 m): 4·5 m.; No. 3 (420 m.), 1·8 m.; No. 11 (150 m.), 0·7 m.; No. 11*a* (100), 3 m.; No. 16 (200 m.), 1·2 m.; No. 28 (700 m.), 4·5 m.; No. 28*a* (700 m.), 2·2 m.; No. 33 (650 m.), 4·1 m.; No. 37*a* (680 m.), 2 m.; No. 40 (980 m.), 3·1 m. It will be seen that the longest courses have the quickest rates, so that we may suppose that when the bottles become entangled in the shore tides and devious drifts, that they do not travel so fast in direct distance. The mean rate of all these bottles is 3·26 miles per day. The rate at which those travel up the English Channel is very much greater, averaging 11 to 14 miles per day.

The foregoing are the principal arguments and facts upon which the existence of the thwart-channel current is inferred. That there is some cause for the drifting of the various vessels, &c., in a northward and westward direction, there can be no doubt; nor can there be any doubt that the stream varies both in strength and in direction. Without inquiring into the sufficiency of the cause to produce these effects, or of the correctness of the views promulgated by Major Rennell, the foregoing remarks have been repeated, as originally given; and here we would add that they were formed long before any correct knowledge of the tides or of the tidal currents was acquired, and also that a very just estimate of the amount of derangement of the *regular tides*, or of the set of the current across the mouths of the English and St. George's Channels, is formed from his dissertations. The remarkable revolution of the tidal streams at the entrance of the English Channel caused by the cross action of that wave proceeding up the English Channel with that of the wave coming northward, has been well developed in the observations discussed by Admiral Beechey as stated on p. 252.

2.—THE EASTERLY AND S.E. DRIFT-CURRENTS TO THE COASTS OF EUROPE AND AFRICA.

(144.) The currents on the shores of the Atlantic seem to have different tendencies to the South and North of the English Channel. They are certainly very devious and uncertain; but along the West Coast of Ireland and Scotland, as well as on the offing, the general set is to the *northward*. Off the southern part of the Bay of the Bay of Biscay there is a well-marked current to the S.E. and *southward*, not only during those periods when the westerly winds have been prevalent, and causing the Rennell's Current last described, but it appears to be constantly met with; and, therefore, in sailing southward from British ports, this tendency of the waters should be carefully considered, especially when the shores are neared, for there they run strongest.

(145.) By a careful calculation of the currents experienced by the ships cited in Maury's and Rennell's Charts, they appear to set with great regularity, and constantly to the south-eastward. The experience of 82 ships for the year gives a mean direction and rate of 9·1 miles per day to E. 34° S. for the offing of 350 miles off Cape Finisterre and the northern part of Portugal. The average of the months is greater than this:—January, 9·4 miles to S. 40° East; February, March, April, 11·, 15·9, 12·8 miles per day to E. 24° S.; May, July, 12·8, 10· miles per day S. 25° E.; Aug., October, November, 20·2, 10·5, 16·7 miles per day to S.S.E. These, compared with the drifts of bottles, show that the latter must be affected by surface causes, as their rate of travelling is much less.* All these observations are integrated on the Chart of the North Atlantic referred to previously.

(146.) In addition to these remarks we give, as in previous editions, the particulars of various bottles and other experiments, which are very interesting, and will be serviceable in estimates of what amount of current may be expected in this part of the voyage.

South-Easterly Current off Channel Soundings.—In August, 1826, Capt. Livingston, in the *Jane*, between lat. 48° 53′, long. 16° 7′, and Cape Clear, had a set of 1″ 14′ S. and 1° 54′ E. So that in four days the vessel was set, by a counter current, 74 miles S. and 65 E., or nearly S. 41° E. about 99 miles; equal to a daily average of 24¾ miles.

Toward the Bay of Biscay.—The ship *Carshalton Park*, Captain J. Steele Park, on returning from Jamaica to London, in July, 1824, in lat. 48°, and long. 13°, got into a stream setting to the southward, and which thence operated so strongly against the ship, that some difficulty was found in getting sufficiently far to the northward for a good Channel track. The wind shifted suddenly from S.W. to North; the vessel immediately hauled up E. by S.; and although the weather was fine, and the water quite smooth, she made no better than a true E. by N. course.

Captain Park says, "The moon happened to be near the full about this time; and I had opportunities for ascertaining the latitude by her meridian altitude three or four nights in succession before we made the land; therefore I could not be mistaken as to the strength and direction of this current; for the interval between the observations of sun and moon was only ten or eleven hours; and the greatest attention was paid to the steerage."†

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* Estimating the set of the current by Captain Becher's bottle-chart mentioned on page 260, we get the following:—Bottle No. 7 (drift 500 miles), 3·2 miles per day; No. 8, the carcase of a dead whale, (220 miles), 8 miles; No. 9 (300 miles), 12 miles; No. 13 (250 miles) 4·1 miles; No. 18 (1,000 miles), 3 miles; No. 13*b* (550 miles), 5·5 miles per day, giving an average of nearly 6 miles per day.

† The same ship, on the 10th of July, was on Channel soundings, the latitude by meridian altitude of the sun, 48° 53′; the longitude, by chronometer and lunar, 9° 44′ and 9° 56′, respectively. "Kept the ship E. ½ S. and generally East till 11.51 p.m., when, by the moon's meridian altitude, it was found that the latitude was 49° 11′. We had gone, during

OFF THE COAST OF PORTUGAL.—A bottle from the brig *Freeland*, Captain T. Midgley (from Liverpool to Africa), in lat. 41° 50′ N., long. 14° 23′ W., 11th of February, 1833. Picked up close to the shore, off the Harbour of Vigo, on the 1st of March following; having traversed, in a true E. ½ N. direction, about 80 leagues.

ST. GEORGE'S CHANNEL TO CAPE ST. VINCENT.—On the 14th of August, 1823, Captain Livingston, in the sloop *Favorite*, on his passage from Liverpool to Gibraltar, took his departure from the *Smalls Lighthouse*, and thence he regularly made observations on the current, &c., so far as adverse weather permitted. On the 23rd he had arrived on the parallel of 46° 23′; previously to which the course seems to have been materially affected by the *tide*, but here the differences amounted to 51′ 55″ southerly, and only 4′ 39″ N. From lat. 46° 23′, August 23, to lat. 36° 52′, August 31, the current invariably predominated to the southward, and between these parallels amounted to 89 miles in the eight days.

At 4h 53m of August 31, with Cape St. Vincent bearing true North, an excellent meridian altitude of the planet Saturn gave lat. 36° 52′ 8″. The total southing to this point gave 2° 18′, and the difference of longitude between dead-reckoning and that by landfall gave 1° 42′ 7″ of easting.

In the brig *Friends*, of Glasgow, 24th August, 1820, Captain Livingston states—"The current set us round Cape St. Vincent without our having seen the cape, though we steered courses for the purpose of seeing it, and we were looking out for it, when I got a lunar, and ascertained that we were then past it. Immediately after this the sea became smooth, being broken off by the cape."

Between CAPE FINISTERRE and the AZORES, the general drift of the surface of the sea appears to be to the south-eastward; varying, however, to the East and West, and even to the northward, as the winds operate, either one way or the other, more especially during winter, as already noticed.

H.M.S. *Pactolus*, in May, 1816, experienced a current south a little East, at the average rate of 30 miles a day, from the English Channel to St. Michael's.

Captain *Charles Hare*, in the brig *Ward*, from New Brunswick, Sept., 1823, with westerly winds, which had prevailed for fourteen days, between lat. 43° 40′ and 45° 20′, long. 22½° to 16°, found the current E.S.E. 1½ miles in the hour.

Between PORTUGAL and the WESTERN ISLANDS.—Captain *George Cheveley*, June, 1830, lat. 44° to 27°, long. 11° to 21°, current S.E., three quarters of a mile an hour.

Captain *W. J. Capes*, on his passage in the *Lady Mackworth*, from England to the West Indies, in August and September, 1823, found the currents as follow, taking the ship's position at noon:—

Aug.	27	Lat.	43°	38′	Lon.	12°	40′	Current easterly.
	28	..	42	43	..	12	17,	By good chronometric observation, the current had set 30 miles to the eastward.
	29	..	43	41	..	12	28,	Current, 10 miles E.S.E.
	30	..	41	42	..	12	28,	Current, 25′ easting and 11′ southing, by good observation.
	31	..	30	3	..	13	23,	Current, 9′ to the S. and 14′ to the E.
Sept.	1	..	38	5	..	14	17,	No current perceptible in the 24 hours.
	2	..	35	59	..	15	6,	Current, 26 miles to the southward.
	3	..	34	8	..	15	55,	Current southerly, 3 or 4 miles.
	4	..	33	1	..	16	7,	Porto Santo, distant 4 or 5 leagues.
	5	..	32	22	..	16	49,	

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this interval of 11h. 51m., 68 miles by the log, carefully attended to, in smooth water. Now, allowing 2½ points of variation, we ought to have made 26′ of northing; whereas, in point of fact, we made 13′ only."

Influenced, probably, by the Channel ebb, the current appeared also to have a tendency to the West.

Sept.	6	Lat. 31°	16′	Lon. 17°	26′	Current, 7 miles to the southward.
	7	.. 29	28	.. 17	38,	Current, 10 miles ditto.
	8	.. 28	48	.. 17	26,	Current, 17′ S. and 13′ E.
	2	.. 28	32	.. 17	17,	No observation on current.
	10	.. 28	9	.. 18	10,	
	11	.. 27	4	.. 19	41,	Current, 16′ to the southward.
	12	.. 25	46	.. 21	43,	Current, 15′ to ditto.
	13	.. 24	44	.. 93	52,	Current, 4′ to the S. and 13′ W.

8th April, 1823.—Captain *Hamlin*, in the ship *George IV.*, on the passage from Greenock to St. Thomas's, found that they were much to the southward of dead-reckoning on several days, and during the last twenty-four hours not less than 45 miles. Lat. at noon, 38°. 50′, long. 19°, or more than 300 miles E. by N., *true*, from St. Michael's.

The CURRENT along the COAST of PORTUGAL appears to set nearly in the direction of that coast. On the 25th of October, 1810, a gun-boat for the service of Cadiz, being in tow of the *Rebuff* gun-brig, broke adrift in a gale of wind, in lat. 39° 44′, and long. 9° 38′ W. On the 19th of November following, his Majesty's sloop of war *Columbine*, when cruising 8 or 9 miles to the westward of Cadiz Lighthouse, observed a gun-boat to leeward, which proved to be the identical boat that twenty-five days before had broken adrift from the *Rebuff*. The distance traversed by the boat was about 350 miles, or 14 miles a day, chiefly by the current, the wind in the meantime being so various as nearly to render the drift negative, or, if anything, against the set of the current.

On the currents setting toward the Bay of Biscay and the Strait of Gibraltar, Captain, afterward Admiral, *Sir Erasmus Gower* made observations in five passages to Madeira, from which he concluded the most general direction to be to the S.E., and the mean velocity about 11 miles in every 50 leagues.*

In proceeding to Tenerife, Sir Eras. Gower observed a constant current setting to the southward at the rate of a mile an hour; equal to 22 miles in the distance between Madeira and that island.

Captain Mackintosh, of the *Hindostan*, who had made twenty passages in this route, generally experienced a current from the 39th degree of latitude to that of the Canaries. In this part of the ocean he generally found, from repeated and accurate observations, that this current set to the E.S.E. He found it strongest opposite to the entrance into the Mediterranean or Strait of Gibraltar; and, in one voyage, the

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* The effect of a current setting to the south-eastward, and the necessity of a competent knowledge of currents in general, cannot any way be more forcibly shown than by noticing the melancholy catastrophe of his Majesty's ship *Apollo*, Captain J. W. T. Dixon, and the merchant ships under her convoy, on the 2nd of April, 1804. The *Apollo*, with sixty-nine ships for the West Indies, sailed from the Cove of Cork on the 26th of March. With a fair wind, blowing strong, they steered about W.S.W. until the 31st, when the wind changed more to the westward. At noon, on the 1st of April. latitude observed 40° 51′ N., longitude, by *account*, 12° 29′. At eight p.m. the wind shifted to S.W., and increased to a gale, with a heavy sea. The convoy stood to the S.S.E., and, at half-past three next morning, struck on the coast of Portugal, in about 40° 22′ N., 3 leagues to the northward of Cape Mondego. Captain Dixon, and about sixty men of the *Apollo*, perished in their endeavours to reach the shore; the other part of the crew remained two days clinging to a fixed part of the wreck, without nourishment. About forty sail of merchantmen were wrecked about the same time; some sank with all their crews, and most of them lost several men. This lamentable event has been attributed to want of chronometric observations, and the consequent ignorance of the set of the current, which must certainly have been very strong.

"The immediate cause of the loss of so many of the *Apollo's* convoy appears to have been the blind confidence with which the commanders followed their commodore; either keeping no reckoning themselves, or believing his more accurate than their own. Several ships were saved by leaving the convoy, and it is said that the commander of a Clyde ship warned the commodore of his danger in time to have avoided it."—*A. L.*

current was computed, by his chronometer, to set about 40 miles per day. This current inclines more southerly as it approaches the Canaries. It strikes on the coast of Marocco, and takes, about Cape Boiador, a different direction. Nearly in-shore, from an indefinite point, one part of the stream sets northward toward the Strait of Gibraltar, and the other part sets to the southward.

M. le Baron le Roussin, in the corvette *Bayadère*, bound from Rochefort to Brasil, in February, 1819, after passing Cape Finisterre, found the prevailing winds from noon to noon and currents as follow :—

	Latitude.	*Longitude.*	*Winds.*	*Current.*
Feb. 22	42° 43′ 38″	11° 40′ 6″	N.—W.N.W.	S.S.E. 24 miles.
23	40 3 28	13 44 17	N.—N.E.	S.S.E. 12 —
24	37 3 49	13 35 30	N.E.	S.S.E. 12 —
25	34 13 11	14 10 30	N.E.—S.E.	S.E. 6 —
26	31 9 17	15 14 40	N. and N.E.	S.10°E.12 —

But on arriving at the Canaries, with the wind N. and N.E., the current had changed.

On the course of the same vessel, from Brest toward Brasil, in October, 1821, the current had set on the last twenty-four hours (October 6), lat 40°. 24′ 36″, long. 14° 29′ 30″, S. 15° E. 20 miles; on the three following days, nearly in the same direction, but with less than half the strength. In lat. 35° 20′ 50″, long. 12° 54′ 40″, 15 miles S. E. In lat. 33° 54′, lon. 12° 48′, it had set only 6 miles S. 5° E.; but, on the next day, in 34° 18′ 24″ N., and 12° 21′ W., 25 miles S. 25° E.; and again in 34° 14′ 34″, and 12° 13′, South, 20 miles. Off the African coast, lat. 32° 56′ 20″, long. 13° 16′ 20″, it had set 32 miles to the S.W., or in a direction nearly parallel with the shore.

At about 74 leagues W. ½ S. from Cape Mondego, on the 9th of June, 1799, M. de Humboldt, in the sloop *Pizarro*, was on his voyage to the West Indies; and, on this day, in lat. 39° 50′, and long. 13° 50′, he says that they began to feel the effects of the current setting toward the Strait of Gibraltar, &c. From the parallel of 37° to that of 33° the vessel was sometimes carried, in twenty-four hours, from 18 to 26 miles to the eastward. The direction of the current was, at first, E. by S.; but nearer the strait it became due East, and it assumed a more southerly direction on the passage toward Tenerife. "Several pilots, who frequent the Canary Islands, have found themselves on the coast of Lanzarote, when they expected to make good their landing on Tenerife."

The frigates *Sta. Maria de la Cabeza* and *Lucia* sailed from Cadiz, 12th April, 1795, and on the 17th, at six a.m., they made Point Naga, in Tenerife, when they found, by a comparison with their chronometers, that the current had carried them sixty-two minutes to the eastward.

Don Vincente Tofino had, ten years before, proceeded in the *Lucia*, from Cadiz, for Mogodor; he sailed on the 27th of April, 1785, and on the 1st of May, before mid-day, arrived at the last-named port. On the 6th he sailed from it, ond on the morning of the 8th anchored again in Cadiz. On his voyage out, he found that the current, in four days, had set him 21½ miles S. 18° E., and on his return S. 49° W. 39 miles. This variation of the current shows, that the waters throughout all this extent do not always run to the S.E., but that they vary, with the line of coast, to the south-westward also.

Admiral *Don. Cosme de Churruca* sailed from Cadiz on the 15th of June, 1792, for the purpose of surveying the West Indian Islands and Spanish Main. He took his *departure* at half-past three p.m., in lat. 36° 29′ 25″, and long. 0° 6′ 40″ W. of Cadiz. In his Journal he says, "It is well known among our seamen, that in the Bight of Cadiz (that is, the coast comprehended between Cape St. Mary and Cape Trafalgar) there is a current setting constantly to the eastward; but as, near the shore, the effect of the tide must necessarily be felt, it may also modify the direction of the current. When we established our point of departure, the strength of the ebb had already begun to decrease; but as, during the early part of the night, we were unable to get any considerable distance from the shore, we consequently felt all the force of the flood tide setting to the northward; and this appears to have been the reason why we experienced a current to the N.E.; for the current which commonly sets into the Strait of Gibraltar, combined with the flood tide, ought nearly to give that N.E. direction. After our *departure*, and from midday of the 16th, we sailed with variable winds until the 21st, when the wind became fixed at N.N.E., and we found that, in the twenty-four hours, from the 21st to the 22nd, the current had set S. 42° E. 9¼ miles; though in consequence of uncertainty in the dead reckoning, and the variableness of the wind, it is possible the error was contracted without any current; the situation at midday of the 22nd being in lat. 30° 18′ 51″ N., and long. 15° 17′ West. The intention was to ascertain the position of the Salvages, which were seen the same evening, and he then makes the following reflections:—"The whole error of longitude by dead-reckoning was 34′ 6″ East; the sum of all the errors in latitude, after various compensations, was about 3′ 45″ to the North; therefore, the total error made during the voyage was 34′ 6″ to the Eastward, and 3′ 45″ to the Southward; and as if we had experienced a daily set of 4 miles S. 82° 35′ E."

H.M.S. *Pique* was once set to the S.E., 98 miles in five days, between Cape Finisterre and Madeira. H.M.S. *Raleigh*, August, 1826, found the current from off Cape St. Mary, toward the Strait, to set W. 34° S. 26 miles in the twenty-four hours.

(147.) The following observations on the currents between the *Canary and Cape Verde Islands*, have been selected from Commander Maury's "Sailing Directions," 1859, vol. ii. The experience of all the ships whose logs are there recorded, is nearly unanimous in stating the southerly and easterly drift. Of course the vibration of the Trade winds with the seasons has much to do with the southern limit of this southerly set, as will be seen below:—

Ship *Jenny Pitts*, Captain J. L. Snow, December, 27, 1853, lat. 30° 3′ N., long. 20° 0′ W., current 8 miles S. by W.; 28th, 28° 52′ N., 18° 10′ W., 6 miles S.S.W.; 30th, 25° 26′ N., 18° 26′ W., 8 miles S. by E.; January 1, 1854, 19° 51′ N., 22° 55′ W., 8 miles S. by E.; 2nd, 16° 42′ N., 21° 23′ W., 10 miles S.; 3rd, 13° 42′ N., 22° W., 8 miles S.

Ship *Margaret Mitchell*, Captain T. Jameson, January 11, 1854, lat. 30° 16′ N., long. 17° 35′ W., 22 miles E. by S.; 13th, 26° 7′ N., long. 20° 24′ W., S. 39° W. 14 miles; 14th, 24° 15′ N., 20° 11′ W., 12 miles E. by S.; 16th, 20° 18′ N., 20° 34′ W., 18 miles S. ¾ W.

Ship *Romance of the Sea* (W. W. Heury), February 18, 1855, lat. 30° 10′ N., long. 18° 10′ W., 1½ knot N.E.; 19th, 29° 20′ N., 19° 0′ W., 1½ knot N.E.; 20th, 26° 0′ N., 19° 28′ W., 1 knot E.N.E.

Ship *Gloriana*, Captain Henry Toynbee, from London to Sydney, April 22, 1855, 30° 18′ N., 19° 20′ W., 12½ miles S. 5° W.; 24th, 26° 3′ N., 21° 32′ W., 8½ miles N. 25° E.; 25th, 23° 38′ N., 22° 50′ W., 4½ miles N. 12° W.; 26th, 20° 37′ N., 24° 22′ W., 6½ miles N. 15° E.; 27th, 17° 22′ N., 26° 4′ W., 9½ miles S. 57° W.; 28th, 14° 5′ N., 26° 23′ W., 16 miles S. 60° W.; 29th, 11° 12′ N., 26° 36′ W., 30 miles S. 9° W.

Ship *Resolute* (D. McKenzie), Juno 17th, 1854, lat. 29° 54′ N., 21° 12′ W., 12 miles S. 60° E.; 19th, 26° 1′ N., 24° 2′ W., 12 miles, S. 13° E.; 21st, 21° 44′ N., 26° 22′ W., 12 miles W.S.W.

Ship *Orion* (H. Libbey), July 3, 1856, 29° 5′ N., 23° 30′ W., 12 miles S.

Ship *Panther* (N. G. Weeks), August 10, 1854, lat. 28° 9′ N., 22° 30′ W., 12 miles W.S.W.; 12th, 23° 32′ N., 25° 38′ W., 15 miles W.S.W., &c. *Note.*—The ship was at this time in the N.E. Trades, which have during the summer reached to the higher latitude.

Ship *Hurricane* (St. Very), August 22nd, 1855, lat. 30° 31′ N., 18° 0′ W., 12 miles S.W.; 23rd, 27° 11′ N., 19° 15′ W., 8 miles S. ½ W.; 24th, 23° 50′ N., 19° 25′ W., 11 miles S. by W.; 25th, 21° N., 19½° W., 6 miles S. ½ W.: 26th, 18° 4′ N., 19° 45′ W., 7 miles S. ½ W.

Barque *Mea* (B. Buxton), August 17, 1859, lat. 25° 41′ N., 21° 14′ W., 12 miles S.; 18th, 23° 16′ N., 22° 54′ W., 8 miles S.

Barque *Adler* (E. Thiel), October, 27, 1849, lat. 25° 17′ N., 23° 33′ W., 27 miles S. 31° W., two days; 30th, 18° 13′ N., 25° 49′ W., 13 miles S.W.; 31st, 15° 45′ N., 26° 35′ W., 12 miles S. W. ½ W. (trade wind).

Ship *Colorado* (Ricker), October 19th, 1855, lat. 31° 15′ N., 16° 49′ W., 12 miles S.E.; 20th, 28° 33′ N., 18° 47′ W., 24 miles S.S.E.; 21st, 26° 16′ N., 20° 11′ W., 12 miles S.W.; 24° 22′ N., 21° 15′ W., 6 miles, S.W.

(147.) Mr. James Grey Jackson, in his valuable "Account of the Empire of Marocco,"* has stated, that the coast, between the latitudes of 20 and 32 degrees North, is a desert country, interspersed with immense hills of loose sand, which are, from time to time, driven by the wind into various forms, and so impregnate the air with sand, for many miles out to sea, as to give the atmosphere an appearance of hazy weather; navigators, not aware of this circumstance, never suspect, during such appearances, that they are near land, until they discover the breakers on the coast, which is, in some parts, so extremely flat, that a person may walk a mile into the sea without being over the knees; so that ships strike when at a considerable distance from the beach; added to this, there is a current, which sets in from the West toward Africa with inconceivable force and rapidity, with which the navigator being generally unacquainted, he loses his reckoning, and, in the course of a night, perhaps, when he expects to clear the African coast, in his passage southward, he is alarmed with the appearance of shoal water; and, before he has time to recover himself, finds his ship aground on a desert shore, where neither habitation nor human being is visible. In this state his fears are soon increased by a persuasion that he must either perish in fighting a horde of wild Arabs, or submit to become their captive; for soon after a ship strikes, some wandering Arabs, strolling from their duar in the desert, perceive the masts from the sand-hills; and, without coming to the shore, repair to their horde, perhaps 30 or 40 miles off, to apprise them of the wreck, when they immediately assemble, arming themselves with daggers, guns, and cudgels. Sometimes two or three days or more elapse before they make their appearance on the coast, where they await the usual alternative of the crew either delivering themselves up, rather than perish with hunger, or throwing themselves into the sea.

(148.) But to resume the description of the currents:—M. de FLEURIEU, in his illustrations of the voyage of *Etienne Marchand*, states, that in a run which he himself made, in 1768-69, in the *Isis* frigate, from Cadiz to Tenerife, by a direct course, and with a steady breeze from N.E. to E.N.E., he had an opportunity of ascertaining the constant effect of the current, which sets to the eastward so long as a ship sails in the tract of sea situated to the westward of the Strait of Gibraltar, and at a little distance from it, during the four days employed in this run. On the first day, the current had set to the eastward 11¾′; on the second day, 12¾′; on the third, 9½′; on the fourth, 1′; when the current ceased, in lat. 31°, to be perceptible.

Therefore, during the first three days, the movement impressed on the ship to the eastward, carried her toward that side 33½′, or 37¾ miles; and, by a mean, about 8 miles in twenty-four hours.—(*Voyage de l'Isis, en* 1768 *et* 1769.)

The ship of *M. Marchand*, named the *Solide*, left Cape Spartel, bearing South, on the 29th of December, 1790, and made the Peak of Tenerife, bearing S. 6½° E. about 35 leagues distant, on the 5th of January, 1791. In this time it was found that a current had set the ship 39 miles E. 13° S., equal to a mean drift of 5·8 miles per day of twenty-four hours.

From the 5th to the 9th of January, inclusive, when the ship, on the latter day, was in lat. 21° 24′, long. 19° 26° (from Greenwich), it was found that the current had

* London, quarto, 1809. See, also, the affecting "Narrative of the Shipwreck and Captivity of M. de Brisson," in 1787; and that of Robert Adams, wrecked in the American ship *Charles*, John Horton, master, 1810. The latter is noticed more particularly, with others, in the Description of the Coasts of Africa, hereafter.

set her 50½ miles E. 13¾° S., being at a mean rate of 12⅝ miles in twenty-four hours.

Between lat. 21° 24′, long. 19° 26′ (as above), and the Isle of Mayo, during an interval of five days, the ship was carried, by the current, 35¼ miles W. 30¾° S., or at the mean ratu of 7·1 miles in twenty-four hours.

In July, 1792, the *Solide* returned to the westward and northward of the Azores; and, on the parallel of 41° 42′, at the distance of about 2° North of Corvo, she had a set in one day of 9 miles S. 29°.E. Proceeding thence toward Lisbon. she appeared to have a set, in three days, of 27 miles W. 19° S., equal to 9′ per day in that direction; but, in the following six days, from the N.E. of the Azores to Cape St. Vincent, the current set 74 miles E. 25½° S., equal to 12·3′ per day; and between Cape St. Vincent and Cape Spartel, in forty-two hours, she found an indraught of 30 miles E., equal to 17½′ per day, setting toward the Strait of Gibraltar.

AFRICA.—The ship *Montezuma*, of Liverpool, Knubley, master, sailed on the 26th of October, 1810, for Brazil, but was wrecked on the 23rd of the next month, at three a.m., on the African coast, somewhere between Capes Noon and Bejador. Among the crew, who were taken and sold by the Arabs, was Alexander Scott, an apprentice: this person was detained in the country for nearly six years; and a very interesting account of his captivity, drawn up by Dr. Traill, with geographical observations on his routes, and remarks on the currents which produced the catastrophe, by Major Rennell, were given in the fourth volume of the *Edinburgh Philosophical Journal*. As these remarks give a very clear notion of the movement of the waters, derived from observation, which have not since been contradicted or superseded, we repeat them as heretofore.

MAJOR RENNELL'S REMARKS ON THE CURRENTS BETWEEN CAPE FINISTERRE AND THE CANARY ISLANDS.

(149.) "I should consider myself highly culpable, if I neglected to state, by way of caution to navigators, the result of my inquiries respecting the currents which appear to have caused the shipwreck of the *Montezuma*, and of a great number of other ships of our own and other nations, on the western coast of Barbary; having examined a multitude of journals of ships that have sailed in that track, with timekeepers on board, and which have also, when opportunities presented themselves, had their rate checked by celestial observations.

"The general result is, that navigators, who depart from the parallel of the southern part of the Bay of Bengal (or say 45°), and sail in the usual track southward, will be assailed first by a *S.E.* current, and then by an *easterly* one, until they have passed the parallel of Cape Finisterre; when the current will again turn to the *South* of *East*, and gradually become a S.E. current, till, having passed Cape St. Vincent, it becomes easterly again; owing, no doubt, to the indraught of the Strait of Gibraltar; and this easterly current is pretty general across the mouth of the bay, between Cape St. Vincent and Cape Cantin.

"Beyond this bay (which may be termed the *funnel*, of which the strait itself is the *spout*) the current again becomes S.E., or rather more southerly (as it is more easterly toward Cape Finisterre), and continues as far as the parallel of 25°, and is, moreover, felt beyond Madeira westward; that is, at least 130 leagues from the coast of Africa; beyond which a S.W. current takes place, owing, doubtless, to the operation of the N.E. trade-wind.

"The rate of motion of this current varies very considerably at different times; that is, from 12 to 20 or more miles in twenty-four hours. I consider 16 as rather below the mean rate. I have one example of 140 miles in eight days, in one of his Majesty's ships, equal to 17½ miles per day; and, in another, of only 12. And in a very well kept East India ship's journal, 170 in nine days to Madeira, or 19 per day. The direction of the stream likewise varies, but commonly more toward the *South* than the East, after passing the mouth of the strait.

"Near the coasts of Spain and Portugal, commonly called the Wall, the current is always very much southerly, owing, perhaps, to the falling in, obliquely on the shore, of the great mass of water brought by the S.E. current; which can run off only to the South, and round Cape St. Vincent toward the strait's mouth. And among the Canary Islands, and between them and the coast of Barbary, the currents are less regular.

"It may be taken for granted that the whole surface of that part of the Atlantic Ocean, from the parallel of 40° to 45°, at least, and to 100 to 130 leagues off shore, is in motion toward the mouth of the Strait of Gibraltar.

"According to what has been said, in the course of the above remarks, it must be expected that a ship sailing in the usual track to Madeira or the Canaries will be carried to the *south-eastward*, at the rate of 13 miles per day, that is, even if she has a fair wind, she will be carried by the current 150 or 160 miles to the south-eastward, in the course of her voyage to Madeira or the Canaries; and, consequently, on a *S.E. by S.* course will be carried 80 or 90 to the eastward of her intended port. If we suppose a *S.E.* course, the error in easting will be no less than 109; which distance, if they are bound to Tenerife, would carry them to Allegranza or Forteventura; and, if intending to make Allegranza, would place them on shore on the coast of Barbary. The French and Spaniards report that their ships have often made Allegranza when they supposed themselves on the line toward Tenerife. It must be added that, if a ship had a long passage, the error would be greater in proportion. and might possibly amount to 200 miles of easting.

"It would seem advisable, therefore, that every ship going to the Canaries, or intending to sail between those islands and the main land of Africa, and being without timekeepers, as that class of merchant ships commonly are, should, to every day's reckoning, *add ten miles of easting.* This would, in the first instance, prevent them from *deceiving themselves* as they went forward; in like manner, as it is better to set a clock forward at once, than to charge one's memory continually with its being too slow. *Ten miles* do not seem too much as a cautionary measure, as a ship has very lately been carried 99 miles to the *East* in eight days in that track. What would not have been the error had she had even a moderately long passage?

"It is this current which has furnished the roving Arabs of the Desert with their victims from every nation, and the good Mr. Willshire* with objects of benevolence." —27th February, 1819.

The *Eliza*, commanded by John Searchwell, sailed from Cork for Rio Janeiro, with settlers, on the 12th of August, 1827, and ran ashore on the coast of Africa, during a fog, on the 25th of the same month. Whilst making signals of distress, three fishing-boats from Canary came to her assistance, and succeeded in saving all the lives on board, consisting of 18 mariners, 244 men, 46 women, and 42 children; in all, 350 persons, who arrived at Canary on the 3rd of September.

About the end of October, in the same year, the *Olymphe*, from Havre for Buenos Ayres, with colonists, was cast away on the same part of the African coast. The passengers, about 300 in number, consisting of French, English, Germans, and Swiss, were taken from the shore, saved from captivity by Canarian fishing-boats, and conveyed to the Grand Canary, where they were landed on the 7th of November. Such have been, even within a few years, the effects of the current!

The preceding description of the currents between the English Channel and Canary Islands was corroborated, in 1826, by Captain R. H. Newby, in the *Napoleon* schooner, which left Dartmouth on the 21st of July, and was set to the eastward of reckoning, while crossing the Bay of Biscay, 1° 21′ of longitude in forty-eight hours. On Monday, the 25th of the same month, the entrance of Ribadeo bore S.W. by compass, about 15 miles, and the vessel was then in about 6° 55′ West.

The effect of the easterly current was proved by the bearings of a remarkable mountainous island. and some whitish cliffs on the shore; and Captain Newby says, the schooner was setting to the eastward as fast as I have noticed a ship to lose ground

* William Willshire, Esq., the English Consul at Mogodor, to whose active goodness Scott and many others owed their deliverance from slavery.—Ed.

to the eastward while standing in-shore off Beachey Head during a strong flood tide and moderate westerly breeze. At about five p.m. the wind veered to the N.E., and even then, although the vessel was going at the rate of 3½ knots through the water, she made very little way to the westward till toward sun-down, when the breeze freshened to 7 or 8 knots.

During the night, passed Cape Ortegal; and the next morning, at six a.m., the light-tower at the entrance of Corunna bore South.

It did not appear that the current relaxed in strength between the time of observing the inland objects, and that when the wind freshened. Mr. N. adds, that is the third time he has experienced its effect, without ever perceiving it to set at all to the westward. The last time previous was on the 9th and 10th of September, 1835.

At three p.m., July 27th, 1836, Cape Finisterre bore E.S.E. by compass [*true East*], distant about 12 miles. A fresh breeze from E.N.E. prevailed up to the following noon, when the current had set to the southward about 14 miles, as frequently found on the Portuguese coast at this season of the year.

July 28 to August 1, inclusive, variable weather and north-easterly winds to lat. 29° 15′, long. by account, 19° 52′ W. On the 1st of August it was found that the schooner had missed Madeira in her attempt to make and pass the West end of that island, and at one p.m. the dark, bold, northern end of Palma came in sight from under a dispersing cloud, and bearing by compass about W.S.W., distant 7 leagues.

Upon going over the last two days' work, it appeared that, instead of passing, as supposed, to the westward of Madeira, the *Napoleon* was actually without a sight of the island to the *eastward*, and had the vessel been involved in fog, or have been bound to Lanzarote or Forteventura, and steering, by reckoning, a fair course for them, the consequence must have been that she would have fallen into broken water when least least expected, or have grounded on the main shore, somewhat between Cape Ghir and Cape Noon, and property, if not life, would have been lost. It is, moreover, to be observed, that the sea had been, for the most part, comparatively smooth; had there been a strong N.W. swell, such as is commonly felt toward the mouth of the Strait of Gibraltar, then the vessel must have been set farther to the eastward of her reckoning.

After making the North end of Palma, the breeze continuing rather light at N.E., the vessel hauled on a W.N.W. course, in order to get the westward of the island, and so as to avoid the risk of getting into the calms or eddy winds to leeward of it; but up to sunset she made very slow progress westward; the swell was short and cross from the northward, and there appeared to be a strong current from the N.W. toward the island, and the captain found it necessary to steer N.W., but still the vessel was found to be approaching the North side of the island. At nine p.m. he began to be alarmed at his proximity to land; braced up the yards and trimmed sails by the wind, but the breeze died away so light, and the swell kept up so cross, that at ten it was thought the vessel must be driven upon the island, unless a spot could be found for the anchor to take hold of; but, in about half an hour after, it was found that they had gained a different stream of current, and the vessel was visibly set from a S.S.E. to a S.W., or to the westward of a S.W., direction; and after passing a headland which appeared in the night to be the N.W. part of the island, and sloping toward the sea, the breeze again freshened, and the vessel increased her distance from the black and inaccessible-looking shore of Palm.

Captain FitzRoy, in H.M.S. *Beagle*, January 15, 1842, says:—"In consequence of a thick haze, very prevalent about the Cape Verde Islands, land was not distinctly seen until we were within three miles of it, and we then found ourselves rather too far westward, owing to a current setting toward the West, at the rate two knots an hour; this was close to the North point of St. Iago. Next day we anchored in Port Praya."

(150.)—The Baron Roussin's Remarks on the Currents between Cape Bojador and the Isles de Los.

The general currents on the African coast, between Cape Bojador and the Isles de Los, with the exception of some places subject to a more or less regular tide, are uniform during the eight months which comprise the fine season. They follow exactly the trend of the coast from North to South.

From Cape Bojador to the Bay of St. Cyprian (lat 22° 20′) they therefore set to the S.S.W., from that bay to Cape Blanco; and along the whole extent of the Bank of Arguin to its western point, which is in the parallel of 20° 6′ 20″ N., they set S. by W. To the southward of this point the waters, being no longer guided by the edge of the bank, which turns abruptly to the S.E., do not follow in a body, within a certain space, any fixed or determined direction. One part of their mass experiences a number of irregular windings, until, finding itself in the active body of the general current, which left the bank at its most salient point, it rejoins it, and is carried on as before.

In the vicinity of Tanit Bay, in the parallel of 19° 10′ N., it again resumes its former direction, and follows the trend of the coast, thus setting to the southward as far as the two Palms, near Portandik, and from thence S.S.W. to the Marigot of Musquitoes. It then sets S. ¼ W., till abreast of the Bar of the Senegal, where, in a space of 4 leagues in circumference, it is disturbed by the stream of that river. This stream is so strong as to oblige vessels at the anchorage off the bar to tend to it, in spite of the strongest winds. The current, joined by the waters of the Senegal, pursues its course along the coast, which trends to the S.W., observing a very gentle curve, which forms the Bay of Yof, and which terminates at Cape Verde. The strong currents hitherto pretended to set into the Bay of Yof are, therefore, merely chimerical, and the depth given to this bay in all the charts is no less so. Cape Verde being the most western point of Africa, and hence forming an obstruction to the general direction of the waters which flow along that coast, must occasion a great variety of currents in its vicinity. It is, in fact, what takes place, and it would, therefore, be difficult to define a particular one. This only appears certain: vessels passing in sight of Cape Verde are not carried on it, as is generally supposed; but, on the contrary, they are swept off by the prevailing tendency which the waters have to flow to seaward. In running close to the Almadie Rocks, this repulsion is sensibly felt during the eight months which I have mentioned: it appears that the current rushes between the rocks, and spreads itself in different directions.

Immediately to the southward of Cape Verde the current is almost imperceptible, and it is scarcely possible to assign any particular direction to it as far as Cape Naze. The whole of the coast lying between this cape and Cape Manual forms a well-defined bay, totally free from current, and in which there is not a single river. The same is observed with respect to the roadstead of Goree, although, according to the observations of Mr. Adanson, a regular tide exists there, with a rise and fall of 2 feet 6 inches. In the offing of Cape Verde the current has been always found to set to the southward. From Cape Naze it again follows the direction of the coast, interrupted only at the mouths of the principal rivers, which lie between this cape and Cape Roxo. From this point, localities of a very different nature produce particular effects in the current. The Archipelago of the Bissagos here succeeds the straight coast which extends to the northward. Large rivers empty themselves amongst these islands, forming various channels, more or less encumbered with sand-banks. These obstacles cause a variety of currents, which will be explained when treating on the Bissagos.

Strength of the General Current.—The rate of the general current on the African coast, deduced from numerous observations, has never exceeded a mile and five-tenths per hour on the coast itself, and on the outer edge of the banks; and more frequently it has been found from seven to nine-tenths of a mile. This is diminished one-third, and frequently one-half, at a distance of 4 leagues from the coast. Should a vessel have run past her port, there is no fear of her stemming this current, and, by long boards, easily regaining her destination.

In the rainy season, which is from the commencement of June to the end of October, as the winds blow from various directions, the currents are no longer regular, and it is impossible to establish any positive law respecting them; but, even under these circumstances, their strength is not so great, but that it may be surmounted.

3.—THE AFRICAN OR GUINEA CURRENT:

BEING AN EASTERLY STREAM ACROSS THE ATLANTIC, AND ALONG THE COAST OF AFRICA, INTO THE BIGHTS OF BENIN AND BIAFRA.

(151.) In the description of the winds (6,) p. 179, and (49, 50.) p. 201, it is shown that between the N.E. and S.E. trade-winds there is a belt of calms and variable winds, which on the African coast assume the character of monsoons, as during the summer months especially the wind blows more or less toward the African coast.

In the currents there appears to be an analogous system, as there is an easterly current flowing with considerable velocity eastward, in an opposite direction to the great equatorial drifts on either side of it. Its existence and character along the Guinea coast has been long known, hence the name applied to it; but the origin of the current does not appear to have been well understood hitherto. It has been supposed that it is a continuation of that current which we have just described as passing southward from Western Europe.

(152.) But in tracing the currents of the Pacific Ocean,* we find that there exists a precisely similar current in that great ocean setting into the Bay of Panama, in the same latitude. This current is traced very far to the westward—in fact, nearly across the ocean.

In a similar way it can be shown that this Guinea current, instead of being limited westward by the Canary Islands, has its origin, or a portion of it, nearly over on the coast of South America. This is almost certain as regards the summer and autumn months, as this *easterly* drift is almost always encountered between latitudes 4° and 8° N. over the whole breadth of the Atlantic.

This, therefore, is the origin of the main body of the Guinea current, which is doubtless increased by the southerly current before alluded to, and which in itself is but a continuation of the easterly drift from the gulf stream.

We are not yet quite in a position to speculate on the cause of this seeming anomaly, because the current is strong and persistent, not weak and variable as the winds which blow over it. As we as yet know very little of those subsurface actions which must play a very important part in the great circulation of ocean waters; it must be reserved for more extended experiment to enable us to pronounce absolutely on its real character.

(153.) Commencing with the ordinary westernmost part traversed by vessels crossing the equator, we select from Commander Maury's Sailing Directions the following facts:—

(154.) Capt. H. T. Walter, barque *Phantom*, says:—In July, 1853, between lat. 5° and 8° N., and about long. 36° and 38° W., the current set us fast to the eastward. Again, in August, 1854, about the same latitude and longitude, the current set is 110 miles N.N.E. in three days. Capt. Millet writes:—Dec. 25, 1855, lat. 4° N., long. 29° W., have experienced an easterly current these last two days. I have always noticed such along these latitudes, sometimes more to the northward than this, and in lat 1° N., and long. 44°.

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* See Pacific Directory, by A. G. Findlay, Part II., p. 1243—1247.

We have here examples at opposite seasons of this current in the western crossing of the Atlantic.

Ship *James Brown* (Capt. C. W. Kerlin), Jan. 12, 1856, lat. 8° 43′ N., long. 31° 37′ W.: current 20 miles East. 13th, lat. 5° 30′ N., long. 30° 21′ W.: 28 miles East. Crossed the equator on the 16th, and experienced north-westerly current.

Ship *Margaret Mitchell*, Jan. 23, 1854, lat. 4° 36′ N., long. 22° 25′ W.: 13 miles E. by S. 24th: lat. 3° 1′ N., long 22° 30′ W., S. by E. 20 miles.

Ship *Gravina* (C. Sprague), March 4, 1855, lat. 2° 48′ N., long. 26° 46′ W., S. 34° East, 17 miles. 6th: lat. 1° 22′ N., long. 27° 43′ W., 12 miles N. by E.

Barque *Eglantine* (Gleason), April 7, 1855, lat. 11° 28′ N., long. 24° 25′ W.: current setting to eastward, though the ship was steering S. by W. ½ W.

Ship *Mary L. Sutton* (P. E. Rowland), April 24, 1856, lat. 16° 4′ N., long. 33° 30′ W.: current E. 45 miles. 25th, lat. 12° 40′ N., long. 32° 32′ W.: East 10 miles. 26th, lat., 9° 22′ N., long. 31° 20′ W.: East 10 miles. (This is more to the northward than usual.)

Ship *Aetos* (D. McLaughlin), May 18, 1856, lat. 5° 43′ N., long. 24° 44′ W.: 24 miles E. by N. 19th, lat. 3° 39′ N., long. 24° 44′ W.: 14 miles E.N.E. 20th, lat. 2° 56′ N., long. 24° 0′ W.: 15 miles E.N.E. 21st, lat. 2° 16′ N., long. 23° 34′ W.: 15 miles E.N.E. 22nd, lat. 1° 20′ N., long. 25° 15′ W.: 10 miles N.E.

Ship *Edwin Flye* (W. Flye), June 27, 1856, lat. 5° 38′ N., long. 26° 17′ W.: N. 8° E., rate 1·2 miles per hour. 28th, lat. 4° 5′ N., long. 27° 29′ W.: N. 18° E., 1 mile per hour. 29th, lat. 3° 52′ N., long. 25° 12′ W.: N. 22° E., rate 1·3 mile per hour.

Ship *Panther* (N. G. Weeks), Aug. 19th, 1854, lat. 7° 57′ N., long 25° 54′ W.: 24 miles E. by S. 20th, lat 6° 55′ N., long. 23° 28′ W.: N.E. ¾ E., 48 miles. 21st, lat. 5° 41′ N., long. 20° 30′ W., 48 miles N.E. by E. ¾ E. 22nd, lat. 4° 56′ N., long. 18° 7′ W.: E. by N., 1·2 miles per hour. 23rd, lat. 2° 41′ N., long. 20° 4′ W.: 1 mile per hour S.E. by S.

Barque *Mea* (B. Buxton), August 27, 1849, lat. 5° 57′ N., long. 19° 32′ W.: ½ knot N.E. 28th, lat. 4° 12′ N., long. 17° 33′ W.: ½ knot N.E. 29th, lat. 4° 0′ N., long. 19° 47′ W.: 6 miles E.N.E.

Brig *Director*, Capt. Skinner writes:—"You perceive that I had a strong current between lat 7° and 5° N. on Sept. 7—10. Not getting an observation for 4 days, I found the brig nearly 3° further East than I expected; whether I had it in one, two, three, or the fourth day, I cannot say, but suppose I had some each day. I was speaking with several captains, and they say that they have always found a strong current about them going to the eastward."

Capt. Maury adds—"An eastwardly current is often found north of the line in summer and fall; and at those seasons it may be counted on with some degree of certainty." (This refers to the western crossing of the equator recommended by Capt, Maury.)

Ship *Flying Dutchman* (A. Hubbard), Oct. 12, 1854, lat 8° 55′ N., long. 40° 52′ W.—"I notice for the last two days (from lat. 11° 28′) the lines of agitated waters, previously noticed, appear all to run nearly E.N.E. and W.S.W., and follow each other at regular intervals of some four or five miles; the motion of the waves running at right angles to the line of rip. Oct. 14, lat. 6° 46′ N., long. 39° 4′ W.: current East, 1 knot. 15th, lat. 6° 50′ N., long. 37° 26′ W.: current East 1¼ knots. One year ago last July I experienced a similar current in the same latitude, but some 10° further East. Oct. 16th, lat. 6° 49′ N., long. 36 25′ W.: current East 1¼ knots. 17th, lat. 6° 29 N., long. 35° 18′ W.: current S. 79° E., 2 knots. 18th, lat. 5° 59′ N., long. 35° 19′ W.: current east, northing 1½ knots. 19th, lat. 5° 43′ N., long. 33° 33′ W.: current east, southerly 1½ knots, slight current rips. Oct. 20, no current. All these days generally calm, or light variable airs."

Ship *Raven* (J. Crocking), Oct. 27, 1855, lat. 6° 18′ N., long. 26° 50′ W.: current N.E. 1 mile. 28th, lat. 5° 24′ N., long. 29° 50′ W.: current N.E. 1 mile. 29th, lat.

5° 10′ N., long. 30° 0′ W.: current N.E. 2 miles. 30th, lat. 4° 40′ N., long. 30° 0′ W.: N.E. 2 miles.

Ship *Robert Patten* (G. S. Paine), Oct. 30, 1856, lat. 10° 14′ N., long. 33° 50′ W.: "tremendous tide rips, the strongest I ever saw." Oct. 31, lat. 8° 26′ N., long. 32° 28′ W.: current changes to eastward $\frac{1}{2}$ knot per hour.

Ship *Scargo* (N. Crowell), Oct. 4, 1856, lat. 6° 53′ N., long. 25° 13′ W.: 24 miles East. 5th, lat. 6° 25′ N., long. 24° 42′ W.: 18 miles E. by S. 6th, lat. 5° 36′ N., long. 24° W.: 18 miles E. by S. 7th, lat. 4° 48′ N., long. 23° 29′ W: 18 miles E. by S.

Schooner *Thomas A. Ward* (J. D. Hoff), Oct. 12, 1855, lat. 6° 5′ N., long. 27° 40′ W.: the last twenty-four hours have been the most calm that ever I saw, not a breath from any quarter, and a terrible rolling sea. We drifted S.E. 35 miles.

Ship *Colorado* (Ricker), Nov. 1, 1855, lat 5° 51′ N., long. 21° 54′ W: current 20 miles S.E. 2nd, lat. 5° 22′ N., long. 20° 55′ W.: 29 miles S.E.

Barque *Clara* (E. Cook, jun.), Dec. 9, 1854, lat 6° 48′ F., long. 26° 56′ W.: 1·3 knots per hour N 35° E. 10th, lat. 6° 9′ N., long. 27° 57′ W.: 1 knot N. 62° E. 11th, lat. 6° 10′ N., long. 26° 46′ W.: 0·8 knot N. 37° E.

The foregoing are the principal notices of this easterly current as recorded in Capt. Maury's Sailing Directions, vol. ii., eighth edition, and, in fact, is nearly all that is mentioned on currents, as but very few, if any, of the abstract logs quoted in that work mentioned any westerly or other currents, the only exception being that in some very few cases a northerly set is noticed. Besides this, there is frequent mention of current or tide rips, often of a very formidable character, denoting great activity and change in the currents of this troublesome region.

(155.) The easterly current thus passing across the Atlantic strikes the coast of Africa about Sierra Leone and the coast of Liberia. Of course, when near the shore, it assumes its direction to the S.E., and runs with great velocity. As is shown by the Chart of the Currents at page 259, its mean annual velocity is between 14·1 miles and 26·5 miles per day, strongest in the summer months.

Its mean direction off Cape Palmas and Cape Coast Castle is E. 12° N., and its calculated velocity from Major Rennell's and Maury's observations is—for January, 17·4 miles to 27·6 miles; February, 26 miles to 32 miles; April, 11·5 to 33.7 miles; May, 22·7 miles to 36 miles; June, 30 miles; July, 18·2 miles; August, 15·7 miles to 26·4 miles per day. These are from the records of 75 observations.

(156.) Its southern edge appears to be in about $2\frac{1}{4}$° to 2° N. up to the head of Bight, and as the southern streams set in an opposite direction, they are serviceable in making a return passage as presently explained.

The temperature of the Guinea current is high, and demonstrates its equatorial origin, although the branch of it which comes from the northward past Cape Verde has probably a lower temperature as coming from a higher latitude. The equatorial current to the southward of the Guinea current is also of a lower temperature, coming direct along the African coast from the southern polar regions. The mean summer temperature is about 78°, but in our winter and autumn months it is higher, being from 82·6° to 83° as a mean, and sometimes it is found higher than this.

(157.) At the distance of about 59 leagues South of Cape Palmas (long. $7\frac{3}{4}$° W.) the outer border of the Guinea current sets to the East; and the same direction of it continues to a similar distance South of Cape Three Points (long. 2° W.); we thence, at 2° North of the Line, find it take a more northerly course, toward the Bight of Benin and the Bight of Biafra; in the latter it mixes with the waters of the *South African Current*, which, coming from the South, set thence to the North and N.W., and both, uniting, form a head in the bight. From this bight and southward of the Equator the currents thus blended set to the S.W., W.N.W., and NW., in one expanding and united stream, which greatly facilitates the passage of ships from Fernando Po to Sierra Leone.

The prevalence of the Harmattan wind, which has been described (p. 203), must interrupt the course of this current; but its existence. at other times, nearly as described, has long been confirmed, and is incontestable.

(158.) Near CAPE MOUNT the current sets in toward the shore as above stated. The ship *Charles*, a French whaler, in 1833, was wrecked on the coast of Liberia, at about 30 leagues to the S.E. of Cape Mesurado, probably on the reefs near the River Sestros. This vessel had left the port of Havre for the fishery near *Tristan da Cunha*, in the Southern Ocean, but the captain, while intending to run along the coast beyond Cape Palmas, in the hope of falling in with whales, unfortunately lost his reckoning, by being deprived, for forty-eight hours, of all means of taking observations: and was moving at the estimated rate of 7 miles an hour, when he found himself close on shore in the midst of breakers, which in the course of the night forced him on the reef and dashed the ship to pieces. The captain and crew got safe to land, but were soon stripped by the blacks, and the captain himself left without covering. In this condition they made their way along the shore to the N.W., until they reached Cape Mesurado, where they were received with all kindness by the colonial agent of Liberia, who sent them in a small government schooner to the Isle Goree. The catastrophe is evidently attributable to this easterly current.

On the western side of *Cape Palmas* it sets along shore with such force to the S.E., that ships which do not steer a point nearer than the true course will be carried from the land. About *Cape Three Points*, likewise, the stream runs strongly to the eastward, and frequently sets directly in upon the reefs about that cape. Eastward of this cape the current has carried many experienced mariners, bound to Cape Coast or Annamaboe, to leeward of those ports, and occasioned much trouble, with delay, in beating up again. About *Terra Formosa*, in July and August, the current has also been found to set strongly to the eastward.

(159.) The *Equatorial Current*, which sets from the Bight of Biafra, and then westerly to the southward of the Line, has been illustrated, as already explained, in our "Directory for the Ethiopic Ocean," by Mr. Jas. Finlaison. That gentleman has shown how, by taking advantage of it, ships may effect, without difficulty, a passage from the bight to Sierra Leone, His instructions are as follow:—

"*Ships bound from the Bight of Biafra to Sierra Leone*, if from Calabar River, when the wind does not permit them to proceed by the N.W. of Fernando Po, may pass between that island and Camaroens River, when they will find a strong current setting to the southward, out of the River Del Rey. After they have advanced to the southward of Fernando Po, they must endeavour to make all the southing and westing they can; passing either to the eastward or northward of Prince's Island, as winds will permit. On the East side of this island the current sets strongly to the southward, at the rate of a knot and a half; westward of Prince's Island, it generally sets strongly to the N.E. at the same rate.*

"Having arrived to the southward of Prince's Island, if the ship will lie no higher than W.N.W., tack immediately, and try to cross the Line; for by so doing you will keep out of the strong N.E. current that sets toward the Bights of Benin and Biafra. After you have crossed the Line, you will find that you are nearly out of the easterly current. In the parallel of 1° South you will find the current set to the westward, at the rate of one mile an hour. *In the month of May or June*, when the sun has a high declination, the trade-wind is far to the southward, and you will not gain the regular breeze nearer than in 3° South. This breeze commences from S. by W. As you make

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* In the last edition of the *Derrotero de las Antillas* the following remarks are said to have been found among the papers of the deceased Admiral Don Josef Varela. "At Prince's Island, and in its vicinity, the waters generally run to the *North*, which circumstance ought to be kept in mind in making the Island and steering for the anchorage. There are also currents to the *South*, but they are not so strong, or of so long duration. The pilots of the place say that the currents depend on the phases of the moon, but we found that they were irregular." From this we may infer that there is some irregularity in the outset or revolving current; for which, consequently, every precaution should be taken.

westing, the wind will be found to haul more to the southward and eastward, and the current increases to the rate of $1\frac{1}{2}$ knots in an hour, until you arrive as far to the westward as 15° West. On proceeding hence to Sierra Leone, come no farther to the eastward than 15° West, until you are as far to the northward as 8° 30′ N.; then you may steer boldly in for the cape. You will strike soundings in that parallel in 14° 40′ W.; and as you approach the cape the soundings will be found very irregular, from 20 fathoms to 12 at a cast. You will then be 7 leagues from the cape, and in the fair track of the river.

"Having given these directions to our prize-master, they generally made the passage from Fernando Po and Bonny in five weeks; merchant vessels have frequently been three months, by keeping in shore."

(160.) In his investigation of the Guinea Current, *Major Rennell* says: "I have now brought you to the Cape Verde Islands, by what is called the *Outer Passage*, and which is to be preferred, at all seasons, for ships bound to the southward; because, even when the S.W. monsoon prevails,* between lat. 15° and the Equator, and you are compelled to go to the eastward (between June and September, you will be farther to windward, and will have a more steady wind, and favourable current to the S.E., than near the coast of Sierra Leone, &c. But if you are bound to Sierra Leone you will of course keep a southerly course from the Canary Islands (Palma and Ferro), and you will find a favourable current the whole way to that place.

Although yon will, at this season, carry a fair wind with you to Sierra Leone, yet it may be proper to inform you that, within the space, lengthwise, between Cape Verde and Cape Mesurado, and in certain places to the extent of 70 leagues off shore (50 off Sierra Leone), a regular change of winds and currents takes places, according to the seasons; that is to say, a N.E. or North wind and S.E. current from September to June; and, in the rest of the year, S.W. wind and N.E. or northerly currents, in effect, a *monsoon;* and this extends, in respect of the winds, nearly through the whole space between the two continents.

The current in the offing, in the parallels South of *Cape Roxo*, $12\frac{1}{4}$° N., continues its course, gradually bending more and more to the south-eastward, till about the latitude of 5° N. it turns decisively to the East; and running with considerable rapidity, sometimes at the rate of 2 knots, it ranges along the whole coast of Guinea until it is partly dissipated in the Bight of Benin, &c. The *Guinea Current* may be taken at 60 leagues in breadth; its greatest rapidity is during the season of S.W. winds in the sea lying West of Sierra Leone and South of the Cape Verde Islands.

(161.) Bottles.—We have not many bottle experiments on this current. One is curious. A bottle from the ship *Kinnear* (Captain Kelsall), thrown over May 15th, 1843, in lat. 6° 1′ N., long. 24° 5′ W., was picked up near the River Nunez on the 58th July, following; the direct distance is 650 miles, which in 74 days shows a daily rate of 9 miles. Another bottle from the same ship thrown over a week before 127 miles due north (lat. 8° 8′ N.), was picked up 86 days afterwards on August 12, 1843, at Paraiba, on the Braziliar coast, the direct distance would give it a daily rate of above 14 miles per day, but as it went probably to westward and thence southward its rate was greater. These two bottles show the limits of the Equator and Guinea Currents.

A bottle from the *Windermere*, thrown over in lat. 4° 6′ N., long. 20° 0′ W., on August 20, 1850, was picked up at Lahou, on the Ivory coast, on March 6, 1851. A direct course would make its rate 4·5 miles per day, but as it was probably carried by the Equatorial Current till caught in the Guinea Current, we cannot argue much, except that it is an evidence of the direction of the Guinea Current.

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* The term Monsoon, or rather *Mousoon*, among the native mariners in the Indian Ocean, is said to mean nothing more than *season;* that is, the vicissitudes or changes of season.

By a *partial monsoon* is meant a periodical wind, or stream of air, which does not extend all the way across the sea, as on the coats of Brazil, Africa, &c.

A bottle from the brig *Freeland*, Captain T. Midgley, of Liverpool, in lat. 1° 13′ S., and long. 4° 11′ W., 31st July, 1835, picked up in the surf at Grand Cestros, lat. 4° 39′ N., long. 8° 6′ W., on the 15th of November following; and forwarded to England by Captain Penrice, of the brig *Meg Merrilies*, belonging to the same owner. This was probably carried on a circuitous route to the westward by the stream South of the Line; and thence to the North and N.E. by the in-shore current.

4.—THE SARGASSO SEA.

(162.) The central portion of the Atlantic, that is comprised between the Trade wind and Anti-trade wind systems (19), p. 184, also bounded on the south by the westerly drifts of the Trade winds, and to the north by the easterly current, presently described, appears to be a different physical condition to the other portions of the Atlantic Ocean, and indeed from any other portion of the globe.

Its apparently chief characteristic is well expressed by the name now usually applied to it—the *Sargasso*, or *Weedy Sea*. The well-known gulf-weed, which is found more or less over its whole area, seems to be quite peculiar to it. There may be a somewhat analagous physical condition in the North Pacific, but this is not so easily defined. This gulf-weed is constantly found, in greater or less quantity, scattered over its whole area, and when it is found on places not its usual habitat, it may be safely inferred that it has drifted out of this extensive area by the action of the current.

(163.) It is very difficult to define the limits within which this gulf-weed is found. It is more than probable that the fluctuations of the season, greatly affects them as it does the limits of the Trade winds and intervening calms, the more particularly as it is to the varying currents caused by these winds that the weed is retained in its locality. Consequently we may look for its N. and S. boundaries more to the southward during the northern winter months, and the reverse during the summer. The tropic, or about the parallel of 23° N., may be its southern edge in the longitude of the Azores, from whence this limit extends to the Virgin Islands and the Bahamas. Its northern edge runs from the Azores to the outer edge of the Gulf Stream off Cape Hatteras. It is not so abundant to the westward of the meridian of the Azores. This will give a breadth of 1,000 miles in its eastern part, and a length of 3,000 miles from E. to W. As before stated, its limits may change greatly at different times, but it may always be looked for within this area, that is, between the southern edge of the Gulf Stream and the northern limit of the Equatorial Current.

(164.) There has been much speculation as to the causes and conditions which have made and retained this peculiar area in its integrity.

Major Rennell says:—"It has been observed that the waters of the Atlantic have a greater tendency toward the middle of the ocean than otherwise, and this seems to indicate a reduced level, forming a kind of hollow space or depressed surface. It is certain that the setting of the currents is such as might be expected to take place if such a hollow existed; for the currents do really set into the Sargasso Sea from the North and from the South; whilst in the middle part, although within the region of the Trade wind, the currents are not regular, but indicate a kind of vortex.*

By others it is considered as an immense eddy or whirlpool, formed by the inclination of the water to the westward, caused by the influence of the Trade winds and the Gulf Stream.

Others, again, argue that it is a raised surface, maintained in a quiescent condition by the surrounding currents, and retaining all that is poured into it by the surrounding influences.

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* Rennell's "Investigation," p. 72.

It is also considered as the grand receptacle of the Gulf Stream, which receiving at the Azores, here turns into this space all that it has transported through its long course.

All these theories have some facts to bear them up in some degree, but others can be adduced to show their futility.

(165.) It is here urged that a simple explanation can be given of this curious region, in the analagous condition of the atmosphere, so powerful an agent in the production or alteration of ocean drifts and currents.

By referring to Maury's Trade Wind Charts, cited on page 186 (26.), it will be seen that there is an uncertainty about meeting with the northern edge of the N.E. trade winds through an extent of at least 10° of latitude; add to this the vibration of this zone of trade winds consequent on the motion of the sun in the Ecliptic, which amounts to from 5° to 8° in latitude, as exemplified in the diagram of the limits of the trade winds at page 185, we have a range of 15° to 18° of latitude over which, during some portion of the year, and over a large section of it throughout the year, that there is nothing but light airs and variable winds, being, in fact, the "horse latitudes," *see* pages 206–7 (58 to 61.).

Under this zone, therefore, the sea is subject to no continued or regular drift, and consequently whatever is thrown on to its surface will remain for a long time, and the Sargasso, or gulf-weed being one of the few marine plants which lives when broken from its rocky bed, it may exist here for a very long period, and thus accumulate by the fresh additions constantly making by the outer or eastern edge of the Gulf Stream, as well as that drifted around the northern part of the Atlantic, and passing by the S.E. Current by the Azores (144.) into this quiescent zone. That the Gulf Stream is the primary feeder to this weedy sea will be shown presently.

(166.) There is another condition also which favours the maintenance and growth of this peculiar plant. The temperature of this water is very equable, less warm than that under the more vertical sun, and not varying more than 6° or 7° Fahr. throughout the year in the eastern part, or 8° or 9° in the western part. This temperature is, as said, lower than that of the southern part of the great equatorial streams to the south of it, but it is higher than that of the current, which sets S.E. and S. between the Azores and Spain, and lower than that of the surface of the Gulf of Mexico and the early course of the Gulf Stream. It may, therefore, be considered that it approximates to the water-climate of the bottom of the Gulf of Mexico, that of the sea around the Bahamas, &c., where it is known that this weed grows naturally.

(167.) The *Sargasso, or gulf-weed*, which is its peculiar characteristic, is one of the few plants, aquatic or terrestrial, which will live and flourish when separated from its native stem. Its appearance is too well known to require any detail. The sea was called *Sargaçao* by the early Portuguese navigators, from the weed bearing berries like grapes, "sarga." This term has thus been corrupted into *Sargasso*, and been applied to the plant itself instead of the place it grows on. There are more than one species of it known to botanists, as *sargassum vulgare*, &c. It is frequently called *fucus natans*—floating sea-weed; and is known to sailors as *gulf-weed*, that famous stream being always more or less marked with it.

The old story of Columbus, who had much difficulty with his men, when they declared that even the sea changed its nature into terrestrial to prevent his proceeding on his discovery voyage to America, has been oft repeated.

The sea is commonly studded over, like an inundated meadow, with the bushes, which are in some places very abundant, and in others more dispersed. "If we could imagine the surface of a wide extended moor, covered with water, the furze and heath bushes would appear something like the clusters of fucus scattered over the thickest part of this sea."

The fructification of all sea-weeds is peculiar, but they require a fixed basis to vegetate. Although apparently flourishing in vast areas in this Sargasso Sea, they can only be looked on as cut flowers rather than as complete plants, although their constitution enables them to live a long period without being fixed to their parent rock like most other algæ. They are found in every state of decay, and when old they become covered with minute and beautiful parasitic growths, which deserve much attention to those who have the leisure and taste to examine them, especially with the microscope, which in this region reveals a vast and little known world. Besides this, too, the tufts afford protection and shelter to a vast quantity and variety of minute fishes, crabs, and other crustacea and animalculæ, which will afford an inexhaustible fund of interest to the observer. Naturally enough, there is a limit to its separate existence, and when subjected to any change of temperature, or difference of locality unsuitable, by a continuous wind or current, large areas become decayed, die, and sink to the bottom, to be renewed by the continual fresh importations from the Gulf of Mexico.

It is sometimes drifted on to the shores of the British Isles and Western Europe, and appears among the other sea-weeds in the works on algology, but it is accepted as a shipwrecked stranger, not as a native of our shores.

(168.) The gulf of Mexico abounds with the native growths of the Sargasso-weed. It is found attached to the rocks, at the bottom, in most parts of it. The soundings on the Campechè Bank, Chiriqui, the Andros Islands, on the Bahama Banks, New Providence, &c., all furnish the supply of growing plants. The spores (or seeds) of these become attached to these rocks in the manner usual with all algæ, and the young plant grows, not from a root, because the attachment to the rock is not of that nature, till it attains some size, when offering greater resistance to the progress of the continual current than the stalk is able to bear, it becomes detached, rises to the surface, and then is borne onward by the stream till it emerges through the Gulf of Florida by the Gulf Stream. As will be shown hereafter, this stream has a tendency to throw all floating bodies off to the right hand of its course, it follows, that this weed is gradually cast off into this central area, aided probably by the westerly prevalence of the winds which at times occur in this part.

One opinion may be safely controverted, that which assigns the depths of the Atlantic over which it is found as its native place. The great depth and consequent cold disproving the possibility of a plant living in such extremes of temperature.

We give a number of examples and opinions on this subject, as in previous editions, but any new light which can be thrown upon the physical condition of this peculiar region, would be well worth the study of any one who will undertake it. But little has been added to our stock of knowledge for many years.

(169.) *Captain Livingston*, in his way from New Orleans to the Strait of Florida, saw large quantities of it; and every one who has navigated the Gulf Stream has remarked the weed in it, or along its borders. Sir Philip Broke and the Baron Alexander von Humboldt say, that the stream contains a great deal. Sir Philip says: " We were always surrounded with gulf-weed." Major Rennell adds, " He spoke of that part of the Gulf Stream out in the Atlantic; the others might speak of other parts."

In the second volume of the " Colombian Navigator," 1848, p. 220, is a description of the Andros Isles, as lately surveyed, and it is there shown, that in the great sponging district, upon the Bahama Bank, West of Andros, vast quantities of the gulf-weed are produced; and this is one of the beds from which the ocean has been supplied."

On the weed found in the ocean, we have the following remarks, by *Captain Livingston*, whose name has so frequently occurred in the preceding pages:—

" Many persons suppose that the gulf-weed (*fucus natans*) grows upon the rocks about the Bermudas; others, that it originates among the Florida Reefs; and a third party, that it grows upon the water, without ever adhering to anything fixed.

" All these positions seem to me equally wide of truth. Neither on the Bermuda Rocks, nor among the Florida Reefs, has a single branch of gulf-weed ever been found growing upon the rocks; and, among all the gulf-weed met on the ocean, no person has ever found a single tuft with roots, or that, on mature examination, could be supposed, by any person of sound judgment, to have grown on the surface of the water. On the contrary, every stalk of the weed seems to have been broken off short from something to which it firmly grew, and *all the ends* of these stalks are uniformly decayed, or dried up, from the end to a short distance.

" It has been stated, as a well-known fact, that the *fucus natans* grows on the rocks along the Gulf of Paria, and on the coasts of Caraccas, &c. If this be the case, it is rather strange that it should not rather grow on other rocks and coasts of the West Indies. It has also been stated, that in the whole sea of floating bushes, *Mar do Sargasso*, not a withered plant is ever discovered. This is not true, as I have seen abundance of the *fucus natans* in a state of great decay. I note the following from my journal of the *Brilliant*, from Gibraltar towards Havanna: 8th February, 1819, 'the weed much decayed;' 9th. 'weed passed through, a.m., much decayed;' 10th, p.m., 'passed through much decayed weed; I remark, that the farther we run to the westward, the more decayed is the gulf-weed;' 13th, 'the gulf-weed begins to look fresher.'*

" These particulars have been given, in order to show that I have not spoken at random; on the contrary, actually made my remarks on the spot. Some of the weed was quite brown, and in small fragments, evidently separated into such by its state of decay. It is true, that the weed soon decays when it is taken out of the water, as I have often tried the experiment. The weed is never of a verdant green colour, but seems as if blanched from having been, in some degree, hid from light: I suppose from vegetating under water."

(170.) *Mr. Turner*, who has so well made known the family of the sea-weeds, and many other celebrated botanists, think that the greater part of the *fuci* (weeds) which we gather on the surface of the ocean, and which, from the 23rd to the 35th degree of latitude, and 30th of longitude, appear to the mariner like a vast inundated meadow, grow primitively at the bottom of the ocean, and float only in their ripened state, when they are torn off by the motion of the waves.

To the North of the Cape Verde Islands, we met with great masses of floating sea-weeds. They were the tropic grape, *fucus natans*, which grows on submarine rocks, between the Equator and lat. 40°, both North and South. I am assured from the comparison of a great number of journals, that, in the basin of the Atlantic Ocean, there exist two banks of weeds, very different from each other. The most extensive is a little to the West of the meridian of Fayal, one of the Azores, between lat. 25° and lat. 36°. The temperature of the ocean, in these latitudes, is from 61° to 68°; and the North winds, which sometimes reign there very tempestuously, drive floating isles of weed even to the parallels of 24° and 20°. The vessels which return to Europe, either from the Rio Plata or the Cape of Good Hope, cross these banks, which the Spanish pilots consider as at an equal distance from the Antillas and Canaries. The second bank of fuci (weed) is but little known; it occupies a much small space between the 22nd and 26th degrees of latitude, 80 leagues East of the meridian of the Bahamas. It is found on the passage from the Caycos to the Bermudas. In the latitudes just described, the fuci, far from being fixed to the bottom, float in separate masses on the surface of the water.......

" It were to be wished that navigators would heave the lead more frequently in the latitudes covered with weeds.

" The causes that unroot these weeds, at depths where it is generally thought the sea is slightly agitated, are not sufficiently known. It has been said, that if the fucus adhere to the rocks with the greatest firmness before the display of its fructification, it separates with great facility after this period, or during the season which suspends its vegetation, like that of the terrestrial plants. The fish and the molluscæ

* On the 8th of February, the *Brilliant* was in 24° 17′ N., and 65° 1′ W. On the 9th, in 24° 34′ N., and 66° 59′ W. On the 10th, in 24° 51′ N., and 68° 39′ W. On the 12th, in 25° 34′ N., and 71° 5′ W. On the 9th, the ship passed the meridian of Porto Rico, and was hence proceeding toward Providence Channel, Bahama. The decayed weed, we have no doubt, had drifted from the central bed of the ocean.—Ed.

that gnaw the stems of the sea-weeds no doubt contribute also to detach them from their roots.

"On proceeding hence, toward the West Indies, from the 22nd degree of latitude, we found the surface of the sea covered with flying fish, which threw themselves up into the air 12, 15, or 18 feet high, and fell down on the deck. I do not hesitate to speak of an object, of which voyagers discourse as frequently as of dolphins, sharks, sea-sickness, and the phosphorescence of the ocean. None of these objects can fail of affording interesting observations to those who make them their study."

(171.) *Captain Bourke*, in the brig *Archibald*, December, 1815, found large quantities of the weed near the parallel of 20°, to the northward of the Island Porto Rico, and of the eastern part of Hayti; but on the passage through the Bahama Channel, eastward of the meridian of 70°, and on the North sides of Hayti and Cuba, none of the weed was seen. This may be accounted for on the supposition that it was drifted by the current from the great bed of weed to the N.E., as before explained.

Lieut. John Evans, R.N., states:—"In November, 1810, H.M.S. *Belvedere*, in the centre of the Atlantic, lat. 33° 20′, long. 41° 37′, passed through prodigious quantities of *fucus natans*, in line North and South, as far as the eye could see; and notwithstanding that there prevailed a very heavy swell from the North, their position was not altered. The quantity of this weed met with between the 30th and 36th degrees of latitude is really astonishing; at times you may sail for leagues through it, covering, as a mantle, the surface of the sea. I have often seen it in lines about 300 or 400 fathoms in length (sometimes only a few yards), and frequently in large and small patches of irregular shape, but generally in a circular form. The deep-sea line should be put over the side frequently in this particular part of the Atlantic."

On the 17th April, 1828, at noon, in the Mexican Sea, a vessel under the command of Lieut. John Evans was in lat. 26° 52′, long. 89° 17′. On this day *fucus natans*, or gulf-weed, was seen, in parallel lines, S.S.E. and N.N.W. It was in flower, and completely covered with young barnacles. "From the lat. 25° to 28° in this sea we met with the fucus in parallel lines S.S.E. and N.N.W.; it flowers like fern and other *cryptogamia*." In calms the fuci float near the surface, some of the leaves appearing above water; the patches seen in the Florida Stream, and the bunches examined, were old, brown, and covered with young barnacles.

In the year 1825 the brig *Erin*, from the Pacific Ocean to Liverpool, when to the westward of the Azores, passed compact parallels of *fucus natans* in lat. 39° 59′, long. 33° 46′. The weed was less broken than any they had before seen; the nodules large and of a deep yellow-brown colour, and the lines extending, as far as the eye could reach, in a direction about S. by E., being nearly at right angles with the vessel's line, which was E. by N. The wind was S.E. by S., strong gales and a heavy sea.

(172.) The *fucus natans* is found in localities to the *eastward* of the Sargasso Sea. For the following communication we are indebted to the late Captain *Thomas Midgley*, and it is a great acquisition to our knowledge of the wide range that this plant has:—

"On my outward passage to Africa in a perfect calm, at daylight of the morning of 18th of January, 1841, in lat. 6° 46′ N., and long. 14° 56′ W., I found the ship amongst a number of small bunches of weed, and many cuttle-fish shells.

"On carefully examining some of the bunches of weed, I was surprised to find it the true *fucus natans*, or Sargasso or gulf-weed, being, in every respect, precisely the same as that found in the N.E. trades, but apparently much fresher, having exactly the same kind of oblong, narrow, serrated leaf, same stem, same nodules, and just the same pale yellow colour. The pods were also surrounded with a very fine kind of net-work (*flustra*), and there were a very few minute barnacles attached to the stem, which scarcely showed any marks of decay; indeed, the two bunches brought on board (which were each about 4 inches in diameter) appeared to have been but very recently separated from the parent stem, and they each contained a small, but very lively, crab.

"The lively fresh appearance of the weed, and the two crabs, induced me to try for soundings, and, as the weather was perfectly calm and the water smooth, I was enabled to get a perpendicular cast of 112 fathoms, with a well-armed heavy lead, but found no bottom.

"The weed was in detached and small bunches, and could only have extended over a comparatively limited space; for when a breeze of wind sprang up, and the vessel had sailed 20 miles to the eastward, there was not a single sprig or bunch to be seen.

"This weed appears to be unknown upon the Krou coast, for I had two intelligent natives of Sangwin and Grand Sestros on board at the time I picked the weed up, and they severally declared they had never seen it upon any part of the coast.

"The vessel had been perfectly becalmed for fourteen hours previous and two hours subsequent to the time of picking up the weed, so that she gradually drifted amongst it by a current, which I found, by good observations and carefully-kept reckoning, to set E. by S. by compass, very nearly three-quarters of a mile per hour. Temperature of water, when weed was picked up at daylight, 79°, and at noon, 81° Fahrenheit."

(It had evidently been drifted out of the area by the current described on p. 283. Its not being known farther East is probably owing to the difference of temperature of the sea, which kills the weed before it arrives there.)

(173.) *Mr. Luccock* in his *Notes on Brasil*, has likewise described the *Green* or *Weedy Sea*. He states that it extends from 11° to 35° of North latitude, and from 30° of longitude to an indefinite distance westward. "Here," he says, "the ocean is covered by nodules of sea-weed, from 3 to 18 inches in diameter, somewhat resembling in form a cauliflower when stripped of its leaves. They float lightly on the water, in parallel lines, at a very few yards from each other, and have a yellow-brown colour, like the long stringy fibre which is sometimes seen floating in the English Channel, and which I suppose to be the natural colour of all marine plants, growing deeply beneath the surface of the water. These nodules, or spherules, are composed of a vast number of small branches, about half an inch long, which shoot from each other at an angle of about 40°; hence they multiply continually toward the superficies of the sphere; and each extreme point produces a round seed-vessel. This is little more than one-tenth part of an inch in diameter, is hollow, and contains a small reddish-brown seed, scarcely occupying one-fifth part of the husk. The leaf of the plant springs from the joints of the branches, is oblong, indented at the edges, about 1½ inches long, and a quarter of an inch broad.

"When the nodule is dexterously taken up, all the branches may be traced to one principal stalk; and this invariably shows a fracture, the part by which it has been joined to some larger stem. This fracture is frequently quite fresh, and, in large and vigorous plants, shows distinctly a woody part and a cortex. On the edges of the latter, the first symptoms of decay appear. They become brown, and separate themselves from the wood. This also then assumes a darker colour, and exhibits the regular process of disorganisation, just in the same manner as does a slip from a currant or gooseberry bush. In process of time, the whole of the plant assumes a darker hue; and, as it decays, floats considerably lower than it did. When kept out of the water for a few hours, it becomes harsh and brown, and acquires the peculiar smell of marine vegetables in a state of putrefaction.........

"A great number of very minute barnacles are found upon the leaves and stalks. The seed-pod is usually enveloped in a sort of honeycomb work, which may be taken from it, and, when examined by a lens, resembles in appearance the net-work in a fly's eye. (This is called *flustra*.) Among other inhabitants of the plant, is frequently a number of small crabs, perfectly formed, and evidently young, yet vigorous and active; and when a nodule, taken fresh from the water at night, is hung up in a small cabin, it emits phosphorescent light enough to render objects visible.

"The singular arrangement of the plants, in parallel lines, is evidently owing to the wind, whose direction they always observe. Each nodule places itself under the lee of its more windward neighbour, and thus observes the law of floating bodies when exposed to a current of air. Should the wind suddenly change, as it sometimes does, a point or two, in this part of the Atlantic, and blow strong, these lines become broken, and form what are commonly called *fields of weed.* These, however, are generally small, and seldom, I suspect, remain long so disarranged.

"In the month of October, I have run with a fine schooner, due North, through the N.E. trades, in the longitude of 26°, and found no weed, being perhaps to the East of it. In the month of March, on board a different vessel, we formed a diagonal line, from 26° to 44° West, across the parallels from 11° to 44°, and saw a great quantity of it. In May, of another year, along the same track, there was much less observed; yet I dare not say that these dates are sufficient to point out the season of ripening, maturity, and decay of the plant, although I have never taken up a nodule which was not full of seed-pods, and never heard of a person who had noticed one destitute of them. It is said, that whales come down to the vicinity of Bermuda at a particular season, and feed upon these plants; yet I do not recollect ever seeing an individual of that species in the Weedy Sea; but, on the contrary, have noticed a deficiency of fishes in general; and most, if not all, of those which I have seen opened on board, appeared to live, not upon vegetable food, but their fellow-inhabitants of the waters. It is probable, however, that none but such will take a bait or approach a vessel."

Captain *Martin White,* R.N., says:—"It is certainly remarkable that the *loci natales* of the *fucus natans* (spread, as it is, among the other *rejectamenta* of the sea, so profusely over the Atlantic, Indian, and Pacific Oceans), should have remained so long undiscovered; we are informed, however, that *two* varieties have been found in the Red Sea, and a solitary specimen has been produced by Dr. Wright from the West Indies, another by Guinani from the Mediterranean; but without any remarks as to the *soil* it grew upon, or the *depth* of water where taken, both of which are very important. It is stated, also, to have been received from Bermuda, and to have been seen on the rocks along the Gulf of Paria, and on the coast of Caraccas; but, if the latter were so, would it not be also found on the coasts contiguous? I do not presume to question the fact of the *fucus natans* having been received from Bermuda; nevertheless, I have often heard surprise expressed at not finding this weed growing among the rocks at that island, and still more at its absence from the anchorage eastward of New Providence, where, to my knowledge, the water is so clear as to render it quite possible to distinguish the varieties, even under the ship's bottom."—*Remarks on the Winds, the Tides, and the Currents of the Ocean,* p. 144.

5.—THE EQUATORIAL CURRENTS.

(174.) The name which is usually given to the great drifts of the trade winds, having as wide a range or latitude as 50° or 60°, is scarcely expressive. The *Equatorial* Current, strictly speaking, is the counter-current we have just described. However, the drift which is intended passes to the S.W. and West of the Azores and Canaries, and from the coast of Africa to the Gulf of Mexico, northward of the easterly counter-current in the North Atlantic; while the great drift of the S.E. trade wind, crossing the Equator, southward of the counter-current, and running strongly to the N.N.W., along the coast of Guayana, joins its strength to the northern portion, and thus, together, passes through the Caribbean Sea.

(175.) The drift of the N.E. trade is not so powerful probably as that of the S.E. trade, as the interference of the land causes such a great change in the regularity of the winds which certainly must be taken as the greatest cause in the production of these currents. The mean rate has been over-estimated in former times by many observers. In its northern limits in the open ocean its annual average, from a careful calculation, amounts to from 8·2 miles to 11·6 miles per day; in its southern and stronger portion it is from 16 to 22·4 miles per day. Westward of the Cape Verde

Islands, its mean direction is nearly due West, which is remarkable, considering the northing of the trade wind. It would seem scarcely necessary to enlarge much upon the rate and extent of this well-known current; but, as it may be interesting to compare individual experience with that of preceding voyages, we give as heretofore a series of examples by which the ordinary rate and circumstances may be reckoned on.

(176.) EXAMPLES.—*Captain J. W. Monteath;* on his passage from Liverpool to Norfolk, in Virginia, in February, 1816, between the Island of Terceira, Azores, and lat. 32°, long. 45°, in a run of eight days, by lunar observations, found the current had set the vessel *three degrees* to the W.S.W. of the reckoning; but from this position, until his arrival in the Florida Stream, little or no current was found.

In 1823 the corvette *Bayadere*, Captain Roussin, on approaching and passing the Azores, upon her return from Rio Janeiro, Nov. 20 to Nov. 25, found the prevailing Winds and Currents as follow:—

	Latitude. ° ' "	Longitude. ° ' "	Winds.	Current. ° M.	
Nov. 24,	26 48 12	33 24 50	E. by S. to W.	S. 46 W. 23	EQUATORIAL CURRENT, westward of the Azores.
21,	37 42 3	31 16 15	N.N.N. to W.S.W. by W.	S. 10 W. 24	
22,	38 13 56	27 43 40	N.N.W.	S. 8 E. 24	
23,	39 36 28	25 3 15	N.N.W.	S. 65 E. 28	S.E. CURRENT, eastward of the Azores.
24,	40 16 0	23 29 0	North.	S. 50 E. 13	
25,	40 25 50	22 53 20	East.	S. 75 E. 10	
26,	41 41 50	19 15 50	S.S.W.	S. 70 E. 11	

Here, therefore, the line of distinction between these currents was experienced in a very sensible degree.

In June, 1816, H.M.S. *Pactolus* experienced a southerly and south-westerly current of 10 miles a day between St. Michael's and lat. 36°, long. 42¼°. This must have been on the tail of the Gulf Stream and in the Weedy Sea. The *Pactolus* felt no other current on her way to the Bermudas until she came within 70 miles of those islands, and then had a current of 13 miles a day W.S.W.

Captain W. J. Capes, in the *Lady Mackworth*, in September, 1823, from the 14th of that month to the 8th of October, pursued his direct course to Barbadoes, from lat. 24° 0', long. 25° 1', his situation at noon on the 14th. He says that, from leaving the Island Ferro, we found the current setting us at the rate of from 3 to 5 miles a day westward, and generally a little southing. The weather was remarkably fine all the way to Barbadoes, and always fair, so that I never took in a royal; the log-glasses well adjusted, as well as the log-line; but, on making Barbadoes, we found the chronometer to be remarkably correct, and that the ship was 112 miles a head of dead-reckoning.

To the south-westward of Madeira, between the island and lat. 28° 0', long. 18° 24', Captain Livingston found the set to be 14' 38" S., and 37' 5" W., 10th and 11th April, 1826.

Proceeding south-westward, from the spot last mentioned, to lat. 14° 7', long. 44° 6', in fifteen days the sets were 14' 40" N., 1' 11" S.; 11' 15" E.; and 2' 6" W.—Surplus effect, 56' 20" S., and 1' 54" W.

7th Dec., 1810.—H.M.S. *Belvedere* sailed from Bermuda, and proceeded toward the Azores. On the 21st (fourteen days' run to the eastward), lat. observed 36° 22' N., long. by account, 34° 9' W., by lunar, 35° 5', by chron., 35° 0'; leaving 51' for westerly current.

25th of Novemder, 1790.—The merchant ship *Rosalia* sailed from Cadiz for Vera Cruz, having, as passengers on board, Don Josef de Espinosa and Don Ciriaco Cevallos, officers of the Spanish navy, who had two good chronometers. This ship made Cape Cabron, on the N.E. side of Hayti, after a voyage of twenty-three days, and it was then found that the currents had carried them *four degrees* to the westward of dead-reckoning; and that, consequently, the daily drift averaged about 7 miles.

In 1770, a small vessel laden with corn, and bound from the Island of Lanzarote, one of the Canaries, to Santa Cruz, Teneriffe, was driven to sea, while none of the crew were on board. The motion of the waters, to the South and West, carried it to America, where it went on shore, at La Guayra, near Caraccas.

By the *Jane*, Captain Livingston, toward Demerary, between lat. 14° 7′ N., long. 44° 6′, and lat. 6° 53′, long. 57° 18′, in six days, ending 30th April, 1826, the sets of current were 33′ 10″ N., 21′ 25″ S.; 0′ 0″ E., 3° 16′ 50″ W. *Surplus effect* (for Equatorial Current), 11′ 45″ N., and 3° 13′ 50″ W.

In November, 1825, between Maranham, on the North coast of Brazil, and lat. 6° 8′ N., long. 47° 17′ W., Captain Livingston was set 1° 12′ 35″ N., and 1° 55′ 28″ W., *without any southerly or easterly differences.*

(177.) It will be scarcely necessary to recapitulate the evidence upon which the mean rate is set down in the Chart of the Atlantic Ocean before referred to (see (22.) p. 184). Suffice it to say that the rate which may be anticipated when going southward outside the Cape Verdes to 8° N. will be from 12 to 20 miles per day. In longitude 40° the westerly set reaches frequently to the Equator, and averages 15 to 22 miles per day. The General Chart of the Currents at page 259, will sufficiently explain this part of the subject. As the current is well established, we need not extract the numerous observations given by Capt. Maury as they almost all tend to the same conclusion. But the drift of bottles is so marked an evidence that we give a number of instances which will be very instructive.

(178.) **Bottles.**—The following have been selected from Captain Becher's list, explaining his bottle chart in the "Nautical Magazine," of November, 1852. It has been before quoted from (131.), page 260:—

Ship.	Signature.	Where left.			Where found.	Interval Days.	Distance.	Rate Per Day.
		Year	Latitude. N.	Long. W.				
			°	°			M.	M.
Thunder	Owen	1833	28·4	25·5	Bahamas	506	2750	5·4
Osprey	....	1822	13·3	39·2	Bahamas	216	2610	12·1
C. Dunmore ..	Robertson..	1828	27·4	28·0	Cuba	437	2530	5·8
Kate	Cresswell ..	1825	24·0	19·0	Musquitia	519	3300	6·3
Wellington	Liddell	1836	17·9	29·0	Abaco	265	4000	15·1
Echo	Belcher	1837	17·3	36·6	Antigua	196	1410	7·1
Stratford	Locke	1836	14·5	34·4	Jamaica......	278	2460	8·9
Osprey	....	1820	4·1	24·3	Barbadoes	139	2220	16·
Wm. Lockerby	Parker	1838	14·1	25·2	Grenadines ..	169	2110	12·4
Osprey	....	1820	5·2	24·7	Martinique ..	322	2300	7·1
Osprey	....	1822	6·2	15·6	Trinidad	192	2920	15·2
C. McCarthy ..	Field	1824	22·0	53·5	S. Salvador ..	226	1200	5·7
Harlequin	Cunningham	1851	24·7	30·4	Turks Island..	300	2300	7·6
Calliope	Kuper	1843	19·2	30·8	Caicos	375	2250	6·
Two Brothers..	....	1820	C. Verde	Ids.	Crooked Island	382	2800	7·1
D. of Marlboro'	Thorn	1820	C. Verde	Ids.	Hayti	283	2610	9·2
Nisus	Rey	1842	14·5	34·4	Martinique ..	277	2100	7·6
Mary	Locke	1836	14·5	34·4	Barbuda	278	1700	6·
Enterprise	Collinson ..	1850	1·1	26·8	Honduras	367	3800	10·3
Investigator ..	McClure ..	1850	12·4	26·1	Ambergris K.	186	3610	20·
Rapid	Messum....	1852	0·5 S.	22·6	Martinique ..	155	2430	15·6
Sophia........	Saxon	1848	5·2	40·3	Grenada	151	1320	8.7
Race-horse	Home	1835	8·6	52·0	St. Vincent ..	35	610	17·4
Race-horse	Home	1835	1·3	47·8	Tobago	50	1000	20·
Race-horse	Home	1835	11·5	61·5	Maracaibo....	17	240	14·

The mean rate of travelling of all these bottles is 10·6 miles per day. But this average requires several qualifications which will make it considerably higher. The distances are measured *direct*, but it is most probable that these messengers pursued a more or less *devious* course. Again, it will be seen that the bottles thrown out on the northern part of this trade wind drift have travelled much slower to their destination than those which started from near the equator.

(179.) Besides the above we add the following examples of bottle drifts from our former editions.

Westerly Drift to St. Eustatius.—A bottle from the ship *Wm. Miles*, Captain James Pike, bound to Jamaica, lat. 18° 28′, long. 57° 20′ (date omitted). Picked up on the beach of St. Eustatius, 26th of February, 1839.

Central Drift to the Virgin Isles.—A bottle from the *Emerald*, Captain Nockells, bound to Jamaica, 17th December, 1831, in lat. 36° 40′, long., by chron., 12° 32′. Found on the North side of Anegada, 8th January, 1833. The winds for the last three days, previous to the 17th of December, were from North and N.W. to S.W. For eight days preceding these it blew a continued and heavy gale from S.W. and W.N.W.; the bark lying-to the whole time, and drifting from lat. 41° 28′, 227 miles to the northward.

A bottle from the ship *Isabella*, of Leith, 2nd April, 1835, in lat. 23° 19′, N., long. 37° 50′ W. Having lost the N.E. trade in the morning. Wind then E.S.E. Found by Cooper's Island, near Tortola, 13th September, 1836.

Equatorial Current to Tobago.—A bottle from the schooner *Julia*, Wm. Davidson, master, in lat. 6° N., and long. 40° W., Nov. 6, 1821. Found 7th of March, 1122, near the shore of Little Rocky Bay, Tobago.

Central Drift and Equatorial Currents.—A bottle from the ship *Gambia*, in the River Gambia, lat. 13½° N., in the latter part of 1831. Picked up on the southern side of Virgin Gorda, lat. 18° 30′.

Central Drift and Equatorial Currents.—A bottle from the *Two Brothers*, of Baltimore, in lat. 17° N., long. 26° W. (off St. Antonio), 21st of November, 1826. Found at Acklin's or South Crooked Island, in lat. 22° 12′ N., long. 74° 18′, on the 8th of December, 1827. Hence it appears to have drifted, in a W. by N. direction, from the vicinity of the Cape Verde Isles to the West Indies, under influence of the Drift from the N.E. and the Equatorial Current, probably in the first instance W.S.W. and thence W.N.W.

Madeira to the West Indies.—A bottle from the ship *Symmetry*, of Scarborough, Captain Smith, on her way from Leith to Buenos Ayres, off Madeira, 9th of June, 1825. Picked up at Salt Kay, Turks' Islands, after a lapse of ten years, 9th of June, 1835.

Guyana to St. Vincent's.—A bottle thrown into the sea on the 20th of May, 1835, in the latitude of Demerary; picked up in Sable Bay, St. Vincent's, on the 24th of June. At the same time several large trees were washed ashore, among them a Spanish cedar, and which, from their appearance (being covered with a coat of barnacles and sea-weed), must have been a long time in the water; these were, no doubt, driven out to sea by the overflowing of the Orinoco, occasioned by the heavy rains.

Some years back a very large cedar came on shore at Sable or Sandy Bay, bringing with it a large female *boa constrictor*, which took to the neighbouring wood, and when shot, some days after, was found to contain many young ones, nearly ready to escape; and which, but for the destruction of the old one, would have taken up their abode in the woods.

A bottle thrown from the *Osprey* at noon, on the 1st of April, 1820, in lat. 12° 56′ S., long. 29° 10′ W., was found, 10th of June, 1820, on the Barra Grande, coast of Brazil, latitude about 9° 20′ S. Its true direction seems to have been N.W. by W. ¼ W. Attested by Messrs. Low and Co., of Maçaio, in the province of Pernambuco.

CAPE VERDE ISLES TO BRAZIL.—The *Hazard*, of Greenock, August 4th, 1812, lost the N.E. trade, in lat. 11° N., long. 25° W.; and the wind, until the 12th, varied from West to S.W.; from the 12th to the 17th it generally blew from South, never exceeding one point easterly. Gained the S.E. trade on the 17th, in lat. 2° N., long. 27° 30′ W.; the trade kept southward between Penedo de S. Pedro, or St. Paul's Islets, and the coast of Brazil (at Rio Doce), and experienced a westerly current amounting to nearly *four degrees*. Attested by Captain J. W. Moneath.

BETWEEN MADEIRA AND BRAZIL.—In the *Jane*, Captain Livingston, April and May, 1824, found a surplus effect of currents, between Madeira and Brasilian Trinidad in thirty-nine days, equal to 1° 19′ 47″ S., and 6° 3′ W.

Finally, Captain Sabine has shown, that in 1822, after H.M.S. *Pheasant* sailed from Maranham, she entered the current, the full strength of which she had quitted to go to that place, and it was then found to be running with the astonishing rapidity of 99 miles in twenty-fours hours. On the 10th of September, at ten a.m., while proceeding in the full strength of the current, exceeding 4 knots an hour, a sudden and very great discolouration of the water ahead was announced from the mast-head; the ship being then in 5° 8′ N., and 50° 28′ W. (both by observation), it was evident, that the discoloured water could be no other than the stream of the Marañon, pursuing its original impulse at no less than 300 miles from the mouth of the river, its waters not being yet mingled with the *blue* waters of the ocean, of greater specific gravity, on the surface of which it had pursued its course. It was running about 68 miles in thirty-four hours.

(180.) The foregoing is a sufficient elucidation of the features, velocity and limits of the N.E. trade wind drift of the Atlantic, but, as has been before mentioned, particularly in (27 to 33.), pages 186—189, the division between the the northern and southern systems of wind, and consequently of current, being to the northward of the equator, and consequently that the South Atlantic Current, enters the Caribbean Sea, and increases the force of the Gulf Stream.

(181.) The SOUTH EQUATORIAL CURRENT, which passes over the equator in its northern portion, has a mean velocity of about 20 to 26 miles per day in the open ocean, and its direction is, like that of the Northern Equatorial Current, nearly due east. Setting upon the northern coast of South America, it runs with great velocity close in-shore at times, sometimes reaching 100 miles per day, and not unusually 60 miles. It is scarcely necessary to dilate on this current, as it appears to be regularly and constantly met with. Its progress through the Caribbean Sea, &c., will be dealt with in the next section.

(182.) It will be seen that throughout the breadth of this ocean that the set of the stream is not to S.W. or N.W., as might be expected from the direction of the trade winds, which may be taken as the prime mover of these mighty drifts, but *eastward.*

This fact would seem to indicate that the rotation of the earth on its axis has more to do with its motion than has usually been attributed to it. But our present knowledge of the subject is not sufficiently extensive or accurate to define what amount of action is due to that source, or how much to the wind, lunar influences, or temperature, all of which combine to produce the phenomena we are considering. Theoretical speculations, however, are not necessary in a practical work, although they may be interesting.

(183.) Arrived at the Barrier formed by the line of the Antillas, a large portion of the stream is necessarily arrested, the remainder pouring through the openings, which between Barbuda and Trinidad are not in the aggregate 230 miles in width, or not one-half of the range. From this, or other causes, the westerly drift through the Caribbean Sea is not so persistent, probably, as it is in the ocean to the eastward, as will be presently described.

(184.) *Of the currents in the vicinity of Anegada and Virgin Islands* Sir Robert Schomburgk says:—

"It is well known that the tropical current, caused by the earth's rotation, sets to the westward, and its grand movement in these latitudes is directed through the Caribbean Sea; but it is probable that a branch of it, turned aside by the north-eastern coast of South America, sweeps along the Caribbean Islands to the N.W. till it reaches the Bahamas; and it is this branch which, at present, attracts my particular attention, and in proof of the existence of which I adduce the following remarks:—*

"Vessels bound from America to the West Indies, and chiefly to St. Thomas's, frequently find themselves to the North of the Virgin Islands; and this deviation from their intended course has proved but too often fatal, having brought them on the reefs of Anegada when they thought themselves far to the southward of that dangerous island. Nor can repeated occurrences like these be attributed exclusively to errors in the observations for determining the latitude, or to false reckoning."

The American brig *William and Thomas* left New York 28th of October, 1829. Made Bermuda on the seventh day after departure, when, contrary winds retarding her course, land was discovered in the morning of November 15th: according to reckoning, it was supposed to be St. Martin's; but it was fortunately known, on approaching, to be Virgin Gorda, or probably, in the night, the vessel would have gone on the reefs of Anegada.

The English brig *Francis*, bound from Nassau, in New Providence, to Trinidad, cloudy weather having precluded an observation for several days, was supposed to be far distant from Anegada, but making land in the evening, supposed to be St. Martin's, was wrecked at eleven p.m. on the reefs of Anegada.

The American brig *Lewis*, bound from Philadelphia to St. Thomas's and Maracaybo, and supposed on the day previous to be on the parallel of St. Thomas's, was wrecked on the south-eastern reef of Anegada, 9th or April, 1831.

During his continuance at Anegada, Mr. Schomburgk acquired additional proofs of the existence of a north-westerly current. He found on the south-eastern reef several buoys with tyer [coir] ropes attached to them, which appeared to come from St. Martin's. On the 24th of September, 1831, after a severe gale, two buoys were found on the same reef, which had probably been attached to anchors on some ground to the S.E.

On sounding between Virgin Gorda and Anegada, Sir R. Schomburgk threw the log every thirty minutes, and taking bearings of some remarkable objects, the drift was found to be always westerly: and the result appeared to be the same whether the tides set North or South. On one day he left his anchorage, and sailed 10 miles to the northward of Anegada, where the boat was lowered, and rendered stationary by means of a kettle filled with stones, it being then southern tide; in spite of which the log was carried N.W. by W. A similar experiment was made in the waters between Virgin Gorda and Anegada, with the advantage of anchoring; and the set was always the same, the drift being nearly one knot.

The north-western or ebb tide between Anegada and Tortola is much stronger than the flood to the S.E.; undoubtedly from the circumstance that tide and current work the same way.

On these circumstances Sir R. Schomburgk observes, that the wind, from March to June, frequently blows from the South and S.E., and the velocity of the N.W. current will be thus increased; in consequence of which, vessels bound during that time for these islands are more subject to error in their course than at any other period; and lighter bodies being more influenced by currents than heavier ones may be taken as the specific cause of the last remark.

(185.) EXCEPTIONS.—The equatorial drift is not *always* encountered. As will

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* A great quantity of cork shavings are washed annually ashore on the N. side of Anegada; they are drifted by the Equatorial Current from the coasts of Spain and Portugal.

be seen it is not a very rapid motion of the waters, and therefore other causes will readily alter or reverse its action.

Major Rennell has said:—"Experience most fully proves, that although nature effects all her operations in such a manner as that, ultimately, the whole system is balanced and preserved, yet that, in detail, she often appears irregular, according to our limited comprehension. The trade winds and the currents of the ocean partake of these irregularities, although the general system is upheld. The trade winds in the Atlantic are often unsteady, even to 5° or 6° within their northern boundary; and instead of N.E. winds, there are found N.W., and even S.W. winds, for many days consecutively; and this state of things prevents the *drift* current from being so regular there, as in the heart of the trades.

"Anomalies also take place in the great Equatorial Current, and in that of the S.E. trade. The former has been known, at one time, to run to the eastward, or directly opposite to its general, and as is commonly understood, perpetual course; and at about the same rate, and with it, the whole mass of water from 5° N. to 12° S. At another time, a like anomaly took place between the parallels of 2° N. and 7° S. This latter was *observed to take place* at 6° or 7° to the eastward of Cape St. Roque; but the other about midway between the two continents. In a third case, nearly in the middle, the current *ceased altogether*: or rather there was neither an easterly nor a westerly current. This happened in February; the other two in July and August."—(pp. 66, 67.)*

The instance as given in the Spanish *Derrotero*, is as follows:—

The deceased Amiral Don *Cosmé de Churruca* sailed from Cadiz on the 15th *June*, 1792, for the purpose of surveying the West India Islands and Spanish Main. On the 6th July he crossed the Tropic of Cancer in 28° 56′ West of Greenwich, without having discovered any error in the dead reckoning; neither did they find any on the 8th: the trade wind was then fresh, and it was remarked that it attained the greatest strength when the sun was on the meridian, by night as well as by day.

"On the 10th of July they found a current of 1 and 1-10th miles per hour, setting N. 49° E., reckoned for two days: care had been taken to heave the log very frequently, and always on any alteration of the sail carried. Their course was S. 64° W. From the 10th to the 12th they also found a current setting N. $31\frac{5}{8}$° E., nearly a mile an hour; from noon of the 12th to noon of the 14th the current had carried the vessel to the N.E. $44\frac{1}{3}$ miles out of her course; and at noon of the 15th, 17 miles N. 21° W.

"At noon of the 17th they found that in the preceding forty-eight hours the vessel had been carried 43 miles to the N.E. of her reckoning. On the 18th, in the evening, they saw the Island Tobago bearing S. 55° W. By making this island, they found that the reckoning by account was 2° 13′ 45″ *ahead* of the ship; equal, in this parallel, to $43\frac{1}{3}$ leagues: and Don Cosmé thereupon made the following reflections:—

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* The American exploring squadron, which left Madeira on the 25th of September, 1838, after passing the parallel of the Canary Islands, experienced a north-easterly current of about half a mile an hour, where a current in a south-westerly direction is generally supposed to prevail; this continued until they reached the latitude of Bonavista. Captain Wilkes says:—"We hove-to and tried the current morning and evening, always found the same result." The current log used, was two kegs, with a distance-line of 5 fathoms between them, the lower one being just loaded sufficiently to sink the air-tight one under the surface of the water, with the usual log-line attached to the centre of the distance-line, precluding the possibility of its being a surface current: besides which, the dead-reckoning of the ship, and our observations, gave the same result.

On the 29th of September the squadron passed into coloured water, quite as green in appearance as that of 50 fathoms in depth on soundings. On entering it, the temperature decreased 1½°, and rose 2° on leaving it. The vessels continued in it until the 2nd of October, having then run a distance of 450 miles. They repeatedly sounded with from 100 to 300 fathoms of line, but no bottom was found.—"Athenæum," 21st of September, 1859.

This discoloured water is frequently mentioned by other navigators.

"In ten days, between the parallels of 21° 45′ and 11° 44′, and the meridians (West of Greenwich) of 33° 30′ and 59° 50′, the vessel was set 2° 48′ 27″ to the North, and 2° 27′ 45″ to the East, of dead-reckoning, or 71½ leagues, as if they had experienced a daily current of 21½ miles, setting N. 38° E. This great error cannot be attributed to any carelessness in making up the dead reckoning, nor to its insufficiency, for it is known that a log-line marked to 50⅝ English feet, between knot and knot, ought not to measure distances greater than those sailed: and, consequently, it must be concluded that they had a constant and powerful current setting them to the N.E.

"There can be no doubt," Don Cosmé says, "of the existence of a current to the westward in the tropical zone: the action of the moon must necessarily produce it; and the experience of navigators, who have generally found their vessels ahead of their dead-reckoning on making the coast of America. The constant action of the trade wind must also co-operate, and it would be temerity to oppose an opinion so satisfactorily established, and so generally adopted. My own observations are, however, certain; my dead-reckoning was most circumspectly and prolixly made up, and there can be no possibility of a doubt that we experienced a current to the N.E."

The ROLLERS, or HEAVY GROUND SWELL, of the north-eastern portion of the Antillas, which has, from time to time, produced so much mischief, was first described by Mr. R. H. Schomburgk, as shown in the Journal of the Royal Geographic Society, 1835, and copious extracts from the same are given in the third volume of the "Colombian Navigator," to which the reader is referred for a more complete explication of the subject.

The phenomenon appears to be caused by the meeting and combination of the drift from the N.E., and the Equatorial Current from the S.E. or S.S.E. It rises, rages, and subsides, says Mr. Schomburgk, when the air is calm, when there has been no indication whatever of a previous gale, or even when light airs have, for a considerable period preceding, come from the southward of East. The waves approach in gentle undulations, but suddenly swell against the shore, and break with the greatest impetuosity. The rise takes place sometimes gradually, but more frequently quite unexpectedly, the waves reaching an uncommon height.

A heavy "Ground Sea" is distinguished by something grand and sublime. The sea approaches in undulating masses, which suddenly rise to large ridges, crested with foam, and form billows that burst upon the beach with the greatest impetuosity; the spray flying, where the waves dash against cliffs, often more than 100 feet high, attended with loud roarings resembling thunder, which subside into a rumbling noise, caused by the nodules and fragments of rock with which the breaker was charged when advancing, which on its retreat roll backward, and are again driven forward by the next surge. Wave then follows upon wave in quick succession, there being apparently only a short interval after the third. The sea, for many miles from shore, assumes a peculiar aspect, different tints of blue, from the lightest to the darkest, forming a strong contrast with the snowy foam of the breaking waves, when they strike against a hidden rock, or with the white line visible along the whole coast. The Eastern Bahamas, the north-eastern coast of Jamaica and Hayti, but chiefly Porto-Rico and the Virgin Islands, and, in a less degree, the northern Caribbee Islands, are subjected to this ground sea.

It may be considered as a rule that, whenever the wind gets to the northward of East for a day or two, there will be a *ground sea* on the northern side of the islands. The friction of the wind on the surface of the water causes little elevations or ridges, which by continuance of the force gradually increase, chiefly when the wind sweeps over a great extent of water. Finding no resistance, and having sufficient depth to sink directly down, they proceed with the direction of the wind and remain natural, waves, until they meet repercussion from dashing against the shore, when they rise to an elevation much above their natural state.

The period when the ground sea sets in is generally *October*, and it continues though with some intermission, till April and May. The wind accompanying or preceding a ground sea is, generally, from the East of North; the winds are, therefore, propelled, more or less, in a western as well as southern direction, and the Bahamas, and even Bermuda, may escape, whilst the islands from Barbadoes to Porto Rico, but more particularly the latter and the Virgin Islands, receive its first impulse.

A southern gale will likewise produce a heavy swell on the southern side of these islands; and, during the gale of the 30th and 31st August, 1833, this was felt with great violence on the southern shore. But generally speaking, neither in force nor duration are these surges to be compared with those of the northern side; the group of the Virgin Islands being protected, in this direction, by the Carribbean Islands or by the Colombiam coasts, and not exposed to the swell of the main ocean.

To one who crosses, during a severe ground sea, from the southern side of Tortola to the northern, where the breadth of the island is inconsiderable, the singular spectacle is afforded of the sea, which, on the southern side is perhaps "as smooth as glass," on the northern shore tossing, foaming, and roaring, as if agitated by a severe gale. The effect is most curious, and if it were not for the warning that is heard long before the cause becomes visible, one might fancy the wand of a magician in action.

The northern coast of Porto Rico is subjected to a ground sea, of scarcely less force, and which has had the same effect on its coast as that of the Virgin Isles. The 'Old English Pilot" observes that the sea along the North coast of Porto Rico "beats sometimes very ragingly." The force of the waves that batter against the cliffs on which the Moro stands is amazing; and any observer will admit that the spray is sometimes carried more than 100 feet high. It has been said that, several years ago, a brig, in consequence of carelessness, here became unmanageable, and was soon dashed to pieces against the cliffs, but few of the crew escaping.

6.—THE CURRENTS OF THE COLOMBIAN OR CARIBBEAN SEA, AND THE MEXICAN GULF.

(186.) "On the Colombian coast, from Trinidad to Cape la Vela, the current sweeps the frontier islands, inclining something to the South, according to the straits which it comes from, and running about 1½ miles an hour, with little difference. Between the islands and the coast, and particularly in the proximity of the latter, it has been remarked that the current at times runs to the West, and at others to the East. From Cape la Vela the principal part of the current runs W.N.W.; and, as it spreads, its velocity diminishes. There is, however, a branch, which runs with the velocity of about a mile an hour, directing itself toward the coast about Cartagena. From this point, and in the space of sea comprehended between 14° of latitude and the coast, it has, however, been observed, that, in the dry season, the current runs to the westward, and in the season of the rains, to the eastward.

"On the Mosquito shore, and in the Bay of Honduras, no rule can be given for the alterations of the current. All that can be said is, at a good distance from land, it has generally been found setting towards the N.W.

"In crossing from the coast, or from Cartagena, to the islands, it has been discovered that from La Guayra to the eastern part of Hayti, on a voyage made in December, a difference of 106 miles to the westward was found during the seven days the voyage lasted."—*Derrotero de las Antillas.*

(187.) The Baron Alexander von Humboldt, in describing his passage from Cumana, westward, to La Guayra, said:—"The general motion of the waters between the tropics toward the West is felt strongly on the coast during two-thirds of the year only. In the months of September, October, and November, the current often flows toward the *East*, for fifteen or twenty days in succession. Vessels on their way from La Guayra to Porto Cabello have been known to be unable to stem the current that runs from West to East, although they had the wind astern. The cause of these anomalies is not yet discovered. The pilots think that they are the effect of some gales of wind from the N.W. in the Gulf of Mexico; yet these gales are much more violent in spring than in autumn. It is also remarkable, that the current to the East precedes the change of the wind. It begins to be felt, at first, during a calm; and after some days the wind itself follows the current, and becomes fixed in the West."—*Personal Narrative*, vol. iii. p. 378.

(188.) Captain C. S. Cochrane, R.N., in his *Journal*, 16th March, 1823, says—"In the afternoon we perceived high land through the haze, and hauled up for it, wishing to make a point about 50 miles to the windward of Santa Marta; but, on getting in-shore, we found that we were 7 miles to the *leeward* of that place, the current from the eastward having been running for the last twenty-four hours upward of 2½ knots an hour; which agrees with Baron Humboldt's account, that the current runs from 1½ to 4 knots an hour, according to the force of the wind and season of the year. The natives say, that the moon likewise has a considerable effect on this current, which, at the changes of new and full, runs to the *eastward* for 24 hours.

"Here I must caution all captains of ships navigating on this line of coast to allow for the current, in general, at least 1½ knots per hour, on an average, with an increase in proportion to the strength of the breeze, and an abatement at the new and full moons; otherwise vessels heavily laden, overshooting their ports, may lose as much as three weeks by having to stand away nearly to the Antillas before they can get sufficiently to windward to gain the port they have missed; and even men-of-war run a risk of carrying away spars and masts in beating up."—Vol. i. p. 52.

(189.) In the third volume of the "Colombian Navigator," 1839, may be found "Remarks on the Currents of the Atlantic and West Indies made by Lieut. A. H. Bisschop Greevelink, in the *Echo*, a brig of the Dutch Royal Navy, during four years of service, 1833—1837," and which describe the route of that vessel from England to Surinam, in August and September, 1833. On the evening of the 13th of the latter month, the *Echo*, having arrived in lat. 17° N., and long 35° W., lost the trade-wind, and the wind then shifted to the N.W., with a strong breeze, gloomy weather, and much rain, during the twenty-four hours. The following day the wind, diminishing, passed to the S.W. and S.S.E., and terminated in a calm; currents weak and variable to the S,W. and eastward.

On the morning of the 16th, in lat. 14° 40′, and long. 36° 20′, a light breeze sprung up from the S.E., and from that time till we reached the coast we had to struggle with a never-ceasing variety of wind and weather, continual rains with squalls, and scarce a day passing without lightning in one or other quarter of the horizon. On the 18th we passed by several ripplings or eddies, being then in lat. 12°, and long. 39°·30′ W. They usually stretched from East to West, and were often seen to cover the whole surface, everywhere boiling and bubbling as in a cauldron. Current always weak, and during the last forty-eight hours to the West and W.N.W. at a rate of half a mile an hour.

After losing the trade-wind we had to creep over more than 900 miles, as the wind had left us, in every appearance, for ever; the rates were copious and continual in this space, and lightning was seen very frequently. On the 18th (lat. 11° 52′, long. 39° 25′), we passed through a number of eddies; and on the 24th (lat. 8° 3′, long. 45° 37′), the first indication of a change in the colour of the sea became visible: yet it was slight, and may be attributed to a branch of the northerly current observed in the succeeding day. On the 27th (lat. 5° 52′, long. 48° 38′), we received a gentle S.E. breeze, which brought us, though slowly, toward the coast. In the night of the 28th (lat. 5° 7′, long. 49° 56′), we crossed the edge of meeting currents from the Ethiopic Ocean and Brazilian shore and from the Marañon; after which we entered the boundary of the tides. In the evening of September 30 came to anchor in 5½ fathoms. In the night observed longitude by chronometer, 54° 11′ 45″.

Although we had not seen land since we lost sight of the Lizard, by which to examine our timekeepers, I felt not the least doubt about their rate (the one a *Knebel* and the other a *Parkinson* and *Frodsham*), by their reciprocal conformity, corroborated by my lunar observations (which, by-the-by, I think are never to be neglected); and as I was desirous to obtain some observations about the currents, so peculiarly remarkable in these seas, I took every opportunity which circumstances allowed to satisfy my curiosity.

On the 22nd of September and subsequent days the ripplings became less in number; and on the 24th, in the afternoon, about the 8th degree of latitude and 46th of longitude, we perceived the first change in the colour of the water from the common blue to a somewhat darker hue, and, as this was a somewhat uncommon case, I attributed it to a branch of current observed the following day at noon, setting due North, at the rate of more than a mile an hour, straight across a south-easterly current observed during the preceding days, mingling the muddy waters of the Marañon and other rivers with those of the ocean. From the 24th till the 28th nothing particular occurred; we were always steering to the S.W. with light, variable winds, and a continuance of rain sufficient to penetrate our very bones. Currents weak and changeable, being lastly observed to have run N. by W. 18 miles in twenty-four hours. This at present I call weak, being afterward accustomed to fall in with a velocity of twice and thrice that number of miles. At noon we altered our course to W.S.W., being then in lat 5° 7′, and long. 49° 55′ 55″.

In the night, however, having a lunar altitude, we were not a little surprised at finding the ship thrown 35 miles to the northward of her supposed situation, although I may say to have been prepared for this occurrence by Capt. Edw. Sabine's relation in the *Memoir*, whose track we were crossing just then, in the same month.

At break of day we saw the water totally altered in colour, and thickly mingled with mud, as if we were sailing in a flood of ochre; hove the lead, and found 45 fathoms, fine sand, white and black. At seven in the morning, by chronometric observations, I found the westerly offset 33′ 38″; and finally, at noon, in lat. 5° 21′ 49″, lon. 51° 46′ 15″, it appeared evident that the current, in the last twenty-four hours, had been running with the rapidity of 67 miles to the N. 30° W. In the afternoon we perceived the land toward the S.W. by S., being the *Family Islands* of Cayenne, and at the same time we entered the boundary of the tides.

This, indeed, seems to confirm the opinion of those seamen who attribute the principal strength of currents hereabout to the waters of the Marañon, &c., predominating over those of the ocean; but this is to be admitted in a partial degree only; for, as operating on the general direction of the Equatorial Current, I esteem it as of no influence at all.

(190.) The numerous voyages made by the *Echo* in the West Indian Seas, with a particular detail of each, more especially in regard to the currents, are given in the volume above mentioned; and from these voyages and experiments the general inductions are, that between the Caribbee Islands and the coast of Guyana, in the months of August, September, and October, the current veered to the northward of North-west, and in other months more westerly, or even to the southward of West, as in November and December, 1834; but we learn, also, that the greatest velocity of current has been observed in August and September, when the Marañon is at its lowest level, as well as in December and March, when this river begins to increase and attains its greatest height; even on examining the details, in order to discover any regularity in its force, we find an irregularity reconcileable only with that of the wind; and, more generally, by applying the theory of trade-winds, and their influence upon the surface water of the ocean.

After having once rebounded from the Brazilian coast, the united Equatorial and Ethiopic Currents are again compelled to retire westward by influence of the S.E. trade-wind (apparently, also, by the disposition of the waters in these regions to retire westward); and, although at pressing the Marañon, which disembogues toward the N.E., the combined current may, in some degree, and according to its variable form and strength, derive an impulse to the northward, yet it soon yields to the force of the N.E. trade-wind, and the south-westerly drift thereby produced, which sets toward the Caribbee Islands.

In proportion to the force and extent of these winds, the general current is pressed toward the shore of Guyana, as in December, 1835, and November and December, 1834; or allowed to expand freely to the North, as in August, September, and October; yea, even to the N.E., as in March, 1837, especially when preceded by long and violent indraughts, and followed by calm weather.

By influence of the Marañon waters, the general current is prevented from sweeping the coast to the westward of Cape North; as the stream of this great river, being unobstructed, seems to gather all its strength, and force the western boundary of that gigantic drift to an uncertain distance from shore. In this manner we may account for the weak westerly current, creeping along that part of the coast comprehended between the Marañon and Gulf of Paria, called the *region of the tides*, and which is produced by the remaining effluxion of the Marañon, confined between the western border of the general current and the muddy banks of Guyana. It is incorrect to fix this border in 9 fathoms of water, as I have found it in twice and thrice that depth; but on the other hand, I think that, if what has been supposed by Admiral Cosmé de Churruca should ever again happen,—I mean the destroying of the Equatorial Current by the action of the rivers,—the Atlantic will be found of a whitish hue, so far as these currents shall reach, because their thick muddy waters never mingle with those of the ocean until they have been subdued by, and are at rest with, them.

The direction of currents in the Atlantic is reconcileable with the force and direction of the trade-wind, but not without exceptions; because the height of the water-level in the Caribbean Sea will sometimes baffle every calculation both within and without the range of islands, as shown indubitably by experiments founded, not only upon the method of ascertaining currents at sea, but also within sight of land, and observations made on shore along the coasts. It has also been found that during calm weather, even with strong easterly winds, the currents have sometimes been running for days together to the eastward, especially in the latter parts of January and July, when, by the then prevailing strong winds, the water is heaped up in a very uncommon degree, and the inner part of the Caribbean Sea, most probably overcharged, succeeds in re-establishing its equilibrium by forsaking the power of its wrathful driver. In this manner, I think, we ought to reconcile those circumstances mentioned by that illustrious Spanish commander.

In the Caribbean Sea the force and direction of currents are more distinctly modified by the direction of the wind. With continual light winds and smooth water the currents are generally weak, augmenting only in proportion to the increasing wind. This may serve as a proof that, among other less perceptible causes, under which they are governed here, wind is the most powerful agent; for the indraught through the channels appears plainly to proceed from the force and extent of the trade-winds. In this sea, from the Windward Islands westward, to 72° of longitude, the general direction of currents, observed during our four years' cruise, was N.W. and westerly; the weakest in October, November, April, and May, the strongest in December, January, February, and March, along the coast of Venezuela, and in July and August in the northern parts; but, in general, so much always always depended on the force of the wind, that, with few exceptions, *almost every voyage was affected by a force of current corresponding to that of the prevailing wind.*

(191.) Extracts from the Journals of Lieutenant Greevelink.—"*In January*, 1834, the *Echo*, in crossing the Caribbean Sea, from Curaçao to windward, experienced a drift of 40 miles to the West, and escaped only by running straight for the coast of Hayti, beating to windward along that and the coast of Porto Rico, with the best success, and even assisted by weak easterly currents when near the shore. Wind from the E.N.E.. sometimes blowing a gale; but, when sheltered by the land, the water was tolerably smooth.

"*In December*, 1836, the *Echo*, then on her passage from Surinam to Curaçao, with sharp breezes, found the current sweeping through the channel between Tobago and Granada, and farther on, along the Leeward Islands, with a velocity of more than 2 miles an hour to the W. by N.; but, in October, 1836, on the same route, with light winds and calms, the water ran for days together to the northward, at the rate of only half a mile an hour.

"*In March*, 1836, the same vessel, from Curaçao to La Guayra with very strong winds, spent six days in beating up against a current of 40 miles mean daily strength; and on the 8th of April left La Guayra for Porto Cabello, in the bight to the westward, when, instead of making this passage in some hours, she had, during three days, to contend with light, variable, and even westerly winds, and currents to the N.E. 15 miles daily.

"The Baron von Humdoldt's remark about the increase of the currents near the Testigos proved true on our approach to the same islands, in December, 1835.* In the morning of the 12th, the longitude observed was 62° 45′ 15″, and the difference West in twenty-four hours appeared to be 32′ 15″; shortly after, that cluster of rocks came in sight; and at noon, at the very moment that the sun passed the meridian, the S.W. island, placed by Don J. F. Fidalgo in 63° 12′, bore East, distance one mile, having run by log 20 miles to the W. ¾ N.; so that, during these last four hours, the westerly difference amounted to 8 miles, whereas, in former watches, it was only 5¼ miles.

"A similar circumstance, we have reason to believe, also takes place at other groups of this range of sunken islands, and near such capes as are low and reaching far out, so as to obstruct the motion of the water beneath, and thereby redouble the force of the surface current; as denoted by the many instances of shipwreck and carcases of vessels (sad admonishers of precaution) spread among these flat, barren rocks, and produced solely by the irregularity of currents, which baffle every calculation, even those of the coast traders.

"But this variety in the westerly currents here is not the only cause of danger. The total change in the setting of the currents from West to East is of a nature which requires the utmost care and attention, as they not only occasionally happen with calms, but also sometimes with fresh breezes from the eastward. One of the first-mentioned instances, particularly remarkable, we observed during our passage, in October, from Surinam, through the Channel of Granada, toward Curaçao. On the 7th and 8th, between the Island of Tobago and Cape Malapasqua, the water flowed to the *N. by E.* and *N. by W.*, with a trifling force; when suddenly, on the 9th, we had a difference of 17′ 54″ North, and 34′ *West*; and on the following day, at the *new moon*, we were driven 11′ 12″ to the North, and 35′ 54″ to the *eastward* of our supposed situation. This case was too singular not to excite our attention, as the high mountains of Caracas showed us almost hourly the East or westerly direction in which we were driven; the weather being perfectly calm, and the water constantly smooth, by which means we were able to verify our chronometrical observations, and to remove every doubt respecting the truth of so extraordinary a circumstance, the result whereof was as follows:—

"By the westerly current we drifted in sight of the high land near *La Guayra*, and kept working up against the strong easterly set in the whole following day. On the 10th, from seven in the morning till four in the afternoon, we had 14 miles difference West, agreeing with the bearing of *Monte Avila*. From that time till six in the evening, when that mountain, of which we had lost sight for a moment by drifting to the westward, again became visible, the water flowed again to the eastward; and on the 11th, at six in the morning, with an observed latitude, and the said mountain bearing S.E. by S., we were in long 67° 21′; and this by calculation being 67° 47′, we found a difference of 26 miles to the eastward in sixteen hours. From this time till four in the afternoon, again 10 miles to the West; and from thence until the following morning, 22 miles easterly difference. During the night we hove-to, to the southward of Caracas Bay, Curaçao, and were obliged to keep *Little Curaçao* in mind, as the current was setting strongly to the eastward.

"Whether this flux and reflux were caused by the moon (then new), or by any other agent, I shall not attempt to determine. Indisputably there occasionally

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* The remark is as follows. The Baron, on approaching the Testigos, 14th July, 1799, says—"During a calm, the current drew us on rapidly toward the West. Its velocity was 3 miles an hour, and increased as we approached the meridian of the Testigos, a heap of rocks, which rise up amid the waters."

appear satisfactory reasons for ascribing to that luminary some influence over the currents in these regions, and the above-mentioned case is probably one of them; but, as Captain Livingston says on the subject, 'the winds have a still more powerful influence.' Indeed, when roving in these seas, studying the *Memoir* and the *Columbian Navigator*, and enjoying the pleasure of reading all that science and skill have ever produced in the description of these regions, we always meet with Captain Livingston's remarks as so many illustrations, and feel a continued increase of respect for so accomplished a navigator.

"The reflux of the current to the eastward, for some hours daily, we had also occasion to observe, in January, 1834, near the coast of Hayti, Porto Rico, and even in the Atlantic, while working up with smart breezes, and even with very strong winds; and once, in May, 1835, a merchant vessel, steering for Curaçao, with her mainmast broken, passed in the night to the southward of Buen-ayre and Little Curaçao, without seeing the land, being totally unacquainted with any existing current, and consequently with her real situation. At daybreak, finding herself opposite the eastern part of Curaçao, and supposing it to be the Island of Buen-ayre, she stood to the West for Curaçao, as she thought; but on her passing the harbour of St. Anna, she guessed her error, and tried to gain the entrance, in which she succeeded toward sunset, after hard struggling with a strong wind and a rough sea, but assisted by a current to the *eastward.*

"It should be borne in mind that the captain of this vessel was unprovided with a time-keeper, from want of which he knew nothing about easterly or westerly currents; and if, on his approaching Buen-ayre, he had accidently stood a few miles to the N.W., so as to make its northern coast, he would have found a watery grave, designated, perhaps, only by some piece of floating timber, a splinter, or broken spar.

"The uninterrupted easterly currents alluded to have already been mentioned by Baron A. von Humboldt; and, whenever I witnessed them, I found them just as described by that celebrated traveller. It may, however, be remarked that although this change in the general motion of the water is most common in the three months quoted, and chiefly along the Colombian coast, yet sometimes it also happens in other months, and in other parts of the Caribbean Sea; as we, in fact, once experienced it in December, once in April, near the coast above mentioned, and once in March, on our passage from Guadaloupe to Barbadoes, during which vessels from St. Vincent's made their way toward the same islands in a few hours."

(192.) Mr. Town, in his "Directions for the Colombian Coast,"* has said:—"Although between the Island of Jamaica and the Spanish Main westerly currents are most frequent, yet they do not always prevail; for ships have been known to be driven by the current from 50 to 60 miles to the *eastward* in four or five days. From the beginning of May till November (*the rainy season*), the sea-breeze seldom or never blows home to the main; and ships going there should never go to the southward of the latitude of 11°, until they are at least 40 or 50 miles to the westward of their intended port; after which they may make a South course, as the land-breeze, which is generally from the S.W., and the strong *easterly* current, will set you to the eastward of your intended port, if great care be not taken. When to the eastward, if light winds prevail, you must stand to the northward until you meet the sea-breeze, which will be between the latitudes of 10° and 11°, and then run to the westward.

"Being off Porto Bello, in H.M.S. *Salisbury*, on or about the 12th of August, 1816, and being a little to the eastward of that port, with light variable winds for several days, the ship was to the *eastward*, at the rate of 30 miles per day; and, having been afterwards placed in the same situation, I found it necessary to make the land well to the westward, and to keep close to it. From November until May (the *dry season*) you should endeavour to make the land well to the eastward, and run along shore; as

* See the "Colombian Navigator," vol. iii.. p. 231.

the sea breezes generally blow very strongly, and the current sets to the westward at the aate of about 2 or 3 miles an hour.

"Between Chagre and Porto Bello, during the rainy season, there is generally a northerly current, at the rate of from 1½ to 2½ miles an hour. After the end of the rainy season the current sets to the southward and westward, and strong southerly and easterly winds prevail here. From November until May (the *dry season*) the southerly and westerly are very light winds, except in squalls, which end with heavy rain. In sudden squalls you will often have the wind from all points of the compass.

"If at Chagre at any time during the rainy season (May till November), and bound to the eastward, endeavour to get 4 or 5 leagues from the land so soon as you can; foa the winds are, in general, very light, and the current very strong. The latter sets from Chagre directly on the rocks of Porto Bello, and thence along the land from E. by N., E.N.E., E.S.E., and according as the land lies; its general rate being from 1½ to 2½ miles in an hour. Great care should be taken when near the land, if a heavy squall and rain appear to be coming on. During this you will have the wind from all points of the compass, and often so strong that all sail must be taken in.

"In crossing the Gulf of Darien, little or no current will be found: wherever there is any, it sets about South, S. by W., or S. by E., up the gulf.

"Near Cartagena the current generally goes with the wind; but off the Islands of Rosarito it sets to the N.W. and N.N.W., from 1 to 2 miles an hour.

"Between Cartagena and the Magdalena, in the rainy season, you cannot put any dependence on the winds or currents; but, from November to May, the trade wind blows home.

"I should recommend, if turning to windward, with strong trade winds, to keep the shore close-to; whereas, by going off from the land, you will not only have a heavy sea, but also a strong N.W. current. If you have light variable winds, approach no nearer to the land than 4 or 5 leagues, as you may be certain of easterly current."

Captain Livingston says:—"During five weeks in which I remained at *Cartagena*, in June and July, 1817, the current in-shore set constantly and strongly to the northward, at a rate, I am convinced, of not less than 1½ miles an hour, or nearly as strong as the Mississippi at New Orleans: I have seen the *Esk* sloop of war, current-rode against a very fresh sea-breeze, when at anchor, nearly West from the city, distant about half a mile."

(193.) Upon the CURRENT between the GRAND CAYMAN and CAPE ANTONIO, Capt. Monteath had said: "In the months of May, 1814 and 1815 (two voyages in which I was chief mate of the ship *Prince Regent*, from Kingston); in June, 1817, in the ship *Fame;* and in April and December, 1820, in the ship *Mary*, between Grand Cayman Island and Cape Antonio, I invariably found the current setting strong to the eastward, or E.S.E.; and I have heard it generally remarked that vessels shaping a course from the Caymans for Cape Antonio have found themselves off, or even to the eastward of, Cape Corrientes: this has, in the above cases, invariably happened to myself."

Farther on, "In my passage from Kingston toward Campeché, in the ship *Fame*, June, 1817, between Cape Antonio and Cape Catoche, I found the current to set due *North*, 27 miles, in a run of eighteen hours."

We have already given, in a preceding page, the remarks of the Spanish navigators on the Currents of the Mosquito Shore and Bay of Honduras. We now add those of our friends Captains W. J. Capes, of London, and John Burnett, of Port Glasgow.

Captain Capes says:—"Between JAMAICA and BONACCA the current generally sets to the northward and westward. Here, in May, 1816, I was set 60 miles to the westward by the current, and found that it set rather northerly, from one quarter to half a mile an hour."

"If a ship be lying-to, under RATTAN, it will not be amiss to try the current. It is my opinion that the current about Bonacca takes two different directions; one part setting to the N.W., and the other part branching to the S.S.W. I have found it so on several trials, which is the reason that I prefer taking a departure (for the bay) from the middle or East end of Rattan: for, if a ship take her departure from the West end, her course will be N.N.W.; but it very frequently happens that ships get down on those reefs when they take their departure from the West end. The reason is this: a ship steering N.W. from the West end has more of the current on her beam, which sweeps round the end of Rattan very strong at times; consequently, ships that take their departure from the East or middle part do not feel so much of the current."

Captain Burnett, in his directions for sailing from the BAY of HONDURAS, says:—

"When the trade wind prevails, a current, often very strong, sets down between Mauger Kay and the Northern Triangle; there, dividing itself, it sets to the southward, between Turneff and the main reef, and to the northward between the Triangle Reef and Ambergris Kay. It is most advisable, with the wind from East to E.S.E., to sail to leeward of the Triangle, as you will have a strong current in your favour so soon as you bring it to the eastward of you.

"In the channel between the Island Cosumel and the shore, the current along shore runs at the rate of nearly 2½ miles an hour, till lost in the Mexican Sea."

In the ship *George IV.*, 14th of March, 1824, Captain Hamlin found the inset into the Mexican Sea, along the coast of Yucatan, E.E. 42 miles in the twenty-four hours. Lat. at noon 19° 24', long. 87° 7'. On the next day it set toward Campeché Bank, northerly 50 miles.

In the brig *Recovery*, 5th of September, 1822, the same commander found the current on the N.E. side of the Yucatan or Campeché Bank setting about 1½ miles to the northward. Next day, on proceeding toward the Mississipi, weather calm and very sultry, at five p.m. saw two very large waterspouts to the N.W. At half-past seven a smart squall came on suddenly. At eight cleared up; light winds with much lightening. At ten, next morning, severe squalls, which split the main top-gallant-sail and boom mainsail. Lat. at noon 25° 42', long. 86° 53'.

(194.) **Bottles.**—CARIBBEAN SEA TO YUCATAN.—A bottle from H.M.S. *Chanticleer*, in lat. 15° 29', long. 76° 3', at noon on the 53rd of February, 1831 (the ship being to the southward of Jamaica), was picked up on the 20th of the next April upon the eastern coast of Yucatan, after having traversed over a distance of nearly 700 miles, at the rate of 28 miles per day.

SERRANILLA TO YUCATAN.—A bottle from a boat belonging to H.M. surveying-ship *Thunder*, at anchor under Serranilla West Kay, 10th of March, 1834; picked up at Half-Moon Kay, in the Bay of Honduras, on the 23rd of the next month, April; rate 10 miles per day.

TOBAGO TO THE CAYMAN.—A bottle from the American brig *Emma*, on her way from Philadelphia to Berbice, 17th of June, 1838, in lat. 11° 4', long. 58° 50'; picked up on the 27th of the following August, upon the eastern shore of the Grand Cayman, 2000 miles, at the rate of 28·6 miles per day.

WINDWARD CHANNEL, between Jamaica and Hayti.—A bottle from H.M.S. *Thunder*, in lat. 18° 56', long. 74° 56', 7th of April, 1839; current then setting S.W. by S. half a knot; picked up in the Grand Anse, near Jeremie (long. 7° 1'), on the 24th of the same month.

HAYTI TO FLORIDA.—A bottle, some years ago, from the ship *Robert*, Captain Coulter, eastward of Alta Vela, on the south coast of Hayti; picked up about thirteen months afterward on the shore near St. Mary's in Florida.

From bottles enumerated in Captain Becher's list:—Ship *Race-horse*, Captain Home, thrown over in lat. 12° 12', long. 65° 50', 17th April, 1836; picked up April 22nd, at Bonaire, 150 miles in 5 days. Ship *Chanticleer*, Captain Austen, thrown over February, 23rd, 1831, in lat. 15° 30', long. 76°; picked up on the east coast of

Yucatan, April 30th, 680 miles in 56 days. H.M.S. *Thunder*, Captain Barnett, thrown over at Chagres, April 29th, 1840; reached Belize, October 1st, 1840. H.M.S. *Thunder*, March 10th, 1834, started at Serranilla Bank; picked up near Belize, April 23rd, 575 miles in 44 days.

(195.) *On the northern coast of Hayti*, and in the Windward Passages, there does not appear to be any general current. Ou the North side of Cuba the case is nearly the same; but in the channel here is a regular tide throughout the year, subject, however, to certain variations.

The currents of the Caribbean Sea appear to be varied by the influence of the moon and change of seasons, and combine, in some degree, with the tides; especially about Cuba, Jamaica, and Hayti.

In the Cahama Passages the currents are devious; both weather and lee-currents having been found. These, also, appear to be influenced by the tidal causes; for the tides are operative on the banks, and sometimes set strongly.

(196.) Bahama Islands, &c.—The following is extracted from Captain Maury's "Sailing Directions," eighth edition, vol.. ii. Captain Wm. C. Berry says:—

"Having had long expecence in the trade between New York and New Orleans, I herewith furnish you with a few remarks on winds and currents. For the last six years I have commanded the ship *Vicksburgh*, constantly trading between these two ports. In making the passage out, after passing the Hole-in-the-Wall, I have frequently found a current from one to three miles per hour, setting to the eastward through the north-west channel of Providence, particularly after the wind has prevailed from the eastward a few days. This no doubt has been the cause of putting a number of vessels on shore among the Berry Islands. I have latterly made it a point to take the last bearings of the light on the Hole-in-the-Wall, and either haul up or keep off as I found the current; generally running on a west course until quite down with Little Stirrup Keys, then steering W. by N. ½ N., by compass, if in the night, until I was up with the Great Isaacs. The last three voyages, having reached the the vicinity of the Little Isaacs in the day time, I have hauled in on the bank between the western Little Isaacs and the east Brother Rock, and steered S.W. by W., by compass, which has brought me out in good passing distance from the Moselle Shoal. During one of my summer passages out, after passing the above shoal, I was compelled to anchor, and remained there for six days. The wind during all this time was light from the southward, and I could not help remarking the regularity of the current setting along the Bemini Islands, ebb and flow, about two miles per hour. This continues as far as Gun Key, when close in little or no current is experienced, except the ebb and flow, which is directly off the bank. In crossing the Santaren Channel, the current is governed greatly by the winds; with strong southerly winds the current sets about N.N.W., two miles per hour; on the other hand, with strong northerly winds, little or no current is felt. After leaving the Double-headed-Shot Key, I have generally hauled over for the Florida Reef, and in the day time kept close-in, when I have frequently found an eddy current setting to the westward from one to one and a half miles per hour. After passing the Tortugas, I have invariably felt a southerly current until I had reached the longitude of 84° 30′ W., and even further than this at times, as will be seen by referring to my journals, particularly in November, 1848.

"Returning from New Orleans, I have always made it a point to keep to the westward until I had reached the longitude 85°, latitude 28°, before keeping off. My object in doing this is, that the wind here generally prevails from the northward and eastward, and that the current generally sets to the southward and eastward, which generally facilitates the passage. After rounding the Tortugas, with the wind from the eastward, I have generally beat down on the Florida side, knowing that the strongest current prevails on that shore, unless too close-in. From Carysfort Reef to Matanilla, I have always endeavoured to keep in the centre of the stream. During all my voyages, I have made it a rule to steer from Matanilla to latitude 22°, N. by W., and then north to latitude 31°, before hauling up N.E. by N.; by so doing I have, with a few exceptions, kept the strongest current. On some other occasions, I have hauled up on a N.E. by N. course, when in latitude 30°, longitude 79° 40′, and have soon found myself on the eastern edge of the gulf. After rounding Cape Hatteras, it is advisable to keep to the westward, especially in the winter season, on account of the prevailing westerly winds."

(197.) The FOLLOWING is an additional DETAIL of the best information we have been able to collect of the currents in the Caribbean and Mexican Seas, from the *Derrotero de las Antillas, &c.*

In the Channel between Trinidad and Grenada the current has been found to set nearly West; on the South side half a point southerly, and on the North side half a point northerly. Its velocity from 1 mile to 1½ and 2 miles per hour.

Between Granada and St. Vincent's, among the Granadines, the currents are devious; but the general inset appears to be W. by N.

Between St. Vincent's and St. Lucia the current, from the eastward, sets in more northerly; and within, on the West, it has been found setting to the N.W. Between these islands it seems to be as strong as in any other part of the range.

Between St. Lucia and Martinique it has been found nearly North. Very variable on the western side of the latter.

The current sets nearly in the same manner *between Martinique and Dominica. Northward of Guadaloupe*, it sets W. ½ S.; and between *Montserrat and Antigua*, N.W.

At the distance of about 1°, *within the range of the Caribbee Islands*, and to the Virgin Islands, the current has been found setting, in general, to the W.N.W. from 1 to 1½ miles an hour.†

In the *Mona Passage*, between Porto Rico and Hayti, the current has been marked as frequently setting to the N.W., and we have instances of a set through to the S.W.; but Captain Monteath, in February, 1816, when proceeding southward toward Porto Rico, in from lat 23½° to 22°, long. 64° to 65°, found the current seting N.N.E. at the rate of 20 miles in the twenty-four hours: and he says, that off the N.W. point of Porto Rico it invariably set from the Caribbean Sea to the North and N.N.E. On the western side of the passage it set North, 2 miles an hour: but there have been instances of an inset from the N.W.

From Trinidad, westward, and off the North side of the Spanish Leeward Isles, the current has been found setting West and S.W. to the Gulf of Maracaybo; thence S.W. also to Cartagena: but it varies, as already described.

From Cartagena toward tbe *Channel of Yucatan* it has been found N.N.W., N.W., W.N.W., and N.W. by N., from 1 to nearly 2 miles, and then decreasing to 1½ miles per hour. It has also been found setting to the eastward, as shown in the present pages.

(198.) **Counter Currents.**—From the foregoing it will be seen that the great drift which, passing from the Atlantic through the Caribbean Sea into the Gulf of Mexico to feed the Gulf Stream, is not nearly so constant nor so strong as might be argued, *à priori*, from the apparent magnitude of that mighty current. Not only is it inconstant even in the mid-channel, but it is diverted by local causes and land configurations into opposite directions, as is shown to be the case in the great Bays of Guatemala and Honduras, as described below.

Upon referring to the description of the Equatorial counter-current, as recited in (151 to 161.) pages 283 to 288, it is shown that it extends much farther to the westward, during the period when the sun is in northern signs, than had been before attributed to it. This western extension of the Guinea Current, coincident with the increase of the belt of Equatorial calms (45.) page 198, and (50.) page 201, may owe

* On the leeward side of the Virgin Isles devious currents are found, frequently to the south-eastward. The same have been observed on the western side of St. Christopher's, &c.; but see, hereafter, the Particular Directions for Navigating among the windward Islands.

its origin to the same causes, hitherto almost unexplained, as that to which this uncertainty of the great westerly drift across the Caribbean Sea is owing.

Whether it is owing to the influence of tide, the effect of distant and local winds, or of temperature, or of some hitherto unexplained effect of the earth's rotation, has yet to be argued. It is probable that hereafter a systematic examination of these apparently contradictory phenomena will lead to some important conclusions in the general subject of meteorology.

(199.) In the BAYS of GUATEMALA and HONDURAS, as above said, the currents are frequently found to be running rapidly from *west to east*, especially near the shores. This counter-current is seldom encountered outside the lines which join their outer points. From Cape la Vela, or northward of the Gulf of Venezuela, the current generally sets to the N.W. toward the Channel of Yucatan, as has been before remarked.

"In the space between Cape Gracias a Dios and Cape de la Vela offshoots and eddies from the great Equatorial current are found. This assertion is not merely grounded on those of former navigators, or on the examination of the coast outline, but on actual experience.*

"A writer worthy of great respect, Captain Mackellar, R.N., has stated—'The current between the island of Jamaica and the Spanish main, or coast of Colombia, is not always to be depended upon as setting to the westward, as is generally supposed; for, in crossing from Jamaica to the main, ships have been known to be driven to the eastward by the current.' This circumstance must be of rare occurrence at the northern part of the passage, and is here mentioned to make known its possibility. I myself have made the runs across between Jamaica and the opposite main at many times and seasons, and am, therefore, governed by practice as well as theory in the following remarks.

1st. *Local Current between the south side of Jamaica, the Morant Kays, and Pedro Shoals.*—This is very uncertain, both in rate and direction. Its rate may be from 0 to 1½ knot per hour; and it direction either north, east, or west, according to existing circumstances.

At the Morant Kays, the current is known to be variable. Over the Pedro Shoals it is supposed almost ever to run in a westerly direction. Between these two dangers, therefore, it behoves a ship at night to be full of precaution, and not to rely on the continuance of any current she may have ascertained, wheh either to the northward or southward of her then situation.

2nd. *Current southward of the Morant Kays and Pedro Bank,* or between the parallels of 17° and 15°. This current runs, perhaps always, true West to N.W. by W. from 20 to 55 miles per day.

Among the Mosquito Shoals the currents are equally strong and more uncertain. Between latitude 15° and a line extending from Cape de la Vela and Cape Gracias a Dios, including some of the Mosquito Kays, the direction is W.S.W. to N.W. 20 to 40 miles per day.

3. *Southward of the imaginary line between the Capes de la Vela and Gracias a Dios* and to the distance of 30 miles from the coast, the sets are so very variable as to as to baffle all system. Sometimes no current whatever is felt; at other periods it may run north, south, east, or west, 35 miles a day. Let it be borne in mind, however, that their direction is very seldom toward the *east,* but generally toward the *west.* St. Andrew's Isle and the frontier rocks of the Mosquito Bank are equally beset by changeable currents, of velocities amounting to *fifty* miles a day.

4. *Inshore or Land Current,* between Cape Manzanillo, near Porto Bello, and San Juan de Nicaragua. This current sets from *westward* to *eastward.* It is an eddy, striking out from the Caribbean Current at Cape Gracias a Dios, and eventually returning into it, with a broken and divided force, to the north of Cartagena. The

* Remarks by Capt. W. S. Smith, R.N., H.M.S. *Larne,* 1833.

breadth of this current extends from the land to a distance of about 30 miles in the offing. Its rate is from one to two knots, and its direction parallel to the curvature of the coast and capes.

The streams out of numerous rivers, entering this current, seems to increase its rapidity; for close in shore, between the rivers, the rate is seldom less than two knots; at six miles off the land it runs about one knot; and at a greater distance the same.

(200.) From CAPE ANTONIO the current sets, *at times*, to the E.S.E., past the Isle of Pines. Captain Livingston has informed us that, in March, 1818, he found the current between the Great Cayman and Isle of Pines to set in that direction, at the rate of fully 2½ miles in an hour, or 60 miles in the twenty-four hours. In August, 1817, he found the set nearly the same, but the current not half so strong. The *Spanish Directory* says:—"From Cape de Cruz, on the South side of Cuba, it is noticed that there is a *constant current to the westward*, with some inclination to the southward or northward, and which has been known sometimes to set 20 miles in a single day." In opposition to this, the exact words of Captain Livingston are—"I have twice experienced a strong current, setting about E.S.E., between the Caymans and Isle of Pines; and on the latter of these occasions both my mate and myself separately calculated it to set about 60 miles per day, or 2½ miles per hour. This, however, I incline to think a very particular case, such as may but seldom occur. The winds at this time were light and westerly. On the other occasion, so far as I recollect, it set about 12 or 14 miles per day only. All my papers on these subjects have been lost; but the first instance was too remarkable to be forgotten."

(201.) Off the South side of Cuba the current has frequently been found setting to the eastward when the moon is increasing, or in her first two quarters; and thus it continues from Cape Antonio to Cape Maize. It is represented that it runs to the eastward for a fortnight, and then to the westward about the same time. Coasters from the Caymans commonly take the advantage of the easterly current for making their passages to Jamaica.

From this information we may conjecture that the current, which has been described as setting to the E.S.E. from Cape Antonio to, is not *permanent*, but, at times, on the contrary, imperceptible, according to the age of the moon; and this has, we believe, been verified, in several instances, while the cause has remained unknown.

Captain Manderson had stated, that when a strong easterly wind has been blowing between Cuba and Florida, vessels heaving-to off the South side of Cape Antonio, at about 2 leagues from shore, have, in the course of one night, been carried against a strong sea breeze, nearly as high as Cape Corrientes, being a distance of 10 leagues. Our friend Captain Rowland Bourke, when once lying-to in the *Archibald* for the night off Cape Antonio, found himself next morning off Cape Corrientes.

Mr. Dunsterville has said, "I am firmly established in an opinion, from twelve years' observation, that not only are the winds and weather on the West India station influenced by the changes of the moon, but the currents also; and it is frequently found that, if the waters run to the eastward, it is at the change and full of the moon."

In an old book, already noticed (*Kelly's Navigation*, vol. i., 1733), is an abstract from a journal, which contains the following passage:—"Between the West end of Hispaniola and the Island of Jamaica, if I took my departure upon a full or change of the moon, I found that I made many leagues more than I did at the quarters of the moon. At the full and change I was looking out for the land long before I saw it; and at the quarters, I was down upon it long before I looked for it. The reasons, as I found afterward, were, that the full and change made a strong windward current, and the contrary on the quarters. This has been exemplified in many instances."

On this subject Captain Livingston says, "It is a prevailing opinion with many, that the moon governs entirely the currents among the West India Islands. No doubt the moon has some effect on them, but the winds have a still more powerful influence.

"It is rarely, indeed, on the North side of the Island of Jamaica that there is a westerly current when the North and N.W. winds prevail; the current then always, or almost always, setting to the eastward.

"On the South side of Cuba, when the wind is westerly, which it often is, you are always certain of a reflowing current round Cape Antonio. This is easily accounted for; as when the fresh trade-wind ceases, and the westerly winds set in, the barrier is, in some degree, removed, which confined the waters in the Mexican Sea, and they seek to regain their level as well by the channel of Yucatan as by the Strait of Florida."

Between the Isle of Pines and main land of Cuba is a strong north-easterly indraught, generally running from 1 to 1½ miles an hour, and which has caused the loss of many vessels on St. Felipe Kays and the dangerous bank stretching therefrom to the westward.

In the Windward Channel of Jamaica, the current generally sets with the wind to leeward or S.W.; yet both here and at Jamaica it is variable. Some have affirmed that, when a current runs to leeward, on the South side of Jamaica, there is frequently one setting eastward on the North side; and, at other times, no current is to be perceived; also that, when a lee current runs on the North shore, the same circumstances may be perceived on the South shore as were before observed on the North.

(202.) CHANNEL OF YUCATAN.—The principal entrance from the Caribbean Sea into the Gulf of Mexico is 110 miles in width, between Cape Antonio, marked by its fine lighthouse, and Cape Catoche, the N.E. point of Yucatan. The current most usually sets with considerable rapidity to the northward through it.

According to the calculation of all attainable observations derived from Major Rennell, Commander Maury, &c., the following is the mean rate of the current in the various months:—January, 33 miles per day; February, 34 miles per day; March, 36 miles; April, 33 miles; May, 17 miles; June, 26 miles; July, 39 miles; August, 31 miles; September, 30 miles; October, 38 miles; November, 36 miles; December, 48 miles per day. These velocities are much inferior to what might be supposed from the magnitude of the outset as formerly calculated, but this, as will be seen presently, has been over-stated.

(203.) At times the current is very strong, and every precaution should be taken against it.

The ship *Carshalton Park*, Captain J. Steele Park, sailed for Jamaica for London on the 20th May, 1824. At noon on the 27th she was off the S.W. side of Cuba, in lat. 21°. 26′, long. (by chronometer and lunars) 84° 47′ W. Here was dicovered a current setting to the N.W. at the rate of 2 miles an hour. At half-past seven Cape Antonio bore N.W. 5 or 6 miles. "The current to the N.W.," says Captain Park, "swept us into the Gulf of Mexico; and there we were beating about three or four days, making northing and westing in spite of our teeth. All this time the wind was easterly, and we might have cruised about there till Christmas, had the wind not got a little to the southward of East, which enabled us to get over to the N.E. side, where we found the current running directly opposite to the former," being now in the Florida Stream.

At about 40 miles *northward of Cape Catoche* the current has been found N.W. by W.; changing thence to S.S.W. off the N.W. point of Yucatan, nearly at the same distance from the coast. Rate, something less than half a mile an hour.

(204.) GULF OF MEXICO.—The Mexican Sea appears to be the receptacle and terminus of all the waters flowing westward, and although we are not perfectly acquainted with all the features of the currents, yet sufficient is known to warrant the affirmation, that the current through the Yucatan Channel diverging to eastward and westward, the western branch circulates around the whole of the shores of the Gulf to westward northward, and those flowing eastward and south-eastward joins the eastern, and perhaps principal, branch of the Yucatan current, forming the mighty Gulf Stream.

On the Chart of the North Atlantic before mentioned the observations given in Rennell's and Maury's Chart having been integrated, it plainly shows that the circulation stated above does exist, and that it follows the main trends of the coasts of Yucatan and Mexico, and thence along the coast of Texas, at rates varying from 14 to 31 miles per day.

(205.) The mean temperature of the water of the Gulf of Mexico is probably as high as any part of the ocean, from several manifest causes, and hence it is, in the bed of the sea, that those nurseries of the Sargasso weed exist (168.), which, torn from their habitat by the force of the current, are drifted into that great central area of the Atlantic, to which they give the characteristic peculiarly.

It is also probable that animal life is peculiar and abundant in these tepid waters. "The phosphorescent lights observed in the Mexican Sea shine with greater brilliancy (April) than I had noticed elsewhere: some of these were very large, and flashed like the priming of a gun, sometimes at a long distance from the ship. I observed that the little shing spiracles were confined to the sides of the vessel and her wake, and that the waves, when they broke into foam, did not (as in other parts of the ocean) sparkle.

"The colour of the water in the Sea of Mexico is of a dark indigo, darker or more intense than that of the ocean generally; the colour of the sea in the Florida Channel is a fine blue, not so dark as that of the Sea of Mexico, or of the ocean generally. Phosphorescent lights are equally abundant in the Florida Stream, some unusually large and brilliant; and some of the small lights appeared to spring out of the water with a sweep motion, which I had never before observed; the temperature of the water was 79°, that of the air 76°."—J. E.

(206.) The following exemplification of the currents of the Mexican Gulf is taken from the eighth edition of Maury's "Sailing Directions," vol. ii., p. 17:—

There is a constant set from the Carribbean Sea into the Mexican Gulf to find the Gulf Stream. Vessels passing up to the northward may take advantage of it. It is bifuricated just after entering the Gulf. The bottle paper of the *Hermes* followed this Yucatan current to the "fork," and then took the western branch.

"H.M.S. *Hermes*, 15th April, 1858, lat 17° 59′ N., long. 78° 50′ W., H. Congton, commander, J. E. Solfleet, master. This bottle thrown over at the West end of Jamaica, was found on the South point of Padre Island, lat. 26° 5′ N., long. 97° 10′ W., Aug. 23, 1857, and forwarded by Mr. J. R. Baker, who says, 'The drift shown by the course of this bottle confirms my own observations since I have been here, viz., that the current divides between Cape Antonio and Cape Catoche, the western part of it keeps a westerly course until it reaches this coast between San Fernandino on the coast of Mexico, and Corpus Christi on Texas, where it meets the south-westerly current from the coast of Florida and Louisiana. And it is strange to remark the mixture of floating objects thrown on the beach of this coast by this meeting of the currents. Flat boats, oars, saw-logs, clap-boards, old skiffs, &c., from the Mississippi mixed up with branches of the mangrove, mahogany, bay cedar, young cocoa-nuts, canoe paddles of mahogany, &c., from the Carribbean Sea and coast of Honduras.'

"It may be remarked on this that the easterly winds may have something to do with the westerly drift from the Mississippi of objects which float high out of the waters.

"Another bottle, from the ship *Admiral*, S. Picken, commander, thrown over on the Equator, long. 30° W., 17th February, 1856, came ashore at Aransas Pass, Texas, Oct. 24, 1856, 250 days afterwards, having drifted 4,300 miles, or 16 miles per day."

(207.) It is difficult to define the separation between the currents which pass eastward and westward to the North of the Yucatan Channel. It is certain that they set with considerable velocity to the southward and south-eastward over the Tortugas Bank, and also to the S.E. from the Mississippi. Perhaps a line might be drawn from the centre of the strait to the mouth of the Mississippi, to the west of which it will usually be found that the streams have westing in them, and to the east of it that they set towards the Gulf of Florida.

In the strait between Cuba and the Florida Reefs, that great stream which is described in the next section, has really its commencement.

7.—THE GULF STREAM.

(208.) The Florida or Gulf Stream has received more attention—has been the subject of more speculation—and has served as the basis of more theories, than all the other currents of the ocean collectively. Although modern research, conducted with all refinement, in contradistinction to the imperfect observation of the passing seaman in former years, has shorn it of much of the grandeur and magnitude it has been invested with, still it is a mighty and majestic current, well worthy of all the laborious investigation which the philosopher or mariner have bestowed upon it.

In the preceding pages we have traced the course of the waters from the shores of Europe down to the great set or tropical drift, and thence through the Channel of Yucatan to the entrance of the narrow channel between the north shore of Cuba and the Florida Kays. Here may be said to be the commencement of the Gulf Stream as an independent current, as it flows swiftly hence to the eastward in opposition to its previous course, and then northward through the narrows between Cape Florida and the Bemini Isles. Keeping this direction with its high velocity and temperature, it is deflected to the N.E. by the form of the American coast, and assuming a more easterly direction, and gradually spreading its warmer waters over a broader area, it pursues its course with a gradually decreasing rate, though still much warmer than the sea on each side of it, it reaches the southern part of the banks of Newfoundland. At this part it encounters the southern Arctic Current, which, crossing its track and importing into it the influences of an artic temperature, and the counteracting effects of an adverse current upon its diminished force and much decreased volume, it ceases to maintain its character as a Gulf Stream or an independent current. Its effects, however, in bearing the tepid water of the Gulf of Mexico with all the floatable objects collected in its progress, are still drifted onwards by the prevailing westerly and W.S.W. winds, which it has been shown (73.) page 212, predominate over the ocean between this part and the western face of the Old Continent. It transports its influence and attaibutes over to the shores of Europe, the southern shores of Ireland, past Norway, and into the Arctic basin.

Inside, or to the West of the Gulf Stream, along the eastern face of the United States, there is a cold, counter-current setting southwards from the Arctic regions, which will be described in its place hereafter. A similar counter-current, though of a different origin, runs to westward between the Gulf Stream and the Florida Kays.

(209.) *History.*—The Gulf Stream was known by its present name, and in its now known form, from very early times. Probably it was recorded and discussed at the first voyage undertaken by the discoverers and colonisers of North America, who passed out by this Channel on their return voyage to Europe. As an example, John White, who went a voyage thither in 1590, says:—"July 30, 1590, lost sight of the coast of Florida, and stood to sea, for to gain the help of the current which runneth much swifter afar off than in sight of the coast; for from the Cape [Florida] to Virginia all along the shore are none but *eddy currents setting setting to the S. and S.W.*" Here we have not only the Gulf shown, but the inner counter-current alluded to, as will be dilated on hereafter.

Again, that excellent observer, William Dampier, in his "Discourses on the Trade Winds," &c., published in 1699, page 105, gives the following observations:—

"And 'tis as probable, that the Current, which sets to Leeward on all the coast from Cape *St. Augustine* to Cape *Catoch*, never enters the Bay of *Mexico*, but bends still to the Northward, till 'tis check'd by the *Florida* shore; and then wheels about to the East, till it comes nearer the Gulph's Mouth, and there joyning with the soaking

Current that draws down on the North sides of *Hispaniola* and *Cuba*, passes altogether with great strength through the Gulph of Florida, which is the most remarkable Gulph in the World for its Currents, because it always sets very strong to the North. Yet near the shores on each side this Gulph there are tides especially on the *Florida* shore; and Ships may pass which way they please, if they are acquainted.

"It has formerly been accounted very dangerous to meet with a North in this Gulph; and for that Reason our *Jamaica* ships, to avoid them, have rather chosen to go to the Eastward and pass through the *Cacuses* in the season that the Norths do blow. The *Cacuses* are sands that lye off the N.W. end of *Hispaniola*. Those that went from *Port Royal* in *Jamaica* had good reason for this; for if a North took them at their going out, it would help them forward in their way, which, should they have been going towards the Gulph, it would obstruct them. Then besides, if a North take a ship in the Gulph, the Wind blowing against the Current makes an extraordinary Sea, and so thick come the Waves one after another that a ship can't possibly live in it, yet of late they go through at all times of the Year, and if a North takes them in the Gulph, they put away right before the Wind and Sea, with a small heed sail; yet the Current is then as strong or stronger than at other times, and forces them back, stern formost against both Wind and Sea; for tho' the surface of the Sea is raised in Waves and driven violently with the Winds to the southward, yet the Current underneath runs still to the Northward; neither is it any strange thing to see two different Currents at one place and time, the superficial Water running one way, and that underneath running a quite contrary: For sometimes at an anchor, I have seen the Cable carryed thus by two different Streams, the under part having been doubled one way, and the upper part the contrary."

It is, therefore, somewhat surprising that a claim should of late years have been made for Dr. Franklin as the real discoverer of its nature and its warmth in 1770. The tale is this: Being in London in that year he was consulted by the Treasury as to why the Falmouth packets were generally a fortnight longer to New York than common traders were from London to Providence, Rhode Island? He, therefore, consulted a Nantucket whaler, who explained that the Rhode Island captains being acquainted with the Gulf Stream, avoided it, while the Falmouth commanders being ignorant of it, were set back 60 or 70 (!!) miles a day by it. The Nantucket captain laid its course on a chart, which is also stated to have been followed almost without an alteration. Without stopping to refute this altogether, which may be done by Dampier and his predecessors, it will be evident that something else than the Gulf Stream must have retarded them 60 or 70 miles a day in that latitude, if they were thus delayed.

(210.) Causes.—There have been very many speculations as to the cause of this great stream, but they have been promulgated before any increase of knowledge upon which to found arguments, and as has been said above, recent investigations have overturned most of those which have been advanced. It has been supposed that it runs out of the Gulf of Mexico from the superior level of that sea, but facts are wanting for such an assumption. Captain Manderson, R.N., promulgated an opinion in his "Examination as to the true course of the Florida Stream," that it was owing to the Mississippi and the floods from the other rivers falling into the Gulf of Mexico. It was still further argued that the velocity of the Gulf Stream might be determined by the flood from these rivers. But Captain Andrew Livingston, in our former editions, overturned this hypothesis by showing that what is poured into the sea by the river Mississippi is not a three-thousandth part of the volume of the Gulf Stream. He thought that it might be accounted for by the motion of the sun in the ecliptic, and its influence on the Atlantic waters.

The effects of temperature is also advanced as the prime mover, by increasing the heat of the water it expands, and thus becomes higher than the cooler waters beyond it, and as the Gulf of Mexico has the highest temperature here is the head water of the Gulf Stream on that account. Sir John Herschel says on this point:—"Let us see what this declivity, formed by unequl temperature, would amount to. The equatorial surface-water has a temperature of 84°; at 7,200 feet, the temperature is 39°, the level of which temperature rises to the surface in lat. 56°. Taking the dilatability of sea-water to be the same as fresh, a uniform increase of temperature from 39° to 84° would dilate a column of 7,200 feet by 10 feet (or 9·971 feet more exactly), at which height, therefore, above the spheroid of equilibrium (or above the sea level in 56°), the equatorial surface is actually raised by this dilatation. An arc of 56° on the earth's surface is 3360 geograpical miles, so that (were the water to run direct north) we have a slope of 1-28th of an inch per mile for the water so raised to run down. As the accelerating form, corresponding to such a slope (of 1-10th of a second, 0·1″ of arc) is less than the two-millionth part of gravity, we may dismiss this, as a cause capable of creating only a very trifling surface drift, even were it the proper direction to form, by concentration, a current from east to west; *which it would not be, but the very reverse.*"

Evaporation has been assumed as another cause, but it can be shown that the lines of maximum evaporation are near the tropics, that is near to the point where the Gulf Stream removes and flows away from, instead of running towards, if this be taken as a sole cause. But the line of greatest precipitation is near the equator, and therefore the surface-water of the ocean is lighter, or of less specific gravity than under the evaporating tropical influences to which line this source of instability will cause the waters to flow directly towards, throughout the whole circuit, and not in the form of partial stream. Besides this, it may be shown by the few experiments hitherto recorded, that the density of sea-water, at some fathoms below the surface, is very nearly the same all over the ocean, so that surface experiments afford but imperfect data upon which little or nothing can be grounded in our present state of knowledge.

(211.) There have been so many objections raised to the plain fact that the trade and anti-trade winds will account for many or most of the phenomena of oceanic circulation, that it would be far too discursive for a practical work to enter into such a field speculation. As has been stated before (2.) 177, the winds and water of the Atlantic seem to follow much the same law, as far as their different natures will allow, that is, they circulate more or less around a central axis or area—the calms of Cancer in the one case, and the Sargasso Sea in the other. All further theory must be sought for in those works which deal with speculative science.

Captain Maury has adduced arguments against the theory of assuming the trade winds as the prime cause of the Gulf Stream, in opposition to the line of reasoning followed by Sir John Herschel. He has drawn up several tables to show that the S.E. Trades have a greatly preponderating force over the N.E. Trades in the Atlantic, but throughout he proceeds on the assumption that the *equator is the division* between the two systems. This basis, which he elsewhere disproves, will very inadequately explain the relative force and duration of the two trade winds, as is shown in (23.), on page 184. In fact from arguing in this way, he endeavours to prove, that from the much greater force, (nearly twice) of the southern trades, from their much greater constancy, and still further, that from the greater preponderance of *westerly* winds within the tropics, on the north side of the equator, *that the North-East Trade Wind scarcely blows at all in the North Atlantic.* A position which is amply disproved by his pilot charts, and by the experience of all sailors. It need scarcely be argued against that the S.E. trades have *quadruple* the force, and nearly *double* the duration of the N.E. trades, making them *eight* times as important.

But besides this, the wind and current charts demonstrate that the S.E. trades, and their consequent drift, are almost always felt throughout nearly the whole year, to the *north* of the equator, and in fact send a large proportion of the water into the Caribbean Sea (11.), page 180. The trade winds may therefore be held to be a great cause of the Gulf Stream.

(212.) The Gulf Stream has had from very early times a very bad reputation among ship-masters for its dangerous character, and the hundreds of wrecks and millions of property which have bestrewed its margin have given good occasion for such a character. For not only is it to be dreaded for its stormy character, but also its violent stream renders a ship quite unmanageable during a calm, and at these times should hazy weather occur, and the sameness of the shores mislead the stranger, he is open to many difficulties and dangers. But the excellent system of beaconage along the Florida Reefs, as presently described, and the important lights which direct by night, have very much reduced its bad chacater, and diminished the employment of that enterprising race, the wreckers of Key West and the Florida Keys. Still the high rates of insurance for ships which navigate it, and which are yet maintained, although not so entirely as formerly, show that the reputation was not quite groundless.

(213.) *Characteristics.*—The *indications of the stream* are the *appearance* and the *temperature of the water*. The stream, in its lower latitudes and usual course, in fair water, where it flows uninterrupted, may be known by its smooth and clear blue surface; for, without the line formed by a ripple on its edge, the water in some places appears like boiling water of a blue colour; and, in other places, it foams like the waters of a cataract, even in dead calms, and in places which are fathomless.

On the outer edge of the stream, especially in fair weather, there are great ripplings, which are very perceptible. The appearance of the sea-weed, by day, is an indication of this edge of the stream; this weed being, *commonly*, on the edge without the stream, in greater quantity and larger clusters than within it.

It has been said that the water within the stream does not sparkle in the night. We are assured by Captain Livingston that, though this is a common, it is a misconceived, idea. "I have frequently seen it sparkle much; even last night it sparkled considerably, when we were in about 25° N., and 80° or 79° 40′ W.; and off Cape Roman, Cape Fear, Cape Hatteras, and the entrance of the Deleware, I have seen the water sparkle pretty much, though I think not equal to what it does in many other parts of the ocean."—*In the Stream*, 10th of September, 1818. *A. L.*

"It has been mentioned by Dr. Franklin, that the water of the Gulf Stream *does not sparkle in the night*. This, so far as my observations go, is incorrect: I saw little or no difference between that and the other water on the coast; but, if there was any, that of the Gulf Stream was the most sparkling and luminous. It may, however, be observed, that the same water is very different, at different times, in this respect.

"The same ingenious writer and philosopher likewise observes, that the gulf-weed is a sign of being in the stream. This is in part true, but by no means to be considered as a general rule, because *the water on the borders of the stream is constantly mixing with the adjoining water, and leaving some of the weed behind*, which consequently falls into the eddy currents, and is carried off many leagues."

(214.) *Extent.*—The Gulf Stream commences its great career between the Tortugas Bank and the coast of Cuba, therefore the line joining the Dry Tortugas and Havana may be taken as its starting point. It is here 95 miles wide. At the channel between the Kay Sal Bank and Sombrero Kay it is only 48 miles wide; off Cape Florida, its narrowest (and shallowest) part, it is 45 miles. Between the edge of soundings off Jupiter Inlet and the Matanilla Reefs it is 55 miles. This part of the Gulf Stream, which confines it, before it shoots off uncontrolled into the Atlantic is 330 miles long.

Pursuing its way northward, its warmest waters and strongest current keeps near to the edge of the bank of soundings which fronts the coasts of Georgia and the Carolinas, following the general curve very strictly, and in its main strength keeping 50 miles off Cape Hatteras. This portion of its course from the channel within the Matanilla is about 590 miles further.

To the northward of this it still follows the edge of the banks of soundings, and being diverted more to the east by the obstacles lying off it, gradually winds more

* Journal of Commissioner Andrew Ellicott, Philadelphia, 1803.

eastward towards the parallel of 40°, and skirting the southern edge of the Grand Banks of Newfoundland, it proceeds with diminished velocity and temperature to about the meridian of 40° West, when its further drift to the westward cannot be distinguished from that to the north and south of it. This further course may be taken at about 1,600 miles. The total distance we have thus gone over will be about 2,500 miles, throughout the whole of which its characteristics may be distinctly traced, although its lateral boundaries are not so easily defined. It has been usual to extend its independent existence some 1,200 or 1,500 miles further to the shores of Western Europe, as before stated, but when its volume in the outset, or in its *narrowest* part, is considered, it will be no great sacrifice of previously formed opinions to curtail it of its more extended features.

(215.) Throughout its latter course its left-hand margin carries the greatest strength. In the Gulf of Florida its southern side is the most powerful. Northward of the gulf its eastern and south-eastern side is difficult to define, as it is found that the Gulf Stream may be said to consist of several longitudinal bands of water, as presently described. To the southward of British North America its force gradually disappears till it is lost in the central still water of the Sargasso Sea. The diagram of the currents which elucidates this section will give a clearer idea of its relation to the great circulatory system, than any long description can do.

(216.) *Depth.*—Deep-sea sounding has of late years been conducted with such precision and certainty that any doubts which were formerly held on this topic ought to be abandoned. It is true that the labour and appliances can only be at the command of Government vessels in their extended use; but the United States' Government officers have done well to maintain their national honour in their endeavours to elucidate their famous current.

We are now made intimate with the former hidden mysteries of the commencement of the Gulf Stream, through the observations conducted by the United States' Coast Survey between 1855 and 1859. In the first named year, Lieutenant-Commander Craven obtained soundings and temperatures along the bottom of the stream in its narrowest part, 45 miles wide, between Cape Florida and the Bemini Isles, which are so remarkable as to overturn all preconceived notions. The next section is from the Carysfort Reef Lighthouse to the Bahama Bank, about 50 miles southward of the former, and was examined by Lieutenant-Commander Craven in May, 1859. The next, by the same officer, and in April of the same year, is between Sombrero Kay on the Florida Reefs to the West point of the Salt Kay Bank, and thence to the coast of Cuba, near Cayo Piedras; and the fourth is at the point where the Gulf Stream, as a stream, may be said to commence, between the Dry Tortugas and the, Havana. This was examined by Commander Sands in 1858.

In the section between the Tortugas and the Havana, 13 stations were observed, the distance across being about 95 miles. The stations are not quite equally distributed in distance over the whole interval; but the following figures will give the common results. The stations commence from the northern side:—

33 35 65 130 200 330 520 610 710 770 fathoms.

It will be seen that the deepest water, about 800 fathoms, is on the Cuban side, being within five miles of Havana. This characteristic is followed all the way along the Cuban side and that of the Great Banks. This effect seems to have been produced by the action of the sub-current in wearing a deeper channel upon the concave side of the stream. At the Havana, as above shown, there is an abrupt descent of nearly a mile within five miles of the shore, while, on the side of the Tortugas and Kay West the water is comparatively shallow and the descent gradual.

This fact goes to confirm the conclusion that the strong current of the Gulf Stream makes the circuit of the Gulf of Mexico (204.), since if it impinged directly upon the land of Kay West and the Tortugas, we should find its effects in the wearing of a deeper channel on that side.

(217.) The next section is about 120 miles farther East, from the Sombrero Lighthouse to the Salt Kay Bank, and 4 stations were observed in the distance of forty-five miles.

60 130 600 375 fathoms.

The last being within 5 miles of the Salt Kay Bank, the descent from the Florida side being more gradual.

(218.) The next section is between the Carysfort Lighthouse and the Great Bahama Bank, a line bearing about E. by S. and W. by N. true, distance 63 miles. 6 stations were observed, commencing from the Florida side; they were as follow:—

120 380? 500? 470? 370? 213 fathoms.

The steepest descent is that on the eastern side of the stream as before noticed.

(219.) The next is the most important because the most remarkable—that across the narrows of Cape Florida, a distance of 45 miles. It was taken nearly East and West true, and at equal distances 5 miles apart. The depths were as follow:—

72 170 170 260 300 315 325 300 100 fathoms.
320 370

(220.) The *shallowest* and *narrowest* part of the stream is therefore here. From hence westward there is a rapid descent of the bottom from 350 to 800 fathoms, or 2,700 feet, in a distance of 200 miles; and the temperature sinks from 80° on the surface to 40° at the bottom. At this last section, also, instead of the even curve which the bottom seems to have as in the southern sections, it is here somewhat irregular, and hence northward there are some curious variations of temperature discovered in crossing the axis of the stream which are not found to the south-westward, as will be presently explained.

The fact of the shoalest part of the bed of the Gulf Stream being on the Florida side will account for the existence, on that side almost exclusively, of a counter or westward current, which will be more fully dilated on hereafter.

(221.) The same process of deep-sea sounding and gaining the temperature has been carried on at various points to the northward on lines perpendicular to the axis of the stream, extending from the shore to beyond its outer limits.

It is difficult to explain the nature of these soundings and their results without the accompanying diagrams; but they are, of course, of more utility to the physical geographer than to the sailor. What follows on this head is mainly derived from the Reports of the United States' Coast Survey.

The general plan of exploration of the Gulf Stream, laid down in 1845, was to observe the phenomena on sections perpendicular to its axis from well-determined points on the coast. In pursuance of this design, sections were run from near Montauk Point, Sandy Hook, Cape Henlopen, Cape Henry, and Cape Hatteras, previous to 1848. Lieut. Comg. Craven was directed in 1853, in returning from the Florida Reef, to run four sections across the stream from near Cape Canaveral, St. Augustine, St. Simons, and Charleston; and Lieut. Comg. Maffit, after closing his work at Georgetown, South Carolina, to run three sections respectively from Charleston, Cape Fear, and Cape Hatteras.

On the Charleston section, bottom was carried from ten fathoms, thirty-eight nautical miles south-east from Charleston Light, to one hundred fathoms, sixty-five miles south-east from the light. The bottom was not reached at five hundred fathoms, nor in 600 fathoms in the stream. At 97 miles from Charleston Light, after crossing the warmest water of the Gulf Stream, bottom was struck in three hundred fathoms in the main strength of the current, and was kept at variable depths from five hundred to three hundred and seventy fathoms to two hundred and seven miles from the coast, or eighty miles beyond the outer limit of the stream. The bottom was brought up in every case, and has been preserved, showing some very interesting results.

After crossing the Gulf Stream on the Canaveral section, Lieut. Comg. Craven struck soundings at four hundred fathoms at sixty-nine miles from the coast. It appears thus that the existence of soundings of from three hundred to four hundred fathoms, after crossing the Gulf Stream at these two points of our coast, was discovered independently by the two officers nearly at the same time. In the subsequent sections run by the *Corwin*, soundings were struck one hundred and twenty-five miles off St. Simons in five hundred fathoms, and off Charleston in four hundred and eighty fathoms.

The form of the bottom on the Charleston and Canaveral sections shoals gradually from the shore to fifty-three and thirty-six miles respectively, then suddenly falls off to below the depth of six hundred fathoms. On the Charleston section, ninety-six miles from the coast, is a range of hills steep on the land side, and having a height of eighteen hundred feet and a base of about eleven miles on the seaward side; a second range one hundred and thirty-six miles from the coast, fifteen hundred feet high and twenty-eight miles base towards the shore, and six hundred feet high, with a base of about seventeen miles, on the outer side. Beyond this is a more gradual rise. On the Canaveral section the inner range is sixty-eight miles from the coast. In fact, on the Canaveral section, after sounding at the depth of one thousand and sixty fathoms, the steamer drifting about a mile and a quarter, the line showed bottom at four hundred and sixty fathoms. Both are stated to have been good up and down casts. These first observations, while they are merely a foundation to build upon, are undoubtedly in the highest degree interesting and important in their connexion with the phenomena of the Gulf Stream.

On the sections from Cape Fear and Cape Hatteras, after leaving the shoals near the shore, the depths increase very rapidly.

Lieut. Comg. Craven noticed ripples in connexion with the irregularities of the bottom on the Charleston section. Similar ripples were observed on the Sandy-hook section and on the Montauk section in 1845, and were compared to the "rips" on the Nantucket shoals. These are, however, probably a secondary effect of the irregularities by the changes of current produced.

(222.) As far, then, as Cape Hatteras the bed of the Gulf Stream has been found not to exceed 600 fathoms in depth, and is in many parts very irregular. We know but little as yet to the northward of this; but infer that the ocean is here very deep, as at 100 miles N.E. of Cape Hatteras Lieutenant Lee, U.S.N., in the *Dolphin*, found it to be 1,460 fathoms; and at 225 miles south of Nantucket, Lieutenant Berryman, in the same vessel, found the depth to be 2,920 fathoms. South of Sable Island, in lat. 40° $\frac{1}{2}$ N., 2,750 fathoms were found. South of the Grand Bank, from 1,700 to to 2,710 and 3,130 fathoms were found by the *Dolphin*, These are depths to which the Gulf Stream can have no influence, as it will be shown that even in its narrowest part it does not reach to the bottom. Although thus deprived of a large portion of the magnitude with which it was formerly believed to be invested, it is not the less a wonderful stream, as it is able so expanded and thinned out to maintain its course and character unimpaired over the counter-currents of a totally different origin and nature which flow beneath it.

(223.) **Breadth.**—As has been stated before, it is difficult to define the exact boundaries of the Gulf Stream, which is, in fact, but one out of a series of several. But whilst the more minute examination which has been made has added something to our knowledge of its features, it has not hitherto been sufficiently extensive to fix its limits, either by an average, or, if it is more exactly defined, to give us the position of its margin in different seasons. However, as numerous observations have been given on its drift, we may give a rude approximation to its extent from the positions where the drift has been found to be appreciable. In the narrowest part it is about 40 miles broad—a breadth it maintains to abreast of Cape Canaveral. Off Charleston, it is about 70 miles; off Cape Look-out, 100 miles; off Cape Hatteras, 120 miles; while off Nantucket, it is probably expanded to 300 miles, so that it has widened to more than seven times the extent it commenced with. This fact ought to direct attention to its physical condition, more particularly as its warm waters could not be, arguing from this, more than 10 to 20 fathoms deep, if, as is shown, it does not extend, as warm water, to one-half the depth of the narrows of Capo Florida, or

150 fathoms. Some explanation of this anomaly may be found in the fact of the N. W. current along the North side of the Bahamas as shown on page 299; and there is little doubt but that this drift is also the parent of some of those warm belts which have been encountered outside the main stream.

(224.) **Velocity.**—Our knowledge of the velocity of the Gulf Stream is not sufficiently extensive to pronounce absolutely at what rate it flows as a mean rate. It is very irregular in all parts, and there has been no systematic collection of observations recorded on the subject. The results of a large number are given in our Chart of the North Atlantic; but, as will be seen from the following summary, there are more variations than can be reconcileable with the change of the seasons.

Between the Tortugas and Florida, it has been found to run at the following rates: —*January*, 40 to 60 miles per day; *March*, 64 miles; *April*, 36 miles; *May*, 54 miles; *June*, 24 (?) miles; *July*, 26 (?) miles; *August*, 65 miles; *September*, 28 miles; *October*, 48 miles; *November*, 30 miles; *December*, 31 miles.

In the narrows off Cape Florida—*January*, 54 miles; *March*, 112 miles; *June*, 60 miles; *July*, 96 miles; *August*, 78 miles; *October*, 42 (?) miles; *November*, 76 miles.

Farther north these rates are diminished, as we find that in the parallel of 30° N. the mean rates are—For *January*, 58 miles; *April*, 33 miles; *May*, 97 miles; *September*, 84 miles; *October*, 50 miles.

Off the Chesapeake, the mean daily rate is 45·5 miles; off Nantucket, 55 miles; South of Sable Island, 36 miles; South of Newfoundland, 28 or 26 miles; and South of the Grand Bank, not more than 15 miles per day.

(225.) The latter part of the month of August and beginning of September is the period in which the Gulf Stream runs in its greatest strength and highest temperature. Its weakest and lowest is in February. In October the stream is considerably weaker; and it fluctuates in all seasons according to circumstances. The strength of its western and northern borders, in its entire and vast extent, is much greater than those on the East and South, which have invariably a tendency to spread over the ocean in whirls or eddies, and which are, therefore, comparatively weak.

The winds are found to affect the position of the surface considerably. Between Cuba and Florida northerly winds press it southward toward the shore of the former; southerly winds have a contrary effect. When turned to the North, easterly winds press it to the Florida side, and westerly winds nearer to the Bahamas. Southerly winds cause it to spread, and so may those from the North.

In the Strait of Florida, within the Bahamas, when a northerly gale, increased to a storm, opposes the stream in its course, this adverse power causes it to fill all the channels and openings amongst the Martyr Isles and Reefs, and to overflow all the low coast. Shipping have even been carried over the low kays, and left dry on shore.

In the month of September, 1769, there happened an inundation, which covered the tops of the highest trees on the Cayo Largo, &c., and during which the *Ledbury* snow, John Lorain, master, was carried over the reef by the N.W. current of the stream, caused by a gale from the N.E. The vessel bilged in shallow water, but an anchor was thrown out, and the next day the vessel was found to have grounded on Elliot's Kay, with its anchor among the trees.

The water is supposed at times to have risen to the height of 33 feet; and to have been running against the fury of the of the winds at the rate of 7 miles an hour. During these times the Strait of Florida exhibits a scene beyond description.

Besides the effect which different winds have upon the stream, it is subject to another power that also directs it toward or from the coast; and that is, the moon, which, according to her position, has different effects upon it, not, however, in equal power with those of the wind; but the disposition of the stream is increased to its extreme, if the effect of both the wind and the moon are combined; for, at this time, the ocean rising highest, this regulates the flood and ebb, and divides them in proportionate times; consequently it directs and increases them, with an easterly moon and wind to the West, and with a westerly moon and wind to the East; so that the West and East shores are at times deprived of, and at other times overflowed by, tides, occasioned by these vicissitudes.

The boisterous East, N.E., and North winds which affect the Gulf Stream, generally begin in September, and continue until March; when, if the moon happens just at the time to be on the full or change, they commonly end with a hurricane.

(226.) Lieut. J. C. Walsh, of the U.S.S. *Taney*, in 1849-50, made several interesting experiments on the temperature and extent of the Gulf Stream, the first in October, 1849. On the 31st of that month he first encountered the Gulf Stream, in lat. 37° 22′ N., long. 71° 26′ W., the temperature of the water suddenly rising from 66° to 76° and 77°, the air being at 53° and 54°; by making a S.S.E. course good, they got out of it, judging from the water getting back to 70°, in lat. 36° 16′ N., long. 70° 57′ W., the breadth being 71 miles; the velocity being about 3·6 knots per hour.

Re-crossing the stream, on his return, May 30th, 1850, he entered it in lat. 35° 30′ N., long. 72° 35′ W.; the temperature at eight a.m. being 71·8°; at 50 fathoms, 71·8°; at 100 fathoms, 67°; the air, 70°. At noon, the surface was 78·5°; at 50 fathoms, 77·5; at 100 fathoms, 72·5°; the air 76°. Its velocity was 2·5 knots per hour, setting N. 77° E. He left in lat. 36° 42′ N., long. 72° 10′, bearing from the point of entrance N. 16° E. 78 miles, which, therefore, appears to be the breadth at this time. When on soundings next day, June 1st, in lat. 39° N., long. 70° 30′ W., the water showed as low as 51° at the surface, and maintained an average temperature of 53° until he reached New York. This was a difference of 28° from the adjoining Gulf Stream. Shoals of porpoises and black fish were seen in the hot waters of the stream; but little gulf weed in it, but much at its outer edges.

(227.) Captain Livingston has said:—"The calculations of the velocity of the Gulf Stream are not to be depended on. I have found it setting at the rate of 5 knots, and even upwards. This was on the 16th and 17th of August, 1817. On the 19th and 20th of February, 1819, it seemed to be almost imperceptible. In September, 1819, it set at much about the rate described in the charts."

One remarkable instance of its diverging from the usually supposed velocity is given in a communication of Captain Giles, of the barque *Charles*, who found it to run 5 and 5½ knots, in January, 1843. "The first day I began to make any material progress was with the Tortugas bearing about S.E.; the following day I had a current of 53 miles S.E. by S.; the next day, 60 miles S.S.E. ½ E. I was then in lat. 24° 10′, long. 83° 0′ W. The weather would not permit our sighting the Tortugas, though we passed them very closely. The next day we made, by very good observations, 75 miles of due easterly current, which, with the ship's work, placed her in lat. 24° 12′, and long. 81° 33′ W. The succeeding day, towards dark, the wind being strong from E.S.E., and considering myself in the vicinity of the indraught of the Great Inlet, I put the ship's head to the southward, under *close-reefed* topsails, and nothing more set, and reached her to till daylight, that being twelve hours good; towards noon it fell calm. I then found that we had been set nearly in the direction that the elbow of the land trends, *one hundred and ten miles*, we being at noon in lat. 25° 15′ N., long. 79° 45′ W. The following day we had light, variable airs and calms, heavy rain, much thunder and lightning, and very thick weather (as it had been the day previously). We picked ourselves up at noon, lat. 27° 20′ N. and long. 79° 30′ W., having had the current N. by E. *one hundred and twenty miles*. I intended to pass through the Providence N.W. channel, but the current sweeps us past the mouth of it in the light airs which we had on the last two days of our passage."

(228.) Captain (now General) *Sabine*, F.R.S., says:—"There can be little hesitation in attributing the unusual extension of the stream in particular years to its greater initial velocity. It has been computed by Major Rennell, from the known velocity of the stream, at different points of its course, that in the summer months, when its rapidity is greatest, the water requires about eleven weeks to run from the outlet of the Mexican Sea to the Azores, being about 3,000 geographical miles.

"July and August are generally the months of the greatest initial velocity of the stream, and the period when the levels of the Caribbean and Mexican Seas are most deranged.

"The initial velocity in November, 1822, was 70 miles in the twenty-four hours. The temperature 80°·8 to 80°·5. After passing Cape Hatteras, 77 miles.

"In the summer months the stream issues from the outlet with a velocity nearly one-third greater than at the period of the *Pheasant's* voyage; or the latter part of November, 1822.

"On the 5th of December, 1822, the *Pheasant*, bound to New York, quitted the northern boundary of the stream in lat. 36½°, long. 72½°. In the stream, in lat. 36° 14′, long. 72° 25′, the temperature of the surface water was 74°, and of the air, 65°. Between ten a.m. and noon the temperature had fallen from 74° to 62·4°, being a difference of 11·6. The surface water on which the ship entered was in motion to the westward, at the average rate of 16 miles in the following twenty-four hours, and generally to the West and S.W. between the northern side of the stream and the banks on the coast of Maryland. This motion may be more properly characterised as a *drift* current, occasioned by the prevalence and strength of recent northerly gales, than as a *counter*-current. In approaching the bank (or soundings), the surface water at eight a.m. and at noon, on the 7th of December, was 59·5°; at three p.m. it had fallen to 54·2°; on which, upon sounding, bottom was found in 33 fathoms; on the following morning, in 30 fathoms, the surface was 53·5°, and at eight a.m. on the 19th, in 12 fathoms, but still with no land in sight (being 20 miles off the coast), 41·5°. In the afternoon of the same day, when about 2 miles distant from Sandy Hook (New York Harbour), the water had finally lowered to 45°. Thus, in a space of the ocean scarcely exceeding 200 miles in direct distance, the heat of the surface progressively diminished from 74° to 45°."*

REMARKS ON THE STREAM, by Captain *W. J. Monteath*.—Between lat. 25° 40′ and 28° 20′, Captain Monteath found the current *in the strait* had set 80 miles in the twenty-four hours of June 27, 1820. On the southern border of the stream (northward of the parallel of Cape Hatteras), 6th July, 1820, lat. 35° 20′ to 36° 30′, long. 72° 30′ to 71° 3′, Captain Monteath found the current setting N. 45° E. 75 miles in the twenty-four hours. Next day, July 7, to lat. 37° 40′, long. 69°, he found it N. 53° E. 80 miles in twenty-four hours. On the following day, July 8, to lat 38° 38′, long. 67°, it ran N. 58° E. 30 miles. July 9, to lat. 39° 10′, long. 66° 10′, westward only 10 miles. The observations were continued each day, by chronometer, which agreed within a few miles.

In the stream, on the 21st of March, 1824, lat. at noon, 29° 4′, long. 79° 22′ Captain *Hamlin* found the stream had set North 83 miles; on the next day, lat. at noon, 31° 8′, long. 79°, N.N.W. 63 miles.

REMARKS ON THE STREAM, &c., by *Captain J. Steele Park*.—We have given on a preceding page (314.) Captain Park's description of the north-westerly inset into the Mexican Sea, and his notice of the outset from the same. After rounding Cape Antonio, the land of Cuba was not seen. At this time (the latter days of May, 1824) the stream along the Florida side, and even in the strait, was by no means so strong as it is generally found. In the narrowest part, where, of course, we have a right to expect the greatest velocity, it was running at the rate of only 2½ miles an hour. This was correctly ascertained by meridian altitudes of sun and moon, and an excellent chronometer.

"When we cleared the gulf," Captain Park adds, "I was anxious to keep in the influence of the stream, and pass near the tail of the Bank of Newfoundland, but it came on to blow hard from the northward, in lat. 34° 35′, and long. 72° 20′ (E. by S. from Cape Hatteras). This, of course, drove us away to the eastward, out of the favourite track, and we passed about 300 miles to the northward of the Bermudas. During this gale for several days a current was found to proceed from the eastward to

* Remarks made in H.M.S. *Pheasant*, 1822.

the W.S.W.; but in lat. 38°, and long. about 59°, the ship was in the Gulf Stream, setting finely to the N.E.

"On June 23rd, at noon, lat. 37° 51′, long. 61° 54′; June 24th, lat. 39° 56′, long. 57° 26′ (by altitudes and chronometer). Here the ship really made 4° 28′ of easting in the twenty-four hours' run, and the log gave only 3° 16′. In the same time much northing was made. The true difference of latitude was 125 minutes, but the log gave about 80 only. The vessel had been running all the time E. by N. by compass, and went through the water 173 miles. Allowing half a point of variation, gives the true course N.E. by E. ½ E. Subsequently, on making Scilly, there was not an error in the watch of a single mile,

(229.) **Temperature.**—The high temperature of the Gulf Stream is one of its chief characteristics, and has attracted from very early times almost as much attention as its velocity. A work was composed on this subject, entitled "THERMOMETRICAL NAVIGATION," written by Colonel Jonathan Williams, and published at Philadelphia, 1799, from which the following extracts are given.

Commodore Truxton says:—"In the stream the water is much warmer than the air; indeed, I have known it 10° warmer; but as soon as you get within the stream (that is, between it and the coast), the water becomes colder than the air; and the more as you get on soundings, and approach the shore. If mariners, who have not the opportunity of determining their longitude by celestial observations, will only *carry with them a good thermometer*, and try the temperature of the water, and compare it with that of the air every two hours, they may always know when they come into, or go out of, the Gulf Stream. Indeed, I have always made a practice, when at sea, of comparing the temperature of the air and water daily, and often very frequently, during the day, throughout the voyage: whereby I immediately discovered anything of a current that way going, and afterward found its strength and directions by observations for the latitude and longitude. It is of the utmost consequence, in making a passage to and from Europe, to be acquainted with this Gulf Stream; as, by keeping in it, when bound eastward, you shorten your voyage; and by avoiding it, when returning to the westward, you facilitate it inconceivably: so much so, that I have frequently, when bound from Europe to America, spoke European ships, unacquainted with the strength and extent of it, off the Banks of Newfoundland, and been in port a very considerable time before them, by keeping out of the stream; whereas they lengthened their passage by keeping in it. The general course of the Gulf Stream being marked on the chart, I would advise those who make the northern passage from Europe never to come nearer the inner line it, by choice, than 10 or 15 leagues; and then the probability will be that their passage will be assisted by the help of a counter-current, which often runs within it. In coming off a voyage from the southward, be sure to steer N.W. when approaching the stream, if the wind will permit you; and continue that course until you are within it, which may be easily known by the temperature of the water, as before mentioned. I have always considered it of the utmost consequence, when bound in, to cross the stream as speedily as possible; lest I should be visited by calms or adverse winds, and by those means driven far out of my way, which would prolong the voyage considerably, especially in the winter season."

By the journals of Captain W. Billings, of Philadelphia, it appears that, in June, 1791, the water on the *coast* of America was at the temperature of 61°, and in the Gulf Stream at 77°. By those of Mr. Williams, it appears that, in November, 1789, the water on the coast was 47°, and in the Gulf Stream at 70°, viz.:—

1791, June,	Coast	61°	1789, Nov.	Coast	47°	Difference between	Coast	14°
	Stream	77		Stream	70	June and Nov.	Stream	7
Stream warmer		16			23			

The difference of heat is, therefore, greater in winter than in summer.

In the *America* of 500 tons, Captain Heth, for Richmond, Virginia, 2nd May, 1817. "After a series of baffling winds and boisterous weather, we find ourselves on the western, or in, side of the Gulf Stream, and, of course, not far from our destination. Yesterday the temperature of the air was 65°, and of the water 71°. To-day, the air remains at 65° but the water has fallen to 59°. We have, therefore, crossed this warm ocean river, which flows from the Gulf of Mexico."—"NOTES" *of Maurice Birkbeck.*

"On my voyage from Philadelphia to Kingston, Jamaica, on board of the Schooner *Young Dasher*, October, 1817, I particularly attended to the thermometer. Close off the mouth of the Delaware, in about 16 fathoms, it stood at 60°; on the inner edge of the Gulf Stream, it rose pretty rapidly, to 66°, and, in the course of an hour, to 76°; next morning, 78°, which heat continued till we were to the southward of Bermuda; whence it gradually increased, until between Cuba, Hayti, and Jamaica, it was 82°, which appears to me to be the mean temperature of the sea water about Jamaica."—*From memory*, 26th August, 1818. *Andrew Livingston.*

By the advantage of knowing how near to the coast a ship may venture, and how to distinguish the Gulf Stream from the water between it and the coast, we can be sure of a favourable current either way, and a small vessel might make a short voyage from Halifax to Georgia, which is thought by some a longer one than to Europe. Suppose you had the wind ahead all the way; take your departure and stand for the stream; so soon as you find the water increase in heat, about half as much as you know it would when in the stream, heave about, and stand for the coast; you will infallibly discover the edge of the soundings by the cooling of the water; then stand off again, and so on to the end of the voyage; when it is almost certain that the distance would be run in a shorter time than if there were no stream; for you would have a favourable inside current. On the return passage, take your departure, and run off till you get into the warmest water, which will be middle of the stream, and take the advantage of its current.

The following fact may serve to illustrate the propriety of these directions. In June, 1798, the mail packet for Charlestown had twenty-five days' passage in going, but returned in seven. The captain accounted for this by having calms, or very light airs, and a northerly current. This was the true cause. He was in the middle of the stream, where there generally are calms or light winds; the edges, only, which come in contact with colder regions, being tempestuous. After being in the latitude of Cape Hatteras, he found himself in that of Cape Henry (37 leagues to the northward). The vessel, however, arrived at last; and on the return voyage the captain steered the same course back again, and with the same light airs he performed the voyage in seven days. Had the captain known the use of the thermometer, need he to have been much longer in going than in coming?

(230.) From the fact that when crossing the Gulf Stream from east to West, that the temperature *suddenly* fell when its western edge was passed, that is, coincidently with obtaining soundings, it was argued by Colonel Williams, and long maintained that the thermometer would certainly indicate the approach to soundings by a fall in the temperatpre of the water in any part of the ocean.

"In June, 1791, Captain W. Billings, of Philadelphia, in lat. 39°, long. 56°, abreast of the Banks of Newfoundland, found that the mercury in the thermometer fell 10°. It was near the same place that a similar obervation was made by Dr. Franklin, in November, 1776; and another by Mr. Williams, in November, 1789, who from these and other facts infers that, "By the coincidence of these three journals, at so great a distance of time, and without any connexion with each other, this important fact seems to be established:—*A navigator may discover his approach toward objects of danger, when he is at such a distance as to be able easily to avoid them, by attentively examining the temperature of the sea;* the water over banks and shoals, in these regions, being colder, in general, than that of the deep ocean."

Now although this remark holds good as to this portion of the American coast, and in some other parts of the world, under similar influences, yet it is founded on a fallacy, and certainly has not that universal application which former observers endeavoured to claim for it. This question is now generally well-understood, and it is only necessary thus to refer to it, as a memorial of past times. When it was first promulgated, the extension of the Arctic Current to the southward in such a remarkable manner inside the Gulf Stream was not suspected. And although Mr. Redfield's views, given hereafter, are now fully maintained, yet the more extended observations of the United States Coast Survey, have revealed such singular facts, that even now we must confess that our knowledge of the compensating system of the ocean is exceedingly imperfect.

(231.) The *mean surface temperature* of the Gulf Stream, in the early part of its course may be ascertained from the vast and confused mass of figures contained in Captain Maury's Thermal Charts. The temperatures there recorded, however, show large variations between themselves in the same periods. This may arise from two causes—the one from the variation known to exist in the stream itself (234.), and which is frequently considerable; and the other from the imperfection of the thermometers used, and this, as many of the observations appear to have been derived from voyages made before standard thermometers were employed, may include a considerable portion of the discrepencies which exist.

The following are the result of the calculations for the temperature of the main strength of the current from the narrows of the Little Bahama Bank to the meridian of Halifax. To the eastward of this, or longitude 60°, the temperature, especially in winter and spring, becomes rapidly lower and very irregular, as will be presently alluded to, and therefore our comparison will now be limited to this section, which comprises a distance of about 1,200 miles, and which is traversed by the stream in about 25 to 35 days. The degrees are Fahrenheit.

Winter.—Off the Matanilla Reefs, 77°·2; off Charleston, 75°·9; off Cape Fear, 73°·6; off Cape Hatteras, 71°·0; off the Capes of Virginia, 71°·0; S.E. of New York, 70°·5; S.E. of Nantucket, 67°·9; south of Halifax, 62°·5. It has thus cooled 14°·7 in its passage.

Spring.—In the Florida Channel, 77°·5; off Charleston, 76°·5; off Cape Fear, 74°·7; off Cape Hatteras, 72°·0; off the Capes of Virginia, 72°·0; S.E. of New York, 70°·5; S.E. of Nantucket, 67°·4; south of Halifax, 63°·5. In the latter part of its course it is cooler in the spring than its ratio to the earlier part, owing to the higher velocity of the Arctic Current, which flows under and mixes with it.

Summer.—In the Strait of Florida, 83°·2; off Charleston, 82°·4; off Cape Fear, 81°·2; off Cape Hatteras, 79°·8; off the Chesapeake, 79°·8; S.E. of New York, 79°·2; S.E. of Nantucket, 80°; south of Nova Scotia, 77°·9. Here the water preserves its heat without much diminution being only 5°·3 colder than when it leaves the gulf.

Autumn.—In the Florida Strait 81°·7; off Charleston, 81°·6; off Cape Fear, 78°; off Cape Hatteras, 75°·5; off the Chesapeake, 75°·5; off New York, 73°·0; off Nantucket, 71°·5; south of Nova Scotia, 69°·2.

(232.) Upon comparing these temperatures, which are carried so many miles unimpaired by the Gulf Stream with the inner Arctic Current between the stream and the shores of Virginia, New Jersey, New York, &c., a surprising difference will be seen, especially in the spring months, when the difference is at a mean 30°, and at other seasons from 15° to 23°. This will be more fully entered into in the next section.

(233.) It has been found that the temperature of the stream varies in a greater degree than could be accounted for by the climates it had passed through, being sometimes warmer to the north, and cooler to the south, of any particular position. This seems to be accounted for by the variability of the source of the stream in the Gulf of Mexico and elsewhere, which it would be very difficult to follow up to any specific determination; but this, practically, is of minor importance to the sailor.

(234.) The Gulf Stream was found, in the early operations in its investigation in 1845-48, to consist of a series of alternations of cold and warm water, a fact which was very surprising at the time, but the results of the later explorations in 1853, entirely confirm the former ones in this respect. In fact, the Gulf Stream is merely one of a number of bands of warm water separated by cold water. The observations on the Hatteras, Cape Fear, and Charleston sections, show a *counter-current* where the cold streaks are found; and as these observations and those for temperature are entirely independent of each other, the coincidence in result is very striking. This fact is of too great importance not to be very carefully followed up. It would appear, from general reasoning, that this was not unlikely to be the case."—*United States' Report.*

On the land side the division between the cool and warm water is very distinct. It is now concluded that this separation into distinct belts is owing to the form of the bottom, as they appear to be strongest north of the section of Cape Canaveral, where the range of submarine hills and dales (221) is found very much to coincide with the position of these cool and warm belts; and this conclusion is strengthened by the fact, that south of Cape Florida, where the bottom is even, they disappear altogether.

(235.) *Submarine Temperatures.*—It was formerly held that the Gulf Stream flowed on in one majestic current of warm water from its surface to its bed. The magnitude of its effects and the extent of its area seemed to leave room for no other conclusion. But the first observation of ice-cold water at a small depth in its narrowest and strongest part overturned all these hypotheses, and left a most perplexing condition in which we are at a loss to know where to look for an explanation.* How this cold water, flowing directly contrary to the course of the upper strata, should preserve its polar characteristic almost unimpaired to such an enormous distance from its origin, and under such apparently adverse circumstances, cannot be explained with our present views. Again, by what power, or source of action, are these lower strata made to move in an opposite direction to those superincumbent upon it, and which, it might be supposed, would be acted on by the same laws and move in the same manner? It is one of the most remarkable evidences of that grand compensating system by which the Great Creator has commanded that all the harmonies of the universe shall be maintained—which keeps the atmosphere and ocean in a perpetual condition of interchange, and thus makes them fit for the sustenance of his creatures.

We have alluded to this universal intermingling of the ocean waters before (133). Of the presence of polar water in these tropical regions there can be no doubt. The following extract from the Report of the Superintendent of the U.S. Government Survey will place it beyond question:—

"The southern sections present, on a small scale, the same phenomena which we formerly traced over a large expanse in the more northern ones. Examining the Canaveral section, which is the furthest south, we see the cold wall almost as plainly as on that from Sandy Hook; the curve, showing the mean results between 70 and 100 fathoms, rises some 17 degrees, from $57\frac{1}{2}°$ to $74\frac{1}{2}°$ Fahrenheit, in the distance of 23 nautical miles. The warm water, overlying the cold, is deeper in its overflow towards the shore—that is all. After passing through the warmest water, which, in June, 1853, was only $80\frac{1}{2}°$ Fahrenheit at two fathoms and a half, there is a fall of temperature of several degrees, followed by a rise. On the St. Simons section the cold wall is again well shown, and is the first of those distinct bands of minimum temperature dividing four maxima, of which the greatest body of warm water of the Gulf Stream is the second from the shore. Near the surface the first and fourth maxima are the highest; at 15 fathoms, the first and second; at 150 fathoms, the successive maxima rise as they recede from the shore. The Charleston section presents, as a general feature, between 25 fathoms and 250 fathoms four minima and three

* In the experiments made by the United States' Coast Survey the temperature was gained from all depths, from the surface down to 600 fathoms. At great depths a peculiar thermometer was used, constructed for the purpose, whose principle of action depends on the differing expansion of two metals. It is a spiral coil, composed of two strips of silver and platinum soldered together, which, from their unequal contraction and expansion by the effects of temperature, act on an index, which registers the extreme temperature ascertained, and was found to answer exceedingly well.

maxima. Within the cold wall minimum is a decided *warm* belt, and probably further on in-shore is a cold one. The rise in the mean of the temperatures at 20 and 30 fathoms is 11° Fahrenheit, namely, from 64° to 75°. The advantage of not relying on surface temperatures, or those near the surface, where the distribution is so much less regular and marked than below, will be recognised in all these results, and was early provided for in my instructions.

"The underlying cold water from the northern regions is as plain in the southern sections as it was in the more northern. 400 fathoms vertically below the warmest water of the Gulf Stream, on the Cape Henlopen section, in August, 1846, the temperature was 49° Fahrenheit, and in the same position off Cape Canaveral, in June, 1853, it was 48½° The latitude corresponding to the first temperature was about 37° 20′, and to the last about 28° 20′. Lieut. Charles H. Davis, in October, 1845, found a temperature of 40° at 1,000 fathoms, in lat. 39° 25′, and long. 69° 01′, and Lieut. George M. Bache 40° at 2,160 fathoms, in lat. 34° 13′, long. 68° 05′. Lieut. S. P. Lee, in August, 1847, found 37° below the Gulf Stream, at the depth of 1,000 fathoms, in lat. 35″ 26′, long. 73° 12′; and again 48° beyond the Gulf Stream, at the same depth, in lat. 30° 10′, and long. 68° 9′. Lieut. Richard Bache, in July, 1848, found a temperature of 42° at 1,000 fathoms, in lat. 35° 6′, and long. 74° 7′, below the surface of the Gulf Stream.

"The fact that the side limits of the polar current recede from the shore as the depth increases, is clearly marked on all the sections. Directly down below the maximum surface temperature we soon plunge into this cold current, the warmer water receding from the shore, and at 400 fathoms reach temperatures, the differences between which at the north and south are of an order corresponding to the variations of the ocean waters in different years and at different seasons. For example, at the depth of 400 fathoms, on the Sandy Hook section, in 1846, vertically below the crest of the Gulf Stream the temperature was 51° Fahrenheit; on the Henlopen section, at the corresponding point, 51°; on the Cape Henry section, 54½°; in 1848, on the Cape Henry section, 52½°; and on the Hatteras section, 52°; in 1853, on the Hatteras section, 51°; and on the Cape Fear section, 54°; all the foregoing observations being made in July and August of the several years. In June, 1853, the temperature at the point and depth before noted, on the Charleston section, was 55°, and near Cape Florida, 14 miles E.N.E. from the light, was 51°, varying from 54° to 46° in the intermediate localities. The low temperature of 46° was observed on the Canaveral section. The temperature at 400 fathoms, near Cape Florida, is the same as was observed on the Sandy Hook section in July, 1846, viz., 48°.

"I remarked that these differences came within the annual changes near the surface. Not to complicate the examination with surface irregularities, if we compare the maximum temperatures at 12 or 15 fathoms below the surface of the different sections, in the same year, we shall find, as a general rule, an increase of temperature in passing southward, as 81°, 83°, 82°, from the Sandy Hook to the Cape Henry section; in 1846, 75½°, 76°, 77½°, 79½°, from the Charleston section to Cape Canaveral. But in successive years we have for the highest temperature at 12 fathoms, on the Cape Henry section, higher than that of Hatteras; and the temperature in July, 1846, on the axis of the Gulf Stream, higher at Sandy Hook than in June, 1853, at Canaveral, by a degree and a half, and higher than Charleston by five and a half degrees. It is obvious that here an interesting field of inquiry opens, requiring careful research."*

(236.) *The Cold Wall.*—The separation between the warm, deep, blue waters of the Gulf Stream and the inner cold counter-current is sometimes so well marked that "one end of a ship is sometimes seen in the one, and the other end in the other current." Although it does not follow that this line of demarcation is as distinct as Captain Maury says as above, yet a remarkable feature has been eliminated by the United States' Coast Survey so often quoted here. It is that the separation between the two currents is so well marked beneath the surface, and to the greatest depths, as

* Professor A. D. Bache, Report U. S. Coast Survey, 1853, pp. 48-9.

to have obtained for it the title of the "Cold Wall," being, in fact, an upright division between them. This peculiarity has been found to exist almost along the whole coast of the United States, where the stream skirts the bank of soundings. Without diagrams the features cannot be made quite intelligible; but the main fact, so interesting to the physical geographer, is as above stated—that there appears to be a marked non-affinity between the waters flowing in opposite directions.

It was at first supposed the cold wall was cut off at Cape Hatteras, but the subsequent researches have qualified this notion. The cold water has been traced as far as the Tortugas. Off the Sombrero Kay the existence of the cold wall was strongly marked at depths varying from 70 to 100 fathoms, while everywhere the warm water overflows the cold wall, and reaches quite to the shore.

The shallowness of the stream in the Strait of Florida, connected with the fact that that the bottom falls off rapidly to the north and south, afforded an excellent opportunity for testing the question whether the cold water of the under polar current is forced upwards by the change in depth—as, should this be the case, the cold water would appear in the shallow part of the strait; and this has actually been found to be the case, as the warm surface water of the temperature of 80° and the cold water of the bottom of the temperature of 49° nearly approach each other. It does not follow by this that the "waters run up hill," as has been stated.

(237.) **COUNTER CURRENTS.**—Besides the great arctic current which flows southward inside the stream to be described in the next section, there are some other counter currents on each side of the stream which require notice here. The appear in the first part of its course in the Gulf of Florida, where they have been known to flow from the earliest times, as has been alluded to in (209.), page 316.

(238.) *The Counter Current along the Florida Reefs* is marked on all the old surveys of these reefs, and is, during the summer months especially, frequently met with. It may be readily accounted for. On page 320 (216.) it will be seen that the main strength of the Gulf Stream, after passing the "Great Whirlpool"* of the Mexican Gulf, runs with the greatest swiftness past the coast of Cuba, and that the channel is by much the deepest close to the south side, slopes more gradually from the north. On the shallower water, but not within the reefs, this counter current runs, by which a vessel may with ease and knowledge work to westward. It may be taken as an eddy, aided by the trade wind, which may give it an additional impetus. It has been well elucidated by Lieutenant E. B. Hunt, Engineer, U.S.A., who, having stayed in the neighbourhood for some time, obtained some particulars from the well-informed residents of these Kays.†

(239.) Captain Geiger, who for some thirty years, has been observing the waters of this vicinity, most of that time having acted as a pilot off Kay West harbour, and who is, perhaps, better acquainted than any other person with the currents there prevailing, gives the following statement of facts:—

A strong north or north-east wind keeps the Gulf Stream back, and makes a westerly current near the shore. During June, July, and August, the westerly current prevails more than the easterly current from 5 to 15 miles from the reef. The direction of the current depends mostly on the wind. The westerly current prevails for from one-third to two-fifths the entire time from year to year for from 2 to 15 miles outside the reef off the west. He has known it 25 to 30 miles off Sand Kay.

When the Gulf Stream is strongest on the Cuba shore, the westerly current is strongest on the north side; and when it is weakest along the Cuba shore, the Gulf Stream sets close along the reef. He has found the westerly current as far up as Carysfort, but not frequently, and not broad or strong. This current broadens from Carysfort to the westward, and continues about constant along its course.

The tides on the two sides of the reef are about six hours apart on an average, but

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* See Dr. Lorimer, April 21, 1769, "Trans. Amer. Phil. Soc., Philadelphia," vol. i., p. 250.

† Silliman's American Journal, March, 1859, vol. xxvii., pp. 207—214.

set, on the whole, as much one way as the other over the reef. Sometimes there is a narrow *easterly* current for a mile from the reef, then a westerly current, and then the Gulf Stream. A considerable number of the Gulf traders know of, and make use of, this current in going westwardly. After northers the westerly current may be expected. Sometimes in crossing to Havana no Gulf Stream indications are found, and sometimes a westerly current is found along the north shore of Cuba.

Notwithstanding Captain Geiger's long observation of these currents, he says that he is quite unable to reduce them to rule, or in any way to know beforehand how the current will be found to set.

Captain Richardson, pilot of the United States' Coast Survey steamer *Corwen*, says:—" The westerly current appears irregularly chiefly in winter, but sometimes during the prevalence of the regular trades. It extends from 10 to 15 miles off from Sand Kay, and runs sometimes 2 miles per hour. It never prevails over the reef proper. It spreads further from the reef as it goes west. Off Indian Kay it sometimes extends 7 miles from the edge of the reef; at Bahia Honda, sometimes 10 miles; and at Sand Kay, from 10 to 15 miles. Some years (as in the winter of 1856-7) there was very little of this current. The Gulf Stream usually runs stronger on the Cuban side. In one case, in 1852, two vessels bound east passed Tortugas which separated about 100 miles in twenty-four hours, by one captain knowing this current and the channel, while the other kept in the westerly or counter current. The tide below the Quicksands and Tortugas sets flood N.N.E., and ebb S.S.E., differing from the Charts."

(240.) But this counter current, also, is felt on the Cuban side sometimes, probably all the way from the Bahamas Old Channel. Of this we have several instances from the communications of Captain Livingston and others; the most singular of these, however, is that of Captain Loudon, of the brig *Perry*, on returning, in the latter part of November, 1827, from New Orleans to Liverpool. Captain Loudon had made the *Iron Hills* in Cuba; shortly after noon he tacked ship to the northward and westward about 8 or 9 miles off shore; next day he kept beating to windward, as near to the middle of the strait as he could judge, and, without sighting the land on either side, the wind then blowing a fresh gale to the northward; and he continued beating in the same manner until about eight a.m. of the second day, when, by *reckoning*, he ought to have been near the Salt Kays; but obtaining a lunar observation, it showed, to his astonishment, his longitude to be to the westward of 83°. Supposing his observation to be erroneous, he took a second set of lunar distances, which gave a similar result. Still, however, doubtful, he stood on, and in a short time afterward gained soundings on the *Tortugas Bank!* The northerly gale had now abated, and he worked his vessel in, on soundings, to the northward of the Dry Tortugas. With a favourable wind he ran through the Tortugas Channel; but as light and baffling winds succeeded, he made for the stream as it became dusk, and with such wind got through the strait in the two following days, having, on his way, found the current very rapid along the Martyrs.

Captain Loudon justly remarked, that so extraordinary a circumstance, of which he is *positively certain*, ought to be generally known.

" Masters of vessels from Vera Cruz, &c., to Havana, often lengthen their voyage by keeping away too much to the southward after rounding the Dry Tortugas, fearful of being carried away to the eastward of Havana by the strength of the Florida Stream! Some have fetched in about the Port of Honda, the Cock's Comb, and one vessel even as low as Cape Antonio!"—*Lieut. John Evans.*

(241.) Off-set or Easterly Drift from the Gulf Stream, on the North and N.E. of the Bahamas, &c.—The Gulf Stream about the Bahamas appears to have a drift or tendency to the eastward; and there is reason to believe that an offset of the stream, from without the Maternillo Bank, sets, if not generally, very frequently, to the eastward and S.E. With the usual set of the currents along the eastern range of the Bahama Islands, we are not accurately acquainted; but with a N.W. wind we have no doubt that it is in a S.E. direction. The *Europa*, a ship of war, returning to Jamaica by this passage from a cruise off Havana, in 1787, steered

East on the parallel of 30° N. with a westerly wind, until the run was supposed to have brought her on the meridian of Turks' Islands, by which it was intended to pass southward; but an easterly current had swept her along as high as that of the Mona Passage. Captain Manderson, of the Royal Navy, who first noticed this event, observes, " If it were once ascertained that a current was common in that part of the ocean, might it not be favourable for vessels bound from Jamaica to the Caribbee Islands, especially in the summer months, during the prevalence of the sea breezes?"

Our respected friend, Captain Livingston says:—" I have no doubt that there is a current, or rather off-set, from the Gulf Stream to windward, between Bermuda and the Bahamas. In the *Brilliant* we found ourselves retarded very much in making westing when running for the Hole in the Wall, one day, about 30 miles of longitude, by excellent observations, the truth of which was confirmed by our land-fall. In the *Dispatch*, we got out of the gulf on the 13th of March, 1819, when we were at noon, by observation, in lat. 28° 0', long., by account, 79° 12'; on the 20th of March, at noon, we were, by meridian altitude, in lat. 29° 48', and long., by account, 72° 32'. Observations by sun and moon, a good lunar of three sights, altitudes and distances, and worked three times, gave 71° 18' 30".

" In the schooner *Young Dasher*, January, 1818, I spoke an American vessel, out five days from the Chesapeake, in lat. 24° 40', or thereabout; my longitude by lunars was then about 69° 50'; his, by dead-reckoning, was 72° 20'. On the 11th of February, 1819, in lat. about 25° 10' N., we spoke the schooner *Hester*, Captain Lawrence, out five days from Bermuda, bound to Jamaica; his long. was 69° 15'; ours, by observation, 68° 39'.

" In the ship *Fame*, Captain J. W. Monteath, a good lunarian, assured me that he had been carried 3° and upwards to the eastward, between the time of his departure from the American coast and making the Windward Passages; but this may have been partly occasioned by the Gulf Stream, which he may have crossed too obliquely in proceeding from Norfolk." The *Fame*, above mentioned, was bound from Norfolk, in Virginia, to Kingston, Jamaica, in May, 1816; and in a run of thirteen days, until in the lat. of 29°, and long. 61°, it was found that the current had set the vessel 3° 10' East.

Captain Livingston adds, that " Captain Hall, in the brig *Lowland Lass*, passed to windward of Porto Rico, when he thought that he had run through the Mona Passage. Captain Patterson, of the brig *Clyde*, as I am informed, passed down the Anegada Passage, when he intended to have made the Mona. I have heard of two vessels falling to *leeward*, but both were commanded by men whose names, as *seamen*, are not entitled to notice.

" In addition to the above notices, I have been assured, by an intelligent Spanish navigator, that about thirty years since, vessels bound from Havana to Europe used generally to cut off 3° of longitude from their reckoning, on account of this set, which he said was considered then as certainly existing. At that time the charts were about a degree wrong, which would reduce the Spaniard's allowance to 2 degrees, or thereby.

" These notices tend to prove that an easterly off-set from the Gulf Stream sets to the northward of the Bahamas; of this I am so firmly convinced, that, if in charge of a ship from the Havanna, or even New Orleans, bound to Jamaica, I should, if allowed to follow my own plan, run out the Strait of Florida, and attempt making my passage with the aid of this off-set. This is to be understood, in case I should not have westerly winds in the southern parallels; for such winds are, I am told, more frequent than formerly; and I know that they are by no means of rare occurrence on the S.W. of Cuba."

Captain Thomas Hamlin, in the brig *Recovery*, then in the Gulf Stream, was set to the northward 104 miles, in the twenty-four hours of the 20th March, 1820. The ship's place at noon, 28° 4' N., 79° 50' W. To the north-eastward, on the next day, without the stream, in lat. 29° 35', long. 77° 25', the current was found to have set only 11 miles North, but considerably more to the eastward.

On the 16th February, 1811, the ship *Mars*, under the same commander, was at the back of the Maternillo Bank, and no northerly current was found; and nearly 2° further eastward, in 28° 7′ N., and 76° 58′ W., the current in twenty-four hours had set 3° S. and 14° E. The ship was, therefore, evidently in the off-set from the Gulf Stream.

(242.) The last remark is one that would be adduced by many to prove that the surface of the Gulf Stream is *roof-shaped*, and that any floating body remaining inactive on it has a tendency to drift to its margins, especially to the eastward and south-eastward. How far this assumption will be borne out by more exact observation, it is difficult to judge, but there certainly seems to be some ground for the opinion, as its edges especially are marked by a larger collection of Gulf weed and other drift matter than are found in the centre. Again, there seems to be a tendency for vessels to be floated to the East and S.E. without their knowing it. It has been argued by Captain Maury that this may be owing to the effect of the earth's rotation, which runs the current from under the ship, and as, as he says, the tendency of a railway train going north or south, is to run off the rails to the eastward of its route. This has been made the subject of some interesting experiments by M. Foucault and others; but we know so little that it were futile to argue on it.

(242.) In the northern regions of the stream, when the cold upon land is in winter most intense, which is generally between December and March, heavy and continued gales very frequently prevail, which commonly proceed from between the north and west, across the course of the stream, from Cape Hatteras until past George's Bank, and bend its direction to the eastward; being aided at the same time by the discharge of the great bays and rivers, increased by the force of the wind blowing down them, and the constant supply of stream that passes along the coast of the Carolinas, the whole produces so strong a current to the eastward as to render it impossible for a ship to approach the coast until a change of wind commences.

During the prevalence of a southerly or easterly wind, which is not so common here, it has been found that the current is forced close to, and in some parts upon, the edge of soundings; being thus bent in between the wind and the shoal grounds near the shore, the breadth is greatly diminished, and the velocity proportionably increased. This circumstance has been in particular observed from about the longitude of Block Island, along the edge of the Nantucket Bank, thence beyond George's Bank, and also along the coasts of Georgia and part of South Carolina. In the first instance, that the southerly winds forced the current to the edge of soundings, where it then ran from 1½ to 2 knots; and in the latter instance, that the easterly wind forced the current upon soundings. With West and N.W. winds, the stream would be removed some leagues further off.

From what has been said, it is clear that the eddies about the edges of the stream must vary according to the circumstances above explained. Along these edges, but more particularly along the outer edge, there is generally a current in a different direction, which is accelerated by the wind in proportion to its strength, blowing contrary to the stream, and retarded, or perhaps altogether obstructed, by the wind blowing in the direction of the stream. In the latter case the limits of the stream will be extended.

(243.) Physical Geography of the Channel of the Gulf Stream.—The peculiar and dangerous character of the shores of the Gulf, and the necessity which existed for the establishment of some means of averting the mischief it annually occasioned, led to a minute examination of its features so geologically and geographically interesting, which has been made practically useful by the erection of a fine line of beacons and the necessary lighthouses upon the Florida Reefs.

Professor Agassiz, who investigated this subject, has shown that the Florida Kays and Reefs are essentially of coral formation in various stages of existence. At Kay West, the basis of this of this is shown to be a coarse oolitic rock with cross stratifications, and dipping at various angles in different directions. The formation of coral upon this rock extends not only over the Kays, but also to the main land of Florida, and by a careful process of inquiry and reasoning it may be inferred that a very different order of things existed at no very remote period of the world's history.

We have a peninsula—a narrow, flat strip of land, projecting for about five degrees from the main land, between the Atlantic ocean and the Gulf of Mexico, and forming an effective barrier between the waters of the two seas, which otherwise, even by the change of a few feet in the relative level of the intervening peninsula, would communicate freely with one another; and this peninsula we now know to have been added to the continent, step by step, in a southerly direction.

We know that the time cannot be far behind us when the present reef, with its few kays, did not exist, and when the channel, therefore, was broader, and the Gulf Stream flowed directly along the main range of kays. We know, further, that at some earlier period the kays themselves were not yet formed, and that the channel between Cuba and Florida was wider still, washing freely over the grounds now known as the mud flats, between the kays and the main land, and that there was then nothing to impede a free communication between the Gulf of Mexico and the Atlantic ocean.

If it is true that the Gulf Stream and the south-west winds have an influence in determining the course of the isothermal lines upon the two sides of the Atlantic, and of raising beyond their normal altitude the mean annual temperatures of north-west Europe, then we may look to the physical changes which have occurred on the south-eastern extremity of the North American continent for the cause, or at least a partial cause, of those changes of temperature which have taken place in the beginning of the present period, in those very north-western portions of Europe which are now so much warmer than the corresponding latitudes on the American continent, and which, soon after the accumulation of the glacial drift, had as low mean annual temperatures as the coasts of Labrador, Nova Scotia, and New England in our day.

The present condition of the Florida country then is this;—On the outer edge we have "*the reef*," a submerged line of danger to the navigator, which rises nearly to the surface of the water, on which every variety of coral life is developed. It follows the line of Kays within it in a perfectly parallel curve, and forms the boundary to the Ship Channel inside it for hundreds of miles. Upon this line and space are small patches which rise above the surface, of course of dead coral, and upon these is gradually heaped the *débris* of the reef, in the from of sand and broken coral till it attains a permanent level above the surface. Within this reef is a channel which has a depth of from 2 to 7 and 8 fathoms, which, with care and some knowledge, may be navigated, and which has various openings to it through the reef.

These Kays consist generally of coral boulders and the fragments of coral and shells heaped up by the action of the waves, and which have become agglutinated by some obscure process, till they become firm land, not by the upheaval of old coral growths, but by the action of a stormy sea and tremendous waves. They are generally level, and it is only at times that the water rises sufficiently to occount for their elevation. We have noticed on page — an instance long recorded of an extraordinary rise in the waters.

In the year 1846, the water rose eight and a half feet above high-water mark at Key Vacas. Key West was entirely inundated during the same gale; and though that island is somewhat protected by the reef, even at present the rushes, driven upon it by the flood, may be seen among the trees and bushes, at a height almost equal to its loftiest summit. In 1841 the water rose ten feet above high-water mark at Cape Romaine, on the western shore of the peninsula.

This brief notice must suffice on this head. Proceeding still further northward, we find an important result of the operation of the Gulf Stream, in the formation of the range of the Sea Islands of Georgia, so famous for the growth of its peculiar cotton. These low alluvial deposits are the results of gradual accretion still going on, which affords a genial soil for the cotton plant, while the tepid waters of the Gulf Stream, which rush past them, tempers the easterly winds which blow on this seaboard, and add their important influences to the peculiar growth of this cotton plant.

(244.) Although its shores afford many living wonders, the bed of the Gulf Stream is still more the subject of marvel. The bottom has been brought up in considerable quantities from the greatest depths, and has been found to consist almost entirely of minute animal forms, covered with or having skeletons of a calcareous or siliceous nature. The following is the account given of them by Mr. L. F. Pourtales, U.S. Coast Survey; they were procured by Lieutenant Craven, U.S. Navy, as before stated:—

Lat. 26° 12′, long. 79° 54′ (off Hillsborough Inlet), depth 500 fathoms. This specimen consists almost entirely of foraminiferæ with a very small proportion of quartzose sand, estimated at about 10 per cent. in bulk. *Globigerina rubra* forms the mass, with a pretty large proportion of *Rotalina cultrata*, *Orbulina universa*, and *Textularia turbo*. It also contains minute gasteropods (natica nassa?) and fragments of the shell of a crab. The whole is of a chalky white colour, only a few of the globigerinæ being pink.

Lat. 27° 37′, long. 79° 19′, depth 600 fathoms; has the appearance of fine white mud, mixed with yellow sand. It is composed entirely of foraminiferæ and their fragments, in the form of a fine powder. No silex.

Lat. 28° 24′, long. 79° 13′ (on the outer edge of the stream off Cape Canaveral), depth 1,050 fathoms. Composed of foraminiferæ; silicious sand in almost imperceptible quantity. A small portion taken from the lower part of the specimen, after shaking it with water, only showed one or two per cent. of silicious sand after dissolution in acid. *Globigerina rubra* (white, yellow, and pink—the two first colours predominant) forms the greater bulk. Also, *Orbulina universa*, *Rotalina cultrata*, *Bayleyi* and *Ehrenbergii*. Of other animal remains there were fonnd pieces of coral (cariophillia—?—some white and worn, and some brown, and in better condition), a piece of a large Gasteropod, old; and worn pieces of Anatifa, and very small pteropods (spiratella).

Lat. 29° 48′ 0″, long. 79° 31′ 0″ (in the strength of the stream off St. Augustin), depth 560 fathoms. *Globigerina rubra* and *Rotalina cultrata*, in about equal proportions. No quartzose sand or other material.

Lat. 29° 48′ 0″, long. 79° 17′ 0″, depth 450 fathoms. *Globigerinæ*, *Orbulinæ*, and *Rotalinæ* (R. cultrata). No quartzose sand. It contains, also, considerable numbers of very delicate shells of pteropod molluscs, belonging to the genera Hyalæa, Spirialis, and Spiratella; also, small pieces of coral.

Lat. 31° 32′, long. 78° 20′ (in the centre of the stream off Savannah), depth 600 fathoms. Consists in foraminiferæ and small shells, and in fragments of shells and corals. The foraminiferæ are chifly larger specimens of a kind of Rotalina, of a rough ard heavy appearance. The other kinds found among them present also a similar appearance. The fragments of shells and corals are worn and rounded, and seem to indicate an agitation of the water near the bottom.

The scientific names attached to these minute creatures can be explained in other works. But some interesting questions arise on this unexpected discovery. The first is, did these creatures live and die in their present position? or were they living on the surface, and when dead have fallen to the bottom? At first it was considered that the latter was the true solution of the difficulty, but later researches have made it almost certain that their natural locality is in these vast depths, and that here they grow and accumulate, perhaps forming vast deposits similar to those of our chalk and marl formations, which, as it is well known consist for the most part of the calcareous coverings of microscopic animalculæ. In the changes which have occurred in the geological history of the crust of our earth, there are but few animals which have passed through several epochs. But the *Foraminifera*, the *Globigerina*, so abundantly found as above, is also most abundantly met with fossilised in the chalk. They are met with in this apparently light-brown mud brought up by the sounding machine, of all dimensions, from less than one-thousandth of an inch in diameter up to more than one-sixteenth of an inch. They are very beautiful objects in the microscope, and as quoted above, are found to be coloured *pink, &c.*, showing that *light* does penetrate to these vast depths, and they also contain the animal tissues, which demonstrate that they are, or have been, recently alive. This latter point was not believed to be possible beyond 300 or 400 fathoms a few years since, but the important discovery of *live star-fish* brought up from the depth of 1260 fathoms, between Greenland and

Iceland (as quoted on page 261) show this opinion to be unfounded. A *worm* was also brought up from 725 fathoms at 180 miles E.N.E. of Trinity Bay, Newfoundland, by Lieutenant Dayman, in 1857.

(245.) It is shown above that the bottom at the greater depths of 1,000 fathoms and upwards consisted almost *exclusively* of these minute organisms, and that the temperature at these depths is about 40° Fahrenheit. The same circumstances and conditions are found to exist in a very remote part of the ocean; that above alluded to, between the British Isles, Iceland, and Greenland. In the operations of sounding for the Atlantic Telegraph Cable by Lieutenant Dayman, in 1857, and Sir L. M'Clintock, in 1860, the bottom was plentifully brought up from these high latitudes. In an examination, by Professor Huxley, of these deposits, he found them almost in the same condition as they had been found by Mr. Pourtales in the Gulf Stream.

"The soundings which present most attraction to the naturalist are those obtained from great depths. Those which I have examined range from 1,700 to 2,400 fathoms (taking the depths marked upon the labels of the bottles), that is to say, from depths equivalent to heights between that of the Peak of Teneriffe and that of Mont Blanc.

"A singular uniformity of character pervades these soundings so far as I have hitherto gone. As they lie undisturbed they form an excessively fine, light brown, muddy sediment at the bottom of the bottles in which they are preserved; but in this mud a certain slight grittiness can be detected, arising from the intermixture of minute hard particles (hardly any exceeding 1-50th of an inch in diameter), in larger or smaller proportions, and, as might be expected, always existing in much greater quantity towards the bottom of the deposit.

"When a little of this mud is taken out, and thoroughly dried, it becomes white or reddish white, and (though less white) closely resembles very fine chalk.

"Fully nine tenths, as I imagine, by weight, of this deposit consists of minute animal organisms, called *Foraminifera,* provided with thick skeletons composed of carbonate of lime.

"When a little of the mud is diluted with water, and spread out under the microscope, the first thing that strikes the eye is the immense number of exceedingly minute granules and fragments which strew the field of vision.

"Many of these particles have a brownish colour, and are insoluble in strong hydrochloric and nitric acids; many are simply fragments of the organisms contained in the deposit, and siliceous or calcareous, as the case may be.

"The comparatively heavy and solid calcareous organisms to which I have above referred, are those which, by their larger forms, are the chief source of the grittiness of the deposit. They are nearly opaque, and appear white by reflected light. I have estimated their proportion as nine-tenths of the whole; of these nine-tenths I am certainly under the mark in saying, that eight and a half tenths, or 85 per cent. of the whole, consist of one genus, and, as I believe only one species of *Foraminifera*—*Globigerina,* in all its various and multiform stages of growth. I have traced this, *Foraminifer* through a complete series of gradations from less than one thousandth of an inch in diameter, when it consists of only one or two cells, up to more than one-sixtieth of an inch; but, except for the marked peculiarties in the structure of its skeleton, I should hardly have ventured to include all its protean varieties under one head.

"The other five per cent. of the calcareous organisms are *Foraminifera,* of, at most, not more than four or five species.

"The remaining five per cent. of the whole deposit consist partly of the granular matter above mentioned, partly of animal and partly of vegetable organisms, provided with siliceous skeletons and envelopes."

These two regions, so remote from each other, under such opposite climates, and yet having such remarkable indentity in some particulars, are thus brought here together to suggest to the sailor, who passes unheedingly over these microscopic and

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hitherto hidden worlds, a theme of wonder and enquiry, upon which volumes may be composed.

(246.) There is another singular point of resemblance, too, which would lead to the supposition that our theories of the internal heat of the globe, of the law of heat at great depths in the ocean, or that of the sub-surface circulation, may be at fault. It has been shown that 1,000 fathoms beneath the surface of the Gulf Stream, with a temperature of 83° and upwards, the water at its bed is not above 40°. Lieutenant Dayman found the temperature at 1,000 fathoms, in latitude 52° N., longitude 30° W., to be 40°·8; and in latitude 51° N., longitude 40°, at the same depth, it was 32°·7, the surface temperature being 54°·5. The bed of the ocean, the habitation of the minute animalcule has the *same climate in both instances.*

These considerations must conclude this topic.

THE GULF STREAM SOUTH OF THE NEWFOUNDLAND BANKS.

(247.) The Gulf Stream, in the course described, has flowed with a gradually decreasing rate and temperature, and with a well defined north-western margin, the "cold wall." It brings its tropical character almost unimpaired up to the Nantucket Banks. These are almost the first outlying obstacles it encounters in its onward course, and their position and character would lead to the supposition, that their existence was in some degree owing to the matter carried northward by the Gulf Stream, and that transported by the arctic current from the north-eastward, which here meet and pass each other on opposite courses. The very peculiar configuration of the Cape Cod peninsula will point to current-action in some former geologic era for its character.

The Gulf Stream appears to be diverted to the E.N.E. by the obstruction presented by the Nantucket Banks, and it then bears away past the banks which front Nova Scotia and Newfoundland, skirting the lower edge of the Grand Banks. The main body of the stream still proceeds with considerable velocity from 28 to 16 miles per day, and its southern limit is gradually lost in the quiet water or varying drifts of the Sargasso Sea.

(248.) The *northerly edge* of the stream, if such it can be called, between the meridians of 70° and 40° W. presents a very singular aspect, as it seems to be a perpetual struggle between the icy waters of the arctic regions and these tepid waters of the tropics. They here interlace and intersect each other in the most extraordinary way, "in the manner of the fingers of the clasped hands," and no definite limit can be assigned at any time for either of these streams. It would be impossible by mere words to explain the entanglement of these two currents. The Thermal Charts of Maury will be the best exemplification, and the confusion they show in this part will tell how hopeless it must be to reduce them to an exact system.

The late respected and eminent Dr. Scoresby has left us some observations on this point, partly derived from his own experience and partly from remarks supplied to him by Captain Jas. Delano. They were read by him at Hull, in 1853, and as they bear upon our subject we here repeat a portion of them. It may be premised that Dr. Scoresby divides the ocean traversed, as usual in the voyage between the English Channel and Long Island, U.S., into 6 sections of 10° of longitude, the first three of which, from longitude 12° to long. 42° W., exhibit a striking uniformity of character as regards the surface temperature.

"In the fourth section, 42° to 52° W., however, the indications respectively of the two great currents of the North Atlantic become striking and characteristic. Beyond the meridian of 42°, where the cold current from the north becomes first decided, an increase of its prevalency, gradually becoming more and more conspicuous, is observed. Thus in the two degrees' space, from 42° to 44° W., the somewhat low temperature of 44° was only observed in *one* out of *thirteen* passages; but in the next two degrees a like moderate fall of temperature (about 7° below the mean) occurred in *three* or *four* of the passages; in the next meridional stripe, cold water was met with in *eight* of the passages (four or five falling from 10° to 16° below the mean); in the next, the cold water occurred in *nine* or *ten* passages (six falling 10° to 24° below the mean); in the next stripe, longitude 50° to 52° W., the cold water met with in *eight* passages (five falling 12° to 22° below the mean).

"Within the same section, 42° to 52° W., very perceptible marks of an ascending *tropical current* occurred, yielding, in alternations with the cold water from the north, an occasional warmth of 66° to 68°. The prevalency, however, of the occurrence of warm water in this position of the Atlantic appears from the observations tabulated to be in reverse order (when sailing westward from longitude 42°) to that of the cold current; the first two-degree stripe presenting a rise of from 63° to 68° in six passages; the next, a rise of similar extent in five; the next, a smaller rise in four; the next, less marked in three; and the last, 50° to 52° W., in four, but still less marked. Hence from the observations it appeared, that the *greatest prevalence* of the *polar* currents (betwixt 42° and 52° W.) is within the meridians of 46° and 52°, and of the *warmer* current in 42° to 46° W.

"It is within this meridional section mainly, corresponding in its central part with the eastern edge of the great bank of Newfoundland, in which the icebergs and drift ice from the north are usually met with; so that the prevalence of a descending polar current obtains actual demonstration.

The *fifth* section, reaching from 52° to 62° W., is found to be equally characterised by peculiar phenomena as the one preceding it. The general prevalence of the *descending polar current* is shown by the *minimum* temperature of each meridional space of 2°, ranging betwixt 32° and 42°, with a mean of the five minima of 37°·2. The prevalence of an *ascending current* from south-westward is, in like manner, shown by the occurrence of a *maximum* surface temperature ranging betwixt 63° and 74°, with a mean of the five maxima of 68°·9.

"But the characteristic features of this fifth decimate section were found to consist *in the suddenness of the changes of the surface temperature and the various alternations, indicative of singular interlacings of warm and cold water.*

"In a passage in the *Patrick Henry*, in May, 1844, made by Dr. Scoresby, these sudden and alternating changes were remarkably prevalent. Thus when in longitude 57° 0′ W. (lat. 41° 31′ N.) the surface temperature, at 8 a.m. of May 17th, was found to be 60°·5; but after sailing W.N.W. (true) 10 miles, it was found to be 50°, at noon 16 miles further on the same course 46°. At 2 p.m. of the same day, longitude 57° 55′ W. the sea was still at 46°; but at 4 p.m., after 15 miles' sailing W.N.W., it had risen to 57°, and in 15 miles further in the same direction it was found to have fallen to 42°! The next day, May 18th, presented further remarkable changes. At 8 a.m., longitude 59° 52′, latitude 42° 8′ N., the surface temperature was 46°; but at 10 a.m., 15 miles W. ½ S., it had risen to 61°, a change of 15° in two hours! At midnight, again, of the 19th-20th the sea was at 50°; four hours afterwards, 26 miles to the S.W. by W., it was 63°.

Within this section the cold or polar current was found to be chiefly prevalent in the first and last of the two-degree spaces, but the most most so in the last, that is, in longitude 60° to 62° W.; and the most prevalent examples of the Gulf Stream appeared within the meridians of 58° and 62°. W.

"The relations of the polar current and Gulf Stream, as thus indicated by the analyses of thirteen transatlantic passages generally, change, it should be observed, materially with the seasons of the year. Thus the descending polar current, which appears so prevalent within the western half of the belt of waters referred to in the discussion of the whole of the voyages, is found to be of comparative small importance in the summer and autumn passages, whilst the Gulf Stream is then the most predominant. Hence the shifting of the upper margin of the Gulf Stream northward at these seasons, as popularly understood, obtains very decided confirmation."*

* Report of the British Association, 1853.

(249.) It has been stated, from the information of American coasters, that the northern edge of the stream extends to the latitude of 41° 20′ or 41° 30′, on the meridian of Sable Island (60° W.); but this assertion has been controverted by others, who have averred that its northern edge never ascends beyond the parallel of 40°. The latter is erroneous; for many instances prove the contrary. Colonel Williams, in his "Thermometrical Navigation" (Philadelphia, 1799), states that the whirlpools of the eddy on the northern edge of the stream have been seen in lat 41° 57′, long. 65° 1′. He also observed great quantities of weed, supposed to be on the northern edge of the stream, in lat. 41° 53′. long. 15° 33′ It has subsequently been ascertained by Lieut. Charles Hare, R.N., that on the meridian of 57° W. in the summer season (the *rainy season* of the West Indies), the northern edge of the stream ranges up to 42¾° N.; and even in the winter months to above 42° N.

(250.) There is one special feature in the irregularity of the temperature south of the Grand Bank: it is, that the arctic stream seems to set farther to the south by 2° or 3° on the meridian of the Bank, or 48° to 50° W., than it does either east or west of it. This is doubtless owing to the effect of the Bank in raising the cold lower stratum to the surface, and rendering it cooler than it would otherwise be from the latitude, and also that the southward current may be somewhat stronger here than it is on either side of it.

The ice which is annually drifted from Baffin's Bay, Greenland, and Labrador passes over the Bank, perhaps, in the greatest quantity in this tongue of cold water, which protrudes so far in to the Gulf Stream, and which is such a terror to navigation in this part of the route—a danger not diminished by the constant haze which overhangs it from the unequal temperature of the warm sea and the cool atmosphere.

(251.) Referring to the peculiar character of the land and shores in the neighbourbourhood, the opinion was alluded to in (247.), page 238, which made the existence and formation of the banks of Nantucket and Nova Scotia, as owing to the transporting influences of the Gulf Stream, bringing to the northward the *débris* of the shores and bottom of the ocean which it passes in its course, and depositing the matter when it encounters the adverse arctic current from the northward. The same argument may be held as to the Newfoundland Banks, which probably owe a portion of their formation to the same origin. Besides this, there can be no doubt but that the icebergs which come down from the north in such enormous quantities in the spring and early summer bring large quantities of earth and rocks from the land where they are formed, and here deposit them as they melt. It might, therefore, be expected that these banks, in the quality of the bottom, will have a mixture both of tropical and of polar additions—a question of great interest to the geologist. But there is another opinion which may also be partially correct: it is, that they are natural plateaux upon which the marine deposits are laid and increase their elevation.

M. Beautemps-Beaupre (son of the famous hydrographer) procured fragments of the rock at the bottom in lat 45° 16′, 56° 35′ W., 37 fathoms—a piece of rock containing shells and broken shells. It was brought by Captain Miliner, of the ship *La Jeune Agathe*, in June 6, 1844. In June, 1846, the same commander procured other and similar pieces in 45° 18′ N., long. 6° 31′ W., in 38 fathoms; and again, in 1850, in 45° 15′ N., long. 56° 8′ W., in 38 fathoms. He never found this rock but in this neighbourhood. It consisted of layers of a grey calcareous sandy stone, containing shells similar to the tertiary deposits on the sub-Apalachian hills of the Southern States; and, according to M. Elie de Beaumont, it verifies a conjecture of his, that these banks are but a submarine prolongation of the tertiary plateaux of Georgia, the Carolinas, and Maryland.*

A special section on this important subject in connection with transatlantic navigation is given hereafter.

* Comtes Rendus; Academie des Sciences, April, 1860, p. 825.

NORTH-EASTERLY DRIFT BETWEEN THE NEWFOUNDLAND BANKS AND EUROPE, &C.

(252.) The Gulf Stream, as an independent current, seems to be neutralised by the counter-effect of the arctic current and its own diminished powers about the Banks of Newfoundland (257.). In its greatest strength, that is, when the sun is in a northern latitude, of course its strength is maintained to a greater distance eastward. It is singular to say that we have no very perfect or extended series of observations on record of the drift-currents which unquestionably extend from this longitude to the shores of Western Europe. Not that there is any doubt of the fact, because numerous climatorial and natural effects render it certain, and we have, moreover, the evidence of numerous bottles which have been drifted by its current to its shores, as will be quoted presently.

But from some cause or other shipmasters have not so carefully recorded their observations on the drift between Europe and Newfoundland as in other parts of the ocean. Perhaps one reason of the absence of any marked drift being announced is, that ships, in passing east and west, are alternately affected by the Gulf Stream drift and the arctic current, which thus neutralise each other's effects, and leave the impression that no current has been encountered.

(253.) As before said, we have many evidences of the extension of the tropical waters to our own shores. The gulf weed is not unfrequently encountered in the English Channel or on its shores. Many articles, too, are annually thrown upon the shores of Portugal, as mahogany logs, &c. Again, the coasts of Norway show every evidence of the effects of warm water drifted up to its shores. The great Lofoten fishery is a good example.

(254.) It is true that some observations on the temperature of the sea about the Scottish Islands made by Dr. Stark, has thrown doubt as to the actual presence of tropically-heated waters; yet it must be confessed that as yet we know so little of sub-surface action that it may be quite possible that some under-set may be coming down from the northward, and rising on the bank of soundings lower than the sea temperature in the bays and harbours of our shores. That his important observations in some degree negative the opinion that the Gulf Stream reaches thus far unimpaired in its characteristics, need not be a subject of surprise, since we have shown that the volume of the Gulf Stream in its greatest strength is almost insignificant when compared with its hitherto supposed effects. The climate of the northern countries of Europe is more ameliorated by the prevailing S. W. winds which have passed over the warmer waters in lower latitudes.

By referring to pages 209, 210 (67.) and (68.) and the illustrative diagrams, it will be seen how the westerly and south-westerly winds predominate, not only in a numerical proportion, but also a greater amount of force. It is to this that is to be attributed so large an amount of that amenity of climate which distinguishes the eastern from the western shores of the Atlantic in high northern latitudes.

(255.) But while the wind thus tempers the climate in its passage to the North and N.E., it also drives the water before it, and, beyond all question, causes the surface of the ocean to be of a higher temperature, even up to the Sea of Spitzbergen. Many well-known instances of its effects might be cited, as that of the fiords and inlets of Norway, even as far north as Hammerfest and the North Cape, never freezing over in the winter, the climate of Norway allowing the cultivation of corn, &c., in such marked contrast to the countries on the American side in the same latitude, only adapted for the habitation of the Esquimaux and the arctic animals.

(256.) We are indebted to Captain Irminger, of the Royal Danish Navy, for a collection of observations and experiments on the currents of high northern latitudes, which he has published in a work in the Danish language. These observations stand almost alone, and have still farther increased our knowledge of this interesting branch of meteorology. He has also well explained how it is that Iceland is in-habitable, and possessed of a comparatively mild climate to what would be argued from its latitude and position. It is to the effect of the warm waters brought to the East of the Newfoundland Banks by the Gulf Stream, which are drifted as far north and west as the west side of Iceland by the prevalent winds as before described.

(257.) Some of the data supplied to Commodore Irminger were collected by Captains Holböll and Ulrich, and others, in the voyages between Denmark and Iceland, Greenland, &c., in various men of war. Between Shetland and Iceland, the mean of the observations give a daily rate of current of 2·4 miles to N. 52° E.; but it was very irregular. It was strongest near the Shetlands, 4·7 miles per day N. 72° E.; and Iceland, 3·1 miles N. 47° E. true. A northerly current was also found to run from 3·2 to 5 miles per day between Iceland and Greenland in April and September.

As regards the temperature, which is a sure test of the origin of the stream, it is found that between the meridian of Fair Island and 30° W. there is no great variation in temperature,* but the ocean to the westward of 30° W. is found to increase in coldness as Greenland is approached. Again, it is found that the temperature of the ocean in spring is as high at South Iceland as it is at the Shetlands and Færoes, although lying several degrees more north. The observations for temperature between Iceland and Shetland show that there are stripes of warmer and cooler water, with a difference of temperature of 2°·5 to 4°·5 Fahrenheit, in a similar way to those noticed in (248.), page 339. These lines follow the direction of the current, but are not constant in their position.

The current runs in a north-westerly direction from long. 18° W. toward Reikianess, the south-west cape of Iceland. Commodore Irminger found it in a mean of five days in May and June, 1846, to run in a N. 15° W. direction, at a mean rate of 4·3 miles per day. This northerly current on the *west* side of Ieland is well known to the fishermen, and in evidence of it the temperature of the water in Reikiavik Harbour may be cited. In May and June it has been found to be 47°·4; in July, 53°·3; and in August, 51°6; while on the coast of Greenland abreast of it the mean varies between 28° and 34° Fahrenheit. This warm current runs still farther northward till it is stopped by the southern drift, which sets south-westward from Spitzbergen down towards the south coast of Greenland and Davis Strait, and which approaches the N.W. point of Iceland.

(258.) There is, as has been stated, abundant proof that tropical products reach the shores of Portugal and Western Europe. But they are also found much to the northward. Several species of Mimosa (mimosa scandens, &c.) are found on the coasts of Norway, the Faroe Islands, Iceland, &c., among other drift-wood frequently thrown ashore. In some cases this drift-wood is very abundant and serviceable to the inhabitants for fuel. On the Faroe Islands one place (Kirkeboe) used to afford the owner an annual revenue of 50 or 60 dollars, which, however, was diminishing. The wood seems to be fir, probably from America. One trunk was 5½ feet in circumference. On the north coast of Iceland very considerable quantities are found, among which is larch, thought to be cedar by the inhabitants. This probably comes from Siberia.

(259.) As a general summary, then, it may be said that the anti-trades drift the waters brought by the Gulf Stream to the meridian of the Newfoundland Banks in a north-westerly, westerly, and northerly direction, at a moderate rate, towards the coasts of Portugal, the British Isles, Norway, and to Iceland. The further progress of this drift on to the arctic basin, around which it circulates, and finally emerges around the coast of Greenland, and thence down Labrador, and finally is lost in the Gulf Stream as before explained.† The final evidence of its action which will be here adduced is the drift of bottles, to which we have before referred (131.).

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* See the Observations of Dr. Scoresby (251), page 338.

† See Transactions of British Association, Liverpool, 1854; Section E.

(260.) **Bottles.**—The following statement of the drift of bottles is derived from Captain Becher's Bottle Chart. Many of the particulars contained in it have been given in our former editions, but they are here given entire, in order that an estimate may be formed of the strength of the current in which they have drifted. It may be premised that the length of their courses is given in the shortest or direct distance. It therefore underrates their progress, as they have doubtless not generally pursued the shortest track to their destination:—

Ship.	Signature.	Where left. Year.	Where left. Lat. N.	Where left. Long. W.	Where found.	Interval Days.	Distance.	Rate Per Day.
			°	°			M.	M.
Osprey	McGill....	1822	49·6	12·5	Wales	36	270	7·5
Wallace	Robertson .	1835	52·2	15·0	Ushant	130	450	4·2
Tyne	R. Hope ..	1834	46·6	16·9	Devon	71	600	8·4
Kent	W. L.	1836	50·3	19·0	Boulogne	126	890	7·0
Niger	Merret ..	1839	48·2	18·9	Quiberon	177	700	4·5
Bolivar	....	1840	46·9	18·6	France	94	700	7·0
Mary	Lock	1832	44·2	18·0	France	310	700	2·2
Ibbetson	of Stockton	1826	55·5	18·3	Killala	59	300	5·0
President	Scott	1836	48·5	19·6	France	128	650	4·1
Virginia	....	1838	42·2	19·3	Cork	45	750	17·0
Persian	Mallard ..	1834	47·1	20·4	Ireland	113	600	4·1
Albert	Robertson .	1822	47·3	21·9	Somerset	186	820	4·3
Ardent	Duncan ..	1824	57·0	24·5	Lewis	171	610	3·6
Superior	Munson ..	1842	53·8	24·0	Dunnet Head	175	800	5·0
Enterprise	....	1833	45·1	24·3	France	316	980	3·1
Mary	Godfrey ..	1840	47·3	27·4	Clare I.	111	850	7·7
Orbit	Boot	1811	46·8	27·0	Ireland	330	860	2·7
Romulus	Crawford..	1819	57·8	30·7	Shetland	110	1000	9·1
Helen	Butman ..	1834	47·3	33·6	Scilly........	179	1150	6·4
Sandwich	Squire'....	1821	50·3	36·4	Hebrides	184	1100	6·3
J. Cropper.....	Marshall..	1824	48·3	38·1	Mounts Bay ..	398	1230	2·4
Seine	....	1811	50·7	40·3	Kerry	274	1130	4·5
British Queen..	Hamilton .	1838	43·9	44·5	Newport	66	1700	25·7
Royal Union ..	Grant	1822	48·2	45·2	Scilly	75	1450	19·9
Elizabeth	J. E.	1819	47.0	49·2	Rathlin Isle ..	311	1600	5·0
Victoria	....	1834	45·0	50·0	Lands End ..	215	1760	8·2
Alexander	Parry	1818	59·1	52·3	Staffa........	437	2400	5·5
Alexander	Parry	1818	62·0	54·0	Donegal	416	2600	6·2
Newcastle	Napier....	1819	38·9	64·0	Ireland	356	2700	7·3
J. Esdaile	King	1821	36·9	71·8	Lancashire ..	495	3000	7·0
R. de Holland..	Groeneld ..	1850	46.0	20·5	Glandore	345	680	2·0
Jessy	Cook	1846	50·6	20·5	Brest........	59	480	8·0
....	Johnstone .	1847	47·3	21·7	Brest........	206	700	3·5
Delia	Adey	1842	50·0	26·0	Ireland	138	60	4·6
Normandie	Spalding ..	1844	57·1	33·2	Norway......	228	1400	6·1
Graham	Beach	1847	51·1	45·5	Barnstaple ..	233	1560	6·7

These bottles taken from Captain Becher's list in the "Nautical Magazine," 1852, have been selected from those which have made the ordinary drift. The chart which shows their direction, points most clearly to the westward and north-westward drift, although the rate is not high, being for the above 6·6 miles per day, which, as is said above, is probably below their actual rate. It will also be observed that their velocity varies greatly, a long course having been performed at a mile an hour and upwards, while in other cases their progress would be inappreciable in the navigation of a ship.

(261.) The effect, then, of this extension of the waters of the Gulf Stream will not have much influence on the course of a ship passing through it, and its general effect, it is believed, is properly represented in the diagram of the currents, at page 259. Its general direction in its main strength will be a little to the north of east, between the latitudes of 43° and 50°, and its main mean velocity from 9 to 11 miles per day, but at times, as shown above, rising to above three times that rate, especially during and succeeding heavy westerly gales. Further to the north, that is, between latitudes 50° and 60°, its mean direction will be about E.N.E., bearing more northward as it approaches the coast, and its rate from 5 to 8 miles per day. Still further northward, our scanty knowledge will only lead to the inference that it drifts irregularly to the N.N.E., and partially to the N.W. at times, but is then probably very feeble, and intermixed with the veins of cold water drifted by the N.E. winds which prevail in the latitudes above Norway, &c.

Lastly, although its relation to navigation is not of very high importance, its effects in the great economy of the ocean are most important. By its influences the North Polar Basin is annually opened to navigation, and its shores made habitable to the wandering and scattered Esquimaux tribes, who flourish under the terrific winter temperature. It makes the north a marked contrast to the Southern Polar regions, where no warm gulf stream penetrates, and where, in a constant deposition, those amazing ice fields are formed which cover the whole of the region in perpetual ice of many hundreds of feet in thickness. Were it not for this influx of warmer waters into the Arctic regions, where the mean annual temperature is beneath the freezing point, the whole of the Arctic circle would be like Antarctic, one solid mass of ice, sea, land, and everything being solidified into one immense mass, whose varying margin would protrude over the northern coasts of America and Asia, alternately dissolving with the summer, and increasing during the winter.

8.—THE ARCTIC, OR LABRADOR CURRENT.

(262.) The last section treated of the warmer tropical waters which passed into the northern regions, carrying with them the ameliorating influence on the Arctic climate. The present deals with the same waters as they emerge, at a minimum temperature from these frozen regions, and bring their ice and cold into the grand system of circulation and compensation.

The limits of the N.E. drift about Iceland has been mentioned in p. 242 (257.). To the west of this, then, we may place the great drift which comes down from beyond Spitzbergen, and transports the immense quantities of ice upon the eastern shores of Greenland, which has generally rendered this, one of the most inclement regions of the world, unapproachable by ships. Several instances of this drift could be recited, but as it is not interesting to navigation, they need not be dilated on. The ice this current brings into the low latitudes is an important consideration in the navigation of the Atlantic as is well known. This branch of the Arctic drift, however, does not probably furnish many of those gigantic icebergs, which, drifting down Davis Straits, float over the Newfoundland Banks, and far into the northern margin of the Gulf Stream.

The estimated rate of this drift from Spitzbergen, calculated from the rate of vessels in the pack-ice is from 8 to 14 miles per day.*

* See Findlay on the Course of Sir John Franklin's Expedition, "Journal Royal Geographical Society," xxvi., 1856, p. 33.

(263.) It was formerly considered that this S.W. Stream after passing the Cape Farewell, the south point of Greenland, made direct for the coast of Labrador, and thence over the Newfoundland Banks. But Commodore Irminger, of the R. Danish Navy, has demonstrated that it does not do so, but that it passes around Cape Farewell to the westward, and thence passes northward along the shores of West Greenland.

"If the current existed, which the beforenamed writers state to run in a direct line from East Greenland to the banks of Newfoundland, then the ice would likewise be carried with that current from East Greenland; if it were a submarine current, the deeply immersed icebergs would be transported by it; if it were only a surface-current, the immense extent of field-ice would indicate its course,* and vessels would consequently cross these ice-drifts at whatever distance they passed to the southward of Cape Farewell. *But this is not the case:* experience has taught that vessels coming from the eastward, steering their course about 2° (120 nautic m.) to the southward of Cape Farewell, seldom or ever fall in with ice before they have rounded Cape Farewell and got into Davis Strait, *which is a certain proof that there does not exist even a branch of the Arctic Current which runs directly from East Greenland towards the banks of Newfoundland.*"†

The limits of this Spitzbergen current, as it may be termed, is therefore indicated by the distance to which the ice it transports is found to extend, and the examples cited may be taken, as above, to a distance of 120 miles south of Cape Farewell, and to 150 miles of the Danish settlements of S.W. Greenland.

(264.) In the space of ocean between the southern limits of this current and the known south-easterly drift down the Labrador Coast, an anomalous condition seems to exist, we have no notice of the set of the streams, if any within it, but its characteristic seems to be the *drift-wood* within its area. These floating relics have evidently a southern origin, and point also to the truth of the statement that a warm current sets toward and past Iceland (255.)

"Another proof that the current from East Greenland does not run in a straight line towards the banks of Newfoundland, is also derived from the observations of the temperature of the surface made on many voyages to and from Greenland.

"Supposing that the Arctic Current from East Greenland pursued its course in a straight line towards the banks of Newfoundland, it would be crossed, on the voyages from Copenhagen to the Danish colonies in Greenland, between 38° and 45° W. Gr., and so high a temperature in the surface of the ocean as from 4° to 6° R. (41° to 45°·5 Fahr.), as is found on this route and marked in the plan, would, according to my opinion, be impossible only 1° or 2° to the southward of the parallel of Cape Farewell; as it is a well known fact that the principal ocean-currents maintain their temperatures through very considerable distances of their courses.

"This comparatively high temperature of the surface of the ocean so near to the limits of that current which carries enormous masses of ice from the ocean near Spitzbergen round Cape Farewell, warrants my opinion that the waters of the Atlantic Ocean move in a north-westerly, or northerly direction, towards the eastern and

* "An observation which it is interesting to mention here, and which gives a proof of the very little difference between the temperature of the surface and that at some depth, is mentioned in the Voyage of Captain Graah, p. 21. He says, 'The 5th of May, 1828, in lat. 57° 35′ N., and 36° 36′ W., Gr., the temperature of the surface was found 6°·3 (46°·2 Fahrenheit), and at a depth of 660 feet 5°·5 *plus* R. (44°·5 Fahrenheit).' This proves that there is no cold submarine current in the place alluded to, to the S.E. of Cape Farewell. A still more conclusive experiment is recorded by Sir Edward Parry in the account of his first voyage, June 13, 1819: in lat. 57° 51′ N., long. 41° 5′, with a very slight southerly current, the surface temperature was 40½° Fahrenheit; and at 235 fathoms 39°, a difference of only 1½°.—Ed."

† "Journal of the Royal Geographical Society, vol. xxvi., 1856, pp. 40, 41."

southern coasts of Greenland,* and that this in-draught towards the land is undoubtedly the cause of the ice being so closely pressed on to these parts of the coast as it is so frequently on the S. coast, and almost constantly on the E. coast, rendering the eastern coast entirely inaccessible from the seaward.†

"From the foregoing it seems to me to be demonstrated that the current from the ocean around Spitzbergen, which carries so considerable masses of ice, after it has passed along the E. coast of Greenland, turns westward and northward round Cape Farewell, *without detaching any branch* to the south-westward, directly towards the banks of Newfoundland.

"This current afterwards runs northward along the S.W. coast of Greenland until about lat. 64° N., and at times even up to Holsteinborg, which is in about 67° N."—*Captain Irminger.*

(265.) This current, then, after drifting over the Atlantic, passes up the eastern shore of Davis Strait to and beyond the entrance of Baffin's Bay, between Cape Walsingham and Holsteinborg. It here encounters the *southern* set which passes down Baffin's Bay, especially on its western side, transporting those immense icebergs which are annually launched from the glaciers of West Greenland and other parts, as described by Dr. Rink. This current, which enters Baffin's Bay, especially by Lancaster Sound, is the grand outlet of the waters which run from west to east through the labyrinthine Archipelago, of late the scene of the exciting search for the expedition of Sir John Franklin, and is unquestionably the continuation of that drift past Spitzbergen, described in (262.).

It thus brings into warmer latitudes all the ice which remains from the melting influences of the Arctic summer, and also is continually floating southwards that which collects in Baffin's Bay and its inlets. Its southward drift is constant, winter and summer, as has been demonstrated by the drift of several vessels of the Arctic searching squadrons—as the Grinnell Expedition, Sir James Ross, H.M.S. *Resolute*, Sir L. M'Clintock, in the *Fox*, &c.

About 10 miles per day may be taken as the drift down Baffin's Bay, as estimated by the author in the "Journal of the Royal Geographical Society," quoted above.

(266.) The Baffin's Bay Current and the Spitzbergen Current thus joined in the strength, set with great force down the coast of Labrador, the westward tendency being probably owing to the earth's rotation, which here rapidly increases southwardly in these parallels. It is probable that it sets at from 1½ to 2 miles per hour close ashore on the Labrador coasts. But its chief interest to the sailor are the masses of drift ice and tremendous icebergs which it floats southward across his track, and constitutes one of the most formidable dangers of the Transatlantic navigation. As

* "Graah says in his Narrative (p. 23, English translation):—'In the mouth of Davis Strait I found the temperature of the surface of the ocean from 4° to 3°·1 R. (41° to 39° Fahrenheit), though we were in the proximity of the ice. From this I concluded that a current from the *South* predominated here, because I never before in the vicinity of ice had found the temperature of the water exceeding 1°·8 R. (36° Fahrenheit), and this conclusion was confirmed when, coming to the northward of the ice, I found the temperature of the water 1°·1 *plus* R. (34°·5 Fahrenheit).'"

† "Besides the evidence afforded by the ice-drifts and the temperature of the water, as cited by the author, conclusive proof of a northerly set is found in the driftwood which has been so frequently met with around Cape Farewell and off the W. coast of Greenland. A few examples will suffice. A plank of mahogany was drifted to Disco, and formed into a table for the Danish governor at Holsteinborg ('Quarterly Review,' No. xxxvi.). Admiral Löwenörn picked up a worm-eaten mahogany log off the S.E. coast of Greenland. These in all probability were transported from the S.W. by the Gulf Stream. Captain Sir Edward Parry, in his second voyage, September 24th, 1823, picked up a piece of yellow pine quite sound, in lat. 60° 30′, long. 61° 30′ W.; and on his third voyage seven pieces of driftwood were found in the vicinity of Cape Farewell. Again, Captain Sir John Ross found much driftwood around Cape Farewell; and Captain Sir George Back saw in lat. 56° 50′, long. 36° 30′, a tree with the roots and bark on. These instances might be multiplied, but their character indicates a southern origin.—Ed."

this is the most important feature it has, it will be dilated on more fully hereafter, as the limits within which these ice-drifts are encountered are also the limits of the current now being discussed.

(267.) These *ice-drifts* are seldom met with to the eastward of the meridian of 40°, that is, about 300 miles beyond the limits of the Grand Bank. Nearer to the Banks they become more numerous, and some years the sea appears to be covered with them, and vast numbers of bergs ground on the banks.

To the southward the extent of this ice-drift is uncertain, as it depends upon two causes:—the one, the force and extent of the Arctic Current from the northward; and the other, the depth to which the ice-bergs are immersed. As before mentioned, (248.) p. 338, there appears to be a perpetual struggle between the opposing forces of the Arctic Current and Gulf Stream to the southward of the banks. This process, invisible at other seasons, is made apparent during the season of the ice-drifts by the deeply immersed bergs passing quite into the course of the Gulf Stream under the influence of which they rapidly disappear. As will be seen presently, the view now accepted of this phenomena is that the Gulf Stream overruns the cool waters proceeding southward and south-westward; and although the northern edge of the warm waters of the stream are met with in the summer months over the southern end of the Newfoundland Banks, or as high as 45° N., yet these bergs are found drifting as far south as 39°, and even to 36° 10′, or 420 miles southward of the tail of the Banks, and beyond the limits of the Gulf Stream. This latter circumstance, however, is of rare occurrence.

As this debateable ground for the currents is peculiarly interesting, we give, as heretofore, the account of a passage during the ice season across this portion of the Atlantic. It may not differ from the ordinary experience of any seaman, but it points to some facts heretofore discussed.

(268.) Remarks from the journal of Lieutenant J. Steele Park.—"On *Monday*, 9th of July, 1827, our latitude at noon was 40° 29′ N., and the long. 53° 30′ W., by lunars and chronometer. The temperature of the water 73°, and the air 75°; the wind S.E. by E., a light breeze: the ship close-hauled on the starboard tack, lying N.E. by E., and going 2 knots (she was now in the Gulf Stream). At five p.m. tried the water again, and found the temperature down to 67°! Hove the ship to immediately to sound, but got no bottom with 100 fathoms of line, right up and down. Nothing to be seen from the mast-head; no ice nor danger of any kind, and the temperature of the air not affected (a cold vein of water from the north). Took altitudes for the chronometer at the same time, which made the long. 53° 18′. We then filled and made sail again. At half-past five the water was 1° warmer, viz., 68°; at six it was 69°; at seven, 69°; at eight, 70°; at ten, 70°; and at midnight it was 71°. On Tuesday morning, at four o'clock, the water was 72°; at eight it stood at 74°; and, at noon, 74°; when the latitude and longitude were 41° 16′ N., 52° 24′ W.

"Had the atmosphere not been perfectly clear when we hove the ship to, I should have suspected that we were in the vicinity of an iceberg, but it was serene and beautiful; therefore the sudden fall of 6° of the thermometer, in this part of the ocean, must be attributed to some other cause. There is a danger of some kind laid down about this spot, by Captain Watson, of Liverpool (to say nothing of our old friend 'Daraith'). We have sailed over the very place where it appears in Purdy's Chart of the Atlantic. However, the water has been so remarkably smooth and unruffled, that we may have passed within a ship's length of a 'rock even with the water,' without perceiving it.

"I am inclined to believe, that we should have found the temperature of the sea below 67°, if it had been tried an hour or two sooner. We have a right to presume that it was rising when I first discovered the change; for, half-an-hour afterward, it was 68°, and it went on progressively, getting warmer and warmer, until it mounted up 74°, and there it stopped: thus furnishing a beautiful illustration of the susceptibility, and, therefore, the usefulness, of this most simple of all instruments.

"The latitude of the ship (at five p. m. Monday) may be called 40° 36′, long. 53° 18′.

"*Wednesday* July 11th.—The temperature of the water I try every four hours on ordinary occasions; and every hour, or every half hour, in approaching soundings or 'Vigiæ.' Now, the temperature of the water was 74° yesterday morning at eight o'clock, and it continued nearly the same till midnight, when I found it cooling a little; it was then 71°. During the night it was neglected, and I can say nothing with certainty about the temperature; but I felt a very sensible change in the atmosphere this morning when I went on deck; and when I plunged the thermometer into the sea, I was surprised to see it down to 58°.* We hove the ship to again, and passed the lead forward, but there was no bottom with 100 fathoms of line. As I knew we were only about the parallel of 42°, I did not expect soundings, but I thought it right to try, and make quite sure of the thing. The weather very fine, and nothing in sight from the mast-head. Thermometer in the shade 63°, with a southerly wind, and yesterday it was upwards of 70°. Altitudes for the chronometer were taken, when we hove-to, which made the long. 50° 20′; and the observed latitude at noon was 42° 7′. The ship made 5′ of northing in the interval between noon and the time we tried the lead, so we must have been in 42° 2′ N., and 50° 20′ W., at eight o'clock this morning, when the water was down to 58°. At nine it was 57°; at ten, 60°; at eleven, 56°; at noon, 56°; at two p.m., 57°; at four, 58°; at eight, 59; and at midnight, 60°.

"*Sunday*, July 15th.—There was very little change in the temperature of the water, from midnight of the 11th till this day at noon, in lat. 44° 17′, long. 45° 4′. The cold has been diminishing gradually and very slowly (the atmosphere as well as the sea), but the water is now up again to 70°, and the air to 74° (the ship had again got into Gulf Stream water).

"I presume the great difference in the temperature of the ocean-water, discovered on Wednesday morning, must be ascribed to the proximity of the Grand Bank of Newfoundland; but if the generally received opinion be correct, that 'the water is' only '5° colder at the *edge* of the bank than the deep ocean,' how are we to account for a fall of 14° or 15° when we were unquestionably in very deep water, and 30 or 40 miles at least, from the nearest soundings on the very tail of the bank? This is a problem I do not pretend to know much about.†

"By-the-bye, I may notice here again (*en passant*) what I have had occasion to remark more than once before; that is, the *northerly* set which I have uniformly encountered near the tail of the bank. Now, on the 11th, last Wednesday, the weather was beautiful; but the next day a fog, with all the density so peculiar to this part of the ocean, closed round us, and we were left to grope about in the dark, or by dead reckoning, which is the same thing. We never got a glimpse of the blue sky until this morning, when, by chronometer and excellent lunar distance, together with the sun's meridian altitude, we find out that a current has swept us N. 10° E., 54 miles in three days.‡ The latitude to-day, at noon, is 44° 17′ longitude, by chronometer and lunars, which go hand-in-hand uncommonly well, 45° 4′.

"During the three days' fog the wind was southerly; we, of course, were standing to the eastward, and I could not understand why the temperature of the sea continued

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* "She had now entered that peculiar tongue of cold water, very often encountered and spoken of which extends far the southward of the ordinary range of the Arctic Current. It has been alluded to on (250.) page 340."

† "It may probably be accounted for by the effect of the banks in raising the cooler water of the Arctic Current nearer to the surface, and thus sending southwards a stronger current of colder water than is found to the eastward or westward of it."

‡ "Another example of this northerly set, see (256.) page 341, which demonstrates how uncertain the currents are hereabout, is given by Lieutenant Evans, in describing his run across the Atlantic, from Newfoundland, in *June*, 1828, says, 'We experienced a current setting to the northward, sometimes as much as 20 miles in the twenty-four hours; this circumstance, so contrary to the generally received opinion of a permanent current from

so low and so nearly in the same state all the time; for, according to our calculation, we were making a great deal of easting, consequently increasing our distance from the bank: but, when it brightened up, the mystery was explained: we then discovered that the northerly current had carried the ship round the tail, on a course almost parallel to the edge of soundings; therefore the change was slow and gradual until we got beyond its influence."

(269.) The waters of the arctic ocean are thus brought again into that system of circulation which gives to sea water a universal character (133.). In former years it was not thought that its effects extended further than this, and the cool S.W. current inside the Gulf Stream was considered to be an eddy of that great current, whose temperature was dependent on the shallowness of the soundings, in contradistinction to the supposed unfathomable depth of the Gulf Stream. Captain *Pornton*, in the earlier editions of this work, had, however, been led to conclude that the southward drift past Newfoundland, and the current from the Gulf of St. Lawrence with the eddy from the Gulf Stream composed the counter-current in question.

Its true character was first argued by Mr. W. C. Redfield, a name well-known to science. He drew up a summary of remarks and suggestions for the observers of the United States' Exploring Expedition, under Captain Wilkes, in 1838, and which was read before the American Philosophical Society in May, 1843. From that paper we will make a few extracts:—

" . . . . From what source is that south-westerly current derived, which commonly prevails along the coast of the United States, in the direction which is opposite to the Gulf Stream?

"I am aware that it is usually considered by seamen as an eddy current derived from the Gulf Stream; but from this view I am compelled to dissent. For, in the first place, this current never assumes the gyrating form of an eddy; but continues its course, when unobstructed by gales, in a direction which is generally parallel to the coast. But, secondly, in case this current be derived from the Gulf Stream, it must necessarily partake of the same elevated temperature; whereas the reduction of temperature which occurs on crossing the north-western limit of the Gulf Stream is most remarkable, and is almost without parallel in the Atlantic, except in the immediate vicinity of ice.

"It appears vain to allege the proximity of soundings or shallows as explaining this extraordinary change of temperature, for this cannot avail if the waters of the counter-current be derived from the Gulf Stream, to say nothing of the erroneous character of the position here noticed.

"From the evidence which is afforded by numerous facts and observations, it appears that the current in question is neither more nor less than a mere sluggish prolongation of the *Polar or Labrador Current*, which sweeps along the north-eastern shores of this continent and the Island of Newfoundland; and this current, if I mistake not, may be traced in its gradations of temperature, by the thermometer, from off the southern coasts of Newfoundland and Nova Scotia, through the entire distance, to Cape Hatteras, if not to Florida.

"An eddy current, off-setting to the Gulf Stream, would nowhere be so likely to be met with as at the point of intersection of this stream with the extremity of the

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the North, may be accounted for from the circumstance of the winds being principally from the South and S.W. A long continuance of southerly winds would have the effect of turning the fluent waters of the Florida Stream, east of the banks, to the northward and eastward, sufficient to produce the superficial current we experienced, and to check the general flow of the waters from the northward. We met no ice of any description, nor any indication of its vicinity, unless when crossing the tail of the bank; the constant southerly wind, of course will easily account for our not seeing any of these formidable dangers; but it is remarkable (and the instance is a proof of our imperfect knowledge of the theory of winds), that an American brig, making a similar run at the same time, but being about a degree or two farther North than our parallel, had to contend with strong northerly gales and to encounter numerous icebergs."

Grand Bank of Newfoundland, and sweeping from thence upon the southern shores of the island of that name; and yet the Harbour of St. John's, in the southern part of Newfoundland, is known to have continued ice-bound, in 1831, so late as the month of June, although in the latitude of Paris. This fact is a convincing proof of the unimpeded continuation of the Polar Current to the southward, in this region, notwithstanding the near proximity of the Gulf Stream."

(270.) The velocity of the current over the Banks and to the southward of Newfoundland is very variable, but at times is great. We can rather argue from its effects than from direct observation; for one result of this influx of warm water into a cold region is the production of dense fogs so peculiarly characteristic of the Banks. "Bank weather" is not favourable to astronomic observation, and hence the paucity of them.

(271.) Upon a survey of the *Virgin Rocks*, in July, 1829, the current at about 80 miles E. by S. from Cape Race, was found setting over them to the W.S.W. at the rate of a mile an hour.

To different currents must be attributed the loss or the sloop *Comus*, the transport *Harpooner*, H.M.S. *Drake*, and the brig *Spence*, all of which were lost, at different times, upon *one spot*; the little bay, called *St. Shot's Bay*, on the South coast of Newfoundland, and lying between Cape Freels and St. Mary's Bay. The particulars of all these melancholy events have been given in our "British American Navigator," 1861, and therefore need not be repeated. The *Comus* was from the West, and was lost in the night of the 24th of October, 1816, after having sounded, as supposed, on the inner edge of the Green Bank. The *Harpooner*, a transport, with troops, was from Quebec, and bound for London. She struck at 9 p.m. of November 10th, 1816. The *Drake* sailed from Halifax for St. John's, 20th June, 1822, under very favourable circumstances, upon a direct course, for Cape Race; but on the 23rd the weather became thick, and at noon she was supposed to be 90 miles from Cape Race, but at half-past seven p.m. breakers were reported ahead, and the ship was soon after a total wreck. The *Spence* was from Richibucto, in the Gulf of St. Lawrence, with lumber, bound to Liverpool, and was totally lost at St. Shot's, at four p.m., 16th July, 1822. Another vessel, the *George Canning*, from Chaleur Bay to Aberdeen, was wrecked here, during a dense fog, on the 17th of June, 1829.

The five vessels, it may be seen, were all from the *westward*, and all, it may be presumed, were set to the *northward* as well as to the *westward*, of the situations which they were supposed to occupy, and the route which each intended to pursue. They can be accounted for only by the supposition of currents winding round the coast, opposing each other, and operating as above explained; for it seems clear that the westerly current from the Grand Bank so opposes the easterly one as to limit its operation *eastward*, and give it a northern inflection; thus producing the indraught into the southern bays of the island.

It appears that the south-westerly current, over the Grand Bank, sets over the whole of the northern part of that bank. In a summer voyage, 1826, lat. 46° 24′, Lieutenant Hare (30th September) sounded on the outer edge of the bank, with thick blowing weather from S.W.; and, on the next day, in 45° 56′ N., and 48° 6′ W., had no bottom at 120 fathoms, with a very heavy swell from W.S.W., although he found that a current had carried him S. 67° W. 34 miles. Thus appeared, in close conjunction, a south-westerly current, with another from W.S.W., where the edges of the two entered into collision with each other.

(272.) The current which sets out of the Gulf of St. Lawrence, between Newfoundland and Breton Island, also adds its effect to the current setting to the S.W. It is composed of the stream of fresh water which constantly sets down the river, and the water which enters from the Labrador current through the Strait of Belleisle.

The current usually sets into the Strait of Belleisle, between the island and the coast of Labrador. It transports immense quantities of ice in some years into the Gulf, if they are not too large to be intercepted by the moderate depth of the strait, although this feature varies very much indeed in different years. This current has been observed to run two miles an hour with the wind from N.E., while at other times it is almost insensible, and it is stated sometimes to run in the opposite direction, especially during the ebb tides with S.W. winds. After it enters the Gulf, it runs 30 or 40 miles further, when it becomes dispersed and merged into the general streams.

The outset from the Gulf is very frequently of some considerable strength, especially with westerly winds or in calm weather. But its strength is reduced, or it even is retarded altogether, with opposing winds, which have a powerful effect on it at all times.

Both these currents are modified by the tides, but in a way directly contrary; for, while the Strait of Belle Isle current is ameliorated by the flood, and retarded by the ebb, the other is increased by the ebb and checked by the flood tide which enters the Gulf from the southward. The tidal hour is therefore important in estimating the probable set of these currents, which, however, it may be said to be said to be exceedingly difficult at all times to estimate and allow for correctly.

(273.) *Sable Island* has been famous for its wrecks, which greater knowledge and consequent caution have rendered less frequent. Its position and formation are remarkable, as it lies apparently in the strength of the Gulf Stream. Its dangerous character is greatly increased by the prevalent fogs, which are dense and very constant. As is well known, it is a mere sand bank, with two parallel ridges of sand blown above the sea level, and forming a curve convex to the southward, showing the direction of its principal growth. From each end extend long "bars" or shoals: that to the west extends 17 miles, and that to the east 14 miles, the whole extending over 50 miles. The westerly winds and current tending in the same direction are constantly wearing away the west end, and adding to the east, by drifting the sand of which it is formed and that which it brings to leeward.

The wrecks, which now average two annually, have usually occurred from the effects of the S.W. current which we are now considering, and which, though irregular in its action, has usually some effect on a ship's course; added to this, as has been previously shown, the Gulf Stream is here found with much diminished force, and consequently there are some anomalies in the immediate neighbourhood of Sable Island. The best account we have of the streams is that given by Mr. Darby, who was superintendent of the establishment here.

Mr. Darby has said, "On the south side of Sable Island, the current, in shoal water, with prevailing south and S.W. winds, sets rapidly eastward until it reaches the end of the N.E. Bar. It then unites and blends with the *St. Lawrence Stream*, which passes the bar in a S.S.W. direction, and runs strongest in April, May, and June. I have sufficient reason for believing that the Gulf Stream, on the parallel of 42° 30', running E.N.E., occasions the St. Lawrence Stream, then running S.S.W., to glide to westward. The strength of this stream has never been noticed, and three-fourths of the vessels lost on Sable Island have been supposed to have been to the *eastward* of the island, when, in fact, they were in the longitude of it."

"Easterly, southerly, and S.S.W. winds set a rapid current along shore in shoal water, to W.N.W. and N.W.; that is, along the shore of the western end of the island, but not the eastern nor middle, as there the current, with southerly and S.W. winds, sets to the eastward. The natural tendency of the flood-tide is toward the coast. When it strikes the island it flows to the eastward, over the N.E. Bank, and to the westward, over the N.W. Bank, and passes the west end, in a N.W. direction, so rapidly that it carries the sand with it; and the hills of the west end being high and narrow, they are undermined at their base by it, and tumble down some thousands of tons of sand at a time. This the current beneath catches, and sweeps away to the N.W., increasing the bank. So soon as this current passes the extreme point of the dry bar, it tends more across the bank to the N.E.; the motion of the sea contributing to keep the sand in motion; the current carries it to the N.E.. and spreads to the N.W."

(274.) In following the course of this current along the coast of the United States, we have no very clear notion of its mean velocity; but that it does run to the southward, we have many evidences, besides the temperature of its waters. It is probable that the surface, at least, is obedient to the varying of the winds, which blow over it, but it preserves its course almost unimpaired and quite appreciable on the surface as far south as Cape Hatteras, after which its presence does not appear so manifest, except as a submarine current. In (220.) &c., the presence of the cool water it transports is shown to exist, in a great degree, even close beneath the warmest and strongest parts of the Gulf Stream.

There is great evidence of current action all along the coast of the United States beyond the Cape Cod peninsula, itself of remarkable formation. The long straight lines of low alluvial shores, fronting extensive shallow lakes, separated from the ocean by narrow beaches thrown up by the sea, all bespeak the work of the ocean and its drifting waters.

There is another singular feature, too, in the more southern portions of its course. The long lines of shoals which project seaward from the Capes Hatteras, Fear, Lookout, &c., that is, in the section where its surface action is not so manifest, indicate some process going on which as yet has not been entirely explained.

In a nautical sense the allusion to this current is sufficient to guard against its effects in approaching the coast, or in taking advantage of it to work against the current of the Gulf Stream. No particular instructions have been issued respecting it, and therefore this will close our notice of it as an inner current of the Gulf Stream.

(275.) But there is another part of the ocean in connection with this where the currents are not strong or regular, but is peculiar. It is the part between the Bermudas and the coast of Georgia. There seems to be some connection with the fact of Cape Hatteras cutting off a portion of its southern progress and the very irregular temperatures that are met with to the south-eastward of that Cape. The cold veins alluded to on page 328 (234.) are, perhaps, a portion of this; but it certainly seems as if the cold water, after passing under the Gulf Stream, appears on the surface intermingled with the warmer waters of the Equatorial Current, and cause a slight drift to the south-eastward, and have something to do with that eastward tendency of the Gulf Stream (242.) in throwing off its floating objects to the eastward of its course—a fact which has been attributed to its being "*roof-shaped*," a form owing to the greater force and velocity of its centre which causes the water along the middle of its course to be higher than the lateral portions.

In the southern part of th[illegible]rent its influence on navigation, as said above, is of minor consequence. Its pri[illegible] feature is its ice-transporting powers in the more northern portion of its career; and as this has a most important bearing on the navigation between Europe and America, some notice on this point follows.

ICEBERGS, ICE ISLANDS, AND DRIFT ICE IN THE ARCTIC CURRENT.

(276.) Although we have noticed the annual floats of ice which descend from the northern regions, it may not be inapposite to recall to the seaman's mind the necessity of guarding ainst these tremendous and dangerous objects—more dangerous than permanent rocks, because unfixed, and more dreadful, because frequently obscured in snow and fog.

The ice which is thus met with is of two descriptions: that which is found on the surface of the sea during the polar winter—the field and floe-ice; and that which is formed in the course probably of many years upon land, and is periodically launched into the sea in the form of gigantic bergs of enormous height and dimensions.

Of the first description of ice no special mention is necessary, as its production and presence in the regions under consideration is very readily comprehended.

(277.) *Ice-bergs* are a much more interesting subject, and their majestic proportions at once attract attention and invite inquiry as to their formation; consequently we find many accounts and speculations have been advanced to account for them, and various localities pointed out as their birth-place.

Captain (afterwards Dr.) Scoresby, whose opinion is invaluable, observes, "that, however dependent the ice may have been on land, from the time of its first appearance to its gaining an ascendancy over the waves of the ocean, sufficient to resist their utmost ravages, and to arrest the progress of maritime discovery at a distance of, perhaps, from 600 to 1,000 miles from the Pole, it is now evident that the proximity of land is not essential, either for its existence, its formation, or its increase."

Dr. Scoreby's acquaintance with ice-bergs in process of formation was confined to Spitzbergen and portions of Greenland, where they do not form so marked a feature as has been found by others. It is to Dr. Rink, a resident in Greenland, that we are indebted for the most complete account of these marvellous phenomena, and in making a few extracts from his work,* we may draw attention to the parallel condition of the south pole in producing these icebergs on a far more stupendous scale than is found in the northern region; for while in the north their dimensions are confined to a few hundred yards, in the south they are very frequently miles in extent, and from 2,000 to 3,000 feet in thickness—a magnitude owing to the vast extent of country in which they are produced as explained on page 354 (281.). Their protrusion into the sea involves the same considerations as the "glacier theory" of the land, so very interesting and important in geological questions.

(278.) The larger icebergs in the northern regions rise above the surface of the sea to the height of from 100 to 150 feet and upwards. and some are 4,000 feet in circumference. The part *above* can scarcely be considered more than one-eighth of that *below* the surface of the water, so that the cubic contents of the iceberg may amount to 100,000,000 of cubic ells, or about 60,000,000 cubic yards—a fragment of ice, which, if we suppose it to be fairly landed, would form a mountain about 1,000 feet in height. All agree that the icebergs of these arctic seas are originally formed on *terra firma*: from the snow and rains which, from the severity of the climate, are never able to reach the ocean in a fluid state, but which, in the course of years, are transformed into a mass of ice, and are then, through some physical agency, thrust forward into the sea.†

The ice thrust forth into the sea, in the form of massy mountains, is originally formed over an enormous extent of country, from whence it, by an agency similar to that by which the progress of glaciers is effected, is thrust forward to and brought to a point at the place from which the icebergs proceed. For the formation of icebergs accordingly a tract of land of a certain extent is necessary, in which the sea forms so few and small creeks or inlets that rivers or watercourses of some magnitude must necessarily be present.

(279.) Where the above-mentioned condition exists, in conjunction with the necessary temperature of the climate, the formation of ice does not proceed from certain mountain heights, but *the whole country is covered with ice to a certain elevation*:

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* Dr. Rink "On the Origin of Icebergs," &c., Journal Royal Geographical Society, vol. xxiii., 1853, p. 143, *et seq.*

† It is a well-known fact that all the ice formed from snow upon the surface of land, where the heat of summer is incapable of melting and preventing its gradual increase, has a tendency to extend and move downward, as water would do, according to the same laws, in case rain instead of snow had fallen upon the surface. Those masses of snow accumulated in high regions of mountain chains, even in the hottest parts of the globe, gather in the valleys, which thus form the natural drainage for the highlands, and being congealed into a compact body of ice, move slowly down into lower and warmer regions, till the increasing heat, by thawing them, sets a limit to their further spread. These masses of compact ice spreading down through the valleys or clefts, and constantly furnished farther supplies by the snow accumulated in the surrounding highlands, are, in Europe, seen on the largest scale upon the Alps, where they are known under the name of "Gletcher," or glaciers.

mountains and valleys are levelled to a uniform plane; the river-beds are concealed, as well as every vestige of the original form of the country. A movement, commencing *far inland*, thrusts the outer edge of this mass of ice forward towards the sea; and when it reaches the frith, it may be seen to sink, and to diverge and even extend out several miles. There the agency of the *obliterated rivers* may be observed in the greater or lesser rapidity with which the matter in a solid state is carried forward to the ocean. The massy crust, *still preserving its continuity*, proceeds from the shore, borne by the sea, until some circumstance or other destroys the equilibrium, and breaks some fragments off the outer edge, which is again thrust forward, and again detaches new fragments, thus continually renewing the supplies from the interior.

(280.) A tract or body of land of the requisite size is, in the northern hemisphere, *only to be found in Greenland*, and more especially in that part which lies to the north of the Arctic Circle, where in the interior, beyond the inlets of the sea, the country increases in breadth from east to west, and affords space for the original birth-place of these large icebergs. Neither Spitzbergen, nor the narrower parts of Greenland, nor the peninsula nor the islands which surround it, are adequate in size to produce the yearly excess of indissoluble ice which, *from that large and unknown continent, is very slowly protruded;* and, as it seems, in a lesser degree toward the eastern shores of Greenland, along which the icebergs are driven past Cape Farewell, the greatest quantity going to the west, into Baffin's Bay. The friths or fiords, which, piercing far into the country, receive and transmit the icebergs, are called *ice friths.*

(281.) From November to June the water, in which the icebergs are to proceed to the ocean, is so covered by the ocean ice, that they are shut up in the inner ice friths; but in July, and especially in August, they are carried in mass by the current to the open sea. This is called *the shooting out of the ice friths*, which lasts till late in the autumn, when the continual easterly storms finally clear out the inner waters, unless the icebergs are intercepted by certain banks, on which they sometimes remain long aground.

(282.) Icebergs consist mostly of hard, brittle ice, of which the white colour originates from very fine lineal pores, uniformly divided through the whole mass, all being of the same size, equi-distant, and parallel throughout the whole iceberg. This uniform structure may have arisen at the time it was formed in the interior of the country from corned snow—perhaps repeatedly thawed and frozen. The white iceberg is in many directions crossed by broad stripes of intense blue-coloured ice, which is quite clear, and either contains no air bladders, or, at all events, very irregular ones. These blue stripes are several feet in dimension, and in them are generally found "dirt bands" of foreign matters, such as stone, gravel, and clay, which the icebergs carry off embodied in them. The *blue* ice is, by thawing, dissolved into regular large grains, which is not the case with the *white* ice that forms the main mass of the icebergs. It seems probable that these blue stripes are formed by a filling up of the fissures in the *inland* ice with water—perhaps mixed with snow, gravel, and stones; and such a refrigeration of the water in the fissures may be supposed to be an important agency in setting in motion these great mountains of ice.*

Is would be out of place to enter into detail upon this subject, but from the above-mentioned notice, as well as the works of Dr. Scoresby and others, much interesting matter may be gleaned. We must, therefore, consider them here as only affecting navigation.

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* Transparent ice, free from interior spaces or bubbles, is one of the purest substances in nature, and it is not possible to detect the presence of the minutest portion of air, or any substance that may have been held in solution by the water from which it is formed. The strongest poisons, or colouring matter of any description, are most effectually separated from water by the process of freezing it. This must, of course, only be understood to refer to those masses which are quite clear and transparent, or the spaces or vacancies left in the ice will naturally contain portions of the adventitious matter. Ice, therefore, is one of the best sources from which a supply of fresh and wholesome water can be obtained, and if these hollows be washed in fresh water, ice water will be found preferable to, and purer than, any other.

(283.) *Mr. W. C. Redfield*, to whom the world is so largely indebted for his researches in meteorology and physical geography, has published a pamphlet, accompanied by a chart, upon the ices of the North Atlantic. In this he has clearly shown that the Gulf Stream *passes over* the cold Arctic Current, which transports the deeply immersed icebergs into and across it. "No impulsion but that of a vast current, setting in a south-westerly direction, and passing beneath the Gulf Stream, could have carried these immense bodies to their observed positions, on routes which cross the Gulf Current, in a region where its average breadth has been found to be about 250 miles." Other observations on this subject have been given on pages 338 to 340. The same influence will also cause the presence of floating ice in the Gulf of St. Lawrence, by carrying it through the Straits of Belle-Isle; but the depth of this would prevent the progress of the larger icebergs (272.).

It need scarcely be mentioned, that great circumspection is necessary in passing near the regions where these dangers may reasonably be expected. The following instances, selected from many others, may operate as sufficient cautions:—

(284.) On the 21st of June, 1794, in lat. 45° 18′, on the eastern steep edge of the Grand Bank, in a thick fog, H.M. frigates *Dædalus* and *Ceres* were suddenly involved amidst some very high and dangerous islands of ice. The weather was so thick that objects were not visible at 50 yards distant. The *Dædalus*, commanded by Sir Chas. H. Knowles, hauled up and passed close to the stern of a ship that lay stranded upon one of the ice islands, and sailed to windward of it through a great quantity of drift ice, and to leeward of another ice island. The *Ceres*, Captain Thomas Hamilton, passed in the same track, and saw the wreck a quarter of an hour after the *Dædalus*. The course was east, the wind S.W., the sea very high, as the wind blew hard, the night preceding, from the southward.

Again, on the 15th June, 1810, the *Dædalus*, commanded by Captain Inglefield, with a fleet from Jamaica, in lat. 41° 33′, and long. 51° 17′, to the southward of the Grand Bank, passed two icebergs, and the next day another; providentially, the fog, which had been very dense, cleared up for an hour, and allowed the fleet to clear the dangers.

On the 2nd of August, 1813, H.M.S. *Bedford*, 74, then bearing the flag of Vice-Admiral Stirling, accompanied by the *Cyane*, 20, Captain Forrest, and *Fawn*, 18, Captain Fellows, with a fleet of 105 sail from Jamaica, at eight a.m., just as the fog cleared away, fell in with an extensive ridge of ice, having an iceberg at each extremity, and about one mile in extent, even with the water, over which the seas broke with considerable violence. Had the fog not cleared up as it did, about thirty ships must have struck upon it, as that number were steering directly for this formidable reef, and were within the extent of it its sweep. The thermometer was at this time ranging from 63° to 65°, the lat. 45°, the long. 44° 30′.

On the 31st of August, 1816, Captain Gooday, in the ship *Jones*, on his passage from St. Petersburg to New York, in lat. 46° 50′, long. 47° 54′, saw an island of ice, from about 1 mile to 1½ miles long, and from 54 to 70 feet high. When first seen, it appeared like a white cloud.

In January, 1818, the brig *Anne*, of Poole, W. Dayment, master, left the harbour of Greenspond, Newfoundland, in the morning, and in the evening of the same day got among ice; proceeded thus about 40 miles, and at daylight next morning was completely beset, and no opening to be seen in any direction from the mast-head. In this state the vessel continued for fifteen days, drifting with the ice about 60 miles S.E. by E., or about 4 miles in every twenty-four hours. The ice was now become very heavy, high above the surface, and about 20 large bergs were in sight. With this ice the vessel drove until she was in 44° 37′ N., and about 300 miles to the southeastward of Cape Race, when, on the 17th of February, she got clear through the only opening that appeared in the horizon from East to S.E., all the rest of the circle forming one compact body of ice, as far as the eye could reach. The vessel had been shut in for twenty-nine days, in the last fourteen of which she drifted from lat. 46° 57′ to lat. 44° 37′, about 280 miles, or 20 miles a-day, S.E. by E., tremendous gales of wind blowing the whole time from the west to the N.W. In the course of this passage the master declared that he saw more than 100 large islands of the solid blue ice, known to traders by the name of *Greenland Ice*.

On the 17th day of the same month, January 1818, the brig *Funchal*, of Greenock, sailed from St. John's, Newfoundland. At about 15 miles to the westward of this port she fell in with a field of ice coming down from the northward, about 8 miles in breadth, and extending to the northward beyond the reach of sight. Having cleared this, and proceeded westerly about 250 miles, on the 20th, in lat. 47½°, she encountered a still more extensive field, floating to the westward, in the midst of which was an iceberg; she cleared this, though not without difficulty, and brought with her a gale of wind, with snow, sleet, and rain, the whole way to Scotland.

On the 6th of May, 1823, the *Mountstone*, of and from Plymouth, was lost on an iceberg, on her passage to Newfoundland. The master and crew, with passengers, in all ten persons, took to the boat, without provisions, from which three only of the number were taken by a passing ship, on the 14th of the same month, the remainder having died of hunger!

Our next case is that of the *Ajax*, of Wiscasset, New England, on the passage toward London, March and April, 1826. The following is an extract of a letter from *William S. Shaw*, the commander, to his owners, on the subject. His means of protecting the vessel, under perilous circumstances, are worthy of especial notice.

"On the 12th of March, at four a.m. (sea account), between lat. 42° and 44° North, weather thick and cloudy, with squalls of hail and snow, we ran the brig in between two reefs of ice, jammed together apparently in a solid mass, the sea being much smoother than usual, which did not alarm us; we knew we were far from land or breakers, until we felt the ice alongside of us; as soon as we perceived which, we hove-to until daylight, when we found we were surrounded by a solid body of ice. Around us were 30 icebergs about 150 feet high, and nearly the size of Segwine Island. Finding the ice chafed us badly, we got out fenders. As we had run into the ice before the wind, it was impossible to get out the same way. At sunrise discovered a narrow opening to leeward, for which we steered under easy sail, and drove her through. We were now in a bay, about 1½ miles wide, the reefs on either side, and large cakes of ice in contact with us.

"The wind still blowing fresh at N.W., we kept her before it about 3 miles, but could not discover an opening to the southward and westward; tacked, and steered N.E. about 12 miles, it being very difficult to avoid the large cakes of ice that crowded thickly around us.

"Finding there was no opening in this direction, and that the two reefs extended as far as we could see; that there were numerous large islands of ice north of us, and an almost innumerable collection of small ones ahead, we concluded, at 10 a.m., to crowd her through the ice; and having prepared fenders of every kind, such as old junk, spars, cordwood, bales of cotton, and part of one cable, we drifted her into it. We were now in the midst of the ice in a severe gale, accompanied with a thick snowstorm; and had it not been for our precaution, in preparing fenders, the ice must have soon made a hole through us. At mid-day, old Sol deigned to show his brazen face, and laughed at our comical situation. This circumstance enabled us to take an observation, by which we found ourselves in lat. 44° 30′ North, and long. 43° West (between the Azores and Newfoundland).

"As our fenders were nearly destroyed, we were compelled to cut up more of our cable, wooden fenders not sinking deep enough for the purpose of defence under water. You may judge of the difficulty of *crowding* the brig through by our progress, which was but half a mile an hour, under two reefed topsails and foresail, the wind blowing heavily. At one o'clock p.m., we suspended two bales of cotton under our chains, that they might not be carried away by rolling against the cakes of ice which we occasionally met, some of which were 100 feet circumference, and 6 feet thick.

"At one time we were so completely enclosed, that I got out, with part of the crew, and walked on the ice—a walk that few mariners have probably enjoyed at that distance from land on the Western Atlantic Ocean. At 8h. in the evening, found the surrounding ice much thinner, and the islands less frequent; handed all sails except the close-reefed main-topsail, which we hove to the mast to keep her from ranging ahead on the islands.

"At daylight, finding ourselves clear from the great body of ice, though not from the islands, we made sail, and steered E.S.E. and E.N.E. for three days, with a good breeze, and under short sail during the night. It was the opinion of all hands, that we sailed *three hundred miles* before we were clear of the large islands of ice!"

In July and August of the same year, 1826, H.M.S. *Ringdove* was on her passage from New York, and fell in with an immense iceberg off the Banks of Newfoundland, drifting to the southward, the magnitude and sudden appearance of which astonished every person on board. For the description of an iceberg seen by Captain J. S. Park, 29th June, 1826, see page 359.

In the month of March, 1828, several vessels arrived at New York, which had fallen in with islands of ice in lat. 43° to 44°, long. 47° to 49°. This was considered as unusually early in the season for such dangers to be met with. In this season, the brig *Catharine and Hannah*, Captain Lumsdsn, which afterwards arrived at Cork, picked up, on the 4th of May, in lat. 45° 11′, long. 56° (near Banque-reau), a boat belong to the *Superb*, of and from Bristol, for Quebec, which ran foul of an iceberg on the 21st of April, that stove her forward. This unfortunate occurrence obliged all hands to take to take to the pumps, at which they continued without intermission for two days and a night, when a schooner hove in sight; and the captain proceeded in the jolly-boat to treat with them to take the crew. While the captain was so engaged, the vessel being quite in a sinking state, the crew left the pumps to get the boats out to leave her. They succeeded in getting out a boat (the one subsequently picked up), and seven men got into her; upon which they unhooked the tackle, slipped from the ship, but could not regain her, and it coming on thick weather, they could not find the schooner; thus the unfortunate men were left without provisions, water, mast, sail, or anything that would enable them to struggle for existence, save and except two oars! In this state they were buffeted about for eleven days, when they were fallen in with by the *Catharine and Hannah*. Of the seven men only two were alive; and one of these survived only twenty-four hours. It is almost superfluous to say, that the only food which they had taken was from the bodies of deceased companions.

Captain Barclay, of the *Brilliant*, for Leith, from Quebec, which he left on the 5th of June, 1829, and narrowly escaped shipwreck, having fallen in with a heavy body of ice, about 20 miles east of the entrance to the Strait of Belle-Isle, in foggy weather. The vessel got clear on the 19th of June, after being three days and nights amongst them, and being obliged to proceed 1½ degrees to the southward.

On the 11th of May, 1833, between the Outer and Grand Banks of Newfoundland, the brig *Lady of the Lake*, John Grant, master, from Belfast, with 230 passengers, in lat. 46° 50′, long. 47° 10′, fell in with ice, and while endeavouring to pass between two large pieces, a tongue under water in the ice struck the port bow, and stove it entirely in. It is not requisite here to repeat an afflicting detail; the consequence was, that the brig soon foundered, and only the captain, with fourteen other persons, were ultimately saved.

The barque *Perthshire*, R. Simpson, from Pictou, Nova Scotia, fell in with a field of ice, in lat. 46° 19′, long. 46° 40′, on the 8th of June, 1845. It was about thirty miles in extent, and on its north end there was a ship, high and dry on the ice, with the crew on board; but could not render them any assistance.

(285.) The following are from Mr. Redfield:—On the 1st day of January, 1844, Captain Burroughs, in the ship *Sully*, met with an iceberg in the Atlantic, in lat. 45°, long. 48° This is earlier in the winter than any other case which we have met with. Captain B. States, that he had met with ice near this position on the 1st of February, on a former voyage.

In September, 1822, Captain Couthouy say an iceberg aground on the eastern edge of the Grank Bank, in lat. 43° 18′, long. 48° 30′. Soundings 3 miles inside of it, the depth was found to be 105 fathoms. In the month of August, 1827, the same observer, while crossing the banks, in lat. 46° 30', long. 48° W., passed within less than a mile of a large iceberg, which was stranded in between 80 and 90 fathoms. He was so near as to perceive distinctly large fragments of rocks, and quantities of earthy matter imbedded in the sides of the iceberg; and to see, from the fore-yard, that the water, for at least a mile round it, was full of mud, stirred up from the bottom by the violent rolling and crushing of the mass.

On the 27th of April, 1829, Captain Couthouy passed, in lat. 36° 10' N., long. 39° W. (probably south of the Gulf Stream), an iceberg, estimated to be a quarter of a mile long, and from 80 to 100 feet high. It was much wasted in its upper portion, which was worn and broken into the most fanciful shapes. In 1831. at daylight of the 17th of August, lat. 36° 20' N., long. 67° 45' W., upon the *southern* edge of the Gulf Stream, he fell in with several small icebergs, in such proximity to each other as to leave little doubt of their being fragments of a large one, which, weakened by the high temperature of the surrounding water, had fallen asunder during the strong gale which had prevailed from the S.E.—(*Silliman's Journal*, vol. xliii., 1842.)

Ship *St. James*, Meyer, July 12th, 1844, lat. 44°, long. 47° 12', passed twelve large icebergs; July 20th, passed 25 ditto; and July 21st, passed 30 ditto, lat 43° 50', long. 52° 26', saw the last of it.

Ship *Formosa*, Crawford, June 18th, 1842, lat. 38° 40', long. 47° 20', saw an iceberg 100 feet high, and 170 feet long.

(286.) A very interesting item in our enumeration of ice-floes is that of those met with in April, 1851, on which were the wrecks of two ships, which had the appearance of, and from all probabilities were, the ships of the unfortunate Arctic expedition under Sir John Franklin. The particulars have been so extensively detailed elsewhere, that we shall merely give the original announcement, which will suffice for the present purpose. Much more extended particulars will be found in the public newspapers of April 9th, 1852, and subsequently; the *Naut. Mag.*, May, 1852, p. 265, *et seq.*; and the Parliamentary Paper on the Arctic expedition.

The brig *Renovation*, of Shields, Captain E. Coward, bound to Quebec, on April 20th, 1851, when near the east edge of the bank, in lat. 45° 30', wind N.E., fresh breezes, clear weather, as much as they could carry fore-topmast studding-sail, fell in with ice-floes, one of which was very large, with field-ice attached, on which there were two three-masted ships, having their masts struck and yards down, and all made snug; to all appearance they had passed the winter together on the ice. Took the spying-glass, and carefully examined them to see if there was any one on board, but could see no one, &c., &c. A further statement says they were apparently two full-rigged ships (one about 500 tons, the other 350), on an iceberg high and dry, the larger one on her beam-ends, &c. Singularly enough this statement had been published in the *Limerick Chronicle*, May 28th, 1851, ~~a year previous~~.

In our minds there is no doubt but that these were the ill-fated ships which had been drifted out of Melville Sound and Baffin's Bay; and thus eluded all the elaborate and anxious searches that have been made. The incident is a singular one in the history of arctic ices*

The *Carlo Mauran*, commanded by Mr. Tillinghors, passed on May 23, 24, 25, 1851, between lats. 44° and 45°, and longs. 49°-54° large quantities of ice.

On June 27, 1851, the *Washington* steamer, from New York to Southampton, passed 10 very large icebergs between longs. 50°-45° in lat. 47°.

(287.) Lieutenant *Evans*, the intelligent officer to whom we are indebted for a part

* See Journal of the Royal Geographical Society, vol. xxvi., pp. 26—35, "On the Probable Course pursued by Sir John Franklin's Expedition," by *A. G. Findlay*. Notwithstanding that this great mystery has been partially cleared up by the expeditions of Dr. Rae and Sir L. M'Clintock, yet no vestige of the ships themselves have been seen by Europeans. That portion, as well as others, is still involved in mystery; and the opinion is still tenable, and maintained by many, that these derelict ships were the *Erebus* and *Terror*.

of these extracts, says, "There is scarcely a doubt but that most of the vessels from the West Indies and America, that have been missing, perished in the same manner as the *Mountstone*, icebergs having been met with some degrees to the southward of the Banks of Newfoundland in June and July. The commanders of vessels, therefore, who have occasion to pass between the parallels of 35° and 50° N., cannot be too cautious; a look-out man should be placed on the fore-yard during the night, and in foggy or hazy weather. also in the daytime; in addition to these, there should be one on each bow; and during a fog, the foresail should be hauled up, especially in crossing the banks, where icebergs have been met with aground. Careful attention, too, should be paid to the thermometer, as experience has shown that it is an indicator of the vicinity of ice. Captain Franklin observes that the approach to ice would be evidently pointed out in those parts of the Atlantic where the surface is not continnually chilled by the passing and melting of ice, as in the Arctic Sea; and he strongly recommends a *strict hourly* attention to the *thermometrical state* of the water at the surface, in all parts where ships are exposed to the dangerous concussion of floating icebergs, as a principal means of security. There would be very little trouble attending such a point of duty; yet, we believe, there are many masters who would not undergo it, but trust to chance the safety of their vessel, their own lives, and those of their crew and passengers. Many have made repeated voyages across the Atlantic without having seen floating ice, and, therefore, become incautious. It is to these we would particularly recommend the perusal of this paper. The following extract fully corroborates Captain Franklin's assertion:—'The morning of the 1st of August (says Captain Lyon) was thick and foggy, with rain; at 10 a.m. we discovered, through the haze, our first pice of ice, a small berg, of about 70 feet; we soon passed this and several others, but saw no *floe* or *brash ice*, although there was every reason to suppose that a *pack* was near, from the sudden smoothness and change of temperature in the water, now at 32°, while the air was at only 34° Repeated observations of this kind have now brought to a certainty the assertion, that the approach to ice from an open sea may be ascertained by the sudden change of the thermometer; and, acting from past experience, I caused the most active look-out to be kept, on observing it to fall suddenly this morning; yet this change first took place in a very thick fog, and we ran about 10 miles before the ice was seen.'

Cautions.—"Captain Weddell recommends that, with a free side-wind, an iceberg or ice island should be passed on the windward side; as by this mean the loose ice, which always drifts farthest, is avoided."

We may sum up the admonitions which have been given by the following remarks:—

The INDICATIONS of an iceberg are—1. A natural effulgence, or *ice blink* which frequently renders them visible at some distance, even in the darkest night. At a short distance this effulgence may appear like a white cloud, extending over, or nearly over the vessel's masts.

2. A considerable decrease in the temperature of the water, as shown by the thermometer, in comparison with the heat of the adjacent sea, and with the air above.

3. The roaring of the sea at the base of a berg, which, excepting in a steamer with its paddles in action, may be heard by an attentive listener, when afar off.

(288.) Lieutenant J. Steele Parke, whose journal we have given extracts from elsewhere, recites the following incident which will speak for itself an inculcatory *caution*:—

"*June* 29th, 1826.—A light breeze from the southward, with foggy '*Bank weather*,' as the sailors call it. Steering E. by S. At eight o'clock this morning it cleared away, and I took altitudes for my chronometer, which made the longitude 49° 42'; and, at the same time, we discovered an island on the starboard beam, 3 or 4 miles off. Shortened sail, hove the ship to, and sent the mate to see what it really was; for, although I had no doubt of its being an iceberg, yet it certainly looked something like land; and I did not wish to leave it in any kind of uncertainty. The fog, which had cleared away at eight o'clock, and left a beautiful blue sky, returned suddenly when the boat was about half-way from the ship. The mate, an active, skilful seaman, had a compass with him, and he apprehended no danger, but pushed on for the island, instead of returning, when he saw the fog spreading. Hour after hour passed away, and no appearance of the boat. Night came on, dark as the grave, with a cold, benumbing drizzle, and a fog so dense that we could scarcely see across the deck. My grand object was to keep the ship as near the same spot as possible. All day and all night we kept the bell tolling, and fired a great gun occasionally: a tar barrel was also blazing at the main-yard arm, but all was unavailing. I shall never forget the terrors of that night. I reproached myself as the cause of their destruction; and I prayed most earnestly for daylight and clear weather. I thought daylight would never come; but it came at last, and the fog was thicker, if possible, than the day before. The most sanguine now began to despair. About five o'clock something was heard, like the blowing of a conch shell, but so faint and indistinct that we thought it was only the echo of the great noise we were making on board. However, it was soon discovered that the sound was coming nearer and nearer: but, as no person on board knew that they had a shell in the boat, we were still in a sad state of anxiety: for it might, perhaps, be a ship sounding her shell in the fog, as usual at sea. In a few minutes the plash of oars was heard, and in five minutes more the boat was alongside, with all hands safe and sound, thank God! but cold and hungry enough. The mate tells me he rowed round the iceberg, which he thinks was about 300 feet in length, 150 feet in breadth, and 40 or 50 feet above the surface of the water. It was melting away rapidly: streams of water were gushing down its sides, and they had only got a few yards from it, on their return, when (to use his own words) 'it took a sally and fell over on its beam ends.' Our last sight of the ice, when bearing S.W. 3 or 4 miles, was in lat. 42° 13', long. 49° 44'."*

These may be of service to vessels crossing the Atlantic, during the season of these floating dangers, between March or February and July.

9.—GENERAL OBSERVATIONS ON THE CURRENTS.

Remarks by Lieutenant John Steele Parke, R.N.†—Sailed from Falmouth (Jamaica), May the 23rd, 1826, and bore away for the "Strait of Florida.

May 30th.—Rounded Cape Antonio with a gentle breeze at E.N.E. In May, 1824, I found a current here setting with considerable strength into the Mexican Sea. This voyage there is none. I have perceived no current between the Grand Cayman and the S.W. end of Cuba; but there was a little easterly set between Jamaica and the Grand Cayman (200.).‡ The day we called there for turtle (the 27th) it was going to windward at the rate of a mile an hour.

June 1st.—In lat. 23° 50', long. 84° 20'.—This day we first began to feel the influence of the current from the Mexican Sea.

It is well and truly remarked, by a skilful and a very intelligent navigator, in Purdy's "Memoir of the Atlantic," that, "the calculations of the velocity of the Gulf Stream are not to be depended on." In the early part of June, 1824, it was running at the rate of 2½ miles an hour between the Bemini Isles and Florida: in July,

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* On the 18th of June, 1839, an iceberg was seen, supposed to be about a mile in length, and from 50 to 70 feet high, in lat. 40° 50' N., and long. 48° 39' W.

† On board the *Carshalton Park*, on her passage from Jamaica to London, 1826. They are repeated here, from our former editions, as they afford a good example of the application of the preceding description.

‡ The figures, thus (200.), refer to the sections in the preceding pages.

1825, its velocity was 4 miles nearly; and this voyage it is rather more than 4. This has been ascertained by sidereal observations, made repeatedly during the night.

Let us now pursue our voyage. On the 7th of *June* we cleared the "Strait," and stood to the northward with an easterly wind. It was laid down as an established (and I believe an uncontroverted) position, that a rippling of the water is never seen *in* the Gulf Stream, but only on its outer *edge*. I have no objection to receive this doctrine as a general rule; but it is certainly not an infallible indication of the edge; for I have seen it more than once in the very heart of the stream. To-day, for instance, June 9, we are in lat. 32° 10′, long. 78° 2′, and I never saw the ocean more agitated by a current in my life, see (221.) page 322.

Every now and then we get into an extraordinary boiling, like the race of a spring tide over a shoal, and by a reference to the chart it will be seen that we are very far from the outer edge. It is true, the boundaries of the Gulf Stream cannot be laid down in a chart as fixed and unchangeable: the stream will be affected, both in its breadth and velocity, by causes that we know nothing of—causes that operate to-day, and may cease to-morrow: but there cannot be a doubt that these ripplings I speak of are in the strength of the stream, for the ship has been swept 60 miles N. 40° E. by the current in the last twenty- four hours.

June 10th.—Wind westerly; a moderate breeze; lat. 33° 51′, long. 75° 4′.—The current has carried us 58 miles N. 56° E. in the last twenty-four hours, and we have passed through four or five ripplings to-day as well as yesterday (222.).

June 11th.—Wind from S.W. to N.W.; a gentle breeze; lat. 34° 38′, long. 73° 23′. —Current has set us N. 76° E. 9 miles in the last twenty-four hours. No ripple seen to-day.

June 12th.—Wind westerly; a nice little breeze.—To-day and yesterday very little gulf-weed has been seen. A spring now and then. Yesterday the current was very weak, and to-day there is none at all. On the 9th and 10th the sea was almost covered with weed, and we had then a beautiful current. It would almost appear that the weed (as well as the ripple) is but a fallacious test of this stream of streams. The truest indication is the temperature of the water. Compare the temperature of the water every four hours hours, and the rise or fall of the quicksilver will be a useful guide.

June 13th.—Wind from N.E. to East; a strong breeze and hazy weather; lat. 35° 34′.—No altitudes for chronometer—the sun was not out at a proper time from moon. There seems to be northerly current. The dead reckoning agrees with the observed latitude.

June 14th.—Wind veering between North and East; a moderate breeze; lat. 36° 10′, long. 70° 55′.—A few sprigs of weed seen now and then, and we find a little current to the N.E.

June 15th.—Light wind and very variable; between N.E. and W.N.W.—In the last twenty-four hours the current has set N. 66° E. 26 miles; a few sprigs of weed have been seen occasionally; lat. 36° 34′, long. 70° 7′. At one p.m. got into a prodigious quantity of gulf-weed: the ocean covered with it for 2 or 3 miles. Passed through it in about half-an-hour, and during the remainder of the day saw very little: a cluster here and there, now and then (on the outer edge of the stream).

June 16th.—Wind between N.E. and East; a fresh breeze.—The courses and distance, by compass and log, give the same easting and northing as the ship has made by celestial observations. Lat. 36° 52′, long. 68° 45′: we still pass sprigs of gulf-weed (still on the eastern margin).

June 17th.—We have been standing to the northward since yesterday morning at eight o'clock, with the wind about East, and are now in lat. 37° 50′, long. 68° 50′, at noon. The log gives a true North course, and the chronometer gives five minutes of westing, therefore we may presume there is little or no current, for the latitude, by dead reckoning, agrees within a mile of the observation. *P.M.*—I find by altitudes, taken this afternoon at five o'clock, that the ship has made seventeen minutes of easting by chronometer since the sights I took in the morning at nine. We must be getting into the stream again, for the ship has not made a single mile of easting, by fair calculation, according to dead reckoning. A few sprigs seen to-day.

June 18th.—The wind has been steady at East all the last twenty-four hours, and we have been standing to the northward all the time. These currents of the ocean are puzzling phenomena! The true course and distance by log is N. ½ W. 50 miles; and what course do you think we have really and truly made by celestial observations? By the meridian altitude of the sun, our latitude is 38° 7', and the longitude, by chronometer and lunar, 67° 46'. So we have made seventeen minutes of northing, whereas the run by log gives fifty minutes; and we have made sixty-four minutes of easting, when the most skilful seaman, without a knowledge of lunars or chronometer, would say we have made five or six minutes of westing. This sweep of the current I fancy we must attribute to the combined action of two streams: one, the Gulf Stream, pursuing its ordinary course to the eastward; the other, perhaps, from the St. Lawrence, running to the South.—Perhaps there may have been a southerly set occasioned by the proximity of the Nantucket Shoals (247.).

June 19th.—Southerly wind, with foggy, miserable weather. No altitudes for chronometer or latitude. By the log we are in 38° 45' N., and 66° 6' W., at noon.—Effects of the Arctic Current (250.)

June 20th.—The same sort of weather as yesterday, with a moderate breeze from the S.S.E. By log we are in 39° 59', and 63° 16'. *P.M.*—Passed some weed; long and stringy; not gulf-weed.

June 21st.—The wind drew round to the eastward last night, and we stood to the northward. At one a.m. the sky brightened, and I was lucky enough to get an altitude of the moon, when she was just on the meridian, which made the latitude 41° 15'; being 36 miles farther north than the latitude by account, since the observation on the 18th. Tacked and stood to the S.S.E. There has been very little current to the eastward since the longitude was ascertained on the 18th: the log gives nearly as much easting as the chronometer. Lat. 40° 59', long. 62° 40'. We have seen a good many clusters of gulf-weed to-day. As we approach the usual northern limit of the stream, I am watching the weed particularly to see how far we shall carry it.—See (248.) for the northern edge.

June 22nd.—The wind E.N.E., blowing hard, with a high sea and dark dismal weather (250.); but we got the meridian altitude of the sun; and also sights for the chronometer this morning at nine o'clock. The longitude was then 61° 52', therefore we are decidedly in a fine easterly current. The log cannot possibly give a single mile of easting, for we have been lying-to, under the main-topsail, in a heavy gale of wind, all the twenty-four hours, with our head to the southward and eastward. The ship has also been carried to the North by the current: our latitude is 40° 45'. So that she has really made forty-eight minutes of easting, and only fourteen minutes of southing: and the log gives thirty-eight minutes of southing, and six minutes of westing. Making every reasonable allowance for the inaccuracy of dead-reckoning, we may safely say the current has set us upward of 40 miles in a N.E. by E. direction (261.). No one can have less faith in dead reckoning thin I have; but still it is necessary to attend to it, in order to compare it with the ship's true position: for I am not aware of any other means to determine the set and velocity of a current, in a gale of wind, but by comparing the common calculation by log with the true place of the ship, indicated by celestial observations. *P.M.*—At five o'clock, by chronometer, we have still a fine current. No weed seen all day.

June 23rd.—Wind E.N.E. Still blowing hard; but less sea, and wind abating. Ship's head to the S.E. Lat. 40° 1'. *P.M.*—Fine weather again. Made sail. At half-past four got altitudes for chronometer, and I am sorry to find we have lost the current. The longitude is 61° 57'. Tacked ship immediately, and stood to the northward. We have passed some weed to-day, both in large clusters and small sprigs.

June 24th.—The wind came round to the S.S.E. in the night, and we shaped a course E. by N., with a light breeze. The longitude, by chronometer, this morning at eight o'clock, disappointed me very much: at half-past four p.m., yesterday, it was 61° 57', and we have been standing to the eastward almost all night. The log makes it 61° 18', and the chronometer, 61° 45'! We have had a westerly set, undoubtedly; and a southerly one too, for the latitude is 40° 9', and by the log it should be 40° 16'. A few sprigs of weed in sight to-day. *P.M.*—Chronometer (at five o'clock) gives five minutes of easting more than the run by log, since the altitudes in the morning at eight (the Arctic S.W. current felt).

June 25th.—Wind South: a gentle breeze and fine weather. Lat. 40° 18', long. 60° 8'. No perceptible current these last twenty-four hours. Passed several sprigs of weed.

June 26th.—Wind southerly, a steady 6-knot breeze and fine weather. Steering E. by S. Lat. 41° 3', long. 56° 46'.—Ship has gone 138 miles by log, and 155 by chronometer. The difference between chronometer and dead-reckoning must not always be attributed to a current. Some allowance must be made for the carelessness of sailors (especially in the night watches) at the helm, and other circumstances relating to the run by log. However, I think I am warranted in saying we have benefited something by a current. I make it N.E. by E. 10 or 12 miles. *P.M.*—The chronometer tells me (at six o'clock) that we have an easterly current.

June 27th.—A moderate breeze at S.W. Running E. by S. Lat. 41° 27', long., by lunars and chronometer, which differ very little, 53° 41' at noon. Current has set us N. 62° E. 26 miles in the last twenty-four hours. *P.M.*—Two sprigs of gulf-weed this afternoon, in lat. 41° 29', long. 53° 8'.

June 28th.—Steering E. by S. with a gentle 4-knot breeze at S.W.—The longitude by chronometer was 52° 11' this morning, and we made eleven minutes by log between that time and noon. So we shall call the longitude 52° 0', and the latitude 41° 50'. We have had a little northerly set these last twenty-four hours, 8 or 9 miles North, and 2 or 3 miles East. I have observed, in my last three voyages from Jamaica, that we have always felt a *northerly* current of some strength in this part of the ocean, setting toward the Bank of Newfoundland, in June and July. This, if I mistake not, is contrary to the generally received opinion (256). Some weed in sight to-day; a few sprigs decidedly gulf-weed: they had all the well-known characteristics of the regular gulf-weed; but there was some of a different kind, with long stringy stems.

June 29th.—Long. 49° 42', at 8 a.m., saw an immense iceberg, which I sent the mate to see, as related on page 359.

June 30th.—Light breeze from the westward. When the boat returned this morning, made sail again on the same course, E. by S. At noon, atmosphere thick as melted butter. No sights for chronometer or latitude, and I was in too much distress to attend to latitude or longitude by dead-reckoning.

July 1st.—Westerly wind, with thick fog generally, but clearing away now and then during the day, so that I got a glimpse of the sun this morning for the chronometer, and also a good meridian altitude for the latitude. I was even lucky enough to get three sets of the lunar distances. I worked them all separately, as well as by the mean of the three sets, and they differed only 2 miles. The lunar is sixteen minutes to the eastward of the chronometer, but I rely more on the chronometer than the lunar. Lat. 42° 46', chonometer, 47° 11', at nine a.m. Immediately after noon the fog returned with all its density.

July 2nd.—Wind westerly. Light breeze; 3 or 4 knots.—In confirmation of my position, that a ship makes more northing than the log will give, near the Bank of Newfoundland, in this season of the year (my remarks have been made in June and July only), I find we have made 28 or 30 miles of northing more than the dead-reckoning can account for satisfactorily since noon yesterday. The water is smooth, and we have been steering one course, E. by S. ½ S., with a fair wind: by log we have gone 82 miles, and I think the ship has been attended to as carefully as one can expect in a merchantman. The chronometer also gives more easting than the run by a very great deal. It cleared up about twelve o'clock, and gave me the meridian altitude;

lat. 43° 31′. And it brightened again at three p.m., when my chronometer gave 44° 6′. The current is unquestionably goin to the northward and eastward (254.). I make it N. 61° E., 48 or 50 miles, since nine o'clock yesterday, when the longitude was found by chronometer.

July 3rd.—Steering E. by S. ½ S. Wind westerly, a nice little steady breeze.—Longitude, by chronometer, this morning, at twenty-four minutes past eight, was 41° 44′; and the latitude 43° 58′. Current had set us N. 73° E. 17 or 18 miles in the last twenty-four hours.

July 4th.—Wind westerly, a beautiful breeze. Running E. by S. ½ S.—It is my constant practice to take sight for the longitude two, three, or four times a day, according to circumstances, as well as sidereal observations, for the latitude in the night watches; and by these means I think it is a fair conclusion, that I can discover, generally, the set and velocity of a current very soon after the ship begins to feel its influence. Now, the current has been setting altogether to the eastward during the last twenty-four hours (N. 85° E. 10 miles), the longitude only will be disturbed, therefore the chronometer will be our truest guide, and she tells me that the current ceased in 44° 16′, long. 38° 32′. This I call the eastern boundary, or rather the termination, of the Florida Stream (214.). I saw some bunches of weed to-day; it was decidedly what is commonly called gulf-weed, the same kind that we met with in the Florida Stream, along the coast of North America, but it had not the same flourishing look. I call them bunches, in contradistinction to sprigs; for the sprigs that we fall in with to the southward float lightly on the surface, but those to the northward are more like bunches of oakum—bunches of oakum saturated with water, and almost stinking.

July 5th.—Wind W.N.W. A fine steady breeze. Running E. by S. ½ S. Lat. 41° 53′, long. 35° 45′. I have no doubt that the weed mentioned yesterday was at the eastern end of the stream, for we have seen none since, and none was seen for two days before; and the run, by log, gives now as much longitude as the chronometer. I fany we may presume that the weed was carried there by the Florida Current, unless, indeed, we adopt the hypothesis, that the current has nothing to do with it: that it grows and ripens at the bottom of the sea; and, when in a state of decay, the stems are broken off by the agitation of the water, or some other accidental cause, and then it comes to the surface. Be that as it may, the weed, in this part of the ocean, I have invariably found in a perishing state; and I have generally found it fresh and healthy in the stream sweeping along the coast of America.

[From the 6th to the 14th of July, when the ship arrived at the Lizard, the Journal presents nothing remarkable, excepting a current setting N.W. by W. on the edge of soundings. The current on other days was scarcely perceptible.]

Major Rennell says:—"It is well known how easily a current may be induced by the action of the wind, and how a strong S.W., a N.W., or even a N.E. wind, on our own coasts, raises the tide to an extraordinary height in the English Channel, the River Thames, the East Coast of Britain, &c., as those winds respectively prevail. The ingenious Mr. Smeaton ascertained, by experiment, that in a canal of 4 miles in length, the water was kept up 4 inches higher at one end than at the other, merely by the action of the wind along the canal. The Baltic is kept up 2 feet at least by a strong N.W. wind of any continuance; and the Caspian Sea is higher, by several feet, at either end, as a strong northerly or southerly wind prevails. It is likewise known, that a large piece of water, 10 miles broad, and generally only 3 feet deep, has by a strong wind, had its waters drived to one side, and sustained so as to become 6 feet deep, while the windward side was laid dry. Therefore, as water pent up so that it cannot escape acquires a higher level, so, in a place where it can escape, the same operation produces a current, and this current will extend to a greater or less distance, according to the force by which it is produced or kept up by the wind."*

These facts are so well ascertained, that it may generally be taken for granted, a certain degree of current will obtain on the Alantic, after a continuance of any uniform wind, where the sea wonld be otherwise in a placid state, and unaffected by other causes. For it is supposed that the winds, where uniform and permanent, produce currents equally uniform and permanent. Hence it is that the winds between the tropics, having a general course westward, protrude the water of the Atlantic in the same direction, and cause the flow of a current the same way, unless where it meets with land, islands, or shoals, to obstruct its course or change its direction, or where it runs through channels which draw it a different way.

There is reason for believing that the great currents within the torrid zone are increased by the influence of the moon, which draws them on from East to West (201.). One instance that currents are affected by this cause is, that in the Faro, or Strait of Messina, between Sicily and Calabria, in the Mediterranean Sea, where there is *neither rise nor fall*, a current sets to the northward and southward alternately, for six hours, having every appearance of being governed solely by the lunar influence. Other instances might be given; and there is little doubt but the power of the winds is blended with the attraction of the moon in forming the currents which set westerly from the Atlantic into the West Indian Sea.†

(289.) SUBMARINE CURRENTS.—Another feature of ocean currents has been elicited in the experiments made under the direction of the hydrographic department of the United States' Coast Survey (to whole labours we have had occasion to allude in other places), and that is, that the set of the submarine currents *does not correspond either in velocity or direction* with those of the surface. How far such a singular fact will overturn our preconceived notions, it must be lelt for more extended remprks to elicit. The following is the account given by Lieutenant Walsh, of the U.S. brig *Taney*, the officer alluded to:—

"The surface current was first tried by the usual mode (a heavy iron kettle being lowered from a boat to the depth of 80 fathoms); then, for the trial of the under current, a large *chip-log*, of the usual quadrantal form, the arc of it measuring full 4 feet, and heavily loaded with lead to make it sink and keep upright, was lowered by a light but strong cod line to the depth of 126 fathoms (the length of the line); a barrega was attached as a float, and a log line fastened to this barrega; and the rate of motion of this float, as measured by this log line and glass, as well as the direction, as shown by a compass, were assumed as the velocity and set of the under current. No allowance was made for the drag of the barrega, which was always in a different direction from the surface current. It was wonderful, indeed, to see this barrega move off against wind and sea, and surface current, at the rate of over one knot an hour, as was generally the case, and on one occasion as much

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* Major Rennell, on the Thwart Channel Current. It has furthermore been noticed, that the effect of wind in altering the level of the surface of water is strongly exemplified in the reach which forms the summit-level of the Forth and Clyde Canal in Scotland. This each is about 18 miles long, nearly in a straight line, East and West. When a westerly gale has blown for some time, the action of the wind sweeps away the water from the West end, sinking its surface, and accumulating it at the East end, where it escapes over the lock-gates, in a stream sometimes 10 inches deep.—"Ed. Ph. Journ.," vol. vi. p. 71.

In a gale of wind, in 1823, a part, or *reach*, of the *Grand Junction Canal*, was raised 21 inches.

The effect of S.W. and southerly winds, on the level of the sea upon the coast of Guinea, has been shown on page 257.

† Particular convulsions in the interior of the earth sometimes occasion an extraordinary derangement of the tide, &c. After a late occurrence of this nature in the Mediterranean Sea, called by the Italians a *sea-earthquake*, the course of the tides in the Gulf of Spessia was totally deranged for the seven or eight succeeding days. But the ebb and flood were sensibly perceived at intervals of a quarter of an hour, half an hour, and an hour, during that whole space of time.

as 1¾ knots. The men in the boat could not repress exclamations of surprise, for it really appeared as if some monster of the deep had hold of the weight below, and was walking off with it. I will cite from the log several instances of these experiments.

"On *May* 11th, 1850, in lat. 24° 43′ N., long. 65° 25′ W., we found a surface current of one-third knot per hour, setting to the West, and an under current, at the depth of 126 fathoms, of the knot, setting W.S.W.; temperature of water at surface, 77° 3′; at 50 fathoms, 77° 5′; at 100 fathoms, 73° 5′. The current felt by the vessel on that day (as deduced from the comparison of the true position obtained by astronomical observations and chronometers, with those by dead reckoning) agreed with this trial of the surface current, being the same within a fraction, viz., 0·3 knot westerly. On this day the sea was covered with a species of medusæ, of a dark red colour, spherical in shape, from one-eighth to three-eighths of an inch in diameter.

"On *May* 12th, at four p.m., in lat. 25° 55′ N., long. 64° 43′ W., the surface current was found to be one-third knot, setting N.N.E., and the under current (at 126 faths.) 1¾ knots, setting S.E., being the strong under current I have alluded to; this was well ascertained by several trials; temperature of water at surface, 75°; at 50 fathoms, 76°; at 100 fathoms, 69°. From this time, four p.m. to eight a.m. the following morning, we experienced a strong currrent of 1·3 knots per hour, setting N. 14° E., as determined by the observations. While trying the currents in the boat, all hands remaining on board the schooner were employed sounding with 500 fathoms line, but failed to get the temperature at that depth, there being at that time too much swell.

"On May 13th, at half-past five p.m., in lat. 26° 42′ N., long. 64° 4′ W., the surface currents was found to be one-third knot, setting E. by S.; the under current (at 126 fathoms) 1½ knots, setting W.S.W.; at the same time obtained the following temperatures: at surface, 77° 5′; at 50 fathoms, 76° 5′; at 100 fathoms, 75° 5′; at 500 fathoms, 53°. The current felt by the schooner, in the interval between eight a.m. and four p.m., was easterly 0·4 knot per hour, agreeing with the trial in the boat.

"On *May* 14th, in lat. 26° 46′ N., long. 63° 53′ W., found a slight surface drift, too small to be measured, setting to the westward, and an under current (at 126 fathoms) of 1½ knots, setting N. by E. No current had been acting on the vessel for the preceding sixteen hours, and dead reckoning agreeing with observations. On this day the sea being pretty smooth, we tried soundings with the wire, and got 1,050 fathoms without bottom, and we succeeded in getting, by one of Six's self-registering thermometers (which came up uninjured by the immense pressure) the temperature at that great depth, which was at 49°, while at the surface it was 77°.

"On *May* 18th, at nine a.m., in lat. 36° 6′ N., long. 67° 56′ W., found a surface current of one-third knot setting N.W. by N., and a very slight under-current (at 126 fathoms) not more than one-sixth knot, setting N.E. No current was felt by the vessel during that day, but during the preceding night one-fourth knot per hour, setting N.W. Being calm and pretty smooth, we sounded during this day to the depth of 2,050 fathoms, when the wire broke without reaching bottom. The temperature, at the surface, 70°; at 100 fathoms, 65°. The trial of currents on this day was one of the two occasions which I have alluded to, on which we found a less under current than that above it.

"On *May* 29th, at eleven a.m., in lat. 33° 58′ N., long. 72° W., found the surface current one-third knot, setting S.E., and an under current (at 126 fathoms) of one knot, setting W.N.W. Temperature at surface, 71°; at 50 fathoms, 70·5°; at 100 fathoms, 67°. We were set during this day, as determined by the afternoon observations, to the eastward, at the rate of one-half knot per hour. On this, which happened to be the last occasion of these experiments, I tried the current at the depth to which the kettle was lowered (80 fathoms), which it would have been better always to have done. I founded it tended in the same direction as that at 126 fathoms (counter to the surface current), but at so small a rate that it could hardly be measured, not more than one-tenth knot per hour, the float moving at only this small rate, being but one-tenth of the velocity at which it had moved just before, when trying it at 126 fathoms. This indicates that the kettle had just penetrated the under current; and thus, by this means, it would appear practicable to measure the depth of the surface current, or its point of contact with the counter under current. Such experiments in the Gulf Stream would be particularly interesting."

Captain Irminger, of the Royal Danish Navy, has also recorded some experiments on submarine motion. They were made with an instrument invented by M. Aimé, and described in the "Annales de Chimie et de Physique en 1845":—

"March 17, 1849.—Weather calm, lat. 25° 4′ N., long. 68° 41′ W; the current indicator and self-registering thermometer lowered 2,934 feet, or nearly 500 fathoms, when the current was found setting N.W. true; surface temperature, 78.8°, and at 500 fathoms 46·0°.

"In another part, in sight of Madeira, lat. 31° 58′ N., long. 17° 12′ W., Sept. 14, 1847; no surface current; at 1,980 feet, or 330 fathoms, the current was running W.S.W true; temperature of surface, 76·1°; at 330 fathoms, 51·8°. The surface current here usually sets to S.E."

With our present imperfect acquaintance with this important branch of the subject of currents, it would be useless to build up any argument. We shall, therefore, dismiss it for the present, leaving it for the seaman to add to our store of knowledge hereafter.

(290.) In the year 1804, Captain James Manderson, of the Royal Navy, published "An Examination into the True Cause of the Stream of Florida," &c. In this treatise he considers the floods of the Mississippi as the "prime mover of the Florida Stream;" and he presumes that it is caused by the waters which fall into the Gulf from that and other rivers. Captain Livingston, on the subject, says—"From the best information I could obtain, relative to the quantity of water discharged into the sea by the Mississippi, Rio Bravo, &c., there seems no probability that, in the aggregate, they exceed a three-thousandth part of the water which is discharged through the Strait, between the Florida Reefs and the Bemini Kays, or the narrowest part of the strait."*

Upon the hypothesis of Captain Manderson it was subsequently stated, in an American work, that the velocity of the Gulf Stream might be calculated by the *rise and fall of the floods in the Mississippi*. Thus is one error propagated upon another! "I have," adds Captain Livingston, "experience of the contrary. In August, 1818, the River Mississippi was *uncommonly low*, and I never saw the Gulf Stream run with greater velocity. The trade-winds raising the level of the Gulf of Mexico seem to me the principal cause of the Gulf Stream.

"I am of opinion that its velocity depends on the motion of the sun in the ecliptic, and the influence he has upon the waters of the Atlantic; as, when the sun's declination is north, the N.E. trade-wind blows fresher, and extends farther to the northward, than when the sun's declination is south. This causes a greater pressure of water toward the Caribbean Sea, and a superior elevation of the surface of the gulf of Mexico, the superfluous water of which escapes by the Strait of Florida, where it is least opposed by the trade-wind, which only affects it laterally (except in the short distance between the Dry Tortugas and the Salt Kay Bank), and even there the effects of the trade-wind must be very much diminished by the Bahama Bank, with the islands and kays thereon.

"There can be little doubt that the attraction of the sun, while in the northern hemisphere, influences the current which generally prevails about Madeira, and causes it to set with greater velocity toward the southward and eastward. One well-known

* Captain *White* has argued, at considerable length, against attributing the origin of the Gulf Stream to the Mississippi. But it would seem to us to be decided in very few words. The *turbid* and *fresh* waters of the river, its volume, and its fluctuations, are all incompatible with the facts of the Gulf Stream. Again: arguing from analogy, in what part of the world do we find a *river* preserving an independent current across an ocean, and which can be recognised at 5,000 *miles from its source*? The effects of all rivers are utterly insignificant when compared with this.—Ed.

fact seems to corrobate this idea, namely, that the above-mentioned current is always much stronger in the summer than in the winter months. On a reference to my journals it appears, that although we were a considerable time in the limits over which the influence of the Gulf Stream generally extends, in the forenoon of Friday, the 19th, and on the whole of the 20th of February, we felt its effects in a slight degree only, the water appearing during that time to have been perfectly stationary. It may also be remarked, from the journals of my voyage through the Strait of Florida, in September, 1818, in the ship *Asia*, and in March, 1819, in the brig *Dispatch*, how very little we gained, in the latter instance, from the assistance of the stream, when compared with the manner in which it hurried us to the northward on the former. All this tends to confirm me in the opinion that the velocity of the Gulf Stream depends almost entirely on the sun's place in the ecliptic."—*A. L.*

It may here be remarked, that the Gulf Stream is augmented during the *rainy* season of the West Indies, and reaches its highest parallel (about 43° N. between 56° and 57° W.) in the summer only. In that season it there spreads over a vast extent of oceanic water. It is also to be recollected that in the same rainy season the waters of the Caribbean Sea, which is then surcharged, seek an escape along the Colombian coast to the *eastward*, as well as by the Channel of Yucatan to the West.

(291.) The EASTERLY CURRENTS in the *Northern parts of the Atlantic*, and which in the Bay of Biscay exert their tremendous effects so as to be proverbial, originate in the north, as we have described, and then conform to the winds, which in these regions are, as already shown, mostly from the N.W., and violent during a great part of the year.

The more general prevalence of westerly winds off the coasts of the United States operate to produce a depression of the water off those coasts, and of course contribute to an easterly tendency in the waters of the ocean.

The indraught into the Strait of Gibraltar is attributed to the evaporation of the Mediterranean Sea, which appears to be the cause of the currents setting immediately in that direction, and of biassing the water from the West.*

These circumstances, combined, must indisputably produce the set or drift of a great portion of the Atlantic to the east, E.S.E. and S.E., which, however, varies with the winds, with the seasons, and local circumstances.

The auxiliary winds on the African coast are the means of continuing and carrying it down that coast in the manner in which it has been described.

To the prevalence of westerly winds and easterly currents is to be attributed the shorter period of voyages from America to Europe than from Europe to America; a fact established by general experience.

At any considerable distance from the coast of America, the easterly current caused by the action of violent west or N.W. winds is seldom felt to the southward of latitude 36°; consequently, the sea about the Bermudas, and thence southward, is free from the influence of this current. The currents here, though slow, are produced in the direction of the wind, particularly when it is of long continuance. These currents are found stronger near the islands and rocks of Bermuda than at a distance, because the obstruction which the water meets with from the islands causes it to run proportionably faster past their sides. In a brisk gale the current here has been experienced from 12 to 18 miles in the twenty-four hours, in the direction of the wind; at other times, when the wind was not settled, no current has been found.

Major Rennell is of opinion that those transient and contradictory currents that

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* This was the opinion of Dr. Halley, which has been controverted by those who suppose that the effect may be accounted for by the motion of an under current, setting outward. The flood tide, on either side of the strait, does certainly set outward, but the ebb sets inward with the general current. The easterly indraught appears to commence at about 100 leagues west from the mouth of the strait.—See, upon this subject, our 'Sailing Directory for the Mediterranean Sea."

are met with in the mid-ocean are owing to gales of wind, which sometimes are but narrow in their column of air, but affect the surface very strongly so far as they extend.

The system of ocean currents having, from the numerous observations before related, amidst a crowd of others, become tolerably well arranged and understood, may be readily comprehended, although it must not be considered that we have nothing more to learn upon the subject.

(292.) A great addition to Hydrography has been laid before the world by the United States' Government, the result of the Exploring Expedition, under the orders of Captain *Charles Wilkes*. From that work we extract the views of its author concerning the Hydrology of the North Atlantic.

"The approach of the Gulf Stream to our shores (United States) has been ascribed to the influence of N.E. winds. These are known to affect the tides in our bays and harbours; but I am unwilling to admit that these are an adequate cause for the change in position and velocity of so great a body of water. The action is far too trivial to account for such an effect. It is certain, on the other hand, that the Gulf and Labrador Streams both owe their existence to the unequal distribution of temperature on the earth's surface; there must be a difference in the intensity of the causes that act to produce these effects at different seasons of the year; and it may be inferred that the changes of the seasons act unequally upon the two streams. The force of the portion of the Labrador Current which follows the coast of the United States will, when superior, carry the Gulf Stream outwards, and when that force diminishes, the Gulf Stream will approach more nearly to the coast, and most nearly when its own relative force is the greatest. Whatever be the ultimate causes of the streams, it would appear that their approximate causes are influenced by temperature, the Gulf Stream being increased in mass and velocity when the temperature is highest, and the Labrador Stream when it is lowest; and in conformity we find it a general impression that the former is broader and more rapid in the summer of our climate than in winter. I must, however, state that I have been unable from my own personal observation, either by the thermometer or the set of the vessel, to distinguish this increase of the Gulf Stream in summer. Thus, in my passage to England, in August, 1846, from the time we passed to the east of St. George's Bank, in a latitude about 1° to the south of it, we experienced a low temperature in the water, and the vessel was retarded. We were, therefore, in the Labrador Current.

"After the squadron had crossed the Gulf Stream we experienced little action from current till we reached Madeira, the whole difference between our dead-reckoning and the true place of the ship being no more than 175 miles in twenty-six days.

"Before leaving this part of our subject, it may be as well to refer to facts familiarly known, but which did not come within the scope of our observations. The stream known on our coast by the epithet of gulf may often be traced upon the surface, but with diminished velocity, entirely across the Atlantic; throwing, at some seasons, the seeds and drift of tropical climates upon the British Islands, even as far north as the Shetlands. At other times, when the Gulf Stream ceases to flow, or is overpowered by the great Polar Current, they are carried by the latter to the S.E., on the coast of Spain and Portugal, which current has been so disastrous by the number of vessels that have been wrecked on Cape Finisterre, where it divides, one branch of it passing around the shores of the Bay of Biscay, along the western coast of France, and thence crossing the English Channel, which is now so well known as the Rennell Current while the main Polar Stream flows south, along the coast of Portugal, towards Madeira, with a diminished velocity, as a surface current.

"That the stream which sets upon Cape Finisterre is the origin of the Rennell Current, the following remarks by Horsburgh clearly show :—'The current is found to set east from March to November, particularly when west winds prevail; and off Cape Finisterre, and near the southern part of the Bay of Biscay, it sets mostly along the coast to the east; and along the east coast of the Bay it sets to the north, parallel to the west coast of France.'

"At Madeira and the Canary Islands the surface Polar Stream seems to have ceased; but by our observations on the deep-sea temperature a *submarine stream* still appears to exist. In lieu of the former, we have the current familiarly known as the African Current, by its causing so many distressing wrecks on that coast, and to which attention has often been drawn by the captivity and cruel slavery to which their crews have been subjected.

"As has been seen in the narrative, but little surface current was found on our voyage from Madeira to the Cape de Verdes; but the submarine stream was still found, as was shown by the low temperature of the deep-sea soundings. At, and in the neighbourhood of, the latter islands, and between them and Cape Verde, on the African coast, a strong surface current is felt. In endeavouring to account for this remarkable circumstance of the creation of a current, and its increased velocity, of which every navigator must be aware, when in the neighbourhood of many islands, and the effects of which we often experienced in our long voyage, I shall now advert to the cause which, I think, is quite sufficient for the effect; and that is, the accumulation of water caused by the obstructions that islands offer to the onward flow of submarine streams, thus raising the level of the ocean in their vicinity, and consequently a tendency to run off, and thereby create a current where none was perceptible before, or an increased velocity in that which was felt.

"To this cause, then, I believe the currents around the Cape Verde Islands owe their origin, as well as all others prevailing near islands and banks; and, as corroborative proof of this, I will mention the fact, that, where no submarine Polar Stream exists, permanent currents are not found. This will, I trust, be amply shown in the sequel.

"That remarkable current along the coast of Guinea, from which it derives its name, passing Cape Palmas, and flowing into the Bight of Benin, I attribute to the same cause. This current is in the immediate vicinity of the Equatorial Stream, but runs in an opposite direction, and for a long distance parallel to it.

"This Guinea current is lost in the Bight of Benin, near Prince's Island, which lies under the Equator, in the longitude of 7° E.; and it is confined and obstructed by a southern polar stream, much in the same manner as the Labrador is affected by the Gulf Stream on the coast of the United States, and which is supposed to be lost near Cape Hatteras.

"Beyond the Cape de Verdes, overfalls, rips, and a continued tendency to change in the surface of the ocean, are experienced, as if two great conflicting submarine currents were meeting at some depth beneath the surface.

"As we proceeded on our route from Porto Praya to Rio Janeiro, the same appearances continued; but we did not meet the Equatorial stream until we had crossed the Equator and reached the latitude of 3° S., and longitude 25° W. It was then pursuing its course towards the coast of Brazil, whence, passing between the Windward Isles, it finally enters the Gulf of Mexico.

"This part of our passage afforded many interesting observations, exhibiting extended rips, and the boilings above spoken of, alternating with smooth spaces, and variable currents, setting for a short time in one direction, and immediately afterwards in the opposite. All spoke of a conflict of currents, and a forcible mingling of the waters beneath the surface. From Porto Praya to Rio we were influenced by currents 280 miles, N. 41° W.

"No current of the velocity here mentioned has ever been experienced to the East. To what is this sudden increase and rapid flow to be imputed? or to what other cause can it be imputed, but to a submarine stream, flowing directly on the shoal coast of Brazil, and raising the level of the ocean on those banks which it endeavours constantly to restore, by flowing off rapidly in the opposite direction?

"Before proceeding into the South Atlantic, I will recapitulate our results in the northern.

"Beginning at the Equator, we find a great surface stream setting to the West, across the ocean, which, passing along the coast of Brazil, enters through the Windward Island Passages into the Caribbean Sea, and thence into the Gulf of Mexico, whence the water flows into the Gulf Stream, which, although at first narrow, soon spreads itself, crosses the Atlantic, and expands its force in mid-ocean, or, at times, upon the British Isles. This great stream, of moderate temperature on the open ocean under the Equator, becomes more heated on the coast of Brazil; and opposite the coast of the United States retains, both in summer and winter, a temperature approaching to, or often exceeding, 80°. In the meantime, another great stream sets south along the coasts of Labrador and Newfoundland; and, dividing at the banks, a branch of this follows the line of soundings off Nova Scotia and the United States, while another flows beneath the waters of the Gulf Stream, passes south, and mingles with the waters of the ocean, and affects the surface temperature where it comes in contact with islands and banks. The uninterrupted flow of this vast Polar Stream is along the coast of Portugal and Spain, and a small part of it flows into the Bay of Biscay, caused by its striking upon Cape Finisterre, and forms eventually the Rennell Current; another part flows into the Mediterranean, in consequence of the higher level of the stream, when compared with the waters of that sea. The main branch now pursues its course on the surface, until Madeira and the Canaries are reached in its course, beyond which it is no longer apparent. But below the surface, as shown by the low temperature of the deep-sea soundings, a submarine stream pursues its way to the Equator, where the waters again commence the same round as before.

"In the south portion of the space included within the above limits, is an expanse of water which presents remarkable phenomena. This is called by the name of the Sargasso Sea, and is noted for the quantity of the aquatic plant, known as the gulf-weed (*fucus natans*) that is found in it."

(293.) Most willingly would we give here, *in extenso*, an excellent paper with which we have been favoured by Captain R. Leighton, on the general system of ocean currents, but space will only allow a brief notice of it. Captain Leighton, from his own observations, aided by the remarks of others, traces in a more connected manner than has hitherto been done the progress of circulation in the ocean waters, as follows:—

The amount of rain which falls in the Gulf of Mexico and the basin of the Mississippi River cannot be the source of the Gulf Stream; for although there is a wet and dry season in the West Indies, yet the amount of rain which falls there is a mere sprinkling compared with the deluges of rain that fall in the whole of the countries surrounding the Bay of Bengal during the S.W. monsoon, which may be judged of by the fact that the average annual fall of rain at Maulmain, in six years, was 15 feet; and at Tavoy it was 16 feet, and it sometimes rains for six weeks without cessation at Maulmain. In the Mexican Gulf the great Mississippi is almost the only river of great magnitude; but what is this compared with the Ganges, the Irawadi, the Sittang, and the Selween Rivers, all falling into the N.E. part of the Bay of Bengal? Now, from this cause, and from the N.E. monsoon driving the current along the west coast of Sumatra, and the S.E. trade hemming the water into the Bay of Bengal, the only outlet for these influxes of fresh water would be the Straits of Malacca; and if the argument of fresh waters giving rise to the Gulf Stream or other currents held good, the Strait of Malacca would be an unnavigable torrent; but it is not; therefore the natural inference is, that the Gulf Stream is a continuance of the great tropical current.

Captain Leighton argues that the trade-winds are the great motive power of the currents; that the winds outside the tropics may, by their variableness, counteract each other, but the effect of wind is well exemplified in the effects it has in retarding the flood-tides. The general features of the monsoons and the trade and passage winds, all tend to throw light on the movements of the surface waters, and may be reconciled with those actions.

Considering these circumstances, the Indian Ocean, southward of Timor, appears well adapted to form the head-quarters of a great tropical current nearly surrounding the globe, and found under the various names of the Equatorial Currents of the Pacific Ocean—the Drift Current of the Indian Ocean—and the Agulhas Current round the Cape of Good Hope, where it gives the best proof of its being a great and deep-seated current, by its following the windings of the Agulhas bank, in 60 fathoms water. We have it again in the Atlantic Ocean (where it gives rise to two circular currents), and it is here called the Equatorial Current—and again, the Drift Current of the Caribbean Sea—and, lastly, in the North Atlantic, as the Gulf Stream.

Captain Leighton then proceeds to trace an unbroken current from the Indian Ocean to the North Atlantic, by his observations made during a single voyage, as follows:—

Barque *Secret* to Calcutta, 1850, November 4th, in lat. 23° S., long. 78° 0′ E., to November 15th, in lat. 6° 11′ S., and long. 84° 7′ E., time eleven days, the currents were *N.* 71° *W., true;* and the distance 138 miles.

Barque *Secret* from Maulmain, 1851, June 21st, in lat. 8° 22′ S., and long. 85° E., to July 8th, in lat. 28½° S., long. 44° E., the currents ran *N.* 82° *W. true;* and the distance 216 miles in seventeen days.

From July 8th to the 17th, in lat. 32½° S., long. 32° E., time nine days, and the currents *S.* 86° *W. true;* distance 52 miles.

From July 17th to August 5th, in lat. 33° 46′ S., long. 15° 16′ E. (bad weather in a series of five rotary gales round the Cape of Good Hope), time nineteen days, and the currents *S.* 66° *W. true;* distance 354 miles, or averaging 19 miles per day.

From August 5th to August 21st, at St. Helena, time sixteen days, currents *N.* 58° *W. true;* and the distance 175 miles.

From August 22nd, at St. Helena, to September 7th, in lat. 3° 23′ N., long. 23° 48′ W., time sixteen days, the currents *N.* 72° *W. true;* and the distance 241 miles.

There is thus manifestly a continuous current traced by this voyage from the borders of the Eastern Archipelago to the well-known tropical current of the North Atlantic. The paper then proceeds to trace this current across the Atlantic into the Mexican Gulf, where its final exit in the Gulf Stream proves that this latter is a prolongation of the great tropical current, which nearly encircles the earth.

In our recent "Directory for the Pacific Ocean" (1851, Part. II., p. 1238) we have described the tropical currents of that great ocean, and demonstrated that this great westerly drift becomes broken up and enters the Oriental Archipelago through the numerous channels dividing the islands, and thus becomes neutralised as to its westward set. We might, therefore, suppose that the open spaces in this archipelago will have a generally higher temperature than the rest of the ocean, and also be, as above argued, the initial point of the great curent systems which circulate around the Indian and Atlantic Oceans.

The tendency of the waters in the North Atlantic certainly seem to be a circulation *around* the central portions known as the Sargasso Sea. We do not require the supposition of Major Rennell, that this is a hollow, or depression of the surface, *into* which the currents run on all sides; nor that of Lieutenant Wilkes, that it is a raised *area.* This phenomenon of the waters revolving around a central quiet space is also well exemplified in the basin of the North Pacific on a magnificent scale; it is less so, but equally clear, in the area of the North Sea. It is true that the southward tendency of the Arctic waters in the Labrador Current, across the Newfoundland Bank, is to break in upon this uniform circulatory movement, still it is sufficiently symmetrical to form a feature in the great movement of the waters.

There is another current whose origin was involved in some obscurity; it is the

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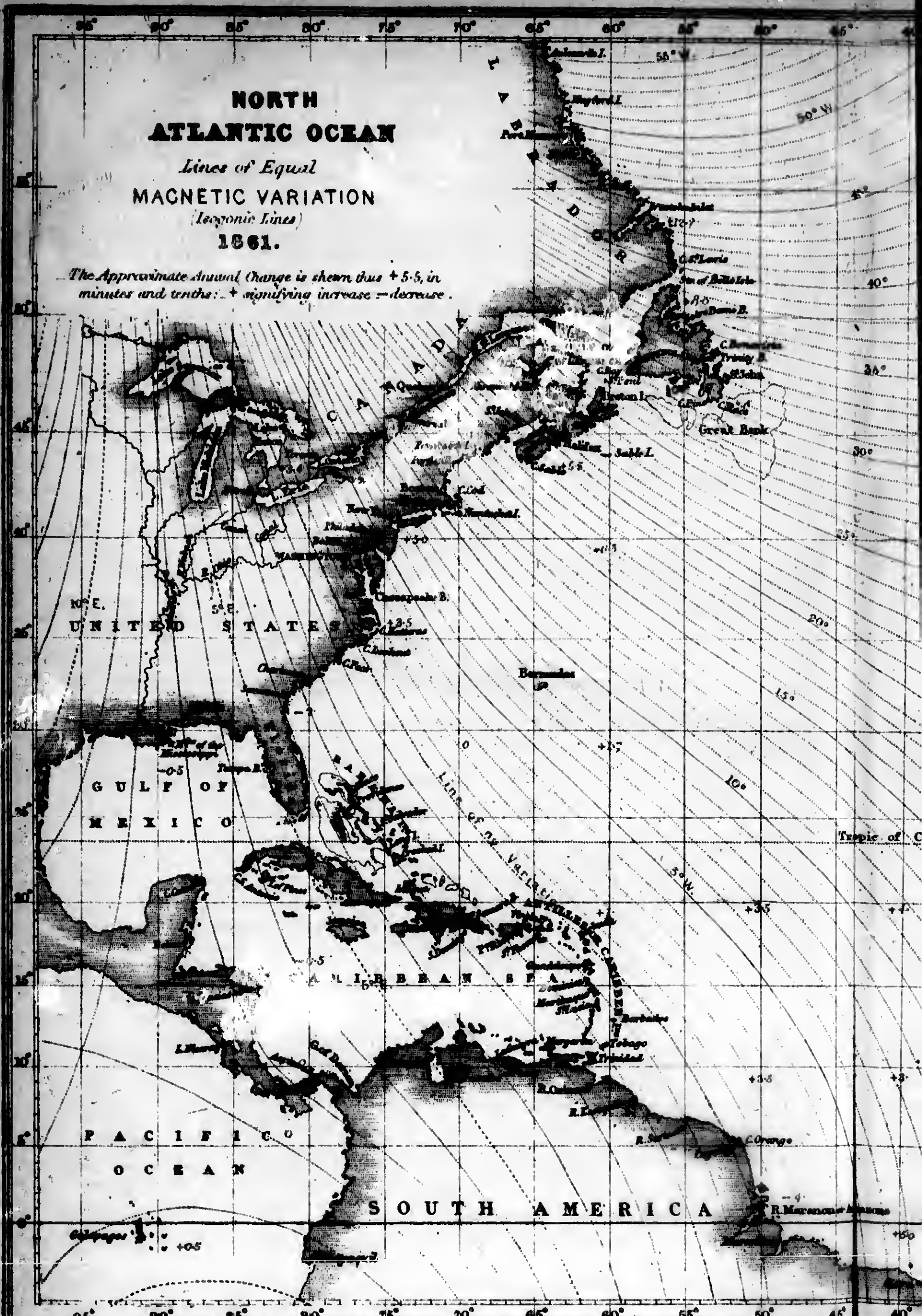
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Lines of Equal
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(Isogonic Lines)
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CARIBBEAN SEA
PACIFIC OCEAN
SOUTH AMERICA
LABRADOR
CANADA
Line of no Variation
Great Bank
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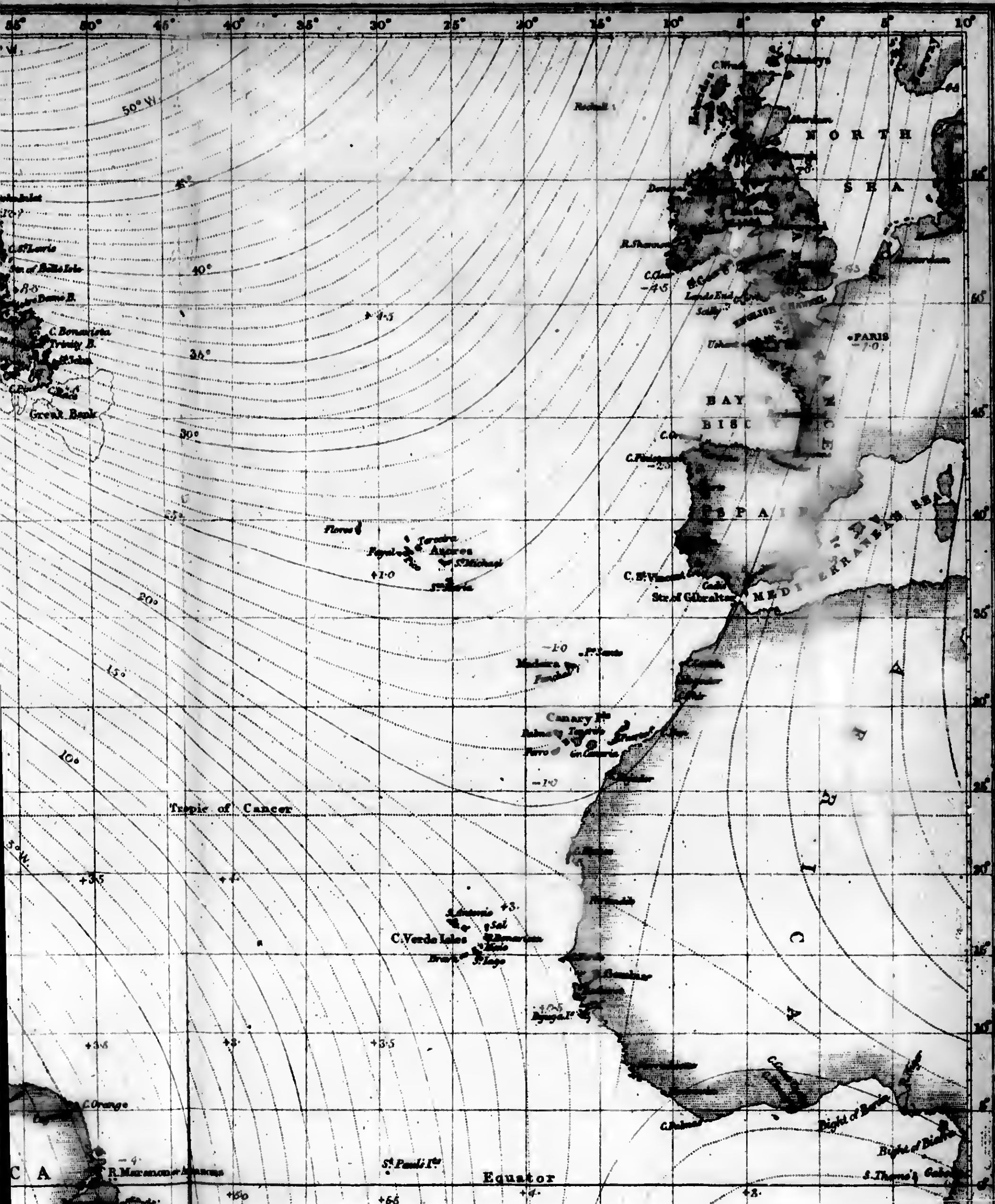
Chesapeake B.
Bermudas
Barbadoes
Tobago
Trinidad
C. Orange
Tropic of C
Galapagos
95° 90° 85° 80° 75° 70° 65° 60° 55° 50° 45° 40°



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SPAIN
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Str. of Gibraltar
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Terceira
Fayal
Azores
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St. Maria
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Funchal
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Guinea Current (151.). It is, certainly, partly due to the prolongation of the African Current from the N.W., but, by analogy, we should suppose that it would recurve to the westward when it got fairly within the scope of the trade-winds and consequent tropical drift.

Captain Leighton argues that it is a continuation of the central current, which, after passing between the Sargasao Sea and the Bermudas, turns to the south-eastward towards and into the Gulf of Guinea, blending with the current from the North and eastward. This appears feasible, but what is this easterly current?

In the "Pacific Directory," 1851, pp. 1243—1247, there is an *easterly* current described, which extends entirely across the Pacific between the latitudes of 4° and 10° N. This remarkable current would seem to be the effect of the Equatorial calms; or, rather, that the water, being driven by the N.E. and S.E. trades, is here heaped up, as it were, and not being able to reflow *over* the adjacent drifts, like the aerial currents, assumes the form of a counter-currents.

The question arises, Is there a similar current in the Atlantic Ocean? By analogy we reply in the affirmative. But the configuration of the land, and the greater interferences that the currents have from each other, renders this fact less evident. Nevertheless, it can be fairly assumed that some portion of the Guinea Current is due to an Equatorial counter-current, which would set directly along the African coast into the Bights of Benin and Biafra, as the Pacific counter-current sets into the Bay Panama. The arguments upon which the Atlantic counter-current may now be recognized are given on pages 283—288.

IV.—MAGNETIC VARIATION.

(294.) Among the changes which have come over the system of navigation of late years, none have been more important than the different relation which the compass now bears to the ship as compared with its place in former times.

Rude instruments, unadjusted, with errors unsuspected, and under influences destructive to their accuracy, have given place to what may be, in some cases, over estimation, of this primary aid to the seaman. In its very nature the compass is imperfect and incompetent to show, at sea, the minute quantities, which are now disputed over. The consequence is, that it is made, like the topic we have just discussed, ocean currents, the scapegoat for many errors of seamanship and judgment, which a more intimate knowledge and therefore greater mistrust and induced caution would have avoided.

(295.) Our present task deals with the *geographic* distribution of magnetism, not with those local effects caused by the ship or its relations to outer circumstances, but to its position in the Atlantic. The other points, most important in themselves, must be discussed elsewhere.

The features of the earth's magnetism, as related to the ship, are the declination, inclination, and intensity. The dip and intensity are very important elements in the adjustment of the compass in its passage through the varied magnetic condition which an over-sea voyage across the Equator, conducts a ship through, but they have but little influence on the directive power of the needle in the latitudes usually traversed in commercial pursuits. The *declination* or variation is one of the most important elements in navigation, and its correct estimation and application most essential to the safe conduct of a ship.

(296.) The reasons why the compass is now placed in so much higher consideration to what it was in former years are manifest. The great increase of the use of iron both for ship building as well as in the fabric of wooden ships, and the consequent vastly increased influence that the ship has upon her compasses has been our chief reason why attention is so imperatively demanded. Again, since the universal use of steam, the course of a vessel in passing directly from one point to another requires to be much more accurately laid, than it was thought necessary when wooden ships only were used.

Another reason, which has arisen in the course of years, in that caused by the secular variation. The accurate government surveys, which have now been in progress for 30 or 40 years, in their earlier portions have, in many cases, remained as they were issued, and consequently this change from the variation of the compass they show has amounted to a considerable quantity, such as would endanger the safety of a vessel where they have been implicitly trusted to. The survey of the St. Lawrence, as commenced by Cape Bayfield, may be instanced.

The appreciation of this change, which has thus become manifest simultaneously with the necessity for improved compasses and improved methods of using them, have placed the magnetic element in charts on a fresh basis. One most important result of this movement was the appointment by the Admiralty of the late Captain E. J. Johnson as superintendent, in 1842, of the Compass Department. The great improvement in compasses dates from this appointment, and the investigation of the difficult and varying problems of local deviation have been since pursued by eminent men, among whom may be noticed Professor Airy, Dr. Scoresby, W. Walker, Esq., R.N., Archibald Smith, Esq., and many others. These researches have been mainly directed, as before observed, to the effect the ship's iron has on her compasses. F. G. Evans, Esq., R.N., who has succeeded Captain Johnson, has drawn up a far more perfect chart of the geographic distribution of the magnetic variation than we hitherto possessed; former charts having become of impaired value from the lapse of time, and from the imperfection of the observations on which they were based. It is from this chart brought down to the period, 1861, by applying the secular change requisite to the chart of 1858, that the illustrative chart has been constructed.

(297.) The *isogonic lines*, or those upon which the variation is of the same amount, on this chart, will represent this element, generally as near as the ordinary ships' compass will show it, and will serve to draw attention to any unsuspected change in the magnetism of the ship, besides affording the sailor some information when observation cannot be had.

(298.) The *variation* of the *compass* in all parts of the coasts of the Atlantic are given with the Tables of geographic positions at the commencement of this work, and the amount of annual decrease or increase in this variation is also indicated. To these notices therefore the reader is referred.

It is for the open ocean that the illustrative chart and these notes are intended, and on the chart are inserted the amount of annual change in different parts, so that the approximate variation may be ascertained in future years by applying the necessary correction.

(299.) But it must not be supposed that this annual change is regular, and of the same amount in each year. By the accurate observations that are now self-recorded, the connexion between these changes and apparently very remote causes have been identified. One of these, at the first glance a very singular one, is that the spots in the sun, if absent or present in large quantities, have a marked magnetic influence on the declination, thus demonstrating the source from which the magnetism of the earth is chiefly derived. As the Greenwich observations will illustrate our subject as well as any, and this volume might be filled with interesting results on this subject, the extracts will be limited to the extracts from those observations as being sufficient to impart a notion of the ever varying amount of the magnetic variation.

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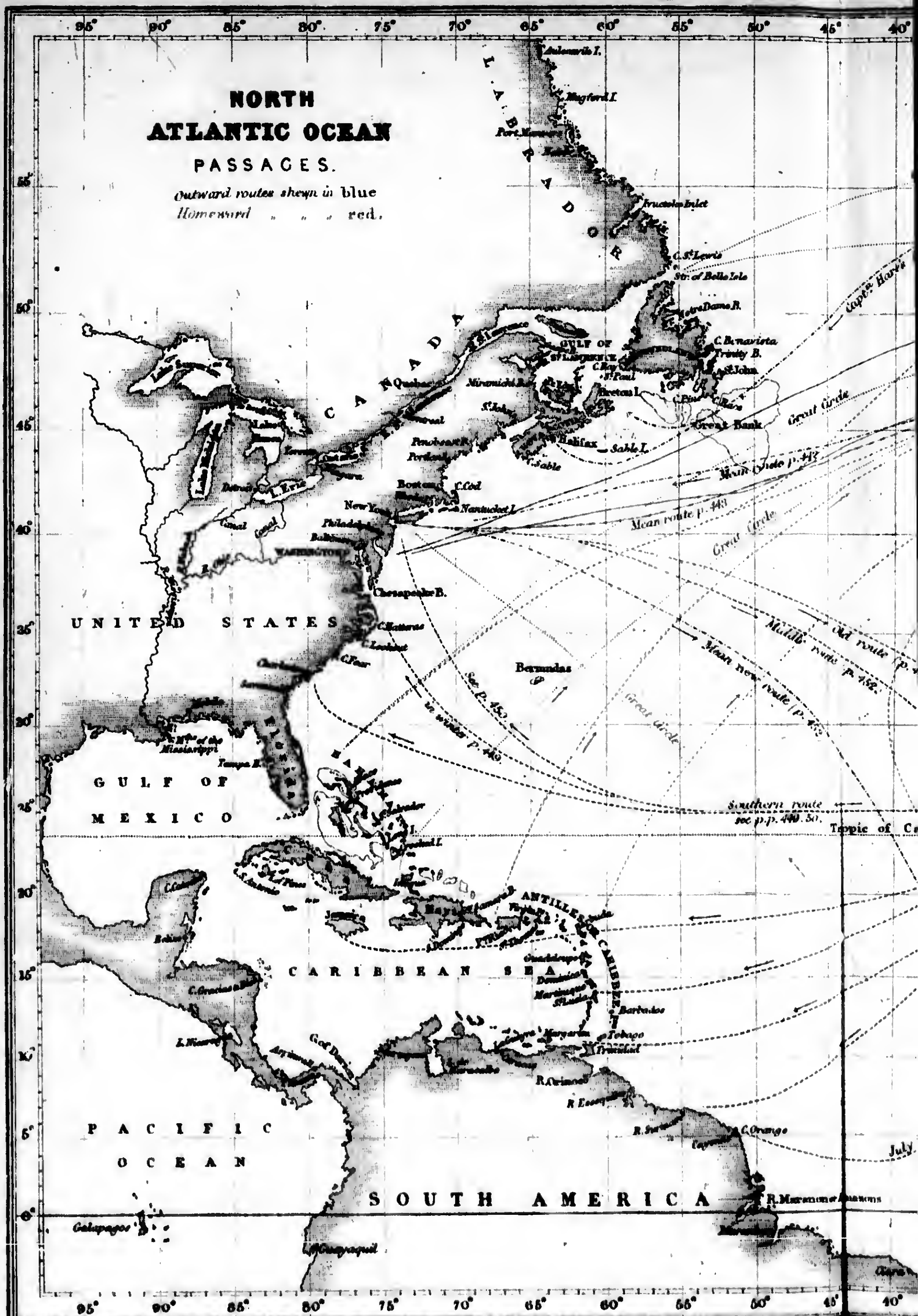

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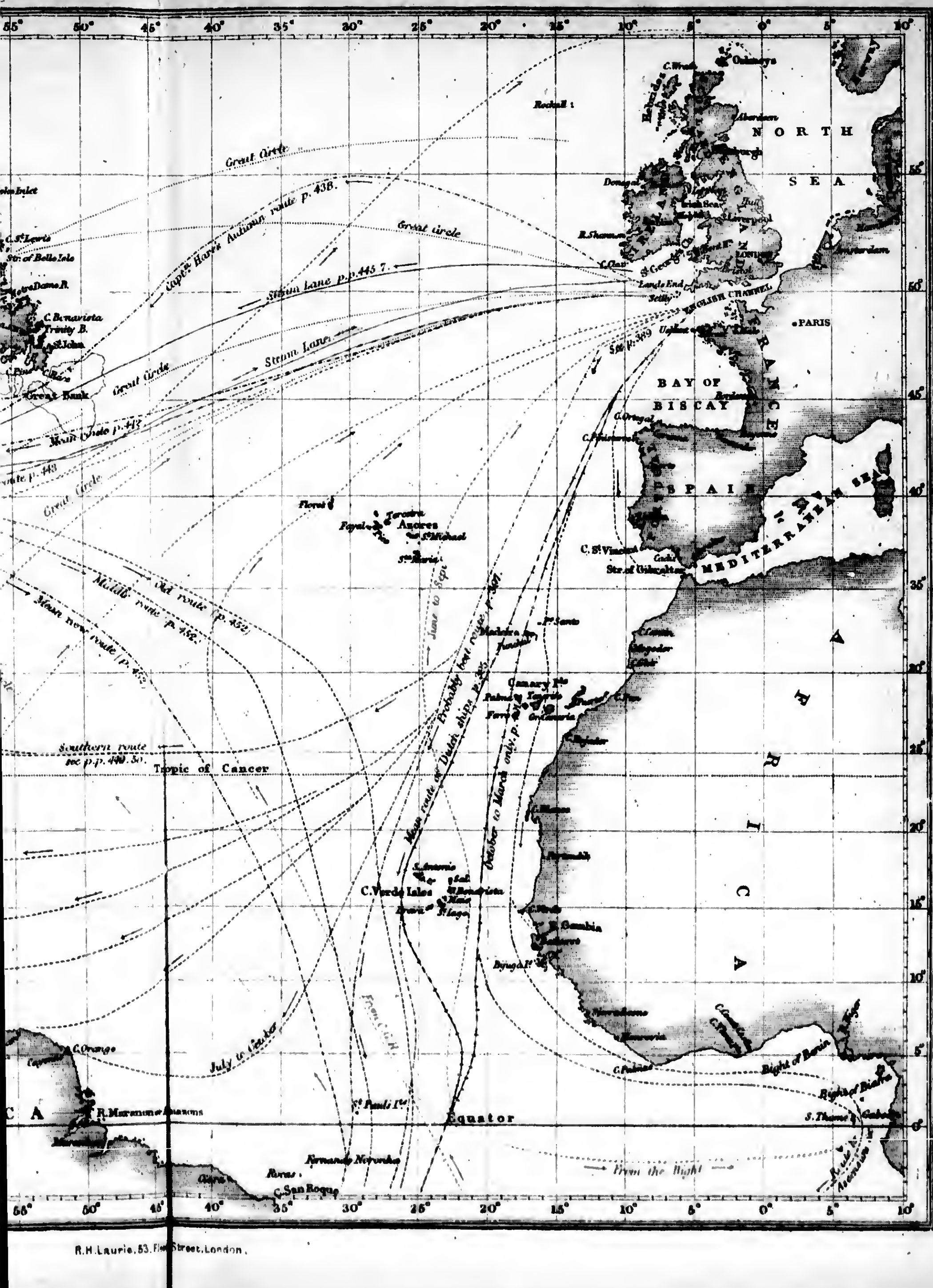

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WESTERLY MAGNETIC VARIATION AT GREENWICH.

	1844.	1846.	1848.	1850.	1855.	1858.
	° ′ ″	° ′ ″	° ′ ″	° ′ ″	° ′ ″	° ′ ″
January ..	23 19 22	22 50 56	22 50 2	22 28 5	21 49 50	21 32 47
February ..	23 18 43	22 50 17	22 49 5	22 27 28	21 48 13	21 32 14
March	23 18 42	22 49 21	22 53 46	22 26 54	21 48 41	21 32 31
April......	23 18 42	22 51 51	22 52 27	22 25 44	21 48 44	21 32 26
May	23 19 23	22 49 32	22 52 46	22 25 1	21 48 25	21 29 16
June	23 19 8	22 51 48	22 53 21	22 24 47	21 50 12	21 27 34
July	23 18 40	22 49 24	22 53 18	22 23 41	21 48 14	21 28 28
August	23 13 25	22 49 33	22 52 36	22 22 4	21 48 31	21 27 24
September..	23 13 6	22 48 55	22 51 31	22 25 43	21 47 9	21 26 43
October	22 12 52	22 47 55	22 52 11	22 19 1	21 46 21	21 25 33
November..	22 11 50	22 47 38	22 51 46	22 18 27	21 45 59	21 29 45
December ..	22 49 41	22 47 51	22 51 40	22 18 27	21 45 54	21 28 40

(300.) Upon examing these columns of figures, it will be at once seen that the decreasing amount of westerly variation is very far from being regular, and that at some times the variation is absolutely *increasing*. Thus the variation in June, 1847, 22° 43′ 0″; in June, 1848, 22° 53′ 21″, an *increase* of 10′ 21″. The *decrease* between January, 1846, and January, 1847, was only 1′ 38″; to January, 1848, 1′ 4″; to Jan. 1849, it decreased 14′ 6″; and to January, 1850, 5′ 51″; the mean annual rate for these 4 years being 5′ 44″. The variation in 1860 was about 21° 32′, so that it had decreased 1° 57′ 50″ in the 14 years that had elapsed since 1844, or at the rate of 8′ 4″ per annum; but its mean rate at Greenwich is about 6½′ at present.

The needle also varies very considerably at times in the course of the day, the maximum westerly declination is at 2 p.m.. This diurnal change amounts to 7′, 8′, 9′, and 10′. This topic is so large and comprehensive, that it must be left to other works. In a later part of this volume some further remarks will be found. The present and the illustrative chart will suffice for the present purpose.

V.—OF PASSAGES OVER THE ATLANTIC.

1. GENERAL REMARKS.

(301.) In the preceding pages we have described those natural phenomena of winds, currents, &c., which govern the track of a ship across the ocean. The object of the present section is, to apply these principles to the seaman's practice; but, previous to entering upon this portion of the task, we will make a few general observations upon great circle sailing, which has been revived as a *new* subject, when in fact it is one which was among the earliest principles recognised in navigation. This is not the place to enter into disquisitions on the working of great circle problems—that must be left to works specially devoted to nautical mathematics. The excellent "Practice of Navigation," by Lieutenant Raper, or Towson's Tables, published by the Hydrographic Office, will be found excellent guides; but still a greater simplicity in the application to ordinary purposes of navigation is a great desideratum, and one which, perhaps, we shall endeavour to supply at a future day.

Great circle sailing was known and acted on very early in the history of navigation. It is more than probable that Cabot, Columbus, Magalhaens, and all the first great navigators, were acquainted with the subject;* but this, it must be remembered, was prior to the knowledge of the principles of finding the longitude. When Gerhard Mercator, in 1569, published a universal map, on the projection now known by his name, a new era commenced in navigation; but its true principles were not correctly described till they were done so by Edw. Wright, in 1599. In this projection, as is well known, the meridians being parallel to each other, and straight lines, the latitude is distorted and increased in proportion as these meridians are more distant from each other than the correct difference of longitude would give for that latitude. Consequently a straight line drawn between any two points on a such a plane chart will give the correct compass bearing, which, if maintained throughout the course by a ship, will lead her from one point to the other. This course is well known as the rhumb course, and is that in universal use from its simplicity. But it is *not the shortest course*, except it be due East or West on the Equator, or North or South on a meridian, which are great circles. This course, developed on a sphere, is found to be a *spiral*, and is considerably removed from a great circle or shortest distance if a great extent of longitude is traversed by it. We need not pursue this subject, but an example will explain its application.

(302.) From a point off the Lizard, in lat. 50° N., long. 5° 30′ W., to Cape St. John's, in the Bay of Notre Dame, in Newfoundland, also in lat 50° N., and 55° 30′, the course, *true*, is of course *West*, and the distance on this parallel is 1,928½ miles. But if a ship were to quit the Lizard on a *N.* 70° 20′ 30″ *W.* (*true*) course, and then gradually bearing more westward, attaining the latitude of 50° 45′ N., in long. 30° 30′ W., thence bearing more southward, and approaching Cape St. John's on a similar angle to the parallel that she had left the Lizard, she will have sailed over 1,893 miles, or 35½ less than on the parallel; but, in her greatest separation, she will have been 165 miles distant from the rhumb course. Therefore, if she were to take any course between this great circle course and the parallel of 50°, she would have a less distance to traverse; and this is the great advantage which the great circle sailing offers—that of a wide range of choice (in a higher latitude) without increasing the distance.

Further, if she were to assume a course as much higher in latitude as the great circle course is above the rhumb, she will find that it will be of the same length as the latter. Thus, in the example cited, if on leaving the Lizard she were to bear away for a point in lat. 55° 30′ N., long. 30° 30′, and then approach Cape St. John's, such a curve will be found to be exactly 1,928½ miles in length, and yet be, in its maximum separation, 330 miles apart from the parallel. The advantage of such a range of choice will appear subsequently in the remarks upon the transatlantic passages.

(303.) The great difficulties in application of the principle of great circle sailing to practice are, the laborious nature of the calculations, now, however, much reduced, and the inference as to how a course so much at variance with that which the chart will apparently dictate as the most direct, will place a ship in respect to favourable winds or currents. Still, the scope it allows to the navigator must be considered as no mean advantage, even if its shorter distance may not be an inducement to rigorously follow out its principles.

(304.) In the following general sailing directions, the application of the facts in

* It is alluded to directly in a work by Pedro Nunez, in 1537; again, by Pedro de Medina, in 1545; but his system was erroneous, and was corrected by Martine Cortes (or Curtis), whose work, "The Arte of Navigation," was soon after, in 1561, translated out of the Spanish into English, by Richard Eden, and was long the text book of British seamen. Numerous other works, in which it is correctly and distinctly described, afterwards appeared, as one by Michael Coignet, of Antwerp, in 1581; an excellent work by Roderick Zamarano, in 1585, &c. That by this time it was thoroughly recognised is evident by John Davis, published in August, 1594, called "The Seaman's Secrets; wherein is Taught the *Three* Kinds of Sayling—Horizontall, Paradoxall, and *Sayling upon a Great Circle.*" It is also described in Richard Polter's "Pathway to Perfect Sayling," about the same time. After this it is found in most of the old works on navigation.

physical geography which have been described in the preceding sections of this work must be left to the discretion of the commander in most cases. In fine weather and with fair winds, the estimation of the various influences which affect the ship's course are not difficult to make. But it is the adverse circumstances of a voyage that call for the seaman's skill and intelligence, and what has been said will help him to form a judgment of what is going on and how best to proceed.

But there are an infinite variety of circumstances which render it impossible to lay down any fixed rule which may be implicitly followed to advantoge at all times. Therefore, in cases where a definite course is pointed out as the best to be pursued, and a vessel should be driven out of her intended route, it does not follow that it is right to endeavour to regain that course to pursue it afresh, but rather it should be considered that a fresh voyage has to be commenced, and the course shaped from the latest point as if it were a starting place.

(305.) A vessel under *steam* only is considered in the light of a sailing vessel with a fair wind. In a certain sense this is true, as it enables her to be independent of wind or current. But it should be remembered that the same contrarieties which affect and hinder a sailing vessel from pursuing a direct course, will also, in degree, be adverse to the progress of a steamer; and, therefore, if a moderate deviation from the shortest route will lead her into more favouring winds or currents, that course will be most advantage to the vessel under steam as it is to the sailing ship.

There is one circumstance which may be mentioned respecting a ship under steam as to how she is affected by the direction and strength of this wind. If a vessel be steaming before a fresh breeze, strength No. 5, at the rate of 12 or 13 knots, she will experience a perfect calm, while the sailing vessel will be only able to carry her top-gallant sails and royals. If she steams in the teeth of the wind, she will seem to have a strong gale, under which a sailing ship could only carry close-reefed topsails. This will be made apparent by consulting the table of the velocity of the wind on page 182. Now, a vessel steaming with the wind otherwise than directly fore or aft, will not feel the wind in its *true* direction; for it will appear to blow from that direction and with that force which is a combination of the rate and direction of the ship's course with that of the velocity and direction of the wind itself. Its apparent and real course and velocity may be found by constructing a parallelogram of forces—a well-known problem. It is for this reason that the wind as registered on board a steam-vessel does not give the correct bearing of its course, and it is much more disguised than it is in a sailing ship when close hauled, as alluded to in (12.) on page 180.

As the steam-vessel, then, may be considered in a great measure independent of wind or current, the great object of the past and succeding remarks is mainly applicable to *sailing* vessels.

(306.) It has been well observed thrt the wind systems of our globe naturally govern the tracks of ships crossing the oceans, the trade winds carrying them from east to west within the tropics, while the anti-trade or passage winds will bring them back again eastward beyond the tropics. If it were not for the intervening belt of calms, sailing directions for vessels going into opposite hemispheres would be of the simplest kind; but the well-known Equatorial embarrassments—"the doldrums"—generally make a very different matter of it, and cause many considerations to enter into the problem of shaping a course. In the North Atlantic, these obstacles of the intervening calms seem to be at their maximum, and in the future remarks one chief point, now still argued, will be found to be that which has engaged attention almost ever since over-sea voyages commenced—where is the best place to avoid these calms and contrarieties of the Equator.

The directions which follow will commence with our own country, although very briefly; for it is presumed that almost every one who will use this book is either well qualified to navigate our own channels, or has more extended works on this point to guide him.

And even in the remarks on more distant voyages very brief notices would generally suffice, for most are now familiar with the varied particulars of the hydrography of the Atlantic as it affects a ship's passage. Notwithstanding the vast labour that has been bestowed on the research into its phenomena, it does not seem that a corresponding advantage has accrued to shipping; for in many cases the directions of a century since will be found as useful as those based upon these refined inquiries. However, one thing may be averred, that passages are now made with much greater certainty than formerly, and even if the average duration of a voyage is shortened a few hours, very much has been gained; and, by the comparison of a great number of voyages made under different circumstances, it may be safely pronounced which is the best course to pursue, and what the average length such a voyage will be.

2.—TO AND FROM THE ENGLISH CHANNEL.

Outward.

For vessels leaving the Downs, and having rounded the South Foreland, the track is W. by S. ½ S. 21 miles to Dungeness, the depth 20 to 10 fathoms. From a mile off Dungeness to 2 miles south of the shoals off Beachy Head, the course is W. ¾ S. 24 miles, and in depths varying from 18 to 12 fathoms. In working down, and while to the eastward of Folkestone, stand in to 13 fathoms, and off towards the Varne to 16 fathoms. This latter bank has lost much of its dangerous character by the placing of the light-vessel, which now marks its N.W. face. Between Dungeness and Bexhill keep outside of 9 or 10 fathoms, and within 25 fathoms. To the westward keep Beachy Head light or lighthouse in sight, which will keep you clear of the shoals. Having arrived at 4 miles south of Beachy Head, a course may be shaped down Channel. This course will necessarily be much controlled by the wind and tide; bus, under any circumstances, the English coast should not be left. If the wind be contrary, the best position with the commencement of the *ebb* is inshore. The flood tide, especially at its commencement, tends to the southward, filling the large indentations of the French coast before it sets fair up the Channel, and then it sets on to the coast south of Boulogne. It is well to remember that the tidal streams throughout the fairway of the English Channel set towards Dover while the tide is rising there, and away from it while falling, so that the Dover tide-table answers for the whole distance between the Lizard and Beachy Head. H.W. F. and C. at Dover 11h. 12m. All this is explained on pages 251—253 *ante*.

If the wind is favourable a W.N.W. ½ W. course for 63 miles brings you off St. Catharine's Point; from thence W. by N. 94 miles to the Start. In working down do not come nearer the Owers than in 20 fathoms, and to St. Catharine's than 22 fathoms. From thence to St. Alban's Head into not less than 22 fathoms toward the indraught. Between Portland Bill and the Start, if the weather be clear and favourable, you may stand into Lyme Bay to 17 or 16 fathoms. Throughout all this course, keep off until in from 35 to 36 fathoms. From the Start to the Lizard, the course and distance are W. ¾ N. 64 miles, which course continued for 46 miles further brings the ship 10 miles south of the Bishop Light.

Throughout the course as far as off Plymouth, the tides set fair up and down; westward of this, they revolve in all directions, and must be most carefully attended to, as is also most necessary when to the east of Beachy Head.

In case of bad weather or contrary winds, and necessity for shelter, the following places may be safely sought for. With the winds *broad* easterly or westerly, ships may stop on either side of Dungeness, in East or West Bay, and also on either side of Beachy Head, in Seaford Road, westward and eastward of the shoals on the other side, and near Bexhill; and with westerly winds the Park inside the Owers Light-vessel is also used. Within the Isle of Wight there is anchorage sheltered from all winds. Westward of the Wight, Studland Bay (near Poole) affords good shelter from westerly gales. The new Refuge Harbour in Portland Roadstead affords security against nearly all winds. Good anchorage is also found against southerly winds in Torbay, Plymouth Sound, and Falmouth.

Most sailors have had some experience of the detention caused by contrary winds in the English Channel. Some of the more remarkable of these detentions have long lived in remembrance. The Right Hon. Maurice Fitzgerald, in some evidence respecting the Western Harbours of Ireland, gave a curious illustration of the difficulties in making way against these westerly gales. An officer of considerable experience commanded a small vessel of war belonging to the Cork squadron. Information was received that a smuggler was to land on the western coast; he was ordered to cruise off the Skelligs to intercept her. He sailed from Cork, but was brought up six different times at Crookhaven, and, being extremely anxious to reach the ground upon which he was to cruise, he determined to sail round the north of Ireland, and he did so, and reached the Skellig in a very few days.

The detention of Rear-Admiral Christian was proverbially known. He sailed from Portsmouth with an expedition for the West Indies on Nov. 16, 1779, and, after having been repeatedly blown back, he did not ultimately clear the Channel till the end of the following March.

It seems that the wind generally draws up and down the Channel more or less, and does not blow true as in the open ocean. Thus, a westerly wind in the offing may become a W.N.W. wind in the English Channel, and a N.W. wind in the St. George's Channel; and the same with the easterly winds. By referring to (67.), page 209, and the illustrative diagram, the reader will see some exemplification of this in the case of Liverpool, and in (71.), pages 211, 212, those of the English Channel are discussed, where it will be seen that the western predominate over the eastern quarters as 229 is to 132.

As a further illustration of the direction of the wind in the upper part of the Channel, we may adduce the following *resumé* of 10 years' observations made by the Royal Society:—

TABLE OF THE WINDS OBSERVED AT THE ROYAL SOCIETY'S APARTMENTS IN LONDON.

	Easterly.	Westerly.		Easterly.	Westerly.
1820	102	168	1826	129	187
1821	91	196	1827	115	189
1822	101	181	1828	104	192
1823	99	189	1829	130	171
1824	81	195			
1825	97	188	Mean	101	186

Or, supposing a feather to have been abandoned at the beginning of each of these years, the mean direction and number of days the feather would have advanced is as below:—

Year.	Direction.	Days.	Year.	Direction.	Days.
1820	S. 86° E.	56	1825	S. 75°·8 E.	86
1821	N. 89° E.	92	1826	N. 58° E.	47
1822	N. 84' E.	72	1827	N. 58° E.	54
1823	S. 81° E.	81	1828	N. 39° E.	95
1824	S. 74° E.	91	1829	N. 57° E.	38

Mean for 10 years N. 83° E. 66 days per annum.

This shows how far the westerly predominate over the easterly directions. North-easterly winds are at a maximum in May and June.

Our remarks as to the lighthouses and other points of departure will be useful to a ship leaving dock to gain a sea-rate for her chronometers. In the geographical tables, pages 7 and 8, the chief land-marks are given to the minutest accuracy; and in the tables of lighthouses, the position of any one of the lights there given will equally answer as a point of departure.

Homeward.*

The Bristol Channel I consider safer to approach than either the British or St. George's Channels. The parallel of Trevose Head, on which stand the two lighthouses, has been generally recommended, and that on the parallel of Lundy Island may be used according to circumstances, direction of the wind, &c. In thick or dark weather the soundings will indicate when you have passed a line cutting Scilly and St. Ann's Lights near Milford Haven, and also on nearing the shores on either side. The south side of Lundy is preferred, as you can go safely close round it, taking care to keep the light in sight above the land; and as there are generally pilots lying under the island, you are sure not to miss them by pursuing this route.

For approaching and proceeding up the British Channel, various directions have been given. 1st. *Soundings.* The great difficulty is that the soundings are very deep, and the same water may be got in different positions, both in latitude and longitude, so that a false position by dead-reckoning in the longitude, or in the latitude by the want of observations, is almost as likely to be confirmed as detected; I mean, by *detached casts of the lead.* As a precaution against this, I would advise ships (particularly those navigating by dead-reckoning) to "seek the ground early," so that by striking the edge of the bank they may obtain, as it were, a departure, and then take frequent casts of the lead, and make with them a table in the following form, noting the true course and distance between each two casts, and carefully observing the quality of the ground, as well as the depth of the water:—

True Course.	Distance.	Depth.	Quality of the Ground.

And where a few of these are obtained and set off upon the chart, one will check the other. Ships, as well as steamers, have been lost by "*not stopping to sound.*"

The prevalent winds are considered to be S.W. and westerly from May to December, both inclusive, and from January to April, both inclusive; although long and heavy S.W. and westerly gales may occur at this season, yet they are more frequently interrupted by northerly and N.E. winds, particularly in February and March. N.W. winds are considered to be generally of short duration.

To approach and pass Scilly, the parallel of 49° 15′ to 49° 25′ has generally been recommended; in place of which I would recommend that from 49° 30′ to 49° 40′, according to the wind, &c., as likely to be attended with greater safety; and if the Bishop Rock or Scilly be not made, having taken every precaution to ascertain the longitude, once that its meridian is past, strike for the Lizard, and, if possible, make it, and thence proceed by the rules of the best coasters. Lights can be seen when celestial observations cannot be made; and as the navigation is generally free from outlying dangers, courses should be shaped from one prominent point or light to the next, keeping at a moderate distance to ensure seeing them, if possible. The ships generally met with in this route are coasters, and they keep a good look-out, and are generally very anxious to get out of the way of large foreign-going ships.

Easterly Winds in the Winter and Spring Months.—Those winds are very destructive upon the East coast, and often cause heavy losses and great detention amongst the shipping; and, although those winds may blow long and steady in all the channel, yet at times they do not extend to the westward of Cork, but more generally about

* General Notes on the Approaches to the Channels and for Navigating the British Channel, by Captain Richard Leighton.

the edge of soundings; I have known them to blow long and remarkably steady in the Bristol Channel, and yet ships were arriving at Cork with heavy *S. W. winds.* There is also a kind of periodical occurrence of easterly winds upon the coasts of the United States of America, which have been described by Mr. W. C. Redfield, and he considers them as distinct from the revolving theory of the winds.

Whilst speaking of soundings and channel navigation, I want to strongly urge the use of Captain Sumners's method, as by it a single altitude, giving the line A A with a cast of the lead, or a bearing of the land, will often fix a ship's position with certainty, and its many uses and advantages will soon suggest themselves after a little practice.

My reasons for dissenting from choosing the parallel of 49° 15′ to 49° 25′ to approach the Channel, are—

1st. A ship in this parallel will pass from 30 to 40 miles to the southward of Scilly, and will not expect to see it. I think this precaution attaches too much importance to Major Rennell's thwart channel current, which I do not consider to be a definite current, but only at times occasioned by a combination of circumstances, driving a great excess of water into the Bay of Biscay, and the excess of *tide* to the northward does not require so great an allowance.

2nd. That parallel is the centre of the dangerous group of Guernsey, Jersey, the Caskets, &c., which, I believe, have caused more wrecks to ships bound up the British Channel than getting to the "*northward of Scilly*" has done, and the channel course trends to the northward, the difference of longitude between Scilly and the Caskets may appear great, but great errors occur in dead reckoning, and a ship goes far in a winter night and a westerly gale, but allowing them to avoid those dangers.

3rd. That parallel has led to or encouraged the imprudent and dangerous practice of galloping up in mid-channel, with neither anchor nor cable clear, and trusting to celestial observations and chronometers, as though it were in the middle of the Atlantic; and here we have the *Conqueror*, *Reliance*, &c., sad examples of the effects of not making and keeping hold of the English coast, lights, &c. A great deal was said and written about those cases, but I consider that the amount of error in the course and distance from a position off Scilly or the Lizard, to place a ship on shore between Boulogne and Calais, instead of being in a position off Dungeness, to be an *every-day occurrence* in navigating such a distance in tideways and blowing weather without any check to correct the account, and neither "storm-waves" nor "storm-currents" were required to cause them.

4th. Foreign-going masters generally keep at too great a distance from the land, by which they not only frequently miss a sight of lights, &c., which it is important that they should see, but they lose the benefit of some degree of familiarity with the land, objects, &c., which a nearer approach would give them, and which in the want of having to go into roadsteads, &c., would be found of very great service.

5th. It is not by keeping near the land that ships get embayed and lost. If it were, colliers would never be safe; they are as much afraid of getting off the land as foreign-going masters generally are of coming near it. The general rule in coasting is to see every guide as you pass it (unless thick weather should prevent it, and in that case strict attention to the lead until you find the next); this rule and attention to the set and duration of the tides are the grand points in coasting.

3.—TO AND FROM THE ST. GEORGE'S CHANNEL.*

"Many shipmasters have been bewildered in St. George's Channel, especially in thick weather, from ignorance of the tides and want of experience; some, we are sorry to add, from want of due consideration, and others from not allowing for the in-draught into the bays on the Welsh coast. The light-vessel in Cardigan Bay is placed to remove some of this latter danger.

"The writer of the following hints and observations begs to be understood as laying no claim to merit in their compilation; his only motive being to assist and advise the *stranger*, and those who, from want of experience, have acquired only a slight knowledge of this dangerous navigation."

Special caution to the effects of the tides seems necessary to be inculcated of late. Some most lamentable shipwrecks have recently occurred on the banks on the S.W. coast of Ireland, by vessels leaving Liverpool under what ought to have been favourable circumstances. The unthinking hardihood of the commander who will place his ship's keel on a special course as if it were a groove, which, if most accurately kept, will just shave clear of destruction, and without taking into account the numerous causes which will horse him off his course, such as bad steerage, leeway, heave of the sea, and, above all, the *set of the tides*—cannot be too strongly deprecated. And yet, as above said, some losses have occurred which have most certainly arisen from a culpable neglect of all these particulars, and attributed to *charts* or local magnetic attraction unadjusted, or, indeed, anything but the real cause—the thoughtlessness of the sailor. On page 254 some brief remarks on the tidal streams of the St. George's Channel are given, which will do to remind the sailor of what is said in more extended works.

Another point of caution most important is, the character of the lights marking its dangers. In the table their present condition is given, and it is sincerely to be hoped that no misleading alteration will take place. Government official entanglements led to much confusion and unnecessary alterations in the Irish lights, which, as they were, or as they are, answer their purpose well; but unknown alterations must lead to confusion, doubt, and danger. Therefore, let the seaman who has been absent, perhaps for years, enter these difficult channels with all caution.

Captain Midgley's instructions are arranged as follow:—

(*a*) On proceeding from Liverpool westward to the Bay of Holyhead.

(*b*) On taking the North Channel, and proceeding thence to Tory Island.

(*c*) On proceeding by the South Channel, and thence westward to the Ocean.

(*d*) On proceeding by the South of Ireland from the Ocean to Liverpool, &c.

(*Throughout these remarks, the courses, bearings, and state of the winds, &c., are to be understood as by compass.*)

(*a*) On proceeding from Liverpool westward to Holyhead.

Liverpool being the principal and central port in St. George's Channel, and the prevalent winds being from the westward, W.S.W., and S.W., during eight or nine months of the year, I shall suppose that a large ship leaves that port, with an adverse wind from the westward. Having discharged the pilot off the lightship, stand to the northward all the ebb tide (which, in Liverpool Bay, sets to the N.W.. and the flood to the S.E), and, if laying N.N.W., or to the westward of this direction, during the first quarter of the flood, keep the lead occasionally going, with a careful look-out for the Isle of Man, which is moderately high, and on the south side bold-to.

* General Instructions and Admonitions for Vessels bound from Liverpool and other Western Ports to the Atlantic Ocean, and for Returning from the Ocean to the same; by Captain Thomas Midgley, of Liverpool, 1839.

Should there be a strong breeze and a heavy sea, the vessel may not weather the West Hoyle Sands, on the starboard tack; and great caution is, therefore, required when going near them, as they are bold-to and very dangerous. In thick weather the lead must be constantly used, and, and the sands should not be approached nearer than in 10 fathoms of water.

The soundings along the north coast of Wales, eastward of Point Lynas, will pretty accurately determine the distance of the ship from the land, provided due attention be paid to the *depth* of water; but the *quality* of the soundings will not indicate the particular part of the coast she may be abreast of.

The *Ormes Heads* are very bold, and any vessel may safely steer a direct course from thence to Point Lynas, which may be known by the castellated building near its extremity, used as a lighthouse, and its telegraph station upon the summit.

Point Lynas and the land to the westward of it is very bold, but the ebb tide hence runs very strongly to the W.N.W. and through the Sound inside the Skerries. Off the Middle and West Mouse the spring ebbs run at the rate of 7 knots; and all vessels should, consequently, give this part of the land a good berth, during light winds, at such times as the flood or ebb may be running strong; or they may, upon an ebb-tide, get into the vicinity, or perhaps upon, the Coal Rock or the Skerries Platters.

The Coal Rock bears E. ½ S. 2½ miles from the Skerries, and lies with the West Mouse (a large rock always high above water) on with the two beacons on Carnel Point. By night, a *red* ray from the Skerries light will now point out its direction. The Platters are nearly the whole length of the Skerries Rocks, and lie at about one-third of the distance between the Skerries and Carnel Point.

BEAUMARIS is a good harbour for all ships, into which a Liverpool pilot will conduct them, provided no licensed pilot for the port may be found; but the Beaumaris pilot-boat is generally cruising off the chops of the bay, between the Ormes Heads and Lynas, or lying at anchor within it.

HOLYHEAD is also an excellent harbour, now much more sheltered by the new Government pier.

(*b*) ON TAKING THE NORTH CHANNEL, AND PROCEEDING THENCE TO TORY ISLAND.

If, after weathering the Hoyle Sands, the wind should be so far to the southward of west as to enable a vessel to weather the Isle of Man, it may be a matter of consideration whether it be most advisable to go through the North or the South Channel; but this should not be hastily decided on. In the summer months the winds are more variable than in winter, and then it is certainly advisable to choose that passage which is nearest to the destined port; giving the preference to the North Channel if bound to British America, Newfoundland, or the northern ports of the United States. In winter, the prevalent winds are from S.W. and W.S.W., and these winds often blow steady for several days.

Should the North Channel be preferred, with southerly and S.S.W. to W.S.W. winds (and it should not be attempted with any others that have westing in them, especially by a stranger), it is advisable to take a departure from the lights on the Calf of Man, and steer a direct midchannel course, with a careful look-out, as the passage is narrow and the tides very rapid, but running directly through the Channel; the flood setting from the northward toward the Mull of Galloway. With a W.S.W. wind it will be necessary to keep the Irish shore aboard, after passing the two lights on the Maiden Rocks; or it is possible, in a strong gale from this quarter, that there may be some difficulty in weathering the Isle of Ila.

The North Channel is well lighted, and has many excellent harbours, fit for the largest ships, as Lough Foyle, Belfast Lough, Loch Ryan, Campbelton, Lamlash, &c.; but it is advisable for vessels, if possible, to take those upon the Irish coast, as they can get to sea with southerly and S.W. winds, when it may be difficult to get away from either Lamlash or Campbelton.

After passing Tory Island, do not be too anxious to make southing, but steer well to the westward, if possible; for there is always a very heavy sea and a strong indraught upon the west coast of Ireland, and strong westerly and W.N.W. gales are very prevalent in the winter. Although there are some excellent harbours in the N.W. of Ireland, they may be considered as inaccessible to a stranger, owing to the great difficulty of procuring a pilot in the winter season; every exertion should, therefore, be made to keep off this dangerous and too often fatal coast.

The depth of water, or quality of the soundings in the North Channel, will give little or no indication of the progress of the vessel, so that a good look-out is here the mariner's best safeguard; the coasts on both sides being bold, excepting about the South Rock and Maiden Rock, both of which dangers are well lighted, but require a good berth in passing, particularly the latter.

In running through the North Channel with S.W. winds, every stitch of canvas should be carried that the vessel will possibly bear, as these winds often fly suddenly round to the N.W. quarter; and in that case blow so hard, for twenty-four or thirty-six hours, as to compel a vessel either to bear up for the South Channel, take a harbour, or lie-to in a narrow and dangerous channel for a more favourable wind.

(c.) On proceeding by the South Channel, and thence westward to the Ocean.

If it be intended to persevere in working down the South Channel, it will be the best way to keep the Irish shore aboard by short tacks, should the weather be squally with heavy rain, as the vessel will then have the benefit of the N.W. wind and smoother water, should it fly round to that quarter, as is often the case. In dry or moderate weather there is little fear of a sudden shift of wind; and a vessel, in such case, may make a long board toward the coast of Wales. Should it come on to blow from the S.W., with much rain, get the Irish coast on board as soon as possible, especially in the winter.

Vessels passing up or down the South Channel with westerly winds will find a strong indraught setting into Caernarvon and Cardigan Bays, as well as into the Bristol Channel; and this may be probably, in some degree, accounted for by the following, and, perhaps, other causes:—Southerly, S.W., and westerly winds prevail over the Atlantic, between the Azores and Great Britain, during eight or nine months of the year, causing the surface-current in this vast space to flow to the eastward; the tides in the neighbourhood of and to some distance westward of Scilly run nine hours out of the twelve to the northward, or into St. George's Channel, which, like the Strait of Gibraltar, has some resemblance in form to the pipe of a funnel; and it is probable that, in gales of winds from the S.W. quarter, there is very little, if any, ebb from the western edge of Channel soundings to a position 15 leagues West from Scilly, and thence to the northward, on the same meridian, until within 15 leagues of the South coast of Ireland: neither do I think it at all unlikely that a portion of the stream of "Rennell's Current," which frequently, as I shall hereafter show, runs with velocity to the N.W., may be diverted by westerly gales into a more northerly direction, and being opposed in its course by the South coast of Ireland, finds its way to the eastward, and thus contributes to raise the level of the water, and make a strong tide or indraught into St. George's Channel.

This stream of tide sets E.N.E. toward the Tuskar, and nearly in the same directoin, or a little more northerly, toward the Smalls, and rushes, with great velocity, past Skokham and Skomar, through the sound, towards St. David's Head, and along the South and East coasts of Cardigan Bay, from whence it diverges toward Bardsey Island; in the sound between which island and the main it runs with great strength.

It is generally advisable to keep the Irish shore aboard in turning down St. George's Channel, with S.W. winds and heavy rain. In the South Channel the lead will impart some idea of the position of the vessel, or, at rate, will indicate, by the depth of water, the probable distance of the vessel from the land. The banks on the Irish coast, between Howth Head and the Arklow Bank, may be safely approached to 20 fathoms of water, and nearer should it be clear weather, which, by-the-bye, is not often the case in this neighbourhood. When near the N.E. end of the Arklow Bank, and from thence to the westward, no vessel should shoalen her water under 28 fathoms, without daylight and constant caution. The lights on these banks require close attention, as they have of late been mistaken, which has led to several alterations in their character, as before noticed. The tides of both flood and ebb run directly over these banks, in a N.N.E. and S.S.W. direction, and in light winds must be carefully attended to.

In beating to the westward, should a vessel shoalen her water on the coast of Wales to 30 fathoms, she will be quite far enough in-shore, and should tack immediately, for it should be recollected that there are 36 and 40 fathoms very close to Bardsey.

Should a vessel be caught with hard N.W. gales upon this dangerous coast, every exertion must be used, by carrying taut well-set sail, to get the ship round the Bardsey, when she will have St. Tudwal's Road (which is well sheltered with westerly winds) under her lee, but a pilot can seldom be obtained here. The fixed light of Bardsey is open to seaward only when it bears from N.E. $\frac{1}{4}$ E. to E. $\frac{3}{4}$ S. Should N.W. winds continue blowing hard, it will be better to run for St. Tudwal's Road, on the North, or to Fisgard Bay, on the South, than to persevere too long in attempting to work out of Cardigan Bay.

Any moderate-sized vessel may find good and safe anchorage in Fisgard Bay, by running in to 2 or 3 cables' length from the *Cow Rock*, on the West side of the entrance, and anchor when the land to the westward of it is shut in, and the rock bears N. by E., distant 4 cable's length. At this anchorage there is full 5 fathoms at low water, over a bottom of stiff clay and mud, which holds remarkably well, and the ship will lie well sheltered with all winds, except those from the North round by the eastward to S.E. by E. or S.S.S. N.E. winds throw in a heavy sea.

The coast in the vicinity of Fisgard Bay is clean and bold, and the bay may be readily distinguished from the offing by the Cow Rock, which is always above water off the western point of the entrance, and by the remarkable appearance of Dinas Head (the eastern point), which, upon an easterly or S.E. bearing, exactly resembles the head of a large gurnet.

Were the advantages of Fisgard Bay more fully known, they would be duly appreciated. When the writer commanded the brig *Freeland*, of Liverpool, that vessel was disabled, by the loss of her sails, in the heavy N.W. gales which prevailed in December, 1833, and was obliged to run into this bay in order to save the vessel from a lee shore; and in this place she lay in safety, at single anchor, with 70 fathoms of chain, during the tremendous gales that caused the Liverpool Lightship to part her moorings, and compelled her to run into the Mersey for shelter.

From what has been stated above, it will be seen that this bay is of easy access and egress, but it should never be used unless in a case of necessity, and then with a good and careful look-out at all times, and everything should be in readiness to trip the anchor at the moment the wind veers to the eastward of North, if the weather be not very moderate and settled.

On weathering the Smalls, when outward bound, it is advisable to keep well to the westward if the wind will permit, so as, on advancing southward, to give Scilly a large berth—say of 18 or 20 leagues.

(*d.*) On proceeding by the South of Ireland, from the Ocean to Liverpool, etc.

In coming from the westward, many navigators endeavour to make the Fastnet Rock and Cape Clear, as it is high land, and has an excellent revolving light. The coast in the neighbourhood is also generally bold. But I do not think this is an advisable plan for a stranger, unless he has obtained good observations a very short time previously; for I have known vessels to be detained several days in endeavouring to work round the cape against strong southerly gales and a N.W. current—unquestionably *Rennell's*.

In two of these cases, one in 1836, and the other in 1839, two different shipmasters ran with confidence for Cape Clear, upon the faith of good observations for latitude, taken forty-eight hours previously, and both made the *Skelligs* on the starboard bow, when steering E. by S., with the wind from the southward and S.S.W., thick weather and rain. When the Skelligs were near, one of these gentlemen considered his vessel to be on the parallel of the cape, and the other (in 1839) thought that he was at least 10 to 15 miles to the southward of it. It may be proper, however, to add that the latter denied the existence of Rennell's Current, until he thus found the effect of it.

In thick, hazy weather, it may be well to run upon the parallel of 51° N., until the vessel gets into 65 fathoms or less water; then steer E. by N. or E.N.E., keeping the lead occasionally going, and be careful not to advance into less than 40 fathoms, when a channel course of E. by S. may be shaped, having constant recourse to the deep-sea lead. By proceeding in this manner, it is probable that the land will be made in the vicinity of Waterford, or about the Saltee Islands. Waterford may be known by its lighthouse on the Hook Point, on the East side of the entrance of the harbour.

A little to the westward of Waterford are the THREE towers, on Great Newton Head, and TWO towers, upon Brownston Head, as described in the *Sailing Directory*. The latter are about 6 miles to the westward of the Hook Point of Waterford, and are too remarkable to be mistaken. The Saltee Islets are 4½ leagues to the eastward of the Hook Point, known by its tower and fixed light. The *Great Saltee* is high, and may be readily known by the Coningbeg Lightship, moored to the S.W. of it. No vessel should attempt to pass between the light-vessel and the land if it can possibly be avoided, the passage between being rocky and dangerous.

The weather is often very thick on the Nymph Bank, with wind from the southward and N.W. quarter, and the Tuskar is, consequently, very difficult to make. The Smalls and Tuskar, on the opposite sides of the Channel, when seen in this thick weather, have often been mistaken for a large sloop with a peaked gaff-topsail set. No vessel should run with confidence up St. George's Channel without previously seeing one or other of the lighthouses on these rocks, or the land in the vicinity, as the tides are hereabout very strong, and hidden dangers abound in the vicinity of both places, as shown by the charts. To the eastward of the Nymph Bank the weather generally becomes a little clearer than upon it.

The course may be safely altered when the Tuskar bears North, and an allowance of one point or more must be made for the direction of the wind; particularly if blowing from the N.W. quarter, as this wind not only increases the indraught into Cardigan and Caernarvon Bays, but it throws a heavy sea upon the whole line of the coast of Wales northward of St. David's Head.

In running from the *Smalls* toward Holyhead, it is, at all times, advisable to steer a point or more to the *northward* of the direct course, unless there is easting in the wind; and should Holyhead or the South Stack Lighthouse be made upon a bearing to the *northward* of N.E. by E. ½ E., the course should be altered a little, to bring it upon this bearing, otherwise the vessel may find some difficulty in weathering it upon an ebb-tide, if the wind should come out from the N.W. quarter, as there is a strong set (along the land) to the southward into Caernarvon Bay.

The island or rock called the *South Stack*, distinguished by its lighthouse, is very bold, but, with light winds and a flood tide, strangers should give it a berth of 3 or 4 miles, as there is much danger of being set inside the Skerries, if this is not attended to. In light winds and a flood tide steer well to the northward, until the Skerries bear E. by N., then gradually edge away to the eastward, until the lighthouse bears E. by S., distant 2 miles, when the flood tide, with a very little assistance from the wind, will carry a vessel safely to the northward of it.

The Skerries may be approached by a stranger, on the north side, within a mile; and when the lighthouse bears S. by W., steer E. by N. 2 miles, and East 1 mile, or until the upper beacon on Carnel Point comes open to the eastward of the lower one, when the vessel will be clear to the eastward of the Coal Rock. On proceeding thence with a southerly wind, give a small berth to the Middle Mouse, a large rock always above water, and very bold. On steering thence toward Point Lynas, take particular care not to shut up the light if it be in the night. Should the light happen to be shut up, instantly run to the northward or N.N.E. until it opens, and heave-to or stand off and on for a pilot, about 4 or 5 miles to the eastward of the light, or between it and the Great Ormes Head.

In thick weather, after passing the Skerries, and at night if the light cannot be seen, great caution is requisite in order to avoid the Coal Rock, and keep clear of the ebb tide running through the Sound; for, upon an ebb tide, the land between Point Lynas and the Skerries must not be approached within 3 or 4 miles without a commanding and favourable breeze.

Vessels bound to Liverpool should make signal for a pilot immediately after passing the Skerries, as the pilots are very often well to the westward, and keep a diligent look-out; but should no boat be seen, cruise about for one, in the position before stated (between Lynas and the Ormes Head), as the tides here do not run strong; but do not, on any account, run a single mile to the eastward of the Great Ormes Head; for, should thick weather come on, the vessel will be in danger of being upon the West Hoyle or the Burbo Banks, and lost. It sometimes, but rarely, happens, when an unusual number of vessels come up on one tide, that there is no pilot-boat on the Lynas station, but it will only be left for a few hours, and vessels should wait with patience, for *here* a pilot is *sure* to be obtained.

The Liverpool pilot-boats are sloop-rigged, with a square-headed gaff-topsail, painted with a white bottom and black bulwarks, and have their number conspicuously painted on the foresail and mainsail. These boats have no topmast, but when upon their station carry a flag at the mast-head. If in the night fire guns occasionally, hoist a light, and show a torch composed of new rope-yarns, unlaid and saturated with bright varnish, then marled slack upon a stick. This shows an excellent light, which may be seen at a great distance; it is also much better and more noticed than a blue light, from the latter being so frequently used as a signal of recognition by passing steam-boats.

The Liverpool pilots are under very excellent regulations, are exceedingly skilful in their profession, and in point of character and conduct are not surpassed by any similar body of men on the coast of Great Britain.

Although I have before noticed the necessity of an unremitting attention to the lead in thick weather, perhaps I may be excused for adding here, that such attention is of the *greatest importance;* as, owing to the velocity of the tides, it affords the mariner the only certain indication of his safety or danger, and contributes to relieve his mind in some degree from the anxiety he must feel whilst his vessel continus within the limits of this dangerous navigation.

4.—OF SHIPS BOUND ACROSS THE EQUATOR.

To and from the East Indies, etc.

It is probable that there has been more discussion upon the route from the British Islands to the Equator, and on the best meridian for crossing the line, than upon any other passage. And yet the results of these inquiries as to this, the great highway of the ocean, have served to confirm in a great degree the opinions published in the early days of navigation, before any of the modern improvements and appliances had been brought to bear upon navigation.

The directions which were given by *M. D'Apres de Manevillette* in his great "Neptune Orientale," published nearly a century since, might be followed now without losing much, if any, of the advantages which deep study and extensive inquiry into data lately acquired, would give to the shipmaster.

There is only one prominent point elicited, and that has come out of the investigations undertaken in the United States, by the office under Captain Maury, so often alluded to in these pages. It is that a more *westerly* crossing of the Equator than has been advocated heretofore may be pursued advantageously during a portion of the year. As will be evident, this has arisen from looking at the voyage from the opposite side of the Atlantic to that on which almost all previous directions had been composed. The configuration of the land about the equatorial portion of the Atlantic is peculiar, and causes the difficulties of a trans-equatorial voyage. The eastern point of the continent of South America, the "great bugbear" Cape San Roqué, as Maury calls it, and the land about Pernambuco, lying in the strength of the S.E. Trade, and the consequent strong current to leeward which runs past it, were constantly the dread of the older mariners whose ships made so much leeway, and were incapable of sailing on a wind as our modern clippers do. But from the improvements in ships and their rig and management, much that was formerly insuperable is now quite practicable, and many of the difficulties of clearing Cape San Roqué have vanished upon later inquiry. It is upon this fact that Maury bases the greater portion of his arguments for a more westerly crossing of the Equator than had been usually done previously.

The other difficulty, which also combines with Captain Maury's argument, is the intervening belt of calms and monsoons (which extends nearly across the ocean between the trade winds), which have a triangular form, the base lying upon the African coast, between Cape Verde and the Equator, and gradually getting narrower to the westward, as shown in (46.), on pp. 198, 199, and therefore by crossing them well to westward they are traversed in a shorter distance, and their detaining effects are much less experienced.

The great object, then, of all vessels from any port of the North Atlantic, whether on the European or American side, being to clear Cape San Roque, it follows that often the routes are the same from all quarters, and that the Equator is perhaps most advantageously crossed by all at the same point. This generally is the American argument, but, as will be seen presently, it not universally accepted yet. It is probable that as much advantage is gained by making the northern edge of the N.E. Trades at a proper point, as by leaving their southern limit, but this will be discussed hereafter. All these discussions of course refer to *sailing vessels*, those entirely dependent on the peculiar meteorological condition of the localities they have to traverse.

Steam-ships of course are in a different category, and the *shortest* distance is therefore their best route, provided it does not lead them through any adverse influences.

Now the Great Circle route from the Lizard to Cape Horn is probably nearly the best that could be followed, even if it were not the mathematical course. It passes near to the west end of Madeira and the Cape Verde Islands, as is directed for sailing ships, and thence crosses the equator in longitude 31° ¾ W. It almost touches Pernambuco and close to Rio de Janeiro towards the Strait of Le Maire, the total distance being 6988½ miles.

Again, the Great Circle route from New York to the Cape of Good Hope is a good route out or home. It cuts the Equator in 22° W. passing through Ascension and just westward of St. Helena, the distance being 6877 miles.

To steam-vessels there will be no difficulty in following either of these nearest routes, and they will be only modified in sailing vessels by the force of the trade winds, which will make the course through the Trades more southerly than the Great Circle in going southwards.

Although a voyage round either of the great capes—the Cape of Good Hope or Cape Horn—involves a more extended problem than that of the passage over the North Atlantic, with which this book especially deals, yet the difficulties and all phenomena which regulate the whole voyage are encountered north of the Equator, and therefore the discussion of the voyage to the Equator includes the whole difficulties, and what would follow for the South Atlantic is simple and easily followed.

The General Instructions for making the passage from the English or St. George's Channels to the Equator may be very briefly summed up as follows:—

1. From the Lizard or the Tuskar, steer W.S.W. to gain an offing, to longitude 10° or 12° W.
2. From thence steer so as to pass to westward of Madeir.

3. Thence to the west of the Cape Verdes (or inside of them in the spring, December to April).
4. Thence to cross the Equator eastward of 30° W.

(Each of these portions of the voyage will be discussed separately.)

1. Leaving the Channel.

As has been said before, the Great Circle course from the start to Pernambuco, commencing S.W. by W. ½ W. (*S.* 37° ¾ *W. true*), carried on for 1220 miles, taking to a point 30 miles west of Madeira, passing 15 miles outside Ushant and 45 miles of Cape Toriñana or Cape Finisterre.

With every circumstance in a vessels favour, this course made good may be followed; but, as will be seen by former discussions, that she will be affected by numerous causes, which generally have a tendency to place her to the eastward of her course, and thus involves her among the dangers of the French and Spanish coasts.

A much more prudent course is at once to make your westing after leaving the entrance of the channel, as time will generally be saved by so doing, and all uncertainty avoided.

Therefore steer to the W.S.W. or S.W. by W. in *fine weather* after passing the Bishop Rock or the Lizard, until the longitude of 10° or 12° be attained. By doing this, the perplexing influence of the revolving tides which occur between the Start and the French coast, page 254, will be, in some degree avoided. Again, the uncertain Rennell's Current, pages 262—272, will less affect a vessel, or if strong, will assist her in making the necessary offing.

But the most important object, in thus early in the passage getting to westward, is to avoid the well known indraught into the English and St. George's Channels and the Bay of Biscay, see (142.), pages 270—272. This westward tendency of the wind and current would, if not properly estimated, cause some difficulty in weathering Ushant, should the wind become at all adverse, and the strong tides, and dangerous navigation around these projecting headlands, render them very unpleasant neighbours.

It is probable, too, that the wind may veer more to the westward, as you get beyond the influence of the St. George's Channel in drawing it towards its more northern direction; and again, as westerly winds have a tendency to veer to the N.W., if you give plenty of sea room, you can pursue your course a point or two free. With the wind decidedly contrary to making a course to the south of west on reaching the chops of the channel, it may become a question as to how far a more northerly route is advisable.

In a discussion on the Packet Service about 1834, when a western port of Ireland was advocated as a better starting place than Falmouth, Sir Francis Beaufort drew up a comparison of 60 passages made by the Falmouth Packets in contrary winds (30 outwards, 30 homewards), and what would have been the advantage had Cape Clear have been the starting place instead of Falmouth, the desideratum being of course the safe weathering of Ushant and Cape Finisterre. Of course this was previous to the Steam Mail Service, and when then the Falmouth Packets were in a high state of efficiency, that is, from 1826 to 1830. Sir Francis Beaufort constructs the diagrams by laying off the tracks from Cape Clear of the vessels as if sailing with the same wind as that experienced by them in sailing from Falmouth. The average time occupied by the 30 outward packets from Falmouth to lat. 42° 40′, off Cape Finisterre, was 9 days 12 hours, varying from 12 days to 6 days. Had the packets started from Cape Clear, they could have arrived at the same parallel in a mean time of 4 days and 21 hours, thus showing a saving of 4 days 11 hours, or nearly one-half. In the homeward route, the same mode of calculation shows that 4 days 9 hours may be saved in the same manner. Now, as Cape Clear is about the same distance from Madeira as the Land's End, it is clear that a vessel is in no worse position by approaching it. Crookhaven, or some of the harbours on the S.W. of Ireland, will afford her shelter as well as the S.W. of England.

This is said in case the vessel encounters strong head winds which will not allow her to make southing, which after all is the grand object, in order that you may quickly gain the S.E. trade. If the ship will not lay better than N.W. on the port tack, perhaps it is better to make a short board until the wind veers a little either way. If you are well to the westward of Ushant, and the weather moderate, supposing the ship will lay South or S. by W., you may safely stand on to the Southward; but should the weather be threatening, and a westerly gale apprehended, it will be prudent to keep the channel open, rather than by beating to windward, you get past Ushant, and thus embayed on the dangerous French coast, where also the wind is liable to shift close in shore. By keeping the English Channel under your lee, should you not be able to maintain your course, you may then run for some shelter.

2. Passage to Madeira.

When the ship is sufficiently to windward of Ushant or Cape Finisterre, there can be no difficulty in making for Madeira, so as to pass within sight of it to the westward.

Cape Finisterre should be passed at a considerable distance, or, at least, the course should be so shaped as to do so, for fear of the prevalent drift which is frequently powerful along the north coast of Spain, and the effect of the prevalent westerly winds should horse the vessel to leeward and into the Bay of Biscay, which is especially to be avoided. The prominent headlands of the coast of Spain being now marked by a fine system of lighthouses, there is less danger of mistaking the country than there was formerly, as in many parts it is difficult to make out the bays and inlets, and of course it is a most dangerous iron-bound and lee-shore.

By sighting Madeira an opportunity is afforded of testing the rate of the chronometers, as a sufficient interval will have elapsed to gain a sea rate, and having it thus early in the voyage will avoid much uncertainty in the subsequent passage. It may be stated that any point of the island will answer equally for giving a longitude. The table on page 42 will give the position of the most prominent point, or the description and chart hereafter will give further information.

It is better to pass 7 or 8 leagues off Madeira, as the winds are generally steadier, particularly in winter. In November, December, and January, westerly gales prevail, which produce eddy winds and severe squalls near the land, occasioned by the mountains obstructing the regular course of the gales, and besides the weather here is very precarious.

However, notwithstanding all that has been said in former directions as to passing within sight of Madeira and the Cape Verdes, it is a question whether a more westerly course to the equator may not be attended with some advantages. There is some reason to think that the nearer the land the more baffling and uncertain the wind is, and, as its tendency is to the westward, it is argued that some gain of time has been found to arise from crossing the parallel of 30° (as well as the equator) on a more westerly meridian than that of Madeira. The following abstract was made by Lieut. Maury in the former editions of his "Sailing Directory" (in 1855), and showed the number of days (average) that it took from lat. 30° to the equator in the several crossings by 86 vessels:—

East of 16°	24	days from the mean of	6
Between 16° and 17°	23	„	6
„ 17° „ 18°	24	„	14
„ 18° „ 19°	24	„	22
„ 19° „ 20°	23	„	19
„ 20° „ 21°	22	„	6
„ 21° „ 22°	21	„	7
„ 22° „ 23°	18	„	6

Thus, as the place of crossing the parallel of 30° is further and further to the west, so is the average passage thence to the equator diminished. East of the meridian of 19°, the average passage, as far as the data of these tables may be relied on, is about 24 days. To the west of 19° the ratio of decrease as to length of passage, according to this showing, is most rapid.

Now the winds along this route are an exact counterpart of those that are found in the Pacific, on the route from California to Peru, Chili, or Cape Horn: for the for the deserts of Mexico and the United States hold very nearly the same relation to the N.E. trade-winds of the Pacific that the deserts of Africa do to those of the Atlantic; and though quick runs may be made now and then, both along the west American and west African coast, yet, in the long run, experience in the Pacific has amply proved that the navigator saves time by keeping off from the coast, and so I apprehend it will be here. Indeed, experience in the Atlantic goes directly to show the same thing, and to place the opinion almost out of the category of conjecture, for this is the very point upon which the advantages of the new route from the United States to the line are based.

The passage to the line from England and the English Channel ought not, on the average, to be as long by several days as it is from the United States. In the first place, the distance from the Land's End is not so great by two or three days' sail; and, in the next place, the winds are fairer. Vessels bound to the line from any of the Atlantic ports of this country have to sail close hauled most of the way, but from Europe they go free.

If the performance of the ships whose abstract logs I have, and which furnish the data for these tables, be a fair specimen of what ships generally do on this route, and I suppose it is rather above than below, it would appear that the average passage the year round to the line from England and the English Channel is 36 days; the months giving the longest averages, such as they are, being January and March 47 days, August 46, and June 39. The first two are evidently too long, their averages being determined from only two or three passages each. The average to the line from the United States has been brought down from 41 to 31 days; and the average from the British Isles and English Channel can be, I am encouraged to believe, reduced to less than the American average; and the observation, to be contained in the abstract logs that shall be kept for us during the next year or two, will, probably, enable us to decide this question.

In the meantime, the route which I ventured to recommend—not, however, without some misgivings, arising from the want of more ample data—is the same, very nearly, for all vessels from whatever part of Europe.

They should aim, whenever the wind will allow the option, to cross the parallel of 30° N., between the meridians of 25° and 30° W., but should not contend with adverse winds for it; having reached this crossing, their course thence is due south for the line, between the same meridians. In summer and fall they should enter the southern hemisphere about the meridian of 30°, but during the rest of the year they will generally not be forced so far over to the west, though they should not care to go east of longitude 25°.

Vessels from as far north as the English Channel should aim to cross the parallel of 40°, between the meridians of 20° and 25°; and for this reason—besides that of winds a little more propitious—viz.: In crossing the calms of Cancer the navigator wants to be in such a position that he may always be able to go on that tack which will carry him most rapidly across this belt of calms. In other words, he wants to be in that position where it is immaterial to him whether he be making easting or westing, provided he be on the tack which will give him the most southing. For this reason he should aim to enter the calm belt between longitude 25° and 30° W.

The average crossing place of 30°, at present, is about the meridian of 19° W.*

If the comparison of more extended observation and experience should bear out this reasoning, that even a few hours are saved on the average in the trans-equatorial voyage, of course it behoves every commander to follow out this line of procedure; but it will be seen there is some doubt as yet as to whether the advantages of this western route have been fully demonstrated, and we shall give the opinions of others presently on this point.

3. West, or East of the Cape Verde Islands.

If the line of reasoning held by Capt. Maury, as above quoted, be valid, there can

* Maury, 8th Edition, vol. ii., pp. 366, 367.

be no doubt as to which route to pursue, inside or outside the Cape Verdes. But as a large number of vessels have used the inside route, evidently without much detriment to making a good passage, it will require a large amount of experience to subvert entirely the practice as hitherto followed.

We are greatly indebted to our Dutch neighbours for their zealous endeavours to improve hydrography in the direction pointed out in the Brussels Conference. The Royal Netherlands Meteorological Institute and the Meteorological Institute of Utrecht have done good service to the mariner in their excellent publications. The latter office has published a table of the times and crossings of 455 Dutch vessels from the Channel to the line, which we will give presently; but in this they have distinguished those who passed inside from those who went outside the Cape Verde Islands. To this list the Americans have added the sailings of 144 vessels, chiefly probably clippers, so that there is the experience of these 599 vessels to appeal to in the choice of the route in this part of the voyage.

Number of Vessels, Dutch and American, and their average time from the Lizard to the Line, by the passage east and by the passage west of the Cape Verde Islands.

	AMERICAN.				DUTCH.			
	EAST.		WEST.		EAST.		WEST.	
	Days	Vessels	Days	Vessels	Days	Vessels	Days	Vessels
December	29.5	4	27	4	32.1	11	33.6	16
January	28.5	3	31.5	6	31.5	17	31	17
February	27.8	2	28.9	11	35.3	9	32.9	11
Average and sum	28.6	9	29.1	31	32.9	37	32.5	44
March	29.7	3	30.5	6	36.6	5	30.5	15
April	24.2	1	26.1	8	31.8	23	28.7	39
May	32.1	5	31.8	12	33.2	9	32	34
Average and sum	28.7	9	29.5	26	33.9	37	30.4	88
June	36.7	2	29.7	17	32.5	4	33.1	37
July	34.5	3	30.6	9	35.5	4	33.9	53
August	30.2	2	34.5	11	35.4	4	33.8	38
Average and sum	33·8	7	31.6	37	34.5	12	33.6	128
September	42.4	2	33.3	14	36.3	9	36.2	31
October	33.2	4	32	10	32.4	9	32.9	24
November	29.7	3	32	3	36.8	10	36.8	26
Average and sum	35.1	9	32.4	27	35.2	28	35·3	81
Total average and sum	31.5	34	30.6	111	34.1	114	32.9	341

It appears that the passages east are uniformly longer for the Dutch, except in December, June, and October; and that for the American they give the shorter averages for January, February, March, and April; for August and November. But the averages for these are derived from an insufficient number of passages, only two or three, fourteen in all, for each month.

In this table the Dutch outnumber the American vessels, and the outside exceed the inside passages in the proportion of nearly 3 to 1. The Dutch and the outside passages, therefore, give the most reliable averages. Nevertheless, the monthly means for the passage west of the Cape Verde Islands are uniformly in favour of the American vessels, except for January and August, when for January the mean of 17 Dutch passages is half a day shorter than the mean of 6 American; and for August, when the mean of 38 Dutch passages is 18 hours short the mean of 11 American. The general mean of the outside passages for the year, however, is 2.3 days in favour of the American vessels, and one day in favour of those that go outside as against those that go inside of the Cape Verde Islands.

There is a difficulty here in estimating the relative value of the American and Dutch results, as we do not know what the class and sailing powers of the two fleets were; but it is probable that the superiority of the American tracks would not be so great, if the Dutch had selected vessels of an equal class for the comparison. However, it would seem that there is certainly some few hours' detention on the average by going inside the islands compared with the outer passages contained in the foregoing tables.

In many cases, if they are taken singly, or in small groups, we shall find great diversity of result; but it is manifestly futile to endeavour to raise a system, or to subvert a decision, except upon a widely-extended experience. But as to the British passages in westing in this direction, we have no collection of logs recorded and analysed for the purpose of obtaining the best mean result of their various routes. There is no doubt that a very favourable comparison for the eastern route may be shown in numerous individual cases, and yet in others the time consumed has been very much greater.

Thus, Captain Robertson gives the duration of three voyages inside and three outside the Cape Verdes in the same ships, *Simlah*, *Niagara*, *Clyde*, and *Sappho*, between 1851 and 1860. The inside passages were in June and August, and made 37, 27, and 40 days respectively from the Line to the Start—average 35 days. The outside passages, made in November, January, and March, were 22, 20, and 19 days—average 20 days. The same voyages from 20° N. to the Line took 22, 13, and 18 days for the inside passage—average 18 days; and 12, 8, and 7½ days for the outside passage—average 9 days.

The experience of these voyages would incontestably prove that the inside passage is wrong; but, reverting to our first summary on page 392, it shows also that the *seasons* were wrong for selecting these passages. Had they have been reversed, they would in all probability have been more equal, or, perhaps, their superiority might have been reversed. They also demonstrate that the advantage gained by the westerly route is not confined to that part of it North of the Cape Verdes, but is equally shown between them and the Equator; that is, if they be pursued at the wrong season, as is done here.

If the reader will refer to the diagram at page 185, and to the table on page 199, he will see that the belt of calms and S.W. winds is very much more extended to the westward in the northern summer months, and that while the sun is in southern signs it does not appear to be nearly so extended. In fact, during December, January, and February, the westerly African winds are scarcely felt. As these winds are not usually encountered West of 22° or 23° W. during December and April, the passage inside of the Cape Verdes may sometimes be advantageously pursued, but not in June and August.

Captain Sir Edward Belcher, in his outward voyage round the Cape of Good Hope, in the *Samarang*, March, 1843, diverged from the "beaten track," with considerable advantage. His reason for so doing was, that by crossing the Equator 10° or 15° more eastward than is usually done, when arrived in the parallel of St. Helena, he would be many miles to windward of the usual route. "Having always considered the eastern route the preferable, I attempted, on my homeward voyage, in H.M.S. *Sulphur*, to reach Porto Praya direct from Ascension. In this, however, I failed, owing to the occurrence of westerly breezes driving us toward the African coast, until in the parallel of the Cape de Verde Islands, which proved that from the

Cape de Verdes southerly towards the Equator in the month of June favourable breezes without calms might be reckoned upon; and I was reminded that ships coming from Ascension and St. Helena generally make good passages, passing to the westward of the Cape de Verdes. My experience, whilst employed on the African station, taught me that a fair passage from the Cape de Verdes to Sierra Leone or the coast easterly, could always be anticipated, and that no retarding calms are to be met with on the verge of the African soundings. Vessels also from the African coast, seeking Ascension for change of climate, find this remark applicable, and it might be fairly assumed that if we could reach the Equator under light airs and moderate breezes in a less number of days than the average passage to the twenty-fourth degree of West longitude (the increased distance being impeded by many days' calm), and by crossing to the eastward of the tenth degree of West longitude, the westerly current would be avoided, and we should be able to fetch to windward of Ascension, or possibly sight St. Helena, many hundred miles to windward of the 'beaten track. The result proved as was anticipated. Leaving Porto Praya on March 7th, we experienced light and moderate breezes, with *south-easterly current*. Between the 7th and 21st of March, or from Porto Praya to the Equator on the ninth meridian of West longitude, we averaged 81 miles per day, and experienced no more than ten hours' calm. Before the south-westerly breezes quitted us, we had been carried as far as 8° West. After light south-westerly airs, we were enabled, on the 28th of March, by a succession of breezes from the S.E., to pass 150 miles to windward of Ascension, in 9° 44′ E., arriving in Simon's Bay, Cape of Good Hope, on April 25th." —*Voyage of the Samarang*, pp. 7, 8.

This passage, which takes advantage of the easterly Guinea Current (pages 283—288), will be more specially alluded to hereafter. If a West African port should be sought, of course the advantages are on the side of the inner passage; but this, as said above, will be alluded to presently.

As each portion of the passage over the Atlantic is, in a great measure, dependent on the other, it cannot be pronounced on absolutely whether, of itself, one part of a course can be most advantageously pursued in a certain direction. In the next ensuing paragraphs, this yet undecided problem will be considered in connection with the further progress of the voyages.

4. Crossing the Equator.

In 1848, Lieutenant Maury published his Wind and Current Chart of the North Atlantic, upon which he marked the great circle track joining New York and long. 31° W. on the Equator, distance 3,370 miles, and upon this track was the following:—"The distance by the route usually pursued is upwards of 4,100 miles. Outward-bound vessels are recommended to try this route to Rio Janeiro. The tracks of vessels on this chart show the average passage from the United States to the Line to be 38 days, and to Rio 55 days. There is reason to believe that the prevailing wind along the (great circle) route here indicated will be found more favourable—steadier and stronger than they are by the usual route, and the distanc is nearly 1,000 miles less. Hence I respectfully invite the attention of navigators to this route, under the expectation that, by taking it, they will shorten their passage several days."

By the chart on which this note is placed it seems that the practice of the American ships was to run down to westward between 34° and 40° N., and cross the parallel of 60° between 30° and 38° W. Naturally a better course would suggest itself, and the great circle course is that which would stand prominent. Captain Maury having received much encouragement by the adoption of an approximation to this track, to the great advantage to American voyages over the former easterly track, has argued strongly on the advantages that would be gained by the route from Europe being made to cross the Equator on the same meridian (about 30° W.). As this does not appear to be entirely accepted, we will give the experience on both sides in order that the shipmaster may form some opinion as to their respective advantages.

On page 392 is given a table containing the times occupied in sailing from the "Lizard to the Line," inside and outside the Cape Verdes, as composed from the tables drawn up by the Utrecht Meteorological Institute. The following is the table itself,

The upper line of figures for each month are for those which passed to the *westward*, of the Cape Verde Islands; and the second for those which passed to the *eastward*, or inside them.

TABLE *of the Mean Route from the Channel to the Equator from the Passages of* 455 *Dutch Ships.*

Month.	INTERSECTION OF THE PARALLELS OF																				Total.
	45° N.		40° N.		35° N.		30° N.		25° N.		20° N.		15° N.		10° N.		5° N.		Equator.		
	W. lon.	Days	W. lon.	Days	W. lon.	Days	W. lon.	Days	W. lon.	Days	W. lon.	Days	W. lon.	Days	W. lon.	Days	W. lon.	Days	W. lon.	Days	Days
	°		°		°		°		°		°		°		°		°		°		
January	11·5	3·2	14·7	2·6	17·2	2·9	20·	3·2	22·	2·8	24·5	2·7	26·	2·2	24·	2·2	21·5	3·	22·7	6·1	30·8
	11·7	3·6	14·7	3·5	16·5	3·3	18·	2·9	19·	2·7	20·2	2·5	21·	2·2	20·7	2·2	20·8	2·9	23·2	5·7	31·5
February	12·7	4·	15·	3·1	16·2	3·5	18·7	4·	21·7	2·5	24·5	2·5	25·7	2·2	23·5	1·9	21·2	2·6	21·	6·6	32·9
	11·5	5·2	14·5	3·7	15·	2·9	17·5	3·	19·5	2·4	20·6	2·	20·8	2·	19·7	2·2	18·8	4·1	21·3	7·7	35·3
March........	11·2	3·1	14·7	3·2	17·5	2·9	20·2	3·	22·	2·6	24·4	2·2	25·6	2·	23·5	1·9	21·3	2·5	21·7	7·	30·5
	10·7	7·6	14·	2·9	16·	2·4	18·7	2·6	20·	2·3	20·3	2·5	20·1	2·2	19·7	2·3	20·3	3·3	20·3	6·5	36·6
April	11·5	3·8	15·	2·6	17·2	2·3	19·	2·6	21·5	2·4	24·5	2·3	25·7	1·9	23·7	1·9	21·2	3·	23·7	5·8	28·6
	10·5	3·	13·5	2·6	15·7	2·8	17·3	2·5	19·4	2·8	20·8	2·2	21·2	1·7	20·8	2·4	19·5	4·9	23·2	6·9	31·8
May	11·7	4·1	14·2	2·8	16·5	2·8	18·8	2·8	21·6	2·5	24·4	2·2	25·1	1·9	23·2	2·3	19·6	6·4	23·8	4·2	32·
	11·	4·3	14·	2·8	16·2	2·6	17·7	3·1	19·8	2·8	21·	1·9	21·3	2·2	21·	2·9	19·7	5·8	23·	4·8	33·1
June	11·	4·7	13·7	2·8	16·7	2·4	19·	2·6	22·	2·2	24·5	2·	26·	2·2	24·5	3·4	19·	7·1	24·2	3·7	33·1
	10·2	4·6	14·	2·5	16·2	2·3	18·2	2·8	19·6	2·4	20·6	1·6	22·	1·9	21·6	3·1	18·	7·3	23·5	4·	32·5
July	11·2	4·4	14·5	2·8	17·	2·7	19·2	2·4	21·7	2·1	24·5	2·2	26·	2·4	23·3	4·	17·2	6·3	21·8	4·6	33·9
	10·	4·4	12·7	3·4	16.5	2·7	18·5	2·3	19·4	1·9	20·4	2·	20·6	2·4	21·3	4.7	16·3	7·6	21·8	4·1	35·5
August	11·5	4·4	14·2	2·9	16·7	2·8	19·2	2·7	22·	2·1	24·8	2·1	26·	2·4	23·8	3·7	17·2	5·4	20·5	5·5	33·8
	11·2	6·2	13·5	2·6	15·7	2·	17·2	2·4	19·3	2·1	20·6	1·9	21·	2·8	20·7	4·4	14·5	5·	16·	6.	35·4
September	11·7	4·	14·2	2·9	16·2	3·1	18·5	2.8	21·6	2·4	24·5	2·3	26·	2·1	24·	3·4	20·	6·7	21·7	6·5	36·2
	12·	4·3	14·2	3·3	16·5	2·8	18·5	3·2	20·	2·5	21·	2·2	21·3	2·1	21·	3·5	18·	6·2	20·5	6·2	36·3
October	11·7	4·2	15·2	3·4	17·2	2·6	19·5	2·8	22·	2·7	24·6	2·2	25·8	2·2	24·	2·3	22·7	5·5	25·7	5·	32·9
	11·2	4·	15·5	2·7	17·	4·	18·	3·3	19·	3·	20·6	2·	21·	2·1	20·5	2·4	20·5	4·8	25·	4·1	32·4
November	11·5	4·6	14·5	2·7	16·7	2·7	19·2	2·9	21·5	2·9	24·	2·7	25·8	2·5	23·7	2·1	21·5	4·9	23·7	5·5	33·6
	11·2	6·5	13·7	3·	16·5	4·	18·	2·6	20·	2·5	21·	2·	21·4	1·9	20·8	2·1	19·5	4·9	25·2	7·3	36·8
December	11·7	5·	15·	5·	17·2	3·2	19·2	2·7	21·2	2·5	24·2	2·3	25·7	1·9	23·5	1·9	21·2	2·8	22·7	6·3	33·6
	11·5	3.	15·	3·	17·	3·4	19·	3·7	19·8	2·8	20·4	1·9	20·7	1·8	20·2	1·9	19·3	4·	23·2	6·6	32·1

The upper line of figures for each month are for those which passed to the *westward*, of the Cape Verde Islands; and the second for those which passed to the *eastward*, or inside them.

In this table the routes followed are those usually taken by all ships from Europe bound across the Equator, and the mean crossing of the Equator is about 22° 40′.

In the last column, which must speak for itself, the comparative time of the routes East or West of the Cape Verdes is shown. Where they are less for the inside passage is only in June, October, and December. They are about equal in January and September.

The comparison and number of the ships is given before on page 392; but we cannot be entirely satisfied with the result, as in many months the number of ships taking the inside passage is not sufficient to form a conclusion.

The following table is a summary of the information contained in the foregoing Dutch table, to which are added the mean results of the American logs, which are quoted at length in Maury's "Sailing Directions," 8th edition, 1859 :—

Days and crossings from the Lizard to 30° N., and thence to the Line.

	AMERICAN.				DUTCH.			
	To 30° N.		Thence to 0°.		To 30° N.		Thence to 0°.	
	Days.	Long.	Days.	Long.	Days.	Long.	Days.	Lon.
		W.		W.		W.		W.
December	11.9	21.1	15.1	26.5	15.9	19.2	17.7	22.7
January	14.6	18.7	16.9	25.5	11.9	20	19.1	22.7
February	11.8	22.2	17.1	23.7	14.6	18.7	18.3	21
Means	12.8	20.6	16.4	25.2	14.4	19.3	18.6	22.1
Average miles per day	....	106	....	111	....	93	....	97
March	13.1	19.2	17.4	25.5	12.2	20.2	18.3	21.7
April	10.5	20.5	15.6	26.5	11.3	18.7	16.1	23.7
May	12.4	19.5	19.4	24.2	12.5	19	19.5	23
Means	12	19.7	17.5	25.4	12	19.3	18	22.8
Average miles per day	....	112	....	106	....	112	....	101
June	11.2	20.5	18.5	27.7	12.5	19	20.6	24.2
July	10.3	20.7	20.3	25.5	12.3	19.2	21.6	21.7
August	14.8	19.6	19.7	26.1	12.8	19.2	21	20.5
Means	12.1	20.3	19.5	26.4	12.5	19.1	21.1	22.1
Average miles per day	....	112	....	94	....	107	....	85
September	12.1	19.8	20.9	25	12.8	18.5	23.4	21.7
October	12.9	19.2	19.1	27.7	13	19.5	19.9	25.7
November	11.2	20.2	20.8	31	12.9	19.2	20.7	23.7
Means	12.1	19.7	20.3	27.9	12.9	19.1	21.3	23.7
Average miles per day	....	112	....	91	....	104	....	85
Yearly means	12.2	20.1	18.4	26.2	13.0	19.2	19.7	22.7
Yearly avr. miles per day	....	111	....	100	....	104	....	92

This table shows us the effect of seasons as well as of longitude. It also shows that the American ships make better time both before and after they cross 30° N. than the Dutch do; but it does not reveal the cause of this difference, nor indicate whethe the better speed be due to the more westerly track of the Americans or to their superior sailing qualities. It shows, indeed, that in the winter time, and in the winter time alone, both the Dutch and Americans make better time *from* than they do *to* 30° N. Consequently we infer that in winter the north-east trades are more reliable than the "variables" on the polar side of 30°, and the north-east trades are freshest in spring.

Let us pause to review a little more closely the winds, and survey the part of the ocean through which these vessels hold their way.

I am surprised to find the prevailing character of the winds between the Lizard and 30° N. as baffling as they are thence along the coast of Africa to the Line. The American track from the Lizard to 30° N. is a little more westwardly, and we find the winds, as indicated by the average distance made good per day for the several seasons, much more steady by the American than they are by the Dutch track.

Average miles made good per day from the Lizard to 30° N. in each of the four seasons.

	American.	Dutch.	Difference.
Winter	106	93	13
Spring	112	112	0
Summer	112	107	5
Fall	112	104	8

According to the seasons and the average rate of sailing, it appears that the Americans are remarkably uniform; the Dutch not so much so; and this we attribute, without hesitation, to the circumstance that along the American track the winds, if not fresher, are at least less baffling than they are along the Dutch track, which lies, on the average, more inshore.

This is what the pilot charts have indicated, and this is what all our investigations of routes running through this part of the ocean have suggested. But I did not expect to find the prevailing character of the winds between the Lizard and 30° N., nor on the old route thence to the Line, so adverse and unpropitious as they appear to be, for their average force is here expressed by good ships in terms of $4\frac{1}{2}$ knots an hour.

A track still further from the land even than the American; indeed one that leads from the Lizard to the meridian of 23° or 25° W., at its intersection with 30° N., would, I conjecture, take the navigator through a part of the ocean that would give him an average speed of five knots. Though the distance from the Lizard to 30° N. would be eighty miles greater by this route than it is to the present crossing of that parallel at its intersection with 20° W., the time from the Lizard would, on account of both winds, sea and speed, be shortened; and it is this time, not distance, that our researches seek to shorten.

By the above table it is shown that the mean longitude of the American crossing is $26\frac{1}{4}$° W., while the Dutch is $22\frac{3}{4}$° W.; and yet the contrast between their passages is not so great as the difference in the position with regard to the Equatorial calms or "doldrums" would seem to warrant an inference. It may, therefore, be advised generally that the meridian of 26° W. is a good crossing, and that, if further West, it is questionable whether any advantage is gained.

In an able discussion of the logs of several clippers in the "Mercantile Marine

Magazine,"* the same conclusion is independently arrived at. "We have yet to learn if the most favourable crossing be *westward* of 25° W. for English vessels outward-bound to the East. The passage by the *eastward* of the Cape Verdes has been strongly recommended, as shown by the preceding extracts, and it is certainly worth attention that the best passage recorded in that article was made by a vessel (the *Lady Raffles*), which ran down her southing eastward of the Cape Verdes."

Captain H. Toynbee, F.R.A.S., has also discussed the westerly crossing of the Line, as tried by him in his well-known ship, the *Gloriana*.† This voyage was made in October, 1858, and the Line was crossed in 38½° W.

"On the 2nd October, 1858, the *Gloriana* was in lat. 17° 43′ N., long. 26° 29′ W. From this position, being West of the Cape Verde Islands, *I endeavoured to make a true South course* when the wind was fair, and preferred the tack which gave the most southing when it was foul.

"From the 2nd to the 7th we went on well, for on the latter date we were in lat. 7° 29′ N., long. 27° 52′ W., having been driven by the wind and about thirty-eight miles of current eighty-three miles further West. From the 7th to the 15th we had the 'doldrums." Until the tenth, when we were in lat. 6° 25′ N., long 26° 57′ W., the weather was chiefly fine, with a mixture of Northerly and southerly swells; after that, heavy rain squalls, looking very threatening, but not sufficient wind to require the royals to be taken in, with a high southerly swell. During the whole time the wind was from East round by South to West, but chiefly South; the current was generally to the eastward from 11° to 5° N.

"Oct. 15th.—Lat. 4° 8′ N., long. 25° 41′ W.; current in the last 24 hours West, 16 miles; wind S. by W., by compass; variation 17° W. This was the point where I had to decide whether to steer to the eastward, making a little northing, until I considered my ship far enough to windward, or to the westward, making about W.S.W., with the certainty of a westerly current. I chose to go to the westward, feeling sure that the wind would gradually draw to the S.E., whereas I think that had we gone to the eastward we should have continued in the variables, if we did not run back into calms.

"Oct. 16th.—Lat. 3° 15′ N., long. 27° 22½° W.; course and distance, S. 62½° W. 114 miles; current in the last twenty-four hours, N. 39° E. 12 miles; variation, by azimuth compass, 17° 3′ W., by steering compass, 16° 3′ W. At 10h. a.m. a large ship passed us steering to the eastward, and we lost sight of a barque which was in company, so I suppose that she also went off to the eastward, The wind drew to the South by compass, so that we were able to make true S.W. ½ W. The weather during the last 24 hours looked unsettled, especially in the N.W., where there was lightning; but even when we broke off to W. by N. for an hour I felt that by going on the port tack we were drawing into the S.E. trade.

"Oct. 17th.—Lat. 1° 30′ N., long. 29° 24′ W.; by ✱ lunar, 30° W.; course and distance, S. 48½° W. 162½ miles; current, S. 77½° W. 13 miles. The wind from S. by E. to S.S.E.; the sea smooth and weather very delightful.

"Oct. 18th.—Lat. 0° 52′ S., long. 31° 24′ W., by ✱ lunars 32° W.; course and distance, S. 41° W. 184 miles; current, S. 44° W. 12 miles. The wind from S.S.E. to S.E. by S.

"Oct. 19th.—5h. a.m., lat. per meridian altitude of Sirius, 2° 32′ S.; noon, lat. 3° 15′ S., long. 31° 56′ W.; current, S. 13° W. 8 miles; wind S.S.E. ½ E.; bearing and distance of the Rocas, supposing them to be in lat. 3° 55′ S, long. 33° 44′ W., and taking the mean of the above longitude as my position at noon, S. 38° W. 51 miles. 3h. p.m.—Lat., per meridian altitude of Venus, 3° 33½ S. 3h. 20m., p.m.—Long., per altitudes of the sun, using the London rates for the best chronometer, 33° 10½′ W. Hence, since noon we had made S. 36° W. 25 miles.

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* "On the Passage from England to the Line:" "Mercantile Marine Magazine," Sept., 1855, pp. 328—347.

† See "Nautical Magazine," 1859, pp. 169—177, and 561—563.

"Throughout the afternoon we steered about S. 35° W., and at 5h. p.m. we saw the reef about 12 miles off, extending from nearly right ahead out on the weather bow; and at 6h. we kept away W.S.W., so as to pass it at the distance of about five miles.

"The sighting the Rocas was one of very many instances in my experience proving the look-out man, either from want of practice or from feeling a want of interest in what he was doing, unable to see an object almost staring him in the face. From 3h. 30m., p.m., I ordered a regular look-out from fore-topsail-yard, and at 5h. p.m. felt so sure that the reef must be in sight that I determined to visit the topsail-yard myself; when on stepping into the rigging something strange caught my eye, which proved to be a beacon on the western part of the reef; yet from the topsail-yard the look-out man had seen nothing, and could hardly see it when I pointed it out. A similar case happened one evening on our way towards Torres Straits, when I sent an officer up to look round as the sun set, though I always kept a man on the fore-topsail-yard. He quickly saw a long line of broken water right ahead, it being part of Lihou Shoal extending further to the eastward than it was laid down either in charts or books. I find that in moderately clear weather, when observations show that the land may be sighted, a good night-glass on the forecastle and a patent lead are first-rate safeguards; indeed, the three L's are all right enough, but much depends on the quality of these said L's."

"Now it remains to be decided how we should have fared if on the 15th we had stood to the eastward, making easting, with a little northing, until we thought ourselves far enough to windward. In our present case we certainly had to tack off America (though it is the first time in my extreme westerly routes that I have had to do so), yet in two days we beat 111 miles to the South and 27 to the East, and cleared the difficulty. It would not be right, however, to tempt ships near reefs and land unless they gain by it; and merely by a comparison of my own voyages of other years at the same season I should condemn this route, for I never did worse from 10° N. to the equator than this year. Once at the very same date I passed between the Cape de Verdes and Africa. Then we were 13 days from 10° N. to the Line, but were not troubled near South America and had a better S.E. trade. This time we were only 12 days, but lost a day near South America. In October, 1852, I passed 10° N. about 2° further East within a day or two of our date, and was only 8½ days to the Equator, which we crossed in 20° W., having been carried into 18° W. by a strong S.W. monsoon, which turned into the S.E. trade without a calm. Still, this probably was an exception, and I should like and shall try to see the logs of some ships which passed through the Doldrums with us.

September 25th, 1856, and October 15th, 1857, I crossed the Equator much in the same longitude as this year—that is, 31° W.; in September passed 25 miles to the westward of Fernando Noronha, and in October still nearer, and both voyages we weathered America with ease. Once in May I crossed the Equator between 28° and 29° W. and could not weather America, *but was much bothered off Cape St. Augustine.*

"Again, from Cape St. Augustine to the Abrolhos, the ships which pass far West do not seem to do so well as those which go far to the eastward. For instance, as I am now writing on the 26th of October, we have done but S. 14° W. 51½ miles, and on the 25th S. 23° W. 85 miles. For all this, one feels inclined to blame the westerly route; at any rate until it is proved that the ships which went to the eastward have done as badly or worse than ourselves.

"The conclusion I am inclined to draw from all this is, that in October when once your ship is so near the Equator as to expect the S.E. trade, and the wind sets in from S. by W. by compass, go on the port tack with the yards sharp up, and keep well full; then the wind is almost certain to turn into the S.E. trade, with beautiful weather. My experience would lead me to say that in October, when you are below 5° N., with a steady S. by W. by compass wind, you have the commencement of the S.E. trade, and should stand boldly on on the port tack; but I am not quite decided as to how a ship ought to steer after passing to the westward of the Cape de Verde, though I think as we have done this year; that is, due South with a fair wind, and the tack on which you make the most southing with a foul; because the probability is, that you will have a S.W. monsoon, which will drive you well to the eastward. If there were not this probability I would have a ship in October steer to get the S.E. trade, or rather the S. by W. wind, in about 20° W., for if she does not get into the latitude of Cape St. Roque quite so soon, I think we shall be in a better position by the time she loses the S.E. trade."

In a subsequent discussion, when Captain Toynbee had procured the logs from other ships of similar class which left the Channel at the same time, the *Gosport*, which was also West of the Cape Verdes on the same day, bore to the S.E. crossing the Equator in 25° W., and reaching 20° S. a week before the *Gloriana*. The *Alfred*, which pursued a similar course to the *Gloriana*, crossing the Line in 32¼° W.; and the *Vernon* and *Octavia*, which passed inside the Cape Verdes, crossed the Line in 25° and 26° W.

"The first question raised is—Was the *Gloriana* right in steering due South on the 2nd when the wind was fair? The *Gosforth's* track says no, she ought to have steered S.S.E. until in 25° W., and then to have made a little easting with the southing whenever it was possible. But the tracks of the two ships (*Vernon* and *Octavia*) which passed East of the Cape de Verde Islands, say on no account go to the eastward of 22° W. This advice is only applicable when the wind is light and variable; of course, if a S.W. monsoon is experienced in these parts a south-easterly course must be followed until the wind draws to the South.

"On looking at these tracks I suppose Maury's correspondent, Captain Windsor, would say that the captain of the *Gosforth* is 'one of those men who are kicked through the world in good luck to keep them out of harm's way,' or how could he have had a run of 184 miles between the 5th and 6th of October, when ships to the right and left of him did but little more than half that distance in the same time? Not being a believer in luck myself, it seems to me that the little easting he made from the 2nd to the 9th placed him in a position by which he was enabled to keep off the coast of South America, and so avoid the light winds from the 24th to the 26th which affected all the ships North of 20° S. Here my *second query* is answered, for we find that the westerly crossing of the Line was not the cause of the light winds we experienced on the 25th and 26th; or, to be more explicit, the ships several degrees East of us suffered from them to the same extent as ourselves.

The *Alfred* and *Gloriana* have given the extreme westerly route a fair trial. They started from 20° N., differing one day in their dates, and on the 23rd of October, after passing Cape St. Roque, the *Alfred* was in the same position as the *Gloriana* had held on the 22nd.

The extreme eastern route between the Cape de Verde Islands and Africa was fairly tried by the *Vernon* and *Octavia*. It is manifestly wrong for the early part of October, for they lost much on the ships which took the western route.

"Considering the positions of the four hindmost ships on the 28th of October, I am inclined to think that the *Gloriana's* is the best, for to get South of the calms and variables near the tropic of Capricorn is more important than to make easting, so much so that when there I choose the tack which gives the most southing. Hence the readers of my last paper on the subject will see that this research proves that we were better off than most of our neighbours, and no doubt the commanders of the other ships will examine this chart with great interest.

"It will be noticed that the *Gosforth's* track ends on the 21st, so that although, where it commenced, she was but a trifle more than half a day in advance of the *Gloriana*, she ended with an advance of seven days. Thus she gained on the *Gloriana*, 6½ days; *Alfred*, 7½; *Octavia*, 8½; *Vernon*, 9½.

"The conclusion I draw from this is, that early in October neither the extreme eastern nor the extreme western route is good. Therefore, a ship should pass West of the Cape de Verde Islands, and then, when the wind will permit, haul to the S.E. when South of them, so as to be about 23° W. when she is 5° N., she should then take the tack which gives the most southing.

"Maury's 'Sailing Directions' support this opinion. The averages he deduces from the table in page 148 of the 2nd vol., dated March, 1859, plainly prove that the extreme western route is a disadvantage in October. And, again, the American part of the table in page 369 shows that ships should not go East of the Cape de Verde Islands in October, though it is contradicted by the Dutch part of the same table, with more ships to take an average from. Still, most of the nine Dutch ships may have passed East of the Cape de Verdes much later in October than the Americans; at any rate sound reason seems to support the middle route, for if a ship works her way to the South in the longitude of the Cape de Verdes she is more likely to get a spirt of the S.W. monsoon, which sometimes blows at this season, and avoids the certain calms of a more easterly course, as also the danger of being detained a day or two near Cape St. Roque by the more westerly route.

"From the end of October to February I would pass East of the Cape de Verde Islands, and perhaps also in March and April. Early in December we took this route, and were on the Equator on the 23rd day from England.

"A few tracks similar to these for each month in the year would soon decide the best route."

With these remarks we close this branch of our subject,—one of great importance to the mercantile interest,—and the application of the physical facts enumerated in our earlier pages.

We leave it to the mariner to decide between the able authorities we have quoted, as to the proper course to pursue, and express a hope, with Captain Toynbee, that we may have at an early day a sufficient number of facts to definitively decide the question as to the best crossing of the equator.

We are unwilling to omit those instructions which have appeared in our former editions, and which have now for nearly a century directed almost all the European shipping; but, of course, what has preceded will supersede them where they differ. Still much is good to the present day, and may be followed advantageously.

M. D'Après de Mannevillette, in his Directions for Navigating from the English Channel to the East Indies, says, "When you steer out of the channel, you ought to shape your course so as to pass Cape Finisterre at the distance of 25 or 30 leagues; this distance," he adds, "will be sufficient, in whatsoever season of the year your voyage may happen: you may, indeed, double that cape still nearer, if circumstances require; but, from its latitude, you should always shape a course for the Island of Madeira.

"Though a sight of that island is not indispensably necessary in this passage, it is proper, however, to gain a sight of that, or of the Island of Porto Santo, that you may be able to keep on your course afterward with greater certainty, whether you pass between the Canary Islands, or leave them to the eastward, as may be judged most convenient."

"In the passage from the coasts of France to the Canaries, you may frequently find differences in your reckoning to the eastward, which arise most probably from the indraught of the currents toward the Strait of Gibraltar: some have made the land on the coast of Africa when they expected to have discovered Tenerife; others have gained sight of Allegranza, off the northern part of Lanzarote, instead of Tenerife; and, though the errors in reckoning may not frequently be so considerable, yet it is safer to be on your guard, when you judge, by your reckoning, that you are in the latitude of these islands, especially in the night-time, or when the want of moonlight, or very thick hazy weather, prevents you from discovering dangers at such a distance as to be able to escape them.

"The differences to westward, though much more rare, are yet not without example; chiefly when the winds have hung contrary for some time after the departure from the ports of England or France.

"Ships are, however, now generally recommended to pass to the westward of the Canary and Cape Verde Islands: it having been found, that, in this route, steadier winds may be expected than those generally prevalent close to or among the islands. On the African coast, W.S.W. and S.W. winds are frequent. The track now generally adopted by ships having chronometers, is that to the westward of all the islands.

"Should it be required to touch at Senegal or Goree, the best course will be, to make the coast of Africa near Cape Blanco, lat. 20° 55'; as there are soundings at 5 or 6 leagues off the coast, and no danger in making the land, either by day or night, provided the lead be kept frequently going: and thus you may steer up to the cape.

"Though it may seem natural enough not to suspect any errors of consequence in your reckoning in so short a passage as from the Canaries to the Isles of Cape Verde, yet there are instances of such, as well to easting as to westing. It is with respect to errors in our westings, that I advise all vessels to keep 30 leagues to windward of Bonavista, before they stand in to make the land; lest, in keeping a direct course for that island, they should pass between the Isle of St. Nicholas and the Isle of Sal; and, finding themselves to westward of Bonavista, when they reckoned themselves to be still to eastward of it, they should miss their refreshments at the Isle of St. Iago, an accident which has happened to several vessels.

"The making of these islands is often difficult, occasioned by the fogs which hang frequently around them. For this reason, those who come from the northward, ought to steer their vessels in this track with all possible precaution.

"The most convenient course for vessels, which continue their voyage from the Canaries, without touching at the Islands of Cape Verde or Goree, is to steer, after they lose sight of the Canaries, so as to pass about 45 leagues west of Cape Blanco, or near the meridian of 20°; from this position they will make good their course due South, as far as to 12° N., and afterward S.E. by S., till they meet with those variable winds which succeed to the trade-winds. By this they will keep the mid-channel between the islands and Cape Verde, and coast along the bank below that cape, at a sufficient distance, even though they should make an error in their reckoning of 15 or 20 leagues to eastward."

But as, when the sun is near the northern tropic, the trade-wind has been often found to fail within sight of the Cape Verde Islands, it has been recommended to ships, at these times, to pass the islands to the westward, at the distance of about 10 leagues, in order to preserve a steady wind, and prevent delay, by keeping clear of the light eddy winds, which then prevail near and among the islands. When to the southward of these isles steer to the S.E., so as to get between the meridians of 18° and 23° W., upon losing the N.E. trade-wind. Should the southerly winds then commence, advantage may be taken of the shifts to stand on the tack which will gain most to the southward, so as to cross the Equator between the longitudes above mentioned, if the wind will permit. Be cautious of making a long tack, either eastward or westward, with a dead southerly wind, in hope of having a better, unless the wind should veer, so as to produce much southing.

The S.E. trade-wind, at its northern limit, generally inclines far to the southward, particularly in July, August, and September, but frequently in other months. A ship meeting this trade, should not be kept too close to the wind, but keep clean full, in order to make good way to the S.W., and clear of the southern limits of the westerly current that generally prevails about the Equator.

It has been already shown, in the description of currents, that ships, passing the line too far to the *westward*, run the risk of not being able to weather the coast of Brazil. But *M. D'Apres* has observed, that there is not one instance to prove that, by passing the Line to the *eastward* of the limits above mentioned, ships meet with calms of a long duration, and currents setting with great rapidity toward the River Gaboon, as had before been generally imagined.

M. D'Aprés adds, "Vessels which sail from St. Iago should steer S.E. as far as the

12th degree of latitude: after that S.E. by S. Those which depart from Goree should steer S.S.W., if they desire to keep clear of the coast, till they reach the parallel of 10 degrees; thence their course should be S.E. by S."

His words on crossing the Line are, "When the variable winds succeed the trade-winds, the best method of crossing the Line with speed is, to take advantage of the very first variable winds, for gaining the ordinary track of the trade-winds so soon as you possibly can; and for this end, to keep indifferently to that tack which bears most to southward, without troubling yourself about crossing the line at any determinate point, lest you make your voyage longer than is necessary.*

ON THE RETURN TOWARD ENGLAND, the Equator should be crossed between the meridians of 18° and 25°. When the sun is to the northward of the Line, the longitudes of 21° to 23° are to be preferred; because then light and variable winds extend far from the African coast, especially in July, August, and September, when the sun is returning from the northward.

If the southerly winds become light, a North, or N. by W. course may be kept, in order to reach the N.E. trade-wind as soon as possible; but, if variable light breezes are prevalent far to the northward, you should endeavour to pass the Cape Verde Islands at the distance of between 40 and 50 leagues.

In crossing the N.E. trade-wind, a ship's sails should be kept well filled, to enable her to gain speedily to the northward. In this tract the Sargasso or gulf-weeds will be met with in the SARGASSO SEA, and which are sometimes found as high as 41° N.

Beyond the northern limit of the trade-wind, ships generally cross the parallel of 32° N. in from 39° to 42° W.

Should the wind vere to the N.W. on approaching toward the Azores, you may pass through one of the channels of these islands, and thence pursue a course to the English Channel, according to circumstances.

It is not always advisable to pass to the eastward of these islands, because adverse winds often prevail from the northward between them and the coast of Portugal; and the currents are also generally unfavourable to this route; yet it has sometimes happened, that ships passing this way have, with S.W. and West winds, reached the Channel sooner than those which have proceeded to the westward. With these S.W. and westerly winds, you must be cautious in approaching the Channel, in case the current should prevail, which sometimes sets athwart it, as before described.

5.—ROUTES TO AND FROM THE SENEGAL AND GAMBIA.†

Whatever may be the season of the year, it is advisable to gain an offing of 25 leagues to the westward of Cape Finisterre; from hence it may be immaterial whether a course be shaped to the eastward or westward of Madeira. A commander desirous of touching at the Canaries will adopt the former, and will shape a course

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* Capt. Maury says:—"No sailing directions can be given for these calm belts, except such as are contained in these emphatic words:—"MAKE THE BEST OF YOUR WAY ACROSS THEM WITHOUT REGARD TO LONGITUDE." To which may be added, that nearer to North and South the course is the better, as it crosses their direction at right angles.

† Abridged, chiefly, from the Baron Roussin.

for Tenerife, having nothing to apprehend on this course but the Salvages; the position of which has been well determined. In the Canarian Archipelago the winds are mostly from North to N.E. If the course to the westward of Madeira be adopted, a vessel will make the westernmost of the Canaries only, and her place may be rectified by a sight of Palma or Ferro.

But a sight of the coast of Africa is by no means necessary for vessels bound to the Senegal or Goree. What has been said of the currents and prevailing winds in this navigation, leaves no doubt that it is perfectly useless to make the land more than 15 or 20 leagues to the northward of the Senegal, when bound to the Bar-anchorage. This digression is the utmost which should be made from the above course; and by means of the lead, and some few latitudes carefully observed, it might even be made a direct one. On leaving Tenerife, the course should be S.W. ¾ S. [*S. by W. ¼ W.*] as far as the parallel of 21°, then S. by W. ¾ W. [*South*] as far as 20°, and from thence S. by E. ½ E. [*S.E. by S.*] without any further alteration.

The first course will carry a vessel more than 25 leagues from the nearest point on the African coast, and in a track where no danger hitherto has been found. The second will conduct her 26 leagues to the westward of the westernmost point of the Bank of Arguin. By the third she will make the coast in the neighbourhood of the *Marigot or Lagoon of Mosquitos* (lat. 16° 35½'), from whence she may coast the shore until abreast the Senegal, in 15° 55' N.

If it be found necessary to make the land during the night, the lead, being the only means of correcting the estimated run, should be used frequently and with great care. At about 10 leagues from the shore to the northward of the Senegal, a bottom of white sand will be found, with 70 fathoms. From thence the depth gradually decreases toward the shore, and at 1 mile from it there are 7 or 8 fathoms. When in 15 fathoms of water, it is advisable to anchor until daylight, to avoid running past the bar, which has no distinguishing mark by night.

There is a source of error attached to the navigation of the African coast which must be carefully guarded against. It is the optical illusion caused by the great horizontal refraction, which renders any correct estimation of distance almost impossible. Numerous instances of it might be cited, which would hardly be credited; therefore the moment the coast is seen, the lead only should be trusted, to determine the distance from it.

TRACK FROM SENEGAL TO GOREE.—The *Almadies* of Cape Verde (described hereafter) are 31 leagues S.W. by W. ½ W. [*S. 40° W.*] from the roadstead of the Senegal, and the prevailing currents set nearly on that bearing; it is, therefore, the course to be steered from the Senegal to Cape Verde during the day. During the night steer a quarter of a point more westerly. From Cape Verde to Goree the course is direct. It is merely to coast the shore at the distance of 2 miles. From Cape Verde to Cape St. Mary, at the mouth of the Gambia, the direct course and distance are S. by E. ½ E. [*S.E. by S.*] 30½ leagues, in all which space soundings may be found.

RETURN TO EUROPE.—The voyage from the Senegal to Europe presents no difficulty, and calls for no other precautions than those commonly used in long voyages on seas void of dangers. These precautions are, not to trifle with the wind, but rather to make a good run in a given time, than to endeavour to make good the proposed course. In all return voyages from places within the Tropics, the grand point is to leave the region of the trade-wind and get into the variables, and the currents setting to the eastward, as soon as possible. As the winds generally blow from East to N.W. on the coast of Africa, from the month of December to the end of June, you should keep on the starboard tack until out of their influence. The course made good will be about N.W., and you will then be in the neighbourhood of the Azores. It is immaterial whether you pass to the northward or through the channels of these islands, but it has been remarked that the winds are strongest on the westward. It is seldom possible to pass to the eastward of them. The distance, no doubt, would be shortened; but this passage can be effected only by keeping close to the wind thus far; and experience has proved that, by such procedure, little is to be gained.

6.—DESCRIPTIVE REMARKS AND SAILING DIRECTIONS FOR THE NAVIGATION TO AND OF WESTERN AFRICA.

WITH SOME ACCOUNT OF THE CURRENTS, SEASONS, ETC.; THE RESULT OF EIGHT YEARS ACTUAL EXPERIENCE, IN THE COMMAND OF FOUR DIFFERENT VESSELS, BY CAPTAIN THOMAS MIDGLEY, OF LIVERPOOL, 1837.*

On the PASSAGE from ENGLAND to the Western Coast of Africa, it may be well to make the Island of Madeira and sail to the westward of it if possible; for by so doing the ship will be placed in the best position as to her future course. After passing Madeira, steer so as to leave Palma about 70 or 80 miles to the eastward (if nearer, the ship is liable to be becalmed), and then steer a course to make the N.E. end of Bonavista.—Bonavista requires a good berth, as the currents about it are strong and uncertain, and dangers extend from the North and East sides to a great distance from the land.

In the winter, when strong westerly breezes, of long continuance, prevail to the northward, it may be impossible to make Madeira without much trouble and delay; in this case, endeavour to get a good observation for longitude, or a sight of the Salvages; and, should westerly winds still continue, run boldly to the southward. On nearing the Canary Islands, you will find the wind either gradually decrease to a calm, or it will veer to the northward with heavy squalls. The squalls in this neighbourhood give little warning, but are frequently exceedingly heavy and dangerous. Any ship may very safely run through the passage to the eastward of Palma, as a strong steady N.N.E. or N.E. breeze almost constantly blows through it; and by keeping mid-channel, there is little fear of being becalmed. When clear of the Canaries, a course may be shaped to make Bonavista, as above directed.

The passage between the Islands and Cape Vêrde is generally and very properly adopted by vessels trading to the Western Coast of Africa; for, by running to the westward of St. Antonio, they have again to make easting in that tract of sea which, lying contiguous to the southern limit of the N.E. trade wind, is so often disturbed by calms, squalls, thunder, lightning, and heavy rain.

The currents between the coasts of Great Britain and the Cape Verde Islands are now so well known, that it is almost superfluous to make any further remark upon them, excepting that their velocity is by no means exaggerated; and the dangerous effect which they have upon vessels, between the Bay of Biscay and the Capes Noon and Bojador, on the African coast, cannot be too strongly impressed upon the minds of those who have charge of valuable lives and property.

Those *passing Bonavista* in the months of June, July, August, and September, should not be too anxious to make easting; for they will lose the trade wind soon after passing the parallel of the Island of St. Jago, and, after a short interval of calm, fall in with the S.W. wind and its usual accompaniments of heavy squalls and rain. On the farther progress the vessel makes to the southward and eastward, the S.W. winds generally become variable to the westward, and the squalls not so frequent.

At this season of the year it is advisable to give *St. Anne's Shoals* a berth of 50 leagues to the eastward, as the sea sets in so heavily upon the coast, between these shoals and Cape Palmas, that making southing when near the land, in these months, is attended with much difficulty.

From October, to April or May, the weather in this tract is generally fine, and the nights cool, beautifully serene and clear, with heavy dews; and in these months a more direct track may be pursued from Bonavista to the southward and eastward,

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* In these Remarks, &c., by the late Captain Midgley, as in the other parts of this volume, the courses and bearings are by *compass*, unless where otherwise expressed; and every bearing or direction of the current is intended for the *true*.

than the one above mentioned. In the influence of the trades, the breeze is generally steady from N.N.E. and N.E., and the sea smooth; occasionally, however, interrupted by tornadoes, which, in the neighbourhood of Cape Verga and Sierra Leone, blow with terrible fury. Such is their violence, that it is frequently necessary to keep the ship directly before them, under a foretopmast staysail only.

Between the Cape Verde Islands and the coast, the currents in the above tracks are variable, but mostly found running to the southward, and seldom exceeding 1 mile in hour; generally from ½ to ¾ of a mile, until hauling up for St. Anne's Shoals. At about 40 leagues to the westward of these, I have several times found them setting about E.S.E. by chart, fully 1½ miles in the hour.

The sea between the meridian of 20° W. and the Bank of Soundings extending from the African Coast, is perhaps the most luminous part of the Atlantic Ocean. In the very dark gloomy nights of the wet season, with a strong breeze of wind, and when not one solitary star is visible, nothing can exceed, no pen can describe, the awful grandeur and magnificence of the scene. The whole surface of the sea appears as one vast sheet of liquid fire; and the ship, sailing at the rate of 6 or 7 knots through the water, causes streaks of light to be emitted from the sea, that throw a strong yet sickly and appalling glare upon all the sails, creating an indescribable sensation in the mind, that is very far from being agreeable, as the vessel appears to be surrounded by breakers on every side.

Although I have several times noticed this luminous appearance in the same tract, I am led to remark more particularly upon it on account of a most awful night which I passed on the 24th of August, 1834, in or about lat. 7° 30′ N. and long. 17° 50′ W., which left an impression upon the minds of all on board that I fancy will not be very soon effaced; for the vessel appeared to be sailing through a sea of liquid fire, whilst the heavy dark mass of clouds appeared to rest upon her mast-heads, and not a single star was visible amid the horrid gloom. No bottom was found at 120 fathoms. Temperature of the air 82°, and of the water 79° (Fahrenheit).

Vessels in want of Kroumen should call at *Grand Sestros.*—From some years' experience I can confidently say, that they are the most willing and best disposed men upon the Krou Coast; and, if well used, are faithful to their employer in every difficulty he may have to contend with to leeward. Every vessel should take four or five, or more of them, in proportion to her size; for, in the Oil Rivers, if white men are exposed in the boats or canoes, landing or taking in casks, they very soon fall victims to the climate. The Kroumen prefer rice to any other diet, and a good supply can generally be procured at a cheap rate, except between January and June; but, considering the detention of lying-to, in order to procure it, the rice may be exported from England, for ships' use, at very nearly as cheap a rate. One of the Kroumen is of more real service in the Oil Rivers than two Europeans; they are generally well versed in the English language; and are contented with a dash or present when left at Fernando Po, after the vessel has completed her lading.

On approaching the Krou coast it is usual to hoist the ensign and fire a gun, and the vessel will be soon surrounded by canoes. A small canoe may be purchased for the ship's use for a mere trifle, and will be found extremely serviceable in the rivers.

The navigation between Cape Lahou and the land of Formosa presents no difficulty to the navigator; the currents in the route run to the eastward at 1, 1½, and sometimes 2 knots or more, in the hour. If there be no inducement to call at Bereby, Drewin, or Cape Lahou, for ivory, it will be as well (and will certainly expedite the passage) to shape a course from Cape Palmas for Cape Three Points; and then, giving that land a berth of 5 or 6 leagues, shape a course for the land of Formosa.

In steering across the Bight of Benin, the current will be generally found running about 1 mile an hour to the N.E.; and must be allowed for, by steering one-third of a point to the southward of the direct course.

A mere inspection of the chart will show that what is erroneously called Cape Formosa is, in fact, an elbow land rounding off gradually to the eastward; and regular soundings upon a muddy bottom extend for some considerable distance to the westward and southward of it. The land is here extremely low, and should not be approached in the night nearer than in 8 or 10 fathoms, unless by a vessel prepared to anchor.

After making the land, the oldest and most experienced traders to the Oil Rivers are frequently deceived as to the position of the vessels; for the best description of the rivers from Formosa to Bonny is but vague and imperfect; and I therefore proceed to give such directions as I think, from my own experience, will be found useful to vessels bound to the Bonny or New Calabar River.

The rivers between Terra Fomosa and Bonny have all shoal bars at the entrance, and generally appear from the offing to be narrow. They have no peculiar feature to distinguish them, other than their being open to such points of the compass as are expressed in the Sailing Directions.

SEASONS.—*The Seasons* here appears to have been imperfectly described. The rains generally commence in the latter end of May, or early in June, and gradually increase, with strong S.S.W. and S.W. breezes, during the months of July, August, and great part of September, towards the end of which month they as gradually terminate. In July and August heavy squalls frequently prevail; and in these months the wind very rarely shifts more than between S.S.W. and S.W., and the rain is incessant from sunset to nearly noon next day, when it ceases for a few hours, and again commences with more or less violence in the evening. In October the weather becomes more settled, with light land winds, and occasionally showers of rain, which, however, yield to the moderate sea breeze that sets in about ten or eleven a.m. In November the tornadoes commence, and are at first violent, gradually decreasing in strength as the *Harmattan* or *dry season* commences, although they are occasionally prevalent from this month to May. In December, January, and February, is the Harmattan season; and in these months the sea breeze sets in about noon, and blows with very moderate force from the W.S.W. and westward until sunset, when it dies away to a calm. During the night there is little or no wind, and the weather is extremely sultry and oppressive, and very heavy unwholesome dews. After daylight a light air springs up from the northward or N.N.E, which gradually increases to a moderate force, and continues until about eleven a.m., when it falls calm, and soon after is succeeded by the light westerly breeze. The Harmattan, however, sometimes blows steadily and without intermission from the N.E. quarter for several days together, especially about the new and full moon. It is at this season that the *smokes* prevail, and are exceedingly injurious to the European constitution. These smokes are so dense that it is impossible to see a cable's length from the ship for days together; and any vessels that may be in the offing, inward bound, have no resource but to anchor, and wait with patience for clearer weather. In March, April, and May, the weather is clear, with light land winds at daybreak, which gradually die away, are succeeded by the W.S.W. breeze about ten a.m.; and this breeze blows with moderate force during the remainder of the day and greater part of the night. In these months the atmosphere is serene and clear, particularly during the nights, which are very fine indeed. The palm oil season commences in the early part of March; the oil becomes plentiful in April, and continues to be so until September, when it declines; and from October to March it is, properly speaking, out of season, although small quantities of it may be procured in these months.

In the foregoing remarks as to the seasons and climate, I beg to be understood as speaking of the New Calabar and Bonny Rivers only, and now proceed to consider the best means of preserving the health of the crews of vessels trading there. Masters of vessels should be on their guard against shipping plethoric or lusty men to go to the Oil Rivers of Africa. Drunkards are still worse subjects than these; for if a man undermines his constitution by intemperance in England, he cannot repair it in Africa. I have too frequently remarked that human skill is of little avail in saving the life of a drunkard, when once attacked with the African fever. The fact is, a drunkard is predisposed to sickness, and soon falls a victim to the climate. The plethoric or lusty man, if he has not tampered with his constitution, has a rather better chance; but should he fortunately recover from the fever, he is often annoyed with attacks of ague all the passage home, and does not recover his health until he arrives in England. Thin, raw-boned subjects are the best for the coast of Africa; and they should be selected from men who have made several voyages to the West Indies, as they are, in some degree, seasoned to a warm climate; and those that have never made voyages to a tropical climate should be decidedly rejected. To preserve the health of the crew, the vessel should be housed over as soon as possible after her arrival in the river. Plenty of mats should be procured, and a good, substantial, tight house be at once made, to shelter the crew, and preserve the vessel from the weather. Every care should be taken to make the house perfectly water-tight, as well for the comfort and health of the seamen, as for the advantage of working the palm oil in wet weather. An overstrained economy in the purchase of a few mats is highly reprehensible. The seamen will generally hang hammocks under the house; and, if well sheltered from the weather, will enjoy better health than they would by sleeping below in the steam emitted from the oil. In these rivers it is presumed that the Kroumen do all out-duty required in the boats, &c.; for a European should not be allowed to put his foot over the side, either for the purpose of visiting or going ashore, even on hip's duty (unless unavoidable), as it infallibly leads to dissension and drunkenness from the worst of spirits; and a drunken fit in Africa is the almost sure forerunner of sickness, and probably death.

All vessels should keep a sufficient quantity of English water on board for use in the country, as the Bonny and New Calabar water has an immense quantity of animalculæ, is very unpleasant to the palate, and injurious to the health. Cocoa is an excellent and nutritious article of diet; and the crew should be well supplied with yams, which are the only vegetable, excepting corn and plaintains (the latter not plentiful), that can be procured in these rivers.

If the crew unavoidably get wet, they should immediately rub themselves thoroughly dry with coarse cloths, and put on dry clothes. The forecastle should be frequently cleaned out with a solution of chloride of lime, and the seamen's clothes and bedding kept well aired. Attending to these precautions will be found the best means of preserving health.

Here I may observe that fresh stock of all kinds is very scarce and very dear in these rivers, so that vessels bound to Bonny or New Calabar would do well by procuring their fresh stock and corn to windward, either on the Krou Coast, Frisco, Cape Lahou, the various settlements on the Gold Coast, or at a small village on the sea coast, near Cape St. Paul, called Dokko, or Occo. At these places stock of all kinds is abundant, and very cheap when obtained in barter.

Current.—I have almost omitted putting the mariner upon his guard against the effect of the strong easterly current that runs from Terra Formosa to Old Calabar. This current runs with greater or less velocity almost throughout the year, except in or about the Harmattan season, when it occasionally sets to the westward and W.S.W. Vessels that have advanced much to the eastward of Terra Formosa, and cannot see Foché Point before night, should anchor, in order to prevent the effect of the current; but in squally weather or the weat season it may be as well to work to windward, heaving-to occasionally during the night, according to circumstances; 9 or 10 fathoms is quite close enough to stand in-shore in the night; when in 6 fathoms the surf can be very distinctly heard.

When once to leeward on this coast, getting up to windward again is attended with much trouble and difficulty. I may here remark, that too much attention cannot be paid to the lead upon any part of the coast of Africa, as the current frequently sets directly in upon the land; and from careful observation, upon the windward coast, I can confidently assert that the thermometer is no guide whatever on approaching the land. In more than 100 experiments upon the *surface* water, I could never detect any sensible difference in the temperature when sailing toward the land from no bottom into 45 and 40, and thence close in-shore into 14 or 15 fathoms on the Krou Coast. In the dry season there is little difference hereabout in the temperature of the air and water; the former averaging 77° to 81° (in the shade), and the latter 74° or 75° of Fahrenheit.

Directions.—*The Homeward Passage*, through the Bight of Biafra, presents no particular feature to the attention of the navigator, if I may except the strong N.E. currents that almost invariably prevail in it. All homeward bound vessels that do not intend calling at Fernando Po, should use every possible exertion to pass to the westward of the island, as a good board may be then made to the southward on the starboard tack. Except in the Harmattan or tornado seasons, no advantage can be derived by standing close in-shore, as there are no land winds, and a near approach is, at any time, very dangerous, as the whole of the coast, from Camaroens to the Gaboon (except about Corisco), is generally bold-to, and the soundings in nowise to be depended on. On this part of the coast there is no trade, and the inhabitants are miserable naked savages. On getting to the southward of Prince's Island, the very excellent directions of Mr. Finlaison (given hereafter) may be followed with advantage.

Many navigators have remarked, that on standing to the westward between Prince's and St. Thomas's, even when making a trifle of northing, the N.E. current has been found to diminish in strength as the vessel makes westing. Even so far to the southward as 3° South there is seldom any easting in the wind before passing the meridian of Greenwich.

Vessels bound to the northward should not attempt crossing the Equator to the eastward of 20° W. (the meridian of 21½° W. is to be preferred), and should then make a North or N. by W. course, to get into the N.E. trade wind, which having once fairly gained, the homeward navigation is generally well understood. In this route, after leaving the *Guinea current* in the Bight of Biafra, the ship will gradually get into *Equatorial current* as she gets to the southward, and this current frequently runs with considerable velocity. On examining my journals, I find that, by good lunar observations and an excellent chronometer, I have, at various times, made the following differences to the *westward* of dead reckoning, in the run from St. Thomas's to longitude 20° West of Greenwich, between the parallels of 0° 35′ North and 3° of *South* latitude. In April, 1830, the brig *Anne* was set 237 miles to the westward and 78 miles to the northward of account in 20 days. In October and November, 1831, the barque *Severn* was set 240 miles to the westward, and 94 to the northward of account in 23 days. In October, 1833, the *Freeland* was set 246 miles to the westward, and 51 to the northward of account, in 20 days. In August, 1835, the same vessel was set 228 miles to the westward, and 43 to the northward in 19 days; and in November and December, 1836, the brig *Caledonia* was set 373 miles to the westward and 107 miles to the northward in 18 days. But it may be observed that, in the latter vessel, I never crossed the Equator, but was generally 8 or 10 miles to the northward of it, until I crossed the meridian of 12° W. In the above runs I have occasionally, but rarely, found slight differences to the southward. When to the southward of the Equator, abreast of the Bight of Benin, I have always found a current running at least three-quarters of a mile an hour to the northward.

Directions for Sailing from the Bight of Biafra to Sierra Leone.

By the Late Mr. James Finlaison.

Ships bound from the Bight of Biafra to Sierra Leone, if from Calabar River, when the wind does not permit them to proceed by the N.W. of Fernando Po, may pass between that island and Camaroens River, when they will find a strong current setting to the southward, apparently out of the River del Rey. After they have advanced to the southward of Fernando Po, they must endeavour to make all the southing and westing they can; passing either to the eastward or northward of Prince's Island, as winds will permit. On the East side of this island the current sets strongly to the southward, at the rate of 1½ knots; westward of Prince's Island the current sets strongly to the N.E. at the same rate.

Having arrived at the southward of Prince's Island, if the ship will lie no higher than W.N.W., tack immediately, and try to cross the Line; for, by so doing, you will keep out of the strong N.E. current [the *Guinea Current*] that sets towards the Bights of Benin and Biafra. After you have crossed the Line, you will find that you are nearly out of the easterly current. In the parallel of 1° South you will find the current set to the westward, at the rate of 1 mile an hour. In the month of May or June, when the sun has a high declination, the trade wind is fair to the southward, and you will not gain the regular breeze nearer than in 3° South. This breeze commences from S. by W. As you make westing, the wind will be found to haul more to the southward and eastward, and the current increases to the rate of 1½ knots in an hour, until you arrive as far to the westward as 15° West. On proceeding hence to Sierra Leone, come no further to the eastward than 15° West, until you are as far to the northward as 8° 30′ N.; then you may steer boldly in for the Cape. You will strike soundings in that parallel, in 14° 40′ W.; and as you approach the Cape the soundings will be found very irregular, from 20 fathoms to 12 at a cast. You will then be 7 leagues from the Cape, and in the fair track of the river.

Having given these directions to our prize-masters, they generally made the passage from Fernando Po or Bonny in five weeks; merchant vessels have frequently been three months by keeping in-shore.

By Commander W. B. Oliver, R.N.

Conceiving that a shorter passage from the Bights, or Prince's Island to Sierra Leone, than that made by proceeding as recommended in the Book of Directions, to the southward of the Line, might be made by keeping to the northward, I determined to ascertain the fact; and though each time accompanied and retarded by a prize, made three unusually short passages, viz.—one from the River Bonny, anchoring at Prince's, and landing prisoners at St. Thomas, in 18 days; the other two in 13 days each from Prince's Island to Sierra Leone; and, on returning to England in Her Majesty's schooner, unaccompanied by a prize. Thirty-nine days having been the shortest of three prizes I sent up under the old directions from Benin and the Gaboon. I issued different directions to prize-masters; and, although not acted on, in absence from myself, I feel assured they would have proved, as they did in my company, an improvement on the old one; a copy of which Directions are as follows:—

Your first object will be to get to the southward, unless you can make a West course (*true*) without any northing; nor should you go to the port tack unless you can do so, or to avoid the land. Should the wind hang so much to the westward as to prevent making a good course on the port tack, pass to the eastward of Prince's or St. Thomas, or both, as you will sooner get out of the strong easterly current, but do not approach the land within 20 fathoms, day or night, and get frequent casts of the lead.

When to the westward of St. Thomas, and on or near the Line, steer W. ½ N., or W. by N., according as your noon sights give you a northerly set or not, until in the longitude of Cape Palmas, 7° 45′ W.; when steer, in the rainy season (May to September), N.W. by N.; in the other months, N.W., until in 13° West, the longitude of the western limit of the St. Anne Shoals; you may then make a true North course, sounding every 5 miles by night, or thick weather, and every 10 miles by day, from 6° N. to 8° N. If you reach the latter without striking soundings, it will prove that you have passed to the westward of the Anne Shoals; when keep away E. by N., by compass, to 8° 15′ N.; then steer E. by S. ½ S. (*East, true*), and you will make the high land of Sierra Leone; if by night, anchor on reaching 12 fathoms.

These instructions can only be acted on in a general way, as of course much depends on winds and currents; but I wish them to have full weight with any officer detached in a prize; and remember, the land about Sierra Leone should always be made to the southward of the Cape.

7.—OF SHIPS BOUND TO AND FROM THE WEST INDIES, WITH INSTRUCTIONS FOR NAVIGATING THEREIN.

The courses of these ships are regulated by the winds and currents which have been described in the preceding chapters. The consequence is a circuitous track, requisite to be taken, not only to the West Indies, but to the southern parts of the United States. For, having passed Cape Finisterre, as before described, the best course is then to the S.S.W., so as to gain the trade-winds quickly. The preceding observations on passing Madeira, &c., may, therefore, in this instance, be useful, as well as in the former.

As the great object is to attain the N.E. trade, in order to run down your westing with as little delay as possible, the remarks upon the passage across the Equator will almost apply equally to this voyage: the more especially those given by Capt. Maury as to a *westerly* track from the channel leading through steadier winds, and therefore more particularly applicable to the route across the Atlantic in the Trades, where there is no object in maintaining an easterly position to avoid being driven to leeward of the Brazilian coast.

In confirmation of this view, Captain George Cheveley, of Liverpool, remarks, that he would recommend to ships clearing the English Channel, *if bound for the West Indies*, to make the S.W. quadrant *true*, so as to pass nearly at an equal distance between Madeira and St. Mary's. Captain Cheveley adds, that, by pursuing this track, he has invariably held a steadier breeze, and got much quicker into the trades, than when he proceeded farther to the eastward, and so endeavoured to make more southing. He is aware that the latter is the *general practice*; of which he entirely disapproves, so far as concerns a West India passage.

Ships for Jamaica generally pass to the southward of the Island Montserrat, and thence proceed for the high rock called Alta Vela, off the southern point of St. Domingo, whence they take a departure for the eastern end of Jamaica.* When homeward-bound, they pass either through the Windward Channel or the Strait of Florida, as the wind and other circumstances may prevail or dictate.

Between the months of October and March northerly winds prevail over the Mexican Sea and the adjacent regions; and when northerly winds prevail in the Strait of Florida, the Windward Channel must, of course, be preferred: but, at all other times,—at least, generally at other times,—the quickest and therefore most eligible passage is through the Channel of Yucatan, and thence, with the Florida Stream in your favour, through the Strait of Florida.

Although the Windward Channel appears, by the chart, to be the shorter and readier passage, yet ships are frequently opposed here, both by wind and current; as will appear by the following statement, made by an ingenious officer already quoted:—"After the defeat of the French fleet, commanded by Count de Grasse, in April, 1782, and the British had arrived at Port Royal, in Jamaica, a squadron was detached to gain the Windward Passage, run down the Bahama Old Channel, and cruise to the eastward of the Havana, to prevent a Spanish squadron, in the harbour, from effecting a junction with the French ships that had escaped into Cape François [*Cape Haytien*]. For six weeks did the English squadron beat against fresh sea-breezes and a lee current; and, during that time, never advanced farther to the eastward than off Morant Harbour, though the ships were much strained by carrying a press of sail to attain the object; but, after struggling so long, were compelled to return, baffled, into port. Now, though the first object might have been to meet the Spanish squadron on it way to Cape François [*Haytien*], if it had sailed, yet, so soon as the effect of a lee current was ascertained, the object of gaining the Windward

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* The Americans, who have been much in the habit of going to the West Indies with timber, &c., remark, that when the flying-fish fly in swarms, and are uncommonly small, it is a certain indication of being near the West India Islands.—*And. Livingston.*

Passage ought to have been immediately abandoned, when, by bearing away with a favourable current for some distance, and before a fresh trade-wind, Cape Antonio might have been passed the second day, the squadron have been off the Dry Tortugas on the third, and, by beating along the Florida shore with a weather current, when to the eastward of the meridian of Havana, it could have stretched over to Cuba in the night; and, in all probability, have gained the appointed station in six days, or even, perhaps, as soon as it could have gained Cape Maysi, if the easterly wind had been moderate, and no current to contend with." *

When the trade-wind blows strong, and in frequent squalls, during the summer months, between Jamaica and Hayti, and a short turbulent sea is found eastward of the former, then will those bound for Europe or the United States shorten the period of their voyage by bearing away for the West end of Cuba, and passing through the Strait of Florida. For the strait presents a more eligible navigation in these months than the Windward Channel. The sea-breeze will ensure a quick run to the Channel of Yucatan; and the current, perpetually setting eastward between Cuba and Florida, will, in a few days, carry any vessel into the strait, where it will be nearly impossible to remain much above two days, in the strength of the stream, after being on the parallel of the Bemini Islands, even if there were not a breath of wind.

But as the North winds prevail in the Strait of Florida in October, and frequently during winter, when variable winds and strong land-breezes are not common on the coast of Jamaica, shipping will find this the most favourable period for gaining the Windward Channel. In January or February, if the wind offers a favourable opportunity for gaining the east end of Cuba, this track should be taken; but, if the sea-breeze be strong, the Strait of Florida should be preferred. †

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* "I think that this paragraph, unless qualified, is calculated to mislead; particularly in the words, 'when, by bearing away with a favourable current for some distance, and before a fresh trade-wind, Cape Antonio might have been passed on the second day.' Admitting the general experience of the writer of this passage, I think he states an extreme case. The distance from Port Royal to Cape Antonio is 518 miles; which (divided by 48) equals more than 10¾ miles per hour. Generally, there would be nothing extraordinary in this performance, but I much doubt if it be often accomplished in the locality alluded to, at the time of the year supposed; viz., in the middle of May. Rodney arrived at Port Royal on the 29th of April; it is probable that the squadron was refitted on the 5th of May; allow ten days more for its commander to convince himself of the impossibility of effecting the Windward Passage, and he would have bore up on the 15th; from the inferences I have collected on this head, it appears that the run to Cape Antonio is seldom made in May within a week. In that month of this year [1833] I was ordered from Montego Bay to New Providence: at the former place I consulted some of the most experienced commanders of West Indiamen, whether the most eligible course would be that of Cape Maysi or Cape Antonio: the majority recommended the latter, and I more readily deferred to their advice, from its concurrence with that contained in the extract, the previous consideration of which had occupied my mind.

"*May* 18th, at *six p.m.*, I sailed; the ship, being light, was in most favourable trim; calms, light winds, and moderate breezes, describe the intervening weather, and we did not pass the cape until the 23rd, at *two p.m.*, or in *four days and twenty hours* after leaving port. This solitary instance, however, would not afford a sufficient basis whereon to fix a rule; in its support, therefore, I cite the *Memoir*, p. 226 [10th edition], wherein it appears that the *Carshalton Park*, in May, 1824 and 1826 respectively, was *seven days* in performing the same distance, although skilfully conducted.

"Finally, although the advice, contained in the extract above, is judicious in establishing the advantages of the Leeward Passage, I repeat, that the hopes of making it so speedily as is represented will not often be realized, for the pages last quoted also show, that neither very favourable currents, nor fresh trade-winds, will be experienced upon that track at the season indicated; nevertheless there is the all-important distinction between the passages of *certainty* and *uncertainty*."—*Lieut. W. H. Brady, R.N.*

† In sailing for the Windward Channel, get the coast of Hayti on board as soon as you can, as you may then find a windward current, and, in the evening, the wind off-shore.

When the sun has approached the Tropic of Cancer, strong westerly winds begin to blow along the western coast of Florida, and prevail during the months of June, July, and August, from the Bay of Apalaché, southward. These westerly winds cause fluctuations in the atmosphere, which prevail more about the western end of Cuba than farther eastward; and near the Havanna they have little influence. At this season vessels from Jamaica have met a westerly wind in the Channel of Yucatan; others have experienced a fair breeze at some distance, after passing Cape Antonio; and the wind here will be found sometimes at N.W., West, and S.W., veering about variably.

The wind in the eastern quarter sometimes fluctuates about the western end of Cuba, but not generally.

At this season the wind blows impetuously off Jamaica, and in frequent squalls; and vessels bound thence to Europe should universally prefer the Leeward Passage. They will probably pass through the Strait of Florida before they could gain the entrance of the Windward Channel, though straining, with every effort, against the wind. The *appearance* of a favourable opportunity for passing through that channel should not be suffered to deceive; for it may be no indication of the general state of the wind eastward.

FROM THE WEST INDIES to the ENGLISH CHANNEL, after having cleared the Strait of Florida or Windward Passages, vessels may pass either to the northward or southward of the Bermudas, giving the islands a good offing, and attending to the preceding remarks on currents, &c. (*See page* 282.) In summer, the track to the northward of these isles has been recommended, passing thence to the northward of the Azores. In winter, the track to the southward of the Bermudas is to be preferred; because, in this season, gales of north-westerly wind may be expected from the coasts of America; and, therefore, vessels should continue a little to the southward of lat. 30°, or in about lat. 29° 40′, if wind permits, until certain of being to the eastward of the Bermudas; nor should they run to the northward of lat 35° or lat. 36°, until within a few degrees of the Azores. Thus will the heavy gales be avoided, which frequently rage more to the northward.*

In shaping a course at any season, it should be remembered that the Great Circle course from Cape Florida to the Lizard follows the outer edge of the Gulf Stream in its earlier course, and, passing about midway between the Bermudas and Cape Hatteras, it bears away north-eastward over the tail of the Newfoundland Banks, and reaches the parallel of Scilly on a due easterly course. The vertex of the Great Circle being in lat. 50° and longitude 13° 48′ W., of course its direction is nearly east and West for several degrees on either side of this point. The shortest distance between the Lizard and Cape Florida is 3,671 miles. It leaves the Strait of Florida on a nearly due N.E. course *true* (N. 45° 35′ E.), and reaches the Channel on an E. ½ S. true course.

During a great portion of the year it is probable that this course could be st[illegible] followed to advantage. Of course, the consideration of meeting with cyclones which follow very nearly this Great Circle course toward the N.E. is important, and therefore during their season, July to October, as shown in (82) on page 217, a more easterly route had better be pursued, that is, if the Florida Channel be taken; but if, as is more probable, the windward passage is taken in this season, the Great Circle course thence will be the most advantageous.

But upon this subject Major Rennell has said, "Notwithstanding the advantages to be gained, in point of distance, by ships returning from the West Indies by the favouring current of the *Gulf Stream*, which may be perhaps reckoned equal to

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* As the most destructive hurricanes on record, in this part of the Atlantic, have occurred in the vicinity or on the borders of the Gulf Stream, this is an important reason for ships from the West Indies, bound to Europe, not to advance too far to the northward. See, further, "Voyage from the West Indies to the Azores," attached to the description of those islands hereafter.

several day's ordinary sailing; yet experienced navigators are still of opinion that, on the whole, it does not present equal advantages with the southern route.

"It was, until latter times, held as a maxim not to advance to the northward of the parallel of lat. 33°, in returning from the West Indies, because of the prevalence of storms northward of it. This wise rule of our ancestors has again been taken up, and His Majesty's ships, and of course convoys, will be, in future, directed to proceed by the South of Bermudas, and to cross its parallel at a few degrees to the eastward of the isles, and thence to steer direct for Corvo.

"But, it may be observed, that a track which should cross the parallel of Bermudas at a *very few* degrees to the eastward of it, and then lead directly toward Corvo, would cross a most critical portion of the space, in which not only the warm water of the Gulf Stream prevailed, but in which several gales have been actually experienced. Therefore, it would seem that the parallel of the Bermudas should not be crossed at less than about lat 15° [say lat. 14°] to the eastward of the islands.

"But, it may be asked, Where is the necessity of going to Corvo or Flores at all, for by it ships are placed in a situation proverbially known as a place of storms; that is to say, on the West and N.W. of the Azores? Why not go between *them* and the *greater Azores;* or rather to the southward of them all, and thereby pass through a kindlier climate at all times?

"Any calculation or comparisons of time in making the different passages would be nugatory; since the security of lives and property is the main object; but it even happens that ships, which have had all the advantage of the Gulf Stream, have been crippled, and made more delay than in the southern passage with adverse currents."

On the 17th of July, 1828, H.M.S. *Bustard* sailed from New Providence for England; winds from the southward, and rainy weather. *Found a current setting to the eastward, at an average of nearly three-quarters of a mile per hour, to lon.* 60°. Having passed to the southward of Bermudas, off the Western Islands, had thick hazy weather, with small rain. Winds very variable. On the 11th of August ran into Fayal Roads from the northward, and anchored in 20 fathoms, with the West end of St. George's Island E. by N. ½ N., Castle of Sta. Cruz, situated near the South part of the town of Orta, W.N.W., off-shore about a mile. Supplies may be obtained here at a cheap rate, but the water is rather brackish. Found the longitude of the anchorage, by chronometer, 28° 41′ 30″. The current runs strongly here, and between Pico and Fayal it seemed to set at the rate of nearly three miles in an hour.

Directions for Sailing to and from the West Indies and North America: translated from the "Derrotero de las Antillas," by Captain Livingston.

These advices, or directions, are simple applications of a principle derived from the general prevalence of the winds, as already described.

Were it not for the constant wind from the eastward, which reigns within the tropics, it seems likely that the maritime commerce between the two hemispheres would never have existed; for, by its means, not only are the voyages rendered very simple, which would otherwise be interminable, but people in the most distant regions communicate with facility; and thus the navigator who is bound to the westward has only to place himself within the limits of the general wind, in the certainty that, in this manner, he must effect his purpose in the shortest possible period. Such is the *first* rule, which ought always to be attended to for this navigation.

The *second rule* is derived from the first; it is, that any one, bound to the East from the West, ought to get out of the region of the trade winds into that of the variables or anti-trades.

We have here the two precepts which direct the operation of navigators in extensive seas; and, in attending to them, we shall observe, that every one bound from the Peninsula (Spain and Portugal) to the eastern coasts of America ought to get into the trade winds as soon as may be, holding in mind an advice, which may be considered as a precept, that is, *never, in navigating extensive seas, to keep close-hauled, but always take care to sail with the wind free; or at least to keep seven points from it.*

Taking it as granted that the first care of every one bound to America ought to be to get into the limits of the general wind, it is clear that, with scant winds, the tack in the third quadrant (S.W.) will be most advantageous, and ought to be followed always when it can. All the endeavour ought to be to get into these winds, without being particular as to the means, and without keeping close to the wind to pass between the coast of Africa and the Canaries; but taking the passage that suits best, be it that between the Canaries and Madeira, or be it between Madeira and the Azores; and certainly either of these is preferable to that to the East of the Canaries; for the proximity of the coast of Africa deadens the wind, and, consequently, is unfavourable to the brevity of the navigation.

Having gained the general winds, the navigator must take precautions conducing to prevent any error of situation, in making his port of destination; for, if he who navigates by observations is exposed to be even 10 leagues in error, he who has no more than dead-reckoning to direct him may, probably, be six degrees wrong. It imports much to guard against this error; keeping it in view that, in proportion as it will be easy for any one, making a landfall to windward of his port of destination, to run down to it; so will be the difficulty if he makes the landfall to leeward of his port, in beating up again in a sea wherein both the winds and currents are contrary. Even if bound to the coasts of the United States of America, it will be advisable to run into the limits of the trade winds, in order to get to the westward in as short a time as possible; and although this mode may appear long, on account of having again, after crossing, to augment the latitude, it will be sufficient to keep in view the following maxim, to convince any one of the contrary:—*If in the one way the distance is shorter, in the other the velocity with which the ship proceeds toward her port of destination more than balances it.*

There are, nevertheless, many occasions on which a vessel may run across to the American coast without reducing her latitude, and these occasions may be frequent in the forty or fifty days which follow the two equinoxes, as epochs during which the N.E. winds generally prevail; therefore vessels which, at these times, make their passages, may at once follow their voyage in high parallels, without descending to low ones.

In summer, as the region of the general or trade-winds extends to about lat. 28° 30′ N., it follows that the round about is trifling; and this circumstance ought to be attended to in the calculations which every captain of a ship ought to make before he fixes on the course he will pursue.

Recapitulating what we have said about the course which is most advisable for crossing to the United States, from the coasts of the Peninsula, it follows that, if the winds permit it, West is the preferable course; and, in case the winds will not allow of shaping that course, the most advisable track will be that which comes nearest to it, if the voyage is made at the times above mentioned after the equinoxes; but if at any other time, a course in the third quadrant [S.W.] should be preferred; for this will carry the vessel soonest into the general winds, with which the necessary longitude may be shortly gained.

Vessels bound to Cuba during the rainy season, or season of the South winds, should pass to the northward of Porto Rico and Hayti: but, during the Norths, they ought to go to the southward of these islands. The ports chiefly frequented are, St. Iago on the South, and Havana on the N.W. If bound to the first, it is necessary, in whatever season, to proceed directly to it, that is, in the season of the Norths, to steer from Cape Tiburon, to make some point on the South of Cuba to windward of the intended port, or even to windward of Guantanamo; and, in the season of the Souths, to steer from the Point of Mole St. Nicholas, almost West for the port, marking, in the first instance, various points on the coast of Cuba.

If bound to Havana, in the time of the Norths, you should pass to the southward of Cuba, although you will have to return the distance, between Cape Antonio and Havana; because this inconvenience is not comparable to that which might be occasioned on the North side of the island by a hard *North*, which would not only expose a vessel to heavy risks, but might protract the voyage much longer than the course above described, because the distance in the latter case may be worked up in a short time.

From St. Iago de Cuba, as the coast is clear, a vessel for Europe may easily make her way by the Windward Passages, while all those which are bound from Havana will take the Strait of Florida. The risks in the latter emanated from bad charts and ignorance of the currents: the charts are now rectified, and the current is known.

By the STRAIT of FLORIDA we understand the space inluded between the meridian of the Dry Tortugas and the parallel of Cape Canaveral, The simple inspection of the chart will show this to be a bed or course, which, like a river, conducts the water to the northward. This river, or general current, flows first to the E.N.E. as far as the western meridian of the Double Shot Kays, by which Kays the stream is divided from E.N.E. to N. by E., the direction which it pursues on the parallel of Cape Florida: thence to Cape Canaveral it runs North, with something of an inclination to the East.

As it is undoubted that this general current is cansed by a superabundance of waters, which seek, by this drain, to regain their level in the open ocean, it follows that its rapidity will be greater or less, according to the said superabundance of waters: but, as a change cannot be momentary, on account of the great reservoir in which the water is contained, but progressive, and, of course, slow, we hold that, having once ascertained the velocity of the current, we may calculate it for three days or more, in advance, without much error, if the wind remains in the same direction; for an alteration in the wind may affect the force of the current considerably, as already explained.

On the meridian of the Havana stripes of current are, at times, found setting to the E.S.E. and S.E. from the Tortugas Soundings.* Care should be taken not to confuse the southern differences, caused by this branch of the current, with those caused by the eddy current near the Colorados; the one giving eastern departure, the other West. The distinction is very clear, and can admit of no doubt, because the eddy current is met only from the meridians of Cavanas and Bahia Honda to Cape Antonio, and not farther out from the coast than the parallel of 93°.

As the velocity of the current varies, it is requisite for every navigator to ascertain its strength as frequently as possible, while within the stream. Every one who enters this channel, having marked well either the lands of Cuba or the Florida Reef, so as accurately to establish this point of departure, ought to determine, in his *first day's* work, the velocity of the current by the difference of latitude by account and observation. We say, during the first day's work, because the generality of common navigators make use of meridian altitudes of the sun alone to find the latitude; but it is very clear that *altitudes of the planets and fixed stars ought not to be neglected; not only because by this you cannot be in doubt of your real latitude, but also, because they may be more exact than latitudes deduced from meridional altitudes of the sun, when that luminary passes in the proximity of the zenith, and because these repeated observations, during the night, assure, as much as possible, the situation of the ship.* Thus you may go on, with a clear idea of the operation of the current, and the way that the ship is making. Having ascertained the velocity of the current, use can be made of it to find the ship's departure, and this knowledge will be most important when you fail in obtaining observations for latitude; because, in such a case, wanting a knowledge of the difference of latitude given by the current, you will be in want of everything; but, if you know the velocity of the current, with it and the course which it follows, you may find the difference of latitude and departure which the current

* See p. 2[illegible]1-32 for an account of the Counter Currents.

gives; and which, though it will not give the position of the ship with that precision with which it might be obtained by latitude observed, will still approximate sufficiently to the truth to enable one to avoid danger, if prudence and seaman-like conduct are combined.

For those who have little experience in the art of navigation, we add—

1.—That it is most convenient to direct your course in mid-channel; not only because it is the farthest from danger, but because you will there have the strongest current, which is desirable.

2.—That, as you cannot ascertain, with all necessary certainty, the position of the ship, notwithstanding the rules given to diminish the errors occasioned by the currents, you ought, with the utmost care, to shun the eastern coast of Florida, as being very dangerous, the trade-wind blowing upon it; while there is not the least risk in running along the Salt Kay Bank, and the edge of the Great Bank of Bahama. Upon the latter, also, you meet with good anchorages, very fit to lie in during the hard northerly gales experienced between November and March, and which do not fail to cause many damages, and sometimes even force vessels to bear away, which is always dangerous, for the weather is always thick with such winds, and the worst case will be to run in one of them upon the coast of Cuba, when hoping to have made Havana or Matanzas. Hence, therefore, so soon as there is an appearance of a North, the best way is, if near the Salt Kay Bank, to anchor on it; and, if near the Great Bank, to approach the edge of it, in order to be able to anchor when it may be necessary; for although you may have a hard *North*, so long as you can lie-to in it, you ought to pursue your navigation, as the current will certainly carry the ship through the strait.

3.—It is very necessary to sight the Kays on the Salt Kay Bank, even though you have no fear of a *North;* and there may be occasions in which every exertion should be made to make them; especially if, from want of observations, the situation of the ship is not well known.

4.—When, owing to calms or light winds, a vessel is in danger of being carried through the strait by the current, she ought immediately to approach the edge of the Salt Kay Bank, or of the Great Bank, to descend from it to the coast of Cuba, without trying to beat down the lost ground; for, by doing this, she would only render the being carried through more certain.

5.—Should you involuntarily approach the coast of Florida, you should take extraordinary care to examine whether you have advanced out of the general current and into the eddy. That you may know this, observe, the eddy forms a remarkable and visible line between it and the general current, which line of division is, in many places, out of sight of land; that, in general, you have no soundings on it; and that it shows, not only by the change in the colour of the water, but that also in it, during the greatest calms, there is a kind of boiling or overflowing of the water. From this line of division the water gradually changes colour; so that, near the Florida Kays, it is of a beautiful sea-green, and at last it becomes almost as white as milk.

6.—When in the eddy you have to make the correction of currents on courses entirely different from those in the stream. This is the more necessary to be remarked, because, from ignorance of this circumstance, several have been shipwrecked.

7.—When you enter the channel, or strait, from the Tortugas Soundings, with the intention of passing through, take care to become certain of the land of Cuba, or some part of the Reef of Florida, in order to have a good point of departure; for, although the latitudes and soundings on the Tortugas Bank are more than sufficient to ascertain the place of the ship, yet the variable set of the current toward the Havana may produce a serious error, if not properly attended to. The meridian of the Havana is, in a word, the best point of departure for ships bound to the north-eastward.

On Proceeding to the Windward or Caribbee Islands.

As to choosing the North or South part of any of these isles for making your land-fall, you ought to consider, *first*, which point is nearest to the port or road to which you are destined; and, *secondly*, the season in which you go. In the dry season, it is to be remembered that the winds are generally from the north-eastward, and in the rainy season they are often from the south-eastward. Thus, in the dry season, it is best to make the North side, and, in the wet season, the South, but without losing sight of the first consideration.

There can be no mistake in recognising any of the Antillas; nor, in making St. Bartholomew's and St. Martin's alone, can there be any doubt on seeing at once the eminences or heights of various islands. That this may not mislead any one, they must remember the following instructions:—

When in the parallel of St. Bartholomew's, at less than 4 leagues off, if there be no fog or haze, the Islands of St. Eustatius, Saba, St. Christopher's, Nevis, and St. Martin's, appear plainly.

The mountain of St. Eustatius forms a kind of table, with uniform declivities to the East and West: the top is level; and at the East part of this plain a peak rises, which makes it very remarkable. To the West of the mountain seems to be a great strait, in consequence of the lands near it being under the horizon (or seeming drowned), and to the West of that there then appears, as it were, another long low island, the N.W. part of which is highest; but it is necessary not to be deceived, for all that land is part of the land of St. Eustatius. From this station Saba appears to the N.W.; it is not so high as St. Eustatius, and apparently of less extent than the western part of St. Eustatius, which is seen insulated.

The *N.W. part of* St. Christopher's is also seen formed by great mountains, in appearance as elevated as St. Eustatius, with low land to the East; to the eastward of this low land Nevis will be seen apparently higher than all the others.

The lands of St. Martin's are notably higher than those of St. Bartholomew's; and this island appears also when you are some leagues farther from it than from St. Bartholomew's.

When there are any clouds which hinder St. Martin's from being seen, there may be some hesitation in recognising St. Bartholomew's; and thus it is proper to notice that the latter, seen upon its own parallel, appears small, and with four peaks, trending North and South, and occupying almost its whole extent; and, if you are not more than 8 leagues from it, you will see, also, the appearance of an islet to the North, and another to the South, at a very short distance. As this island has neither trees, high mountains, nor thickets, it is not subject to fogs; and it may therefore be seen oftener than St. Martin's, St. Christopher's, Nevis, St. Eustatius, and Saba; it is therefore advisable to keep its appearance in mind.

At 8 leagues to the East of St. Bartholomew's you may see Nevis, very high; from it to the West the strait called the Narrows, and then the lands of St. Christopher's, appearing to rise out of the water, and which continue increasing in height to the westward, so that the westernmost of two mountains, which are at the West part of it, is the highest. This mountain, which is higher than that called *Mount Misery*, has, to the West of it, a gentle declivity, terminating in low land; and it cannot be mistaken for any other. To the West of this you may also see the large strait toward St. Eustatius; but from this situation you will see only the high S.E. part of that island, or rather, its mountain, in consequence of which it appears like a very small island, while its mountain seems to be lower than Mount Misery; but it is easily known by the *table*, which its top forms, by the uniform declivities to the East and West, and by the peak on the S.E. part of it. Saba seems, from this situation, equal in size to the visible part of St. Eustatius; but it shows only an eminence without peaks, with declivities, and almost round.

If a small islet appears to the West of, and very near to, St. Eustatius, that must not confuse you; for it is the N.W. extremity of that island; and, on getting nearer, you will perceive the land which connects it with the S.E. part. *Mount Misery*, on St. Christopher's, which has a very high and sharp peak, on the eastern part of its summit, seems at a distance to be the summit of Mount Eustatius; but it cannot be mistaken for such, if you attend to its surface being more unequal than the table land at the top of St. Eustatius; and that there is another less elevated mountain to the East, and with gentle declivities, which show much land to the East and West of the high peak.

When you are 6 leagues to the East of St. Bartholomew's, its N.W. extremity appears insulated, and has the appearance of a pretty large island, on the top of which there are four small steps (like steps of stairs, *Escalones*), with a considerable strait to the South, between it and the principal island: in the middle of this strait you may also see a smaller islet: this is really one of the islets which surround the island; but the first is only the N.W. point, to the North of which you will also see some islets: all these are much nearer St. Bartholomew's than St. Martin's.

FINALLY, in navigating from one of the Antillas to another, there is no difficulty, unless you have to get from leeward to windward; yet this will be reduced to a trifling consideration if the passage be made by the straits to the northward of Martinique, in which the currents are weakest; but the same does not follow in the southerly straits, in which the waters set with more vivacity toward the West: and it would be impracticable by the Straits of Tobago, Granada, and St. Vincent, in which the waters commonly run at the rate of not less than 2 miles an hour.

PARTICULAR INSTRUCTIONS FOR THE NAVIGATION OF THE WINDWARD ISLANDS, &c.

It has been remarked, by an experienced captain in the Royal Navy, that for *those bound to Jamaica or to any of the ports in the northern range of islands* (the Bahamas excepted), the safest land to make is the Island of Desirade, near Guadaloupe; for, if you should not see other land before dark, you may haul to the northward, into the latitude of Montserrat, having nearly 60 miles to run on, during the night. Some commanders make St. Martin's or St. Bartholomew's, when bound to Tortola, St. Thomas's, St. Croix, and the islands to leeward; but in this case they should be aware of the dangerous Island of Barbuda, and also of Anguilla; for a small error in the latitude, perhaps, from want of an observation, or irregularity in the current, would place them in a very perilous situation, should they attempt to run on in the night.

Strangers should pass St. Martin's, when they make it, on the North side, the passage between it and Anguilla being clear; St. Bartholomew's, Nevis, St. Christopher's, and Antigua, on the South side. Barbadoes should likewise be passed on the South side, in order to fetch into Carlisle Bay; and Granada and St. Vincent's on the South side. No particular directions are necessary for the other islands, as every seaman knows the danger of running to leeward or past the land;—a very serious occurrence for a dull sailing-vessel.

Vessels on making Barbados and the other Windward Islands, when approaching from the northward, should be very careful not to cross the latitude of the low or northern islands during the night, although their reckoning may be many degrees to the eastward of the isles. The low islands on which so many vessels have been lost, are *Barbuda*, *Anguilla*, *Dog and Prickly Pear*, *Sombrero*, *Anegada*, and its *Horse-shoe Reef*; of all these, the first and last are the most dangerous. Before you see Anegada, in clear weather, Virgin-Gorda, and perhaps Tortola, will be seen very distinctly; distance is often deceiving at sea, and this land, by those not well acquainted with it, has been frequently mistaken for the East end of Porto Rico; and, although directions have been given for avoiding this error, by observing that there is only open sea to the eastward of Virgin-Gorda, and that to the eastward of Porto Rico lie several islands, yet it is necessary to observe that these islands, when the high land of Porto Rico is first discovered, cannot be seen, so that, if you make the land at the close of day, it is proper to be aware of this cirumstance. It may be also remarked, that Anguilla and the Dog and Prickly Pear Isles cannot be seen until some time after you make St. Martin's, which is high land, and lying to the southward of these low isles. Barbuda is not dangerous in the night-time only, but to strangers also in the day, having reefs under water all round, excepting at the extreme S.W. point.

On passing to leeward of the high islands which obstruct the course of the trade-wind, danger arises from strong gusts coming from the mountains, which sometimes dismast a vessel. Be cautious to keep so far from such land as to be able to work your ship, should the wind suddenly shift and blow on the shore, which it often does during the day. When the wind is baffling, you will find it advantageous to keep your course along shore so long as you have steerage-way, although all your sails may be aback, for it frequently happens that the wind comes round to its former quarter before you lose your headway, and by this one ship may get into another current of air, which brings her into a fresh breeze, while another, in company, by altering her course to get her sails full, loses the opportunity of getting into the breeze, and may be detained by calms and baffling winds great part of the day. We have often seen the after-sails filled, with the wind aft, while the headsails were flat aback, with the wind ahead, which continued so long that the foresail was hauled up to continue the headway.

In navigating among the Windward Islands, every precaution must be taken in allowing for the direction and strength of the currents. It has already been shown, in the preceding section, that the general prevalence of them is to the westward, but with different velocities, disturbed at times by the lunar influence, and varied by the contour of the coast, &c. An easterly current is seldom or never found out of sight of land, but N.W. and northerly, in the passages, may generally be found; and it has been remarked that, in some instances, when the current runs to leeward on one side it runs to windward on the other; also, that it may set to windward on both sides, while, at the same time, to leeward in the middle, and frequently the reverse.

The intelligent officer to whose book we are indebted for these observations, says, "In the daytime, attention to the progress you make in getting to windward, by the appearance or bearings of the land, is the best rule you can have, first trying a short tack in-shore, where, if you make little or no progress to windward, your best way is to stand across, and try the other side of the channel; and, if that do not answer, the mid-channel will most likely prove the best; for, although contrary to the general opinion, we have often found it so; much, however, depends on the time of day. In the morning and evening you should endeavour to be near the shore, the North side of the passage in preference, where, if the wind be moderate, and the coast not much exposed to the general trade-wind, you are pretty certain of having the wind two or three points more off the land. In like manner, you should endeavour to be in the offing about one o'clock p.m., as the wind generally blows more on the shore at that time. We have also observed that the land and sea breezes prevail most where the land on the coast is low.

"*Should you be bound to a place to the eastward of you*, and no land in the way, the best tack to be upon is the one on which you will lie up nearest to E. by N., that being the point from which the trade-wind generally blows; when it changes from that point you may consider it a slant of wind, and take advantage of it accordingly—particularly if it veer to the South during the day, or to the North by night; thus it will be found to be advantageous to be on the port tack at night, and the starboard tack by day."

In squally weather the wind is so very variable, that it is seldom possible to take advantage of it in getting to windward.

To windward of the islands and to the North of Barbados, in moderate trade-w[illegible]as, the Equatorial current will be found generally to set in a direction from N.W. by N. to N. by W. at the rate of from half a mile to three-quarters of a mile an hour. As you approach the islands, it becomes more irregular; near to the eastward of *Point Salines*, Martinique, it frequently sets strong to the North, and even N.E. We have also felt this set of the current near to Point Moulacique, the South point of St. Lucia, and have frequently seen vessels bound to Gros Islet Bay, St. Lucia, from Barbados only the night before, driven so far to the North as to have passed the Island of St. Lucia, and also a considerable part of Martinique, before they discovered their mistake; and, being strangers, they had to wait until an observation could be taken to ascertain the latitude, before they could find out their true situation.

In the passages lying nearly in a North and South direction, the current sets generally about N.N.W., until you are past the most northerly land on the eastern side of the passage, when the western current, being no longer obstructed by the land, sets with great strength in a more westerly direction. This is the case in all the passages from Antigua to Hayti, and those on the South between Trinidad and Paria, and on the coast and Leeward Islands from Margarita to Buen-ayre, as the current inside to the South of these islands [in the dry season] sets about N.N.W. ½ W., at the rate of nearly 2 miles an hour. Ships running to westward, inside, should make an allowance for it, and keep a good look out, for it must be borne in mind, as already shown, that the currents here are variable, according to the season.

In order to touch at as many of the Windward Islands as possible, without having to beat to windward;—suppose your vessel to be at Barbados, and you have to call at as many islands as you can, in as little time as possible—from Barbados you can steer for Tobago, hence for St. Vincent's, which is as far to windward as you can fetch; and, with a northerly trade wind, you will not be able to do that. From St. Vincent's you may steer to any of the Granadines, and so on to Granada; and at times you may fetch Trinidad, but this is not to be depended on. From Granada you cannot always fetch St. Kitt's, but in general, the Virgin Islands, St. Croix, St. Thomas's, &c. The general course this way is to go to Tobago, and thence to Trinidad.

Another track is from Barbados (S.W. side) to St. Vincent's (South side), hence to the Granadines and Granada.

From Barbados to the N.W. you may go to St. Lucia, passing round the N.E. point of the island to Gros Islet Bay and the Carccnage; from this place you fetch Fort Royal Bay, Martinique, then St. Pierre, Roseau (Dominica), the Saintes, Basse-terre, and sometimes Point-a-Pitre, Guadaloupe.

From Basse-terre, Guadaloupe, you can seldom weather Montserrat, unless you tack and take advantage of the variable winds under Guadaloupe, which is the best way, if you are bound to Antigua, or to the northward between Antigua and Nevis; but if not, you may pass close to the West side of Montserrat, and so steer for Nevis or St. Kitt's, or to the islands to the westward; or, you may pass on either side of St. Eustatius or Saba, if you can lie round without tacking, and so through the Dog and Prickly Pear or Sombrero passage to the northward.

In steering through these passages, or across them, it is recommended to keep well to windward, as the wind will often head you as you approach the opposite side, and the currents are very strong; and it may be remarked that, in standing to the southward, you feel the force of the current more than when you are standing to the northward.

From these remarks, and a reference to the chart of the islands, it may be readily seen what other track can be accomplished. Thus, from Barbados to Antigua, and the islands to the westward of it, you pass to the eastward of Desirade if you can; if not, between that island and the East point of Guadaloupe; when you are clear of this last point, you have Antigua and all the islands to the westward in your route.

The intercourse between Barbados and Demarary is very uncertain, and you cannot always trust to fetch from one place to the other, even in fast-sailing vessels. From Demerary you can generally weather Tobago; of course, it must always depend on the wind and current; therefore we speak in general terms only. Indeed, we have sometimes seen southerly trade winds continue for a long time, and also northerly winds; and we have seen, owing to N.E. winds and lee currents, vessels from Cayenne not able to weather Barbados, and a vessel from Antigua a month in getting to Barbados, owing to southerly winds.

In working to windward through any of the passages in the night time, it is strongly recommended not to trust to the distance run; for, although you may have an offing of 4 leagues, and you could lie up so as to make a long stretch, yet, before you have gone the distance of your offing, you will probably find it full time to tack from the shore. *In the passages lying nearly East and West,* the western current runs so swiftly, that, in standing to the southward on the port tack, and lying up S.E. by E., you will often find that you have made little or no easting. This has been the case with several vessels leaving the South shore of Antigua; they stood on, lying up S.E. by E., which course they expected to make good, and thought perhaps to weather Point Antigua on Guadaloupe, but the current deceived them, little or no easting had been made, and they ran ashore among the small kays off the Bay Mahaut, Guadaloupe, nearly due South from that part of Antigua which they had left in the previous evening.

When bound to windward it is sometimes difficult to beat through the passages between the islands. Of these passages. the easiest are considered to be between St. Vincent's and Becquia, between Martinique and St. Lucia, and between Antigua and Guadaloupe. The wind, in general, blows a strong breeze, so that a vessel may carry double-reefed topsails, courses, top-gallant sails, jib, and driver. These are the most suitable sails for working the ship in the night, the weather in the passages being too generally squally. If more reefs are out, you will be liable to spring your masts and yards; for, however fine the weather may appear, strong and sudden gusts may come on several times in an hour. Finally, too much sail is hazardous, as the squalls may head you until they blow past, when you come up to your old point; and in this way it is obvious you may run a long way to leeward in carrying sail through a squall.

General Remarks on the Navigation of the Caribbean Sea, from Leeward to Windward, by Lieut. Greevelink.

The best way to beat up in the Caribbean Sea is still an object of dispute among a great many European mariners; there are some, and they form the greatest number, who always prefer the northern part; others who choose to keep in the middle between 14° and 16° of latitude; and a few, to beat up off the southern coast, till they are able to make Antigua, and run out by the channel between that island and Guadaloupe.

The first of these methods, the one generally adopted, is evidently the best; as the South coasts of Hayti and Porto-Rico are tolerably clean, and afford smooth water when the wind is to the northward of East; but in the hurricane months, this part is rendered unfavourable, not only by these dangerous visitors, but also because the currents are then often very strong in the northern channels, whereas they have, at the same time, been observed to be very weak in those southward.

The second route depends, I imagine, more on vague reports of a current setting between those parallels to the eastward; but this will, I trust, no longer be credited, at least, in the tract of sea here described. During the intervals, however, in which light winds are of some duration, the westerly current may be found very weak, as is undoubtedly proved by our passage in April, 1837. (See the entry of that month, "Col. Nav.," vol. iii., p. 26.) Yet this is no reason why a constant weak current, or an easterly one, should be stated when found only occasionally in those parts where they have once been met with.

The third route, by which the hurricanes are generally avoided, has been treated with too much neglect, partly by its being impeded by the Leeward Islands, and partly by the unknown force and direction of currents, and want of local experience of the coast; but hereafter I doubt not but this track will be adopted as the best in those months which threaten destruction in the northern passages, because it is almost universally followed by the coasters and pilots.

Commanders bound from one of the interior parts of the Caribbean Sea, toward the coast of Guyana, generally prefer passing out by the channel of Antigua and Guadaloupe, which is one of the fittest for that purpose with northerly winds; but when, on the contrary, the wind is from the southward of East, I should not advise any attempt to pass that way, but to proceed directly to the North, by the westward of Barbuda, prolonging the stretch well, in order to gain at once, with the other tack, the windward side of the islands. In July, 1836, we laboured for several days to get out of the first-mentioned passage; and in August, 1835, we were happy enough to reach English harbour, though unable to effect our purpose of getting into the main sea, being harassed by south-easterly winds and strong westerly currents.

After having reached the Atlantic, when destined toward the coast of Guyana, it is best to keep your wind, if blowing from the northward of East; as, in that case, it may enable you in one stretch to make the desired port; but, with unfavourable winds, I think it advisable to run straight for the coast, and beat to windward along the bank of soundings. This is most probably attended with less loss of time than the working to the eastward in higher latitude, which may be proved beyond any doubt by comparing some of the many instances which have occurred of vessels falling to leeward of their port of destination, and trying to regain it by making a a long stretch to the northward; when, after fourteen days, they made the coast nearly at the same place: with those of others who effected it completely in only three or four days, in the space mentioned. I know many reports of this sort, but they want sufficient authenticity to be relied on.

As a general remark, it may be kept in mind that to get soundings ought to be the principal object of ships bound to this coast, as, with the present knowledge of depths hereabout, together with an observed latitude, it may show them their place of situation East or West of the intended place very near the truth, because the general tendency of the mud-bank is nearly N.W. and S.E.: and thus, to the eastward of a certain meridian, there will be found more water than to the westward, upon the same parallel.

It is absolutely erroneous to state, that the limit of soundings is marked by the change in the colour of the water; as more than once, and particularly in November, 1834, in 25 fathoms of water, to the N.E. off Marowyne River, the colour was perfectly blue and transparent, and at other times tinged of an ashy hue by the mud.

Bermudas to the Windward Islands, &c.

Mr. Henry Davy, in his description of the passage of H.M,S. *Cornwallis*, between the Bermudas and the West India Islands, with the return toward Halifax, in the winter of 1837, states as follows:—

From Bermuda to Barbados, instead of steering direct, I would recommend a S.E. by S. course. The advantage of this will be apparent, should the trade wind be to the southward of East, and it is also a precaution against a leewardly current.

We left Bermuda on the 26th of November, 1837, and, pursuing the above course until fairly in the trade, anchored at Barbados on the 6th of December. Made the North end of the island at four a.m. at daylight, appearing in a long and very low point. While on the starboard bow Kitridge Point* made equally so, with

* Kitridge Point is the S.E. point of the island.

extensive breakers far out. We rounded the island at a distance of 2 miles, the coast presenting successive low points, encompassed with breakers, and came to anchor in *Carlisle Bay*.

The *Cornwallis* next passed the Granadines, and the lofty summit of Granada became visible at noon of December 10th, as the heavy clouds rolled away to the westward. The ship then proceeded to the anchorage on the S.W. side of Granada. Here, in 15 fathoms, a tide set past the ship to the S.S.W. at the rate of 2 miles in the hour; at midnight the ship tended, and the tide set through to the eastward, at the same rate. At eight a.m. of the following day it again made to the S.S.W., and by ten its rate was 3 miles. This tide renders the spot valuable as a temporary anchorage.

From the information of the harbour-master it appears that, at the springs, the tide here obtains a rate of 4 to 5 knots; that it is strong among the Granadines, at St. Vincent's, and to the southward of Granada toward Trinidad. He was also of opinion that throughout the range of the Caribbean Islands the tides were of more consequence than as hitherto considered; and it appears probable that many of the accounts which reach us respecting the *currents in opposite directions*, often in the same places, may be the effect of *tides*.

At sunset of the 11th of December, the *Cornwallis*, full of troops, set sail for Halifax. Mr. Davy says, "A fine moonlight evening followed; the ship gliding along the western coast, as we shaped a course for St. Kitt's, which I should always recommend to vessels intending to take the Anegada Channel. At sunset, Montserrat, Redonda, Nevis, St. Christopher's, St. Eustatius, and Saba, were in sight. At ten we passed between St. Eustatius and Saba, closing Saba to within 2 miles. When its North point bore West 3 miles, steered N.N.W. for Dog Island and Hat Hay. At half-past three in the middle watch, we made the Dog Islands. At six a.m. Sombrero bore E.N.E., and at eight we were fairly clear of the West Indies, and steering away N.W. for Halifax, with the trade wind at E.N.E. No variation. Thermometer 80°; temperature of the surface water, 78°. From this to the parallel of Bermuda the temperature of the water changed from 78° to 68°. Here, in 33° North latitude, we exchanged the flying fish for the stormy petrel.

The north-westerly winds have a great ascendency at this period, and prevail over every other quarter. I would, therefore, advise making the most of the trade, and steering away N.N.W., continuing to make as much westing as will ensure fetching Halifax with the prevailing wind.

Steam Navigation between Tobago and Demerara.

We take the following from a beautifully illustrated work,* which gives numerous directions for the West Indies:—

"Between *Tobago* and *Trinidad* the current sets strong towards the W.N.W. and W.S.W., almost always at the rate of 2 knots per hour, and not unfrequently 3 or 4 knots.

"After clearing the channel, the stream will generally be found running nearly parallel with the line of coast the whole distance to *Demerara*, though it sometimes takes a more northerly direction, particularly in the months of July, August, and September.

"In shaping a course, therefore, for *Demerara*, vessels should keep well to the eastward of the port, not only to avoid the banks off the mouth of the *Essequibo*, but

* "Practical Observations on the West India Navigation," by a Commander of one of the Royal Mail Steam Packets. London, 1844.

because the objects to the eastward are more remarkable, which is of the utmost consequence on a coast where its features bear one uniform appearance, without a hill, the bearing of which would point out a ship's position; and the land so low that vessels may be aground before it is visible. The *lead* will be found the best guide, as the soundings very gradually decrease, and there is no danger while navigating in 7 fathoms water.

"The most remarkable features of the coast eastward of *George Town* are the *chimneys* of the *boiling-houses*, and a remarkable row of *cabbage trees* about 12 miles from the *lighthouse*. There is also a singular tree about 15 miles from the point of *Corobana*, called *General Murray's Tree*; it is most conspicuous when seen at the termination of a point.

"DEMERARA.—This port should never be taken by a stranger without a pilot; indeed, even those who are most intimately acquainted with its localities, in vessels drawing more than 12 feet water, should always take this precaution.

"In a steam-vessel the navigation is most simple at proper times of the tide.

NAVIGATION TO JAMAICA *viâ* ST. JUAN, PORTO RICO, CAPE HAYTIEN, AND ST. JAGO DE CUBA.

Steamers leaving *St. Thomas's* to perform the *Jamaica* route, *viâ* the north side of *Porto Rico* and *Hayti*, should leave the small islet of *Bergantin* (which is a high rock resembling a ship when at a distance) on their left; and *Montalvan* and *Cabrito* on their right, bearing in mind that a *reef* extends from *Montalvan* a good cable's length.

"After passing *Culebra* and *Culebrito*, I should recommend shaping a course to pass outside a *rock* on which the *Barossa* is said to have struck; for although it seems to be doubtful, yet masters of *Porto Rico* vessels have assured me it does exist. From their statements I am inclined to believe that it is considerably nearer the shore.

"SAN JUAN HARBOUR will readily be distinguished by the *Moro*, which, when first seen, makes like an island having extensive fortification on its summit, rendering it exceedingly remarkable.

"This *Moro Castle* is on the east side of the entrance, and is steep-to within a half-cable's length on its northern side. The position to lie-to for a pilot is about two cables north of the *Moro*, with the ship's head off-shore, taking great care not to drift near the *low rocky island* on the western side of the entrance, which has much foul ground around it; and the current generally setting strong in that direction.

"The harbour is not difficult of access by day, but at times the sea breaks right across the entrance, which calls for the promptest attention at the helm.

"I do not consider it safe at any time to enter this port at night in large ships. Rise and fall of tide, 2 feet.

"From *San Juan* a course should be shaped so as to pass 6 or 7 miles from *Cape Viejo Français* (Hayti), making allowance for a current which sets towards the *Porto Rico* coast, when within the distance of ten miles from the shore. The first land that will be seen on this track (after losing sight of Porto Rico) will be *Cape Raphael*, which is of moderate height, and is the termination of the high land; the coast thence to *Cape Engano* being exceedingly low. *Raphael* may also be known by a small conical hill (*Mt. Redonda*), a short distance inland, which, on coming from the N.W., is seen near the termination of the point.

"The next cape to the N.W. is *Cape Samana*, which makes like an island on many bearings, particularly from the N.W. After passing *Cape Samana*, *Cape Viejo Français* will be seen, which also makes like an island with low points at each extremity.

"CAPE ISABELLA is the next headland, which is very low, and, like *Cape Viejo*

Français, also makes like an island. Between these two capes there is a *remarkable high hill*, sloping down to the water's edge, with a flat summit, and a remarkable *notch* on its extremity when seen from the N.W. This land is *Cape Casrouge*.

"The *Grange* is the most remarkable object, and cannot be mistaken for any other part of the coast if attention be paid to the book of directions.

"Vessels may pass inside the *Monte Christi Shoals*; but as the channel is not well known, I have invariably gone outside, on the principle that a steamer's progress is so rapid through the water, that in a very short period of time after shoal water is descried, the vessel is on shore. Although I have adopted this line of route, I have on former occasions in H.M. ships passed inside, and am well aware that there is a good channel; but a large chart of this portion of the coast should be in possession of the commander before he navigates his ship in doubtful water.

"CAPE HAYTIEN is a high cape, sloping down towards the East, and having a small *rock*, called *Picolet*, at its foot, presenting the appearance of a *white* patch when first seen from the eastward. The water is deep tolerably close to this rock, and it may be approached to the northward without fear.

"I should, however, recommend all vessels to go in at slow speed, with strict attention to the *lead*, as the late earthquake is likely to have changed the face of nature in the bottom of the sea, as well as on the land.

"From *Cape Haytien*, the course should be shaped to pass between the *Tortugas* and *Hayti*, in which channel there is always much less sea than outside, besides being a more direct course.

"ST. JAGO DE CUBA.—This harbour cannot be taken at night, and never even during the day without a pilot, as it is exceedingly narrow, and the greatest attention is required at the helm, owing to the sudden turnings in the channel.

"From *St. Jago de Cuba* to *Morant Point*, I would recommend a course to be shaped (during night-time) 15 miles to the West of the *Formigas*, as I have on more than one occasion experienced a set in their vicinity of half a mile an hour to the N.E. This is by no means a usual occurrence, but, knowing the existence of deviations from the general set of the stream, it is as well to be on the guarded side, more especially as the saving in the distance is very trifling.

"MORANT POINT is very low, with a *lighthouse* upon its extremity having an excellent *revolving light*, which may be seen 16 or 18 miles distant. From the *Point* to the *Keys of Port Royal* it is only necessary to run down about two miles off shore, taking great care at night to avoid the low land about *Cowbay Point*, which is very deceiving.

"*On returning by this route*, the foregoing observations will be equally available. It is, however, perhaps as well to observe, that after leaving *St. Jago de Cuba* great advantage may be gained by keeping about two miles off shore, where there is frequently a weatherly set, and invariably less current.

"In making *Porto Rico* from the westward the land is low, gradually rising to a high chain of hills; thence trending East, it again falls, and then rises to another chain of mountains called *Luquilloe*, which terminate in low land at the eastern extremity of the island. *St. Juan* may be known by its situation between the above two ranges of mountains, and by having on its West side a number of remarkable hillocks in the form of *haycocks*, which are frequently seen before the *Moro* shows itself; but the fortifications are most commonly the first objects descried. I would also caution vessels to be extremely guarded at night, in not mistaking the channel between *Culebra* and *Porto Rico*, which is exceedingly dangerous. The distance run by the ship after leaving *St. Juan* will of course be a good guide, but between August and October the currents are often so variable, that the most careful navigator may be deceived in hazy weather, or at night, as there is under these circumstances a great resemblance between *Culebra* and *St. Thomas's*. The latter, however, if seen before sunset, may be distinguished by its being higher, and making in *three* small *peaks*.

"From the mean of several observations I have found the current along the *Porto*

Rico coast and *Hayti* to the northward to be as follows, though the very unusual state of the weather in the West Indies of late has rendered these very uncertain, and therefore great care should be taken in ascertaining the direction of the stream, always distrusting published accounts.

"Between 18° 29′ North latitude and *Porto Rico*, the current generally sets obliquely on the shore towards the E.S.E. Between 18° 29′ N. and 18° 39′ N. it runs to the E.N.E. To the northward of this latitude the stream takes a more northerly direction, particularly in the vicinity of the *banks* of the *Bahamas*.

"To the distance of ten miles along the *Hayti North Coast* the current frequently runs strong towards the shore, but beyond that distance it takes the direction of the coast.

"During the hurricane months it should be remembered, that the currents are more uncertain than at any other period.

Navigation between Grenada and Jamaica, along the South Side of Hayti to Jacmel.

"Leaving the island of *Grenada*, the current will almost invariably be found setting between W.S.W. and W.N.W., but more commonly in the former direction than the latter. It is generally strongest between December and April, and of least force in the hurricane months; indeed, between July and October, (on reference to former journals,) I find not infrequent sets to the East and N.E., particularly when hurricanes have visited any part of the West Indies; but except in these months it is very rare to find the stream deviating from the W.S.W., W., or W.N.W.

"Alto Vela.—This little island lies about 16 miles S. ½ E. from *Beata Point*, in lat. 17° 28′ 40″ N., and long. 71° 39′ 30″ W., and is directly in the fairway of the steamers coming from *Grenada* to *Jacmel*. It is high, barren, and quite bold close to, and may be seen 25 or 30 miles distant, making in a peak.

"The course from this island (*Alta Vela*) to *Jacmel* is N.W. ½ W., about 67 miles; on which line vessels will make the *Frayles*, which lie about 10 miles from *Beata Island*. They are a cluster of steep *reddish*-coloured *rocks*, and are said to be steep quite close to, though from the imperfect survey of this part of the coast I would advise ships to give them a berth of a mile at least. For the above reason, also, I would not take the channel between *Alta Vela* and *Beata Island*, as scarcely anything is to be gained by it.

"The current most commonly sets very strong to the westward in the vicinity of these islands; but after passing the *Frayles Rocks* a strong S.E. set is frequently experienced, particularly during the night, when the trade does not blow home.

"From *Jacmel* to *Jamaica*, shape a course so as to pass 5 miles clear of the *Isle of Vache*, which is about 8 or nine miles in length, and makes like a group of small islands when first seen, particularly from the westward. The current between this island, and along-shore to *Jacmel*, generally sets to the westward, but when within 5 or 6 miles of the shore, an *easterly* set is frequently experienced, particularly at night.

"The first headland after passing the *Isle of Vache* is called *Abacou Point*, low at its extremity, then suddenly rising to a moderate height.

"The next cape to the westward is *Cape Gravois*, which is very low, the land between being of a moderate and equal height. From this cape to *Tiburon* the land becomes very high. The cape itself (Tiburon) is of moderate height, but a short distance from its extremity it suddenly rises to a high mountain, and when first made from the sea, appears to slope down to the water's edge.

"The *Isle of Saona* is situated at the S.E. extremity of *Hayti*, and is very low, level, and covered with trees. In running past this island, shoal water will be seen some distance from the shore. At night I would recommend running 10 or 12 miles to the eastward of the reckoning, when bound through the *Mona Passage*, as it is the *turning point*, and being very low, ships would be in the reefs before seeing the land, except with clear nights."

Passages between Jamaica and Yucatan, Chagre, Cartagena, Maracaybo, &c.

To the Bay of Honduras; by the late Mr. Johnson Capes, a Constant Trader.

Take your departure from the West end of Jamaica, and steer W.S.W. by compass, until you get into lat. 16° 35′; then run on that parallel till you make the Island of Bonacca, the latitude of which is 16° 30′, long. 85° 47′ West. (The northern and easternmost part of the island is here meant.) Bonacca is a bold high island, and may be made by night, if required; as I do not know of any danger that extends more than 1 or 2 miles off on the North side. Some navigators endeavour to make Swan Islands, but that cannot be of any advantage to them, and is the contrary; for, if you expect to be near them in the night, you get very anxious, as they are very low, and you may run on them before you perceive your danger. I always give them a good berth, that is, keep to the southward; for the current about these islands is very deceiving and uncertain; but, for the most part, sets to the northward and westward. In one of my voyages to the bay, I was set 34 miles to the northward, and 64 miles to the westward, of *account*.

Bonacca ought to be made early in the day, so that you may run down to the middle or West end of Ruatan by the evening, to be ready to take your departure for the Southern Four Kays, at six, seven, or eight o'clock, according to the breeze you have.

If you take your departure from the middle of Ruatan, steer W.N.W. ½ W., making that course good, in order to avoid Glover's Reef to leeward, and on no account whatever run more than 45 miles from Ruatan before daylight; if you run more than that distance, you are in danger of running your vessel on the reef, where there is no possibility of saving her, for in a short time she will be a perfect wreck. At daylight make all sail possible, and if you do not see the kays, you will soon lift them. The principal kay is called Half-Moon Kay, owing to its having a sandy bay, in the shape of a half-moon; on this kay is the Lighthouse, elevated about 50 feet from the surface of the sea; its latitude is 17° 12′ North, and longitude 87° 32′ West. On this kay the pilots live; a set of useful, active, steady, sober men. These kays ought to be made as early in the day as possible, in order to ensure you an anchorage before night.

It frequently happens that vessels, after leaving Ruatan, are becalmed during the night; and, in consequence, they will not make Half-Moon Kay before the afternoon. In this case, I would advise the master to brace sharp up, on a wind, and beat to windward all night, tacking every two hours; for, it is to be particularly noticed that the current sets strongly down on the Southern Four Kays Reef. Several vessels have been lost on this reef, owing to their lying-to; but by keeping the light in sight till morning, it will be sufficient to prevent accident by maintaining your position till you get a pilot, or till you have the day before you.

If it should happen that the pilots are all in Balize (which is very seldom the case), you must make all sail possible. Keep a man at the mast-head, and you will soon discern a kay, called *Hat Kay;* it is about the size of a long-boat, with trees upon it. You may round the reef, within 2 or 3 cables' length, as there is no danger but what you may see, for soundings extend but a short distance from the blue water. After you have rounded the elbow of the reef, steer West, and you will very soon lift the low land of Turneff; at the South end of this marsh is a little kay, called by the pilots *Kay-Bokel*, with several cocoa-nut trees upon it. (Formerly pilots resided on this kay, and now frequently rendezvous here.) You may round this kay by your lead; and, if it be later than three p.m., you must anchor here for the night.

The anchorage is about 1½ miles from the kay, with its bearing E. by S.; but your lead and your eye is the best pilot for this anchorage. You anchor on a fine white sand-bank; the first soundings you will get are about 10 fathoms; run into 3 or 4 fathoms, clueing your sails up as fast as possible, and giving the vessel at least 40 fathoms of cable; for the sand is so hard, that, with a short scope, you will certainly drift off the bank; then you have no bottom. If this should be the case, you must heave up immediately, and make sail again, to get on the bank.

I anchored here one fine night about eleven p.m., let go my anchor in 5 fathoms, gave the ship 30 fathoms of cable; she never looked at it, but drove off the bank. If it had not been a fine night, I should have been compelled to cut from my anchor. I would not recommend any commander to anchor on this ground with a chain cable; at any other part of the bay a chain is preferable. (This bank abounds with fish.) In the morning (if you have not by this time obtained a pilot), get under weigh at daylight, and steer for English Kay.

English Kay is situated on the South side of the channel, and is a small, low, sandy kay, with a few thatched houses on it, entirely shaded with trees. It is distinguished by a flagstaff 60 feet high, for signals, &c. On the opposite side of the channel, that is, on the North side, there is another kay of the same size, called *Goff's Kay*, that has some resemblance of a saddle; at about half a mile to the eastward of which is a little sandpatch, nearly even with the water, called by the pilots the *Sand Bore*. This is the place you must anchor at, for it is impossible for a stranger to proceed any further without a pilot.

In case the current or any other casualty should set you to the northward of Half-Moon Kay, and you fall in with the middle of the Southern Four Kays Reef, I would still recommend you to haul the ship to the northward, and go round the North end. On the North end of this reef is a kay, called by the pilots *North Kay;* after you round this kay, make all sail for Mauger Kay, the northernmost kay off Turneff; after you round Mauger Kay, steer S.S.W., and you will soon lift English and Goff's Kay; then anchor as before directed.

On Returning from the Bay, I would recommend your taking the pilot as far as Mauger Kay, as I have known many vessels run upon Turneff Reefs, owing to their having discharged the pilots at English Kay. Endeavour to leave Mauger Kay at the close of the day, so as to be the length of the Triangles by daylight. There is a very dangerous reef on the West side of the Triangles, that has picked up many ships.

The current, in general, sets rapidly to the westward, by the South end of the Triangles; a ship should, therefore, never attempt to pass to windward of this reef. On approaching the western edge of the Triangles, keep your lead going.

From the channel within Mauger Kay, if the wind is free, steer North; if not, steer N. by E. After you are to the northward of the Triangles, shape your course for Cape Antonio, according to the instructions given in the "Colombian Navigator." From the Triangles the current runs from 10 to 30 miles per day to the northward; this I have ascertained from the mean of twelve voyages.

The Preceding Directions were given by the late *Captain Capes* as the result of many years' experience; but it may be observed that they make no distinction for the *Season of the Norths*, or northerly winds. The following, therefore, from the journals of Capt. *Dunsterville, R.N.*, will be the more acceptable.

Directions for Sailing from Jamaica to Balize, in the Season of the Norths, or between October and March:—

Take your departure from Pedro Bluff or South Negril, keeping near the parallel of 18° N. until you have attained long. 87° W. Should you then get the wind from N.W. or N.N.W., which winds blow very strong, you will fetch Mauger Kay, the northernmost kay of Turneff, on the starboard tack. Keep well to windward, as the currents in these seasons set strongly to the southward.

Should the commander prefer going going in by Half-Moon Kay, which is, to my astonishment, the route of many (because the lighthouse serves as a guide), let it be remembered that the prevailing winds will not, *in this season*, allow you to lay from Hat Kay Reef to Kay-Bokel; and it will also be a dead-beat from thence to English Kay; whereas, on the route prescribed, there is a fair wind direct to English Kay, in a course about S.S.W. 6 leagues. The "Colombian Navigator," which is an invaluable work for these seas, has been led into this error, directed you to make Bonacca in lat. 16° 35′, and those islands which lie contiguous; but these, being surrounded by dangerous reefs, and not surveyed, must perplex the mariner, with a strong southerly current and constant gales from the northward to N.W., and there being no port into which he can enter with safety, except Port Royal, in Ruatan. The latter is a most desirable place when you are in, but the entrance is particularly narrow and intricate between the reefs.

Half-Moon Kay, as already explained, is the S.E. kay of the Eastern Reef, and distinguished by a lighthouse on the East end. To the N.N.W. of this is *Saddle Kay*, about 3 miles distant, with a small clump of trees on it. W.S.W. of Half-Moon Kay is *Hat Kay*, which, with trees thereon, resembles a coronet. To 3 miles S. by E. from this kay extends a dangerous reef, even with the water's edge. The course to clear this reef, from 2 miles South of Half-Moon Kay, is S.S.W. $\frac{3}{4}$ W. about 10 miles. From the reef to Kay-Bokel the course is West, or W. $\frac{1}{2}$ N., according to the wind, 7 leagues.

Kay-Bokel may be known by its cocoa-nut trees, and a fine sandy beach. Rounding it at about half a mile, do not approach nearer, as the ground to the southward is foul. If you wish to anchor, bring the kay to bear from E. by S. to S.E. on a sandy bottom, with 10 to 4 fathoms. Give the ship plenty of chain; otherwise she may drag off the bank.

Should the wind blow strong from the East or N.E., between Kay-Bokel and English Kay, at the entrance of the channel to Balize, steer N.W. by W. 4 leagues. English Kay is sandy on the N.E. part, and is bushy to the water's edge on the South and S.W. sides. Goff's Kay, which is on the North side of the entrance, is much smaller, with a cocoa-nut tree on its centre, and is surrounded with a sandy beach. To the eastward of it, about half a mile, is the patch of sand called the *Sand Bore;* it is even with the surface, and, in rounding it, a great berth must be given. The anchorage is in 8 to 4 fathoms, Goff's Kay bearing from N. by W. to N. by E., or the kays to the northward and Goff's Kay in one.

There is also anchorage under Turneff, as far to the northward from Kay-Bokel as to bring English Kay N.W. by W. in 4 fathoms.

On English Kay, in general, the pilots live who pilot vessels coming in from the northward.

Sailing Outward.—The course from English Kay to Mauger Kay is N.E. by N.; the distance between 6 and 7 leagues. This is the northernmost kay on Turneff; its latitude is 17° 36′ 15″, and longitude 87° 47′. A reef extends from it N.N.W. more than 2 miles. During two cruises in the bay the latitude was confirmed.

As the currents in this season run strongly to the southward, half a mile to three quarters of a mile in the hour, should it blow strong from the northward, on leaving English Kay, run out by the *Southern Four Kays*, as it is very dangerous to beat between Turneff and the main in a dark night. With N.N.W. winds, at this season, it is not unusual to pass out to the southward and eastward of the Triangle.

The Directions for Vessels bound to the Eastern Coast of Yucatan, from April to September, as given by *Captain Dunsterville*, are as follow:—

Take your departure from Pedro Bluff, Jamaica, and pass about 2 or 3 leagues to the southward of the Swan Islands. These are two low bushy isles, which may be seen, in clear weather, 4 leagues off. Between them is a reef, over which the sea breaks heavily, and there is not space even for a boat to pass, from North to South, there being but one foot of water over the reef. On coasting along the North side, within a quarter of a mile, I found the coast very clear. About the westernmost island are spots of coral banks, but so clear to the shore as not to endanger a vessel: their extent, from East to West, is about 6 miles, the reef included, which extends from the West end about a mile and a half. There are two sandy coves on the northern side of the western island, and also on the southern side, where boats are safely landed. A current was, however, found on this and preceding days, setting to the N.N.W. about half a mile an hour. I found the latitude, by meridian altitude, 17° 24′, and longitude of the East end, by chronometer, 83° 48′ 50″. At 2 miles from this point we had soundings on rocky bottom, with from 9 to 13 fathoms.

From the Swan Islands keep in the parallel of Half-Moon Kay, or 17° 12′ N., or, as the current sets to the N.N.W., and should it be hazy weather, do not go to the northward of 17° 6′ by account, as it would be very dangerous to fall in with the centre of the southern Four Kays Reef at the close of the day. The breezes are generally strong from the eastward with a lee current. From Half-Moon Kay proceed as before directed.

In this season, if, on your return, you pass to the westward of the Triangles, you may find a current setting to the northward about 1 mile an hour; and it will be found that the winds often shift to the westward, with fresh breezes and rainy weather.

On a voyage of H.M.S. *Bustard* from Jamaica to and from the eastern coast of Yucatan, in June and July, 1827, Mr. Dunsterville made the following remarks:—

"From the West end of the Pedro Shoals to the Swan Islands, found the current setting to the W.N.W. about 1 mile an hour. These isles are between 3 and 4 miles in extent from E.N.E. to W.S.W., and may be approached (particularly by day) within 2 miles, in any class of vessel. The *Bustard* passed about a mile off shore on the North and South sides. On the S.W. point is a fine sand bay, where a vessel may cast anchor in from 10 to 7 fathoms; but, off the West end, a rocky bank extends full $1\frac{1}{2}$ miles, with very irregular soundings, from 10 to 5, 4, and 7 fathoms. When the weather is clear, this bank is easily discovered by the eye. Latitude of the East end of the eastern isle, 17° 24′; off this we had soundings in from 13 to 9 fathoms, rocky bottom, about $2\frac{1}{2}$ miles, the East point N.W. $\frac{3}{4}$ W. No water could be found on the West isle, the swell being too heavy to admit our landing. Hence we proceeded toward Balize.

"At Balize the weather, during our stay, was heavy rains, with tornadoes from S.W. to N.W. These last for two or three hours, then subside into a calm."

On leaving Balize, the pilots are always ready to accompany vessels as far as *Mauger Kay*, and it is imprudent to discharge them sooner, as vessels have been known to run upon Turneff. Vessels from the Turneff Passage should leave Mauger Kay at the close of day, so as to reach the length of the Northern Triangle by daylight next morning if possible.

As the Triangle Reef is very dangerous, great caution is required in approaching it. Most vessels pass to the westward, as the current runs from 10 to 50 miles per day, particularly to the northward; and it generally sets rapidly to the westward, over the reef, and at the South end, on which there is a small sand-bore.

On approaching the southern and western part of the Triangle Reef keep your lead going. When well to the northward, make the best of your way for your destination, keeping a good lookout in order to avoid the Island *Cosumel.*

Vessels going out by the *Southern Passage*, that is, by the Four Kays of the Lighthouse Reef, should never venture without a pilot. In this case the pilot leaves the vessel at Half-Moon Kay, which is distinguished by the lighthouse.

"On passing the western side of the Triangle, upon returning from the bay, we steered N.N.E. and cleared the kays on the North part; and, having run 30 miles on that course, observed the latitude by the star *Spica*, 18° 35′ N. The current set to the northward about 1 mile an hour, and continued so till we arrived in lat. 22° 5′, and long., by chronometer, 85° 24′ W."

From the N.E. end of the Isle Cosumel, *Cape Antonio*, the western extremity of

Cuba, bears N.E. by compass [*N.* 52° *E.*] 125 miles. Upon this course allowance must be made, in the southern parallels, for the general indraught into the Mexican Sea to the N.W., and afterward for the Stream, which has too frequently been found winding from off Cape Antonio to the E.S.E., as explained in the "Colombian Navigator," and the former part of the present work (200.), page 313.

Jamaica to Chagre and off Cartagena.

Copious Directions for proceeding from Jamaica to and upon the continental coast have been given in the "Colombian Navigator."—(See vol. iii. p. 191, &c.) To that information we now add the following, from the Journal of Captain Dunsterville, 1827.

"Sailed from Jamaica on the 18th of November: the weather fine, with light southerly sea-breezes. In standing across to Cartagena we found the current had set 34 miles to the westward in four days. On approaching land the weather was very hazy.

"We made the land of *Galera Zamba* [long. 75° 25′ W.], which is low, and appears, at a distance, full of hummocks. To the northward of Point Canoas (more to the S.W.) the land is a little higher, and slopes gradually to the point, which is low, and should not be approached nearer than 2 miles.

"The hill called the *Popa of Cartagena* is very remarkable; it stands to the N.E. of the city, and has a convent on it. This is an excellent landmark; and to use the simile of other writers, is like the quoin of a gun. From seaward it makes like an island. The city from the ocean has a fine appearance.

"We anchored, in the *Bustard*, on the Playa Grande, in 5½ fathoms, fine black sand, with the convent of the Popa E.S.E. ¼ E., Point Canoas N. by E., western extreme of Tierra Bomba S. ½ W. Latitude of the anchorage, 18° 28′, off the town 1½ miles, longitude, 75° 34′. From hence to Chagre, light winds from E.N.E. to North: hazy weather.

"*On approaching the land near Porto Bello* [Velo] we experienced strong N.E. currents 1½ miles an hour, which continued until we arrived off Chagre. Therefore, at this season, keep well to the westward, if the winds are light; but if the strong N.N.E. winds have set in, which commence about this time, make the land well to the eastward, it not only affording a better landfall, but the currents then run more rapidly to the S.W.

"*In the vicinity of Chagre* the land presents nothing very remarkable by which it may be known, particularly if the weather be hazy, and the castle cannot be seen when it bears to the southward of S.E. by S. This castle is situate on an eminence commanding the village and river, and mounts about 20 guns.

"The *Bustard anchored* in 5¼ fathoms, with the flagstaff of the castle S.E. ½ E., Point Brujas N.E. ¾ N., off shore, three-quarters of a mile. To the southward of the point is a large white patch in the rock, with a fall of fine fresh water close to it.

"Supplies, water excepted, cannot be obtained here. Fowls were a dollar a-piece, and scarce.

"In turning down the coast, from Brujas Point to Chagre, which is 1 league distant, the shore seems bold; but do not shut in the Point with the southern land. The best anchorage for a large ship is with the Point N.E. about 3 miles off. A strong current out of the river runs to the N.N.E., 2 miles an hour at the anchorage, therefore you cannot ride heavy at the anchor; but the vessel rolls heavily when strong winds blow. We weighed and beat to the eastward for *Porto de Naos* or *Navy Bay*, on the N.E. side of which, under Manzanillo Island, a vessel will be well sheltered from N.E. and N.N.E. winds. This bay is formed by *Manzi Point*, the N.W. extremity of the Island of Manzanillo, and on the West by *Toro Point*. These points lie nearly 3 miles from each other. On Manzi Point is a lighthouse. Toro Point has a very dangerous reef, extending nearly a mile to the N.E., which should not be approached nearer than in 6 fathoms. Manzi Point is bold; it has 5 fathoms within half a cable's length, and under it is the best anchorage, at the present season of N.E. winds, in 4 or 4½ fathoms, with Manzi Point North or N. by E. about a quarter of a mile. From the point off shore are 520 yards of good ground. To the distance of a mile or a mile and a half from the entrance the shores are bold, with 3 fathoms close to the beach, and soundings regularly decreasing from 6 to 4 fathoms. You may, therefore, take an anchoring berth at pleasure, suited to the vessel's draught. This place does not produce supplies of any kind: even water is to be found only in a few stagnant pools, from heavy rains, and is very bad.

"In the season of the rains the best place to anchor in is on the western side, as winds prevail from that quarter. There is a hut on *Point Limon*, in the S.W. extremity of the bay, and which is very high in comparison with the adjacent coast: when it bears S. by W. you will be to the eastward of Toro Reef, and may run into the bay. From this point there is a communication by a pathway to Chagre. Occasionally two or three soldiers are kept there for the suppression of smuggling. Cocoanuts are in great abundance; fish very scarce. The soundings on the coast, from 1 mile North of Point Toro, to the same distance off Point Brujas, are 7½, 8, 8½, 9, and from Brujas Point to Chagre, 10, 9, 7, 6½, 6, 5½, off shore about half a mile, keeping Brujas Point open, bearing N.E. or N.E. ¼ N.

Jamaica to the Bar of Maracaybo, April and May, 1827.

On sailing from Jamaica we had fresh easterly winds and squally weather, then winds variable round the compass.

From Alta Vela, in lat. 17° 28′ N., long. 71° 40′, we took our departure for the Isle of *Oruba*, on the eastern side of the Gulf of Maracaybo, allowing for the strong westerly currents about three-quarters of a mile an hour.

Saw the *Monks*, which are rather high rocks; and, by the altitude of the star *Antares*, made the northern one to lie in lat. 12° 28′. Hauled to the S.E., and ran along the western coast of Paraguana, sounding, when distant from the shore about 3 miles, from 12 to 8 fathoms, till we arrived at *Punta de los Estanques*, whence we took our departure for the Bar of Maracaybo, S.W. ½ W.

To the eastward of the Bar of Maracaybo, about 8 leagues, are high mountains; the land westward of these is low, and continues so, with occasional breaks in, by kays and hillocks, which are at the entrance of the lagoon. Farther westward are two pieces of land, not particularly high, on the low S.E. termination of which are three little hillocks. This is tho *Isla Todos*, on which stands the Castle of San Carlos. When bearing S.S.W. ¾ W. the hillocks are over the fort, which is white. Do not steer for the latter, but continue on about West, not going into less than 5 or 5½ fathoms, when you will open the runins of Fort Zapara to the southward, and the Castle of *Bajo Seco* to the westward, in lat. 10° 59′, long. 71° 42′. This fortress is, likewise, white, and is situate on a small sandy kay. To the westward of this lies the bar, having at this season a depth over it of only 11 feet, hard bottom; but in the rainy season, August, September, and October, there is, at least, 13 feet of water.

The breezes here are very heavy from the N.N.E. to N.E. by E. in the early part of the day, yet at about 8 a.m. the wind is generally more moderate; and from 2 p.m.

to 2 a.m., in the following morning it blows a perfect gale, with a heavy sea, which makes it dangerous to lie at anchor here.

The best anchorage off the bar is in 5 or 5¼ fathoms, with the Castle of Bajo Seco South or S. by W.; off shore about 3 or 4 miles. The soundings on the South side of the gulf [bay?] are regular, decreasing gradually as you approach the shore. The current runs to the N.E. when the moon rises; and it is high water, on the full and change, at $5^h\ 15^m$.

In beating to windward, endeavour to be near the north-western shore at about 1 p.m., in order to take advantage of the winds which draw to the N.N.E., so as to make a good lay to the eastward.

The communication with the city of Maracaybo is kept up by one of the ship's boats, hiring a pilot for the occasion, who, on making the general signal, will come out from Bajo Seco in a boat with latine sails, should the weather be moderate. If you have to communicate frequently with the city, or to cruise in the gulf, I should recommend beating up to the anchorage of Estanques, in the peninsula of Paraguana; but, in beating up, do not go to the eastward of Punta Gorda, the S.W. point of Paraguana.

The *Anchorage at Estanques* is very good for a vessel of the largest class, even within half a cable's length of the beach, and capable of containing twenty sail in safety. The best marks for assisting a stranger to find the anchorage is the Mountain (or Pan) of *Santa Anna*, which much resembles Vesuvius, and may be seen, in clear weather, 8 or 9 leagues off. This mountain, when bearing E. ½ N., leads to the anchorage. The place may also be known by being a long tongue of sand, with some huts on the extreme point, occupied by fishermen, who, in the season, take immense quantities of fish by the seine. The *Bustard* anchored in 4½ fathoms, and veered to 25 fathoms on the N.E. anchor (from which quarter the prevailing winds come stronly), and 82 fathoms on the best bower to the S.W. Point Estanques, S. ½ E., Point Salines, N.N.W. ½ W., off shore 2 cables' length. No supplies can be obtained here. Rabbits may be shot, but can be purchased cheaply. The little water that may be procured is muddy, and not fit to drink.

If you are bound to the eastward, when clear of the gulf (bay?) stretch to the northward, as the currents run so strong between the Isle of Oruba and Cape St. Roman, that it is nearly impossible to beat through; but, should you go between the island and main, be cautious in standing by night to the S.E., as the coast from Cape Roman to Aricula (S.E. 19 miles) is very dangerous, and the currents thereon.

In stretching across, from *Point Chicabacoa*, on the West side of the mouth of the gulf, to Jamaica, we found a strong current, running due West, nearly 1 mile an hour.

The Channels of Providence.

The Channels of Providence, between the Great and Little Banks of Bahama, are copiously described in the second volume of the "Colombian Navigator," as well as the winds and seasons of this portion of the West Indies. The lighthouses on Gun Kay and the Great Isaacs in the Florida Strait, together with those erected on the Florida Reefs by the United States Government, and the fine line of beacons along the face of the latter will be eminently useful in facilitating the navigation. We have been assured, by an intelligent navigator, that it is not unusual for twenty sail of vessels, of from 100 to 400 tons burthen, to pass the Great Stirrup Kay within musket-shot, and even within hail, in one day; these, for the most part, proceeding the United States to Cuba and the Mexican Sea. They make the Hole in the Wall, now distinguished by its lighthouse, then the Stirrup: thence, if the weather appears threatening, they pass through the N.W. channel; otherwise they shape a course, picking their way, across the Great Bahama Bank, to the southward of the Cat Kays, beyond the Gun Kay Lighthouse. Here they enter the Florida Strait, and pursue a southerly course, where the Gulf Stream is found, as described, to run with the less velocity to the northward.—(See farther, "Colombian Navigator," 1848, vol. ii. pp. 223 to 226.)

Directions for Proceeding to Demerary, etc., from the N.E.

[illegible] of the "Colombian Navigator," pp. 128 to 130, we have given a copious [illegible]ion of the coast, and directions for making the rivers, of Guyana. To that [illegible]on, &c., the following remarks in addition, by Captain *George Che*[illegible] in 1831, will be found a useful and valuable addition:—

"[illegible] lat. 10° N., the water changes to a dark or black colour, or dirty drab, and then [illegible] again to the usual sea blue, you may rely on being to windward. There are [illegible]undings, only this remarkable change.* You will then, in running farther in, on the coast, observe a perfect division, or line of change, on the water, nearly N.W., from blue to green, where the current sets strong in that direction. On proceeding, you will again change to thick muddy water, influenced by the tides, which should be carefully calculated and allowed for. Many ships have run to leeward from want of this, and a due allowance in the course when the tide is running, which is always with the flood. As you approach in-shore 4, 5, and 6 fathoms, should the water then be of a *red* colour, you may make sure of being to windward, and need not fear running, even should you obain no pilot. This is most perceptible from Miconie down to Corobana Point: to leeward all is dirty, thick mud.

"The lighthouse on the weather point of the Demerary River shows a bright fixed light to seaward, from 12 to 14 miles; with this light-tower bearing from South to S. ½ W., flood making, you cannot do wrong by steering in on that course, should you not obtain a pilot, and come-to off the fort, keeping outside the poles on the West side. I mean this as a safe plan for a stranger.

"The deepest of the channel has worked of late much to windward; and deepened so as to allow vessels of 17 and 18 feet draught to beat out in two or three tides. I ran in without a pilot in April, 1830; was on the bar at dead low-water spring tides, least water 2 fathoms, and am convinced 11 feet may always be found. The pilots, of course, wish the bar to be thought shoal and dangerous, and endeavour to keep in ignorance those who should make these things more a matter of study than is at present the case."

To the preceding we add the following, obligingly communicated by Captain *Wm. Cook*, of the *Highbury*, of London, 1834.

Ships from Europe, bound to Guana, on arriving in about the lat. of 10° N., long. 48° to 50° W., will suddenly find the water change from a light blue to a dark green colour (no soundings with 130 fathoms of line), with every visible appearance of a strong current. This current, from repeated observations, I have found setting to the northward at the rate of a mile and a quarter per hour; and, in the months of August and September (after the rainy season), I have found it to set about N.N.E. at the rate of 2 miles an hour. I consider this current to be caused by the stream of the River Marañon; for as you proceed to the S.W., the water again resumes its usual colour, and the current takes a more westerly direction, until you reach the edge of the Bank of Soundings, where it takes the direction of the line of coast, and runs about 1½ miles in the hour, excepting during and immediately after the rainy season, when it runs at the rate of from 2 to 2½ miles an hour.

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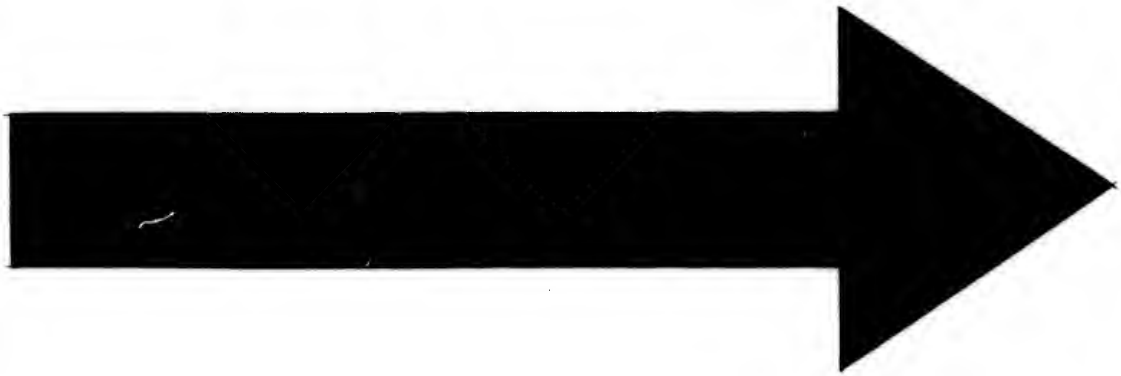
* This discoloured water appears to be in the Stream of the *Equatorial Current*; as may likewise be that which is met with at 80 or 100 leagues to the East of Barbadoes.—Ed.



Strangers bound to Demerary or Berbice (if not quite certain of their longitude) should avoid making the land, and endeavour to gain the parallel of 6° 30′ N., before going to the westward of long. 56°. The course then is W. ½ S. by compass. To the eastward of the River Corentyn, in this parallel, you will have from 18 to 20 fathoms of water, dark sand, with broken shells and mud; when abreast of the Corentyn, you will have 12 fathoms, with clean brown sand. Steering the above course, you will gradually shallow your water to 7, 6, and 5 fathoms, soft mud, when you may be sure that you are approaching the Bar of Berbice.* If it be daylight, you will see the land, which is very low. If in the night, and you are bound to Berbice, I would advise the ship to be brought to anchor.

If bound to Demerary, the better way will be to stand to the northward by the wind until daylight, as there are several dangerous mud-flats between Berbice and Demerary, some of which extend 6 or 7 miles off the land, and shift occasionally.

WINDS.—During the day, throughout the greater part of the year, the prevailing winds on this coast are from the N.E. to N.E. by N. During the months of June, July, August, and September, the wind generally draws more to the eastward after sunset, and continues blowing light until about 9 o'clock in the morning; when it again backs to the N.E., and blows a fresh breeze.

CURRENTS.—Within 15 miles of the coast the tide regularly ebbs and flows six hours each way; the flood running westward, and ebb to the eastward. Without this range the current [Equinoctial] runs constantly in the direction of the coast, from 1 to 2 miles an hour. In sailing to the northward you will find the current, when about 60 miles from the coast, to run about N.W., and in this direction it continues to run until you are to the northward of the islands.

"The velocity of the current between the coast of Guayana and the island is modified by circumstances, which I have never been able satisfactorily to account for, as I have often found it imperceptible, at other times very strong, and not in the least influenced by the seasons."

8.—OF SHIPS BOUND TO AND FROM THE NORTHERN PORTS OF AMERICA.

In the introductory remarks to this section of the work, we have alluded to the principles of great circle sailing, and have pointed out the advantages which it possesses, not so much in the shorter distance which it gives over the rhumb course, but in the scope it allows the navigator in the choice of a parallel on which he can make a good passage, without materially increasing the actual distance to be sailed over.

In no case can this be better exemplified than in the courses over the northern parts of the Atlantic, between the British Isles and the northern American ports. We alluded to a case, not impracticable, of the courses between the Lizard and Cape St. John's, in Newfoundland, and showed that two courses might be taken, not more than 35 miles greater than the *shortest* distance, of exactly the same length, and yet be 330 miles apart in latitude in their greatest separation.

An *imaginative* course will well explain this for our present purpose:—From the Lizard to Sandy Hook, New York, the distance and course by compass are 2,952·5

* Since the 5th of February, 1840, a light-vessel has been stationed off Berbice near the eastern point of the entrance. It exhibits a single bright light, from sunset to sunrise, and by day a black ball at the mast-head. The light-vessel of Demerary is similar, and lies 10 miles N.N.E. ½ E. from the entrance. It may be prudent not to depend too much on seeing those vessels when passing.—ED.

miles S., 78° 51′ W. But if a vessel leaving the Lizard were to commence sailing N., 73° 24′ 40″ W., and passing about 35 miles southward of Cape Clear, gradually bearing to the West, attaining a maximun latitude of 51° 56′ 30″, long. 26° 27′ 20″ W., and then, if it were possible, approach New York on a S. 54° 36′ W. course, she would sail over 2,865 miles, or 87½ miles less than the compass course. This *great circle course* passes over Cape Bonavista and La Hune Bay in Newfoundland; St. Anne's Bay in Breton Island; Picton and Cape St. Mary in New Brunswick; near Boston, New London; and over Long Island, in the United States.

A line, of the length of 2,952·5 miles, placed in a higher latitude than the rhumb line, as shown in page 376, is just as much *above* the great circle course in latitude as this is above that by compass. This corresponding arc from New york leads considerably inland of the coast of the Eastern States, intersecting Chaleur Bay, Cape Bonaventura in Gaspé Bay, Anticosti, passes 45 miles N.W. of the Strait of Belle-Isle, approaches within 189 miles of Cape Farewell, Greenland, attains a maximum latitude of 57° 12′ N., and intersecting the S.W. part of Ireland, at Kinsale, reaches the Lizard in a S.E. direction. These two lines, of the rhumb and the corresponding arc, are *upwards of* 700 *miles apart* at the greatest deviation from each other.

With these considerations so manifest, we shall be better prepared to understand that a higher latitude than the usually received one cannot, of itself, be disadvantageous; and the excellent observations of Captain Hare, presently given, will be more clearly evident.

By referring to the Chart, it will be seen, that from the Land's End of England to St. John's Newfoundland, the true bearing is W. 4° S.; and from the same point to Cape Sable, or the S.W. end of Nova Scotia, it is about W. 9° S. But the circumstances of navigation, in general, render a direct course more tedious and difficult than a circuitous route, and the best passages have been made by pursuing a *high northerly course.*

It seems probable, from all that we have said on the winds and currents, that on prosecuting a north-westerly course, from the Bank of Channel Soundings, the winds and currents, respectively, may counteract and balance each other; that, on further prosecution of the same course, the winds will be found less westerly, and therefore more favourable than in the more southerly parallels: and that, in advancing toward the mouth of Davis's Strait, the advantages both of wind and current may be combined.

Caution must be taken not to advance too near the eastern coast of Newfoundland, if bound to New Brunswick or the southern ports; nor to the eastern coast of Breton Island, as here the vessel may be swept round by the strong westerly currents, which have been described on the preceding pages (347, to 352), and which, now understood, instead of producing mischief, may prove highly advantageous in facilitating the ship's course.

The propriety of these arguments was confirmed by experience, in more than forty passages made to and from New Brunswick, &c., by Lieut. Chas. Hare, of the Royal Navy, previous to the fall of 1824. Annexed is a copy of that gentleman's communication.*

"Ships from Scotland, in the spring of the year, and bound to New Brunswick, have always arrived sooner than those from the English Channel; which is attributed to their being more to the northward on leaving the land.

"Ships from Liverpool generally arrive before those which sail from the English Channel; the cause being the same.

"In the Spring of the year, I would never go to the southward of lat. 46° or 47°,

* Many succeeding passages made by Captain Hare, since 1824, have concurred to prove the propriety of these directions, which have been highly approved by the American captains of home ships, as well as by British masters. This gentleman had crossed the Atlantic for the ninety-eighth time, in the year 1839, and the *one hundred and eleventh*, in 1846.

until I reached long. 37° or thereabout; then edge to the southward as far as lat. 43°, in order to avoid the icebergs, keeping a very strict lookout; this parallel (43°) I should endeavour to preserve, or nearly so, but nothing to the southward, until up to Cape Sable, Nova Scotia; for it carries you to a safe and proper distance from Sable Island, a place that cannot be too much dreaded. In this track you will be without the northern edge of the Gulf Stream, and assisted by a south-westerly current from the Banks until past that island.

"In the Fall of the year my track is far more to the northward than in the spring. On leaving the land as late as the middle of October, or thereabout, I generally steer to the north-westward until I get as far North as 55°, and until I enter the longitude of 30°, then edge to the southward, to enter the banks in lat. 46°, shaping again a course to pass about 60 miles to the southward of Sable Island, as above. If bound to Halifax, and very sure of my latitude, I might be tempted to pass to the northward of Sable Island; but, at all events, it would be at great risk; and I should not, under any circumstences, recommend a stranger to attempt; as the weather is mostly foggy, and the set of the currents unaccountable. The scundings on Banquereau are incorrectly laid down in every chart that I have yet seen; being, in fact, within an hour's sail of the N.E. bar of Sable Island; from which cause I once very narrowly escaped shipwreck. Numerous gannets are always hovering about this island, and are a very excellent indication of your near approach to it, particularly on the South side.

"By crossing the banks thus far North, you will find the advantage as you approach the longitudes of Newfoundland and Nova Scotia; the strong N.W. and North gales having then commenced, you will frequently be compelled to lie-to for two or three days; and should then ensure sufficient drift, before you are blown into the strong influence of the Gulf Stream; which would be the case at a few degrees to the southward, and inevitable in a S.S.E. direction, at an inconceivable rate. Last November (1824) the case occurred; the vessel being hove-to, under main-topsail and storm-trysail to the westward of the banks, in lat. 45°, and was, in four days, swept into lat. 39½, consequently into the Gulf Stream, when the longitude became also considerably affected, and I took the first opportunity of making a N.N.W. course, to get out of it as soon as possible.

"To prove the advantages of a northern track, late in the fall of the year, I may notice that I have, in one or two instances, read in the American newspapers the accounts of very long passages experienced by ships whic[illegible] heavy gales in the latitudes of 35° and 38°, when several vessels were disable[illegible] others suffered loss of sails; yet, *on the same day*, in lat. 54° I had moderate weather from the N.N.E. with top-gallant studding-sails set; which strongly encourages me to believe that the blowing weather, incident to approaching winter, commences southerly, and inclines northerly as the season advances, and not the reverse; an hypothesis generally formed by English ship-masters, but, in my opinion, certainly erroneous.

"I am farther of opinion that the influence of the Gulf Stream, in the parallels from lat. 35° to 42°, whether from the warmness of the water or other natural causes, has a strong tendency to attract the wind from a western direction; as I have invariably found the wind more alterative in the northern latitudes before mentioned than the southern ones; and it unquestionably must be allowed by all mariners of any observation, that gales experienced in the Gulf Stream or its vicinity blow with much greater violence than they do in that part of the Northern Atlantic not under its influence;* besides, the squalls from the southward or S.W. are much more sudden and heavy, and near the banks they are attended with dangerous lightning. The thermometer (an instrument easily understood) is of the greatest importance for ascertaining your approach to it; and, if bound to the West, I would, for my own part, endeavour to avoid its effects as cautiously as I would a lee-shore; for it may be depended on, that no ship, however well she may sail, will effect westing in the Gulf

* See the remarks upon the Gales of the Azores, in the description herinafter given of those islands.

Stream with a wind from that quarter; and it is to be remembered that its velocity is accelerated according to the strength of those winds; and its extent in breadth, at a few degrees to the westward of the Azores, is many more degrees than is commonly supposed.

"These observations, I hope, may be useful to my brother mariners engaged in these voyages; and permit me to say, that they are grounded on the experience of more than forty times crossing the Atlantic in the Royal and the merchant service, and in the command of vessels in both; latterly in one of 400 tons burthen, the *Waterloo*, owned in St. John's, New Brunswick; and, as the custom-books in Liverpool can testify, landed four full cargoes in thirteen following months; which, including the time required to discharge the same, then load outward to St. John's, there discharge and load home again, leaves but very little time for the ship to cross the Atlantic eight times in fourteen months, which, in fact, was done.

"Still further, in corroboration of my approved northern track, allow me to observe, that in the fall of 1823, by keeping in a high latitude, the brig *Ward*, myself master, also owned in New Brunwick, performed a voyage out and home in seventy-two days. The same vessel, likewise, on the 3rd of October, 1824, left the English Channel, and arrived again in the Downs on the 3rd of January following.

"I must add, that a strong, well-found, and well-manned vessel, alone can perform these voyages; for they must be maintained with unremitting attention and perseverance.

"The necessity and propriety of the above remarks were particularly exemplified by the *Ward*, which, on her passing through the Downs, in 1824, left ships there which were bound to the westward, weather-bound, and found them there on her return, having been driven back by adverse winds; while she, getting out of the Channel, performed with ease a prosperous voyage to St. John's, New Brunswick, and back, exactly in three months, assisted by chronometer, thermometer, &c."

Although the voyage to and from North America, between the parallels of 60° and 40°, has always been attended with a degree of peril from masses of ice which drift to the southward, during the summer months, from the polar regions, yet many an unwary mariner makes his run across the Atlantic without any apprehension of meeting these floating dangers, or without sufficiently exercising a proper discretion and vigilance to guard against coming in collision with them. Commanders of ships should, therefore, bear in mind the imperative necessity there is for using their utmost vigilance and attention when crossing the above-named parallels, especially between the meridians of 30° and 60° W., to guard against coming in contact with these formidable dangers of the ocean. Upon the subject of the ices which come down from the northern latitudes, much that is interesting and necessary to be known will be found in a former part of this book, pages 355 to 360.

The *New York packet ships*, when making their winter voyage from Liverpool, kept in high latitudes until nearing Newfoundland. This they did for the twofold object of avoiding the tempestuous weather so generally experienced to the southward, and of obtaining fairer winds; and thus, by slipping within the mighty stream from the Florida Channel, they evaded its retarding influence. The voyage by this route is shortened; and, although bad weather must be expected, it is not so violent as further South; besides which the eastern currents are avoided.—(See further on this subject "Colombian Navigator, vol. i., p. 219.)

GULF OF ST. LAWRENCE, &c.—Those bound to the Gulf of St. Lawrence, after passing to the southward of the Virgin Rocks, on the Grand Bank, and the Island of St. Pierre, should keep a middle course between Newfoundland and Breton Island; not forgetting what has been heretofore said on the winds and currents. Recollecting also, that the harbours on the coast, westward of Fortune Bay, are impeded with dangers; there are many rocks about the entrances, and most of the harbours are imperfectly known. The rocks are not to be seen in thick weather, and fogs very much prevail on the coast.

Commanders of vessels bound to the Gulf of St. Lawrence will do well to observe that, off the South coast of Newfoundland, between the meridians of 55° and 56°, and the parallels of 45° 20′ and 46° 15′, is a deep gully in the sea, extending in a true N.N.E. and S.S.W. direction, and separating the Bank of St. Pierre from the Green Bank. *The method adopted by the French vessels bound to St. Pierre for making that island is as follows:—*

From the longitude of 52° W., in lat. 45°, they steer a N.W. course by compass, which carries them across the Green Bank, in 48 fathoms of water; and when on the meridian of 55° 10′, in about 45° 35′ N., they suddenly deepen their water, from 45 to 90 fathoms. A further run on the same course of about 10 miles carries them across this gully, when they shoalen their water again to 35 and 30 fathoms; and, after a further run of 23 miles, they steer about N.N.E. directly for the island, and seldom or never miss it.—(*See the Chart of Newfoundland, &c.*)

Those who have lost their reckonings, on finding this gully, which may be known by the water shoaling on the East and West sides of it, an experiment that is frequently made for ascertaining whether they are actually in it or not,—may safely take it as a *fresh departure*. Commanders, not being aware of it, when they have found their water deepen from the Green Bank to the westward, have imagined themselves entering the Gulf of St. Lawrence; and, by steering a course too far to the *northward*, have been lost to the eastward of Cape Ray, on the rocks of Newfoundland. The length of the gully is about 60 miles, in a true N.N.E. and S.S.W. direction, and the middle of it is in lat. 45° 50′, and long. 55° 15′.—*Communication of the French Commandant to Captain Sir Richard Grant, R.N.*, 1833.

The little Island of St. Paul, which lies to the north-eastward of Cape North, now distinguished by its lighthouses, is bold-to, steep, and high, and, with a good look-out in the daytime, cannot be considered as dangerous even in thick weather. The land of Breton Island is very high, and though fogs are about it frequently, it is seldom so much obscured as not to be seen in time. On entering the gulf, the Magdalen and Bird Islands will be seen, as they lie in the direct course from Cape North to the River of St. Lawrence.

There is, in clear weather, a safe passage between the Bird Islands and the Magdalens; but, in thick weather, it is advisable to keep either to the southward or northward of both, as the wind may permit.

In Pleasant Bay, on the S.E. side of the Magdalen Islands, there is clear and good anchorage, very near the shore; and it is a very safe place for vessels to ride in, with a westerly wind, and infinitely preferable to beating about in the Gulf with a foul wind. There is a safe passage into it between Amherst Island and Entry Island.

As the weather to to the southward of these islands, between them and Prince Edward Island, is generally much clearer than on the North, the passage that way is preferable, particularly after the early part of the year, when S.W. winds mostly prevail.

Vessels bound to and from the River St. Lawrence now use the Strait of Belle Isle as a channel which gives the shorter and better route to Europe *in the summer months*. It should be remembered that the ices described in (284.), pages 355 to 360, which float down the Labrador coast to the Great Banks have carefully to be avoided during the season of their frequency in February or March to July. Again, the shorter days in the higher latitudes, and the prevailing fogs which infest the Newfoundland coast have to be taken into account during the winter and late autumn months. The new lights erected on Belle Isle and Amour Point, in the Strait of Belle Isle, will very much facilitate the navigation thus pointed out. With the caution thus indicated, this route offers many advantages. The Canadian mail steamers now follow it, although a recent accident from ice to one of them, in the month of May, 1861, will act as a warning.*

* When within the gulf the northern shore should not be made too free with, as it is possible that some outlying rocks may have escaped the vigilance of the Admiralty surveyors. The *Grange Rock*, off Coacoacho Bay, is an example. The S.S. *North America* discovered it by striking on it in September, 1858. It is 1½ miles outside the line of dangers, near a spot where the Admiralty chart showed no bottom at 47 fathoms.

9.—BETWEEN EUROPE AND NEW YORK, ETC.

There seems to be little hope that much can be added to our knowledge of this well beaten track, and that the passages can be shortened by adopting any fresh route. Soon after Maury's Pilot Charts, an analysis was made of them in order to find out the best route by *computation* for each month in the year, of a track between New York and Europe.

It will be needless to dilate on these, or to give the copious tables that were drawn up to illustrate these routes. They are given on the illustrative diagram of the tracks across the Atlantic, and the lines there laid down will be sufficient to show their relative position. These tracks certainly seem to us to diverge so much from any regularity of order in different months, not exhibiting any gradual change with the seasons, as might reasonably be expected, but have a general zig-zag course, at variance with the generally received laws of simplicity and order which natural phenomena, which govern these courses, usually assume. This want of an apparent general law of change is doubtless owing to the imperfection of the data upon which they are based. This has been before alluded to in (29.), on pages 186, 187, and by reference to that and the diagram it will be seen that the records of the direction of the winds are in themselves so imperfect, that they will be quite sufficient to account for the anomalies in the computed best courses for the different months. Therefore the graphic illustration of them will here suffice.

But as these recommendations have been followed out by a great number of vessels, chiefly the fine clippers and passenger ships between Liverpool and New York, their voyages have been discussed and tabulated by Captain Maury in his last edition, and the general *mean* result of the best six passages in each month is given in the ensuing tables.

But this selection may not afford a just estimate of the ordinary voyage of a deeply laden ship less adapted for making a rapid passage. Still the route adopted by the clippers will manifestly be the best, in general, that can be taken by the heavier vessel. And therefore these tables will not be the less useful.

In the development of any new route, or change in an adopted system, much discussion must necessarily be involved, and many facts brought to bear upon the advantages to be derived. From this cause the volumes of Captain Maury have assumed such a bulk that for every-day use their value is in some degree impaired, and even in drawing up a summary of the results arrived at, it is necessary to be discursive, and extend the abstract to a considerable length, as will be seen in the preceding pages upon the best meridian for crossing the equator.

With this view the *computed* routes given by Captain Maury, with the probable amount of fair or head winds, gales and calms, and distances required to be sailed over in each section of the voyage are omitted. The tables of *actual* experience which follow, will, it is thought, be quite sufficient to give an idea of the subject. Only the mean results are given here, not the details from which they are derived.

CROSSINGS AND TIME FROM THE ENGLISH AND ST. GEORGE'S CHANNELS TO NEW YORK.

Month.	LATITUDES OF CROSSING THE MERIDIANS OF																									Total Days to Port.
	Days.	15°	Days.	20°	Days.	25°	Days.	30°	Days.	35°	Days.	40°	Days.	45°	Days.	50°	Days.	55°	Days.	60°	Days.	65°	Days.	70°	Days.	
		°		°		°		°		°		°		°		°		°		°		°		°		
January	3.7	48·5	1·3	47·2	1·4	46·5	1·7	46·0	1·7	45·0	2·0	44·7	1·9	43·5	2·1	42·6	1·6	42·0	2·7	41·5	1·9	41·6	2·2	40·2	2·1	25·7
February	3·0	49·8	1·1	49·3	1·1	48·8	1·6	47·7	1·6	46·7	1·7	46·1	1·7	45·2	2·6	43·5	3·1	41·9	1·9	41·4	2·0	41·4	2·5	40·2	2·8	26·8
March	3·1	49·3	1·4	48·6	1·2	47·5	1·8	46·3	1·6	44·8	1·6	43·7	2·2	42·7	1·8	42·5	1·8	42·2	2·8	41·7	1·7	41·[illegible]	1·9	40·5	1·4	23·9
April	4·2	49·5	1·4	49·0	1·6	48·4	1·5	48·1	1·8	46·7	2·1	45·9	2·6	44·8	1·7	44·1	2·2	43·7	2·4	42·6	2·4	41·7	2·3	40·8	1·6	27·7
May	4·2	48·3	1·3	48·2	1·5	47·5	1·7	46·3	1·6	45·6	1·7	44·6	1·7	44·2	2·0	43·2	2·0	42·3	2·0	41·7	2·2	41·2	1.9	40·4	1·4	25·2
June	3·4	51·2	1·6	50·2	2·4	49·5	1·5	48·4	2·4	47·6	2·0	46·7	3·0	45·2	2·3	44·9	2·4	43·5	1·7	43·0	2·5	42·0	2·8	41·6	1·7	28·8
July	5·0	50·0	2.1	48·6	1·8	47·8	2·0	46·2	2·5	46·1	2·7	44·0	2·9	44·2	4·5	44·0	2·6	43·5	2·2	42·4	1·9	41·6	2·1	40·4	1·8	32·6
August	4·2	48·6	1·6	48·4	1·7	48·1	1·6	47.6	1·7	46·6	1·6	46·0	2·1	45·0	2·1	44·0	1·8	44·5	2·0	42·3	1·9	41·3	2·4	40·2	1·2	25·7
September	4·3	49·2	1·7	47·7	1·6	46·5	1·8	45·1	2·2	44·1	2·2	43·1	1·6	43·5	1·9	43.1	1·7	42·2	2·0	42·0	1·8	41·3	2·0	40·3	1·1	26·0
October	4·2	48·4	1·1	47·8	1·2	46·9	1·4	46·5	1·5	45·6	1·6	44·5	2·2	43·5	1·9	43·5	2·3	42·7	1·5	41·8	1·8	40·5	2·2	40·3	1·7	24·6
November	5·1	48·7	1·4	48·1	1·6	47·5	1·2	46·5	1·6	45·6	1·4	44·5	2·6	43·2	2·0	42·4	2·4	42·5	2·2	41·6	1·7	41·3	3·2	33·2	2·8	29·3
December	4·5	51·5	2·1	51·9	2·4	51·7	2·6	50·7	2·2	49·9	2·3	48·8	1·6	47·2	2·2	44·6	1·6	43·5	2·4	41·7	2·7	41·[illegible]	3·2	40·2	2·3	32·2

CROSSINGS AND TIME FROM NEW YORK TO THE ENGLISH AND ST. GEORGE'S CHANNELS.

Month.	Days.	70°	Days.	65°	Days.	60°	Days.	55°	Days.	50°	Days.	45°	Days.	40°	Days.	35°	Days.	30°	Days.	25°	Days.	20°	Days.	15°	Total Days to Port.
		°		°		°		°		°		°		°		°		°		°		°		°	
January	1·2	40·0	1·5	40·3	1·6	40·8	1·2	41·9	1·4	43·0	1·4	44·0	1·0	45·6	1·6	46·5	1·0	47·7	1·1	48·4	1·1	49·0	1·0	49·7	18·2
February	1·0	39·9	1·7	39·9	1·4	40·1	1·6	40·4	1·4	41·5	1·4	42·7	1·2	44·4	1·2	45·4	1·1	46·7	1·4	48·1	1·1	49·0	1·4	49·2	19·2
March	1·6	40·0	2·1	39·8	1·5	40·8	1·2	41·7	1·3	42·6	1·3	43·9	1·2	45·4	1·1	46·6	1·0	47·3	1·1	48·1	1·0	48·8	1·0	49·4	18·5
April	1·5	38·8	1·1	39·7	1·4	39·9	1·2	40·6	1·3	41·6	1·4	42·8	1·2	44·4	1·2	45·9	1·2	47·2	1·2	48·6	1·1	49·7	1·2	50·6	17·4
May	1·5	40·0	1·6	40·2	1·2	40·7	1·8	41·1	1·2	42·0	1·5	43·4	1·6	44·9	1·8	45·7	1·2	46·5	1·5	47·1	1·3	48·0	1·2	48·9	19·8
June	1·2	39·8	1·8	40·1	1·6	40·7	1·4	40·9	1·4	41·3	1·3	43·2	1·	44·2	1·4	45·8	1·2	47·0	1·0	47·9	1·2	48·5	1·5	49·0	19·6
July	1·8	40·1	1·7	30·3	1·2	41·2	1·3	42·3	1·7	43·4	1·6	44·2	1·8	45·6	1·5	46·9	1·3	48·0	1·0	47·2	1·0	49·2	1·0	49·6	19·0
August	1·5	39·7	1·7	39·5	1·6	40·3	1·7	40·8	1·7	43·1	1·7	44·2	1·8	46·0	1·0	47·0	1·2	48·7	1·2	49·1	1·1	49·4	1·1	49·5	21·0
September	1·3	39·8	1·8	40·2	1·4	41·1	1·7	41·4	2·0	42·0	1·6	43·8	1·1	45·0	1·2	46·6	1·1	47·7	1·2	48·4	1·0	49·0	1·0	49·7	18·7
October	1·3	40·1	1·2	40·3	1·8	41·2	1·6	42·4	1·5	42·9	1·4	44·1	1·2	44·3	1·2	46·6	1·1	47·4	1·0	48·1	1·1	49·0	1·3	49·5	18·6
November	1·2	40·0	1·5	40·0	1·3	40·5	1·4	41·3	1·5	42·5	1·4	43·7	1·5	45·3	1·2	46·6	1·2	47·7	1·5	49·0	1·3	49·7	1·4	50·5	20·2
December	1·1	39·1	1·3	40·6	1·2	40·9	1·5	42·1	1·6	42·8	1·1	43·6	1·1	44·7	1·4	46·3	1·1	47·2	1·1	48·5	1·1	49·3	1·0	49·8	17·1

These two tables give the mean track and time occupied by the best *six* of each of the passages discussed as proceeding from Europe to America, and from America to Europe. The ports on the European side are London, Liverpool, Havre, and a few from the Clyde, Hamburg, &c. The last column gives the total duration of the voyage, and the intermediate day columns the time occupied in sailing between the respective meridians 5° apart.

But these six best passages of course are considerably below the average length of the ordinary voyages, which may be briefly stated as follows:—

Europe to America.—January, 19 to 87 days; mean of all, 40·1 days. February, 21 to 52 days; mean, 32·5 days. March, 21½ to 42 days; mean, 31·5 days. April, 24 to 43 days; mean, 33·7 days. May, 18 47 days; mean, 32·0 days. June, 29 to 54 days; mean, 36·7 days. July, 31 to 45 days; mean, 36·8 days. August, 22 to 42 days; mean, 33·1 days. September, 23 to 40 days; mean, 29·1 days. October, 18½ to 46 days; mean, 31·0 days. November, 28 to 53 days; mean, 37·2 days. December, 27½ to 48 days; mean, 37·6 days.

America to Europe.—January, 17 to 28 days; mean, 21·0 days. February, 16 to 28 days; mean, 22·6 day. March, 16 to 27 days; mean, 22 days. April, 15 to 28 days; mean, 22·5 days. May, 18 to 28 days; mean, 23·2 days. June, 19 to 25 days; mean, 22·5 days. July, 17 to 27 days; mean, 21·5 days. August, 21 to 28 days; mean, 24·1 days. September, 18 to 29 days; mean, 23·1 days. October, 16 to 27 days; mean, 21·9 days. November, 17 to 26 days; mean, 22·0 days. December, 15 to 28 days; mean, 21·2 days.

These figures will show with how much more certainty the eastern voyage is made with the anti-trade winds and easterly currents in its favour, than the average voyage with their adverse influences to retard and embarrass it.

These tables will suffice to show all that is necessary on this well-beaten track.

10.—STEAM TRACKS TO AND FROM AMERICA.

The daily increasing amount of collision, which has advanced much beyond the ratio of the use of steam, has led to many plans for averting it, but, apparently, without a corresponding effect in adopting them. The terrors of this danger in the open sea are manifest, and many sad examples are too well-known not to induce caution—one, that of the U.S. mail-steamer *Arctic* striking the French steamer *Vesta* near Cape Race in Oct. 1854, led our American friends to consider whether some means could not be employed to lessen the danger. Accordingly, R. B. Forbes, Esq., of Boston, proposed one track for steamers going to, and another for those coming from America. This problem was worked out by Lieut. Maury, and we give here the result in his own words:—

"The shortest distance possible for a steamer between Liverpool and Sandy Hook is 3,009 miles; the average distance actually accomplished is 3,069 miles, and the distance by the middle of the lane coming is 3,038. There is also another recommendation in favour of this lane to the West, which is this: it lies along the northern edge of the Gulf Stream, where there is an eddy setting westward often at the rate of a knot an hour. On the average, I assume that the set of this eddy will amount to 12 miles a day for three days and a half, or say 40 miles. This makes the distance by the lane coming practically about 2,998 miles; or, allowing 20 miles for detour, we shall have 3,018 miles, which will shorten the average time of the passage this way three or four hours, with less risk of collision, and less danger from Cape Race by the way.

"It may be urged against this lane that it cannot always be followed on account of the ice, and that, inasmuch as it crosses the Grand Banks, the steamers that ply in it may now and then run down a fishing vessel. The reply is that, as far as the fishermen are concerned, they are now liable to be run down by the steamers both going and coming. Whereas, with the lane, that liability is incident to the steamers alone that are westwardly bound, and the fishermen will have the advantage of knowing pretty nearly where the steamer will pass, and which way she will be coming. And as for its being obstructed by ice, so as to compel the steamers, as it occasionally will, especially in May or June, to turn out of it now and then, the Erie Canal, of New York, is obstructed by ice the whole of every winter, but that does not prove it to be of no value; it only shows that it, like this lane, would be of more value to commerce if it were never obstructed by ice, or anything at all.

"The Grand Banks afford a pretty good landmark, which can be used in the thickest weather. Generally the water thermometer is found to fall as soon as you near these Banks; it is generally a good landmark for them. The eastern edge runs North and South, and, therefore, affords an excellent correction for longitude. Having ascertained by the lead when the vessel first strikes this edge, then noting the soundings and the distance run before clearing the Grand Banks, the latitude will also be known with accuracy sufficient to enable the navigator to decide whether he be in or out of the lane, and if out, on which side. The lane crosses the Banks near their greatest width, 275 miles. If a steamer be crossing there in a fog, and in doubt as to her position, she can judge, by their breadth and the soundings, pretty nearly as to latitude. For instance, if the breadth of the Banks, when crossed, be less than 275 miles, but the soundings not less than 40 fathoms, the vessel has crossed the Bank to the North of the lane; but if she find herself in less than 30 fathoms, then she has crossed to the South of it. Should she, however, find herself in water that suddenly shoals to less than 20 fathoms, and as suddenly deepens again, then she is near the Virgin Rocks, or the Rock and Nine-fathom Bank to the East of them, and her position is immediately known.

"It should be recollected, however, that these lanes are not channel-ways in which steamers must keep or be lost. Gales of wind, ice, and other things will now and then force a steamer out of them, and in such cases she will actually be where she is now, for she will then be in no more danger than she is now; only when she gets back into the lane she will be in less.

"You will doubtless observe the advantageous position of the fork to Halifax, in the lane from Europe. As this lane approaches Newfoundland, it edges off to the South in such a manner as to render it impossible for a vessel so to miss her way as to get ashore. Suppose a steamer attempting this lane to be, when she nears the Grand Banks, 100 miles out in position (a most extravagant case), and that she be out on the Newfoundland side, she would, if behaving properly, be steering parallel with the lane, and if bound to New York, she would go clear of Cape Race. But she might be bound for Halifax, and by steering West too soon, might run upon the land; but recollect that the land to Halifax turns off *on soundings*, and a West course from where the lane from England strikes soundings on the Grand Banks will take you clear of everything. So without the most gross neglect of the lead and all the proper precautions, which it is the duty of the shipmaster to take, it would seem impossible for him to run his steamer into danger here.

"In the longitude of the Grand Banks, the lane to Europe is 200 miles South of the lane to America. As a rule, this lane for the eastern bound steamers can be followed always, admitting that an exception now and then in practice will make the rule general. It will be observed that this lane runs E. 15° S. from Sandy Hook to the meridian of 70°, where it takes a course E. 12° N., towards its junction with the arc of a great circle, South of the Grand Banks. Though the distance by this lane, from Sandy Hook to this junction, is a few miles longer than the direct line, yet on account of the Gulf Stream it is in *time* the shortest distance that a steamer can take. From the Capes of Delaware it is obviously the shortest. . . . .

"I will close this report with a recapitulation as to distances and courses by each lane, between New York, Halifax, and Philadelphia, on one side, and Cape Clear and the Scilly Isles on the other; first begging leave to say that, according to my computation, founded on such statistics as I have touching the velocity of the Gulf Stream, if two steamers bound for Cape Clear, and of exactly equal speed, were to start from Halifax, to see which should first get into the great circle part of the lane to Europe from New York, and if one were to go straight for it by steering East, and the other were to follow the European lane from Halifax as projected on the chart, this one would reach the point of destination quite as soon as the other, the drift of the Gulf Stream compensating for the goeater distance.

" DISTANCE BY LANE TO AMERICA.

			By Great Circle.
" From Scilly Isles to	Halifax	2,351	2,305
" "	Capes of Delaware	2,948	2,909
" "	Sandy Hook	2,882	2,840
" From Cape Clear to	Halifax	2,192	2,170
" "	Capes of Delaware	2,789	2,765
" "	Sandy Hook	2,723	2,695
" "	Do by actual average		2,754

" This statement shows that by the lane to America the distance is actually shorter, both to Sandy Hook, and, we may infer also, to the Delaware, than the average distance by present route; for the route actually pursued by the steamers now, both to Sandy Hook and the Delaware, may be considered the same from Cape Clear or the Scilly Isles, as far West as long. 70°.

" DISTANCE BY LANE TO EUROPE.

	To Scilly Isles.	To Cape Clear.
" From Halifax	2,436	2,285
" Capes of Delaware	3,024	2,873
" Sandy Hook	2,980	2,829

" Besides the detour from the great circle which a vessel from New York, Halifax, Boston, or Philadelphia would necessarily make by following the European lane to Cape Clear, it would require an *additional* detour of only 15 miles for vessels bound into the English Channel to use it also as far as Cape Clear. This lane, therefore, will, in consequence of the favourable currents of the Gulf Stream, put a vessel into Southampton quite as soon as she could reach that port from New York or Philadelphia by the great circle route. Vessels from Halifax will have to make the greatest detour of any by adopting the lane to Europe; but for them it is less than 100 miles out of their way as they now go, and it will prolong their average passage eastwards, perhaps, two or three hours. I say *perhaps*, because I am not sure but that the steamers from Halifax and New England are set back by the cold current 20 or 30 miles on the route now used for the eastern passage. The Gulf Stream, even from where they will join it by this lane, will set them forward, on an average, 40 or 50 miles at the least. It seems, therefore, that the attractions of this lane as it regards safety should more than outweigh the *probable* loss of an hour or two during the passage. When I speak of distances by the lanes, it should be recollected that the *middle* of the lane is meant, as per following table of courses and distances.

. . . . . .

"LANE TO AMERICA.

	Course.	Distance.
"From Scilly Isles to Cape Clear,	W. 33°.7 N.	159 miles.
„ Cape Clear to lat. 51°23′, long. 15°.0′,	1°.55′ N.	187 „
„ lat. 51°.23′, long. 15°0 to lat. 51°.16′ long. 20°.0′	2°.17′ S.	187 „
„ „ 51.16 „ 20.0 „ 50.56 „ 25.0	6.5	189 „
„ „ 50.56 „ 25.0 „ 50.23 „ 30.0	9.50	193 „
„ „ 50.23 „ 30.0 „ 49.36 „ 35.0	13.31	199 „
„ „ 49.36 „ 35.0 „ 48.33 „ 40.0	17.45	207 „
„ „ 48.33 „ 40.0 „ 47.15 „ 45.0	21.8	216 „
„ „ 47.15 „ 45.0 „ 45.38 „ 50.0	25.10	228 „
„ „ 45.38 „ 50.0 „ 45.00 „ 51.45	27.13	83 „
„ „(a) 45.00 „ 51.45 „ 44.10 „ 55.0	19.45	148 „
„ „ 44.10 „ 55.0 „ 42.40 „ 60.0	22.27	236 „
„ „ 42.40 „ 60.0 „ 41.42 „ 65.0	14.34	231 „
„ „ 41.42 „ 65.0 „ 40.30 „ 70.0	17.45	236 „
„ „ 40.30 „ 70.0 Sandy Hook,	0.43 S.	183 „
„ „ 40.30 „ 70.0 to Capes of Delaware,	W. 22.8 S.	249 „
„ „(a) 45.0 „ 51.45 to Halifax,	3.53 S.	503 „

"LANE TO EUROPE.

	Course.	Distance.
"From Capes of Delaware to lat. 39°40′, long. 70°.0′	E. 10°46′ N.	236 miles.
„ Sandy Hook to lat. 39°.40′, long. 70°.0′	E. 14.29 S.	192 „
„ lat. 39.40′, long. 70°.0′ to lat. 40°.31′, long. 65°0′	12.24 N.	237 „
„ „ 40.31 „ 65.0 „ 41.9 „ 60.0	9.39	227 „
„ „ 41.09 „ 60.0 „ 41.33 „ 55.0	6.5	225 „
„ „ 41.33 „ 55.0 „ 41.53 „ 50.0	4.57	232 „
„ „(b) 41.53 „ 50.0 „ 43.55 „ 45.0	29.6	251 „
„ „ 43.55 „ 45.0 „ 45.46 „ 40.0	27.28	241 „
„ „ 45.46 „ 40.0 „ 47.11 „ 35.0	24.4	226 „
„ „ 47.18 „ 35.0 „ 48.32 „ 30.0	20.18	212 „
„ „ 48.32 „ 30.0 „ 49.30 „ 25.0	16.21	206 „
„ „ 49.30 „ 25.0 „ 50.14 „ 20.0	12.46	199 „
„ „ 50.14 „ 20.0 „ 50.45 „ 15.0	9.17	192 „
„ „ 50.45 „ 15.0 to Cape Clear,	E. 4.34 N.	189 „
„ Cape Clear to Scilly Isles,	E. 27.39 S.	151 „
„(b) Halifax to lat. 43°.30′, long. 60°0′	E. 20.7 S.	163 „
" lat. 43°.30′, long. 60°.0′ to lat. 42°.30′, long. 55°.0′	15.17	181 „
„ „ 42.30 „ 55.0 „ 41.53 „ 50.0	9.28	225 „

The courses and distances are for the "middle" of the lanes.

"Thus it appears that one lane will practically shorten the distance from Cape Clear to Sandy Hook and the Delaware by 30 miles, while the other prolongs the distance going to Europe 75 miles; which prolonged distance, when measured not by safety, but *in time* alone, the Gulf Stream, better weather, and diminished frequency of fogs, will more than compensate for. In my judgment, these lanes, if properly followed, will make the average length of passage, as determined by the mean of all for the year, probably less each way, certainly not more than hour or two longer than it now is. Individual passages coming will, perhaps, not be made so quickly as they have been, but, on the average, trips will be shortened."

Admiral FitzRoy has also devoted some attention to this subject, and it is our duty to allude to it here.

"Another question appears to require notice in these pages, because it is still a 'moot point' with many persons interested in navigating the Northern Atlantic. In a well-known publication Maury particularly recommended 'Lanes for steamers.'

"If steamers could always steer direct courses, being full-powered, and not liable to be headed off in occasional heavy seas, such an arrangement might be advantageous; but as it is otherwise, and as screw (auxiliary or mixed) ships sail while steaming, they *cannot* conveniently keep to prescribed 'lanes,' however desirable it might otherwise seem.

"However, as the traffic increases between Europe and America, some special arrangement may be required, even more urgently than now; in which case it might perhaps be found practicable to consider an imaginary line, from latitude 50° and longitude 20° to the crossing of 45° N. and 55° W., the 'line of *separation*,' northward of which should go all vessels bound to the westward, and south of it all those heading to the eastward.

"A great safeguard would be legislative enactment against high speed during fog, heavy rain, or snow:—authorizing a *majority* of passengers to make objection; to inspect, note, and sign the log, before disembarking; and, by a quorum, to give subsequent evidence."—"Meteorological Papers," 1858.

11.—ROUTES BETWEEN NORTHERN EUROPE AND THE UNITED STATES.

"Get your offing and proceed as though you were bound to Rio, until you get into the N.E. trades. Then steer West until you fall in with the track of homeward-bound Rio traders, and then take that.

"Shipmasters, bound as above, should study the trade-wind chart carefully, in order to ascertain the extreme northern parallel near which they may rely upon finding the N.E. trades. The limits of these for the month should then be marked on the chart for every day reference and use. Having reached the mean polar limits for the month, it will, as a rule, be wise to go 2° or 3° further South in order to be sure of a good time in 'running down the trades.'

"Heaving reached the parallel of 30°, between 20° and 25° W., the best course is still a little to the West of South, until the parallel of 20° N. be reached. Do not care to make more than 5° of westing between these two parallels. From 30° N. to 20° N. by this route, the average time will be six days in fall and winter; five in spring and summer; thus putting you fairly within the trades in 18 days, on the average, from the Channel. It will be less from Lisbon, the ports of Spain, and Gibraltar.

"Now, suppose you enter the trades at a mean between the meridians of 25° and 30° near the parallel of 20°.; you should then 'run them down' on that parallel to 60° W. It will take two weeks to do this; total, so far, from the Channel, 32 days. Arrived here, you are in the fair way of homeward-bound Indiamen and Rio traders; and from this point every navigator knows the way to his port. If it be on the Atlantic, South of the Chesapeake, 10 days, on the average, will put him into it—total, 42 days from the chops of the Channel, and from Liverpool a day or two more, from Spain and Portugal a day or two less, to our Atlantic ports. By this route Savannah is brought nearer than Charleston; and Fernandina, made for the voyage *from* Europe, our nearest southern port. If, on the contrary, he be bound into the Gulf, it will take him 15 days, from the homeward-bound Rio track to put him into New Orleans or Mobile—total to Gulf ports, 47 days. These times are for ordinary sailers. A smart ship, with a smart captain, will always make the run in less time.

"This is a mere general sketch of the average route. Clever navigators will know from the charts how to vary it according to the season, and smart ships will gain upon the time, especially in reaching and 'running down the trades.'

"The sketch supposes the ship to enter the trades near the intersection of the meridian of 25° with the parallel of 20° N. There is no particular advantage in entering the trades either on that meridian or upon that parallel, or of entering them at all, if you happen to find good winds before you get to the trades.

"Thus, suppose a vessel to be off the Lizard, bound to Charleston, and that she have a 7 or 8 knot breeze that will enable her to lay up direct for port; why should she, as long as that wind lasts, run out of her way to find one that will not enable her to do any better? On the contrary, let her take advantage of it to make westing as fast as possible, and when it grows lighter or becomes adverse, as it will, then let her master stick her away South in search of a better wind.

"By doing this, the voyage, as I have sketched it, may be considerably shortened. The trade-wind chart will show the navigator exactly how far South he ought to go to look for the trades in each month. A reference to this, with the injunction to make the most of a good wind wherever he finds it, seems to be almost the only sailing directions that are required for the ports above named, especially in winter and spring.

"In the fall of 1856, Captain Macloon, of the *Georgia*, asked to have pointed out to him a better route from Liverpool to Savannah, stating that he had tried three, and had had by them two passages of sixty days each, and one of fifty-four. The reply was, in substance:—

"'You ask for a new way to come from Liverpool to Savannah. I have often thought that if I were in that trade, considering the passage is a long and tedious one, I should try it on the trades; that is, when you come out of Liverpool, proceed as if you were going to cross the Line, for which you will find sailing directions at page 381 *et seq.* of this work. Aim to cross the parallel of 30° N. in about 25° W., and then steer S.W. till you get well into the trades, even if you have to go as far as the parallel of 20° N. Now steer West till you get about the meridian of 60°, and then haul up for your port. If you have a smart ship, and will try this passage next November, you will make something like this run: From Liverpool to the parallel of 30° N., fourteen days; thence into the trades, say 22°—20°, five days; thence to the meridian of 60°, ten days; thence to Savannah, seven days; total, thirty-six days.

"'Within that time this passage *can* be made by this route; but as I suppose the *Georgia* is not a clipper, I will give you a week longer, or forty-three days; and if you do not make it in that time, I shall be disappointed.

"'M. F. MAURY.'

"From June to October, inclusive, there is not much choice of routes. On the one hand the N.E. trades are uncertain at that season of the year—the hurricane season; while to the North, calms are most prevalent, and gales less frequent. During these months, therefore, the best route is the straight course, for the Atlantic ports especially, taking advantage of the winds as they present themselves, for they are too unstable for one to go either to the North or South to look for them.

"At this season of the year the calm belt of Cancer is far North, and vessels that attempt to make westing between 28° and 34° will find the winds more baffling than they will either to the North or the South of those parallels. I caution navigators to avoid the belt between these parallels as much as possible; and when they *have* to cross it, I advise them to cross it nearly on a meridian. The trade-wind chart shows the position of this calm belt for each month.

Transient vessels, bound into Philadelphia and New York, would find the southern route, in the winter months, the most desirable on account of the weather, but the passage by it would, at that the most favourable season for it, be prolonged about a week on the average. The mistake that has been generally made by vessels taking the southern route is in their not going far enough South to get well into the trades. The trade-wind chart will leave no one in doubt upon that point, and no vessel attempting the southern route should think of steering North, whatever be her port, until she falls into the great track followed by the homeward-bound vessels from the other hemisphere. They cross 25° N. in about 65° W.

"Dull-sailing passenger-ships from the North of Europe would do well, especially from December to March, inclusive, by taking the southern route, even though they be bound to New York. If they cannot gain time by this route, they will gain at least smooth water and pleasant weather until they reach the offings of our own coasts.

"In summer the great circle route is the best to all the Atlantic ports. Even for the Gulf ports and Cuba the route in the summer time should be decided upon according to the wind one meets with while gaining an offing from Europe, rather than by considerations growing out of any fancied preference as to winds by the way. If they be such as to force you to the South, make as much westing as you can before crossing the parallel of 38°. Having crossed that parallel it is then advisable to go South in search of the N.E. trades to carry you into the Gulf.

"The reason why the North or Great Circle route is recommended to vessels bound into any of the Atlantic ports during the summer and fall months, from May to October, inclusive;—the reason why no preference is given to the southern route over the Great Circle during that period, even for Gulf-bound vessels; and the reason why such decided preference is given to the southern route, from December to March, may be gathered from a little reflection as to the course of the trade-winds and a careful consideration.

"From December to March gales of wind are most frequent along the northern route. These are mostly from the westward. This circumstance, therefore, is against the Great Circle route in the winter time. But from May to October the case is different. The gales along the Great Circle are much less prevalent.

"On the other hand, the trade-winds being a flow of air from colder to warmer latitudes, the difference of temperature between the calms of Cancer, from which, and the calm belt of the Equator, into which, the trade-winds flow, is greater in the winter than in the summer time. Consequently the more rapid, constant, and steady is the winter flow.

"In the summer, however, the air in the calm belt of Cancer, though it be as far North as 35°, attains as high a temperature, especially on the continents of Africa and America, as it does in the belt of equatorial calms. Then why should not the air flow towards those continental heated places as well as to the Equator? It does; and thus the trade-winds are frequently broken up in the summer time, and therefore they cannot be relied on as in winter. There is another reason why the winter trades should be fresher, more steady, and constant than the summer trades, and it is this: In the winter time the calm belt of Cancer, out of which the trade-winds flow, is some 500 or 600 miles nearer than it is in the summer time to the equatorial calm belt into which the trade-winds blow—the places of high and low barometer are then closer to each other—and no one engaged in the business of commerce need be told that the closer the places of demand and supply be together the more certain and steady will be the supply.

"And there is also another reason why the southern route, even by the Gulf-bound ships, should be abandoned, and why the Great Circle route should be preferred in the summer time, which is this: From July to October the hurricane season rages in the West Indies, while frome June to October the gale charts show the Great Circle route to be the least stormy.

"These remarks about the southern route, for vessels bound in winter as far North as the Chesapeake and New York, are intended especially for the passenger ships from Bremen, Hamburg, and other ports in the North of Europe, and they are earnestly commended to the attention of the masters of such ships."—*Maury.*

12.—FROM THE UNITED STATES TO THE EQUATOR.

In a previous section (pages 387—403) the passage from Europe to southern latitudes was discussed, and it was there shown that a more *westerly* crossing than has heretofore been usual has been attended with great advantage. To those pages we, therefore, refer the reader for the arguments which equally apply to the voyage from the western side of the Atlantic.

One of the great results of Captain Maury's inquiries has been the improvement of this route; and before such a mass of evidence had been collected, he recommended the Great Circle route to the longitude of 31° West on the Equator, as has been alluded to on page 394. This route considered in connection with the direction of the winds and currents is that which would naturally be chosen, if the crossing in that longitude would be considered to be a safe one to guard against being drifted to leeward of Cape St. Roque. Later experience has shown this fear to be fallacious in a great measure, and that it seldom occurs that vessels get into difficulties here.

Captain Maury devotes 220 pages of closely printed matter to this question; but, as his results will answer our purpose as well, we will briefly select the prominent points elicited:—

"Off St. Roque, in Brazil, the tracks of all vessels bound out of the North Atlantic ocean into the southern hemisphere fall in with each other. This is the great passway between the North Atlantic and the other great oceans of the world. Here the tracks of vessels, both from Europe and America, come together, whether their destination be around either Cape Horn or the Cape of Good Hope. Passing the offings of this great promontory of Brazil, the highway then forks. All vessels for India, China, or Australia, hugging the wind, turn off to the East; those that are bound around Cape Horn keep straight on; while those that are bound to the La Plata, to Rio, or any of the South American ports, being restricted in their courses by the winds on one hand and the land on the other, make the best of their way South, and turn off to the right as they reach the proper parallel. For these last, no further sailing directions are required after passing St. Roque. Their way is plain.

"The following time table, by the new route, the old and the middle, is derived from the logs of 1,160 voyages, and it therefore may be held to embody the experience of 1,160 navigators touching the best route hence to the 'fair-way of St. Roque.' The meaning of this table is so plain that analysis and discussion can add but little to the force of its own silent story. This table shows, for each month, the average time from port to 30° N.; the place of crossing that parallel, and the time thence to the Equator, and the place of crossing it, also, by each of the three routes. It shows, also, the distance from 30° N. to the Equator, and the average number of miles 'made good' daily for so much of each route as is included between these parallels.

"The daily distances give to the navigator practically the best idea possible as to the difference in the winds by these several routes as they cross the N.E. trade-wind belt, supposing that belt to lie all the year round between the Equator and the parallel of 30° N. Thus, in some months, as in October, for instance, there appears to be practically no difference in the winds, the average rate of sailing being 87 miles per day by the old route, 88 by the new, and 90 by the middle; a difference purely accidental, for the N.E. trades are, at this season, pretty nearly broken up. The gain by the new route, for this month, is not in crossing the trade-wind belt, but in reaching it. It takes, from our Atlantic ports, 12·6 days to reach it by the new route, 19 by the old, and 16 by the middle; and having crossed 30° N., the trade-winds thence to the Equator, at this season, are the same for all routes. Not so at other seasons.

"*Time Table by the Different Routes.*

		LONG. OF CROSSING—		DAYS FROM—		Distance from 30° N. to Line.		
		30° N.	Line.	Port to 30° N.	30° N. to Line.			
		Longitude.	*Longitude.*	*Days.*	*Days.*	*Total miles.*		*Average per day.*
December......	Old route	32·2° W.	25·5° W.	18·9	20·4	1835	equal	89
"	Middle "	36·6	29·1	12·5	20·5	1860	"	90
"	New "	44·7	31·5	10·8	15·0	1965	"	131
January	Old "	34·3	24·4	17·1	17·4	1885	"	108
"	Middle "	34·5	28·1	16·2	14·9	1830	"	125
"	New "	43·2	30	10·9	14·3	1960	"	137
February......	Old "	29·5	22·6	16·6	23·2	1835	"	79
"	Middle "	35·1	25·6	15·7	14·6	1870	"	128
"	New "	42·5	30·2	11·8	14·3	1940	"	135
March	Old "	31·2	23·7	16·4	20·9	1860	"	89
"	Middle "	33	28·2	14·2	17·2	1820	"	100
"	New "	42·5	29	11·5	16·3	1970	"	121
April	Old "	32·4	25·6	17·2	18·1	1835	"	101
"	Middle "	33·2	28·1	16·7	17·2	1825	"	106
"	New "	40·6	29·9	13·7	15·8	1910	"	121
May	Old "	33	24	22·8	19·4	1865	"	86
"	Middle "	36·4	29·1	19·5	20·2	1855	"	92
"	New "	41·2	31	12·9	16·5	1890	"	114
June..........	Old "	32·7	26·4	21·1	23·6	1830	"	71
"	Middle "	39·5	28·2	17·6	21·4	1920	"	90
"	New "	43·5	30·7	13·8	21·2	1945	"	92
July..........	Old "	31·6	24·2	24·6	20·3	1850	"	91
"	Middle "	42·1	27·7	15·1	24·4	1990	"	82
"	New "	45·2	30·5	13	20·5	2000	"	97
August........	Old "	31·6	25·3	22	22	1830	"	83
"	Middle "	41·4	26·7	16	22·2	2000	"	90
"	New "	45·7	30·4	14·2	24·4	2010	"	82
September	Old "	33·8	25·2	19·3	23·0	1867	"	81
"	Middle "	38·8	29	16·8	25·6	1880	"	73
"	New "	41·7	31·5	15·8	16·4	1890	"	115
October	Old "	28·9	26·7	19	20·7	1810	"	87
"	Middle "	33	29·5	16	20	1815	"	90
"	New "	43	31·7	12·6	21·9	1930	"	88
November	Old "	32	25·8	17·7	18·9	1830	"	97
"	Middle "	34·4	28·9	20·2	19·8	1825	"	94
"	New "	42·5	30·7	11·8	18·7	1940	"	104

"From 30° N. to the line, the average distance sailed daily during the winter months is 92 miles by the old route against 134 by the new. To what is this difference owing? Are the ships that take the new route the faster? That can hardly be. They are better navigated I have no doubt, for, as a rule, the log-books show that. But still that is not sufficient to account for all this difference. In winter a ship that takes the new route from 30° to the line will go nearly as far, on the average, in one day as she could go in a day and a half by the old route. This is owing, in a great measure, to the fact that the new route lies through a region of the ocean where the breezes are brisk, and brisk breezes always help to make both officers and crew brisk. This great difference of time and speed is probably owing to this circumstance more than to any other."

13.—MONITIONS AND INSTRUCTIONS FOR VESSELS NAVIGATING ON THE WESTERN SIDE OF THE ATLANTIC; BY MR. REDFIELD, OF NEW YORK.

1. Between the latitudes of 32° and 45° (the parallels of Georgia and Nova Scotia) a vessel bound to the *eastward*, on being overtaken by a gale which commences blowing from any point to the eastward of S.E., or E.S.E., may avoid some portion of its violence, by putting her head to the northward, and when the has veered sufficiently in the same direction, may safely resume her course. But, by standing to the southward, in like circumstances, she will probably fall into the heart of the storm.

2. Within the same region, a vessel, on being taken in a gale from S.E., or points near thereto, will probably soon find itself in the heart of a storm; and, after its first fury is spent, may expect its recurrence from the opposite quarter. The most promising mode of mitigating the effect of its violence, and at the same time shortening its duration, is to stand to the southward upon the wind, so long as may be necessary or possible; and if the movement succeeds, the wind will gradually head to the southward; and, if the wind does not veer, be prepared for a blast from the north-west.

3. With the wind at East or N.E., a vessel, by *scudding* a gale, shortens its duration. By scudding, on the contrary, before a south-westerly or westerly gale, you will thereby increase its duration.

4. A vessel, on pursuing her way to the westward or south-westward, meets the storms in their course, and thereby shortens the periods of their occurrence; and will encounter more gales in an equal number of days, than if stationary, or sailing in a contrary direction.

5. Vessels, on the other hand, while sailing to the eastward or north-eastward, or, in the course of the storms, will lengthen the periods between their recurrence, and consequently experience them less frequently than vessels sailing on a different course.

The difference of exposure, which results from these opposite courses, on the American coast, may, in most cases, be estimated as nearly 2 to 1.

6. The *barometer*, whether in the higher or lower latitudes, always sinks while under the first portion or moiety of the storm on every part of its track, excepting, perhaps, its extreme northern margin, and thus often affords the earliest and surest indication of the approaching tempest. The mercury always rises again during the passage of the last portion of the gale, and commonly attains the maximum of its elevation on the entire departure of the storm. The indications of the barometer ought not to be neglected, even should the fall of the mercury be unattended by any appearance of violence in the weather, as the other side of the gale will be pretty sure to take effect, and often in a manner so sudden and violent, as to more than compensate for its previous forbearance. The prognostics engraved on the scale are not to be regarded: the mere *rising* and *falling* of the mercury are the particulars to be attended to.

7. The vicissitudes of winds and weather which do not conform to the implied specifications, are more frequent in April, May, and June, than in other months. Easterly or southerly winds, under which the barometer rises, or maintains its elevation, are not of a gyratory or stormy character; but such winds frequently terminate in the falling of the barometer, and the usual phenomena of an easterly form.

SECTION IV.

PARTICULAR DESCRIPTIONS OF THE COASTS AND ISLANDS OF THE NORTH ATLANTIC; WITH DIRECTIONS FOR SAILING AMONG THE ATLANTIC ISLES.

☞ The BEARINGS and COURSES are those by COMPASS, unless where otherwise expressed: but those given thus [*W.S.W.*] signify the TRUE: and the given direction of Wind, Tide, and Current, is to be considered as the TRUE.

1.—ENGLAND, IRELAND, FRANCE, SPAIN, AND PORTUGAL.

It would be beyond the limits and scope of the the present work to enter into the minute description and directions for the extensive line of coast of North-western Europe, which would be sufficient guide to the mariner, such details must be sought for in the special Sailing Directions which accompany each chart, and where all necessary instructions are given.

This book being specially concerned with the general navigation and phenomena of the ocean, only those more prominent features sought for in an over sea voyage in the more frequented coasts, or those which may not be given in any other of our publications are here alluded to.

THE ENGLISH CHANNEL is amply described in our Sailing Directions for the same, and on pages 378 to 381 are given some useful remarks as to its general navigation, with which most sailors are now well acquainted. In passing from the Strait of Dover westward, the first place where shelter may be found on the English coast is Dungeness Bay. The lighthouses are amply described in the lists in the preceding part of the volume.

Dungeness lies 20 miles W.S.W. ¼ W. from the South Foreland, and 13 miles S.W. by W. ¾ W. from Folkestone. Upon it stands an excellent lighthouse and buildings connected therewith, *painted red.* It shows a brilliant fixed light at 92 feet.

Dungeness forms a remarkable shingle point, projecting in a S.S.E. direction 4 miles beyond the fair line of the coast, affording shelter in the East Bay from North round westerly to East, or for nineteen points of the compass. If there is any southing of East in the wind there is no shelter in either bay.

The quantity of bottom in both bays is fine sand over clay and mud, and excellent holding ground throughout.

To the W. ½ S., distant 3¼ miles from Dungeness lighthouse, lies the eastern end of a narrow ridge of sand, called *Stephenson Shoal;* it thence extends for nearly three quarters of a mile in the same direction, and carries a depth of from 19 to 23 feet water, with 4 or 5 fathoms around it. East Mill, at Lydd, on with No. 4 Coast Guard Houses, bearing N.N.E. ½ E., clears the Eastern end in 5 fathoms; Rye Church on with the New Church spire near Rye Harbour, N.N.W. ¾ W., clears the western end in 27 feet; Fairlight Church and Mill in one, leads half a mile to the south-west; and the South Foreland and Dungeness Lights in one, three-quarters of a mile to the southward.

The *West Road* of Dungeness is that space between the first building to the westward of the lighthouse, and the Black coast guard buildings at Jewrys Gap. It affords good shelter against north-easterly winds with the wind as far to the southward as E. by S., and is much frequented by vessels bound to the northward. The best anchorage, in about 6 fathoms, is with Romney Church tower in one with Lydd Church, and Dungeness Lighthouse E. ½ S. Smaller vessels may run further in towards the beach, guarding always against a sudden shift of wind. The western tide runs easy, and affords a good slack for running or working in.

East Road affords good shelter to vessels of all classes in from 4 to 12 fathoms, upon pretty good holding ground with the wind between N. by E. and S.W. The best position for anchoring is, Lydd Church just open to the northward of No. 2 Battery, and the lighthouse bearing S.W. by W. ½ W., in 7 fathoms water.

The Royal Sovereign Shoals are a number of rocky banks which lie directly in the track of vessels proceeding between Beachy Head and Dungeness. The principal names to them are, the Royal Sovereign, Horse of Willingdon, Elphick Tree, Rattan Shoal, Kinsman Nab, Long Shoal, and Southern Head. The *Royal Sovereign* has only 10 feet water on its shoalest part. It lies E.S.E. ¾ E. 6 7-10ths miles from the signal house on Beachy Head, and the marks for the shoalest part are, the first tower standing to the eastward of the Grand Redoubt at Eastbourne in one with the western edge of Willingdon chalk-pit, and Fairlight Mill just opening of Hastings Castle Cliff. A nun buoy of large dimensions, painted black, and surmounted by a staff and ball, is moored half a cable's length to the southward of the 10 feet patch. The *Horse of Willingdon* consists of stone and rock, and lies N.W. by W. 2 miles from the Royal Sovereign Buoy.

Seaford Cliff, kept in sight to the southward of the pitch of Beachy Head, will lead at least 2 miles to the southward of the Royal Sovereign Shoals. Beachy Head light, kept open of the next eastern cliff, also leads outside all the shoals. Fairlight Mill, in a line with the N.W. part of the cliff eastward of Hastings, leads to the eastward of them.

In the STRAIT OF DOVER are some shoals of coarse sand and shells which very much contract the navigation, of which the Varne and the Ridge are the most dangerous. Besides these there is the Bassurelle with 22 feet, and the Vergoyer with 12 feet, least water. Their position will be known by the chart.

The *Varne*, the northernmost shoal, is steep-to, and runs in a N.E. by E. and S.W. by W. direction, and is about 4½ miles in length between the depths of 7 fathoms at each end; its breadth varying from half to three quarters of a mile. The shoalest water on it is 9 feet at about a mile from its north-east end. At its west end is a light vessel showing a quick revolving *red* light, and at 5 miles N.E. by E. ½ E. of it is a red beacon buoy. There are strong ripplings over this bank both at springs and neaps, and during tempestuous weather a heavy sea, which would endanger any vessel attempting to cross it. Folkestone Church seen between two conspicuous chalk-pits on the face of the distant hills, N.W. by N., clears the north-east end of the shoal in 7 fathoms, and leads a mile to the north-eastward of the shoal patch of 9 feet which bears S. by W. ½ W., 8½ miles from Dover Castle; and the eastern terrace at Sandgate between the above chalk-pits N. ¾ W., or the square tower of Lympne Church on with Lympne Windmill, clears the south-west end.

The north-east end of the *Ridge* (or *le Colbart*) in 7 fathoms lies about 2 miles to the south-eastward of the body of the Varne, having 16 to 20 fathoms in the channel between them; it then takes a S.W. ¼ W. direction for about 8½ miles to the same depth, and is about three quarters of a mile broad. Like the former shoal, it is steep-to, and composed of sand and broken shells, the shoal patches lying in ridges across the stream, which occasion strong eddies even at neap tides. There is much sea on it during a weather tide, and in bad weather it breaks upon the shoalest parts; no vessel should therefore at that time attempt to cross it under any circumstances. The shoalest water of 6 feet lies about 2¼ miles from the south west end, with the summit of Mount Couple a little open to the southward of Cape Grisnez; S.E. $\frac{3}{4}$ E., 13$\frac{3}{4}$ miles from Dungeness Lighthouse, and W.N.W. $\frac{1}{4}$ W. 10$\frac{1}{2}$ miles from Cape Grisnez. The mark for the north-eastern extreme of the shoal, in 7 fathoms water, which bears N.W. $\frac{1}{4}$ N. 8$\frac{3}{4}$ miles from Cape Griznez, is, the high trees at the back of Hythe in one with the Swiss Terrace at Sandgate; and Mont Lambert (a very conspicuous hill near Boulogne, with a fort on it) in one with the dome of the new cathedral in the Upper Town of Boulogne, S.E. $\frac{1}{4}$ E., or Sandgate Swiss Terrace between the two chalk-pits, N. $\frac{1}{2}$ E. or the Revolving Light on Cape Grisnez bearing E. $\frac{1}{2}$ S., leads to the southward of the south-western extreme in 9 fathoms.

From *Beachy Head* to the S.E. part, or Elbow, of the Owers (the light-vessel), the bearing and distance are W. by N. 12 leagues; and to St. Catharine's Point, on the same bearing, the distance is 20 leagues. From Beachy Head to Selsea Bill the coast trends in a curve; but the direct bearing and distance are W.N.W., $\frac{1}{2}$ W. 13$\frac{1}{4}$ leagues.

Seaford Road.—Between Shoreham and Beachy Head the depths very gradually decrease from the offing towards the land, and vessels may anchor all along the coast with off-shore winds in from 2 to 9 fathoms water; but the anchorage of most general resort is that in Seaford Road, which lies between the tide mill which stands to the eastward of Newhaven and the Mortella Tower near the beach at Seaford. The best anchorage in the road is between the tower and Blatchington Battery, with Beachy Head Lighthouse just shut in by the cliffs, over a bottom of sand, shells, and mud. At this anchorage Beachy Head Cliffs will afford shelter with the wind as far southerly as E.S.E., and it is therefore superior to the western Bay of Dungeness. Seaford Head is often mistaken for Beachy Head by vessels coming up channel within 4 or 5 miles of the land; they may however be distinguished by there being a small building on the highest part of Beachy Head, whereas there is nothing on the former but a conspicuous large green pactch on the face of it.

At nine miles westward of Seaford Roads is the town of Brighton, the lights of which are conspicuous at night, and at 8 or 9 miles beyond this is Worthing, another watering place. The coast is generally very low.

At 5 miles to the N.N.E. of Worthing is Chanctonberry ring, a large circular thick grove of trees 964 feet above the sea, and is frequently the first object seen on making the land. A reference to this object would often assist the mariner when all other objects are too low or indistinct to be observed.

At 13 miles beyond Worthing is Selsea Bill, off which runs the line of shoals marked at its S.E. point by the Owers Light-vessel, showing one light. These shoals are described in the Directions for the Channel.

The anchorage in Pagham Bay between the Owers and the coast is familiar to seamen under the name of the *Park*, which is well sheltered from the violence of W. and S.W., winds, but most unsafe with the wind anything to the eastward of south. The holding ground is excellent, being a stiff clay under a thin crust of gravel; but the anchorage cannot be recommended as a refuge for large vessels owing to the frequent and sudden shifts of wind, and the astonishing rapidity with which the sea gets up. The above observation is particularly applicable during the winter months, for a long dreary night in the Park is anything but a desirable situation to be placed in.

Small vessels may bring up with the Mixon Beacon bearing W.S.W., and Pagham Watch House on with Chichester Spire, in about 3 fathoms at low water; but large vessels should anchor further out and more to the eastward, with the spire to the westward of Bow Hill, the Mixon Beacon bearing W. by N., and the Owers Light-vessel S. by W. $\frac{1}{2}$ W., both for geater depth of water and increased facility of getting away from the coast, in the event of being surprised by a shift of wind. The nearer the Mixon is approached, the stronger the tide runs.

SPITHEAD.—The limits of the best anchorage at Spithead are Southsea Castle N.E. to E. by N., and Gilkicker Point N.N.W. to N.W. A good berth for large ships is with Portsdown Windmill on the end of the trees on Portsmouth Lines N.E. $\frac{1}{4}$ N., and Kickergill Tower on the western end of Monkton Barracks N. by W. ¾ W. in from 10 to 12 fathoms water; but small frigates and vessels of light draught may berth themselves nearer to the Spit sand, in about 7 fathoms, care being taken not to open Kickergill Tower *from* the east end of the Barracks. Vessels moored should have open hawse to the southward.

The navigation of the Solent and the excellent anchorage of Southampton Water, with the entrance by the Needles Channel, will be found in our Directions. They require too much space to be described here.

In the southern part of *Poole Bay* the ground is clear, and there is an open anchorage in 6 or 7 fathoms water, over sand and gravel, with Studland Church bearing west 1½ miles. In the northern part of the bay, however, are several patches of dangerous rocks, with 6 and 7 fathoms between them.

Studland Bay lies on the north side of Standfast Point, and affords good anchorage for small vessels during westerly winds; and if a south easterly gale should drive them from their anchors, the banks within are soft mud. The best anchorage is off three remarkable projections in the chalk cliff, called the Yards, in about 2 fathoms water, and near the following bearings:—the Agglestone (a large square rock on a small hill half a mile inland) open to the northward of the coast guard buildings on Red-end Point, W. by N. ¾ N., and Old Harry S.E. by S.

Portland.—The Roads of Portland lie between Weymouth and the North end of Portland, which bears from the jetty of Weymouth S. by W. ¼ W., distant 2¼ miles. In these roads the ground is excellent, in from 6 to 7 fathoms, with the North Point of Portland bearing S. by W. Portland Castle S.W. about 1¼ miles distant, with the West Cliffs of Portland just open, and Bellefield Hall on with Weymouth or Sandsfoot Old Castle, N.N.W. ¾ W. There is also good ground in 12 and 13 fathoms, with the North Point of Portland S.S.W. ¼ W. In these roads you will ride safely with westerly and southerly winds.

The Bill, or southernmost point of Portland, lies W. by N. 5 leagues from St. Alban's Head, and about 3½ miles to the southward of the North point of the isle. It has a white obelisk on its extremity, and half a mile within it are two white lighthouses, which bear, when in one, N.N.W. ½ W., and are 1,509 feet apart. When in one they lead between the Shambles and the Bill, but allowance should be made for the set of the tide.

The lights of Portland are brilliant and *fixed*. Height of the high light, 194 feet above the sea, and seen at 4 leagues. The latter is visible from W.N.W. seaward to E. by N.

SHAMBLES.—The eastern end of the Shambles, a dangerous shoal, of coarse shingle, sand, and shells, bears from St. Alban's Head W. ½ N. 11½ miles, and from the Bill of Portland, E.S.E. 4 miles. The bank extends thence W. by N. 2 miles, and the West end lies with the Bill of Portland N.W. ½ W. 2½ miles. It is steep all round, having 14 fathoms close to it; but always shows itself by a break or ripple. On its East and West ends are from 6 to 7 fathoms; but, near the middle, are only 11 feet at low water. The shoal, in fine weather, is always distinguishable by the rippling. The tide rises over it about 10 feet perpendicular. Its outer end is marked by a light-vessel.

The *breakwater* abuts on to the N.E. point of the island, and runs off shore in a direct line East, by compass, for 3,500 feet; but at the distance of 2,000 feet from the shore is an opening of 400 feet wide, between two circular heads of masonry. From the eastern end it curves round to a true *North* direction for 5,600 feet, making the total length of the breakwater, when completed, 3,000 yards, or nearly 1¼ miles. Its outer extremity will be in 8 or 9 fathoms water, and the depth of 4 fathoms will be found 1½ miles within the pier.

During the progress of the works, a *red light* is shown from the extremity of the stage, elevated 30 feet, visible 8 miles off. As the stone thrown over during the works extends beneath the water to some distance, vessels should not approach it within a cable's length. This refuge harbour affords shelter from nearly all winds.

TORBAY.—The entrance into the bay, formed by Hob's Nose and Berry Head, is 3½ miles wide, and the ground within is generally clear and good. In sailing in, you may, if necessary, keep close either to Berry Head or the Orestone. To sail between the Orestone and Loadstone, keep nearly in mid-channel, taking care not to approach too near the West side of the Orestone, as the water is shoal for half a cable's length from the rock on that side. To the S.W. by S., a little more than a cable's length from the Orestone, there is a sunken rock, with only 6 or 8 feet over it at low water.

Ships may anchor in Torbay in 6, 7, 8, and 9 fathoms; the ground is strong clay, and remarkably good. The common marks for anchoring are, Berry Head South, S. by E., or S.S.E., and Brixham Church on with the pier-head. The best ground is about a mile a from Brixham pier-head, in 7 fathoms of water; but ships may ride, well sheltered, on the North side. A great swell is forced into the bay by easterly winds; but, about 1½ miles from Brixham pier-head, there is an underset to windward, by means of which ships ride easier than in other parts of the bay. In general, the deeper that you anchor in the bay, the better will be the riding, being more out of the stream. From the middle of the bay, in 7 fathoms, Berry Head bears S.S.E., and the Orestone E.N.E. Small vessels commonly lie aground at Brixham, on the South side, and at Torquay, on the North side, of the bay.

Dartmouth.—The entrance of Dartmouth Harbour lies nearly 2 leagues from Berry Head, and about 7 miles to the N.E. of the Start Point. It is situated between two high lands, within which is an excellent harbour, sufficiently capacious to contain 300 sail of vessels, secure from all winds, in from 7 to 15 fathoms.

The coast between *Berry Head* and the entrance of *Dartmouth Harbour* is rocky; but the rocks, some of which are above water, as represented on the charts, do not extend more than three-quarters of a mile off, but they require the utmost caution.

The entrance of the harbour is narrow, and the opening does not readily unfold itself to vessels coming from the southward: the square steeple, however, of Stoke Fleming Church, which stands very conspicuously near a white house upon the land to the south-westward of the harbour's mouth, as shown in the chart, will serve to mark its position nearly, until, by a nearer approach, Kingswear Old Castle and St. Petrox Church become visible. St. Petrox Church and Dartmouth Castle are on the western side of the entrance, within St. Petrox Point.

A fixed light, of a deep *red* colour, is shown from the tower of the castle on St. Petrox Point, at the height of 49 feet above the level of high water, and visible when bearing between N.W. ¾ N. and N. by E. at the distance of 7 miles.

Ships coming in from sea, if obliged to wait for an opportunity of entering, generally anchor without, in the part called the RANGE, within Blackstone and Froward Points, which has a depth of from 7 to 10 fathoms. Here they lie safely when the wind does not blow in; and when it does, it will lead into the harbour. From S.W. to E.S.E., the wind blows true in, and from N.W. to N.E. true out: all other winds blow in flaws. Pilots are always ready, with boats for towing and a steam-tug whenever required: a signal may, therefore, be hoisted for one, when approaching the Range.

Exclusive of the *Mewstone*, and other rocks above water, which lie on the eastern side of the Range, there are several sunken rocks, extending outward to the distance of 150 fathoms from the shore on the same side. For the outermost of these rocks the mark is a house, with a balcony, on the North end of Custom-house Quay, bearing N.N.W., on with the easternmost end of Dartmouth Castle. This mark, will, therefore, lead clear of the rest. The Castle Ledge Buoy is *black*, and lies in 4½ fathoms, with St. Petrox Church in line with the centre of a grove of trees on the back land, N.N.W., and a conspicuous double pointed rock off Comb Point in line with the house on Sladton Rock, W. ½ S. On the western side of the Range is the *Homestone*, a rock having only 5 feet over it at low water, which lies about 200 fathoms S.S.W. from a high and steep rock, called the *Blackstone*, lying near the western shore. The buoy on it is *black and white, in circular stripes*, and lies in 7 fathoms, with Kingswear Old Castle, its breadth open of the Blackstone Beach, N.E. ½ N.; and Stoke Fleming

Church, its length down the slope of Comb Point, W. by N. The saddle of the Blackstone bearing N.E. by N., and on with Kingswear Castle, is the mark for the Homestone.

The PIN ROCK, a very formidable danger, lies one-third of a mile eastward of the Homestone. Although well known to the fishermen and pilots, it has only recently been placed on the Government charts, having escaped the vigilance of former surveyors. On the Pins Point a depth of 13 feet was found, and it may perhaps have less water.

The cross marks for the 13 feet are: the East Blackstone and south point of Mewstone in one, E. ½ S., and Dartmouth Castle flag-staff in one with a white house in trees on Yarrow Bank N. ½ W.; the same house open of Battery Point clears it to the eastward, and shut in with St. Petrox Church, to the westward. There is a safe channel between the Pin and the Homestone.

The following mark is to be observed as a *thwart mark for the Sunken Rocks on the East side.* To the eastward of Dartmouth is a red point, beneath which, near the water, the earth appears black, and there is a white stone in the red part above. When the white stone comes directly over the black part below, you will be abreast of the rocks. The town quay, if it can be seen, kept on with the middle of the entrance of the harbour, will lead clear of them.

To sail in for Dartmouth from the eastward, with a leading wind, from off the Mewstone steer for Comb Point, until you bring Kingswear Point on with Dartmouth Castle; thence, by steering with this mark on, you will clear the eastern ledge. When nearly abreast of the Blackstone, keep the castle open on the port bow, until the southernmost house in Kingswear is open of Dartmouth Castle Point. This mark leads clear of the rock called the Cheekstone, whence you may run in and anchor. *A chequered black and white buoy,* and marked "Cheekstone," is placed in 3¾ fathoms water, about 25 or 30 fathoms S.E. of the rock. From it the bearing is, the southernmost house at Kingswear, touching the point under St. Petrox, N. ¾ W.

To sail in from the westward, with a leading wind, give a good berth to the Comb's Rocks, which lie off the shore on the West side; then steer to the eastward, until Kingswear Castle is open to the eastward of the Blackstone. This mark kept on will carry you clear of the Homestone. With Stoke Church shut in, you will have passed the Homestone, and may steer for the Blackstone. Having passed the latter, keep Dartmouth Castle on the port bow, and proceed as above.

Great inconvenience attends the ingress to, and egress from, Dartmouth Harbour, in consequence of the frequent and violent flaws of wind, which issue very suddenly from the high lands. Therefore no square-rigged vessel should attempt to enter or leave the harbour without a leading wind. Between S.W. by S. and S.E. by E. the winds blow truly in, and as truly out when between N.W. by N. and N.E. Even cutters cannot always succeed in getting to sea with S.W. winds.

Start Point may be well known from its rugged cock's-comb-like appearance; the hillocks on its ride within the lighthouse are five in number, each about 200 feet in height. Peartree Head, within the point, rises to 386 feet.

There are no dangers in the vicinity of its projecting points to the south and S.W., except the Pear Tree, the Start, and Cherrick Rocks; the latter lies S. ¾ W. upwards of 2 cables' lengths from the point, and is just awash at low water springs. A sunken rock, with only 12 feet water over it, also lies at the same distance due east from the lighthouse; to avoid it a vessel should not shut in the Village of Hall Sands with the Start Point, until the Pear Tree Rocks open out to the southward of the Start Rocks, when, by giving the latter a berth of about 2 cables' lengths, she may proceed to the westward.

A Lighthouse has been erected upon the Start at 140 yards its extreme point; it is a stone tower 94 feet high, exhibiting a powerful revolving light, at an elevation of 204 feet above high water, and showing a bright flash every minute to seaward, till it comes to the bearing of W.S.W., on which it is eclipsed, and may be seen in clear weather at the distance of 19 miles. A fixed light is also shown in the same tower, 1?? feet above high water, in the direction of Berry Head, visible only when the [illegible] bears W. $\frac{1}{2}$ S. and S.W. by S., to guide vessels to Dartmouth and the [illegible]ead.

To the north-eastward of the Start lies a dangerous bank of pulverised shell and fine gravel, called the Skerries.

To avoid the Skerries at night, a vessel should not approach them within 20 fathoms water; and in coming from the northward, if wishing to run to the westward of them, she should keep the fixed light on a S.W. $\frac{1}{2}$ S. bearing, and pass the Start at a distance of a quarter of a mile on its northern side, and half a mile on the southern. When Start Light bears N.W. $\frac{1}{2}$ W., she will be to the southward of the Skerries.

The Eddystone Lighthouse, with its fixed light, bears E. $\frac{1}{2}$ S. 38$\frac{1}{2}$ miles from the Lizard, and W.N.W. $\frac{1}{2}$ W. 18 miles from Bolt Head, near Salcombe. It has been painted with a broad red stripe, which will distinguish it at once from the Bishop Rock Lighthouse.

From the Eddystone lighthouse, at the distance of 3$\frac{1}{2}$ miles, N.W. by N. by N., there is a bed of sunken rocks, called the *Hand Deeps*, which lie nearly in the fairway of ships bound bound from the westward for Plymouth Sound. On the shoalest part is a pointed rock (so far as can be judged by the lead), on the shoalest part of which are from 22 to 24 feet at low water spring tides. The shoal has, commonly, a ground swell on it; and, with a S.W. gale and ebb tide, the sea here runs very high, so that a ship may depress (or *send*) 5 or 6 feet.

The best mark for clearing this dangerous shoal is furnished by the Breakwater lighthouse, in one with with Penlee Point, E. by N.; it leads a long mile to the northward of them, and a mile to the S.E. of them when in one with Mount Batten in Plymouth Sound, N.E. by E. $\frac{3}{4}$ E.

PLYMOUTH SOUND is the most capacious and secure harbour in South Britain, The magnificent Breakwater is 5,000 feet long, at its West end is the lighthouse. showing a red light seaward, and bright northward of S.W. $\frac{1}{2}$ W. over the anchorage within. Below this red light is a leading bright light, visible only when between the buoys marking the western entrance. A large bell is tolled in fogs or snow storms.

On the East end of the breakwater is a beacon, a granite obelisk, surmounted by a staff and ball. This ball is so constructed that ten persons might find shelter within it should they be cast away on the breakwater.

Besides these standing marks the Trinity Corporation have placed an obelisk, or *beacon*, on the *Hoe*, at the head of the Sound, which has since been heightened, and painted red and white in horizontal stripes.

The entrance of Plymouth Sound is distinguished on the eastern side by two remarkable large rocks, which lie upou the extremity of reefs that stretch from shore. Of these rocks the southernmost is called the *Mewstone*: the northernmost, the *Shagstone*. The first lies nearly S.W. by S., half a mile from Wembury Point, or the S.E. point of the Sound, and has, just without it, a smaller one, called the *Little Mewstone*, from which a shoal stretches to the W.S.W. nearly 2 cables' lengths.

The bearing and distance from the Great Mewstone to Rame Head are N.W. by W. $\frac{1}{2}$ W. 4$\frac{1}{2}$ miles, and to Penlee Point N.W. by W. 3$\frac{1}{2}$ miles. The entrance of Plymouth Sound lies between the two latter, and it may, from a distance, be readily known; the land over Plynouth being high double land. On a near approach, Rame church will appear open to the northward of Rame Head, and the square tower of Pen[illegible] will be seen standing upon the highest part of the land over Penlee Point, which affords the more certain mark.

KENNY ISLET, or *Kenny Rocks*, appears like a black rock, lying N. by W. nearly 1 mile from the Mewstones, and at about one-eighth of a mile from shore. At the distance of a cable's length W.N.W. $\frac{1}{2}$ W. from the islet stands the *Shagstone*.

The TINKER, and the KNAP and PANTHER, are well known as the principal shoals in the lower part of the Sound. Of these, the outer one is the TINKER. This shoal, which it a cable's length broad, stretches nearly one-quarter of a mile East and West, and its western extremity lies N.N.W. ½ W. more than 1½ miles from the Little Mewstone. It has on it from 10 feet to 3½ fathoms of water. The shoalest part of the western end, on which, without the depth of 14 feet, there is a *white buoy*, lies with Penlee Point (the S.W. point of the Sound) on with a dark square spot in the valley to the northward of Rame Head, bearing W. by N. ¾ N., and the flagstaff on Mount Wise and the spire of St. John's chapel in one N. ½ E.

There is also a *white buoy* on the eastern side of the Tinker, which marks the *Eastern Channel*. With the Bolt Head open to the southward of the Mewstone, or hidden behind it, you will be well to the southward of the Knap and the Tinker.

The Knap and Panther are extremities of one rocky ledge, upon which there are 3, 3½, and 4 fathoms of water. This ledge is more than one-third of a mile in length, and extends in the direction of N.E. by E. ½ E. and S.W. by W. ½ W. Each end is distinguished by a *black buoy*.

A reef extends S.S.E. ½ E. nearly a quarter of a mile from Penlee Point, and terminates in a sunken rock of 12 feet of water, called the *Draystone*. A *checquered red and white buoy* has been placed on it. It lies in 5½ fathoms, 2 cables' lengths from the point, with Tor House (whitewashed and conspicuous) on with high water mark of Redding Point, and the Breakwater beacon on with the upper corner of the northernmost quarry at Bovisand.

WESTERN CHANNEL.—This channel, lying to the westward of the Knap and Panther, has sufficient depth for the largest ships; and is now the *principal* channel to Plymouth Sound.

Ships coming in here, for the Sound, should, in the first instance, to clear the Draystone, as well as the Knap and Panther, bring Plymouth church spire in a line with the Trinity red and white beacon, on the Hoe. A better mark than this is, to bring breakwater lighthouse in a line with the white tower on Mount Batten. To keep to the southward of it, you may keep the end of Bovisand Pier in a line with or open to the southward of the beacon on the East end of the breakwater.

The leading mark through the channel is, the breakwater lighthouse in line with the white tower on Mount Batten, at the entrance to the Catwater, bearing N.E. by E. ¾ E.

There is generally a good deal of sea running during the ebb tide, near the West end of the breakwater. Near the West end of the work a ship is very liable to miss stays in working out, by reason of a cross sea and an eddy tide. The ship should, therefore, be put about before she gets too near to the West end of the work, in order to avoid the risk of missing stays and drifting upon it.

To sail in during the night, bring the Eddystone light S.W., and steer N.E. by N. or N.E. by E., according to wind and tide, until you make out the breakwater light, which should be brought to bear N.E. by E. Continue in this direction until the water shoalens to 9 or 10 fathoms, which will be about three-quarters of a mile from Penlee Point; this side being the safest to run in by in the night, or in thick weather. Be careful to go no nearer to the point than in 9 fathoms, as this depth is but little more than half a mile from the shore. With the point W.N.W., you will be above the danger, and may then steer for Cawsand Bay, according to circumstances.

The EASTERN CHANNEL into Plymouth Sound should not be attempted by vessels of any considerable draught of water, unless with a free wind, because of the numerous rocks which are scattered in its vicinity, and the occasional send or depression of the sea there, with south-westerly and south-easterly winds. The mark for this Channel is, to bring the Beacon on the eastern end of the Breakwater in one with the Beacon on the Hoe bearing N. by E. ¾ E. easterly, which will lead between the Tinker and the Shagstone, and nearly up to the Breakwater in 6, 4, and 5 fathoms water.

In the centre of the fair-way, however, are three rocky patches, of 24 and 18 feet water, at low-water springs, the eastern extremities of which rather encroach upon this line of direction; two of these lie nearly half a mile to the southward of the Breakwater, the third about one cable's length; all three are marked by black and white checkered buoys; the Tinker by white buoys; and the shoal bank (which extends from the eastern shore and the Shagstone) by two red buoys. The above mark will lead in between these buoys, and is to be continued till Maker tower comes in one with the signal-staff on the Breakwater; then steer towards Staddon point, so as to bring the spire of Plymouth new church exactly in a line with the centre of Tor house, which will clear the latter shoal alluded to (the one of 18 feet). The Breakwater may be rounded for the anchorage at the distance of 60 or 80 fathoms, leaving the Leek bed and Duke rock to the northward. At night the light on the west Barbican pier-head, open of Mount Batten, bearing N.N.E. ½ E., leads through. There is no anchorage in this channel.

When running into or out of the Sound in the daytime upon any of the before-mentioned leading marks, bear in mind that, so long as the Bolt Head continues in sight to the southward of the Mewstone, you are without or to the southward of all the shoals, and that the Bolt Head shut in with the Mewstone, ranges very closely upon the tails of both the Tinker and Knap.

FALMOUTH.—From Rame Head to St. Anthony's Point the bearing and distance is W. ½ N. 32 miles. The harbour of Falmouth is one of the best in England. Its advantages arise partly from its peculiar situation, and partly from the influx of several rivers. The entrance is formed by the bold rocky coast of St. Anthony's Head on the East, on which is the revolving light, and by the headland called Pendennis Point on the West. This latter is distinguished by Pendennis Castle, which stands over it, on the summit of a hill. From the Point of St. Anthony to that of Pendennis, the bearing is N.W. by W., distance exactly 1 mile.

Within St. Anthony's Head, on the East side, are the castle and town of St. Mawes, which stand on the North side of St. Mawes' Creek, or the entrance of the River Penkule; and within Pendennis Castle, to the N.W., stands the town of Falmouth.

In the entrance of the harbour, at the distance of one-third of a mile to the S.E. by E. ½ E. of Pendennis Castle, and E. ¾ S. from Pendennis Point, is a rock called *Falmouth* or the *Black Rock*, which is uncovered, in spring tides, from 2½ hours ebb to 3½ hours flood. There is a beacon upon it, lately renewed, which sufficiently indicates its situation. Without this rock, at the distance of about a cable's length, S.E. by E. ½ E., is a rocky shoal of 16 feet of water, which lies with the garrison flagstaff on with the rock perch. Between this shoal and some rocks which lie off St. Anthony's Head, is the usual entrance into the harbour.

Without the entrance of the harbour is the *Outer Anchorage*, or what may be more properly called *Falmouth Outer Road*, from St. Anthony's Point toward the Manacle Rocks, where there is good anchorage with the harbour's mouth open, equal in point of riding to Mevagizey Bay, superior to Cawsand Bay, and very little inferior to Torbay, with the wind from S.W. round to the westward, and northward to the N.E. point of the compass.

The marks for the Old Wall, or Pinnacle Rock, which lies to the eastward of this anchorage, are, a small white bowling-green house, at Flushing (on the North side of the river, opposite Falmouth), bearing N. by W. ½ W., just over the northernmost or inner part of Pendennis Land; and Milor Point, nearly North, halfway between St. Anthony's Point and the extremity of the low rocks running off it. St. Mawes' Castle is, at the same time, hid by St. Anthony's Point.

A vessel from the westward bound to Falmouth by night should keep the Lizard lights in sight to the southward of the Beast until St. Anthony light bears N.N.E., to clear the Manacles.

In the daytime the Beast should be kept open of Black Head; and when St. Anthony lighthouse bears N.N.E., keep it on that bearing till Killigannoon house is in one with Penarrow or Mylor Point, bearing N. ½ E. easterly, which will lead in through the eastern channel, and through the narrows between the white buoy on

Falmouth bank and the black buoy on St. Mawes Bank, into Carrick Road, where a vessel may anchor in from 12 to 18 fathoms, or proceed on until Budoc Church comes over the rising ground of Trefusis Point, or the Summer House is in one with Falmouth Church bearing W. by S., which will lead through the Cross Road, till St. Keverne Church comes over Pendennis Point, bearing S.W.; with which mark she may anchor in St. Just Pool in from 12 to 15 fathoms, over a muddy bottom.

In hazy weather, a vessel should give St. Anthony Point a berth of 2 or 3 cables' lengths, and run in with the land of St. Mawes about a point on the starboard bow, and then steer for Penarrow Point. She should not approach the land of St. Mawes nearer than 2 cables' lengths, nor St. Mawes Bank within 9 or 8 fathoms. With the wind at East she will sail in free on the starboard tack, and at W.N.W. on the port tack.

Western Channel.—Vessels not drawing more than 18 feet may safely pass between the Black Rock and Pendennis Point, and at half tide there is water for ships of the line. By taking the centre of the channel, and steering a N. by E. course, it will lead up between the black and white buoys in the narrows; or when the Black Rock beacon and lighthouses are in one, steer for St. Mawes Castle until Killagannoon House comes on with Penarrow Point, bearing N. $\frac{1}{4}$ E., and proceed as before. In this channel a vessel will sail in free on the port tack, with the wind a N.W. by W.; and although the high land of Pendennis may cause it to baffle, there is no danger to be apprehended when she has shot within the Black Rock.

THE LIZARD.—The Lizard is a bold land, which lies 5 miles W. by S. from Blackhead, and W. $\frac{1}{4}$ N. 12$\frac{3}{4}$ leagues from the Eddystone. It may be seen 7 or 8 leagues off, in from 40 and 42 fathoms of water, and may be readily known by the two lighthouses which are erected upon it. These lighthouses, with *fixed* lights, about 222 feet above the level of high water, when in a line, bear W. $\frac{3}{4}$ N. and E. $\frac{3}{4}$ S., 223 feet from each other, and may be seen 6 or 7 leagues off. The towers are white.

This headland is one of the most noted among English navigators, as it is from hence that ships take their departure from the English Channel; and it is also the properest place for a landfall, when homeward bound. The position of the high lighthouse, according to the grand trigonometrical survey, is lat. 49° 57′ 34″, and long. 5° 12′ 4″ W.

MOUNT'S BAY.—This spacious bay lies to the N.E. of the Lizard, and is particularly distinguished by the high island called *St. Michael's Mount.*

St. Michael's Mount, which gives name to Mount's Bay, is a remarkable and picturesque isle, near the village of Marazion, 14 miles N.N.W. (by compass) from the Lizard Point, and 2 miles E.S.E. from Penzance pier. On its summit is a church and residence. At the bottom on the N.E. side is a small harbour. At low water there is a dry passage to the isle from the main land.

Upon its eastern side, at about 4 miles from the Lizard, and at a small distance from shore, lies a remarkable cragged rock, called the *Gull Rock;* ships bound up Channel, if opposed by an easterly or S.E. wind, may run in on the North side of this rock, and here find shelter, near the shore, in 8 fathoms of water; but great care must be exercised in order to guard against a sudden shift of wind.

On the West side of the Bay there is tolerable riding in Guavas Lake, near Newlyn with westerly and southerly winds; but near this place are two sunken rocks, called the *Lowlee* (marked by a red buoy) and the *Carn Base.* The first, which has only 5 feet over it, lies about one-quarter of a mile from Penlea Point, with the church of St. Paul bearing N.W. by W. $\frac{1}{2}$ W. The latter has 6 feet over it, and lies about one-quarter of a mile North from the former, with St. Paul's Church on with a long hedge, appearing end on, about halfway between Penlea Point and Newlyn, and bearing W. by N. Between these rocks, there is a depth of 10 fathoms.

In the winter season the anchorage in Guavas Lake ought not to be resorted to but as a preliminary to entering the pier of Penzance, or that of Mount St. Michael. In approaching the shore from the offing between the Lizard and Land's End, the depths of water will be gradually found to diminish, and the bottom is mostly of coarse sand, interspersed with whole and broken shells.

Near the shore, between Mount's Bay and the Land's End, there are several dangerous rocks. The first is the *Rundlestone*, a small rock, about 4 yards long and 2 broad, the base of which is dry at low water, and covered before half flood. It has a fine conical stone beacon on it. From this beacon the lighthouse on the Longships, hereafter noticed, bears N. 19° W. distant nearly 4 miles; the flagstaff on Point Tol-Pedan-Penwith N. 7° E. three-quarters of a mile; with the point distant a quarter of a mile. The ground without the Rundlestone is clear, but there are rocks and foul ground to the eastward and northward of it; therefore a passage within it cannot be recommended to strangers.

The *Wolf Rock and Beacon;* the rock, which is barely covered at high water in neap tides, bears from the Land's End, or the westernmost point of land, S.W. ½ W. 8 miles distant. Between the Rundlestone and this rock, there are from 20 to 36 fathoms of water. It is steep on all sides, and has within a cable's length of it from 30 to 40 fathoms all round.

The sea makes such a roaring on it, that the noise may, in moderate weather, be heard a great way off.

Longships.—About 3 miles N.N.W. ½ W. from Tol-Pedan-Penwith, or the S.E. point of the Land's End, and 1 mile W.N.W. from the westernmost point, lie the high rocks called the *Longships;* which extend in a North and South direction, about half a mile.

Upon the largest of these rocks stands the lighthouse, with *fixed* light, which was erected in the year 1795, and the lantern of which is lighted with Argand lamps and reflectors, so as to be clearly seen from Point Tol-Pedan-Penwith to Cape Cornwall. From the light, Point Tol-Pedan-Penwith bears S.S.E. ¼ distant 3¼ miles; Cape Cornwall N.E. ¾ E. 4 miles; the Brissons N.E. ¾ N. 3¼ miles; the Rundlestone S.S.E. southerly, nearly 4 miles; the Wolf Rock S.W. southerly, 7¾ miles; and the lighthouse of St. Agnes, Scilly, West, northerly, 25 miles.

Ships sailing down the English Channel, and bound round the Land's End, cannot make the light till it bears N.N.W. ½ W., or open of Point Tol-Pendan-Penwith (on account of the high land which covers it, from this point to Cape Cornwall); but having seen it, and brought it to bear N. 19° W., will have the Rundlestone in the direction of the light; and by bringing the light to bear N. by W., or North, may steer safely for the light, clear of the Rundlestone and all danger, and may give the light any convenient berth, as the westernmost rock of the Longships lies only about half a cable's length from the lighthouse.

Ships bound from the S.W. of the light to the northward must be careful to keep this light clear of a N.E. direction, on account of the Wolf Rock; but by keeping the light a point or two to the eastward or northward of this direction, till they have passed the Wolf, may with certainty avoid it; and the same observations will hold good if bound to the southward, for both these rocks.

Ships bound either northward or southward, when they are to the northward of the light, ought to keep it a point or two to the southward of S.W. ½ S., in order to go to the westward of the Brissons, which are two high and bold rocks, or islets; but there is no safe passage between them and Cape Cornwall.

LAND'S END.—The cape called the Land's End is so high as to be seen in clear weather 8 or 9 leagues off. When first seen at a distance it appears in two round hummocks, on the highest of which is a spire steeple; upon nearer approach, on the outermost point another spire will appear. By these objects the Land's End may be readily known; but at all times the Longships lighthouse will indicate its situation.

Cape Cornwall lies N.N.E. ¾ E. about 3½ miles from the Land's End. In the bay between, called *Whitesand Bay,* which lies about a mile to the northward of the latter, vessels may ride in from 10 to 25 fathoms, well sheltered from E.N.E. and easterly to S.S.E. winds; but the danger arising from westerly winds makes it little frequented. The South side of the bay is formed by Peddenmeandue Point, from which the ground is foul and rocky to half a mile N.W.

The islands of Scilly consist of a great many smally isles, islets, and rocks above water, surrounded by innumerable rocks and ledges, some of which appear at half tide, others at low water, and the greater part not at all. Many have 6, 5, 4 feet on them at low water spring tides. The channels or passages into the harbours are called *Sounds*. They are dangerous, but well known to the fishermen of the islands, who act as pilots. With an easterly wind, a number of pilot boats are on the look-out for vessels from the westward.

ST. AGNES, which is also called the LIGHTHOUSE ISLAND, lies nearly 1½ miles to the S.W. of St. Mary's. It is the southernmost of the Scilly Islands, exclusive of a group of large rocks, which cannot properly be called islands. To the westward of these is that called the Gilstone, where Sir Cloudesley Shovel, in the *Association* man-of-war, was lost in 1707. Shipwrecks have been too frequent about these islands.

The Lighthouse is the principal ornament and great support of the island. It stands on the most elevated ground, built with stone from the foundation to the lantern. It was built in 1680, and is 53 feet high. It is a commodious structure; and being plastered white, is a useful daymark to all ships coming from the southward. The light is revolved every minute, and in clear weather it may be seen at more than 5 leagues off; the lantern being 138 feet above high water mark. According to the Grand Trigonometrical Survey the latitude of this lighthouse is 49° 53′ 30″; and its longitude from Greenwich, 6° 20′ 40″ West.

The S.W. DANGERS OF SCILLY are those called the *Bishop and Clerks*, composed of a high rock, called the *Bishop*, on which is a lighthouse, and of several ledges to the South and East. The *Bishop's Ridge*, having a race upon it, lies nearly a mile to the South of the Bishop, with the lighthouse on St. Agnes bearing East, 4 miles distant.

THE BISHOP LIGHTHOUSE is one of the most important structures in the English lighthouse system. It is a noble granite tower. It shows a brilliant fixed light at 110 feet above high water.

Being placed to the S.W. of all the dangers around the Scilly Isles, it renders the approach to them much easier than heretofore; inasmuch as it was almost the only dangerous quarter from which to make them, and now the interior anchorages can be much more readily reached with confidence by the aid of it and the St. Agnes Lighthouse.

The great importance of the Scilly Islands arises from their advantageous situation, as looking equally into St. George's Channel, which divides Great Britain from Ireland, and into the English Channel, which separates England from France. From this reason many ships, when the wind is favourable, in coming in from the S.W., endeavour to make the islands, in order to steer their course with greater certainty. It is also sometimes convenient for vessels to take shelter among them rather than beat about at sea in bad weather, and a strong gale at East will be frequently the means of bringing in numerous vessels. Upon firing a gun, and making a waft, a boat immediately puts off from the nearest island with pilots.

In coming from the southward you will descry Scilly, in clear weather, at the distance of 6 and 7 leagues, and have 60 fathoms, with grey sand, broken shells; you may also see the land from the southward, in 55 fathoms of water, stony ground with some shells; but at 7 leagues distance to the northward, you will have sand and oaze mixed together.

From the lighthouse of St. Agnes, the Lizard bears E.S.E., distant 14½ leagues; the Longships Lighthouse E. ½ S., distant 8 leagues; and the Wolf Rock E.S.E. ½ E. 6¾ leagues.

The Seven Stones are a dangerous reef of rocks, which appear above water, some at half tide, and some at low water. They are a mile in extent from N.N.W. to S.S.E.; the sea always breaks upon them; and, except in very bad weather, they may be seen from a considerable distance. The North side of this reef lies about 5 leagues

W.N.W., westerly, from the Longships Lighthouse, with Shipman Head, the North end of Bryer, bearing West, 10 miles distant, in a line with the N.W. point of St. Helen's, and opeu to the southward of Round Isle; and Newfoundland Point, the S.W. part of St. Mary's, S.W. by W. ¼ W. 9¼ miles off, and just open of the S.W. part of Menawethan.

The *Light-vessel* showing *two bright fixed lights*, is moored in 40 fathoms of water, about 1¾ miles E. ½ S. from the *Pollard Rock* of the Seven Stones, and about the same distance E. by N., northerly, from the South Stone.

Vessels navigating between the Scilly Islands and the Land's End should endeavour to bring the light-vessel to bear to the westward of South, when coming from the northward; and those approaching the light-vessel from the southward, should keep her to the westward of North.

LUNDY ISLAND.—At about 10 miles N. ½ W. from Hartland Point, N.E. by E. ¼ E. 74 miles from Cape Cornwall, W.N.W. ½ W. 16½ miles from Morte Point, and off the entrance of the Bristol Channel, lies the South end of the Isle of Lundy.

This island is high, and extends N.N.E. and S.S.W. nearly 2¾ miles, while its mean breadth is only half a mile. The position assigned to the South end, by Captain Denham, is 51° 10′ 7″ N., 4° 40′ 15″ W.

The ROADS OF LUNDY present important advantages to vessels outward bound from Bristol, in case of adverse winds: and they are equally useful to homeward bound vessels, in want of pilots or refreshments, and to such as may be unexpectedly driven into the mouth of the Channel by westerly gales.

The *General Anchorage* is to the northward of *Rat Isle*. This islet appears like a low green hummock, jutting up from a gradual descent of the castle bluff, from which it is insulated a few yards only at high water. It lies at four-fifths of a mile East from the *Shutter* or *S.W. Point*, off which is a detached *Black Rock*.

Moderate sized vessels may bring up in 10 fathoms, sand and mud, at half a mile off shore, with the North end of the island just closing with the rock called the *Gannet Stone*, and bearing N.E.; the farmhouse then topping overland, W. by S., and Rat Isle bearing S.S.W., half a mile: thus leaving a scope to clear the either end of Lundy, on a shift of wind. Large ships are, however, recommended to bring up a little farther out (in order to clear the island with the wind setting on), with the lighthouse in sight, bearing West, and dropping the anchor at a moment when the top of the lighthouse dips out of sight. This rule is equally observable by day and by night. Here you will have a depth of 10 fathoms, and mud, at about a mile off shore. Should the top of Lundy happen to be obscured by flying scud, the taking up a spot for anchorage must depend on the lead and the relative bearings of Rat Isle, S.W. by W., and the North end of Lundy N. by W.

To vessels outward bound, if overtaken by westerly gales, the roadstead affords a place of refuge. Here may be found, for ships of every class, sufficient water, with good holding ground, convenient to the shore; and here may be obtained live stock, provisions, vegetables, and water.

Vessels under a doubtful reckoning may advance after once gaining a sight of this island, the approach to which may be known by the soundings and quality of bottom. At 15 miles without it, on the S.W., West, and N.W.; there are 40 fathoms with sandy bottom, shoaling thence to 26 fathoms, rocky bottom, at 5 miles South from the island; to 29 fathoms, gravel, at 5 miles to the S.W.; to 22 fathoms, fine sand, at 5 miles to the West; to 27 fathoms, with fine gravel, at the North; and to 24 fathoms, with broken shells, at 5 miles to the East. Thirty-five fathoms, sandy bottom, is the deepest water between Lundy and Milford, and there is less within, or to the eastward of that line; so that the navigator may be assured of being without, or to the eastward of that line; so that the navigator may be assured of being without, or to the westward of the Bristol Channel, so long as he does not shoalen his water below 40 fathoms, allowing for a rise and fall in tide of 4 fathoms.

VESSELS BOUND UP THE BRISTOL CHANNEL, or to the anchorage of Lundy, should pass to the southward of the island, all circumstances being most favourable, as shown in the general directions hereafter. Thick weather generally accompanies prevalent S.W. winds, and increases the danger of a too near approach to the Welsh shores.

HARTLAND POINT.—The land of Hartland Point is very high, and directly from it, to the distance of about one-third of a mile, is a ridge of rocks, on which the sea breaks very heavily. The mark to clear these rocks on the West is, *Sharp's Nose*, S.W. ½ S., or kept well open. This Sharp's Nose is a high bluff land, nearly 3 leagues to the southward. The mark to clear the rocks on the North is, *Gallendy* or *Gallantry Bower*, to the West of *Clovelly*, with a tuft of trees on it, kept open, or bearing S.E.

Hartland Point may be readily known from the connecting cliffs trending nearly at right angles to each other. It appears of a dark brown colour, and its summit resembles the ruins of a building, elevated 350 feet above the sea, toward which it slopes abruptly to the perpendicular cliffs.

Hartland Point forms the S.W. point of the Bristol Channel, which may also be considered to terminate at Milford Haven, on the opposite coast.

THE BRISTOL CHANNEL.—It has been justly remarked that there is not one safe roadstead between the Land's End of Cornwall and the Flat-Holm, in the Bristol Channel, with the wind to the westward of South; and not very good with a wind to the southward of S.E. by E.; for, although you may have the wind off shore, you will find a great swell; and, if the wind shifts, the sea is instantly up, before there is time for her to weigh. On the coast of Wales there are several good roadsteads, but none are easy of access to a stranger, Milford Haven excepted.

Vessels bound to the Bristol Channel, and approaching from the south-westward, with a wind from that direction, should endeavour, says Captain Denham, to make their landfall on the coast of Cornwall in the parallel of 50° 30′, as well from the height of Trevose Head as from the regularity of the soundings. At 23 leagues *true* West of the Head, after running for some time in 60 fathoms, over mud, the bottom at once changes to coarse hard ground, and thence shoalens so gradually that, at nine leagues off there are still 34 fathoms. The land may, indeed, be safely made on any parallel between Trevose Head and Hartland Point, but it should not be approached at night nearer than in 30 fathoms of water, unless it can be so plainly distinguished that a course can be at once shaped with certainly for Lundy Island.

Should the wind hang between West and N.W., it will be advisable to gain the latitude of 50° 40′, so as to run direct for Lundy Island. This course leads across that great mud basin which seems to be an elongation of the Irish Channel, and which is there about 15 leagues broad. The soundings at first slowly deepen from 50 to 60 fathoms, and then decrease to 46, where the bottom suddenly changes to sand, at 12 or 13 leagues from the island. From the edge of the sand the bank continues to slope up slowly and regularly, there being from 32 to 34 fathoms at six and seven miles from the island; but, unless concealed by fog, the island or the light will have been discovered long before reaching that depth.

Captain Martin White, R.N., says:—"Vessels bound into the Severn from the Atlantic, should endeavour to preserve the parallel of Trevose Head, not only with a view of counteracting the north-westerly and northerly excess of tide (currents) which prevails in the Irish Channel, but because the soundings on approaching it decrease gradually, and because this promontory projects a considerable distance into the sea beyond the general direction of the Cornish coast. The land, also, being very high and steep, renders it the most eligible spot for a landfall between the Land's End and Hartland Point, from whence a vessel may with confidence shape a course for the Bristol Channel. The erection of the lighthouse on Trevose Head also renders it beyond any doubt the best point to make. On this parallel, and in the longitude of 10° 53′, are 140 fathoms, firm dark-brown sand: this appears to be the edge of the bank of soundings in that latitude. From hence the transition to shoal water is very sudden, as 13 miles further eastward are only 94 fathoms. This depth is in the longitude of 10° 32′ W., and as you proceed easterly the depths more gradually decrease. In longitude 9° 44′ are 71 fathoms, very fine dark grey sand, of the consistency of beaten pepper: seven leagues further eastward are 71 and 69 fathoms also; the latter soundings are, however, oasy. Seven miles to the north-westward of the latter position, and six miles eastward of the former, are 59, 55, and 53 fathoms; this is the western extreme of the Nymph Bank, which is nearly midway between the English and Irish coasts. Four and eleven leagues southward of the former position lie the S.W. extremes of this bank in 60 and 64 fathoms. Proceeding easterly from your former position, you will retain nearly the same depths until you advance as far as the longitude of 8° 26′, where you will find as little as 53 and even 45 fathoms, coarse, tenacious, light ground, consisting chiefly of mutilated shells and minute stony particles, and you will almost immediately afterwards drop into 65 and 69 fathoms, oazy ground. The former is the shoalest part of the Nymph, and is distant from Scilly 29 leagues, in the direction of N.W. ½ N., 43 leagues from Trevose Head, N.W. by W. ¼ W., and 22 leagues, S. by E., from Cape Clear; to the eastward of the latter depth, the soundings shoalen pretty gradually towards the western coast of Cornwall, nine leagues from which are 34 fathoms.

Should a vessel be forced into the entrance of the Bristol Channel, so that she cannot lay out again, the most prudent course is to proceed as directly as possible, for Milford Haven; but, should the weather be thick, and circumstances prevent this, she may proceed to Lundy Island, there anchor, or take a pilot for the harbour of Ilfracombe. By obstinately endeavouring to beat out of the Channel, many lives and much property have been sacrificed; it being next to impossible for a vessel to get to windward here, when opposed by the swell and indraught.

A vessel from the Longships, if bound into Bristol Channel, with the wind from the N.E. should stretch as far to the North as she can, and to the westward of the Rocks (the *Man and his Man*) off St. Agnes' Head, and then work up in the slack. With an easterly wind you may find a good stopping place, for a tide, on the western side of Trevose Head, sheltered by the *Cow and Calf*. In the great bight northward of this, between Tintagel Head and Hartland Point, the tide is quite slack, and a vessel may gain ground against the ebb.

With the wind to the South or S.E., and a commanding breeze, you may run between the Longships and the main, or haul close round the Longships within a cable's length, and keep the English shore on board: for so soon as you bring the Longships and Brissons nearly in a line you will gain the true Channel tide.

Spring tides, as already noticed, set very rapidly in the Bristol Channel. When the wind is to the S.S.E. in the Channel, the stream westward of Hartland Point is mostly found setting S.S.W.

Pilots for Bristol may be engaged at Lundy or Ilfracombe. Vessels bound to Bristol, or any port well up Channel, are recommended, in general, to keep near the English shore, though without going into any of the bays, after passing between Lundy Island and Hartland Point.

MILFORD HAVEN is generally considered as the most capacious, the most commodious, and the most secure harbour in the British Islands. It has no sort of danger in its entrance, which may not be avoided without a pilot; and ships may, with perfect safety, sail either in or out (by taking the tide), either by night or day. Those which come in, without anchor or cable, may run ashore, on soft oaze, and lie safely. Now that the South Wales Railway is completed to Milford Haven (285 statute miles from London), the capabilities of this fine harbour for steam-vessel transit are beginning to be developed.

ST. ANN'S HEAD is a bold promontory, advancing from a background of nearly table land, with a large black rock at its extremity, always appearing above water. Its lighthouses on the western side are whitewashed. This point lies N.E. ½ N. 33¾ leagues from Cape Cornwall; N. ½ W. 47 miles from Hartland Point; and N. ¼ W. 34½ miles from the North end of Lundy Island. The entrance is deep, and more than 1¼ miles wide.

To enter the haven with a fair wind by night, at any time before half ebb, give St. Ann's Head a berth of one-quarter of a mile, in a depth of 12 or 11 fathoms, then steering so as to bring the lower light (which shows exclusively in the haven) to bear

W. $\frac{1}{2}$ S., and afterward running E. $\frac{3}{4}$ N. about $1\frac{3}{4}$ miles, the depths will decrease to 8 and 7 fathoms, and you will be in the middle of the harbour.

IN THE ENTRANCE TO THE HAVEN the first danger met with was only discovered in the latter part of 1851—a very singular circumstance, considering that the whole of the coast was supposed to have been carefully and completely surveyed. It is a small patch, called the *Lewis Rock*, $1\frac{1}{2}$ cables' lengths from N.W. to S.E., and having only 18 feet less water at its N.W. end, and 25 feet at its S.E. extremity. It lies exactly on the line of the two lighthouses at St. Ann's in one, or N. by W. $\frac{1}{2}$ W., and nearly a mile from them. A *black buoy*, marked "Mid-Channel Rock," has been placed near it. It lies in 6 fathoms, at about a cable's length W. by N. from it, with the flagstaff at St. Ann's just open West of the Low Lighthouse, N. by W. $\frac{1}{4}$ W.; the fort on the Stack Rock just touching the South part of Thorn Island, E. $\frac{3}{4}$ N.; Mr. Davis's house, its apparent length on Dale Point, N. $\frac{3}{4}$ E.

Besides this rock, there is another, discovered at the same period, called the *Sheep Rock*. It is a small patch of $4\frac{3}{4}$ fathoms, lying half a mile due West of Sheep Island. Both of these patches have deep water around them.

Another rock, called the *Chapel Rock*, lies at the distance of half a mile W.N.W. from Rat Island, and has 14 feet of water over it at low spring ebbs; and a rocky shoal, called the Harbour or *Thorn Rock*, now marked by a buoy, having 20 feet over it, lies at the distance of nearly half a mile N.W. by W. from Thorn or West Angle Point, and without the islet off that point called Thorn Island. The channel between these two last shoals and the western shore is nearly a mile in breadth.

The course in is N. by E. until you open Dale Road, in the N.W. corner of the haven. Here you may come-to, in 2 or 3 fathoms, so soon as Dale Town comes open. But be cautious of not mistaking a bay on the West side for Dale Road, as it is dangerous. In this road you may lie landlocked from all but easterly winds, in 2 fathoms of water, with Sheep Isle on with Dale or Castle Point. Large ships should lie further out, at the distance of about $1\frac{1}{2}$ cables' lengths N.N.E. $\frac{1}{2}$ E. from Dale Point, where there will be found 4 fathoms of water. The best channel, and that commonly used, is to the southward of the Stack. Upon the south side, hereabout, is excellent ground, in from 8 to 13 fathoms, where ships may be landlocked from all winds.

At the distance of a mile S.S.E. from the Stack lies *Angle* or *Nangle Bay*, in which the ground is clear and good. In this place vessels, having lost their cables and anchors, may run aground on soft oaze: but should keep nearly in mid-channel between the outer points.

The most convenient and common anchorage for large ships is in HUBBERSTON or MAN-OF-WAR ROAD, at the distance of 4 miles to the E.S.E. of Dale Point. In sailing for it, keep in mid-channel until the town of *Milford* bears N.E. by E., when you may anchor in 10 or 12 fathoms. On either side, stand no nearer to the shore than to the distance of $1\frac{1}{2}$ cables in length.

SMALLS.—The Smalls consist of a cluster of low bare rocks, upon the largest and westernmost of which is a new *lighthouse*, a white tower, 141 feet high from base to vane. The light is brilliant and fixed, 125 feet above high water. The rocks are about one-fifth of a mile in extent, but very narrow, in a N.E. by N. and S.W. by S. direction, and are never entirely uncovered.

There are several detached rocks at the distance, more or less, of one-quarter of a mile from the main group, which must be carefully avoided.

Passage between the Smalls and Hats.—When the Hats are seen to break, this is a good and safe channel, although not more than $1\frac{3}{4}$ miles wide. If the South Bishop, distinguished by its lighthouse, can be made out, this islet, just open of St. David's Head, will clear all.

To clear the Smalls, Hats, and Barrels, to the northward, care must be taken to give the Smalls a sufficient berth to clear the N.E. rock, the transit of which is passed when the lighthouse bears S.W. by $\frac{1}{2}$ W. When the land is distinguishable, an excellent clearing mark is, the N.E. end of Grassholm on with the S.W. end of

Skomer; this will lead at the distance of about three-quarters of a mile from the Hats, and 1½ miles from the Barrels.

To clear the Smalls, Hats, and Barrels, to the southward, the Smalls ought not to be approached within 1 mile, on coming from the westward, until the lighthouse is brought to bear North, in order to avoid the S.W. Rock, as the soundings are extremely irregular, varying, at that distance, from 40 to 25 fathoms, generally gravel and broken shells, so that no dependence can be placed on the lead. At night, the Smalls light must not be brought to the westward of N.W. ¾ N., nor St. Ann's light to the southward of S.E. by E. ½ E.; these bearings will give the Barrels a berth of about 1½ miles. Observe well that the moment St. Ann's light is unmasked to the southward of Skokham, a vessel is nearly in the line of direction of the shoals.

VESSELS BOUND TO MILFORD HAVEN, &c., *from* the S.W. of Ireland, are recommended to make Grassholm, frequently the first land seen, by day, or the Smalls lighthouse by night. Should there be a long flood to run, it will be the best, particularly with the wind to the southward, to pass well South of the light, or to try and make St. Ann's light upon a bearing of E.S.E. ½ E., passing outside Skokham: but on an ebb tide, opposite precautions may be taken; and having passed to the northward of the Smalls, keep St. Ann's light open between the isles Skomer and Skokham, bearing about S.E. by S., which will lead between them.

ST. GEORGE'S CHANNEL.—To give extended descriptions of this important navigation would swell this work far beyond its proper limits. On pp. 382—387 are given some general instructions for sailing up and down this channel, which must suffice. One especial point requires every attention, and that is the set of the tides. In pages 254, 255, are given the general features of these currents, which, being neglected, have led to several deplorable accidents on the banks off the S.E. coast of Ireland. It is therefore most earnestly recommended to the sailor to pay every attention to this important subject. Some changes have been made in the lights on the East coast of Ireland which should also be carefully attended to.

On the Eastern side of the Channel the indraught on to Cardigan Bay is in some degree deprived of its danger by the establishment of the light-vessel described in the list, which will warn a ship from passing too far to the eastward, and thus getting embayed on this iron-bound shore and its dangerous shoals.

The Refuge Harbour at Holyhead has now assumed an important position in the navigation, and will afford shelter from bad weather for a large portion of the compass.

SOUTH COAST OF IRELAND.—As ships bound across the Atlantic may be driven to seek shelter on the Irish coast, a few brief notices of the principal places on the Southern coast follow. Complete descriptions of the whole coasts of Ireland are given in our Directories accompanying the Charts.

CARNSORE POINT lies N. by E. ½ E. 41½ leagues from Cape Cornwall, and from the Smalls lighthouse, N. by W. ½ W. 37 miles.

To the E.S.E. ½ E., at the distance of 6½ miles from Carnsore Point, is the remarkable rock called the *Tuskar*. Its bearing and distance from the Longships lighthouse, off the Land's End of England, are N. by E. ¾ E. 42½ leagues; and from the Smalls lighthouse, N. 4° W. 11 leagues.

The TUSKAR LIGHTHOUSE shows a revolving light every two minutes, twice bright and once red alternately. The ringing of two bells denotes the proximity of the rock in foggy weather. The rock is about 15 feet above the sea at high water, and the elevation of the lighthouse 101 feet above the base. The bright lights may be seen at 5, and the red light at 4 leagues off.

At half a mile due West of the lighthouse are some rocky heads, and at three-fourths of a mile S.W. of the light is the *South Rock*, of 9 fathoms; to avoid these, be careful to keep sufficiently without the rock on that side. And nearly midway between the Tuskar and main is the long narrow bank called the *Bailies' Prong:* the ripple on the South end of which bears from the Tuskar W. ½ N., and from Carnsore Point E.S.E., about 2½ miles. The bank extends nearly 3 miles N. by E. ½ E.

Its shoalest water is from 5½ to 7 fathoms, with 8 and 10 fathoms near each end. To clear it on the East side, keep nearer to the Tuskar than to the main.

The SALTEES LIGHTVESSEL, showing two lights, lies in 32 fathoms, with the Great Saltee bearing N.E. ¼ E. about 4½ miles distant; the Hook lighthouse of Waterford Harbour, N.W. ¼ W. 11¾ miles; and the Tuskar lighthouse, nearly East, 20½ miles. The Coningbeg Rock lies 1½ miles S.W. ¼ W. from Coningmore, and 2½ miles S.W. ¼ S. from the S.W. point of the Great Saltee Rock, and inside the lighthouse. It shows at half-ebb.

WATERFORD HARBOUR, the ESTUARY of the Rivers SUIR and BARROW. From the Longships lighthouse, off the Land's End of England, the Hook Point of Waterford bears N. by ¾ W. true, and N. ½ E. by compass, nearly 43 leagues: from the North end of Lundy Island, off the Bristol Channel, N.W. by W. true, and N.W. by N. by compass, distant 33½ leagues: from St. Anne's lights, Milford Haven, W.N.W. ¼ W. true, and N.W. by compass, distant 23½ leagues; and from the Smalls lighthouse, W.N.W. northerly, true, and N.W. ¼ N. by compass, distant 17½ leagues.

Upon Hook Head, or the Hook Point, is a white tower, rebuilt in 1791, 110 feet high, which exhibits a brilliant *fixed light*, at 152 feet above the level of high water, and is seen from all points between E.N.E. seaward to N.N.E., 17 miles off.

The entrance of the harbour, between Hook Point on the eastern, and Red Head on the western side, is 2¾ miles wide. Three miles within these points, on the western side, is the remarkable promontory called *Credan Head*, the extremity of which bears N. by E. 3½ miles from Hook Point.

The pier at the little harbour of Dunmore, on the W. side of the entrance, affords a secure anchorage with westerly gales, as well as from the prodigious sea which rolls along the southern coast, but it is not calculated for an asylum harbour, from its space being very confined, and its want of depth, there being only one spot within the pierhead with more than 14 feet, and 9 to 12 being the ordinary depth at low water.

In coming in from sea for Waterford Harbour, you will descry the remarkable inland mountain called the *Slievnaman*, which should be brought to bear N.E. ½ N., as it will, with that bearing, lead in sight of Hook tower; whence you may round Hook Point, which should not be approached nearer than to the distance of 2 cables' lengths, as the tide sets round it very irregularly.

With the entrance open, the course to Duncannon fort will be N.E. by E., which will lead past Credan Head, at the distance of 1½ cables' lengths. In the night, the *two lights* will be seen on the fort of Duncannon, elevated one above the other, to direct vessels to that point. These kept open of Credan Head, and bearing N.E. ½ N., lead directly up the harbour. You pass the fort at the distance of about 1 cable's length, keeping the lead going, and then steer N. ½ E. for Ballyhack church. When the Perch beacon, near Passage, comes on with the town of that name, you may steer upward in mid-channel to the anchorage above the town, in 5 and 6 fathoms of water.

Ballycottin Bay, on the North of the Ballycottin Isles, has been recommended as a place of safe resort in westerly winds. The only disadvantage of this anchorage is, that the wind setting in from S.E. to E. (which wind, however, *very seldom* blows) renders it necessary for vessels to put to sea as quickly as possible.

The prevailing winds on this coast are westerly throughout the year; therefore this anchorage is safe and convenient with the wind from S.W. to N.N.E. by the North.

Vessels taking shelter from a westerly gale, should anchor with the Government houses bearing S.S.W. to S.W., and the outer island S.E. to S.S.E., in about 3 fathoms, low water. The bottom is smooth and even, of fine sand and clay, perfectly clean, and the holding-ground good.

The outside island, on which is the lighthouse, is high, with a bold, rocky coast, steep-to, with deep water, and no dangers; so that a vessel, in taking the bay from the westward, may round the island close to, and find herself suddenly in smooth water.

CORK HARBOUR.—The entrance of this excellent harbour lies at the distance of 46 leagues N. by W. ½ W. [*N.W. ½ N.*] from the Longships lighthouse off the Land's End of England; and from St. Anne's Point, Milford Haven, nearly 39 leagues N.W. by W. ¼ W. [*W. ¼ N.*] In coming up for this place from the southward, bring Knockmeldown Hill, N.E. by N., and keep it thus until you see the Old Head of Kinsale, which is a remarkable bluff headland, with a lighthouse upon it. From this head the entrance of Cork Harbour bears E. ½ N. 5 leagues.

When off the harbour, Roche's tower, with its lighthouse, is remarkable from its standing on the point upon the eastern side. Without this point are two rocks called the *Cow* and *Calf*, otherwise the *Stags*, which will be avoided by attending to the following directions. Without the entrance, which is three-quarters of a mile broad, the ground is clean; and, with a northerly wind, ships may lie here, in from 7 to 10 fathoms, awaiting the daylight, or a flood tide. With a leading wind, line-of-battle ships may enter at any time of the day, if proper attention be paid to the marks for the dangers.

The LIGHTHOUSE on ROCHE'S POINT shows a fixed light. It appears, from seaward, of a clear red colour, but is brilliant toward the harbour. The tower is white, 26 feet in height, and the light, which appears at 92 feet above the level of high water, may be seen at 14 miles off, from all points seaward between S.E. by E. and N. by E.

Roche's Point is bold: so also is *Dog Nose*, a high point half a league further in, on the same side. Upon the latter there is a remarkable white wall, lying on the face of the cliff, to the southward of the fort, and so conspicuous as to be seen from a considerable distance.

From the entrance of the harbour to the Narrows, in the upper part of it, and through them to the anchorage off Queenstown, the fairway is indicated by a double series of buoys, white on the western side, and black on the eastern. Beside these there are two buoys on the *Harbour Rock*, and two on the Turbot Rocks.

On entering the harbour of Cork, the channel eastward of the Harbour Rock and Turbot Rocks is generally preferred, and a vessel may, at any time, be worked in or out. On coming in, therefore, endeavour to pass between Roche's Point and the Harbour Rock, or between the Harbour Rock and Turbot Rocks. The first route may be easily effected by keeping Cuskinny house (already described) wholly shut in with the point at Dog Nose; this mark also leads to the eastward of the Turbot Rocks. The depths in the channel are 5, 6, and 7 fathoms.

Having arrived within or to the northward of the rocks, which will be when a round stone tower, on the heights near Ringaskiddy (westward of Spike Isle), appears four times its own breadth open to the northward of the lowest part of the decling land under Fort Camden, thence steer for the middle of Spike Island, keeping as nearly midway as possible between Forts Carlisle and Camden, until two remarkable houses, inland, to the northward of Cuskinny house, and eastward of the old barracks, appear, the northern house between Cuskinny house and the southern house, three-fourths nearer to the latter than the former.* This mark will lead up between the shoals towards Queenstown, and very close along the eastern bend of the spit, near the white Lower Spit buoy, though in not less than 4 fathoms at half tide.

Continue running upon the mark last given, until two white-washed marks in the upper and lower walls of the old fort or hospital appear in one. This mark will lead you round the buoy last mentioned; and when Ballybrickan house comes nearly into

* These houses are called *Upper Harbour View* and *Lower Harbour View*. Both are of a whitish colour, and roofed with blue slate. The upper one is also weather slated partly down its front.

contact with the S.W. angle of the buildings on Haulbowline Island, you should haul suddenly to the westward, steering N.W. by W. toward a large storehouse on the upper quay at Queenstown, for about 2 cables' lengths, and then W.N.W., parallel to the beach at Queenstown, until Roche's light-tower shuts in with the eastern end of Spike Island. The last mark is the best for anchoring, and where you will have from 4 to 9 fathoms of water.

Large vessels, particularly at low water, should pass to the eastward of the white buoy on the Bar Rock, and after rounding it, at the distance of a quarter of a cable, may haul suddenly round to the westward as above.

The Outer Route or anchorage of Cork Harbour, is between Fort Camden and the buoy of the spit. You proceed up to it with Queenstown church just shut in with the eastern angle of the new citadel on Spike Island, and may take a station at pleasure in from 12 to 7 fathoms. Merchant vessels may ride off Queenstown, in smoother water and less tide; they may also anchor farther up the harbour, off Passage, and ride anywhere between the first houses and Ronan's Point.

Those working into or out of Cork Harbour should be aware that the tide sets, in the first instance, into the bight formed between Dog Nose and Roche's Point, and thence obliquely across to Cross Haven, whence it is again warped into a N.E. direction, which produces corresponding counter tides and eddies along both shores. The tide of ebb has a directly opposite tendency.

KINSALE.—From Poor Head, which lies 4 miles eastward from Roche Point, the Old Head of Kinsale bears W. by S. 6 leagues. Two whitewashed towers are on the cape, and between them are the black ruins of Baron de Courcy's castle. The southern tower is round, the northern square; the southern was formerly the lighthouse.

LIGHTHOUSE.—A new lighthouse (60 feet high with two red belts) is erected on the rocky point at the southern end of the *Old Head of Kinsale*, distant half a mile S.S.W. ½ W. from the old lighthouse tower, the light for which is discontinued. The light is a *bright fixed light*, elevated 236 feet over the level of the high water, illuminating an arc from N.E. ½ N., seaward, to W. by N., and in clear weather will be visible at the distance of 21 miles.

On the arc limited by a limited by a line across the entrance of Courtmacsherry Bay to the line of the Horse Rock it is coloured *red;* further within the bay, northward of that line, it is of of the natural colour. Thus vessels, unless going to Courtmacsherry Harbour, should not pass into the bay within the limits of the red colour of the light.

In order to fall in with the Old Head, when approaching from the offing, bring and keep Knockmeldown Hill N.E. by E. This hill lies inland to the northward of Youghal.

The harbour of Kinsale, though narrow at the entrance and all the way up to the town, is very safe, and capable of receiving vessels of any size. The entrance is formed by *Hangman* and *Prehaun Points* on the eastern, and *Money* and *Strookaun Points* on the western side; and it lies about 5 miles N.E. from the pitch of the Old Head. After rounding the *Breem Rock*, lying under the eastern side of the Head, with 7 fathoms close to it, steer for the harbour's mouth, by keeping the whole of Charles Fort, an extensive castellated building at a mile within the harbour's mouth, open to the westward of Hangman Point, and minding not to bring that fort within its own apparent breadth of Money Point, on the port side; and having reached well within the former point, keep as near mid-channel as possible, and anchor until you obtain a pilot. The anchorage of Queenstown is the one generally resorted to, and it affords good shelter, even within the wind directly in. This place is a little within or to the N.W. of Charles Fort, and about 1½ cables from shore. There is, however, water enough for the largest ships close up to the town of Kinsale, the channel to which lies close along the eastern shore; but it is very narrow and circuitous, and requires the assistance of a pilot. The wind between S.S.W. and E.S.E. is a free wind in, and from W.N.W. to N.E. a fair one out.

There is a bar of coarse sand a little to the southward of Charles Fort, having 12 to 18 feet over it at low water of spring tides. When the body of Charles Fort bears E.S.E. ½ E. you will be within or to the northward of it, and drop thence almost immediately into deep water.

The dangers of going into Kinsale Harbour are, *Farmer Ledge* on the port, and the *Bulman Rock* on the starboard side. The Farmer lies close to the western shore, and is uncovered at three-quarters ebb. The Bulman lies above 2 cables' lengths to the southward of Hangman Point, and has only 3 feet over it at low water, and sometimes dries at very low tides. The marks for it are, the northern angle of a triangular field on with the peaked top of Crow Head, and the Small Sovereign Island on with Froward Point. By keeping Charles Fort wholly open to the westward of Hangman Point, you will pass considerably to the westward of the Bulman; and by not bringing that fort within its own apparent breadth of Money Point, you will avoid the Farmer.

During the night a *light* is kept on Charles Fort as a guide to vessels entering the harbour. It is *bright and fixed*, at 98 feet above the sea, open to the harbour, on a N.E. by N. bearing, and may be seen, in clear weather, 6 miles off. When running for the harbour in a very dark night, some caution is, however, necessary, as this light and that on Old Head are the only guidance, and it will be prudent to keep an offing until daylight, or till a pilot can be obtained.

Cape Clear, the southernmost promontory of Ireland, upon an island of the same name, lies at the distance of 54⅓ leagues N.W. by W. ⅓ W., *true*, and N.N.W. ¾ W. by compass, from the Longships lighthouse, off the Land's End of England; and at the distance of about 5⅓ miles eastward from the S.W. part of this island lies the entrance to the harbour of Baltimore.

A lighthouse was erected on the S.E. side of Clear Island, to the eastward of the cape, and was first lighted on the 1st of May, 1818, but it was superseded by the more important light on the Fastnet Rock, to the S.W.

THE FASTNET ROCK, a small, steep, and conspicuous rock, lies nearly 5¼ miles W. ⅓ S. from Cape Clear. Between is a depth of from 12 to 35 fathoms, the least depth being near to the rock. Near Cape Clear there will be found from 24 to 27 and 30 fathoms.

The LIGHTHOUSE on the summit of the Fastnet superseded that on Cape Clear on January 1, 1854. It is 92 feet high, and has a broad red horizontal belt at mid-height. The light is elevated 148 feet, is revolving, visible once in every 2 minutes to the distance of 18 miles: but is not entirely obscured within short distances.

Between Cape Clear and the River Shannon, the land, on advancing to the North, increases in height, and is very irregular and broken; but the southern part of the coast is seldom wholly free from fog and haze during the summer months, and is generally annoyed by powerful gales and a turbulent sea during the winter season.

Long Island Sound, which lies within Long Island, to the S.W. of Skull Harbour, is well sheltered, of easy access, and capable of receiving large ships, which may enter at either end of the island, and anchor anywhere, the ground being good. The only thing to be avoided is a spit of sand, which extends northward from shore, at about half a mile within the East end of the island, and more than halfway over the channel.

In the anchorages the depth of water varies from 2 to 7 fathoms, and the ground is everywhere a soft cohesive mud. The chief passages are, one from the S.W. between Goat Isle and *Turf Isle*, or the *Black Rock* to the westward of it, called *Man-of-War Sound;* one between Goat Isle and Long Island, and one between Long Island and Three Castle Island on the East. Either of these passages may be safely taken without a pilot, through water sufficient for a line-of-battle ship. When entering by the S.W. passage, you have merely to keep in mid-channel all the way through, as well as from thence to the anchorage.

Crookhaven is a small but important harbour, lying 8½ miles N.W. ¼ N. from Cape Clear. It is only 2 miles in extent, from East to West, by one-third of a mile in breadth. Its entrance lies between a rock called the *Alderman*, on the

South side, and a peninsula called *Rock Island*, on the North. Although narrow, the harbour is well sheltered and commodious for vessels bound to the eastward; the ground is good, and the water, more than halfway up, sufficiently deep for large ships. This is a very convenient place for vessels drawing 14 feet, during bad weather or easterly gales, against which it affords the most ample shelter; but Captain White adds, it is to be regretted that, in the last twenty years, the bottom has considerably risen, and the depth, in consequence, decreased about 2 feet.

A LIGHTHOUSE is erected on Rock Island Point, at the northern side of the entrance. The light was first shown on August 1st, 1843, and is a *fixed* white light. The lantern is open to seaward, and to the haven, from E. by S. to W. by N., and is elevated 67 feet above the level of the sea. It bears from Cape Clear Island (S.W. end) N.N.W. ¾ W. 8 miles; Alderman Rocks (outer point) N.W. ¾ N. ½ mile, and from the Fastnet Rock N. ½ E. 6 miles, lat. 51° 28′ 35″ N., long. 9°. 42′ 31″ W.

Having fairly opened the harbour, run directly in, keeping in mid-channel. The ruined signal tower on Brow Head, three times its own apparent breadth open to the northward of O'Driscoll's house, a remarkable white one, entirely insulated, bearing West, will lead to the northward of the Alderman Rock, and into the fairway.

The opening of Crookhaven cannot be made out until you are very near the Alderman; to make it, therefore, steer in due North from the Fastnet Rock, keeping that rock South, as near as may be, until Mizen Peak comes in one with Alderman Head. In proceeding thus, you cannot be deceived; because, at the same time, or nearly so, Mount Gabriel will appear in one with Leamcon signal tower and castle to the N.E., and Brow Head, with its signal tower, will appear to close in with Streek Head, to the westward. The harbour will now begin to unfold itself; the revenue officers' houses on the northern shore will first be seen, and, ultimately, Coghlan's tower, which stands as above explained.

A vessel cannot enter Crookhaven unless the wind is to the southward and eastward of S.S.W. by compass, or to the eastward and northward of N. by W.; but when the wind happens to be foul for Crookhaven, it will prove fair for Long Island Sound. You may anchor, with westerly and northerly winds, at a mile N.E. from the Alderman Rock, in very good ground, but great circumspection must be taken as to southerly winds.

Bantry Bay lies to the northward of Dunmanus Bay; it is large, safe, and commodious for ships of any size. The stream of tide is scarcely sensible in any part of it; the water is sufficiently deep, almost close to both the shores; and there are no rocks nor shoals in the way, but such as may be easily avoided, even in the night. Ships may stop anywhere in the middle of the bay; or, in most parts, near to either side. The bay extends nearly in the same direction as that of Dunmanus. It is 6 leagues in length, and from 2 to 3 miles broad. Its entrance, between Three Castle Head and Sheep Head, is 3½ miles wide. Off the latter point is a rock of 18 feet at 2 cables' lengths from its extremity. The depth of water throughout the bay varies from 10 to 31 fathoms, and the ground is of the most tenacious description. It is, however, much exposed to westerly winds; but even when these prevail, the harbours named *Bearhaven*, *Bantry*, and *Glengariff*, may be resorted to with great convenience, and even without a pilot.

Bearhaven is an excellent harbour, spacious, and well sheltered from all winds; the ground is everywhere good, and easy of access, in a country abounding with many necessary refreshments. Its proximity to the sea, and situation on the coast, render it an excellent rendezvous for a fleet.

The LIGHTHOUSE on *Roancarrig Island* will materially assist the navigation of Bantry Bay, and more particularly that of the eastern entrance to Bearhaven, off which it stands. It is a white tower, with a red belt around it, showing a *fixed* light at 55 feet, which may be seen at 12 miles off.

The haven has two entrances; one at the East end of Bear Island, and the other at the West end. The western entrance is the most direct and convenient for ships from the westward or southward; but the other is the safest for strangers. You may anchor anywhere off the North side of the island, in from 5 to 11 fathoms; but the best place is off Ballynakilla; and ships that wait for a wind only will find the West end of the haven most convenient.

Valentia.—*Brea* or *Bray Head* is the S.W. extremity of Valentia Island; the island thence extends 6 miles East, and forms the harbour of the same name, which is capable of receiving the largest ships. It affords excellent shelter against all winds that blow, with good holding ground in 36 and 42 feet at low water springs.

Those bound into this place to steer in for Doulus Head, giving the northern side of Valentia a berth of about a mile or more, until the remains of Cromwell's Fort, on which a light is established, bear S. by E., which will then be in one with the square tower of the church standing on a cliff of Valentia Island, considerably above the water's edge, and close to which stands the parsonage house, now in ruins. This mark leads to the entrance of the harbour. When passing Cromwell's Fort, keep one-third nearer thereto than to Beginnis, to avoid the reef projecting from the latter.

COAST of FRANCE.—In the upper part of the English Channel, the coast of France is a part to be avoided by a passing ship. Upon it all the power of the tide and wave which traverse the Channel from West to East seems to be expended. Its shores are the depository of all the matter washed and worn-of from the shores to the westward, and the light drifting sand of which they are composed, choke up all its harbours, and bar access to any shelter when required for a ship in distress. All this is explained in our Channel Directory; and in pages 251—253 *ante*, there are some remarks upon the Tidal Streams, which are very peculiar here, and require very much attention.

Ambleteuse Road, between Boulogne and Cape Grisnez, affords some shelter from gales between N.N.E. and S.S.E. round by the East; but the sea is very heavy, especially when strong winds oppose the current, and moreover the tidal streams are at times very strong, so that a ship may become tide-rode in a very ugly position. Boulogne is difficult to enter on account of the thwart current.

The *Bay of the Seine* is very dangerous. It is open to all winds from N.W. to N.E., and the tides are very strong, so that ships embayed here with those winds are in great danger. There is some shelter inside the banks, which extend N. and S. of Marcouf, but the tides are so strong that they alone will embarrass, and the formidable Race of Barfleur, which runs around the Cape Barfleur so turbulently, is much to be dreaded in N.E. gales.

CHERBOURG, with its majestic Digue, or breakwater, will afford shelter, and ample descriptions and directions are elsewhere given. The following are a few extracts:—

Cherbourg Road is comprised in the space between the Pointe de Querqueville and Pelée Island, lying E.S.E. and W.S.W., 3¾ miles distant from each other. Its southern limits are the shores of the two great bays, the Ste. Anne to the West, and that of Cherbourg to the East, divided by Pointe du Homet.

It is sheltered, on the North side, by an artificial breakwater, *La Digue*, built in 6 and 7 fathoms water, 4,100 yards long. There is a green light on its West head; a fixed and flashing light on the central Fort, and a red light on the West head.

The principal anchorages for large vessels are, the Great Road, and the western anchorage; for smaller vessels, those called the Little Road, and the anchorage between the Pelée Island Bank and the eastern branch of the Digue.

The Bay of St. Anne does not offer many good spots for anchoring; the bottom is uneven, and the holding ground bad. And besides, vessels are in great danger if caught here by gales between N.E. and N.W., which send a bad sea into it.

The Great Road (Grande Rade) is the man-of-war anchorage, and is limited on the North and N.E. by the Pelée Island Bank; and extends to the West as far as to the North of the church at Cherbourg. In the North part, the bottom is, in general, of schistose rock in a state of decomposition, and the holding is good, and there are some spots of bare and cutting rocks. The current of the flood begins half an hour after low water by the shore, and ends three-quarters of an hour after high water in the military port. Its greatest rate is 2 miles, and of the ebb 1½ miles an hour.

THE WESTERN ANCHORAGE, lying to the South, and near to the West end of the Digue, is a fine bottom of sand and broken shells; four-fifths of a mile in extent, and with 6 and 7 fathoms water. It is bounded on the South by the rocky bottom which, running from the Great Road, extends to the S.W. of the West end of the Digue. The current of the flood begins then nearly an hour after low water by the shore, and finishes an hour after high water at the military port.

The LITTLE ROAD is to the South of the Great Road, in the part which is sheltered from West winds, and the sea occasioned by them, by Fort du Homet and the military port. In this anchorage, which is of good holding ground, the pilots placed those vessels waiting for the tide to enter the commercial port, and also those seeking shelter from bad weather, before the Digue was so far advanced; these latter now prefer to anchor nearer to the Digue. Strong winds from S.W. and S.E. are troublesome in this anchorage, as vessels are liable to drive and be carried on the rocky bottom of the Great Road, or even on to the Digue.

The anchorage to the South of the eastern part of the Digue, which is used by vessels seeking shelter, lies between the Digue and the northern slope of the Pelée Island Bank, and extends from the Central Fort, where it is a quarter of a mile wide, to nearly the West end of the Digue, at which part it is narrowed to 1½ cables in width. It is a sandy bottom, in some parts rather muddy, the depth varying from 26 to 32 feet. Vessels are here sheltered from N.W. to N.E. round by the North.

WESTERN ENTRANCE to Cherbourg Roads. Large men-of-war enter by the passes at each end of the Digue, the principal of which is the West, lying between it and the Chavagnac Shoal. The two limits of this are marked by buoys.

You will run precisely in mid-channel, by keeping the light-tower (with a *red* light) on the end of the eastern jetty of the Port du Commerce clear, but seen a very little distance West, that is, to the right of the high battery of the Fort du Homet.

There is no difficulty in entering with a leading wind, but large ships beating in must take care of the Chavagnac, then the rocky head in the opening of St. Anne's Bay, and, lastly, La Ténarde. It is considered that it would be imprudent to attempt to beat in at night through the West Passage with large ships, unless there is moonlight.

The flood tide sets here S.E. and E.S.E., 3 miles at its greatest strength, and begins 1h. 30′ after low water by the shore, and ends 1h. 20′ after high water at the military port. The ebb current nearly the same, running to N.W. ½ W.

The Passage between the Fort of Querqueville and the Chavagnac Shoal is nearly as wide as the former, but is not practicable for large vessels but between half tides of high water. As the bottom is uneven, and covered with rocks, it is dangerous to anchor in it. No vessel should attempt it while it is calm, as you risk being carried on to the rocks at the bottom of St. Anne's Bay. There is no advantage either in coming near the shore of this bay, with the wind from land, as it frequently comes in gusts, particularly with those from S.W.

The EASTERN ENTRANCE is comprised between the East end of the Digue and the western slope of the Pelée Island Flat; the most dangerous points of it are marked by buoys. The mark for this passage was a stone pyramid on the quay in front of the Hotel de Ville, now replaced by a large wooden beacon on the rocks in front of it, on with the church tower of Octeville, bearing S.W. by W.

The eastern passage is separated from the East part of the Great Road by the Pelée Island Bank, the breadth of which on the above bearing is 4 cables' lengths; the least depth on it being 22 feet.

The flood current is first felt one hour after low water by the shore, and ends one hour after high water in the military port, and runs E. by N. between the Digue and La Truite at the rate of 2½ miles; but a little to the North this velocity is increased to 3½ miles, and runs to the E.N.E. To the N.W. point of the Flat of Pelée Island, and on the northern slope of this plateau, the current of flood runs N.E. ¼ E. at a maximum rate of 4 miles an hour; and the eddies and overfalls, occasioned by the uneven bottom, form a violent and dangerous race. The ebb tide is more regular, and runs at a rather less rate.

The eastern entrance, besides being very narrow, is inconvenient from the currents crossing it obliquely. This renders it dangerous for sailing vessels in light winds, and impracticable for them in calms. But when there is sufficient wind there is no difficulty or danger. It is easy for vessels coming from the East; but care must be taken to bear carefully round to the West of the N.W. point of the Pelée Island Shoals, and not to run on the mark for entering till you have doubled it. As you cannot always see the beacon at the esplanade of the Hotel de Ville at a sufficient distance, you ought then to approach the Pelée Island Bank, keeping Octeville church in one with that of Cherbourg. This will bring you in sight of it, or at least of the buoy on the N.W. point of the rocks.

The great bay which is formed on the coast between Cape la Hague and the Bréhat Isles, in which are the Channel Islands, is most dangerous to the stranger. Its furious tidal streams; the countless rocks which cover and uncover to an enormous extent in the great range of tide, render it impossible in a few words to describe any of its navigation. Indeed, local and intimate knowledge alone can conduct a ship through any of its intricate passages.

ALDERNEY, or AURIGNY.—The eastern end of Alderney bears W.N.W. 8½ miles from Cape la Hague. This island is about 3½ miles in length by a medial breadth of three-quarters of a mile.

The coasts of Alderney are surrounded with rocks, which render the navigation difficult and dangerous; more particularly as the tides set strongly and in various directions. The chief port, that of *Braye*, on the N. side of the sea; and on the western side of Port Longy is a signal post.

The REFUGE HARBOUR, which is constructing on the North side of the island, is a formidable and very important undertaking of the British government, under the superintendence of Mr. James Walker, C.E. It will consist of two piers, which will enclose Braye Roads, and have an opening to the northward, and will shelter a considerable area of every depth for shipping.

It is not safe to remain at anchor here in the winter season, on account of the run or ground swell, which often comes in very unexpectedly, and without any apparent warning; nor can a vessel, if surprised there with a northerly wind, easily beat out, both ebb and flood heaving her in bodily.

There is a rock in the middle of Braye Roads called the *Half-tide Rock*, which is especially dangerous to all vessels coming into the roads, being on a direct line in or out of the harbour. Part of the rock is only visible at low water, spring tides.

THE CASKETS, AND LIGHTHOUSES, which lie N.W. by W., 62 miles from Braye Roads, are a cluster of great rocks, some above and others under the water. On the largest, and nearly the westernmost, of these rocks stand three lighthouses, triangularly placed, as shown on the chart, and furnished with argand lamps and reflectors, at 113 feet above high water. The lights *revolve*, and alternately present a bright light in every direction. The eclipses succeed each other every fifteen seconds. Upon a S.E. by E. bearing, these lights appear as two, which may be seen 5 or 6 leagues off. The N.E. and S.E. lights are in *one* when bearing S.W. by W. Attached to the establishment is an *alarm bell*, which, sounded in foggy or snowy weather, is loud and distinct, not unlike a church bell.

The *Hanois* or *Hanoveaux*, which lie off the westernmost part of Guernsey, are an extensive group, the greater part of which is always above water. They extend outward to the distance of more than half a league, leaving no passage between. It is most prudent to give them a berth of about 3 miles on the port hand. Their dangerous character will be much lessened when the lighthouse is completed on them.

BAY OF BISCAY.—In former pages, when the best routes to the southward were considered, the indraught into the Bay of Biscay is especially mentioned as a tendency to be avoided—*see* pages 270—272, 389, &c. But as it may sometimes happen that a vessel may get embayed without being able to weather its outer points, only a few remarks on its more available roadsteads will be given here. In the lists of lighthouses is given a description of these monitors which well mark its coasts, and by means of which a ship may avail herself of many anchorages, which it would occupy too much space to describe here.

USHANT (*Ouessant*) is a steep craggy island, about 4 miles in length from East to West, and 2 miles in breadth. On its S.W. side is a harbour, that of *Lampoul*, but of difficult access. The rest of the island is surrounded with rocks, a part of the North side excepted, where there is anchorage.

LIGHTHOUSE.—On the N.E. part of Ushant is a light-tower, exhibiting an excellent *fixed light*, elevated 265 feet above the level of the sea, which may be seen at 6 leagues off. The position of this lighthouse is latitude 48° 28′ 31″, longitude 5° 3′ 32″. It is proposed (1861) to erect another lighthouse on the S. extremity of the island.

Douarnenez Bay.—This capacious bay, which lies to the southward of Brest Harbour, will accommodate a large fleet, it being more than 6 miles in extent each way. Its entrance is so wide, and its bottom altogether so clear and regular, that no leading mark is required; provided that a sufficient berth be given to several rocks which lie on the North side, as generally represented on the charts. *The course and distance from the S.W. end of Ushant* to the bay are, S.S.E. ½ E. 10 leagues: there is nothing in the way that can take a ship up; only observing to avoid the *Passe Vieille*, off the Bec de Chévre, on the North side of the entrance. This rock lies about one-third over from the point, and appears just above water at two-thirds ebb. It is steep-to, having from 17 to 12 fathoms close to it. The marks for it are, Kidizient Mill, to the westward of St. Lawrence's Church, on with the middle of a reef of dry rocks which lie off the Point or Bec de Chévre, bearing E.N.E. ¾ E.; a village, on with the N.W. cliff of the same point, bearing N.E. by E.; and the western Tas de Pois (or haystack), in one with the Toulinguet Rock off the Lighthouse Point. Its bearing and distance from the Bec de Chévre are, W. ¾ S. 1½ miles.

A clump of trees, with a small chapel in the midst, stands on the North side to the eastward of Point Chévre, having a windmill to the westward, and two to the eastward. With the windmill next to the eastward of these trees, just open of the Chévre Point, you will have passed the Basse Vieille, and may steer for what part of the bay you please, all being fair and clear, excepting what may be seen above water, and what may be near the shore. The best ground, however, is considered to be that toward the North side, being clear sand, with a depth of from 9 to 15 fathoms. The general depths over the bay are from 18 to 12 fathoms; and all, as before observed, is clean ground.

The best leading mark into the bay is the high mount of Locrenan (in the S.E.) just shut in to the southward of the Point Leidé, a rock on the West of the little Bay of Douarnenez. This will lead, in a fair course, clear to the southward of the Basse Vieille.

In the middle of the bay, about two-thirds of a mile North of the town, is Tristan Isle, on which a lighthouse has been erected. It is 32 feet high, showing a bright fixed light, at an elevation of 114 feet above the sea, and visible 10 miles. It was lighted in 1857. This lighthouse, in one with Plouaré steeple, is the mark for a shoal of 7 feet, which lies half a mile North of Tristan.

Chaussee, or Pont du Sein, or Saints' Bridge, requires but little description, as it is clearly exhibited on the Chart. This extensive chain of foul ground trends 9 miles to N.W. ¾ W. from the principal island, and is studded all over with rocks, either above or under the water. The LIGHTHOUSE, with its excellent flashing light, erected on the northern part of the island, in a line with the lighthouse on the Bec du Raz, denotes the general direction of the Chausséo, or Bridge. The fixed light on the Bec is a 259 feet above the sea, and, as well as the flashing light of the Sein, may be seen when 6 leagues off.

The Ile de Sein lighthouse is 141 feet high; the light is fixed and varied by flashes, elevated 148 feet above the sea level; the flashes appear every four minutes, preceded and followed by short eclipses.

The lights on the Ile de Sein and the Bec du Raz lie [*S.* 86° 50′ *E.*, and *N.* 86° 56′ *W.*, *true*, or] S.E. by E. ½ E., and N.W. by W. ½ W., by compass. from each other, 5¼ miles apart. This bearing, which is likewise the general direction of the whole chain of rocks called the Chaussée de Sein, passes about 4 cables' lengths to the southward of the N.W. extremity of the chain, which is 9 miles from the Sein light, and 14½ miles from that on the Bec du Raz.

In approaching these rocks from the westward, the first light seen will be the flashing light on the Ile de Sein; and first light seen will be the flashing light on the mariner whether he is to the northward or southward of the line direction of the two lights. In clear weather, the Bec du Raz light will not not be seen till the vessel is within 4 or 5 miles of the western extremity of the chain of rocks.

BELLE ILE.—This island, being high, and seen from a great distance, may afford good shelter in a westerly gale. Its N.W. end is in lat 47° 23′, and its South point in lat 47° 16′. The N.W. end of the island is surrounded with rocks. In a line between the East end of this island and the Isle de Groix, lies the rocky bank called the *Birvideaux*, already described.

If a ship, with the wind at N.W. or W.N.W., keeps between the latitudes above mentioned, when running for the island, on approaching it, she may steer along the South side at the distance of 2 miles, to *Point de l'Echelle*, or *Point des Canons*, the S.E. extremity. From this point, haul up for *Point de Kerdonis*, the easternmost point, which is situate 2¼ miles from the former. Under this point may be found anchorage, in from 15 to 8 fathoms, sheltered from N.W. and westerly winds. Should the wind here veer to S.W., a ship may run to the northward of the point, and anchor on the N.E. side of the island.

On the South side of the island there are many rocks near shore, both above and under water.

A tower on the plateau near the Cove of *Goulfar*, on the S.W. part of the isle, is distinguished by a brilliant revolving light of the first order, eclipsed *once in a minute*.

The Isle of Hædic, which lies about 7½ miles East from the East end of Belle Ile, has many rocks, with foul ground about them. The *fixed light*, near the eastern point of the isle, may be seen about 9 miles off. The Cardinals extend to the S.E. from Hædic, and the extremity bears E.S.E. ¾ E. 12 miles from the S.E. end of Belle Ile. Should a ship be driven to the eastward of Belle Ile, she must give the Cardinals a good berth, and may then haul up to the northward for anchorage.

In the Bay of Quiberon, after you have brought the Cardinals to bear S.S.W., S. by W., or South, there is good anchoring, with clear soft clay, and very even soundings, in from 10 to 12 fathoms. With these bearings, you will be shut within some foul ground, lying off the Cardinals, in an extent of 3 miles in length, with the Cardinals from W. by S. to S.W. by compass.

BASQUE ROADS lie within the Isles of Ré and Oléron. The northern point of Oléron has a lighthouse, called the *Tour de Chassiron*. The rocks which surround this end of Oléron, called the *Antioche Rocks*, extend 2 miles to the East of the lighthouse; but within them there is anchorage. The Tour de Chassiron exhibits a *fixed* light of the first order, elevated 164 feet above the sea, which may be distinguished at the distance of 6 leagues.

On sailing into the Roads, it is safest to keep over to the Isle of Ré, until near the S.E. end of it; only taking care to avoid the Lavardin, marked by a tower. Then steer for the West part of the Isle of Aix, a low fortified island with some houses on it, which lies about half-way between Oléron and the main land. The roads extend from the Lavardin shoal to this little island, and have from 10 fathoms close to the shoal, to 12 and 13 in the middle of the road; and from 5 to 9 fathoms at about 1½ miles to the North and N.W. of the Isle of Aix. There are 6 fathoms at half a league West from the island, and good ground.

The soundings in mid-channel, between the Isles of Ré and Oléron, are generally from 12 to 15 fathoms, shoaling towards each side. This channel is nearly 2 leagues in breadth. The French Man-of-war Road is on the South side of the Isle of Aix.

THE ROCHE BONNE has been described as one of the most dangerous shoals on the western coast of France, particularly to vessels bound to Rochefort and to coasters. It is a great flat of rock situate between the parallels of 46° 10′ and 45° 15′, at 12 leagues westward from the lighthouse on Baleine Point. M. Beautems Beaupré, who determined its position in 1824, describes the S.E. rock, on which there are only 18 feet at low water, in lat. 46° 11′ 25″, and long. 2° 25′ 0″. The plateau, or flat, according to the new charts, extends N.W. ½ W. to lat. 46° 15′, with a breadth 2 or 3 miles. Not only on this flat is the swell of the sea to be apprehended, but also on several heads of rock, on which there may not be more than 10 feet at low water.

A LIGHT-VESSEL is likely to be stationed in the neighbourhood of this shoal.

The rocky bottom, situate to the N.N.W. of the Roche Bonne, is known to the fishers under the name of *Banche Verte*, and is not dangerous. Westward of the rocks, in all their extent, the bottom is of mud.

THE GIRONDE.—The entrance of this river, with the banks and rocks that impede its navigation, are so clearly exhibited on the general Chart of the Bay, and particular Chart of the Harbour, as to render a minute description unnecessary. But care is requisite at all times, as the banks and channels shift very much. The lights are described in the list.

THE TOUR DE CORDOUAN, OR LIGHTHOUSE, standing nearly in the midway of the mouth of the river, is the most elegant structure of the kind in Europe, and its figure is represented on the Chart. This tower was completed in 1665; its original height was 169 French feet; but in 1727, the upper part being calcined, an iron lantern was erected, which increased its height to 175 feet; and its elevation, from recent improvements, is now given as 63 metres, or more than 206 feet.

Its light is *revolving*, and visible to the distance of 9 leagues. The eclipses succeed each other once in a minute; but every great flash of light is immediately preceded by a flash less brilliant. In ordinary weather the eclipses does not appear total within the distance of 3 leagues.

By the recent surveys of the mouth of the Gironde, it has been found that all the former charts of it were grossly erroneous; and that, instead of *five* channels, as formerly represented, there are now only two which can be used with safety. These are the *Passe du Nord*, or Passage by the North shore; and the *Passe de Grave*, or Southern Passage.

PASSE DU NORD.—The mark for the entrance by day is the Church of St. Palais and that of St. Pierre de Royan in one, bearing S.E. ½ S. These churches lie, as above stated, on the North side of the river, and about 8 and 10½ miles respectively above Point de la Coubre: this direction will lead across the bar, and about one-third of a mile off Point de la Coubre, when off the latter point, and when the semaphore comes between the two beacons on the point, as given on the Chart.

Here you will have fairly entered, and should change the course to S.E. ¼ S., which may be continued for 8½ miles, until the Church of St. Palais bears North, about half a league distant. From the last spot a S.S.E. course, 6½ miles, will bring you up to *Mecher Road*, where there is good ground of sand and mud, and from 8 to 10 fathoms at low water.

Should circumstances require it, you may run up and take shelter under the Point de Grave, which affords a safe retreat during westerly and S.W. winds. The mark is, Royan steeple and mills N.E. ¼ N. At this place, between Verdon and the bank called the *Taille Fer*, coasting vessels are commonly sheltered in bad weather.

BY NIGHT, the entrance to the Gironde by the Passe du Nord is facilitated by the light on the Point de la Coubre, and by a light on the tower of Terre Negre. This is a *fixed* lenticular light, of the fourth order, elevated 118 feet, and visible 10 miles. The object of this light is to offer to navigators the means of avoiding the dangers of the dangers of the Barre à l'Anglaise.

It is not visible South of a line passing through the tower itself and that of St. Palais, bearing one from the other, or S.E. by E.

To make use of this light, the following directions are necessary:—Having arrived South of the Point de la Coubre, and the small fixed light on that point having been brought to bear N.N.E. by compass, the route must be changed; and then steer towards the Cordouan light, until the moment the light on Terre Negre is first perceived: then steer towards it, keeping as near as possible in the line of its direction, which will be S.E. $\frac{1}{4}$ S., until the Cordouan light bears S.S.W.; after which, change the route for the third time, and bear S.E. $\frac{1}{4}$ S.

It is very essential to remark, that the light of Terre Negre, not being visible to the West of the Point de la Coubre, on the direction for entering the Passe du Nord, will not be of any service until that point is doubled.

PASSE DE GRAVE.—This passage into the Gironde is 4 leagues to the southward of the Passe du Nord, and is 2$\frac{1}{4}$ leagues in length. The mark for the entrance is the beacon St. Nicolas on with the semaphore of the same, bearing E. $\frac{1}{2}$ S., and which from the entrance may be considered about 6 miles. This track is to be continued until the Tour du Chay and St. Pierre de Royan, on the North shore, come in a line, bearing E. by N. $\frac{3}{4}$ N. nearly; then steer on this course as near as possible, which will take over the tail of a small bank called *Le Ruffiat*, having 9 feet in one part, which lies W.N.W. 2 miles from the lighthouse on the Point de Grave; therefore bear a little to starboard before reaching this point. This last mark kept on will lead into the main stream of the river, and at the distance of nearly a mile from the Point de Grave. You hence haul round the point to the eastward, according to circumstances.

In going through the Channel de Grave, be cautious of advancing too near the shore, as the tide of flood sets strongly upon it; and never, if avoidable, attempt to anchor in it.

No large vessel should attempt to leave the river by this channel, unless with a rising tide and favourable wind.

Each of the channels is marked by buoys.

TIDES.—At the entrance of the Passe de Grave, with the Cordouan Tower bearing N.E., the tides set as follow:—First of the flood, North; one-third flood, N.E.; half and two-thirds flood, E.N.E.—First ebb, S.E.; one-third ebb, South; half and two-thirds ebb, West. In the channel within, with Cordouan bearing N.N.W., the flood sets, generally, E.N.E., and the ebb, W.S.W. Between the great Bank of Cordouan and the Point de Grave the flood sets, generally, S.E.; the ebb from West to W.S.W.

The tides, both ebb and flood, set through the different channels with rapidity; and great caution is therefore requisite on making the river. Should the landmarks be obscured by thick weather, or if night comes on, it will be prudent to anchor in the first convenient spot.

BAYONNE.—The mouth of the Adour, or Harbour of Bayonne, lies between two sandy hummocks. The bar frequently changes; the sea without is very rough; there is no entrance but at high water, and then a pilot is required. On the full and change, the time of high water is at 4^h. Spring tides rise 12 feet; neaps, only 9 or 8 feet.

TOFINO, in his description of this harbour, says, that to enable a vessel drawing more than 14 feet to pass the bar, a concurrence of favourable circumstances must exist; these are, a smooth sea, a fair wind, a spring tide, and no current from the river.

BIARITS, or BIARRITZ.—At 3½ miles S.W. from the mouth of the Adour are the little port and village of BIARITS, or BIARRITZ, a fashionable watering place. The village is nearly a mile from the sea.

At 2½ miles S.W. from the mouth of the Adour is *Cape St. Martin*, now distinguished by the lighthouse, which displays an excellent revolving light, the flashes of which succeed each other every half minute, and may be seen nearly 7 leagues off. The light is not entirely obscured within the distance of 3 leagues.

COAST OF SPAIN.—Off the North coast of Spain, which is high, bold, and rocky, the depth of water, in general, is from 150 to 200 fathoms, foul ground and coral; but, in many places, there is no ground at that depth, even near the shore. The principal harbours on this coast are those of *Bilbao* and *Santander;* yet both of these are devious and shoal.

BILBAO.—Its entrance, which is 3 miles wide, is formed by the points, named Luzuero and Galea. On Galea is a lighthouse, showing a bright fixed light. The greater part of its coast is lofty, steep, and rocky; but the bottom of the bay, on the eastern side, is low and sandy.

On *Cape Machichaco*, 10 miles to the eastward, is a lighthouse showing a fine fixed light, varied by a flash every 4 minutes.

The mouth of the River Bilbao is impeded by a shifting bar, having less than one fathom over it, at low water. Here are two piers or kays, within which is the town of PORTUGALETE, and off which is the best anchorage in the harbour. Spring tides rise about 13 feet. In winter, a heavy sea sets into the bay, which, at times, renders it impossible for the pilots to go off.

If coming in, when the tide does not serve for taking the bar, with an unfavourable wind, you may come-to in the bay, midway between the outer points, Luzuero and Galea; bring the latter in a line with Cape Villano, in 16 fathoms, with sandy bottom. There is here sufficient room, in case a heavy on-shore wind should bring home the anchor or part the cable, to let go a second anchor, before the ship can get ashore. In summer, you may lie nearer to the land, in from 10 to 12 fathoms, all the bottom being of sand.

On making the bay from the westward, POINT GALEA, on the eastern side, may be readily known by its white colour. On it stands a lighthouse, with a fixed light. Should you pass Santona, the bay may be thence distinguished by three sharp-pointed mountains; of these the northernmost is that of LUZUERO, the middle one and highest, the hill of SERANTES, on the West of the bay. The southern one appears like an island. On steering for the first, you will, of course, make Point Luzuero.

SANTANDER.—Of this harbour a particular plan is given on the New Chart of the Bay of Biscay. Cape Mayor, on the western side of its entrance, lies in latitude 43° 30′ 10″, longitude 3° 45′ 6″. This cape is of moderate elevation, but steep, and distinguished by its lighthouse. Cape Menor, or Little Cape, half a mile more to the S.E., has a battery on it. This is lower than Cape Mayor, and terminates in a low flat point, with a small reef of rock below it.

On the same side, at the distance of 1 3-10ths miles to the south-eastward of Cape Menor, is Point Puerto. The land between forms the sandy BAY OF SARDINERO, in which vessels anchor, when the wind and tide do not serve for going into the harbour. The best anchorage here is with the Capes Menor and Mayor in one; and, at 3 cables' length from the former, you will find from 10 to 12 fathoms, bottom of sand; but more to the southward, it is all of rock or stone.

The extensive sands on the South side of the harbour frequently shift, and a great portion of them is dry, at low water. On the North side, from Point Puerto eastward, the coast is rocky, and defended by several batteries. The town has a small pier.

With the wind blowing fresh from the S.W. or N.W. quarters, it is impossible to take the harbour of Santander; but vessels may, with flood tide, occasionally bring up in the Road of the Promontory, which is clean and roomy, and there wait for a wind. With an ebb tide, it will be better to come to in the outer bay, off the beach of Sardinero, as already described.

An islet, named *Mouro*, which is high and steep, lies in the entrance, at half a mile N.E. from Puerto Point; on it a bright light is established; close to its eastern side is a larger rock, and there is a shoal at a cable's length to the N.W. of it; otherwise there is deep water around it, and the channels on each side are clear and good.

Although Santander has been considered as the best harbour on the North coast of Spain, eastward of Cape Ortegal, there is little doubt that it is now filling up, and that the channel and even the anchorage now used may, in a few years, become impracticable.

On *Cape Penas* is a revolving light, visible every two minutes; on *Cape Busto* (long. 6° 29′) is a bright fixed light with a *red* flash every two minutes; on the *Orrio de Tapia*, near Ribadeo, is another fixed and flashing light; and on *Cape Estaca* is a revolving light. These lights will indicate the chief points of the coast.

CAPE ORTEGAL, Cape Prior, with the other headlands in the vicinity, are high and steep. The ground without generally rocky and foul. At the foot of Cape Ortegal are nine or ten sharp-pointed rocks above water, with 15 or 16 fathoms close to them; and there is a rocky shoal at half a mile N. by E. [*N. by W.*] from the cape. A watch-tower on the highest land, at 1⅝ miles from the cape to the southward, is a good mark for distinguishing it from seaward. Hence to Cedeira the land is steep and rugged, but to the northward of Cape Prior it falls into sandy bays. At different distances from shore are many scattered rocks, on which the sea breaks in a swell.

Both the stream of tide and current of the sea set in toward the land of this coast; so that the utmost attention is requisite, in order to avoid being embayed with light winds. With a good steady breeze, large ships may, however, pass safely within 2 miles of Cape Ortegal.

FERROL.—From Cape Prior to the Harbour of Ferrol the land is highly mountainous, with large rocks above water along-shore. The bay, forming the entrance of Ferrol Harbour, is only a mile wide; and the channel from it into the harbour but 2 cables' length in its narrowest part. There is, nevertheless, sufficient depth in mid-channel for large ships at all times of the tide, viz., 8 to 10 and 12 fathoms. When within, you keep over to the North side, where you may haul up, and anchor in from 4 to 6 fathoms, sheltered from all winds.

CORUNA, &c.—The North part of the Peninsula of Coruña is distinguished by the remarkable lighthouse called the *Tower of Hercules*, constructed with three sides, and exhibiting a fixed light with flash every 3 minutes. On the coast, without the elevation on which the lighthouse stands, there is a bank of rocks extending N.W. to a considerable distance; but, from the meridian of the lighthouse a ship may range along the coast into the harbour, to the S.E. and South, and find anchorage with the town bearing S.W. in 14 and 15 fathoms. A fixed light is also shown from St. Antonio Castle.

GENERAL REMARKS ON COMING IN WITH THE COAST ABOUT FERROL AND CORUNA; from the Spanish of TOFINO.—"During the night, ships should never advance too near the land; for not only does, at times, a powerful current set in for the land from the N.W., but the streams of flood and ebb often draw vessels out of their computed situation, especially in winter, or in thick foggy weather, which is frequent here. In the daytime, the sandy beach at the bottom of the hills may often be seen, when the latter are obscured in mist and haze. Ships from the westward, which cannot take the harbours in the day, should not advance to the eastward of the meridian of Cape St. Adrian, or about Cisargas Isle (8° 44′), where they should stand off and on according to the state of the wind; for lying-to may be dangerous.

"During south-westerly winds, the currents set with great strength between Cisargas Isle and Cape Ortegal; and vessels have often been carried thus to leeward of the harbour of Ferrol, where there is no place of shelter or safety. With north-easterly winds a ship should run within 2 miles of Cape Prior, and thence steer for

Cape Priorino, in order, if the wind be not very strong, to gain the anchorage in the Bay of Carino; or to stand away, if it be so, for Coruña.

In the neighbourhood of Cisargas Isle and Cape Prior, as well as off the intermediate points, it is necessary, in hazy weather, to sound frequently; for the soundings will be a monition before the roaring of the sea on the shore can be heard."

It may be observed that since these remarks were written, the principal points, as Capes Prior, Priorino, Cisargas Isles, Cape Finisterre, &c., have all been marked by the fine lighthouses described in the tables in the earlier part of this work.

From CAPE ST. ADRIAN, the high land continues to the Bay of Camarinas, with rocks above and under water. CAPE VILLANO is of rock, not very high, but perpendicular toward the sea. Within it, at a short distance, is a sharp peak, of a red colour, which, at a distance, appears like a tower. At the distance of a cable and a half N.N.W. from the cape is the *Rock of Bufardo*, steep-to, and over which the sea breaks.

CAPE TORIANA, which is 3 leagues to the S.W. by W. [*S.W. by S.*] from Cape Villano, makes a sharp and steep projection into the sea; it is not very high. At a distance it is not always distinguishable from the high land at the back of it. At two cables' length West from the point of the cape is a small sunken rock, which breaks with a little swell.

The NAVÉ OF FINISTERRE, a high mountain so named, stands at the distance of 5¾ miles to the S.S.W. [*South*] from Cape Toriana. Its summit is flat; and, at about one-third of its height from the sea there appears to be a short point with hummocks on it, and having at its base a small but high island. In the bay formed between Cape Toriana and the Navé of Finisterre, vessels may safely anchor during north-easterly and easterly winds, off a fresh-water rivulet, in from 6 to 8 fathoms, sandy bottom, but not in deeper water, as there the bottom is rocky. Care must also be taken not to advance too near the North shore, as it also is foul.

CAPE FINISTERRE is only half a league South of the Navé. It may be readily known from the sea; because there is a bight between it and the Navé, with low beach, and the land behind less elevated. As there are no other points like these on the neighbouring coast, they cannot easily be mistaken. There is a lighthouse on it, which shows a bright revolving light at ½ minute intervals.

PORTUGAL.—THE COAST OF PORTUGAL is variegated with rocky prominences falling away into low sandy bays. Its harbours universally require the aid of pilots. Such are Viana, Oporto, Aveiro, and even Lisbon. The latter has, however, a good channel with 6 fathoms over the bar at low water, yet it should not be attempted by a stranger, lest the winds fall calm, and the strength of the current set him on the banks. Here the powerful operation of the tides has caused the destruction of many ships. Off the city the ebb runs down at the rate of 7 knots, and the danger in entering is when a strong ebb is running down, opposed to a strong wind from the sea, which makes a complete break, sometimes all over the bar. Under these circumstances a vessel is almost unmanageable, and the tide may sheer her about; but in the middle of the Great or South Channel, the tide sets directly through. To enter the river, during the ebb, would require a brisk gale and all sails set, in order to make any way, or even to stem the current; and it is to be observed, that within the river the wind comes very irregularly through the valleys on each side, unless it proceeds from the West or S.W. It is, however, tolerably steady when in the direction of the river.

CAPE ST. VINCENT.—A light is shown from the convent, revolving every two minutes, at 221 feet. "Soundings extend to a considerable distance from Cape St. Vincent. To the southward of the cape fishing-boats may frequently be seen at anchor, fishing about 8 miles off shore.

"Off the cape, to the westward, the surf, by beating on the precipitous and cavernous rocks, may sometimes be heard to a surprising distance."—*A. L.*

LAGOS.*—According to the latest astronomical observations, Lagos is in lat. 37° 8′ 40″ N., long. 8° 37′ 45″ W., which differs a few seconds from the position generally adopted; but, from a number of coincidences, I should prefer this in a final determination. This place, and Villa Nueva, in time of war with Spain, are of the utmost value and import, more particularly if there is a blockade of Cadiz, as ships are dispatched there to water; on which occasion it is necessary to observe the following instructions:—At half-flood the boats can get near enough to land the casks, and may be taken off as late as quarter-ebb. The tide ebbs and flows in Lagos River at two o'clock, full and change; it rises about 13½ feet in the spring, and 9 in the neaps. The bar is just covered at low water. It has 14 feet on it at high water spring tides, and 10 feet at the neaps. In fine weather, about 180 tons of water may be rafted off in 24 hours. Refreshments, such as poultry, pigs, fruit, rabbits, pigeons, vegetables, &c., are to be procured reasonably.

VILLA NUEVA.—In Villa Nueva River, water may be got in transports, at about 150 butts in 24 hours; which must be rafted 3 or 4 miles down the river with the ebb tide, as the water is too shoal for ships to go nearer the fountain where it is procured. There is a depth of 16 or 18 feet of water on the bar; but, in my opinion, it is only a summer watering-place; as the Portuguese told me, that in winter the bar is seldom passable for ships, as the breakers are very dangerous, and the swell a long way outside it. At the lower water-place a butt may be filled in 8 minutes, and in 7 at the upper. A great quantity of salt is shipped at Villa Nueva.

SAN LUCAR, or the PORT OF SEVILLE.—A vessel bound for San Lacar, or Seville, should, after sighting land, bring the town of San Lucar just open of the point on which stands the ruin of the Fort of Espirito Santo, when a large stone building (not whitewashed) will be seen; it is the easternmost in the town of San Lucar, and cannot be mistaken, as all the others are whitewashed; bring this in a line over the North edge of the Point Espirito Santo, and run boldly in in that direction, until a large square white building is seen at Bonanza, just clear or touching the low sandy point to the northward, covered with trees, called *Point Seville;* then run with this last mark on, keeping the square building in sight, and pass Point Seville at 1½ cables' length; then run over to Bonanza, and anchor in 5 or 7 fathoms before the square building or pier. The square building of Bonanza is close to the river, and about 1¼ miles from San Lucar.

By night Espirito Santo, Bonanza, Chipiona, and Malandar Point are distinguished by lights as shown in the table.

The water breaks on *Picacho* till half-flood; when there is any sea on, leave it on the port side.

It is best to wait till flood tide to run in with; we had 22 feet water at quarter ebb, and beat out, opening and shutting the square building at Bonanza with Point Seville. The South side of the entrance of the river is bordered by low black rocks, covered at quarter-flood. Weather permitting, a pilot may always be obtained, but they only put off when a ship is bound to the port.

It is recommended that no ship taking the bar of San Lucar should attempt it on the ebb tide, especially if they have any suspicion that there are freshes in the river, because, with a broken sea and strong tide, a vessel may sheer on shore before she could recover herself.†

TRAFALGAR.—Cape Trafalgar, by the ancients called the *Promontory of Juno,* is about 15 or 16 miles to the eastward of Cadiz, and 23 or 24 miles to the southward of it; its appearance is flat, and distinguished by a white building, but a lighthouse is in course of construction on it. Those unacquainted with the navigation between

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* The descriptions of Lagos, Villa Nueva, Trafalgar, and Tangier have been communicated by Captain W. H. Smyth, R.N., K.S.F., &c.

† These Directions for San Lucar have been communicated by Captain J. Wharton, of the *Romp,* June, 1845, before the lights were established.

this and Cape St. Mary, generally labour under great dread of a gale of wind from the S.W., and, from want of knowing how these gales come on, frequently get into difficulties. The S.W. gales generally commence with the wind at S. by W. or S.S.W., and continue blowing on these points five or six hours, although the sea sets in from the westward; and it is too common for persons, unaccustomed to navigate in this bight to have their minds impressed with the danger of the shoals lying off Point Regla, commonly called the shoals of San Lucar, and falsely represented as very alarming. Under this apprehension they are induced to haul their *starboard tacks* on board, and push for the Strait of Gibraltar; whereas the real danger lies at the entrance of this strait, and consists of dangerous reefs of rocks, with uncertain soundings, in no wise to be depended on. Between Cape Trafalgar and Tarifa (and when you suppose yourself round them, and the straits open), in thick water, not able to see land on either side, you will feel yourself in a very awkward situation to find out the drift of the ship, or ascertain whether you are in a fair way to push through the gut; which you will be compelled to, do should the gale continue, and you are within the influence of the stream; for you can (as before observed) gain no information by the lead of the reef of rocks which lie W. by N. of the Island of Tarifa, and are extremely dangerous. On the other hand, by standing to the westward, with the *port tacks* on board, at the commencement of a S.W. gale, when the wind is from the southward, for instance, at S.W. by S., and you make four points leeway, you will make a fetch to the westward of Ayamonte; or even with a N.W. course made good, you will weather the Bar of Huelba, and the lead will inform you the distance the ship is off the land, 15 fathoms being the very shoalest part you should stand into along the North shore.

The outer shoal of San Lucar is not at a greater distance than 2¼ miles N.N.W. [*N.W.*] from Point Regla; the ground, outside the shoal, is even and hard, with 10 fathoms of water close to it; about half a mile to the northward of it there is a spot with 8 fathoms. No allowance is made for a S.E. current, which always prevails when out of soundings, and even in 60 fathoms.

A more particular description of the land between Cape St. Mary (on which there is a fixed light) and Cadiz may be found in the Sailing Directory. *Cape Trafalgar*, the last great promontory of this coast, may be known by its remarkable figure, being flat, and terminating with two sharp corners or angles. A round tower stands on the East corner; to the eastward of the flat, the land is very uneven and mountainous. To the East of the flat land are high sandy cliffs, but none to the westward.

It is to be noted that the northern side of the reefs called the *Cabezos*, lies 5½ miles W.N.W. [*West*] from the light-tower of Tarifa. This appears to be the spot on which the British frigate *Thisbe* touched, in August, 1804; the depth over which was estimated at 14 feet.

2.—THE COASTS OF AFRICA, FROM TANGIER TO CAPE MESURADO.

Before proceeding with the description of the coast of Marocco, we will direct the attention to the following notice, issued by the British Consul, and which notice ought to be borne in mind by all frequenting these coasts:—

"In consequence of several boats' crews having landed lately, from shipping of various nations, on the open coast of Marocco, or West Barbary, in search, it is supposed, of water or other provisions, the Moorish authorities are desirous that all persons be cautioned that it is not only against the law of this land, and against the sanatory regulations, to land on any part of this coast, in places where there is not a port for their reception, but that, in consequence of the strict injunctions given to the people of this country by their government to prevent any persons whatever setting

foot on land, or approaching near to it on the open coast, the lives of those who infringe the laws in such respect are exposed to danger.

"The undersigned feels it, therefore, his duty to give all the publicity he can to this notice, for warning all commanders and masters of vessels, and especially those navigating under the flags either of the United Kingdom of Great Britain and Ireland, or of the Kingdom of Hanover, or of the Hanseatic Republics of Lubeck, Bremen, and Hamburg, not to venture, upon any account, to land, or to allow any person under their care or orders, to land or approach within musket-shot of the coast of Marocco or West Barbary, excepting within the harbours of any of the well-known ports of this country.

(Signed) "E. W. DRUMMOND HAY,

"*Tangier, Sept.* 15, 1843." "*Her Britannic Majesty's Consul-General, &c.*

TANGIER.—This place is of importance to the navigator, both in peace and war, on account of the refreshments to be procured, which are almost the only traffic the Moors have. The principal articles are cattle, sheep, pigs, poultry, eggs, fruit, and vegetables, of which a limited quantity is allowed to be purchased by each ship.

The bay affords convenient anchorage for vessels of all sizes opposite to the town, in from 8 to 10 fathoms, sand; but it is to be observed that, on the eastern side, there is a rocky ledge, bearing E.S.E. from Tangier Point, and S.W. by W. ¾ W. from *Cape Malabat.* This cape, in a line with Europa Point, Gibraltar, leads clear of the shoal; and the anchorage, therefore, lies with Gibraltar open of the cape. Ships moor to the N.W. and S.E., with the longest cable to the N.W., &c.*

Tangier is described by *Captain Washington* as situate on a deep acclivity, rising at once from the beach, and presenting its eastern and not unpleasing aspect to a bay about three miles wide. It is surrounded by mouldering walls, round and square towers every 60 paces, and three strong gates. Its defences toward the sea are two batteries, one above the other, on the South side of the sea-gate. Directly in front of the landing-place, high on the wall, are about twelve guns; to the North, in a circular battery commanding the bay, about twenty guns of all calibres, mounted on clumsy Moorish carriages, which would not stand fire for ten minutes; crowning all, to the North, is an old and extensive castle, *L'Kassbah*, and the residence of the governor. On the land side, ruined walls and a ditch are the only defences. The gates are shut at sunset, and a watch is kept by night.

All persons who visit this place should pay implicit obedience to the advice of the consul, as to the conduct to be observed during their intercourse with the natives.

In rounding Cape Malabat, some years since, at the distance of more than three-quarters of a mile from the shore, the *Excellent*, of 74 guns, touched upon a rock previously unknown; at which time, from the starboard chains, were found 5½ fathoms, and 6 from the port. Cape Malabat then bore S. by E. ½ E., and the ship floated off in less than a minute. This rock is known by the name of the *Almirante*, and described as having over its shoalest part 3 fathoms of water. There is also a sunken rock at nearly the same distance from Tangier Point, discovered by the *Pacifico* schooner, in 1818, and which lies with the inner coast of Tangier S. by W. [*S. by E.*]

In all the extent between Cape Spartel and Cape Cantin (lat. 32° 32′), as shown on the chart, there are regular soundings toward the shore. In this track there are no harbours of consequence; those which exist being nearly choked up with sand. On sailing along, the inland mountains may be seen at a great distance, covered with snow, even in April and May.

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* It is to be observed that the proper anchorage is in the centre of the bay. On the West of this anchorage is, or lately was, a large old mooring chain, supposed to have been laid down in the reign of Charles II., King of England, and found to extend nearly in an East and West direction, and in a line on the North side of the town of Tangier; its West end being nearly a mile from the nearest shore. Tangier Point is altogether surrounded by foul ground to a considerable distance.

CAPE SPARTEL, the N.W. point of the state of Marocco, is situate in lat. 35° 47′ 40″, and lon. 5° 56′ W. The cape, at a distance, appears like an island, and is so high as to be seen, in clear weather, at the distance of 14 or 15 leagues. The outer point, when seen from a short distance westward, appears uneven, with eminences on it like hummocks, and the high lands resemble the awning of a galley. The ground about the cape is quite clear, with the exception of some high rocks, steep-to.

Around the West side, and at about one-third of the whole height from the summit, is a range of well-defined basaltic columns, appearing like a coronet. At the distance of 2 miles from shore are 98 fathoms, the bank immediately dropping to an unfathomable depth. To the southward of the cape the bank extends much farther off, and there is excellent anchorage on a bottom of mud and sand, and shelter from easterly winds.

The following descriptions of the coast between the parallels of 36° and 28° (those of Cape Spartel and Cape Juba), we owe principally to the Survey of Lieutenants W. Arlett, in the *Ætna*, and H. Kellett, in the *Raven*, 1835-36; and to the notices of Mr. T. J. Evans, of H.M.S. *Dido*, 1837-38.*

From Cape Spartel the direction of the coast is S.W. 20 miles to *Arzilla*, a small fortified town situate close to the shore, between which and Cape Spartel there is good anchorage all along with an easterly wind. The depths of water are regular, 10 to 15 fathoms, over a sandy bottom, at 1 or 2 miles off shore. The coast-line is a flat, sandy, and shingly beach, rising to a fine grazing country in the interior.

The Roadstead of Jeremia, the usual anchorage near Cape Spartel, extends from it 8 or 10 miles to the S.W. The *Dido* anchored in the following positions in smooth water, and well sheltered from a strong levanter, or easterly wind.

1st.—In 15 fathoms, sand and small shells, Cape Spartel bearing N.E. ½ N.; the town of Arzilla, S. by W. ¾ W.; extremity of land to the right, two points nearly in a line, S.W. by S. Distance to the nearest shore about 1½ miles; soundings very regular to a depth of 5 fathoms, at 2 cables' length from shore.

2nd.—In 13 fathoms, coral rock, gravel, and sand, Cape Spartel bearing N.E. ¾ N.; centre of the town of Arzilla, S. ¼ E.; two bold and prominent points to the S.W. of the town, nearly in a line S.S.W. ½ W.

At the village of *Almadronis*, nearly midway between Cape Spartel and Arzilla, landing can be effected. A boat of the *Dido*, sounding in this vicinity, landed, and numerous herds of cattle were seen grazing in the city; but on two officers and two seamen, part of the boat's crew, walking not more than 100 yards from the beach, in hopes of procuring stock, they were immediately seized by a party of Moors; three were detained and conveyed into the country, the fourth having effected his escape. The Moors were armed, and were savage in their behaviour until they had made their prisoners. The ship, then lying at her first anchorage, was soon under way, and ran down off Arzilla, demanding from the governor the officer and men detained. A party of Moorish horsemen were now sent to scour the country, who found them on their road to Tangier, under a guard: on this they were escorted back to Arzilla, but were refused to be delivered up until permission was granted by the governor of Tangier. The delays were so protracted that the ship anchored off the town, to make a serious demonstration, in 4½ fathoms of water, at about 600 yards from the shore, and 150 yards outside a reef of rocks awash, which describe a semicircle without the beach-line, affording good shelter under its lee, with the principal fortress bearing S. ½ W.

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* The first of these was given in the "Journal of the Royal Geographical Society," vol. vi., 1836; and the second in the "Nautical Magazine" of June, 1839. We have, of course, incorporated such other information as would render the description complete.—(See Notes on the Table of Positions, page 38.)

"The fortifications, which apparently are fast crumbling to decay, cover the whole sea-face of the town, on which we observed mounted about twenty guns, of various calibres: in our position not more than thirteen guns bore on us; and if we had anchored about half a cable further North, not more than ten could have been used with effect. However, the garrison being deficient in ammunition, and defenceless in other points, the ship resumed her former anchorage, having gradual soundings, in all directions, from the reef of rocks to a depth of 15 fathoms.

"The next day we received our people by permission of the authorities of Tangier, and started from their inhospitable shore. It is here necessary to state, that, while prisoners, they had been well treated.

"To account for the foregoing proceedings, it appears, by a treaty, that trading is forbidden at any port on the Moorish coast in which there is not a British consul, or his agent. At Arzilla there is a Spanish Jew in the latter capacity, who behaved uncommonly well on this occasion. Now, as we landed only 5 miles from an authorized port, it appears that they carried this article of the treaty to its fullest extent. In fact, it is generally attended with fatal consequences for a Frank, in an unauthorized port, on any pretence, whether from distress or a want of knowledge of their customs. An instance of barbarous murder committed on an Englishman who (in ignorance) had landed for the amusement of collecting shells on the sea-beach, and actually in sight of the ship, occurred a few years back, not 3 miles from where our party were seized; and it may be considered fortunate that this affair ended without loss of life. As a proof of the general ignorance of this custom, we had on board at the time of the above incident five merchant captains, who had been in the habit of trading to the S.W. ports of Marocco, and who knew not that landing was against the laws; and it is to be regretted that our consuls in Marocco should not have given more general information on so serious a point."*

Four or five miles to the N.E. of Arzilla is the *Wed el Ayasha*, a small river, barred across the entrance, but reported to flow sufficiently strong for a good supply of water; and the distance to roll the casks, the boat being anchored clear of the surf, not above 50 yards. The preceding description shows how far caution may be required.

Twelve miles inland from Arzilla is the *Jibel Habib*, a range of mountains very conspicuous from the sea, the loftiest of which is 3,170 feet above the sea. *Jibel Hasan*, another peak in this range, more to the northward, is 2,270 feet high. Just to the North of the town of Arzilla is a castle in ruins; and date trees, which overtop the walls, are growing in the court. On the wall fronting the sea, which is strengthened by three towers, twenty guns are mounted. Under the southern angle of the wall is a well whitewashed tomb. The country around is well wooded, and a quantity laid out in gardens. The population is supposed to exceed 600.†

From Arzilla the coast trends to S.W. ¾ W., and at the distance of 4 miles the coast hills rise to the height of 734 feet; at 5 miles further is the *Haffa el Beida*, a remarkable white cliff, in the shape of a wedge, which rises to 308 feet above the sea, and presents the same form in all directions. It may be distinguished when 5 leagues off; but the best mark for the coast is the Peak of Fas, an insulated mountain, resembling a sugar-loaf, which stands S. by E. ¾ E. [*S.E.* 2° *S.*] from off the entrance of El Araiche, next described.

EL ARAICHE, a picturesque ruin, is situate on the deep southern point of the River

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* See the Notice issued by H. B. M. Consul, given on page 488.

† In the latitude of Arzilla the bank extends 12 miles from the land. Here is a mackarel fishery, on which twenty or thirty Spanish and Portuguese feluccas are employed. The method of taking the fish is by three hooks fastened together: the fisherman throws a handful of salt or sand into the water, to which the fish rise, and are immediately jigged with great dexterity. They are cleaned and salted on the spot.

Al Khos, which here meanders through a rich and fertile valley. *Al Khos* signifies *the bow*; *El Araiche*, the *pleasure garden*; but the people are barbarous, and the country is in an uncultivated state. The population of El Araiche is about 2,500; and a little trade is carried on between this town and Gibraltar. Supplies are abundant, and there is a fine spring of water on the northern shore, very convenient for shipping.

The best anchorage is with the town between the South and S.S.E. The mouth of the river, which appears very broad, is really very narrow at low water, and has then only 5 and 6 feet water over it, but there is a rise and fall of 9 to 12 feet. Inside the water deepens 24 feet. A "pap," or rising point, on the North side of the river, is 204 feet high above the sea. The best anchorage in the roads for vessels intending to enter the river, is with the distant conical mountain, Fas, appearing in the centre of the entrance, 1 mile from the point, in 12 fathoms, sand.

View of El Araiche. A. The Port. B. The Town.

Between Arzilla and El Araiche the ground is tolerably clean, but not very good, being coarse gravel, with 25 and 30 fathoms of water, at from 1 to 3 miles from shore. Before El Araiche the depth decreases, and there are only 4 fathoms at 2 cables' length from shore. In sailing along this coast, care must be taken not to advance too near, unless it should be with a strong easterly wind; for sometimes, in calm weather, there is here a heavy swell from the West or N.W., which would render it difficult to get off shore.

The site of *Old Mamora*, known by several whitewashed tombs, the chief of which is that of *Muley Bu Selham*, at the outlet of a stream said to flow from a small lake, 20 miles to the southward of El Araiche. At 2 cables' length from the bar is a depth of 5 fathoms, gradually increasing to 34 at 2 miles from shore. The coast between El Araiche and this spot is straight, and for the most part about 300 feet in height; reddish cliffs for the first 10 miles, then sand-hills partly covered with brushwood. There are everywhere from 20 to 25 fathoms of water, at half a league from shore, and you may anchor off the coast hence to Slaa or Salee. Ships, in fact, must sometimes anchor here, during a calm, to avoid being drifted by the currents, which set to the southward, along the coast; and the velocity of which, especially at the full and change of the moon, is frequently from 1 to 2 miles an hour.

The Peak of Fas, above mentioned, serves as a mark for Old Mamora, from which it bears nearly *true* East.

From this place the coast extends 10 leagues S.S.W. to *Mahedia*. The coast is very clear, a little higher than the former, and readily known, being of white sand as far as about the middle of its declivity, while the upper part appears like cliffs. The River Sebou, on the South bank of which the town is situate, is impassable, except in boats, or on rafts, at some distance from the sea, although navigable near the ocean. The town extends from the sea-shore to the top of the highest land, so that you may readily distinguish, from the offing, the walls of an old castle, situate in the upper part of it. Ships may anchor, at half a league from shore, in 12 or 14 fathoms, sandy ground; but, when the wind blows from the offing, and sometimes in fair weather, the swell is here very great, as well as along the coast. The best anchorage is with the town from S.E. by E. to S.E. by S.

Mehedia was formerly a place of some consequence, and is noted for the ruins of fountains, arches, &c. The town now contains only 300 to 400 inhabitants, chiefly fishermen, who subsist by the sale of *shebbel*, an excellent fish, much like salmon, which is caught here in great abundance.

In the summer, the wind generally prevails from N. by E. to N.E. along the coast. During winter, there is a blustering S.W. and S.S.W. wind; and, in this season, when it begins to chop about to the South or S.E., shipping must get off, for then it commonly shifts to the S.W. and W.S.W., with foul weather. When it changes to W.N.W. or N.W., the weather is likely to be clear.

Between Mehedia and Slaa or Salee, the coast is rather low, with double land, very even, with a white sandy strand, therefore readily known. At about half-way the strand rises, and thence, southward, the shore consists of black and steep rugged rocks, with small hills.

SLAA and RABAT.—The towns of SLAA and RABAT are divided by the river called the *Bu Regreb*. In this river, between the two towns, some sloops of war, belonging to the Moorish sovereign, were formerly laid up for the winter. But Mr. Jackson has said that, going thence to Mogodor, a few years since, the vessel in which he was, of about 150 tons burden, struck three times on the bar: and, as the sand continues to accumulate, it is likely that, in another century, there will be a separation from the ocean at ebb tide*

SLAA, or SALEE, says Captain Washington, once the terror of the seas, so renowned for its rovers, whose daring exploits reached even to our coasts; whose city and port were a constant scene of riot, and bustle, and activity; now ruined, still, and lifeless. The present town, built on a sandy point, extending to the sea, forming the north-eastern bank of the river, is about half a mile in length by a quarter in breadth, surrounded by walls 30 feet high, and square towers every 50 paces. Its defences, a battery of twenty guns, facing the sea, a round fort at the entrance of the river, and a gun or two on the gates. The mosques, arches, and fountains in the city, show traces of beautiful sculpture, and of great antiquity. Streets narrow, and houses sombre, like all Moorish towns. Population about 10,000, of which 500 may be Jews, with apparently little or no occupation.

The river, called *Bu Regreb*, is here about 500 yards broad, when full. The bar, about one-eighth of a mile from the entrance, extends almost across in a W.S.W. direction, with 3 or 4 feet on it at low water, leaving a channel at each end; the Moors use the eastern. Rise of tide, 9 or 10 feet. From the anchorage off-shore the water shoalens very gradually till close to the bar, where it suddenly drops from 7 to 2 fathoms. Here is almost invariably a heavy surf.

RABAT, on the S.W. side of the river, is 50 or 60 feet above its level, on banks of crumbling sandstone. It is crowned by a venerable and battlemented *Kasbah*, or citadel. A curtain of 500 yards, facing the sea, flanked by two circular batteries of twelve guns each, about as many more in the Kassbah, and a small battery overlooking the river at the S.W. end of the town, form its sea defences. The town is three-quarters of a mile long by one-third in breadth, and walled orchards of about 200 acres reach along the banks of the river.

The old Kassbah was built in the twelfth century, and some subterraneous magazines in it, remarkable for their strength, being bomb-proof, are still preserved; there are, also, the remains of a small battery, which defended the entrance of the river. At a short distance South of the castle, on an elevated situation, is a square fort, the walls of which are about 2 miles in circuit, and strengthened by square towers; they enclose the castle, the town of Rabat, and a large space of ground, where stand a palace, and the mausoleum of the Shareef, or Emperor Sidi, or Seedy Mohammed.

A remarkable old tower at Rabat, called the *Tower of Beni Hassan*, is the best sea-mark for this place. It is built of hewn stone, is 180 feet in height, 35 or 36

* See Jackson's description of Marocco, &c.

feet broad.* At a small distance to the northward of it are the ruins of an ancient wall, on which were formerly a battery and castle.

The country in the neighbourhood is planted with vines, oranges, and cotton, of an excellent quality. There are docks for ship-building, both at Salee and Rabat.

The tower before mentioned is described by Captain Washington as that of *Sma Hassan*, and is the most conspicuous object, standing 220 feet above the level of the river, and the first by which this coast would be recognised in approaching from sea, as it must be visible from the deck of a frigate 6 or 7 leagues. He adds, the main street of the town, which runs parallel to the river, contains the principal shops; not very attractive; the markets abundantly supplied with vegetables and fruit; orange orchards, vineyards, and cotton plantations, are extensive; the fruits excellent, though grown on a light, sandy soil. Moorish population, about 18,000; Jew, 3,000. The Jewesses the prettiest in the empire. There are ten mosques, besides the mausoleum of the sultan before mentioned, and that of the Moorish hero *Al Mansor*.

The Road of Slaa is dangerous for shipping, and the accumulation of sand at the entrance wil scarcely permit a vessel of 100 tons to enter the river without danger. Vessels may lie in safety out of the river, near Rabat, from April to September inclusive; but they are not secure in the rest of the year, the wind blowing from the southern quarter, and often obliging them to quit their moorings. The best anchorage in this season is between the Mosque of Rabat nd the Old Tower of Hassan, keeping the former to the northward. As a great number of anchors have been lost in the road, much attention must be paid to the cables. The position of Slaa and Rabat may be seen in the Table, page 33.

E[illegible] MANSORIA, shown on the Chart, is a square of 150 paces, enclosing an Arab vil[illegible] The tower of the mosque, 80 feet high, stands 180 feet above the sea, from w[illegible] less than a mile distant. From the deck of a frigate it may be visible at 6 [illegible]. The coast here is iron-bound and rocky.

FIDALLAH, or FEDALA, a peninsula, frequently mistaken for an island, forms a harbour, having a depth of 5 or 6 fathoms, which affords shelter to small vessels during westerly winds. A roadstead here is supposed to be the only one, with the exception of Agadeer, in the parallel of 30° 27′, wherein ships on the coast may ride in security during winter. This is owing to a projection of the land, South of the peninsula above mentioned.

The village of Fidallah, situate at three-quarters of a mile from the sea, is a walled square, of about 200 paces, enclosing a respectable mosque, the ruins of European merchants' houses, and an Arab encampment. It may, perhaps, contain 300 inhabitants—Moors, Arabs, and Jews.

Between Rabat and Point Fidallah there is no danger beyond a quarter of a mile from shore; the Bank of Soundings extends to the distance of 20 or 22 miles from the land, increasing south-westward. From 160 fathoms, mud, the water shoalens suddenly to 90 or 80 fathoms, between which depths and 60 fathoms it continues for many miles, sand and mud, decreasing to 30 fathoms at 3 miles from shore. The inland features vary slightly; two lines of barren and gently undulating hills, from 200 to 300 feet in height, extend nearly parallel to the coast; the more distant are from 4 to 6 miles from the sea, the nearer not more than a mile, sloping gradually to the beach, which is generally sandy, with occasional patches of rock.

DAR EL BEIDA (sometimes called CASA BIANCA, having the same meaning.)—At 4 leagues W. by S. from Fidallah is *Dar el Beida*, or *Anafa*,† a small walled town

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* A particular description of this tower, &c., is given by M. Cassini, in his voyage to Newfoundland and Saleo, 1768.

† *Dar el Beida*, i.e., white house. A vessel, the *Rose*, from Gibraltar, chartered for *Casa Bianca* (Italian, "white house"), not finding the name on his chart, made for Cape Blanco, and on landing, the captain and part of the crew were made prisoners, and liberated with difficulty. The notice from our consul-general, given on page 488, ought to be very strictly attended to.

on the beach, within a point projecting half a mile N.N.E., *true*, and forming a cove, three-quarters of a mile deep, and well sheltered from westerly winds. This town, as well as Fidallah, was built for the exportation of corn. The towers of three mosques are conspicuous, and one is of superior height. Around the town are many palm trees and gardens; water is abundant. Inhabitants, about 700, including Jews, among whom is a British consular agent.

This place is easily known by its towers, one of which seems almost as high as Hassan's Tower at Salee. The coast between is low, and bordered with small islets, all very near the land.

There is a reef rocks at one-third of a mile off the town, and the landing-place is behind them. Some other parts of the bottom are likewise rocky, and in winter the anchorage is unsafe, owing to the current, &c. From the cape, rocks extend to the distance of nearly half a mile, and farther off is a rocky bank of 6 fathoms. At 20 miles to the West is a depth of 150 fathoms, dark sand, decreasing rapidly toward the land to 45 fathoms at 12 miles from shore, and then gradually to the beach.

AZAMOR.—On a sand-hill at about 13 leagues to the south-westward of Dar el Beida is the small town of Azamor, situate on the South side of the mouth of a river called by Mr. Jackson the *Morbega*, and by Captain Washington *Wad-oom-er-begh.** Its walls, crumbling to ruin, are tenanted by storks. The place is dull and lifeless; streets narrow and dirty; but provisions, fish, vegetables, and fruit, abundant and good. The population about 1,000, including Jews. These carry on a considerable trade in wool, which is shipped from Mazagan. The inhabitants of the country around, who are of superior stature, are chiefly pastoral, possessing large flocks of sheep and goats, and mostly live in tents. Wood is scarce and dear.

The bar of the river is dry at low water. The entrance is dangerous, and the shore flat, having not above 8 or 10 fathoms of water for 1 or 1½ leagues from shore, and foul rocky ground, so that it is not safe to anchor hereabout.

MAZAGAN.—From Azamor to the remains of the town of Mazagan, on the S.W., the distance is 10 miles. This place is on a low rocky point, projecting to the North, which forms the western limit of a sandy cove, of about 1½ miles, and affording a good roadstead for small vessels. It is defended by several redoubts, enjoys a little commerce, excellent water, and good supplies. A large proportion of the buildings are used as storehouses for wool, of which great quantities are hence exported. There is a tank, admirably constructed, which will contain several thousand tons of water. A lofty building, 140 feet high, now in ruins, appears to have been a lighthouse. There is anchorage off the coast, at a league from the shore, in 15 fathoms, sandy ground; but at the West point of Mazagan is a ledge of rocks, which stretch to the N. E. [*N.N.E.*] about a league into the sea, and are uncovered at low water. A dangerous patch of rocks, because the sea only breaks on them at low water in bad weather lies 720 fathoms W.N.W. from the old light-tower. The best anchorage is to bring the two flagstaffs on the Sardinian consul's house in one, and anchor in 6 fathoms water; by doing so, you come upon a patch of blue clay, the rest of the bay being all rocky bottom without exception (June, 1839). The shore hence, toward Cape Blanco North, is everywhere rocky and dangerous, to a considerable distance from it; and ships that stop here must anchor at 2 leagues off, in 35 or 36 fathoms of water, oozy ground; the swell is almost always very great, and the current is very strong. From Mazagan to Cape Blanco the distance is 4 leagues. The shore between is merely a ridge of sand-hills. About midway are the ruins of *Tett*, or *Tid*, an ancient town, and a conspicuous tower, 128 feet high and 148 feet above the sea, which may therefore be seen from a great distance. Two large tombs, kept white-washed, stand on either side of it.

The coast hereabout should not be approached nearer than 1½ miles, as scattered rocks lie off the shore, and the bottom is very uneven. The beach, in some places

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* Or *Um' er' beigh*; "Mother of Herbage."

sandy, is generally lined with craggy rocks. A line of barren hills, 200 feet high, slope to the beach along the whole distance, and terminate just to the northward of the cape in a low and dark but abrupt and rocky cliff.

CAPE BLANCO North.—This is in lat. 33° 8′, a little to the southward of the headland last mentioned. It is 170 feet high, appears to be of white sandstone, and the lines of strata, white and red, rising parallel to the horizon for some distance, suddenly drop at nearly a right angle to the water, and the cliff appears like a wall. In a bight on the S.W., which is formed by the cape, is a good anchoring place, of sufficient extent for several ships.

At 22 miles westward of Cape Blanco are soundings of 150 fathoms, fine sand, gradually decreasing to 28 fathoms at 4 miles from the shore.

A dark and rather projecting cliff, formerly represented as an islet, under the name of *Duksal*, stands at about 4 miles southward from Cape Blanco; and, at 6 miles from the cape, hills rise gradually from the beach to the height of 465 feet, the greatest elevation on the western shore of Marocco. Hereabout are the ruins of *Woladia*, where it seems there was once a harbour. At 4 and 7 miles to the southward of these, on the edge of the cliff, are those of two other small towns, supposed to be Eder and Teturia.

CAPE CANTIN, or Ras al Hudik,* in lat. 32° 32½′, is a steep headland, which rises precipitously to 211 feet above the sea, and has a ledge of rocks projecting from it; on its summit is a small sepulchre. At 16 miles westward from the cape are soundings of 100 fathoms, fine sand; this depth gradually decreases eastward.

From the preceding description it will appear, that between Cape Blanco and Cape North the coast is much higher than the coast between Cape Blanco and El Araiche. It trends to the S. by W. ½ W. [*S.W. ½ S.*] 12½ leagues, and is safe all along, having only some small islets very near the land. At 2 leagues off the depths are 40 and fathoms, oozy, ground. The currents are very strong, and generally run in the direction of the coast, S.W. by S.

From Cape Cantin to the North point of Asfee or Saffi Bay the coast trends S.S.W. [*nearly South*] 4 leagues, and is much higher than the coast already described. Between these points, at the distance of a league from shore, is a rocky bank, extending North and South, *true*, having over it from 30 to 40 fathoms, and, at times, abounding with fish. From the North point of the bay (which is foul) to the town of Asfee, or Saffi, the distance to the S.S.E. is 2½ leagues.

Saffi.—The North cape of the Bay of Saffi forms two headlands; on the southern one is a tomb or sanctuary. The coast between Cape Cantin and the bay is one continued white cliff, with a sandy beach at its base; the cliff, rising gradually to its southern projection, is there 530 feet in height, and here the bay commences. In the bight within is a ravine, the bed of a winter torrent; and on the slope stands the ancient town of Saffi, in lat. 32° 18′ or 32° 19′, between two hills, which render it intolerably hot; and, in winter, very disagreeable, as the waters from the neighbouring mountains, occasioned by the rains, discharge themselves through the main street into the sea. The road is safe in summer; but, in winter, when the wind is from South or S.W., vessels are frequently obliged to make off to sea.

Saffi is a considerable town, surrounded by a wall 31 feet high, with a ditch, and defended by twenty-four heavy guns next the sea. The tower of one mosque is 200 feet above the surface. Fresh water is scarce, and procured from wells southward of the town. The country in the immediate vicinity appears sandy and barren; but the interior abounds in corn, and two falls of rain in a year are said to be sufficient to bring it to maturity.

During the summer months, or from March to October, the bay affords as good anchorage, and smoother water, than any other on the coast, but is entirely exposed to westerly winds; the bottom is of sand and mud, and there is generally a depth of

* *Ras al Hudik*—Cape of Palm Groves.

about 15 fathoms at a mile from shore. Vessels may anchor at a league from the town, in 20 or 22 fathoms of water, gray and oozy sand. To anchor in the road, the North point, on which stands a low tower, must be brought a little to the northward of N.N.E. Or, further in the bay, the same point may be brought North (by compass) a little easterly, when the northernmost of two northern points will appear about a ship's length open, without the southernmost; and the high castle of the town S.E. by E. or S.E.; the depths 16 to 18 fathoms, fine grey sand. There is also anchorage within, in 15 fathoms, with the North Point N.N.W. or N. by W.; but these are the summer roads: in the winter, you must anchor further from the land, in 20 or 22 fathoms, as already shown. You may boldly run in to the summer roads by night, with the castle bearing E. by S. or East.

If bound to Saffi, from the northward, shape such a course as will lead sufficiently to the westward of Cape Camin, in order to avoid the rocks about that cape. You may easily know on which side of Saffi you are standing, as the land to the northward of the bay is high and uneven, and that to the southward of it is a plain, even land.

From the South point of Saffi Bay, which is very low, to the mouth of the *Wad Tansift*, or River of Marocco, the coast trends S.S.W. ¾ W. [*S. ¾ W.*] 16 miles, and presents, generally, a line of sand-hills, from 150 to 200 feet high, which, in some places, terminate in low cliffs, and in others slope to the beach. Inland is a ridge of sandy looking hills, covered with brushwood, the highest 650 feet above the sea. There is a large tank on shore, nearly midway between Saffi and the Tansift, and on the southern bank of the river is an old castellated building, square and roofless, which was built for the use of travellers. The Bar of the Tansift, although a considerable river, is in summer entirely dry at low water.

MOGODOR.—From the Tansift the coast extends in the direction of S.W. by W. ½ W. [*S. 40° W.*] to a low sandy point, forming a cove to the northward of it, with rocks within half a mile from the beach. The coast, which from the Tansift is barren and uncultivated, and from 200 to 300 feet in height, here assumes features of fertility. The lofty *Jibel Hadid* or *Iron Mountains*, extending more than 20 miles, is a mass of high land, which here rises to the height of 2,350 feet; another, nearer the sea, with a conspicuous tomb on its summit, rises to 2,100 feet.

A sandy beach continues from the reef point nearly S.W. [*S. 21° W.*] 12 miles, to Mogodor; the inland prospect is here bounded by the *Botof* sand-hills, which extend parallel to the beach, at the distance of a mile.

SUERRAH OR SUIRA, otherwise Mogodor, is the only port on this coast which maintains a regular commercial intercourse with Europe. Its population has been computed at 9,500 persons. The town is built on a low flat desert of accumulating sand, which separates it from the cultivated country, and is defended from the encroachment of the sea by rocks, which extend from the northern to the southern gate; though, at spring tides, it is almost surrounded by water. There are two towns, or rather a citadel and an outer town. Those Jews who are not foreign merchants are obliged to reside in the latter, which is walled in, and protected by batteries and cannon, as well as the citadel.

The wind being high all the summer, with little intermission, nothing grows here in sufficient quantity to supply the inhabitants; all kinds of fruits and vegetables are, therefore, brought from gardens 4 to 12 miles distant; and the cattle and poultry are also brought from the other side of the sandy hills, where the country, although interspersed with *Harushe*, or stony spots, is capable of producing every necessary of life. The insulated situation of the town, and other circumstances, deprive the inhabitants of all resource, excepting that of commerce, so that every individual of the place is supported directly or indirectly by it. In this respect, it differs from every other port of the coast.

An island, which lies to the S.W. of the town, forms the harbour. This island is about 1¼ miles in circumference; and between it and the main land, on the South, is the anchorage. There are here, in some parts, only 12 feet at low water; therefore, large ships do not enter the port, but anchor at about 1½ miles westward of the Skala, or long battery, which extends along the West side of the town toward the sea.

On approaching the land in the parallel of Mogodor, the first remarkable feature which appears, is the craggy summit of Mount Atlas, covered with snow, and contrasting with the dark ridge of hills between it and the coast. To the northward, the *Jibel Hadid* appears insulated, and, as you draw nearer, a long patch of sand becomes visible; and finally, the white towers of Mogodor rise, as it were, from the water. Soundings, in 100 fathoms, may be found at 23 miles from shore, when the water immediately becomes dis[illegible]loured; the soundings decrease very gradually, over a bottom of sand.

Mogodor has a beautiful appearance at a distance from the sea; the houses being all of stone, and white. The streets are, nevertheless, narrow and dull. A winter seldom passes but some ships are driven ashore by the S.W. winds; and this happens generally between the 8th of December and the 18th of January, the season called *Liali* by the Arabs, and the only period dangerous for shipping in the bay.

Lieutenant Arlett says, that, of the inhabitants of Mogodor, in 1835, 4,000 were Jews, separated by a wall from the quarter of the Moors, whose portion is called the *Citadel.* All laborious work is performed by Jews, and domestic servants are all of that class. Much of the trade is also monopolized by the same people; for, owing to certain exemptions from duty, they are enabled to undersell European traders.

The principal exports are wool, gum, wax, hides, skins, almonds, honey, ostrich feathers, and gold-dust. *Imports,*—iron, hardwares, and cotton goods. Duties fixed and not very heavy. The want of water has been diminished, by the construction of an aqueduct, which conveys the stream from the river, 1½ miles distant, to several large tanks in different parts of the town. One of these is exceedingly convenient for vessels watering, being close to a jetty, inside a fortified bridge, which connects an islet with the main; here boats may fill, toward high water, perfectly sheltered from all winds. The market is excellent; provisions of all sorts, including fish, poultry, and game, are abundant and cheap; as are, also, fruit and vegetables.

The position of the British consul's house, as given by Lieutenant Arlett, is 21° 30′ 29″ N., and 9° 46′ 0″ W. Captain Boteler makes the longitude 9° 44′. From the roof of this house, the highest snowy peak of Atlas is seen, bearing S. 45° E.*

The roadstead, during the winter, can scarcely be considered tenable; and even in the summer, the strong N.E. winds which prevail cause a very disagreeable sea. A westerly wind throws a very heavy swell into the harbour; but, notwithstanding reports which prevail to the contrary, it is not generally unsafe for vessels properly found in cables and anchors.

The North Passage into the Harbour is between the town and island. A great ledge of rocks extends from the main, among which those next to the island stand high above water. In coming from the northward, if you would sail in behind the island, you must run between it and those rocks, close by them, where you will have 5 fathoms of water. The best anchorage is under the island, in 2½ fathoms, as there the ground is good.

South Passage.—A small reef extends from the South end of the island, toward the main land; and, on the South side of the passage, a bank extends from the main land to a considerable distance. In sailing outward, run along by the latter, and you will soon be in 4, and thence to 10, fathoms of water. The tide flows here, on the full and change, at 4ʰ, and rises from 10 to 12 feet. The current is scarcely perceptible.

From Mogodor southward.—At 8½ miles S.W. from Mogodor lies *Ras Tagrifelt,* or *Cape Sem,* a low sandy point, sloping gradually from the height of 490 feet, and terminating in a reef of rocks which extend, on all sides, to the distance of rather

* See Captain Washington's note upon this particular, in the "Journal of the Royal Geographical Society," vol. vi. p. 291.

more than two-thirds of a mile. The coast between this and Mogodor is a continuous line of bare sand-hills, 70 feet high, and sloping to the beach. In the background are the *Botof* sand-hills, covered with a dark evergreen. Under the cape is said to be a rocky bank, stretching 2 leagues off, and upon which, at a league from shore, has been found 13 fathoms; at 2 leagues, 20 fathoms, rocky ground; at 3 or 4 leagues, 35 and 40 fathoms, oosy sand. Hereabout the current sets violently to the southward.

CAPE TEFELNEH.—Cape Tefelneh, at 18½ miles S.S.W. from Cape Sem, rises to the height of 780 feet, and terminates in a point from which a ledge of rocks extends half a mile, with deep water close to them. There is anchoring ground under it, on the South, affording shelter from East and N.E. winds, in 10 fathoms, sand. At 8 miles to the northward of Cape Tefelneh is *Kuleihat*, a small village on the side of a wooded hill. A little stream, *Tidsi*, falls into the sea at its foot, through a picturesque ravine: between these, high cliffs, apparently of sandstone, face the sea.

CAPE GHIR, or Geer (properly *Ras Aferni*), is situate, according to Lieutenant Arlett, in lat. 30° 37′ 30″, and long. 9° 52′ 30″, and projects boldly into the sea at 25 miles to the southward from Cape Tefelneh. The intermediate back land rises to the height of 2,895 feet above the sea: the country appears wooded, and numerous villages and tombs may be seen. On approaching Cape Ghir from the westward, it presents a bold bluff slope on each side, the highest part 1,235 feet above the sea. The depths of water gradually diminish, and soundings are found at 26 miles off. The coast between Cape Tefelneh and Cape Ghir is a sandy beach. *Cape Ghir* is very remarkable, and may be seen when 4 leagues off. To the northward of the cape, about 4 miles within land, stands a round hummock, which is a mark for the cape, and the land further to the northward is still higher; but on approaching the cape no land will be seen to the southward of it. From the North side of the cape, a reef extends to some distance out to sea, and should not be approached nearer than in 20 fathoms of water.

AGADIER, or Santa Cruz.—*The Town of Agadier, or Santa Cruz*, stands at 6 leagues south-eastward of Cape Ghir, at the bottom of the bay of the same name. This is the last port of Marocco on the Atlantic Ocean. The town, which stands on the summit of a mountain, is strong by nature, and its walls are defended by batteries; but the principal battery is at a short distance from the two town, down the mountain, and was originally intended to protect a fine spring of fresh water, close to the sea. This battery also commands the approach to the town, both from the North and South, and the shipping in the bay. The ruins of the town, called by the Portuguese *Fonté*, remain at the foot of the mountain; and the arms of that nation are yet to be seen in a building erected over the spring.

The bay is considered as the best road for vessels on the coast of Marocco, being large and well sheltered. It abounds in fish, immense quantities of which are caught by the inhabitants of the town. Owing to the jealousy of its government, Agadier has ceased to be a place of trade; yet it was formerly the centre of a very extensive commerce, whither the Arabs, and the people of Soudan, resorted to purchase merchandise, for the markets of the interior of Africa; and caravans were constantly passing to and from Timbuctoo.

From the northward high barren hills slope to the beach, which is rocky, to the distance of 5 miles N.W. of Agadier, where a streamlet, the *Wad Tamarect*, flowing through a green valley, discharges itself into the sea. The high land, extending from Cape Ghir to Agadier, usually called the *Heights of Idautenau*, is the western extremity of the main chain of the Atlas, which ranges hence in an E.N.E. direction, and rises at 9 miles eastward of Agadier, to the height of 4,408 feet, and a remarkable conical hill, 3,980 feet.

At 6 or 7 miles to the N.W. of Agadier, above a point stretching into the bay, is a good anchoring place, with from 20 to 12 fathoms. In sailing from the cape to the road, be sure to run along by the land of the cape till you are before the castle, because northerly winds are very prevalent here; and should you keep too far from shore, you may be forced to fetch it up again with difficulty. If coming in by night, approach no nearer than in 12 or 14 fathoms.

To anchor in the Road of Agadier, enter the bay so far that the castle may bear N.N.E., and the storehouses E.N.E. Here you will be to the southward of a rocky ledge, lying off the town, in 7 or 8 fathoms of water. The best riding is with Cape Ghir bearing North, in 6 or 7 fathoms. Care must be taken to have your anchors ready; your small bower is always to be laid out before the land-wind, and the others to seaward; the sheet-anchor must also be in readiness, and brought out to the S.W. against a storm, which is soon perceived by the rising and swelling of the sea. It is likewise necessary to keep the foresail to the yard, that you may defend yourself the better, should you happen to be driven from your anchors.

On the COAST OF SUSE, southward of Agadier, there is no port frequented by shipping; but Mr. Jackson has emphatically stated, that "there is a track of coast which holds out great encouragement to commercial enterprise, and secure establishments might be effected upon it, which would amply remunerate the enterprising speculator. The people of Suse are, also, well disposed towards Europeans, particularly the English; and the communication and short distance between this place and the provinces, or districts, where most of the valuable products of Barbary are raised, render it peculiarly adapted to trade." From Agadier southward, the authority of Marocco lessens, and the Wedinoons proudly boast their independence.

Although we may suppose that the features of the coast are properly delineated in the Admiralty survey, yet we have not that detail of the land which would indentify the local knowledge of the inhabitants. All the places along the coast have some names which are not given in the survey. Thus we are not able to follow the tracks of those who have travelled along the coast by our charts.

Immediately to the southward of Agadier a very low and flat country commences, and extends thence 29 miles. At 5 miles to the southward of Agadier is the mouth of the *Suse*, a fine river, rising at the base of the Atlas; but the bar is dry at low water, and can never be passed by vessels drawing more than 4 or 5 feet.* From the Suse the coast southward continues sandy. The *Wad Messa*, about 30 miles from the Suse, has, likewise, a bar dry at low water, but may have 4 or 5 feet over it at high water, spring tides. At a short distance within this, on the North side, is a village; and near the beach, on the South, a castellated building.

At a few miles to the northward of the Messa are the wells called *Tomie*, or the Seven Wells, off which is an open roadstead. On this parallel, about 30° 0', is a depth of 86 fathoms, dark sand, at 16 miles from shore; and 45 fathoms, sand and mud, at 5 miles from the same, decreasing thence gradually to the beach.

Cape Aguluh of the charts is only a slight rounding of the coast, in lat. 29° 49', long. 9° 48'.† From the Messa southward the beach still continues sandy, but verdant hills, approaching the sea, break off into cliffs, apparently of sandstone, about 100 feet in height. In the interior is a ridge of high mountains, at 50 or 60 miles from the coast. The interval between appears like a wooded and well-cultivated country, with many houses and farm buildings. Immediately to the southward of the cape is a little sandy bay, and a valley crossed by a hill on which stands the village of Aguluh. A small stream runs down the valley. The slopes of the hills were waving with corn, nearly ripe, in May, 1835.

At half a day's journey (by land) south of the Messa is a small town, called by Mr. Elton, Seed Bom Noire, where there is a small harbour. At this place a Spanish vessel took in a cargo of wheat and beeswax about 1835. She laid off the place for

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* Mr. W. J. Elton, Vice Consul at Mogodor, says that the depth in the mouth of the Suse and of the Messa (Massa) is 12 feet at high, and 2 feet at low, water.

† Where the Messa has commonly been represented. The latter, we presume, is in lat. 29° 56', or thereabout.—ED.

several days before she was communicated with, and a plan was formed by the Moors for seizing her, but she was saved by private information.

At 12 miles to the southward of Aguluh, the features of the country change; the hills become barren and abrupt, and form in successive ridges, gradually increasing in height till they join the line of distant mountains, which rise to the height of nearly 4,000 feet, and appear to be the S.W. extremity of an off-set of the Atlas. More to the southward the appearance of the inland country continues the same, but the coast changes to dark red cliffs, broken into coves, on the beaches of which boats may be seen; and there are many villages, but inhabited by people of perfidious character.

In lat. 29° 22′ is a remarkable white cliff, supposed to be of limestone, and described by Lieutenant Arlett as follows:—Its strata are extremely curved and irregular, and it forms a good mark for the coast: behind it, and standing alone, is a conical shaped mountain, rising to the height of 3,906 feet. In this latitude, at 25 miles from shore, are soundings in 105 fathoms, broken shells: outside of this the bank drops very suddenly. On standing in-shore the soundings decrease rapidly to 60 fathoms. At 5 miles from shore are 28 fathoms, coarse sand; the depth thence decreases very gradually to the beach. From the cliff above described the country assumes a more rugged and barren appearance; the hills steep, with deep and narrow ravines; the coast, alternate hills and sandy bays, with prominences rocky and rugged.

In 29° 10′ N. is a cove, marked on the charts *Reguala* or *Gueder*. A rocky prominence on each side projects to a short distance; the sides are steep and barren; these are separated by a deep and narrow ravine, down which a slender stream finds its way to the sea. In this cove the water is deep, and bottom clean to the beach; a landing may generally be effected in it, but it affords no shelter.

In lat. 29° 3′ the mountainous country terminates, and a sandy desert commences. There is also a break in the coast, which seems to be the dry bed of a river, and is called by the Canarians *Rio de Playa Blanca*, or White Beach River. At 4 miles to the southward of this the coast is of bold sandstone cliffs, with sand-downs in the interior devoid of herbage, and thus it continues to Cape Noon, in lat. 28° 45′ 45″, as shown in page 38.

Cape Noon presents a cliff of sandstone 170 feet above the sea; but, owing to the cliffs, to some distance on each side, being of the same height, and the country inland a flat desert, it is difficult to make out the exact projection till very near it. The cape is steep-to, and clear of danger.

Here the depth gradually increases outward; and at the distance of 4 miles from shore the depths are from 30 to 54 fathoms, bottom of reddish sand; at 12 miles, 57 fathoms, dark sand; and at 30 miles, 98 fathoms, coarse red sand; the water then deepens very suddenly. For a long distance, both to the northward and southward of the cape, as well as to seaward, the water is very much discoloured. It has a red tinge, and is so thick that the track of a ship is visible for a length of time.* At 4 miles to the south-westward of Cape Noon is the *River Shleema* (the Akassa of the charts); and at 31 miles more, in the same direction, is the Akassa, in lat. 28° 19′. (This must be the Inoon of the Chevalier de Borda, given in page 33.) Each river has a bar, but both appear to have deep water inside, and the banks of both are verdant and fringed with shrubs.

The Shleema, when well open, may be recognised by two remarkable hills, which will then appear in the centre of the gap: they are conical; and on one of them, 325 feet high, are some ruins, said to be those of a fortress. The coast between Cape Noon and the Shleema affords secure anchorage, with moderate depth of water, from the month of March to October.

WEDINOON, or Noon, is a kind of intermediate depot for merchandise on its way to Soudan, and for the produce of Soudan going to Mogodor. Gums and wax

* This discoloration is attributed, chiefly, to the vast quantities of sand blown from the desert.

are produced here in abundance; The people sometimes trade to Mogodor, but prefer selling their merchandise on the spot, being unwilling to trust their persons and property within the territory of Marocco. With Timbuctoo, however, they carry on a constant and advantageous trade, and many are rich. They also supply the Moors of Marocco with convoys to Timbuctoo.*

The coast line between the Shleema and Akassa (or Inoon) is a continued sandstone cliff. A table-land, about 900 feet high, at 3 miles from the shore, shows just above the cliffs, near which there is a regular depth of 20 fathoms, with good ground. On approaching, the table-land appears to break into detached hills, one of which, 950 feet high, and more insulated than the others, serves to identify the river.

The FISHERY carried on by the people of the Canaries commences near the parallel of Cape Noon, the fishermen seldom venturing to the northward, although fish are equally abundant, from their dread of the Moors, who, on that part of the coast, possess boats. From the cape to the Bank of Arguin (an extent of 200 leagues) the inhabitants of the desert have not a single boat. The fishermen frequently land, not only to procure water, but to barter their fish for wood and orchilla; on these occasions great precautions are taken, as atrocities have frequently been perpetrated on both sides.

Porto Cansado.—From the River Akassa (Inoon of Borda?) the coast and country continue as described above. The cliffs are above 120 feet in height to lat. 28° 7′, or the Porto Cansado of the charts. Here the cliffs terminate, and a low sandy beach begins, continuing in a S.W. direction 18 miles, to lat. 28° 2′, long. 12° 14′, where there is the entrance of the *Porto Cansado* of the Portuguese, which is described in the Narrative of Judah Paddock. The entrance of this harbour is narrow, widening inside, and forming a sort of lagoon. The sea breaks heavily across, and, at times, it is barely possible that boats may enter. Its only distinguishing mark is a table hill, 580 feet high above the sea.

Captain Judah Paddock, who was wrecked near here in the *Oswego* in April, 1800, thus describes it:—

"It has 9 or 10 feet within a cable's length of the shore. The distance across it was estimated at about 3 miles; the two outer points are broad, closing to within 1 mile; a ledge of rocks on each point leaving a fair entrance of half a mile in breadth, with deep water. Against those ledges the sea broke violently, but in the harbour it was smooth; from the windward side of the harbour a ship might lie very well, with the wind as it then was, which blew strong four points on shore, or at north-east. Had our situation been less deplorable, I should have been led to examine this fine-looking harbour more particularly. Should any national vessels ever undertake to survey this coast, they will, beyond doubt, visit it. From our judgment, being on shore, it would appear from the offing a nearly straight shore, as the two outer points, or chops, of the harbour would, except being near it, seem nearly to close on the western side of the harbour. Where we stood to look at it, the bank was high, and from sea-board would, in my opinion, appear like a high round knoll; the mountain back, only a few miles distant, would appear black, at least of a dark colour, and the top flat for several miles each way, running E.N.E. and W.S.W. On this nearly flat mountain, supposed to be nearly 400 feet in height, above the level of the sea, is a remarkable bed of salt, about a mile in diameter. Hundreds of ships can ride in the harbour in safety, defended from all winds except the north-west; and, as the entrance is so much narrower than the body of the harbour, no sea through that gut can hinder ships very much, the ground being perfectly clear."

Nothing can be conceived more dismal than the appearance of the shore hereabout. For many miles not a dark spot is to be seen to break the monotonous appearance of

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* To those who wish for further information on this subject, we recommend the valuable work by Mr. Jackson, already quoted. See, also, "Journal of the Royal Geog. Soc., vol. vi. p. 297.

the sand; the fine particles of which, mingling with the haze occasioned by the heavy surf, render the coast very indistinct.

From Porto Cansado the coast trends westward to *Cape Juby*, in 12° 55′ W. At a short distance to the westward of Porto Cansado, a cliff, from 90 to 100 feet in height, again commences, and continues for 17 miles. The cliff is of dark sandstone, and the bottom, being also of dark sand, gives a green appearance to the water. A flat desert extends inland as far as the eye can reach. There is no beach, the sea breaking against the cliffs, on which it appears to be encroaching. Where the cliffs terminate, the land becomes broken into sand-hills partly covered with bushes, and the coast trends in a *true* direction S. 80° W. to Cape Juby, 15 or 16 miles.

Cape Juby is a low sandy point; near its extremity is a hummock, covered with bushes, appearing like an islet. Rocks extend from the cape to one-third of a mile. Here the coast changes abruptly to S.W. (*true*), and forms some coves, off the points of which are scattered rocks. From Cape Noon to Cape Juby the bank of soundings extends to an equal distance, and the depth increases very gradually to the shore.

CURRENTS ALONG SHORE, BETWEEN CAPE SPARTEL AND CAPE BOJADOR.

During five months (from March to August), the time occupied by the *Ætna* and *Raven*, in the survey of the coast, a distance of 750 miles, no day passed in which the former was not at least twelve hours at anchor, usually at the distance of from 4 to 5 miles from shore, and in positions well adapted for making observations on the currents, which were constantly attended to. Independently of this, the *Raven* was repeatedly sent to the distance of 20 and 30 miles from land; particularly when fixed and conspicuous objects afforded opportunities for ascertaining her exact position; by comparing which with that which should have been given by the course steered, the rate and direction of the current could be ascertained to a considerable degree of exactness.

From Cape Spartel, along the coast, to Arzilla, and also to the distance of 7 or 8 miles from the shore, a regular tide was experienced, running parallel to the coast; but its strength was rather greater to the northward than to the southward. In this distance, at 15 miles from land, no tide or current was perceptible.

From Arzilla, southerly, a tide was still experienced, gradually diminishing in strength till its direction could not be ascertained. From the parallel of 34° 30′ N. to the distance of 20 miles in the offing, a steady southerly set was first experienced. This current, in the offing, continues invariably to follow the direction of the land; its velocity increasing or diminishing from the rate of four-tenths to 1 mile an hour, according to the strength or duration of the north-easterly winds.

From Mogodor to Cape Bojador, except in particular instances, the current continues invariably to run in the direction of the coast. Its greatest strength is usually at the distance of from 3 to 6 miles from the land, gradually decreasing on receding from it. Its average rate between 31½° to 28° N. is from one-half to three-quarters of a mile in the hour. At Cape Juby, probably from its stream being in some measure confined by the projecting cape, and perhaps by the Canary Islands (distant 58 miles), it increases its rate to 1¼ miles, but diminishes off Cape Bojador to 1 mile. It did not appear that this current was influenced by any particular wind, but near the shore a tide was generally perceived." (*See* remarks on the currents on pages 278—283.)

Shipwrecks.—The various tribes of Arabs, frequenting the coast of the desert, have already been alluded to, as well as the danger of falling into their power. Their practice has been, when a ship is stranded, and the crew compelled to surrender, to take everything portable from the vessel in boats; and then, if the sea do not dash it in pieces, they set fire to it, that it may not serve as a warning to other ships which may be so unfortunate as to follow the same course.

Mr. Jackson has communicated a stratagem by which a ship was, many years ago, saved on this coast. The vessel was stranded, and one of the crew being a Spaniard, who had been used to fish there from the Canaries, advised the captain to let go an anchor, as if the vessel were riding, aud in safety. Some Arabs coming on board, the captain told them to bring their gums and other produce, for that they were come to trade with them, and were going away again in a few days. As it happened to be low water, the vessel, on the return of the tide, floated; they then weighed anchor, and set sail, to the great disappointment of the people on shore.

Of the vessels wrecked, from time to time, on the coast of the desert, many are probably never heard of; and, if any of the crew survive their hardships, they are induced, seeing no prospect of emancipation, to become Mohammedans, and nothing is afterwards known or heard of them; the vessel is supposed to have foundered at sea, and all passes into oblivion.

It has been stated that there were about thirty vessels of different nations, the greater part English, lost on this coast between 1790 and 1806, part of whose crews found their way to Marocco, and gave some account of their catastrophe; of the remainder, a number were subsequently ransomed; but the majority were either lost, or dispersed in various parts of the desert, after a lapse of time, in consequence of the consul's making no offers sufficiently advantageous to induce the Arabs to bring them to Mogador.

In former editions we gave extended accounts of the shipwrecks and sufferings of the crews of several vessels. These occurred many years ago, before the unsuspected drift to the S.E., which has been dilated on in pages 277—281, was recognised. Although the climate and character of the people remain unaltered, yet it is believed that the wrecks are but few compared with former years, as in those times the losses did not occur from stress of weather, but through errors in reckoning and judgment. While, therefore, the silent and imperceptible influence of this fatal drift, if unheeded, still remains as powerful as ever, it behoves the sailor to be always on his guard to counteract it, and all caution is most earnestly impressed on his attention.

One of the interesting results of these terrible shipwrecks and sufferings was the account given by Robert Adams of the wreck of the *Charles* on the coast in question on Oct. 11, 1810. The crew were instantly seized by the Moors, who were fishing on the coast, and were treated with the utmost barbarity, and many of them were murdered. Adams was sold, and, after many painful wanderings, he visited Timbuctoo, being the first European who had done so, and was ultimately ransomed by Mr. Jos. Dupuis, the British consul at Mogador.

The sufferings of John Riley, who commanded the American brig *Commerce*, and of his companions, who were wrecked near Cape Boiador, in September, 1815, have also been related as a warning. They were also the victims of the brutal treatment of the Moors, but were ultimately ransomed by Mr. Willshire. The narrative of Captain Judah Paddock of the loss of the *Oswego*, through ignorance of the coast and effect of the currents, and the usual sad tales of the captivity of the crew and the consequent sufferings till relieved by the British consul, have also been given as warnings.

The affecting narrative of the loss of *La Meduse*, French frigate, on the Arguin Bank, to the southward of Cape Blanco, on the 2nd July, 1816; which may probably be attributed to a similar cause—the direction of the currents. It has been justly observed, that the annals of naval distress do not offer a more terrible instance of shipwreck. *La Meduse* sailed, 17th June, 1816, from the Isle d'Aix, under the command of *M. de Chaumareys*, having on board 240 persons; of which the greater portion consisted of soldiers intended to garrison those forts at the mouth of the Senegal, which had been restored by the treaty of peace; they were accompanied by the newly-appointed govenor of that place.

The ship ran aground on the bank, in the parallel 19° 36′. A great consternation ensued; and, after many angry deliberations, it was resolved, as they had only six boats on board, to break up the vessel, and with its material construct a raft large enough to place the soldiers on it, who were then to be towed ashore.

On the 5th of July, the embarkation from the wreck took place, in the greatest confusion. One hundred and forty-seven persons (including the captain and surgeon) were confided to the raft. The precipitation with which it was built prevented its being fitted with railings.

By the boats, however, the raft was inhumanly abandoned; it was thus left to its fate amidst all the horrors of famine. In an element which already covered one half of their bodies, the greater part of those upon it at once yielded to despair.

The recital describes the melancholy events of the twelve days; during which time, a principal portion of sustenance was derived from the bodies of deceased companies! At this period, only fifteen men remained, and these were happily discovered and taken off, on the 17th of July, by the *Argus*, French brig, which restored them to their country.

Another case was related by Captain Grover, in the "Geographical Journal," vol. xvi., 1846, page 162. In this the brig *Courier* anchored near the Island of Arguin, and part of the crew were tempted to land, when they were immediately made prisoners with great violence and cruelty, and kept so for eleven months.

Other instances of ships lost upon this coast might be given; but those selected will be sufficient for our purpose.

CAPE BOIADOR TO CAPE BLANCO.—The tropical regions of the African coast between Cape Boiador and Cape Blanco, present to contemplation the *Sahara*, considered as the most extensive desert on the globe. This desert consists of inadhesive sands, which are driven about by the winds, and chiefly by those from N.E., by which they are disturbed and carried to an astonishing distance.

This question of the red dust, which falls in the open air, is more amply discussed hereafter. The few remarks which follow will suffice here.

Of the merchant-fleet from St. Helena, under convoy, in November, 1813, most of the ships had their sails covered with *red* sand, and they must have been from 400 to 500 miles from shore, in about 27° and 28° N., after a succession of easterly winds. "I once," says Mr. Luccock, "saw the sails and deck of a vessel covered with it, when 400 miles from the coast, and have heard of the same phenomenon being remarked at a far greater distance. This moving expanse of sand was, probably, at some anterior period, a large inland shallow sea, communicating with the Mediterranean by the Syrtes [Gulf of Sydra], &c.

A similar phenomenon occurred to the brig *Parssboro'*, on her voyage from Barbadoes to Belfast, and when she was upwards of 900 miles from the main land of Africa. The wind, it will be observed, had been at East, and was interrupted by one of those gales which will be noticed hereafter, in our description of the Azores. In lat. 30° 50′ N., lon. 32° 40′, Cape de Verde Islands bearing S.E., distant 590 miles, the appearance of a heavy squall rising in the S.E. direction. Half-past six p.m., lightning, thunder, and the squall approaching nearer. At thirty minutes past six p.m., the sun about 15° above the western horizon, became overcast with peculiar looking clouds, and every appearance of an approaching storm. I consequently shortened sail, although the barometer did not indicate anything serious. At eight p.m., the wind became very variable, from N.E. to S.W., every ten or fifteen minutes alternately, for two hours. There was a fall of rain when the heaviest of the squall was on the zenith. At midnight it had all passed to the S.W., and the wind resumed its former place, East. At daylight, *the decks, rigging, spars, and paint work were covered with mud:* and as the sun dried it, it had the appearance of a very fine red mould, with no sand in it.

CAPE BOIADOR is represented by the *Chevalier de Borda*, in lat. 26° 12½′, but the late surveys exhibit in 26° 7′ only. The cape has some rocks about it, but on its South side is a bay affording anchorage in 4 or 5 fathoms, and ships may anchor further out in from 15 to 20 fathoms, within a league of the shore, on a bottom of sand, broken shells, &c.

The Baron Roussin says, that the coast to the northward of Cape Boiador is similar to that of the desert to which it belongs. It is arid and sandy, the only signs of vegetation being a few small tufts of dried brambles, scattered promiscuously here and there. It presents no other variety than some flat downs of a tabular form, whose base can scarcely be seen at the distance of 3 miles from the beach. The nature of its soil is exclusively siliceous, being sand without any mixture whatever. The surface of this immense plain is so completely horizontal, that it actually appears to have been levelled. In some places on the coast it terminates in a steep cliff, and in others in a gentle descent toward the sea. These cliffs are streaked with horizontal beds of different shades, approaching to white; the lower ones being generally thinner, and of a more reddish cast than the upper. To the northward of the parallel of 23° N., this soil is overspread with a crust of black earth, which, from its being nearly general, may be taken as its covering, and is of a tolerable thickness. This species of crust, no doubt, derives its consistency from the great humidity which it contracts during the rainy reason, and the extreme heat to which it is again suddenly and constantly exposed. By the repeated shocks of the sea, huge masses of this black crust fall to the bottom of the cliffs, and relieve the sameness of the shore. They first resemble rocks on which the sea breaks, but their corners are soon worn away, and they soon present but a heap of sand. On the whole extent of the coast, as far as Cape Verde, there is not a single piece of granite. Cape Boiador, which lies in 26° 7′ N., and 14° 30′ 34″ W., is not very remarkable. When seen from the northward, it presents a strand of red sand, having a gradual descent toward the sea: and its western extremity, which is very low, forms a small bay with the cliff which immediately follows. The position here given is that of the easternmost point of the cliff, which has been selected as the most remarkable one in the neighbourhood; its height being about 70 feet. The depth along the coast, 3 or 4 miles to the northward of Cape Boiador, varies from 12 to 20 fathoms, increasing gradually toward the parallel of the cape. The nature of the bottom throughout is of sand and broken shells, or of sand and gravel. At the distance of 3 leagues to the seaward there are 25 fathoms of water; and the sandy bottom becomes more general: a circumstance which is common to all the African coast.

It is possible to anchor in the small bay of Cape Boiador, but the bottom is foul. At the distance of half a mile from the shore there are 13 or 14 fathoms of water.

From Cape Boiador the coast trends S.W. ¼ S. [*S.* 20° W.] about 22 leagues, to a very remarkable cliff, about 300 feet high. The cliff seems to be the *Penha Grandé*, or *Great Rock* of the charts. As its height considerably exceeds that of any spot in its vicinity, it may serve as a good land-mark.

All the coast thus far presents, alternately, cliffs and sandy beaches; but more particularly the former. It is from 150 to 200 feet in height; being flat at its summit. The land in the interior, on which brushwood is very scarce, is of a darkish colour.

The depth of water on this part of the coast is considerable. At 2 miles from the beach, bottom cannot be found at 22 fathoms. On the parallel of 25° 50′ N., and at 1½ miles from the shore, bottom may be had in 15 or 20 fathoms, gravel and broken shells. The depth again increases; and under the Penha Grandé, at a mile from the foot of the cliff, there are 26 fathoms, hard bottom, with gravel and broken shells. The summit of the Penha Grandé is in 25° 7′ 6″ N., and 14° 50′ 53″ W.; it is flat and arid; all its declivities are precipices from broken earth, which has fallen down, the colour of which is gray. The whole of the coast is perfectly clean, even to the beach.

From the Penha Grandé, after a slight indentation, the coast trends S.S.W. ¼ W. [*S.* 6° *W.*] 8 leagues, and includes a slender bay, now called *Garnet Bay*. It then forms a well-defined elbow, and trends nearly S.W. by W. ¾ W. [*S.W.*] 29 leagues. On all this extent, it presents one continued cliff, with the exception of two or three places, where it slopes to the sea; the cliff being about 150 feet high. Frequently, at a short distance from the water's edge, between the cliff and the sandy rocks which here cover the beach, there is a chain of white sandy downs. The summit of the cliff is even and horizontal; it follows nearly a right line, interrupted only by some small flat downs, scarcely perceptible. The whole of the beach is continually washed by an exceedingly heavy surf, and there is no sign of vegetation on the whole coast.

Garnet Bay, which is the *Angra dos Ruivos* of the Portuguese, abounds with cod, bream, hake, and various kind of other fish. Two leagues to the southward of it are seven small table-hills, called the *Seven Capes*, which constitute an excellent land-mark.

From the elbow formed by the coast, on the South side of Garnet Bay, to the south-westward, the depth diminishes a little; from 16 fathoms it gradually lessens to 11 fathoms, and continues nearly the same in a space of six miles. We shall now have arrived at the parallel of 24° N., and immediately abreast of an interruption in the cliff, at a beach of white sand, about a league in extent. Beyond this sand, which does not reach far into the interior, is a body of still water, having the appearance of a lake or river, with a sandy islet in the middle of it. This is the upper part of an inlet named *Rio do Ouro*, or *Gold River*.

Continuing a south-westerly course, along a neck of sand, which separates the river from the ocean, and which is alternately interspersed with cliffs, after running 10 leagues from where it was first observed, we arrive at its entrance. In this run, at the distance of 1 to 3 miles from the shore, the soundings vary from 16 to 8 fathoms, with a hard bottom, and shells. On approaching the river, white sand will be found.

RIO OURO, OR GOLD RIVER.—The entrance of this inlet is in 23° 36′ N., and 15° 58½′ W. Its breadth, taken from the outer cliff on the West bank, to the cliff on the bend of the coast forming the East bank, is 7½ miles; but a very low sandy point stretches to the southward, from the West bank, in such a manner as to leave only a free channel of a mile in width at the utmost.

Neither to the northward, nor at the entrance of this channel, does any island exist, although the old charts mark several; but, at 20 miles to the N.E. of the northern point of the entrance, and on the meridian of the islet in the interior before mentioned, there is a cliffy mound of sand, which, being insulated on a low sandy flat, might have been mistaken for an islet. This, however, forms a part of the bank with which it is connected at its southern point.

No particular current was observed off the Rio Ouro, which consequently does away with the supposition of a river emptying itself by this opening. At the distance of about 3 miles seaward from the mouth of the inlet, the bottom is of sand and shells, with a depth varying from 9 to 16½ fathoms. In the middle of its entrance is a circular breaker, 1 mile in diameter, on which there appears to be very little water. The northern point is wholly surrounded by breakers, but they are only a continuation of the surf which is found on the whole coast. The adjoining sea is well stocked with fish.

From the southern point of the River Ouro, the coast trends nearly S.W. [*S.S.W.*] The cliff continues to a distance of 5 leagues, when white sandy downs succeed, of which the summits are mostly flat. At 1 league northward [*N.N.W.*] from the extremity of the cliffs, and at 3 miles from the coast, there is a bank, having only 32 feet of water; its direction is parallel to that of the coast, and it is about 2 miles in length. Thirteen fathoms have been found on the edge of this bank; to the northward of it the bottom is sand and shells; to the southward, fine sand; and on the bank itself, broken shells.

ANGRA DE CINTRA, OR CINTRA BAY.—At the distance of 3 leagues from the southern extremity of the *Fisherman's Cliffs*, or the Cliffs of the Rio Ouro, amongst a number of even downs, there is one somewhat elevated above the rest, extending parallel to the coast. From being flattened at its summit, and having its southern extremity peaked, it becomes remarkable. It is situated at a short distance from the beach, at the head of a small bay, named *Angra de Cintra*. This bay is sheltered, on the North, by a very low, sandy point, which, detaching itself from the coast, runs parallel to it, and a reef projects from its southern extremity, which may be considered as a continuation of it. The break in the coast, between the northern and southern reefs, which forms the opening of this bay, may be about 6 miles; but, on doubling the northern reef, the bay is found to extend about 4 miles inside of the sandy point which protects it.

The depth of water in this bay is not great; at the distance of a mile inside it is only 4½ fathoms, sandy bottom; but the stillness which prevails in it attracts a great number of fish, and it forms a harbour for the night to the fishing-vessels of this coast. It is to be observed, that besides the reefs stretching from the North and South points of the bay, there is also a rock near the middle of the entrance, which breaks in blowing weather.

All the coast from the Bay of Cintra to the Rio Ouro is well stocked with fish, and is frequented by eighteen or twenty small vessels from the Canary Islands, which catch and salt fish for the consumption of those islands. Fresh water may be obtained by digging at the foot of the high down, or sand-hill, above mentioned, as a place of observation.

It does not appear safe to attempt the channel into Cintra Bay, between the point and the northern reef, as the breakers seem to be connected between them; but the entrance to the southward of this danger is quite safe. The least depth found was 6 fathoms, in the middle of the entrance. During the time of the rollers, as the sea breaks over this in 6 fathoms, vessels should pass either to the northward or southward, where they will find from 9 to 10 fathoms. The fishermen who frequent this creek attract some few Arabs, or Moors, to the spot, who seem to have no fixed habitation there, nor on any other part of the coast. These belong to the fourth tribe, who are dispersed in the desert, and called the "Tribe of Thieves," complete wanderers and vagabonds. It is composed of the discontented of the three tribes already mentioned in page 503, and which are scattered along the coast from Cape Boiador to the Senegal; they subsist exclusively on dried fish, and the plunder from wrecks, *which formerly were so frequent here.* No advantage can be derived from any communication with these poor and miserable barbarians.

In the Bay of Cintra, at 2 miles from the beach, are from 9 to 16 fathoms of water; the bottom of sand, sand and gravel, sand and shells, sand and mud, generally covering siliceous or flinty rock, of the same nature as the neighbouring coast. Toward the bottom of the bay the mud becomes thicker; and here the anchor would sink down into a bed of greenish clay, which is excellent holding ground.

The Down of Cintra, according to M. Roussin, is in 23° 5′ 25″ N., and 16° 10′ W. The magnetic variation on the same parallel, at 2 miles from the shore, in February, 1817, was 19° 33′ W.

Anchorage may be found along the coast from Cintra Bay to the Rio Ouro: but the bottom, from being composed of siliceous rocks, must be unfavourable for holding.

From Cintra Bay the coast trends S.S.W. ¾ W. [*S.* 10° *W.*] to a distance of 7 leagues; the shore is low, but it gradually rises, and becomes a continued down of white sand. At 3 leagues to the southward of this bay, in the interior, may be seen four or five small insulated sandy downs, which are rather higher than the adjacent ground, and, with the lower one, may serve as a mark for this coast. These heights are called the *Downs of Cintra*, and they can be seen at the distance of 4 or 5 leagues only.

ST. CYPRIAN BAY.—Having run 6½ leagues along a moderately high coast, which presents alternately cliffs and sandy beaches, we arrive at an inlet, or bay, formed by rather a deep bend of the beach. The bottom of this bay is low, and the sea breaks violently on it. The eastern point of the bay is formed by a cliff, 150 feet high, having a circular form toward the sea, with a flat top, and much resembling a fortification. The western side is also formed by a steep cliff, which, after extending 2½ miles in the westward, turns abruptly to the S.W., and forms Capo Barbas, in 22° 19½′ N., and 16° 39′ W. The bay formed by the cape is that which bears the name of *St. Cyprian.**

* The *Bay of Tribulation* of M. Roussin. But we consider a change in the name quite unnecessary, and, therefore, improper.

The Bay of St. Cyprian, being open from *N.E.* to *W.N.W.* (*true*), is unsheltered from the prevailing wind on the coast. In consequence of this there is generally a heavy sea in it; and the anchorage, although on a bottom of sand and mud, in 10 to 20 fathoms, offers very little security, and should be resorted to only in cases of necessity. The abundance of fish in this bay frequently attracts the fishermen from the Canaries, who, seduced by the hope of being quickly laden, and the appearance of a moderate breeze, anchor too near the bottom of it. In this situation, if the wind freshens up, being equally incapable of beating out with their crazy vessels, or with their ground-tackle of riding out the heavy sea which sets in, they are sure to drive and be thrown up on the beach, where their crews frequently lose their property and lives; or, which is not less deplorable, are robbed and detained in slavery by the Arabs. Here the magnetic variation was observed to be 19° 28′ W., in March, 1817.

FROM CAPE BARBAS the coast trends nearly W.S.W. [*S.W.*] 3 leagues. It is formed almost by one uninterrupted cliff, about 80 feet high, at the foot of which the sea breaks violently. At 1 mile from the beach there are from 9 to 12 fathoms; and at 2 miles, as much as 17 fathoms; with a bottom of muddy sand, or sand and broken shells. The coast then declines into white sandy downs, studded here and there with cliffs. At about 3 leagues from this it forms rather a remarkable little bay, with a shore of white sand. The mouth of this bay is barred, at about 3 miles from its bottom, by a flat of banks and reefs, on which there is very little water. These reefs serve as a foundation for an islet, called that of *Pedra da Gall*, and another small islet, which M. Roussin has named *Virginia*. These islets are merely rocks, of a nature similar to that of the coast. The first, which is rather higher on the northern than on the southern side, is about half a mile in circumference. The latter, or southern one, is three times that size, and has some sandy patches. It is also 3,000 fathoms from the coast, and about a league *S. by W.* (*true*) of Pedra da Gall. They are connected together by a chain of flats, which stretches 400 fathoms to the S.W., and 1,000 fathoms to the N.E. of Pedra da Gall. At 1 mile westward from these islets may be found 18 fathoms of water, with muddy sand. The depth increases to the southward, and the bottom becomes harder.

From Pedra da Gall to Cape Blanco the distance is 29½ leagues. The coast in this extent is nearly straight, and moderately high; its *true* direction is *S.* 15° *W.*, and it presents only a few indentations of a trifling depth. It is one continued down, the whiteness of which becomes more vivid on approaching to the southward. In some places it presents peaked cliffs, in others there is a gentle descent toward the sea, and the whole is devoid of vegetation.

CAPE CORVOEIRO.—Having, says M. Roussin, in our way from the northward, reached the parallel of 21° 50′ N., after passing a sandy beach of about 2 leagues in extent, with few indentations, we find ourselves abreast of a moderately high cliff, whose irregular summit forms a striking contrast with the uniform smoothness of the adjoining coast. This cliff is 5 miles in length N.E. and S.W. [*N.N.E.* and *S.S.W.*], after which the downs again commence, having previously formed a small bay to the southward of the cliff. The most salient point of the cliff is CAPE CORVOEIRO; but it is not well defined, and is only remarkable from the breaks in the breach where it is situated. The strength of the current here is the same as on the whole coast, about nine-tenths of a mile per hour; but further out to sea it loses half that velocity. Between the islets and the coast, at the distance of half a mile from the latter, the depth is from 6 to 9 fathoms, with a bottom of sand, sand and shells, or sand and rocks. At the distance of a mile from the coast it varies from 10 to 20 fathoms, with mud and sand. The muddy bottom prevails to the southward of Cape Corvoiero, and all this coast is perfectly safe. At 25 leagues to the northward of Cape Blanco we discovered, from the masthead, that the beach, along which we were running, was formed by a tongue of sand from 2 to 3 miles in breadth, beyond which we observed water. This is now called *Greyhound Bay*, and is situated to the eastward of Cape Blanco. From Cape Corvoeiro the coast is formed of white and red sandy downs, assuming various shapes, alternately terminating at the water's edge in broken cliffs and low sandy beaches, on which there is a heavy surf.

CAPE BLANCO, in 20° 47′ N. and 17° 4½′ W., is the southernmost face of a white cliff, about 150 feet high. It rises vertically from a gentle slope which extends from its base to the sea. With a point 4 miles to the northward, it forms a bay, at the bottom of which is a beach of white sand, interspersed with masses of the cliffs. Through one of these masses the sea has perforated a hole, which, in shape, much resembles an arch. The anchorage in the bay, as well as on the whole coast from Cape Corvoeiro, is good; a bottom of muddy sand prevails throughout, with a depth varying from 19 to 12 fathoms. At 1 mile to the southward there are 9 and 12 fathoms, and large vessels may anchor at this distance to the eastward, where they will be sheltered from the prevailing N.N.E. and N.W. winds.

The portion of coast terminated by Cape Blanco is a long promontory, which, projecting from the main, forms with it a bay of nearly 8 leagues from North to South, and about 6 broad. The bottom in this bay is generally composed of soft mud, and there is a depth of water varying from 40 to 17 feet, reduced to the lowest springs. On the western side there is excellent anchorage for vessels of a middling class.

In a radius of 8 or 10 miles round Cape Blanco, and in Greyhound Bay, the currents are subjected to regular tides. The flood sets E.N.E., and the ebb W.S.W., the greatest velocity of either being from 1 to 2 miles per hour; but it attains this rate only when the wind blows with it. The greatest rise above the level of the lowest tide is 10 feet, and it is high water, on the second day after full and change, at 0^h 15′.*

All this coast abounds with good fish, as cod, bream, soles, &c. On the little beach eastward of Cape Blanco, a single haul of the seine has produced a thousand pounds' weight. The best kind of turtle, namely, the green kind, also abounds hereabout. According to the information obtained from the Canarian fishermen, who frequent the coast, a small quantity of drinkable water may be obtained by digging a little to the northward of Cape Blanco. This spot is occasionally visited by some Arabs, who possess a few muskets, and against whom it is necessary to guard. Here the magnetic variation, in March, 1817, was 18° 9′ W.

In 1830, *Captain* (now *Sir*) *Edward Belcher*, in H.M.S. *Ætna*, by the mean of several observations, assigned to the extremity of Cape Blanco lat. 20° 46′ 26″ N., long. 17° 4′ 10″ W. This gentleman has given a geological description of the cape and neighbouring country, which is inserted in the "Journal of the Royal Geographic Society" (vol. ii. pp. 299—303), and in which he particularly notices the practice of the Canarian fishers, in the vicinity of Greyhound Bay; the anchorage of these vessels, schooners, with their boats, is in a bay about 3 miles North from the cape, where they are quite sheltered from N.N.W. to S.S.E. Those of the fishermen whom Captain Belcher met with were courteous and communicative, and they stated that their usual fishing-ground is in 25 fathoms, where they take fish of from 8 to 60 pounds each, and that their average daily work is about 3 cwt. in the boats. The schooners have polacca foremosts; and, when fishing, they furl all the sails in one; their burden is from 100 to 150 tons. The fish taken by the *Ætna* were porgy, mullet of several kinds, rock-cod, and red-snappers, probably called bream by former voyagers. Mussels and other shell-fish are very abundant at low water.

The summit of the Blanco peninsula is composed of lines of sand hills and rocky eminences, just what one would expect to find if the sea were to quit its position, and show us the beds over which it flows. In every position, where a bush or rocky islet

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* "*The tides about Cape Blanco* are irregular, and much influenced by the land near which they run. High water, at full and change, may be looked for about noon; the greatest rise, under every advantage of springs and winds, does not exceed 6 feet. Southward of the parallel of the cape the indraught has a velocity of 2·6 miles, and the offset or ebb the same. Eastward of the meridian of the cape the tide bends northerly, and at 3 miles chord its velocity appears from S.W. to N.E., about 1½, following the circular course into Greyhound Bay. North of the parallel of the cape the ebb sets North, and flood South; and, close inshore, the tide is considerably weaker than at 3 miles, where its greatest influence may be expected."—*Captain Belcher.*

is prominent, there, on its southern side, you will surely find its sand hill—a proof of the prevalent winds, as well as an admirable model of the formation of shoals, &c., under water, and pointing out most perfectly the "steep-to" approaches to banks, over which rapid streams or currents flow, with their concomitant shallow tail, formed by dead water or eddies.

With the exception of these newly-formed and forming sand-hills, the whole surface is covered, in a *most extraordinary manner*, with shells, of all dimensions, and of the species generally found in the bay. These are loose, and some are more than 60 feet above the level of the sea! *

The Spaniards affirm that there is no rainy season here, but strong northerly and north-easterly winds the whole year. In June and July they were North, N.N.E., and N.E. Highest temperature of air in the shade, 75°; of the water, 76°.

BANK of ARGUIN, &c.—The Bank of Arguin commences at 4 leagues to the southward of Cape Blanco. It is a great shelf of about 30 leagues in length, and reaches to the southward of Cape Mirk. The North point of it is in lat. 20° 33′ 12″ N., long. 10° 56′ 30″ W. The coast between this point and Cape Blanco is replete with shoals. The most considerable one is that of the *Bayadère*, at 1 5-10th miles to the southward of the cape. There are only 20 feet of water on this shoal, and it occasionally breaks. Another lies W. ¾ N. [*W. by S.*] 3 miles from the cape; and a third at 8 miles S.S.E. ¼ E. [*S.E.*] of it; on which, like the first, 20 feet of water have been found. The channel, leading to the anchorage, eastward of Cape Blanco, lies to the northward of these shoals.

The *Bank of Arguin* is a flat of sand, constantly increasing, of the same nature as the coast. The body of it is hard, and covered with broken shells. Its outer edge, which has been traced from numerous soundings, has been fixed at the depth of 8 fathoms, as no vessel can run within this limit without risk; and, at a very short distance to the eastward of this boundary, there are less than 4 fathoms. No particular part on the edge of this bank has been seen quite dry; but close to the breakers, which occur in many places, there are not more than 10 feet of water; and the shallows between them do not appear to have more.

Between the North point of the bank and its western extremity, situated in 20° 6′ 20′ N., and 17° 7′ 30″ W., on advancing from seaward, the soundings progressively decrease. At 10 leagues to the westward, from 40 fathoms they decrease to 8, with a very gentle ascent; but to the southward of this parallel the bottom becomes more uneven; and from the point where the *Medusa* was lost (see page 503), in lat. 19° 53′ 42″, long. 17° 0′ 35″, a great irregularity takes place.

From the westernmost extremity, the edge of the bank trends S.S.E. [*S.E. ½ S.*] and extends as far as Cape Mirik. The nature of the ground about the Bank of Arguin has a very remarkable characteristic, which may prove of great service to navigators. From the depth of 8 fathoms, which has been assigned as the limits of this bank, to that of 25, to seaward, including an extent of more than 5 leagues, the lead invariably brings up a mixture of sand and broken shells; and, in proportion to the proximity of the bank, the latter prevail. Beyond the depth of 25 fathoms, as far as that of 45 and 50, at 8 or 10 leagues to seaward, the bottom is entirely of white sand. Hence it is evident, that by soundings, and a rough observation for latitude, the distance from the Bank of Arguin may always be known. Should less than 25 fathoms be found, with a bottom of sand and broken shells, you will be less

* On page 504 we have alluded to the captivity of a portion of the crew of the brig *Courier*, in 1844, on the *Island of Arguin*. This island lies in the mouth of a bay to the S.E. of Cape Blanco. According to Captain Grover's account it is about 8 miles from the main land, between which and the island the water is shallow. To the seaward there is a depth of from 5 to 7 fathoms *close to the shore*. On this point the evidence appears to be conclusive. It is formed of a whitish rock, covered with shifting sands to the depth of 9 feet. The South end rises to about 30 feet. The island produces no wood, and only a small caustic shrub, but it has excellent water, though of milky appearance. The wells are difficult to find, but are important. The number of inhabitants was about 60.

than 5 leagues from its edge; and in proportion as shells predominate in the soundings, you will be nearer to it, and should avoid getting to the eastward. Should you have more than 25 fathoms, with fine sand, you will be more than 5 leagues from it. To the northward of the parallel of 20° N., this may be particularly depended on; to the southward of that limit, it is subject to some exceptions; but as the bank then takes a direction S.S.E. [*S.E.* ½ *S.*], it becomes no longer dangerous, if a ship is kept on a wind in 20 to 25 fathoms, and sounds frequently. Henceforth we may conclude (which all mariners must be convinced of), that a strict attention to incessant sounding is so indispensable as to need no further recommendation.

CURRENTS.—It has been already shown, in page 282, that the prevailing currents set from North to South along the whole coast. Along the edge of the Bank of Arguin, as far as its western extremity, this direction is constant; and in the rainy season, should any deviation be experienced, it may be relied on to happen very seldom. One proof of this may be adduced. On the 13th of July, when the wreck of the *Medusa* was found by the brig *Argus*, after thirteen days' absence from the frigate, it was abreast of Portandik, at 15 leagues from the shore, a distance of 90 miles, and nearly on the meridian of the place where she was lost. It must, therefore, have driven at the rate of 7 miles per day along the coast.

Cape Mirik is that point of the coast which terminates the Bay of Arguin on the South, being a very low sandy point, on which there is a small down.* It is surrounded by the southern part of the Bank of Arguin, and cannot be approached by large vessels, on the West, within 3 leagues, and on the S.W. within 2. The magnetic variation, at the southern anchorage, in April, 1817, was found to be 18° 49′ W.

Tanit Bay.—The coast from Cape Mirik tends S.S.E. ½ E. [*S.E.*] 10 leagues, it then forms a complete elbow, gradually trending S. ¾ W. [*S. by E.*] It is low, and presents a continued chain of small regular downs, composed of white sand, and interspersed with small bushes. To the northward of the bay, formed by the bend of the coast, some downs may be observed which are rather higher and more insulated than the rest. A few huts are seen near the beach, and in the dry season numerous parties of the thieving tribe assemble here to catch fish and dry their stock. Two large pieces of water may be seen between the high downs: but whether these be fresh or salt is unknown. The latter seems most probable. This bay bears the name of *Tanit*, and the North point of the down, at the bottom of it, as observed by Baron Roussin, is in 19° 3′ 48″ N., and 16° 12′ 20″ W.

Angel Hillocks.—*From Tanit Bay* the general direction of the coast is South [*S. by E.* ¾ *E.*] in an extent of 12 leagues. At the distance of 4 leagues from the termination of this bearing are some downs, which are rather higher than the rest of the beach, and with some bushes on their surface. The beach itself is formed by a very low flat of quick-sand. These downs are the *Angel Hillocks*, composed of sand, of which the summit is from 15 to 20 fathoms above the sea, and they constitute a useful land-mark. They are divided into two groups: the summit of the northernmost, which is much smaller than the other, is studded with tufts of brushwood; while the southern, which is formed of eight or nine hummocks, is nearly destitute of it. The latter, which is the highest, stands in 18° 29′ 30″ N., and 16° 2′ W. The coast, from these hillocks, gradually declines in height, and more so as it approaches to the southward, when it soon falls into a uniform line of sand, with occasionally a bush here and there, scarcely above the level of the sea.

ANGEL BANK.—No part of this coast, southward from Cape Mirik, should be approached within 5 miles, nor to a less depth than 6½ fathoms. By attending to this rule, all dangers will be avoided, and, amongst others, a shoal which extends outward, 3 miles from the coasts, abreast of the northern part of the Angel Hillocks, from which

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* Captain Owen gives this down in 19° 25′ N., and 16° 34′ W. Baron Roussin as 19° 22′ 14″ N., and 16° 31′ 21″ W.

it derives its name. On this bank there are regular soundings on a bottom of sand, with sand and broken shells, affording anchorage in case of necessity. On receding from the beach, the depth increases; and, at the same distance from it, is greater than to the northward of the hillocks.

PORTANDIC.—At 4 leagues to the southward of the Angel Hillocks, on rather an elevated part of the coast, and a little within the beach, are two palms trees, without branches, standing close together. The northernmost is the smaller of the two, and they are the only palms to be seen on the coast between this and Cape Boiador. They stand in lat. 18° 18′ 54″ N., long. 16° 2′ 12″ W., and Portandic is supposed to have existed at about 1 mile to the southward of this spot. Not a vestige now remains sufficient even to indicate to strangers the spot on which this little establishment once stood. But since the survey it has been ceded to France, and a fort is mentioned. From the two palm trees, the coast trends nearly S.S.W. [*South*], then to S.W. [*S.S.W.*] It is straight and low, interspersed with small bushes, and presents a continued sameness. In an extent of 35 leagues there are only two downs of red sand, covered with brushwood, and discernible only at about 2 miles from the beach. One is in lat. 17° 25′ N., the other in 16° 55′ N. From the mast-head some sheets of water at the foot of these downs may be seen. At 2 leagues to the southward of the latter, the interior of the country becomes a little clothed with brushwood, and occasionally presents some level plains, but the coast remains uniformly barren.

GUM TRADE.—The Dutch have the credit of being the first who introduced the Gum Arabic, commonly called Gum Senegal, into Europe, in the early part of the 17th century, when they carried on the fishery in the Bay of Arguin. The French merchants of Bordeaux and Nantes first brought it, however, into general repute, and decided its purity and superiority to the gums of the East. From 1760 to 1779, England possessed the Senegal, and the trade for the gum; and by the Treaty of Versailles, 1763, reserved to herself the exclusive possession of this commerce, which she protected and maintained. The English demolished the forts and establishments at Portandic and Arguin, which had been formed in 1724 by the old India Company of France, in order to bring the whole of the gum of the African forests into the River Senegal. In 1779, the French obtained re-possession of the Senegal; but, by the Treaty of 1783, it was agreed that the English should have the liberty of carrying on the gum trade from the mouth of the *River St. John* (3 leagues north-eastward of Cape Mirik) to the Bay and Port of *Portandic*, inclusively; provided that they should not form any *permanent* settlement, of what nature soever, in the River St. John, or the Bay of Portandic. The treaty is still in force, as no alteration of it was made by the Treaty of 1814; which merely stipulated the engagement of the English government to restore to France, in full right and sovereignty, the possession of Senegal and Goree. The transfer took place in 1816, when the English withdrew to their other settlements on the coast; leaving the gum trade entirely in the hands of the merchants of Senegal, although they possessed an indisputable right to the trade from the Bay of Arguin to the Bay and Port of Portandic.

At the commencement of the year 1821, the British merchants of the Gambia obtained the support and assistance of the local government, in the attempt to renew the gum trade at Portandic, and revive that friendship and good will which formerly subsisted between them and the Moors in Senegal. Commodore Sir George Collier was solicited to order a vessel of war for the protection of the trade, and to convey presents to the chiefs of the Trazzarh or Tarassa Moors; and, for this purpose his Majesty's gun-brig *Snapper*, commanded by Lieutenant T. Evans, was selected, and proceeded on his important service. The trade afterwards revived, and was going on with the Moors in 1834, when it was unjustly interrupted by the government of Senegal. The particulars of this interruption, were given in evidence before the House of Commons in 1842, by G. C. Redman, Esq.* But these matters have been

* Parliamentary Report, West Coast of Africa, Part I., pp. 176, 177, 183.

adjusted by the cession of the territory to the French, we taking as an equivalent their factory of Albreda on the Gambia.*

PORTANDIC TO THE RIVER SENEGAL.—On the parallel of 16° 35′ 24″, and at the termination of the 35 leagues of coast already described, we arrive at the huts of *Inguiagher*, or the spot called by the French the *Marigot* or Lagoon of *Mosquitos*. This in the rainy season forms a mouth of the River Senegal, the banks of which are covered with mangroves. At the distance of 2 or 3 miles from the beach regular soundings may be found, in from 7 to 13 fathoms, fine sand, occasionally mixed with mud, and affording safe anchorage between this and the palms of Portandic. To the southward the depth gradually increases.

The Marigot of Mosquitos is about 12 leagues to the northward of the Isle St. Louis, in the Senegal; and it communicates with the sea only when the rains have swollen the river. It then covers the bank at its entrance, which may be passed over by boats; but they must be prepared against the surf which is common to it, as well as the entrance of the Senegal. To the southward of this *Marigot*, the river is separated from the ocean by a straight tongue of sand, formed by small white downs, nearly bare, and gradually becoming lower toward the extremity. Within this tongue of sand, the stream of the Senegal washes a number of small islands which lie parallel to the coast, and on which a covering of thick bushes gives the country some appearance of fertility. They are known by the name of the *Antelope Islands, Griel Wood Island, and Thiong Islands*. The last is at a very short distance to the northward of the Isle of St. Louis.

Griel Wood Island is distinguished by its bushes, among which are some trees higher than the rest, presenting a remarkable contrast to the barren desert of 200 leagues, which precedes it. Its distance from the Isle of St. Louis, in a straight line, is not more than 5½ leagues. Both to the northward and southward of Griel Wood Isle, the stream of the river may be distinctly seen from the mast-head, running between the isle and the beach; and it is the surest mark for discovering the landing-place to the northward of the bar.

A vessel may run along the coast, at the distance of 2 miles from the beach, in from 9 to 14 fathoms, over an excellent bottom of thick green mud.

SENEGAL.—On continuing your route to the southward, the French establishment of St. Louis, in the Senegal, will soon be seen. This place is remarkable for its white buildings, and a very high palm tree, which stands conspicuously close before the flag of the fort. The latter is in lat. 16° 0′ 48″ N., and long. 16° 31′ 1″ W. The western bank of the Senegal is so narrow and low, abreast of the northern part of this island, that the town appears to stand on the sea-shore; and it is only on nearing it, that the channel which separates them can be seen.

A little Moorish town, called *Guet n'dar* or *Gattandar*, consisting of huts on a sand hill, stands upon the strand, opposite the town of St. Louis. It was built by the negroes engaged to open the communication in canoes with vessels arriving, and checks the sands, which are constantly in motion. On the S.W. part of the Island of St. Louis is a down, on which cannon are placed. From Gattandar, the distance of the bar of the Senegal is only 2 leagues. The anchorage off the mouth of the river may be taken in 7 to 14 fathoms, according to circumstances. The depth extends from 2 to 4 miles from the bar.

The mouth of the Senegal presents nothing remarkable when seen from the northward. The breakers which prevail on the whole coast as far as *Point Barbary*, the northern point of the entrance, prevent those on the bar from being distinguished; and vessels may run pas without seeing them, if they keep at too great a distance from the shore. From Gattandar you may run at the distance of a mile from the

* By a convention, signed March 7th, 1857, the Queen of England relinquishes her rights to trade between the mouth of the River St. John to the Bay and Port of Portandic inclusively, and in return the French Emperor cedes the Factory, or Comptoir, of Albreda, on the North Bank of the Gambia, with all rights belonging thereto.

beach without danger; which will enable you to observe the smallest alteration in the coast. A small post in the centre of the river, abreast of the *English Islet*, where there is a signal-post, and a guard-house on *Babaguè Island*, at a short distance to the eastward of the bar, will then be passed in succession. This guard-house is a remarkable small square house, near which there is a second signal-staff; and a vessel may anchor when this guard-house bears E. ½ S. [*E. by N.*]. As the winds generally blow from the northward, in consequence of the facility for communication with the shore, it is advisable to anchor rather to the northward than to the southward of the bar.

The Bar of Senegal is not stationary. The western bank of the river, from the Isle of St. Louis, is so low that high tides completely cover it, and, at times, force open a new channel. Its northern point in 1817 was in lat. 15° 55′ 18″ N., and long. 16° 30′ W., and it increases gradually the southward. Here the magnetic variation, in 1817, was 17° 22′ W. It is now 19° 0′ W.

As the nature of the entrance is so variable, it is manifest that no safe directions can be given. Prior to 1857 there were two entrances, that near the *Pointe aux Chameaux*, which led through a long channel diminishing in depth, and that of the *Barre de Gandiolle*, opposite the coast of that name. The Banks to the North were shifting and extending much to the southward, so that they formed a considerable elbow, which obliged vessels to steer N.W. or W.N.W., to clear the southern banks. At the end of 1857 it was announced that the entrance by the Pointe aux Chameaux was entirely closed, and that the obstructing banks extended at least 5 miles off, so that vessels working up for the anchorage should be well on their guard.

The Bar of Gandiolle was then better than ever, and had constantly a depth of 12 or 14 feet, and within it from 15 to 16 feet. Vessels should anchor before this bar in 7 fathoms, and will be in the best position with the flagstaff bearing N.E. by compass.

The dangers attending the bar of the Senegal are well known to be of no trifling nature. In the rainy season, and even in March, when the river, increased by the rains, discharges a greater body of water into the sea, the bar is frequently impracticable even by decked boats. The waves, caused by the impetuosity of the river water meeting with that of the ocean, are very considerable, and succeed each other so rapidly that it is impossible to find a *smooth*. It is not uncommon, in these cases, to see breakers at the distance of a mile from the bar, and in 8 fathoms of water. From the month of April to the end of September the bar may generally be crossed by decked boats, and sometimes even by canoes; but it is advisable that they should be steered by natives.

Vessels drawing 10 feet of water cannot cross the bar. Those of a moderate size only should, therefore, be employed in the commercial navigation of these parts; otherwise the loading and unloading, when necessary to employ lighters, becomes very expensive. Inside the mouth the depth is from 6 to 8 fathoms; and, with the assistance of the tide and a pilot, a vessel may very easily beat up to the Isle of St. Louis.

CURRENTS.—It has already been said, that the general and almost constant direction of the current is along the coast from North to South, as far as the mouth of the Senegal. Abreast of this opening, and in a space of several miles to seaward, the river tides affect the general uniformity of this current. The flood and ebb tides are alternately felt at the bar and anchorage; they have no settled direction, but may be considered as setting about N.W. and S.E.; and are frequently so strong as to make the vessels tend at the anchorage, or at least to lay with their broadsides to the wind, in the strongest breezes. This anchorage is rendered very inconvenient by the short sea which is always upon it.

The preceding descriptions are chiefly those of the Baron Roissin. The following, from our former edition, may also be acceptable.

From Santa Cruz, Tenerife, to the River Senegal, the *true* and safe course is S.S.W.

to lat. 18° 30′, before a ship hauls to the eastward. This is in order to avoid being set by the current too far to the eastward, or on the banks of Arguin, &c. From the above-mentioned latitude haul to the south-eastward, so as to make the land in about 16° 15′, when you will probably see the trees already noticed, which are the most remarkable on this coast.

If standing in for the land by night, heave a cast of the lead every hour, as you fall into soundings all at once, 50 fathoms close to the edge of the bank, at the distance shown the chart, or about 8 leagues from shore, and thence shoaling to 8 fathoms at 1½ miles from it.

The bar of the Senegal is most easily passed in the months of July, August, September, and October; but it is very rarely quite calm. On the contrary, the sea frequently breaks against it violently. The waves, which strike against it, are always united in threes, or leashes. For example, when the sea is but slightly agitated, one may perceive three waves, perfectly distinct, approach and break against the bar, immediately after each other; and these three waves appear to be, as it were, connected; for there is often a considerable interval of time between the attack of the first three waves and the approach of the succeeding trio.

During the prevalence of rough weather, this series of assault by united waves incessantly prevails; but then these attacks follow each other so rapidly that the time between them is no longer perceptible. The sailors call the interval between the two assaults, when tolerably long, a *set-off*, because then the bar experiences a slight degree of rest, during which time it may often be passed; but frequently the violence of the waves is so great, and squalls succeed each other so rapidly, that there is no longer any interval between them; and, consequently no *set-off*.

On passing by sea within cannon-shot of the Isle of Senegal, it affords a very agreeable prospect. Fort St. Louis forms the principal object in this perspective. To its right and left extend the two parts of the town, the streets of which are well arranged; and, in general, composed of thatched cottages or huts, interspersed with some stone houses, covered, according to the custom of this part of Africa, with flat roofs.

The woods which line the East bank of the river appear, at this distance, to belong to the isle, and give it a cheerful and rural aspect; but this allusion disappears on a nearer approach; for no place can be more arid, parched, or deprived of vegetation, than the Isle of St. Louis, the soil of which is nothing but a fine shifting sand. Notwithstanding this, the population amounts to about 5,000 persons. The water of the is brackish and unwholesome.

WINDS.—The winds are not at all dangerous in the navigation of the coasts of the Senegal. They blow nearly along the coast from the N.E. and N.W. during the greater part of the year; and as, in the rainy season, the squalls always come from the S.E., and the winds which succeed them are very weak, when they once pass the S.W. quarter, getting under way is always easy. Those vessels in the road which cannot depend on their ground-tackle, may return to it when the squall is over.

SENEGAL TO CAPE VERDE.—If a straight line were drawn from the anchorage at the bar of the Senegal to the outer rocks of the *Almadies*, on the western point of Cape Verde, its direction would be nearly S.W. by W. [*S.* 40° *W.*], and its length 31 leagues. The arc described by the intervening coast, and subtended by this chord, bends so little, that it would not exceed the whole length by more than 4 leagues, and its greatest depth would be 13 miles.

The coast, as far as 2 or 3 leagues to the southward of the Senegal, is just as low as that to the northward, and resembles it very much; it afterward becomes rather higher, but is uniform in general appearance. It is composed of a chain of white sandy downs, scattered over with brushwood, amongst which a small cluster of trees may be distinguished. It generally presents two well-defined plans. The first is that next to the sea, formed of white sandy downs, on which there appears some verdure. The second, which is considerably higher than the first, commences at about

2 miles in the interior, and is formed by downs of a greyish colour, which are covered with bushes.

In running for the Senegal, from the southward, the mouth of the river is more easily distinguished than when approaching from the northward, from its appearing more open. At the distance of 8 leagues from the mouth, and on the parallel of 15° 26′ N., a large red sandy down may be observed, entirely bare, which, to those ignorant of their latitude, may serve to indicate their distance to the southward of the bar. From this down, southward, the coast presents nothing remarkable as far as the *Little Paps*, of which the northern is in latitude 14° 56′ 24″ N., and longitude 17° 4′ 30″ W.

The *Little Paps* are the two highest downs between the Senegal and the *Paps of Cape Verde.* They are situated on the beach, and are easily known by a slight undulation of their summit, and three or four other small hills adjoining them to the southward. They are visible at the distance of 4 or 5 leagues. The *Bay of Yof* commences from this point.

The Little Paps bear E.N.E. ¾ E. [*N.* 59°. *E.*] from those on Cape Verde, at the distance of 9 leagues. When running this distance, in fine, clear weather, both are frequently seen at once. The latter may be seen at the distance of 7 or 8 leagues. From about 8 leagues to the eastward of Cape Verde, the coast rises very much, and becomes more wooded. The country about the cape is covered with trees, amongst which there are several of remarkable height. All this coast may be approached within a very short distance. Within 2 miles to the northward of the village of Yof, situated near an islet of that name, there are 55 fathoms of water on a bottom of mud and sand.

CAPE VERDE is the westernmost point of Africa; it is the extremity of a peninsula formed on the North by the Bay of Yof, and on the South by the bay in which the Isle of Goree is situated, and is composed of moderately high land. To the westward, as far as the two paps of Cape Verde, as aforesaid, it becomes higher, and on the southern side of these two paps, the coast next the sea becomes nearly perpendicular. This point is usually taken for Cape Verde; it is not the westernmost part of the peninsula, but it is the highest. Its lat. is 14° 44′ 30″, and long. 17° 32′ 0″. Cape Verde, as seen from the northward, terminates in very low land, on which are some unconnected hillocks, which, at a distance, may be taken for islets. The extreme point extends 1,000 fathoms still further East, in a flat of blackish rocks, awash with the water's edge, and which, in two or three places, rise from 8 to 10 feet above the level of the sea. This rocky flat is called the *Almadies*, and the point which joins it, *Almadia Point.*

The sea on the Almadies breaks incessantly. Amongst the rocks are some smooth spots appearing like channels fit for boats. The flat may be coasted at the distance of a mile, there being, on the West, 35 fathoms of water; the bottom is of broken shells. Hence to the northward, in an extent of 3 miles, the depth increases to 80 fathoms, bottom of mud and sand. To the S.E. the depth is not so much; in running along these breakers and the coast, to a distance of 2 miles in that direction, which will extend to the meridian of the paps, the depth varies from 25 to 39 fathoms, the bottom, sand and shells, or sand and rock. The depth then continues to decrease to the E.S.E. The highest and westernmost rock of the Almadies, which appears from a distance in the shape of a die, is in lat. 14° 44′ 29″, and long. 17° 33′ 29″, as shown in the Table, p. 34.

CURRENTS.—The prevailing currents between the Senegal and Cape Verde follow the direction of the coast, in the same manner as those to the northward; and the idea of a current setting violently into the Bay of Yof, as formerly represented, is altogether false. The sea on this part of the coast is not particularly heavy nor dangerous; the smallest coasters of the Senegal and Goree expose themselves to it with impunity every day.

Southward from the Senegal as far as the parallel of 15° 20′, including an extent of more than 12 leagues, at 2 or 3 miles from the coast, the bottom is excellent, being of pure mud, with a depth varying from 12 to 30 fathoms. From this parallel, to the southward, doubtless the depth increases considerably. At 2 leagues to the westward of the Little Paps, for instance, there are from 64 to 70 fathoms of water. The muddy bottom continues here, and is so soft that the lead sinks deep into it, and the anchor alone would hold any vessel obliged to come to in consequence of calm. It is only in these cases that anchoring becomes necessary; if there is wind from either quarter, the formation of the coast will always allow a favourable board to any vessel well found and well managed.

CAPE VERDE to GOREE.—From Almadia Point to Cape Manoel the coast trends S.S.E. ½ E. [*S.E.*] in a distance of about 3 leagues. In this extent it is high, covered with trees, and generally terminates at the sea-side in basaltic cliffs or sandy rocks. In some places only the cliff slopes toward the interior, and forms small bays with beaches of white sand.

At 2,000 fathoms N.W. by W. ½ W. [*W. by N.*] off Cape Manoel and at half that distance from the coast, there is a group of rocky islets, called the ***Magdalen Isles***, of which there are two principal ones. They are perfectly barren; even the largest, in the crevices of which were formerly some *baobabs*,* is nothing but a bare rock of a reddish colour mixed with basalt, and perfectly destitute of any vegetation. The shape of this islet is that of a crescent open to the westward, and its greatest extent is nearly North and South. On the North side it has a gap, forming a very small creek, which affords a landing. The other rocks are to the south-eastward of the principal islet, separated by a space of 1,000 fathoms, in which there is a depth of from 4 to 6 fathoms. The sea breaks with violence on all these rocks.

The space between the Magdalen Islands and the main seems to offer a safe channel; but it should not be attempted by a stranger. In coasting the shore from the Almadies to the Magdalen Islands, the soundings vary from 34 to 19 fathoms. These islands may be approached on the southern side within 100 fathoms.

Cape Manoel is high, formed of columns of basalt, and covered with very thick brushwood; at the distance of a pistol-shot from it, to the southward, there is a depth of 8 fathoms; and at 100 fathoms to the north-westward of its extreme point, close to the beach, is a small insulated rock. In doubling Cape Manoel, the extensive bay is opened, which is formed by this cape and Cape Naze, which may be called the *Bay of Goree*. At the distance of 2,100 fathoms from Cape Manoel, E. ¾ N. [*N. 65° E.*] lies the Island *Goree;* and a vessel intending to anchor must steer for it, and may approach on the South side within two musket shots.

GOREE.—BAY of GOREE.—The Island of Goree with the Senegal fell into the hands of the British in 1809. By the treaty of Paris they were restored to the French in 1816. As far as regards climate, they are more favourably situated than any of our settlements on the coast. The adjoining country is inhabited by the Jaloff nation. It is the seat of a flourishing trade. The French Government attach much importance to its maintenance, and have expended large sums on its military defences.†

Goree Isle is merely a rock, about 400 fathoms in its greatest length, from N. ½ E. to S. ½ W. [*N. by W. to S. by E.*], and 167 fathoms in breath. It is a volcanic production, composed of basalt and sand, of the same description as the Magdalen Islands and Cape Manoel, from which it seems to have been separated. The southern part, which is about 500 feet above the level of the sea, is the highest, and like a round mountain, may be seen at the distance of 5 or 6 leagues. The rest of the island is very low, and the North point is distinguished only by its batteries and private buildings. A fixed light is shown from the fort. The landing-place is on the N.E.

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* The *baobab* (or *Adansonia*) is a species of very large tree, of a fine green colour, but which does not keep its verdure all the year round. From the trees of this sort on Cape Verde that cape derived its name.

† Dr. Madden, Parliamentary Report, 1842. Part I., p. 206, and Part II., p. 508.

side of the island, between the point and the back of the mountain, to the southward, is a small sandy bay.*

Goree contributes nothing toward either the subsistence or comfort of its inhabitants. Its two springs, situated at the foot of a rock, on its southern part, hardly suffice for the consumption of two families, and the inhabitants are therefore obliged to get their supplies of water, wood, and all kinds of food, from the main.

The roadstead is to the N.E. of the island. This roadstead, which is sheltered from all winds from S.S.W. to E.N.E. (by the North), is perfectly safe during eight months of the year; that is, from the 1st of November to the 1st of July; but during the rainy season, the squalls from the S.E. are dangerous. The best anchorage for large vessels, in either season, is at the distance of 800 fathoms from the landing-place, with Cape Manoel bearing W.S.W. ¼ W. [*S.* 52° *W.*], a sail's breadth open of the North point of the island. At this spot there is a bottom of thick clayish mud, with a depth of 12½ fathoms, and it is convenient to weigh from, with the wind from any quarter.

To fetch the anchorage from Cape Verde, in the fine season, when the winds are from N.E. to N.W., it is necessary to run close by Cape Manoel and the South point of Goree; keeping by the wind on the port tack, and sounding until in 8 or 10 fathoms. When within a mile of the land, tack and beat up to the anchorage.

The above position assigned for the anchorage of this island possesses one very great advantage in the tornado season; which is, that if the ground-tackle cannot be depended on, a vessel may run before the squall and even be sheltered for a short time. For this purpose it will be necessary to veer to the end of the cable before the squall comes on, as its violence may not allow of a vessel being managed with the expertness requisite on such an occasion. She should then steer so as to round the North point of the island at a convenient distance, and when to the westward of this point, whatever may be the violence of the squall (which is always from the S.E.), the island will afford sufficient shelter to enable her to keep on the port tack until abreast of the South point. Having reached thus far, she will be in a favourable position for doubling Cape Manoel, as by bringing it to bear W. ¾ S. [*S.* 65° *W.*] she may then steer nearly four points free. All the channel between Goree and the Peninsula of Cape Verde is perfectly safe, having in it from 5 to 13 fathoms of water, and the shores may be approached within the distance of 200 fathoms. A vessel intending to remain any time at the anchorage should moor N.E. and S.W., as the two cables will then bear an equal strain in the heaviest of the squalls. Magnetic variation, in June, 1817, 17° 30′ W.; 1861, 18° 10′ W.

The Watering-place at Goree, and the Resources which this Anchorage offers.—The watering-place of Goree, used by vessels which frequent this island, is about 3,000 fathoms N.N.W. of the anchorage. It consists of several pits dug in the sand on the sea-side, near a marsh, and close to a negro village called *Han*. The water is neither agreeable nor wholesome, and should not be drunk until it has been filtered, acidulated, or cleansed by red hot shot being put into it. The cove in which it is situate is exceedingly well stocked with fish, and hauling the seine will be attended with success, by any number of vessels touching here. Fire-wood is purchased from the negroes of *Ducar*, a little more to the West, at the rate of about twenty shillings the cord. Ballast may be procured at the foot of the point of that name. Small bullocks may be purchased from the neighbouring coast, for six or eight dollars each.

The whole coast, from Cape Manoel to Cape Naze, which forms Goree Bay, may be run along at the distance of 2 miles. One bank only lies at 800 fathoms E.S.E. ¾ E. [*E.* 3° *N.*] from Cape Belair,† having soundings which vary from 16 feet to 12

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* Mr. Finlaison has said that ships sailing from the Cape Verde Islands, and bound to Goree, will strike soundings in 60 fathoms, fine sand, at 80 miles off.—Ed.

† This is, we presume, the *Cape Bernard* of the former ch[illegible], lying to the northward of Goree.—Ed.

fathoms, with a bottom of muddy sand, or sand and shells, as far as the parallel of Cape Naze.

From the BAY OF HAN, northward of Goree, the coast rises a little at some miles in the interior, but it is exceedingly low at the sea-side, where it presents nothing but a white sandy strand. We again perceive the little downs, the chain of which joins the paps of Cape Verde, and which we ran along in going round the Bay of Yof. These downs rise progressively to the south-eastward, and are covered with trees as far as Cape Naze. The Naze Cape is terminated by cliffs of about 200 fathoms in height, the woody summit of which may be seen, in fine weather, at a distance of 7 or 8 leagues. In running along the coast toward Cape Naze, we pass successively several negro villages of the kingdoms of Cayo and Baol, belonging to Damel. The most considerable of these villages is *Rufisk*, on the eastern side of Goree Bay; then follow the anchorages of *Barnier*, *Red Cape*, *Yongop*, &c., all of which points are frequented by coasters from Goree, who trade for stock; they offer nothing interesting. The highest part of Cape Naze is in lat. 14° 31′ 30″ N., and long. 17° 7′ 25″ W. —(*Roussin.*)

There are some rocks, westward of Rufisk, stretching about a gun-shot into the sea, which may be avoided by keeping half a mile from the shore. To the West and W.N.W. of Cape Naze is good anchorage, in 4 or 5 fathoms, fine sand; but to the South and S.W. of the cape the bottom, generally, is not good.

In the night time, you must proceed in 17 fathoms, having sometimes recourse to the lead; the land, even in the night, will direct you sufficiently to avoid the rocks. In the season of the tornadoes the road of Rufisk is not good; but in the summer, you may safely lie there in 6 or 7 fathoms, close to the shore, if agreeable.

About 3½ miles S.E. of the Red Cape lies Cape Naze, with a small bay between; from the latter the coast extends to the S.E. ¾ S. [*S.E. ½ E.*] about 4½ leagues, as far as *Portudal*, formerly a French factory; and then 5 leagues S. by E. ¼ E. [*S.S.E. ¾ E.*] to *Cape Serene:* between this cape and Portudal, 2 leagues off the coast, and parallel to it, lies *Amboroo Bank*, on the South tail of which you find only 1¾ fathoms. Ships that come from the westward must be cautious of this shoal; the ground is very hard upon it, and close to it is a depth of 5 fathoms.

To the S.E. of Cape Naze the land declines in height, and the downs are partially covered with bushes. The point near a little river, the *Soman*, is thus covered, and the country hereabout appears to be clothed with trees.

PORTUDAL consists of a number of huts on the shore. The coasters of Goree frequent this place. All the coast in the vicinity abounds in trees; and at 2 miles to the southward of the village is a small wood, very remarkable from its trees being much higher than the rest, and which, therefore serve as a mark for the coast.*

The Road of Portudal is far from being good, and is fit for small vessels only; they lie close to the shore, athwart of the little houses between the cliffs. All the coast near Portudal is bordered with rocks, and must not be approached too near.

Joal.—Three leagues S. by E. ¼ E. [*E.S.E. ¾ E.*] from Cape Serene lies JOAL or YOAL, standing on the North bank of a river of the same name, from which a shoal, with only 2½ fathoms of water upon it, projects into the sea. The Road of Joal is not much better than those we have just mentioned; the entrance of the river, between Joal Point and the point to the South of it, which they called *Palmarin Point*, is 3 miles broad, with a depth of 3 fathoms of water in mid-channel.

Colonel L. S. O'Connor, C.B., governor of the Gambia, paid a visit to the King of Bur Sin, at his sea-port of Joal, in January, 1856. His object was to enter into a

* A more particular detail of this coast, and of all the shore between Cape Naze and Cape Roxo, by *M. Le Predour* (extracted from the *Annales Maritimes*), was published at Paris in 1828. To the description is annexed a copious table of the positions of places, as determined in 1826 and 1827, on board the frigate *La Flore* and goelette *La Dorade*, under the orders of Captain *Massieu de Clerval*, which may be advantageously compared with more recent observations.

treaty for the protection of vessels and persons wrecked on these shores, which was carried out, and therefore some appeal may be made hereafter to that treaty should misfortune render it necessary.

From Palmarin Point to the northernmost of the *Birds' Islands* the coast extends S. by E. [*S.S.E.* ¼ *E.*] 8 leagues; and, from the mouth of the Salum River, which lies 4 leagues south-eastward of the point, to the Birds' Islands, the shore is bordered with a sand, named the *Red Bank*, that stretches 4 miles into the sea, and close to which are 4 fathoms of water. The *Birds' Islands*, four in number, and very small, lie on this bank.

The Salum River is navigable for 90 miles, and vessels of 250 to 300 tons can always ascend it easily to *Khaolah;* the last and principal trading port, and to which the tide extends. The bottom throughout is of soft mud, and therefore may be grounded on without danger. All the people at Goree are intimate with the river, and can act as pilots. The only difficulty is the bar, which, like that of the Senegal, is liable to shift, and is extending to the South. The Sandy point of Sangomar has thus extended a mile since 1828, the period of the survey. The bar is only about 50 yards broad, and on it are from 8 to 9 feet water, perhaps less at spring tides. In taking the bar you must be able to bear freely to the N.E. by compass, which may be readily done with the sea breeze (N.N.W.) in the afternoon. The best time is, therefore, the two or three days following the first and last quarter of the moon: it is high water then at from 4 to 6 p.m., and you can make sail for the bar at 2 or 3 o'clock the moment the breeze sets in and is well established, but not if it is too fresh, for then the breakers are too strong. *

From Palmarin Point to the pitch of *Cape St. Mary* the distance is 11 leagues, South. [*S. by E.* ¼ *E.*] The entrance of the Gambia lies between the pitch of that cape and the low islets called the Birds' Isles.

In sailing off the coast between Cape Verde and the Gambia, shipping must proceed with caution, as the Amboroo Bank, the shoals of Joal, and the banks in the vicinage of the River Salum, are dangerous, being very shoal.

RIVER GAMBIA.—Between the parallels of 13° 30′ and 13° 40′, in an extent of 10 miles, is the estuary or mouth of the great River GAMBIA: it is bounded on the South side by a point named *Cape St. Mary*, the situation of which is lat. 13° 30′ 12″, lon. 16° 41′ 24″. On a point 6 miles S.E. by E. [*E.S.E.* ¼ *E.*] from this is the British settlement and town of BATHURST.

The Gambia† is one of the principal colonies of the British on the coast of Africa, and the advantages of this noble river for carrying on trade with the natives in the interior were well known upwards of 240 years ago, for a company was formed in England for that purpose in 1618. From the time of the first voyager, Thompson, at that period, up to that of Mungo Park in 1795, it was considered that the Gambia and Senegal were branches of the Niger. Several expeditions were sent out, and the British Factory was placed on the small Island of St. James, about 17 miles from St. Mary's. Besides this settlement in 1724, the African Company had another factory at Joar, about 100 miles distant from St. James's Island. In 1688 the latter fort was captured by the French, and there is now scarcely a vestige of it remaining.

In 1816 a new settlement was formed at the Island of St. Mary's, which was formed on the faith of a treaty for the exclusive trade with the Gambia with the French. The Island of St. Mary's was purchased from the king of Combo; and on the opposite bank, a large tract of country, extending one mile inland, and about 36 miles long, was purchased from the King of Barra. It is to the eastward of Barra Point,

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* Lieut. Bourdon, of the *Alecton*, I. French navy, 1857.

† We have taken this general description from the Report of the Government Commissioner, Dr. Madden. The correctness of that report was much disputed by many competent authorities, as will be seen throughout the evidence before the house, but we have omitted those portions which have been particularly specified. *See* Report on the Western Coast of Africa, Appendix, No. 8, p. 177, Part II., &c.

and is of little advantage except as giving us command of the mouth of the river. There is no British establishment on this tract except Fort Bullen, immediately opposite to Bathurst, and a small house, the residence of a missionary.

In the vicinity of Cape St. Mary's, 7 or 8 miles to the southward of Bathurst, is a more valuable territory acquired by Lieutenant-Governor Huntley, in 1840, by purchase; it is called Baccow, and has some barracks for the African corps.

M'CARTHY'S ISLAND is another British settlement, up the river, at the distance of about 175 miles from St. Mary's, though this distance is usually called 300 or 250 miles. The island is about 5½ miles long and 1 broad, and the river is navigable up to it for vessels of large tonnage; beyond it the trade is carried on in small schooners; the breadth of the river here is about 200 yards. The falls of Barraconda, which stop the upward navigation of the Gambia, are about 300 miles above St. Mary's, and from this to Fort St. Joseph, or Gallam, the French settlement on the Senegal is about 150 miles, or five days' journey on foot. There are several islands on the Gambia, between M'Carthy's Island and the mouth.

The Island of St. Mary's is situated on the South bank of the river, opposite to Barra Point, where a battery has been erected, and where a few black troops are stationed; the breadth of the river is about 2 miles.

The principal buildings on M'Carthy's Island consist of the barracks, the Wesleyan mission-house, school, and chapel, and three other stone houses; the population amounts to 1,200, or 800 males and 400 females.

The island is separated from the main land by a very narrow creek, called Oyster Creek; the length of the island is about 4 miles, and the extreme breadth 1 mile. The total population of St. Mary's is 3,514 souls, including 81 aliens and resident strangers; of the fixed population, 42 are whites and 3,291 coloured people.

Bathurst is situated in the Island of St. Mary's; it is a small, prosperous-looking town, with several excellent stone houses, especially on the wharf where the houses of the merchants are situated. Dr. Madden's report has given rise to much discussion as to the eligibility of the site of this town, but it would appear that there is no other situation which offers superior advantages. *Jillifree* is on the North side of the river, and is about half a mile from Fort James.

Albrida, or *Albradar*, a fort which belonged to the French, is about half a mile from Jillifree; their possession of this place was considered not to be on any well-founded claim, and was also a very serious inconvenience and injury to the British trade in the river:* but, as shown in the note on page 513, it has been exchanged for Portandik.

Of the Gambia, *Captain Belcher* says:—"The Gambia, considered in a mercantile point of view, and, as regards supplies, appears to offer more decided advantages than any of our possessions on the coast of Africa; and may, indeed, be said to be the only point where anything approaching to trade can be satisfactorily pursued. Even in its present state it is by far the most healthy part of the coast; and, had a portion of the liberality of government to Sierra Leone been extended to *Bathurst* and its dependencies, I feel satisfied that, long ere this, it would have acquired that character which eventually, with infinite labour, it will establish for itself from its own resources." The constitutions of the residents appear to be as sound as in any part of the world, and the strongest has been here thirty years without visiting Europe."

But it is to be regretted that, at Bathurst, the only fresh water to be had is from private wells; but, by close work in the dry season, as much as five tons a day may be obtained. Wood may be had at the beach, well dried, in convenient lengths for stowage, at a dollar and a half, or six shillings sterling, per cord.

Cape St. Mary is readily known by its making like a plain; low by the sea-side, with an acclivity toward the interior. It has some trees and one house upon it.

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* Parliamentary Report, 1842, vol. xi., Part I.: "Evidence of F. W. Finden, Esq.," p. 475.

The narrowest part of the mouth of the Gambia is between the town of *Bathurst* and *Barra Point*, to the N.E., the distance between being only 2½ miles.

From Bathurst Point, the Banyan or St. Mary's Shoal, a dangerous rocky shelf, extends 5 miles N. by W. ¼ W. [*N.N.W.* ¾ *W.*] It is even with the water, on the ebb. At a mile to the N.E. of this is a bank called the *Middle Ground;* and, at three-quarters of a mile northward of the latter, is a smaller one, the *African Knoll.* There are from 4 to 6 fathoms of water between these banks; but the best way in is to pass to the northward of the whole, keeping over toward the Red Bank and the bank extending from the Barra or eastern shore, according to the following directions.

"It is strictly to be recommended that vessels, bound to the Gambia, should get into the latitude of 13° 40′, or 4 or 5 miles to the southward of it: then, making a due East course, keeping their lead going, until in 5 fathoms, when you may anchor, and engage a pilot. But, should you be desirous of proceeding up, you may follow the sounding depths of the chart; remembering that on the southern side of the channel the ground is hard; but on the North and East sides the lead sticks in, the bottom being of soft mud. The anchorage is off the town of Bathurst, with any part of it bearing about West, three quarters to half a mile off; the depth being 16, 14, and 12, fathoms. Small vessels may lie closer in, where there are 8 and 7 fathoms. The ground is good; the tides strong: but it is, altogether, a fine harbour."—*Lieut. G. L. Harries, R.N.*

The direct course, from 5 fathoms off Bird Island Shoal, to within the African Knoll, off the edge of the Red Bank, is S.E. [*S.E. by E.* ½ *E.*] 5 miles, where there is, in the main channel, 6 and 7 fathoms. From the last spot to the anchorage off Bathurst, the course and distance, in a fair working channel, is S. ¼ W. [*S.* by *E.* ¼ *E.*] 7 miles.

When advancing to the Gambia, from the northward, you ought not to approach the river nearer than in 7 or 6 fathoms, before Cape St. Mary comes in sight. It may be advisable for a stranger not to proceed farther than in 5 fathoms without a pilot, unless the vessel draws less than 12 feet of water. Those leaving Goree, when bound to the Gambia, may steer about S. by E., keeping their lead constantly going, and approaching the coast no nearer than in 7 fathoms. When near the entrance of the Gambia, the ground will generally be found an oozy sand; but, near the cape, sometimes sand and sometimes red shells will be found. The ebb in the river runs very strongly, nearly eight hours, but the flood is not so strong. Spring tides are very rapid.

Having approached within one mile of Barra Point, from which a small spit stretches off to about a quarter of a mile, keep over for mid-channel between that point and Banyan or Bathurst Point. You have 8, 9, 10, and 12 fathoms between the two points, and good anchorage in 9 fathoms of water, muddy ground, with Barra Point bearing N.E. by N., and Banyan Point N.W.

The tide of flood sets to Barra Point, and the ebb directly on the Middle; be therefore very cautious during calms on an ebb tide.*

From Barra Point to Dog Island Point, on the same side of the river, the bearing and distance are South [*S. by E.* ⅛ *E.*] 8 miles. The coast between forms a deep and shoal bay, and the flats extend from it into the middle of the river. From Dog Island Point and Reef the coast takes a sudden turn to the S.E. and E.S.E., and it trends from Dog Island Point to *Lemaine* or *Lemon Point*, S.E. ¾ E. [*E.S.E* ¼ *E.*] 2 leagues. On this shore, at half a league more eastward, is the French former settlement at *Albreda*, and at half a mile further is the English one named *Jillifree.* One mile south-eastward from Jillifree, on an islet in the river, is *Fort James.*

To go up to James Fort, which is 17 miles above Bathurst, you steer in mid-channel

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* At the Gambia, in the season of the Harmattan, the rainy season has just terminated on the 9th of December. Upon this occasion the colours are hoisted and a gun is fired. On a second visit in May and June, 1831, the end of the dry season, symptoms of approaching rains, with squalls.—*Captain Belcher.*

2 leagues, with the town of Bathurst N. ¾ W. [*N.N.W.* ¼ *W.*] This leads to a fair offing from Dog Island Point. The course hence, in the fairway, to abreast of Lemaine Point, is S.E. ½ E. [*E.S.E.*] 6½ miles; and thence to Fort James, E.S.E. ½ E. E. [*East*] 3½ miles.

In order to avoid the shelf which extends from the Banyan or western shore, approach no nearer to that shore, in turning, than in 5 fathoms; nor near the Barra side, when above Dog Island Point, than in 4 fathoms; but if near that point, then in 6 fathoms. Lemaine Point should have a berth of a mile, as some shoals stretch from it. You may haul in and anchor before Albreda in 4 fathoms, half a mile from it, the ground shoaling gradually to within a cable's length of the shore.

After giving Lemaine Point a berth, do not haul for the Barra shore till you are abreast of *Albreda*, for the flat continues to the eastward of that point to a considerable distance.

Under Admiralty orders, in 1826, the River Gambia, to the distance of more than 190 miles, from its entrance, was surveyed by Captain *Richard Owen*, with his assistants, Messrs. Tudor and Mercer. This valuable survey exhibits the depths of water all the way up to *Pisanea*, where there remain the ruins of a factory, and where the tide, in the dry season, rises 3 feet. It appears from the survey that, at 3 miles above *James Fort*, this noble river is nearly 2⅙ miles in breadth. Here it takes a north-easterly direction, and thus extends for 10 miles, to a point on the South shore called *Moota Point*, and a creek, *Jukarda*, on the North. The depths of this reach, in mid-channel, are 5½, 4½, 4¼, to 5, 6, and 7, fathoms. Pursuing thence an easterly course, its depths alternately shoalen and increase to a great distance.

From *Boonyadoo Creek*, or the Fourth River, which faces the mouth of the Gambia, to *Jukurda Creek*, above mentioned, is a line of coast, 1 mile (*nautic*) in breadth, and 42 miles in length, the sovereignty of which was ceded to His Britannic Majesty, by treaty with the king and chiefs of Barra, signed at Jillifree, 15th of June, 1826. A small spot (400 yards by 300) occupied by the French, at *Albreda*, excepted. (See *ante*, page 512.)

CAPE ST. MARY TO CAPE ROXO.—*From Cape St. Mary* (the true cape) the coast stretches 11 miles W.S.W. to the *Bald Cape*, where *St. Anne's Bank*, with the *Tongui Rocks*, extend about a league into the sea, and include three sandy islets, called the *Byjols*.

Upon the coast of Cape St. Mary the ground varies all along, but it becomes whiter to the southward: when past the cape you find a reddish sand, which, at 2 or 3 leagues more to the South, changes into a gray, then into a whitish, sandy bottom; and, about Cape Roxo, it becomes such fine sand as that which is put in the time glasses. These varieties of ground extend from 25 fathoms in the offing to 5 fathoms off the shore.

The coast between the Bald Cape and Cape Roxo, in a distance of 20 leagues, is very low, with a sandy beach, and covered with trees. The middle part is one low and continued forest, with clusters of large high trees, at a distance resembling islands.

In sailing between the two capes, by keeping in 5 or 6 fathoms along shore, you will find that depth down to the entrance of the *River Casamanza*, 4 leagues to the northward of Cape Roxo; there you have only 4 fathoms, and the ground mostly red sand. About 2 leagues southward from that entrance, and abreast of a cliffy point, near which you may anchor, the ground is so clammy, about a musket-shot from the shore, in 2 fathoms of water, that the lead is brought up with difficulty.

The RIVER CASAMANZA, or Casamance, is situate about 16 leagues to the southward of Bald Cape. If a bar did not obstruct this entrance, the river might be navigated by frigates; but it can be gained only by a very narrow channel, having a depth of 2 fathoms, but it can be entered with ease by a steamer under proper pilotage.

The Portuguese, established on the fertile banks of this river, have ascended to the distance of many leagues from its mouth; they have several establishments on it, the principal of which are called *Zinghicor*, 45 miles up the river, and *Makia Kaconda*.

They have carried on an advantageous trade, especially in ivory, rough hides, aromatic seeds, and dyeing woods, with the Feloop and other negroes, who inhabit the banks of the river.

There is a French establishment, *Carabane*, 5 miles from the mouth of the Casamanza, on the northern point. Toward this there are two passages, divided by the bar, which extends outward, to the West, nearly 4 miles. The deepest channel is on the South side of this bank, and has 3½, 6, 4, increasing to 8, fathoms off the point. The river upward, which has a serpentine form, has been surveyed by Captain Boteler; and from his survey it appears that there is another French settlement, the factory of *Berrin*, at 10 leagues up the river on the South side, and 3 leagues below Zinghicor, which is on the same side. The soundings in mid-channel, from the entrance to the latter place, vary from 8 to 4, 6, 3½, 5, 6, 3½, 8, and 5 fathoms. The French recently placed another establishment at *Sejeu*, having purchased the land of the natives, and they are apparently endeavouring to increase, as much as possible, their commerce in this part of the world.*

CAPE ROXO (lat. 12° 21′) is improperly called a *cape*, it being an obtuse point of *low land*, from which the coast takes an E.S.E. direction to the *River Cacheo*, or *Rio San Domingo*, the navigation to which is impeded by extensive shoals called the *Cacheo Banks* and *Falulo Breakers*. The point or cape, when bearing E.S.E. or East, presents a down of white sand, of moderate height, covered with brambles. On one side of the points formed by the coast to the northward are a number of tufts, of a remarkably red colour, and it is supposed that, from these tufts, the name of *Roxo* (Red) has been imparted to the headland, although they are distant from it about 2½ miles.

M. Roussin says that on all the approaches to Cape Roxo the soundings are regular, but the depth inconsiderable. From the River Casamanza, to the distance of 2 or 3 miles from shore, there is a depth of only 6 to 4 fathoms. At 10 miles to seaward are 8 and 7 fathoms; and at a short distance to the S.S.W. the first bank of the Bissagos is met with.

Cacheo, on the South bank of the river of that name, has been the chief Portuguese establishment between Cape St. Mary and Cape Verga, and was, formerly, very considerable. They carry on the same kind of trade here as at Casamanza. The country is singularly fertile and well peopled.

The mouth of Cacheo River is about 6⅓ leagues to the south-eastward of Cape Roxo, and the entrance is between two reefs. In proceeding for it, give Cape Roxo a berth of about 5 miles. Steer S.S.E. on soundings of from 4 to 5 and 6 fathoms, on a sandy bottom. Go close to the eastward of Cacheo Bank, which has 2½ fathoms of water on it. Continue S.S.E. until you see breakers ahead, and run straight for them, until you are in 5 fathoms of water. You will see a single tree bearing East, then steer E. by S., leaving a reef, which extends out about 4 miles from that tree, on your port hand. This reef, although it is said to have 2 fathoms on it at low water, breaks at half tide. Close in to the beach, at the tree, there is a passage of 2¼ fathoms, which is fit for small craft only. Continue your course E. by S., when you will be apparently 4 miles from the land on your port hand, and will come to a shoal called the *Mud Bar*, on which there is a depth of only 18 feet at ordinary high water, but is only soft mud, and about 2 cables' lengths in breadth. You may then see a clump of palm trees (ten or twelve in number), bearing E.N.E.; and when these palm trees bear N.E. by E., you will be over the bar, and will have from 5 to 5, 7, 8, and 9 fathoms up to *Cacheo Fort*, by keeping in the middle of the river; and, when abreast of the Fort, which belongs to the Portuguese, anchor in the middle of the river in 9 fathoms.

BISSAGOS and BIJOOGA ISLANDS.—We have now arrived at the Archipelago of Bissagos and the Bijooga Islands.

This archipelago is an extensive assemblage of islands and shoals between the

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* See Parliamentary Report, Part I, pp. 475, 657, 699, 700.

parallels of 10° 42′ and 11° 40′ N., and between the meridians of 15° 30′ and 17° W. Of the interior navigation among the isles little is known, and the hostile disposition of the inhabitants renders it probable that no complete survey of it, at least in the present age, can be made.

The principal isles that constitute the archipelago are said to be 16 in number, besides many islets, all surrounded by shoals, as shown on the chart.*

The archipelago is bounded on the North by the JEBA CHANNEL, or GREAT CHANNEL of BISSAO; and on the East by the CHANNEL of RIO GRANDE. These channels were partially surveyed by the officers under Captain Roussin, in 1818, and Captain W. F. Owen, in 1826; and to their surveys we owe our knowledge of the navigation presently to be explained. The southern breaker, called that of the *Bayadère*, was discovered in 1818, and is represented by M. Roussin in lat. 10° 42′ 56″, long. 16° 17′, and the mouth of the Eastern or Rio Grande Channel is 7 leagues more to the eastward.

Jeba Channel, or CHANNEL of BISSAO.—The main land, forming the North side of this channel, is intersected by several rivers, which divide it into islands. The first of these is *Cacheo*, then follow *Jatt*, *Bassi*, and *Bissao*, of all which the land is low. But there is, near the S.W. end of Jatt, at 13 leagues S.S.E. [*S.E.* $\frac{1}{2}$ *S.*] from Cape Roxo (lat. 11° 50′) a small but conspicuous isle, named *Cayo*, which is bold-to, and very useful as a sailing-mark. This isle, when on an easterly bearing, appears like three isles, but, on nearing, will be found to be connected with a flat, which is common to all, though intersected, at high water, by shallow lakes. Its soil is sandy, and mixed with flinty rock. The beautiful trees with which it is covered may be seen, in clear weather, at 4 or 5 leagues off. At 6 leagues more to the eastward [*E.S.E.*], off the S.E. end of Jatt, are several islets, called the *Ancoras*, which distinguish the western side of a river, bearing the same name.

The islands, generally, which border the Jeba channel, are not high. The beach is generally of white sand, interspersed with black and red rocks, which, being covered with lava, are, doubtless, with the whole archipelago, of a volcanic origin. They are all well wooded to the sea-side; and the height of the trees, with their vigorous appearance, indicate that the soil must be fertile. The Island Bissao, on which the Portuguese are established, is not so thickly wooded as the others; but this is owing to the clearance they were obliged to make for their safety, as the isle is equally fertile as the rest. The large isles of the archipelago are inhabited by a race of negroes, known in the country by the name of *Papels*.

On the Rio Grande, the Portuguese have several establishments. The settlements of Portugal, on the coast, do not extend beyond Cape Verga. The objects of trade consist chiefly in elephants' teeth, wax, hard soap, rough hides of every kind, dyeing and building wood, indigo, cotton, drugs, resin, and resinous gums, gold in small quantities, orchilla. &c.

The extremity, or N.W. part of the Bissagos Shoals, is composed of hard sand. From this extremity, the bank and isles extend to the southward and south-eastward, 23 leagues, toward the Eastern Channel of the Rio Grande; and the flat, which is from 12 to 6 leagues in breadth, is interspersed with banks above and under water, and islands, either dry, or drowned and marshy, the detail of which is little better than unknown.

On the 25th of December, 1789, the sloop *Endeavour*, of Liverpool, struck on the N.W. end of the shoal, to the westward of the island named *Carasche*, in lat. 11° 38′. Captain S. Gamble, who was a passenger in the sloop, says, in his journal, that she got over the reef, but, not being able to find a passage through the shoals and islands, was, after twenty days' search, obliged to return the same way she went in, and carried 3 fathoms of water over the bank. All the islands they saw were inhabited, but the natives did not appear to have any canoes, and the few which they persuaded to come on board, in hopes of finding a pilot among them, became seasick. When the

* For the positions, see the Table, page 34.

vessel struck, Carasche bore E.S.E. about 4 leagues; and when she was near the northernmost point of that island, the isle or kay, called Isle Cayo, on the North side of the Frith, bore N.N.E.

The North edge of the Shoals of Rio Grande, adds Captain Gamble, is in lat. 11° 40′, and we led round them in 11° 43′, carrying from 11 to 15 fathoms. The tide of ebb runs very strongly over the flats to the S.W.; and, within the heavy breakers, the ebb runs W. by S., and the flood E. by N. The tide, at full and change, rises 12 feet.

The PASSAGES TO AND FROM BISSAO. — Cape Roxo has already been described. Should you fall in with this point in the evening, come to an anchor, bringing it to bear North, as then you will be well laid, in order to proceed further.

The outer part of the *Breakers of Falulo* bears S. by E. [*S.S.E. ½ E.*] 17½ miles from Cape Roxo, and lies to the south-westward of the River Cacheo. The breakers are divided into two groups, and extend in a *true* E.S.E. and W.N.W. direction 3 miles. They are very steep-to, and close to them are from 6 to 3 fathoms. A merchant-vessel may advance within sight of them, and thence proceed toward the Isle Cayo; but the best way of proceeding to the Jeba or Bissao Channel is as follows:—

From a point at 2 leagues to the westward of Cape Roxo, proceed S.W. by W. ½ W. [*S.W.*] 12 miles; then haul up on the port tack, as at this distance the depth increases. The next course will be S. ½ W. [*S. by E.*] for 25 miles, which will bring you to the parallel of 11° 47′, where a depth of nearly 50 feet, with a muddy bottom, will be found.*

You now enter the Channel of the Jeba, and will find that a run of 12 leagues, E.S.E. ½ E. [*East*] will lead to the South point of the Islet *Cayo*, the trees of which, as we have shown, may be seen at a considerable distance. All the space to the northward of this track is replete with banks, which extend to the main shore; but those of Falulo are the only ones that break incessantly.

Proceeding thus, the depths will be found always regular, from 7 to 8 fathoms, and the bottom constantly of mud. It must be observed, that when entering the Great Channel, the northern banks should be approached in preference to the southern. As the former descend by a gentle declivity, they always warn a vessel when she is out of the channel, by each cast of the lead giving a gradual decrease of depth. The southern banks, on the contrary, are extremely steep; close to a depth of 40 feet there will be found one of 25, on a bottom very unfit for anchoring.

In order to be assured that you are keeping the channel, keep constantly sounding, and observe, that in all the channels which separate the banks to the N.W. of the Bijoogas, the bottom is almost exclusively soft mud without any mixture. At each cast, therefore, when the lead sinks into the ground, you may be certain that you are following the proper channel, and the middle of it may be found, by the lead sinking deeper, and being less easily extricated. If the bottom becomes hard, it is a certain proof that you are near some bank, and if the vessel has much way on her, she must alter course directly for that side on which the bottom is softer.

A vessel seeking or running for the anchorage off the Islet Cayo need not mind passing close to it. This part is perfectly safe to the beach, at half a mile from which there is a depth of 8 fathoms, on a soft muddy bottom.

The Great Channel, on the meridian of the Islet Cayo, is about 4 leagues in breadth; but this space is divided into three channels, by means of two banks, on which there is very little water. Of these banks the northernmost is the *Bank of Cayo*, having a depth of only 10 feet on it, and lying 4 miles to the southward of the

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* Vessels coming from the northward, after making Cape Roxo, may steer S.W. from that cape, in 8 fathoms, all along, until they catch from 10 to 12 fathoms, green ooze; then steer S.E. by E., taking care not to get into less than 6 fathoms on the port hand on Cacheo Bank, &c.—*Mr. Swann, a pilot.*

islet of that name. It is rather narrow from North to South, but its length from East to West is about 5 miles. The best of the three channels is to the northward of this bank, in which there are from 7 to 9 fathoms.

At the distance of 2 miles southward from the Cayo Bank is the *Bank of Carasche*, which breaks continually, and a part of which is dry at low water. Like the first, it extends *true* East and West, and its length is also about 5 miles. The least depth between the two is 9 fathoms. At 4 miles to the southward of the Bank of Carasche is the North point of the island of the same name, which forms part of the South Bank of the Great Channel. There is a channel between the bank and the island, but the depth is irregular, and the bottom is bad.

On advancing for the Portuguese establishment at Bissao, and having arrived to the eastwaard of the two banks before mentioned, you may safely proceed 5 leagues S.E. $\frac{1}{4}$ S. [*S.* 60° *E.*], and will thus coast the Island of Jatt to its S.E. point, which, from the trees upon it, appears to be the highest part of the whole coast on the northern side of the channel. The course thence is E.S.E. [*E.* 5° *S.*] 6 leagues, in which extent the *Ancoras*, situated to the S.E. end of the Island of Jatt, the channel between that island and Isle Bassi, and the southern part of the last island, will be passed successively to the northward: on the South you will cross a large bay formed by the Islands *Carasche* and *Corbelle*, will pass the Parroquet Island [*Papakawa*], lying to the eastward of the latter, and finally arrive on the meridian of the western point of the Island of Bissao, at about 3 miles from it. From the Parroquet Isles, the southern side of this channel is formed by a bank, several parts of which are dry at low water.

To the southward of the town of *Bissao* is an islet, called *Bonn;* and at 2 miles above this is another, called *King's Isle.* On the South side of the river is another called *Arcas*, which is 7 miles from Bonn, and nearly on the same meridian. The latter lies on the eastern side of the channel to Rio Grande, and is the distinguishing mark for that channel. From the S.W. end of the Isle Bissao the course to Bonn is E. $\frac{1}{4}$ N. [*E.* 20° *N.*] This course runs parallel to, and within 2 miles of, the Island of Bissao, and passes over several patches, on which there are only 26 feet at low water. These patches are to the northward of the eastern channel, the mouth of which is near the Island of Arcas, which is seen at the same time. They may be avoided by altering the course occasionally; but as the depth on them is not less than 26 feet, and does not experience any considerable rise, as they are of no great extent, a vessel may pass over them without any fear, and may shape a direct course.

At $3\frac{1}{2}$ miles W. $\frac{1}{2}$ S. [*W.S.W.*] of Bonn, is the *Point and Grove of St. Martin* of Bissao, where the coast forms a slight elbow. This point is not to be approached with safety, nearer than $1\frac{1}{2}$ miles by a large vessel. At 3 miles S.S.W. [*S.* 5° *W.*] of this point, and in a continuation of the line from Bonn to the highest point of King's Island, lies one of the knolls above spoken of. It is the easternmost to be met with on the course above stated. To the eastward of the meridian of Point St. Martin, the depth increases toward Isle Bonn. This knoll, with 26 feet of water on it, is a small bank of not more than 100 fathoms extent in every direction, having deep water to the northward and southward of it.

When a vessel is within 3 miles S.S.W. $\frac{1}{2}$ W. [*S. by W.*] from Bonn, she should steer direct for it, so as to pass within 200 fathoms to the eastward of the island. This part is extremely steep, having, at the above distance from it, a depth of 8 fathoms. From hence she should run between King's Island and the Fort, and anchor in 6 to 8 fathoms, on a soft muddy bottom. Having doubled the Isle Bonn, the coast of Bissao should be approached nearer than King's Island, as the depth is greater, and varies from 6 to 7 fathoms. It would be superfluous to mention the necessity of sounding constantly in this internal navigation.

In March (1856) Captain Canal, of the French ship *Agly*, proceeding to Bissao encountered a most powerful southerly current. He had allowed for $1\frac{1}{2}$ knots, but having become entangled to the South of Carash he found that he had set at the rate of 3 *miles per hour.*—(*See* page 28[illegible].) He had grounded on a shoal, and was compelled to cast overboard 40 tons of ballast to lighten the ship, and after 5 days he contrived to pass safely through the Archipelago to the North and East, and arrived at Bissao. He sent a boat out to sound, and by that and the colour of the water he managed to arrive without casualty. Bissao, he says, offers but few resources for fresh provisions.

Bissao.—The road of Bissao lies in the principal stream of the River Jeba, between the eastern side of the Island of Bissao and the small island opposite, called King's Island. This roadstead is perfectly safe in all weathers. It is so completely sheltered, that the sea is always smooth; and the bottom is of such a nature that with good ground-tackle a vessel may ride there in any season. It is advisable to moor N.E. and S.W., as the tides set in this direction: and in the rainy season, as the squalls come from the S.E., the anchors, being thus placed, will bear an equal strain.

The Portuguese Fort stands at 100 fathoms from the beach, and is a square redoubt, flanked at the four angles by a bastion. The wall of the ditch, which on each face is about 100 paces in length, may be about 30 feet in height. The magnetic variation observed in April, 1818, at the anchorage, was 17° 30′ W. (It is, in 1861, about 19° 20′ W.)

The watering place at Bissao is on the bach, at about 300 paces to the southward of the Fort. It consists of several pits, dug about 4 feet deep in the sand, and may afford sufficient water to fiill thirty casks in 24 hours. This water before being filtered, coming from sand and rock, is not agreeable to the taste, although it has the reputation of being wholesome, and of keeping well; nevertheless it should not be drank without being previously acidulated, or purified by red-hot shot. It may be either brought on board in boats, or rafted off at high water.

Independent of wood and water, excellent bullocks, of about one hundred weight, at the rate of from twenty to twenty-five dollars each, have been had at Bissao; also goats, pigs, and poultry. There is also rice, maize, and yams, and some fruit, such as bananas, lemons, and oranges. These articles are exchanged for gunpowder, brandy, iron, clothing, and dollars, by applying to the governor.

Governor O'Connor says:—"Bissao, declining when I visited it last in April, 1855, has since then greatly deteriorated in trade and appearance. The old buildings, totally neglected, are sinking into ruins, the troops without barracks living in miserable mud huts, the port occupied by only a few colonial and coasting vessels, the market scantily supplied with the commonest necessaries of life, are indubitable evidences that the power and prestige of Portugal are rapidly on the wane in this part of the world."

The waters which surround the Bissagos are far from being supplied with fish, and it is erroneously affirmed, in some works on Africa, that amongst these islands cargoes of salt fish may be procured. Mud prevails too much in the bottom; and the few fish which are found are not even considered as wholesome. No dependence can be placed on this resource, between the Gambia and the Isles de Los.

Dr. Madden says, "Bissao is the great stronghold of the Portuguese slave trade. The island of this group, on which the Portuguese Fort and factory are established, is situate at the mouth of the River Jeba, about 100 miles South of the Gambia."

Winds in the Great Channel of the Bissagos.—The winds here follow nearly the direction of the land, and vary their course according to that of the channel. In the Great Channel they vary from West to North; at the anchorage of Bissao they are generally from S.W., except in the morning, when they are from the northward. In the rainy season, which commences here in the beginning of June, and continues about five months, they blow from the S.E. with the tornadoes, as on the whole coast, and then, passing round by South, return to the northward. Whatever may be the direction of the wind, a vessel, with the assistance of the tides, may always find her way into or out of the Great Channel, and the working is extremely easy with the assistance of the new Chart, which should accompany these Directions. The remark, respecting the northern bank being approached in preference to the southern, should be attended to here; the islands to the northward being perfectly safe, whilst those to the southward are surrounded by very steep and hard banks. Large vessels should not approach nearer to the Isle Corbelle than 3 miles, nor to the line which connects it with Isle Carasche. All the space which lies between the island, to the southward of this line, is filled with banks, having little water on them, and the greater part of which lie in the channel. If it should fall calm, and it be wished to let a vessel drift with the tide, she must not be abandoned to it until she has opened the channel she intends entering.

Anchorage in the Jeba or Great Channel.—A vessel may anchor anywhere in the Great Channel, the bottom being of soft mud and excellent holding-ground, with the exception of one place at 2½ miles to the southward of the Isle Jatt. Here the depth is from 20 to 22 fathoms, and [illegible] of coarse gravel. In all other parts of the channel the depth varies [illegible] to 5 fathoms, without any sudden alteration.

TIDES.—The usual prevailing cu[illegible] the coast to the northward of Cape Roxo are found to be completely chang[illegible]ng this Cape. They have here no longer one only direction; and, in all ch[illegible] of the Bissagos, are suspended by tides, which are more or less regular. Those [illegible] the Jeba or Great Channel are perfectly so. Westward of the Isle Cayo the flood sets S.E. and the ebb N.W., each six hours, or nearly so, with the exception that the current gradually assumes these directions, requiring nearly an hour, from the change, before it is completely settled in its course. The flood generally sets to the northward, and the ebb to the southward. The greatest difference which has been observed between the high and low water marks, is 8 feet; and at the equinoctial full moon the rate of the flood and ebb is about 1 2-5th miles an hour; at other times it never exceeds 1 mile. At the entrance of the Great Channel, which is 6 leagues to the westward, and on the parallel of the Island of Cayo, it is high water, at full and change, at 9^h 15′.

From the meridian of Cayo, and as far as that of the Isle Bonn, the stream follows the direction of the channel; and here the tides are regular. It is not known that the length of the ebb exceeds that of the flood. The greatest rate of either never exceeds 2½ miles per hour, in spring tides, and the rise is found to be 8 feet, as outside the channel.

On the meridian of Cayo it is high water, at full and change, at 11^h. Before Bissao the rates of the highest tides never exceeds 2·6 miles per hour, and the rise is never more than 14 feet. In common tides the rate is never more than 2 miles per hour, and the mean rise is 7½ feet. It is high water, at full and change, at the anchorage of Bissao, at 12^h 30′.

CHANNEL of the BOLOLA, or RIO GRANDE.—The eastern channel, or Channel of the Rio Grande, branches into the Jeba Ghannel to the westward of the Island Arcas. The western bank is formed by a flat, which extends to the eastward of the Parroquet Islands and *Isle Galinha*, the banks which connect these with the *Hog Islands* and by *Kanyabac Island.* The eastern bank comprises the *Isle Arcas*, *Bulama*, or *Boolam Island*, and the banks which connect these two islands. It is then intersected by the mouth of the *Bolola* or *Rio Grande*, after which it again commences at Bossessamé, and forms a chain of reefs as far as the Island Yomber, in 11° 3′ N., and 15° 40′ W.

The channel is then divided into two branches by a bank, which is about 4 leagues in extent from North to South, and on which, amongst several islets and breakers, are situated *Isle Cavalho* and *Honey Island.* Seven miles to the southward of the latter lies *Pullam Island.* The western or main branch has, on its western side, the *Island of Orango*, and a long chain of reefs, which extend S.S.W. from that island.

To enter from the northward.—The first difficulty which presents itself, on entering this channel from the *northward*, is when passing the Isle *Arcas.* From the S.W. part of the island a bar stretches out, on which there is a depth of only 19 feet at low water. It is terminated, at the distance of 4 miles, by a rocky bank, which also forms a part of the bar. Although the depth may be a little more at the distance of

a mile from this bank, a large vessel should not venture near it without previously considering well the time of tide. If she be obliged to anchor, the best ground will be found near the meridian of Arcas, on the North.

The mark fo. running through this Channel, from a position bearing W. ½ S. [*W.S.W.*] from the Isle of Arcas, is to steer so as to keep the western point of the Island Bulama constantly bearing South [*S.* 17° *E.*], until within two miles of the shore of this island. From hence, if it be intended to go to the southward, a vessel should steer for the middle of the strait formed by the island and Galinha; but should a vessel be bound to the northward, she should steer N. by E. ½ E. [*North*] from the above bearing of Arcas, until she has passed the parallel in which it lies.

BULAMA, or BOOLAM.—The western end of this isle may be approached within a mile. This island, which is well wooded and of moderate height, has several well sheltered roadsteads, which afford safe anchorage. One of these, on the S.W. side of the island, has a depth in it of from 22 to 24 fathoms, with a bottom of soft mud. The configuration of the land is such, that the strength of the current, being carried more to the southward, is almost imperceptible at this anchorage; and although the tide rises from 12 to 15 feet, the sea is generally smooth and the landing easy. At this roadstead fresh water may be procured from two places.

Bulama is generally considered as very fertile. Its situation at the entrance of the Rio Grande, which may be navigated to a considerable distance, the facility of its approaches from the westward and southward, and the safety of its anchorages, render it one of the most important islands hereabout. It is situated in the same estuary at Bissao, and about 30 miles to the southward of it. It is claimed both by British and Portuguese, and by the former, in right of a treaty for its purchase entered into with the natives by Captain Beaver. The Portuguese claimed a prior possession to that of Captain Beaver's* purchase, which, they say, was made from a chief who had no right to sell the island.

The island, however, on account of its insalubrity, was abandoned for many years by both; till one of the slave dealers of the Havannah, a Senor Gaetano Nozzalini, obtained a Royal Portuguese Charter for settling on this island; and, in 1820, he established himself there. During ten years the island was in the hands of Nozzalini, it was frequented by slave dealers. But, in December, 1838, Lieutenant Kellett, of H.M.B. *Brisk*, visited the island, attacked and destroyed the factory, and carried away 119 slaves, and subsequently carried away another batch of slaves, which the owner asserted were his domestics, notwithstanding the fetters with which they had been manacled were found amidst the ruins of the barracoon.

In 1840, Lieutenant Hill, of the *Saracen*, had an interview with the governor of Bissao, on the subject of the occupation of Bulama by the Portuguese, and threatening to expel by force any Portuguese subjects he might find on the island. The governor of Bissao repaired to the Cape Verde Islands to complain to the Portuguese Governor-general of the threatened dispossession of the Portuguese. In 1842, it was formally occupied by Lieut. Lapidge, in H.M.S. *Pantaloon*; in 1843, the Portuguese governor landed some soldiers and hauled down our flag. But since the suppression of the slave trade it has been of little use to any one. The old barracoons, &c., of the slaves still exist, and in 1855 a Portuguese Jew held them for Kittam's widow, he being one of the last of the slave dealers.

From the western point of Bulama the course is S. by E. ¾ E. [*S.* 36° *E.*], the distance 3½ leagues. This courses crosses the mouth of the Rio Grande, which separates Bulama from *Bossessamé* or *Bessessema*, continues along the banks to tho S.E. of Galinha, at the distance of a mile, the greater part of which are dry at half-tide, and extends to about 1½ miles from the banks on the western part of Bossessamé. The

* See life of Capt. Philip Beaver, R.N., by Admiral Smyth. Much respect has been paid to his memory by those who knew him. See also a notice of this place and its colonies by Governor O'Connor, in the Proc. Roy. Geog. Society, 1856, p. 43.

soundings on this track are very irregular, and vary from 35 to 8 fathoms, with a bottom, generally, of sand and gravel.

"On the right-hand bank, called Bessessema, are two settlements: one cultivated by a Frenchman, M. Henrique Orteau; the other a small location belonging to a vagrant English subject named Lawrence.

"The bank and grounds at Bessassema are cleared to a considerable distance; of a rich alluvial soil, they produce corn, kus, rice, ground-nuts, sugar-cane, yams, potatoes, vegetables, tropical and *European* fruits, flowers in abundance.

"M. Henrique Orteau employs about 300 natives; has a well-built open town; the huts, very lofty, with thick mud walls, and broad piazzas, are admirably calculated for the climate. He represented the place as healthy, and that even in the rainy season fevers seldom or never prevailed."—*Governor O'Connor*, 1857.

When at 2 miles to the westward of Bossessame or *Bessassema*, a vessel may run for Kanyabac Island, steering South 3 leagues. The depth in this course varies from 7 to 20 fathoms, red sand and shells. To the westward of this track are the four little islands called the *Hog Isles*, and in the country, *Rouban*, *Banak*, *Chieeya*, and *Corett*. The latter, which is the northernmost, is the most remarkable, being covered with large trees.

KANABAC.—All the eastern side of Kanabac or Kanyabac is perfectly safe, and may be approached to within a mile, in from 6 to 10 fathoms. The S.E. point, which the inhabitants call *Barel*, is about 60 feet high, very bold, and formed in peaks. On rounding this point to the westward there is a small cove, called by the inhabitants *Port Manel*. It has a very good bottom for anchoring, but at low water a very small depth. This part of the Eastern Channel is formed by the S.E. coast of Kanyabac Island on one side, and a continued chain of banks, on which the sea breaks, on the other. The latter connect Bossessamé and Yomber Islands, and have on them an islet of white sand.

Kanayabac Island, one of the most considerable of those which form this channel, is of a moderate elevation, and rather higher on the southern than northern end. It presents alternately a sandy, volcanic, and ferruginous soil. If we may judge from the numerous population, and the quantity of cattle on it, this island must be very fertile.

The large trees, called in the country *Pullam Trees*, with palm trees, and vegetables and all kinds, are very plentiful on it.* The Port of Manel, lying between Point Barel and an islet called *Pomp*, seems to be the chief resort of all the canoes belonging to the inhabitants of the southern part of the island.

From *Point Barel*, near the middle of Kanyabac, the course is S.W. ¾ S. [*S. 30° W.*] 13 miles. This will take a vessel within 2 miles of the western side of a very extensive bank which lies to the northward of the Isle Cavalho. The depth on this course is from 10 to 21 fathoms, the bottom of sand and shells.

From 2 miles West of the banks to the northward of Isle Cavalho the direction of the southern parts of the Channel is S.W. ¾ S. [S. 30° W.] This bearing, extended to a distance of 13 miles, will pass the eastern shore of Orango Island, at a proper distance, and also breakers which stretch more than 2 leagues off to the S.W. of this island, and to the parallel of Pullam Island, at 3 leagues from it. Orango Island is the most considerable of the Bissagos. From hence, any course between S.S.E. and S.W. by W. [*S.E.* ½ *S.* and *S.W.* ½ *S.*], will lead a vessel perfectly clear of all danger, and out to sea.

The eastern part of Orango is not very high, and is of the same nature as the adjoining islands. The most conspicuous point, when bearing N.W. by W. ½ W. [*W. by N.*] is a well-defined cape, much higher than the adjacent land, and remark-

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* Captain Belcher has noticed that the Pullam tree is the *bombax* or *silk-cotton trees*, and has no reference to the palm. *Pullam Island*, which will be presently described, as deriving its name from the "large trees with which it is covered," can hardly boast half a dozen palms, which hide their diminished heads beside the more majestic *Pullam trees*.

able from several spots of yellow sand, which form a striking contrast to the brown appearance of the coast. This cape, forming the S.E. point of the island, is called *Cape Cameleon*, or *Yellow Cape*. At 4½ miles to the East of it is a spot nearly dry at low water; but the depths between are from 5 to 11 fathoms.

Pullam Island, which derives its name from that given by the natives to the large trees (Bombax, or silk cotton), with which it is covered, has not above a mile of extent in any one direction, and is very little above the level of the sea. Its shores are rocky, and rendered very difficult for landing, by the constant surf which breaks on them. It is impossible for large vessels to approach this island; from S.W. to E.S.E it is bounded by flats, which extend to a distance of 4 miles from it, several parts of which are dry, or breaking.

On the 21st of April, 1821, H.M. ship *Leven* arrived off Bijooga Islands, and anchored between Yomber and Orango. Upon the latter many natives and herds of cattle were seen. On the following day the *Leven* grounded upon the shoal, at half a mile from the East shore of the Isle *Bawack*, between Canyabac and Orango, where she lay in a perilous situation until the next tide, when she happily got off. On anchoring, many canoes came off with natives, bringing various articles to exchange for tobacco: but they had been reported as ferocious, dishonest, and treacherous; and they were found to be so.

The banks of the river have the appearance of being thickly inhabited, but the huts with which they are apparently studded are, upon a nearer inspection, discovered to be ant-hills, which are built in exactly the same form, and of the same height.

On the island *Galinhas* (*Hen's Isle*) the tracks of elephants and hippopotami were seen; and the largest sized boa-constrictor is also frequently seen in this island. The natives have great respect for these reptiles, and imagine that whoever destroys them will die himself. This island resembles Bulama in every respect, having fine savannahs and abundance of water; both are surrounded by an extensive flat, which renders landing exceedingly difficult at any other period than high tide.

The idea we had been led to form of these islands was extremely erroneous; as instead of being "low and marshy, with scarcely a channel for boats between their muddy shores," we found them a cluster of the most beautiful, fertile, and inviting islands, with moderately high and bold shores, separated by deep water, and containing many fine harbours; most of them being inhabited, and each village having its independent ruler. According to the customs of these people, every vessel stranded upon their shores is forfeited to the chiefs or people, in consequence of which they considered that they had a just claim to the Leven, when she lay grounded near Bawack.

It is a practice of those islands to rear their poultry and stock on the small islets, some abounding only in fowls. The natives of Kanyabac breed cattle on Yomber, and horses on Honey Island, which the people of Bissao called *Yalka-valayo*, being a corruption from the Portuguese Ilha-Cavalho. Galina appears also, by its name, to have been used for raising poultry; and many of the islets do not contain twenty acres of ground, yet are well wooded and fertile, with some stock on most of them.

WINDS, &c., *in the* EASTERN CHANNEL.—The winds in the Eastern Channel are generally light during the fine season, particularly in the night or morning. They set in gradually in the afternoon, and blow almost always from S.S.W. round by West to N.N.W., but they remain a very short time at any intermediate point, and soon follow the direction of the land, which, as well as we could determine, trends nearly N. by E. and S. by W. Easterly winds are limited entirely to the rainy season.

The TIDES are as regular in the Eastern as in the Jeba or Great Channel. The length of the ebb is equal to that of the flood; the former sets to the northward, the latter to the southward, but the different points of the channel, and the irregularities of the bottom, affect those directions. The mean rise of the tide is from 12 to 15 feet. The strength of the stream varies according to the breadth and depth of the channel, being greater where it is confined than in the wider parts; it is consequently more considerable in the Strait of Bulama, and the Honey Island Channel, than in any other part. Nevertheless, it seldom exceeds 2½ miles per hour, but is frequently as much as 2. At 2 miles to the westward of Pullam Island it is high water, at full and change, at 10ʰ 15′. The magnetic variation, in May, 1818, was found to be 17° 33′ W. Now it is 18° 40′ W.

RIO NUNEZ.—The River Kakoondee or Kakundy, commonly called the Rio Nunez, or River of Nuna Tristao, is a very considerable river, broad at its entrance, but impeded by several shoals, among which the least water in the channel is 3 fathoms. It has been celebrated as a place of trade for ivory. The situation of the entrance, as shown in the Table, is 10° 36′ N., and 14° 42′ W.

Between the mouths of the Rio Grande and the Rio Nunez the coast is very imperfectly known, but it appears to be, in general, shoal and dangerous to a great distance from shore. On the edge of the bank, in lat. 10° 37′, and at 25 miles S.E. ¾ S. [*S.E. ½ E.*] from Pullam Island, is a rocky bank, called the *Alcatraz*, with a rocky islet in its centre. It is surrounded with breakers, and the reefs extend from it both to the N.W. and S.W. At 6 miles to the westward is a depth of 20 fathoms. *Captain Belcher* has described the Islet *Alcatraz*, the landing to which was not at all difficult, but the whole summit of the rock was covered with boobies (*pelicanus sula*), the eggs of which were procured. Alcatraz may be approached on the S.E. side; but the reefs stretch from it 5 miles S.W., *true*, and above 3 miles in width, at right angles to this bearing. Lat. 10° 38′, long. 15° 20½′.

Nearly in the route between the Alcatraz and the Rio Nunez, in lat. 10° 30′, and long. 15° 11′, is a much more dangerous reef, surveyed, in 1826, by Captain Owen, and by him named the *Conflict Reef*. Its western edge is 14 miles to the S.E. from the Alcatraz, and its breadth each way is from 3 to 4 miles. Two other rocky banks, to the southward of it, are comprehended within a distance of 8 miles; the South point of the latter is in 12° 20′, and has near it a depth of 11 to 16 fathoms. From this spot the mouth of the Rio Nunez bears about E.N.E. ½ E. [*N.E. by E.*] 10 leagues.

The descendants of the Portuguese, who still exist on the banks of the Rio Nunez, are so mixed with the negroes, that they have been described as negroes themselves.

In the old charts of this coast no island is laid down at the mouth of the River Nunez; and we first learned, from the information of *Captain Livingston*, that a considerable island, where Woodville formerly gave a shoal, had arisen within the last thirty or forty years. It is called *Sandy Island*, is now covered with trees, and has many palms upon it.

Sandy Island, according to *Captain Belcher*, is in lat. 10° 36′ 37″ N., long., 14° 42′ 19″ W. Fifty years ago it was a mere sand-bank, even at low water; subsequent deposition, however, has not only formed it into an island, at least 6 feet above high water, and bearing large trees, with a fair surface soil, but has also added a very extensive range of shoal on its northern, western, and south-western sides.

Vessels bound to the Nunez should make the land in 10° 31′ N.; or if coming from the southward, should, at least, not advance into less than 7 fathoms till in that latitude. They will then approach the river, steering E. ½ S. [*N. 75° E.*] through regular soundings; and it is necessary to remember chiefly, that, with a flood tide, there is a dangerous rocky flat on the starboard beam going in, while, on the other hand, a vessel may play with the edge of the breakers on the point of Sandy Island on the point side. The constant warning also, "Keep in mud," which is familiar in all channels along this coast, should be here especially kept in mind.*

For a vessel to refit, no place can be better adopted than Sandy Island. It is uninhabited; and a vessel may be moored within 150 yards of low water-mark, or even less, if required, but should be prepared to haul off in case of a tornado. Small vessels

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* *Captain Livingston* says:—"In making the Nunez it is advisable to make it from the *southward*; but beware of the very dangerous *Sandkinsal Rocks*, extending 6 or 7 miles to the southward of Bencer or the East Point. The reefs and banks at the entrance of the river are certainly increasing, and generally break, even in moderate weather."

may be grounded, or hauled up, for repair or examination; a space sufficient for the encampment of a crew, even of a line-of-battle ship, is free from trees; and stores may be conveniently landed. Immense quantities of drift-wood lie piled on the S.W. side; and plenty of live timber grows on the island, of which the palm yields an excellent cabbage for the use of the sick or convalescent.* Fresh water, alone, is scarce and ill tasted; and a great annoyance arises from the clouds of fine sand which are incessantly in motion over the island. The temperature, when the *Ætna* was there, did not exceed 105° in the tent; which was, however, oppressive, from the necessity of keeping it pretty well closed, to prevent the sand from imbedding the instruments. A breeze generally prevailed throughout the day, except between nine and noon. The western side is by far the most cool and pleasant, but not so convenient for communicating with the ship.

The river is very serpentine in its form, and the trees on either side impede the wind in its true course. Still, however, a pleasant, and after noon, even a fresh, breeze generally favours vessels bound up, and affords favourable slants in many of the reaches down. The general depth may be stated at 2½ to 3 fathoms at low water, with a rise and fall of about 12 feet; and, although the lead generally gives mud, the anchor frequently hooks a rock, and good and long buoy ropes are especially necessary, which should be got on board the instant the tide slacks, in order to be in readiness to trip the anchor instantly, if found to be foul. The change of the tide is very rapid, and much inconvenience will be felt if completed before breaking ground.

The three principal settlements, *Walkeria*, *Cassasez*, and *Rebucko*, or *Debucko*, are all near each other, and from 70 to 80 miles up. We had formed great expectations of the supplies which could be procured at these settlements, but were much disappointed. Bullocks and sheep could be procured with some difficulty; fowls were very scarce; and vegetables could not be got at all. These native towns are never prepared to meet a sudden increase of demand for food.

Below Walkeria not a single habitation was observed on the Nunez, though the cultivation of its banks might be profitably pursued. The want of fresh water prevents the natives settling here.

Above Cassasez, which is 2 miles above Walkeria, the river is much interrupted by rocks of close-grained basalt, several of them presenting a perfect columnar formation.

The range of the thermometer, while the *Ætna's* boats were in the River, March and April, was at six a.m. from 75° to 84°; at noon from 84° to 94°; and nine p.m. from 81° to 83°. The dews were slight; but at other seasons are said to be very heavy, accompanied by a fog, lasting frequently till noon.

The FOLLOWING OBSERVATIONS on the KAKUNDY or RIO NUNEZ are from a copious and valuable communication by *Captain Livingston,* who visited the river in the year 1829.

To enter the Nunez, bring *Sandy Island,* above mentioned, to bear N.E., or perhaps a little (but very little) to the northward of that bearing, and steer in right for the island, which is bold-to on the South side. The shoals generally break, and extend about 5 or 6 miles to the S.W. by W., or thereabout, from Sandy Island.

Giving Sandy Island a small berth, steer about N.E. for *Big Island,* which, in clear weather, may be seen after passing Sandy Island. Keep close to Big Island, as a rocky spit extends two-thirds or more, over from the *Tulabunch* (Talaboonche?) or western shore. It is scarcely prudent for a stranger to run much above Big Island, but rather to send a boat up the river for a pilot, and one may generally be engaged at Walkeria, or a little higher up; or one may sometimes be had from a coasting vessel.

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* This cabbage makes a delicious pickle, and is considered one of the finest anti-scorbutics in the world, doubly valuable when other vegetables are not to be had.—*E. B.*

On going up the Nunez in a boat, be cautious not to mistake any of the creeks on the western side for the main river.

In case of necessity, fresh water may always be obtained by digging a few feet deep at the root of any palm tree.

In going up the river Captain Livingston grounded about three-quarters of a mile or a mile to the northward of Sandy Island. The vessel lay for two tides on fine sand, without receiving any damage.

When at anchor, on coming down the river, in 7 fathoms, about a quarter of a mile off shore, the centre of Sandy Island bore N. by W., and the extremity of the breakers on the long spit of sand, which extends 5 or 6 miles from the West end of the island, W. by S.

The situation of *Talabunch* (Talaboocho) village may be known by some remarkable large trees, which may, in certain situations, be seen from sea, before Sandy Island can be described. I have heard it remarked, that wherever you see a large clump of majestic pullam trees (the cotton tree of the West Indies) you are sure to find a negro village; and wherever you meet with a palm tree, you may be sure of finding fresh water, by digging a few feet deep, however arid the soil may appear.

No person ought to land at Talabunch unless in company with eight or ten others, well armed, and on their guard; but on the opposite or eastern side, *Talabunchana*, the negroes, though of the same tribe, are remarkably civil and honest.

The Barrier of the River (as it has been translated to me from the Soozee language) is, I think, about half-way up the river between Big Island and Walkeria. Ridges of rocks, almost like walls, and which appeared to me, when in a boat at low water, like walls of lava, extend about two-thirds across the river from the port or western shore; and at about a mile or a mile and a half above that, it is said that rocks, even worse, spit out from the starboard or eastern shore; but these were not seen in passing, when covered with the tide. There are other dangers in the river, but none of magnitude until after passing Walkeria and some houses about 2 miles above it, at Cassashe. These places are both on the eastern or starboard shore. Between them and the village *Rebucko* is a very dangerous spot; but vessels drawing 10 feet may proceed to the latter near high water.

Both banks of the Nunez are generally muddy; mangroves grow into the very water, and some of the finest tree or mangrove oysters adhere to their trunks and branches.

In the rainy season tornadoes are frequent and violent; but, with caution, vessels may have sufficient time to prepare for them. I observed none here to begin with small clouds or a small cloud, but all with heavy thunder clouds.

Vessels going to the Nunez ought to be well supplied with provisions, and not to depend on what can be obtained there, as a great scarcity frequently prevails. There are many cat-fish in the river, and above Rebucko some other kinds of fish. There are pike, similar to those of Britain, but with scales much larger.

The time of high water, on full and change days, at Walkeria, is $10^h\ 17'$ a.m. Rise, from $16\frac{1}{2}$ to 18 feet or more. Depth, at low water, 15 feet: bottom of fine mud. Latitude of the wharf at Walkeria, by two meridian altitudes of Jupiter, agreeing to one second, 10° 54′ 22″; long., by 52 sets of lunars East and West, mean, 14° 18′ 55″ plus 3″ for distance of place of observation equal 14° 18′ 58″. The tide at Walkeria runs strongly, and while I was there flowed five hours and ebbed seven; but during floods in the river (which sometimes rise considerably) it ebbs or runs down longer.

Walkeria was named from Waker, a slave factor, who realized a large fortune and died here. This place is composed thatched huts, mostly supported on stakes, though some have mud walls, and there are two of two stories each. The population may be from 500 to 600; all Mandingo Mohammedans, excepting the slaves. *Buoy Modé*, the chief, who speaks a little English, said he had five wives, but he wanted to get some more! His arms bore many *gris-gris* or charms (they called them gregories), and even his horse's neck was loaded with no small number of them.

RIVER COMPOONEE.—CAPTAIN (SIR EDW.) BELCHER, in the prosecution of his survey, made out three mouths to the Rio Nunez, and 10 miles N.W. of the northernmost, much to westward of where land was expected, saw a cluster of islands, which gradually showed their close approximation to the main, and were ascertained to form the North and West boundaries of the entrance to a river or inlet, larger at its mouth than the Nunez; and, at 12 miles within the distance to which he surveyed it, deeper, swifter, and promising as large or larger branches. Where Captain Belcher stopped, it came from the East, and showed several extensive arms leading to the North and West. The entrance by which he ascended has two large channels, equally navigable, but its mouth is so studded with shoals, that until better known, few vessels will probably venture into it; the natives North of the Nunez having also the general reputation of being dangerous. The western entrance is equally fair and navigable to the sea. The northern alone is very shoal, and probably passable for canoes only: several of these were seen at a distance, and one country schooner; from which, and the numerous fires at night, it seems likely that the banks are well inhabited, and have some traffic.

Upon a renewal of the survey in 1832, it was found that small vessels only could navigate this river without great risk, there being a chain of reefs, which nearly bars the passage; but, above this barrier, the channel is sufficiently deep for larger vessels, and has few dangers.*

THE COAST FROM THE RIO NUNEZ TO THE ISLES DE LOS, &c. — From the Rio Nunez to Sierra Leone, in an extent of about 55 leagues, the coast is in general low, in most parts swampy, and intersected with creeks, which, connecting the adjoining rivers, form an excellent navigation; but at unequal distances, from 5 to 20 miles, in a right line from the sea, the land rises gradually; and beyond that distance, in many places, towers into lofty mountains, which, after a tornado, when the air is pure, may be seen 10 or 12 leagues off.

A small isle, called *Young Gonzalez*, ies about 5 miles to the eastward from the regular entrance of the Rio Nunez. It is the southernmost of three, having channels communicating with the Nunez; about 5 miles true East from it is the mouth of the *River Cappatches*. From Young Gonzalez a long and dangerous flat of rocky ledges, gravel and sand, extends S.W. (by compass) nearly 6 miles. At low water, a patch, three-quarters of a mile in length, has over it only 6 feet of water. Its composition is a coarse red sandstone, or conglomerate, like lava, till broken. The *Coppatches* is a trading river, but shallow, and frequented only by boats, or vessels not drawing more than 4 feet of water.

CAPE VERGA, in lat. 10° 19′, is the termination of some moderately elevated land, and not a mangrove island, as commonly described. A long and dangerous spit extends from it N.W. 6½ miles. In the deep bay within this no vessel can enter which draws more than 4 or 5 feet of water. This place is S. 21° E., *true*, from the mouth of the River Coppatches.

The coast hence southward appears to be a great series of islands, some forming, others breaking up, so that in twenty years the aspect probably will be materially changed. The high mountains of Cape Verga, which stand about 3 leagues inland, to the north-eastward of the cape, serve as a mark for it, and may be seen at the distance of 15 leagues. Thus, bearing East [*E.N.E. ½ E.*], are they equally useful to ships bound to the Rio Nunez, which, with this bearing, will clear the banks lying without the river at 5 or more leagues to the south-westward.

Of the mountains within Cape Verga, two, in particular, are the most conspicuous,

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* On prosecuting the examination it was found that this river is named the *Compoonee*. Captain Belcher has given a pleasing description of its course upward; for which see the Geographical Journal, vol. ii. pp. 287-8. In the upper part many indications of buffaloes, hippopotami, deer, lions, panthers, monkeys, &c., were seen.

and the highest, according to M. Roussin, is in lat. 10° 18′ 52″, long. 14° 21′ 20″. These mountains have no particular peak, but form nearly one mass, extending from N.E. to S.W.; and are about 500 fathoms in height.

RIO PONGO.—The entrance of the Rio Pongo is about 24 miles S.S.E. ½ E. [*S.E.*] from Cape Verga. The river is well known as a place of trade on this part of the coast, and its consequence has been increased by settlements of slave-traders on its several branches. To the country are several entrances, or inlets, but all seem to be included under one general name, *Pongo* or *Pongas;* each is impeded by a bar of mud or sand; and the coasts, to the head of the several rivers, are entirely covered with mangroves.

The first of the *Pongas*, or entrances to the *Rio Pongo*, is about 10 miles to the south-eastward from Cape Verga. This is called the *Cossencey Bar*, having a shallow and dangerous entrance, though within are 4 and 5 fathoms of water.

The best channel in, for a stranger, is over that called Rissing Bar, or the MUD BAR, which lies in lat. 10° 2′, and extends more than 2 miles out from the river to the westward. On the North side of it are only 6 feet, on the South side from 6 to 9 feet, and on the middle 12 feet at low water. From this bar, two hills up the country, called the *Paps*, bear E.N.E., and serve as the mark for the river. A grove of palm trees, on the North side, is also a distinguishing mark.

To sail over the Mud Bar, get the river open, and steer in N.E. by E., keeping the Paps, which are moderately high, a cable's length open of the North point, by which you will carry 4 fathoms in depth at high water, or 2 fathoms at low water. Anchor in 7 or 8 fathoms, in the middle of the river, abreast the palm trees on the port hand, which trees appear to extend about 2 miles in length. Then send your boat up the river for a pilot, or fire a gun twice or thrice, at intervals of about an hour, and in all probability a pilot will come off to you.

If bound to this place in the night, approach no nearer than to the depth of 4 fathoms until daylight. If beating in, stand no further to the northward than to bring the two hills in the middle between the two points of the river; then stand to the southward to 2 and 2½ fathoms, and proceed as shown hereafter.

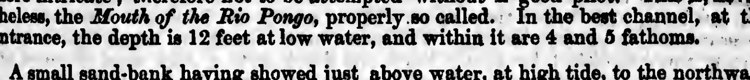
If going in, with a fair wind, bring the North point of the river, with its palm trees, to bear N.E., and run in with it bearing N.E. by E. On entering, keep on the South side, within the bar, as the flood-tide sets on the northern breakers. Should you here have a quarter-less-two, you need not fear, as the bottom is all of mud. The river hence lies East and West, about 8 miles, and its depths, id mid-channel, are 3, 4, 7, 6, and 5 fathoms.

The SAND BAR is 5 miles to the southward of the Mud Bar, and its entrance is more intricate; therefore not to be attempted without a good pilot. This is, nevertheless, the *Mouth of the Rio Pongo*, properly so called. In the best channel, at the entrance, the depth is 12 feet at low water, and within it are 4 and 5 fathoms.

A small sand-bank having showed just above water, at high tide, to the northward of the Sand Bar, and mangroves having taken root on it, the bank consequently increased, and the natives have planted palm trees on it. There is said to be a passage of 3 fathoms.

Vessels bound to the Pongas sometimes make the high land of Cape Verga, and sometimes go to the Isles de Los for a pilot, although one is not always to be found there. Some run in by their latitude, taking care to sound frequently, as soundings extend ont 1½° to the westward.

The time of high water here, on the full and change, is 9^h. The rise, about 10 feet.



Sand Bar of the Rio Pongo N.N.E. ½ E.—A—*Barkia Hill; remarkable table-land.*

In May, 1842, Captain Nourse, H.M.S. *Iris*, destroyed a slave-trade factory in the Rio Pongas, the business of which was carried on by Mrs. Lightburn, but the slaves were removed during the preparations for the attack, with the exception of eleven, which were liberated. In destroying the factory several barrels of powder exploded, wounding several, and killing one man belonging to the *Iris*.

From the Mud Bar of RIO PONGO to DEMBIA RIVER, a place of some trade, and more to the south-eastward, the distance is 6 leagues. Two leagues to the southward of the latter is *Sangaree River*, whence the land juts out to the *S.S.W.*, *true*, 6 or 7 miles to *Tumda Point*; beyond which, to the eastward, is the high volcanic land named *Mount Suzos*; and westward are the *Ilhas dos Idolos*, or *Isle de Los*, at 2½ miles from the point.

Mount Suzos, properly so named, but which in the charts appears under the name of *Sangarees*, has a regular conical peak, excepting that, on its southern side, at half-way up, there is a large protuberance. This insulated mountain, in lat. 9° 34′, is a certain mark for the Isles de Los during the rainy season. In the dry season the atmosphere is always so hazy, that the coast of the continent is seldom seen, even near these islands.

At about 4 leagues to the northward of Mount Suzos is another mountain, called the *French Mountain*, to which M. Roussin assigns the latitude of 9° 45′ 50″, and long. 13° 26′ 10″.

On the 24th of May, 1826, Captain Owen, when in lat. 10° 2′ N., saw the Sangaree mountains; one formed a sugar-loaf, between 4,000 and 5,000 feet in height. Having been twelve days in this neighbourhood, on a previous occasion, it may seem strange that it was not then observed; but it was during the dry season, when there is always such a haze over the land, particularly in the day, that the view is always much limited; but in the rainy season every shower clears the atmosphere, and the most distant objects may be discerned.

WINDS, &c.—In March, 1831, H.M.S. *Ætna*, after passing Cape Verga, lost the land-breeze, which had previously blown with extreme regularity from about 10 p.m. till morning, and been calculated on, with certainty, in moving the ship along-shore. The winds also became much affected by changes in the tides and time of the moon; as, for example, if it were low water at noon, there was seldom wind enough to move the ship till the first quarter flood, and then the tide was too strong to weigh. The weather also became more hazy, so as to prevent the use of the sea horizon; and for the three days preceding full and change, this was so much the case, as inconveniently to shorten the bases of triangulation.

ILHAS DOS IDOLOS, or ISLES DE LOS.—These isles, which have already been mentioned, lie between the parallels of 9° 25′ and 9° 42′ N., and between meridians 13° 46′ and 13° 52′ W. They are six in number, but only three are inhabited, the rest being little better than rocks. Those which are inhabited are extremely pleasant, and, in general, healthy. The easternmost island, on which the English factory was established, lies nearly North and South, with a high wood-crowned hill at each end, which, when seen from sea, appears like two islands. It is 4½ miles in length. The road is on the eastern side; and, during the dry season, is very safe; but, in the tornado and rainy season, there is no security, unless in the goodness of anchors and cables.

Tamara, or *Footabar*, the largest and westernmost of these islands, is nearly semicircular, rising on both sides from the sea by a gentle ascent, to a moderate height, and is covered with good timber trees. It is 5 miles in length, and the summit of its northern part is 465 feet above the sea. That of Factory Island is 470 feet.

In a description of the Idolos, or Delos Isles, by the Baron Roussin, the admiral says, the isles worthy of description are, Tamara, the Isle Idolos, or Factory Island, and Crawford Island, by the French called Isle Françoise. Tumba, on the East, is so connected to the continent by beds of sand, mostly dry, that it can hardly be considered as an island.

TAMARA, the largest and westernmost island, may be seen in fair weather at the distance of 7 or 8 leagues. On approaching, it appears like a range of hills, thickly wooded; its elevation is moderate, and the northern part higher than the South. It is, in shape, like a crescent, with its concavity to the S.E., forming several fine anchorages and depths of 6 to 3 fathoms, at low water.

You may enter the roadsteads on the eastern side of Tamara either from the northward or southward, only giving the coasts a berth of three-quarters of a mile, beyond which distance both the North and South points are quite clear. A reef, the *Arethusa*, surrounds the North point to the distance of a quarter of a mile. The western side is bold-to, and may be approached safely. Variation, 18° W.*

Near the principal anchorage within Tamara is a spring of fresh water, where 80 hogsheads may be obtained in 24 hours.

At the distance of 1½ miles S.S.E. from the South end of Tamara is an inlet named *Coral Isle*, leaving a passage between of 9 and 8 fathoms; but, in the same direction, at a quarter of a mile from Coral Isle, is a small but dangerous reef, which must be cautiously avoided.

The central island of the group is *Rooma*, or Crawford Island, the western summit of which is 300 feet in height. From this island to the N.E. are shoal flats, extending to the distance of 2 miles, toward the North end of Factory Island, leaving a channel between of only two-thirds of a mile.

The Isles de Los are of volcanic origin, being formed chiefly of hard blue and iron-coloured lava, with occasional masses of porphyritic hornstone of different elevations. Of the vegetable productions, the most remarkable are the palms, which furnish palm oil and wine, and the silk cotton tree. The natives also speak of a tree, the bark of which is an excellent bitter, but it was not seen.

The natives belong to the tribe named Baccas or Barkas [query Bagos?], who also occupy other islands along the coast. A great similarity exists between their language and that of the tribes inhabiting the banks of the Nunez.

The rainy season here commences in April, and ends in December.

The seasons have here been described as follow:—To begin with January. About the 8th or 10th of this month the *Harmattan*, or cold strong easterly winds, continue, with some strength, for about a week or ten days; after which, the land-wind and sea-breeze take place till about the middle of February, when the wind becomes continual and N.W. or N.N.W., till the last full change of the moon in March. The tornadoes generally begin and prevail, more or less, till May or June; then the rains set in, and are almost continual all July and August; they begin to abate in September, and go off in October, giving place to the tornadoes, which continue till about Christmas. During the rainy seasons the winds are mostly between South and West, or in the S.W. quarter; and the tornadoes always blow with prodigious force from the E.S.E. or thereabout, accompanied with thunder, lightning, and a deluge of rain. When a tornado has happened in the night, it is impossible to imagine the clear state of the atmosphere next morning; we have nothing like it in Europe.

Captain Belcher says, that the rainy season between the Gambia and the Isles de Los ranges, in its commencement, between the 1st of April and the 1st of June; and terminates from the 1st to 31st of Decembe. Off the Conflict Reef and Bijoogas, rains and tornadoes were experienced on the 12th, 14th, and 15th May, 1831.

The flood, at the Isles de Los, sets to the North. The tide rises and flows as shown in shown in the Table, page 268.

COAST between the ISLES DE LOS and the PONGO.—(*Captain Belcher.*)—Tumbo Point is about 2 miles distant from Factory Island: and is a long rocky flat, partly covered at high water, and divided from the main by a narrow channel, navigable for canoes at high water, but nearly dry at low, where the natives affirm that they can

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* Survey by Lieutenant James Badgley, of H.M. ship *Leven*, 1827.

walk across, though the depth of mud makes this improbable. From this the main land rises gradually, and partakes much of the features of the Isles de Los, without, however, being quite so denuded or bare as the summit of Tamara. The whole interior is mountainous; the highest peak of which we could obtain a measurement being 2,910 feet above the sea. This mountain is called *Kakulimah*. Further on, the *Sangaree* or *Soomba Ridge* commences, and forms the entrance of the *Sangaree* or *Debrika River*. The highest point of which, Tikitee-chin, or, as pronounced, *Tikit-chin*, is 1,705 feet above the sea. Its western point is called *Alligator's Point*, and off this the mud extends above a mile, dry at low water.

The whole of this bay is one series of flats and reefs; and no vessel drawing above 6 feet should venture within a line drawn from Tumbo to Alligator Point. Vessels drawing 15 feet should not, when working up along this shore, do more than open Crawford Island; and, to ensure good room, should even tack when the East end of Tamara opens the South end of Factory Island. Within these bearings the soundings are very regular, and nowhere less than 5 fathoms.

The entrance of the Sangaree River has 2 fathoms in it; but there is little inducement to ascend it, there not being the slightest trace of trade along its shores, nor any supplies to be procured from them, excepting wood. The water is scarce and bad. The *Ætna's* boat ascended 65 miles.

More to the North there is a small isle in the centre of a river called the Dembia, but which is, in fact, a mouth of the Sangaree. From this isle, Alligator Point bears S.E., *true*, 5½ miles. The river will admit very small vessels; but the greatest depth is only 1 fathom at low water, where the sea curled.

The shores hence are thickly clothed with mangroves, and extend about 16 miles to the first acknowledged mouth of the Pongo, called *Taboury* or *Old Pongo*, which is bordered to a mile out by dangerous breakers.

Directions for Sailing from Cape Roxo to the Isles de Los.

By the Baron Roussin.

The description of the Bissagos, already given (page 525), points out the course to be steered in order to double their S.W. extremity. A vessel starting from a point at 4½ leagues to the westward of Cape Roxo, which will be a little without the medium of 17° 0′ 0″ W., to the parallel of 10° 40′ N., will be outside of all the dangers. From hence a course of S.E. ½ E. [*S.* 68° *E.*] and distance 68 leagues, will lead her to the West point of Tamara Island. On this course the soundings will never be under 8 fathoms, until near the shore of the island; and those on the first course will be considerably more.

From the parallel of Cape Roxo to that of the western breaker, 11° 31′ 32″ N., at a distance of more than 4 leagues to the westward of the meridian of 17° 0′, the depth will increase progressively from 8 to 28 fathoms, and the bottom be entirely of mud. This remark may be depended on to show that a vessel is not far to the southward of the parallel of the Jeba or Great Channel; she cannot at the utmost be more than 10 miles from the positions already given. From this point, as far as the parallel of 10° 40′ N., the bottom is nearly free from mud, and on passing to the southward of the parallel of 11° 20′, very slight traces of it remain, but are succeeded by a bottom of fine white sand, sand and gravel, sand and broken shells, with a depth varying from 12 to 50 fathoms. A vessel, having left Roxo, and arrived in lat. 10° 40′, may thence steer a direct course for the Isles des Los.

The S.W. edge of the Bissagos follows a gentle curve from the western breaker as far as the southern one, that of La Bayadère. The bottom, in this part, presents a singular peculiarity. Amongst the fine white sand, sand and broken shells, sand and gravel, of which it is most frequently composed, a greenish-coloured sand is sometimes found. The depth decreases very gradually from 50 to 9 fathoms, from S.W. to N.E.

The remainder of the course to the Isles de Los passes over deep soundings, as much as 50 fathoms, at the point of departure, and the least depth is 12 fathoms. No precise rule can be given as to the changes in the depth along this track, nor as to the various nature of the bottom. It is known only that the ground, in the space passed over by this course, seems to be furrowed with channels, which, commencing from the southern extremity of the Eastern Channel of Bissagos, diverge toward different points between *S.W.* and *S.S.E.*, *true*. The furrows above mentioned appear to have been caused by the regular tides in the mouth of the Rio Grande, and prove, beyond a doubt, that the outlet of the same channel is partly caused by that river. With respect to the nature of the bottom, M. Roussin says that he remarked the total absence of mud. The bottom is of fine sand, in some places mixed with broken shells, small pieces of brittle rock, and gravel, which appeared to be only a covering to beds of a whitish volcanic sandstone, into which the lance penetrated but 3 or 4 inches, and did not hold. A muddy bottom is not found until about 10 leagues to the westward of the Isles de Los, and then only in small quantity, till within a very short distance to the N.W. of those islands.

TIDES.—In proportion to the distance from the mouth of the Jeba or Great Channel of Bissagos, either to the northward or southward, the tides lose their regularity. This interruption in the tides is evident in going to the southward, as, at a few miles South of the parallel of the western breaker, 11° 31′ 32″ N., they are no longer perceptible, even on the edge of the Bissagos.

No decided course of the current was ascertained to exist, but it is generally allowed that the waters have a greater inclination to flow to the southward than to the northward; and it may be presumed that it follows the direction of the winds on the western edge of the Archipelago, but it is seldom found to be considerable.

COAST BETWEEN ISLES DE LOS AND SIERRA LEONE.*—The portion of coast between the Isles de Los and Sierra Leone comprises an extent of 66 miles, and contains several rivers, islands, and banks, besides various inconsiderable creeks.

Between the ISLES DE LOS *and the sharp low point of Tumbo* there is a safe channel, through which, by Captain Owen's charts, ships may carry 3 fathoms of water, and which may be, at times, highly convenient to use, or even to run through the group; yet, without some good reason for so doing, it will always be advisable to go outside the islands, where certainly no dangers are to be met with.

In approaching this part of the coast it may be remarked, that though the 3 fathoms' boundary, in some places, extends to a considerable distance, yet the soundings are so regular as to give ample warming. A tumbling sea, at times, may prevail in a strong breeze, yet, as no gales but the TORNADOES, which are of short duration and off shore, are known upon this coast, a commander need never be alarmed; for there is always good anchorage under foot, and no long swell current to force the vessel into danger.

From TUMBO POINT to MATACONG ISLAND the bearing and distance are S.E. by S. 23 miles. Tumbo Point is the S.W. extremity of an island bearing the same name, and separated by a very narrow high water channel from the main land. To the southward of this point the land falls back to the north-eastward about 7 miles, forming an extensive but shallow bay, at the bottom of which is an inconsiderable stream, called *Tannaney River*, accessible to canoes only.

In the extensive bay between the Isles de Los and Matacong Isle no detached dangers exist. The coast is safe to approach, the soundings being gradual, and

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* Description and Directions by Captain Botelor, of H.M.S. *Hecla*, 1829.

always affording good anchorage; and it is, in all parts, accessible to large ships to the distance of 6 miles, which generally may be considered sufficiently near to distinguish the land, and often to recognise the mouths of the rivers.

Mahneah River, about 12 miles E.S.E. from Tumbo Point, is, at low water, scarcely accessible to the smallest coasting vessels, but the rise of tide exceeds 2 fathoms. The entrance is about 6 miles south-eastward from that of Tannaney, but the water between is very shallow; and a mud bank, which extends south-westward from the West point of the entrance, is uncovered at low water, more than 2 miles from that point. A similar mud bank lines the East side also, leaving the channel between above a mile wide, but carrying only from 4 to 8 feet at low water.

To enter this river it is necessary only to bring the western point of the entrance, while at the distance of 5 miles from it, bear N.E. by E. ½ E., and then steer toward it in that direction, until you get close to the S.W. mud bank, when you may proceed along by the edge of that bank, in a convenient depth, according to circumstances. Within the river the depths at low water are from 6 to 10 feet only.

The water discharged from this river must very great, as the ebb tide runs out with great rapidity.

River Morebiah.—The mouth of this river is about 18 miles S.E. by E. ½ E. from the Isles de Los, and about 7 miles northerly from Matacong Island; and, though its breadth within the points nowhere exceeds half a half a mile, yet it is far superior to the Mahneah, last described. Its entrance is narrow, and forms an elbow at the commencement, which, to render perfectly safe, would require *two buoys*, because the coast is destitute of good objects to serve as marks.

In approaching the coast abreast of the river, with its opening bearing E.N.E. ½ E., distant about 9 miles, and Matacong Island S.E. by E. ½ E., you will have 6 fathoms of water or black mud; from this situation the depth will decrease gradually, on a bottom of the same kind, to 3½ fathoms at the entrance of the channel. With the rounding of the land between the rivers Mahneah and Morebiah bearing N.N.E., the East point of the entrance E. ¾ N., and the middle of Matacong Island S.S.E. ¾ E., you will have that depth. From this position steer N.N.E. until the East point of the river bears E. ½ S., and then stand in toward this point, or about East; but remembering, that both flood and ebb set partially over the extensive shoals that form the S.E. side of the channel: some of these, however, being dry at low water, and nearly so at high water, their steep boundary is nearly discernible. In the elbow of the channel the least depth is 1½ fathoms at low spring ebbs: this depth, however however, continues but a short way; and, from the time of altering your course to the eastward, or steering straight in, you will seldom have so little as 2 fathoms. Beyond the East point the depth varies from 4 to 6 or 7 fathoms, and for the extent of 7 miles up the river it appeared to be clear of all danger.

About 4 miles above the East point of this river, and on the same side a remarkable round mass of granite rock rises abruptly, about 40 feet from the water's edge; it is about 400 yards in circumference: others may be seen inland; and the natives assert, that several are scattered about as far as the *Sangaree Mountains*, which, they say, are also of granite.

It is high water, on full and change days, at $7^h\ 40'$, and spring tides rise 11 feet.

The contrast which this coast presents to the eye, in different states of the atmosphere, has been already noticed in pages 205, 206, and 538.

Matacong Island.—The beauty of this island consists of the luxuriance of the trees, the verdure of those spots which have been cleared away, and the gentle rise, which renders it a conspicuous contrast to the low swampy tract opposite. It is more than a mile long, and having been purchased from the natives by Mr. Gabadon, a merchant of Sierra Leone, is now established for rearing cattle. The island appears to be of lava, yet on its summit there are two large pieces of granite; but there is reason to believe that they have been artificially placed there.

Matacong is surrounded by mud banks and rocks in all directions, so that no vessel of any burden can lie at anchor within 2 miles of it. The channel, which divides it from the main, is nearly three-quarters of a mile broad, but its muddy bottom, at low water, is left dry.

From MATACONG ISLAND to SALLAHTOOK POINT, a distance of 14½ miles S. ¾ E., the general features of the coast are the same as those already described, but the mountains are too distant to be distinctly seen; here and there a *cotton tree*, with smooth trunk and spreading foliage, rises above the surrounding thickets, and serves to identify the locality of the coast to those who are acquainted with it; but a stranger can make the mouth of the river which he intends to enter by his latitude only, or by running the coast down from some known point.*

From Matacong Island the coast trends to the eastward a little more than 3 miles, where it turns abruptly to the northward, and forms the West point of the mouth of the RIVER FORECARREAH: the interval being fronted with sand and mud banks, which extend more than 3 miles to the southward. The entrance of this river is above 2 miles wide, and the least depth is 1 fathom at low spring ebbs. To sail in, it will be necessary to pass close to the banks which project from the West point, but, at the same time, to be cautious in approaching them, as they are steep-to, and dry at low water. The outer sand will be apparent, even in fine weather, at any other time than high water, and if seen, it may be safely skirted in 2 fathoms near low water, or in 4 at high water; and that you may not get in at the back of this sand, do not bring the highest part of Matacong Island to the westward of N. by W. ½ W., until the West point of the river bears N.E. ½ E. You may then safely enter, recollecting, as a guide, that you should always keep the western side aboard, off which, however, you will have to edge occasionally to avoid the banks; yet this river is of very little consequence, as a ridge of rocks nearly crosses it at a short distance from its mouth. The ebb tide is extremely rapid, and the overfalls in the vicinity of the rocks are dangerous to those who do not possess a local knowledge of the river.

THE RIVER MELLACOREE which is or was of considerable importance in the timber trade, has better objects for marks than any of those already described, and the facilities of its navigation are greater, yet buoys are indispensably requisite to make this secure.

For entering the Mellacoree, observe that, at 8 miles off shore, there are six fathoms of water; and, with the river's mouth bearing E. by N., it will be fairly open. Steer toward it, in that direction, until the soundings have decreased gradually to about 3 fathoms at low spring ebbs, with the following bearings: East Point of Yellaboi Island S. by E.; Sallahtook Point, distinguishable by the trees being higher than elsewhere, bearing S.E. ½ S.; Bentee Point,† known by a remarkable large tree, E. by N.; the outer point of Tannah River, E.N.E. ¼ E.; and the rounding of the land to the northward of the river, N.E. ½ N.; you will then be at the spot indicated by the outer *anchor* in the plan, and in the fair way. The MIDDLE GROUND is steep and dangerous, but the soundings on the southern side are gradual, though the mud bank is very wide; borrow, therefore, rather on that side until nearly as far as Bellangsang Point, when you must haul over to the mouth of Tannah River, and there anchor. Higher up, there are some patches of rocks in the middle of the river, but at low water they are seen, as well as the deep water channel between them, which is one-third of a mile in breadth, with a depth of 7 to 9 fathoms. By keeping the East point of the River Tannah, bearing N.W. by W. ½ W., you may pass through this channel in safety; and, there being no further danger, you may ascend the river to the factories established below Devil's Island, on the South shore; the general depth

* In the Table of Positions, the position of Matacong, is given, according to Captain Owen, &c., in lat. 9° 14′, lon. 13° 25′ 30″; but Captain Boteler (1829) gives the house on the North side of the same island in lat. 9° 16′ 10″, and lon. 13° 26′ 20″; and hence, by survey, the latitude of Sallahtook Point will be 9° 3′ 5″.

† This point is on the South side of the river, and immediately opposite to another point, on which there are *two* very large trees.

varies from 5 to 9 fathoms. Here it is high water on full and change days, at 7h. &c. spring tides rise 11 feet.

Besides the channel on the South side of the Middle Ground, for which directions have been given, there is also an inferior one to the northward; to enter which, when 5 or 6 miles off shore, bring the West point of Tannah River to bear E. ¾ S., and by by carefully using the lead, you may proceed in with safety; for, although at its termination it takes a slight turn round the N.E. corner of the Middle Ground, yet this is generally so well indicated that you can scarcely be deceived.

The TANNAH RIVER, which falls into the Mellacoree, is also navigable, though much smaller, and the tides are not so strong as in the main stream.

On account of the soft nature of the bottom, vessels may ground in several places in the vicinity of the Mellacoree River, without being injured; but a patch of foul ground, which surrounds the long reef of *Sallatook Point*, must be carefully avoided.

From SALLAHTOOK Point the coast trends S.S.E. 7 miles, to a small river, on the western point of which is situated Sangahtook Factory; and about 1¼ miles to the westward of this point is Yellaboi Island, surrounded by mud banks that are dry at low water.

Yellaboi is a low swampy island, nearly two miles in length, and covered with trees, which, toward its western extremity, give it the appearance of an abrupt cliff, easy to be recognised; abreast the S.E. extremity of the river there is another small river called Inglis Pahboyeah.*

Corteemo Island.—Four miles S.E. from Yellaboi we come to a much larger island, with extensive mud banks on the north-westward, but with a deep channel between it and the main; it is called *Corteemo*, and lies in the mouth of the *Rivers Scarcies*. These rivers are known on the coasts by the names of *Great* and *Little Scarcies;* the former is navigable for large ships, but the other is adapted to very small vessels only, and requires very careful pilotage.

Great Scarcies.—The channel into the Great Scarcies River is the best on this part of the coast; for, although the banks are steep, yet it is broad and deep, and a of the line, by taking a proper time of the tide, might moor off the inner point of Yellaboi Island.

To sail into this anchorage, bring the West end or highest part of Yellaboi Island to bear E.N.E. and steer toward it in that direction, until you decrease the depth to 5 or 4 fathoms, which will happen suddenly. Now change the course, and keeping in 4 to 5 fathoms, steer direct for *Inglis Pahboyeah River*, bearing E. ½ N.† taking care to keep it well open of the inner point of Yellaboi Island, until the West point of that island bears N. by E. ¾ E., when you must haul directly in toward it, and skirting along the steep mud bank which borders the South side of the island, steer for its S.E. point, close to which you may anchor in 4½ fathoms. In reaching this anchorage, the least depth you will have to pass over will be 2½ fathoms at low spring ebbs; and this occurs only after hauling in for the island, and running along the edge of the mud bank.

A timber-ship, lying at this place, could easily have her cargo rafted down to her, excepting during the *rains*, when, as affirmed, the strong winds occasion so heavy a sea, as to make it unsafe to lie there with her raft ports open. With little difficulty, however, she might proceed to Kakongkah Island; though the channel is narrow and crooked, and would perhaps require buoys to point it out.‡ It would be scarcely

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* Yellaboi, or Yellaboa, according to Captain Owen, as shown in the Table, p. 35, is in lat. 8° 55′ 42″. long. 83° 17′ 45″. Captain Boteler gives its West end as in lat. 8° 57′ 5″, long. 13° 18′ 25″. Variation, 18° 4′ W., 1829.

† *Inglis Pahboyeah River*, the entrance is nearly a league to the North of Corteemo Island.

‡ *Kakoongkah* is a small isle in the mouth of Great Scarcies River, having a factory near its western extremity.

possible to give intelligible marks for this winding channel, but it is so apparent in the plan, that by using the boat ahead, and never passing over the 3 fathoms boundary line described therein, except in crossing the three short flats, you can scarcely go wrong; the bottom, however, is so soft, and the water so smooth, that no damage will arise from touching. It is high water here, on full and change days, at 7^h 10′, and spring tides rise 11 feet.

For Captain Boteler's General Remarks on the Coasts and Seasons, see page 206.

SIERRA LEONE, etc.—From *Yellaboi Island*, mentioned in the preceding page, the CAPE OF SIERRA LEONE bears S. by W. ½ W. [*South*] 25 miles. This cape, with the coast eastward, forms the South side of the great river, bearing the same name.

The coast northward of the mouth of the river is low and level, bordered with a shoal bank 3 miles in breadth, and which has upon it several dangerous rocks; but on the South side the land rises into hills, which, forming one upon the other, tower into lofty mountains, crowned with perpetual verdure. These are, properly, the *Sierra Leone*, or *Lion Mountains*, which have given name to the river and country. From the foot of the hills, points of land, projecting into the sea, form excellent bays for shipping and craft, and convenient places for hauling the seine.

The mouth of the river, which is 2 leagues wide, is obstructed by an extensive bank, called the *Middle Ground*, but on the South side of this is a safe and deep channel for vessels of any burden. The latitude of the cape is 8° 30′ N.

Vessels bound from Cape Verde to Sierra Leone are recommended to gain soundings in lat. 9° 15′ N. on the grand bank which extends from the Bissagos to Cape St Anne; and having gained bottom in 50 fathoms, gray sand, on the edge of the bank. to make a *true* S.E. by S. course, keeping in soundings until in lat. 8° 20′ or 8° 30′. Then make an *East* course good, and you will make the land of Sierra Leone, the mountains of which may be seen in *clear weather* 14 leagues off: but as, on this coast, the weather is generally hazy, it is seldom seen farther off than 6, and frequently not more than 4 or 3, leagues; although, at the same time, a good observation may be had. This is occasioned by the constant vapours, caused by the sun, which ascend from the mountains covered with thick woods.

Appearance of Cape Sierra Leone, bearing S.E. by E., distant about 5 leagues.

In standing in for soundings, and approaching Sierra Leone, keep the lead constantly going, as the current sets in various directions, but generally tending to the eastward. It is requisite to be very attentive to this particular. Should you be standing in, in the night, in lat. 8° 30′, and shoalen your water from 20 to 18, 13, and then suddenly to 8 and 7 fathoms, you will be at the distance of 3 leagues from the river, and should immediately anchor and remain till daylight.

The danger on standing in for the cape is, the *Middle Ground*, hereafter described, which extends 7 miles from the eastern shore, and nearly to the meridian of the cape, leaving an entrance only 2 miles broad. Having made the land of Sierra Leone, bring the cape, which may be easily known by a small negro town standing upon it, to bear S.E. by S.; then steer directly for it. At this place pilots for the river may be had.

A rock, called the *Carpenter*, lies at the distance of nearly a mile W. ½ N. [*W.S.W. ¼ W.*] from the N.W. extremity of the cape. This rock always shows itself by the breakers over it, and at half-tide may be distinctly seen. The flood-stream sets directly through between the cape and the rock. You may advance within half a mile of the rock; but those beating down the river, with the sea breeze, and a strong ebb tide, must be careful and give it a good berth, as the ebb tide sets strongly between the rock and the cape. From the cape, a ledge of rocks extends in a direct line toward the Carpenter.

The LIGHTHOUSE on CAPE SIERRA LEONE was completed in 1849, and shows a brilliant fixed light. It stands on the extremity of the cape, and is 69 feet from the base to the top of the lighthouse. It bears from Carpenter Rock E. ½ S. by compass, and from the western edge of the middle ground, S.W. ½ S. Vessels, therefore, coming from the westward should be careful not to bring the light to bear more to the eastward than E.S.E. ½ E., and coming from the southward not to alter the course until the light is on that bearing; and coming from the northward, should not bring the light more to the westward than S.S.W. ½ W., until King Tom's Point comes in one with the centre barrack, S.S.E. ¾ E. to avoid the middle ground.

Bearing of the Carpenter Rock, W. 13° 7′ S.

Within the cape the general trend of the coast is nearly *true* East 6 miles, but it is broken by several inlets, which are called *Bays*. Of these, the first within the cape is a small cove, of pleasant appearance, called *Cape Bay;* the next is *Pirates' Bay*, so named from being the place where the pirates formerly used to careen and refit their vessels; the third is *Whiteman's Bay;* the fourth, *St. George's* or *Freetown Bay*, whereon stands FREETOWN, protected on the hill-side by a fort, and above the fort, on the summit of the hill, are the new barracks. On the East of Freetown is *Susan's Bay*, and at a mile eastward of the last is *Thompson's Bay*, bounded on the East by Farran Point. (*For the position of Freetown, see the Note on page 39.*)

FREETOWN.*—The general aspect of the country in the immediate vicinity of this colony, and the external appearance of Freetown, give a stranger, on arrival, an idea of salubrity and prosperity, which subsequent experience may not altogether realize, or, at least, reconcile with the result of further observation.

Its more striking features are the largeness of the scale on which the public buildings are constructed; the wideness of the streets, and the regularity of their lines; the number of stone houses, and the excellence of the roads; the abundance in the markets, the multitude of well-dressed negroes in these places, the variety of stalls and shops in their own quarter, well supplied with British goods; the cleanliness and the comfortableness of their small abodes, the size and structure of the principal church, and the numerous chapels and schools in the town and suburbs; and last, though not least, the admirable order that seemed to prevail amongst the negro population, without any apparent exercise of magisterial severity, or rigour of political restraint, to repress or control the people.

From ten o'clock in the morning till five in the evening a white man is seldom seen abroad; at the latter hour, the race course and the promenade on the battery are frequented by equestrians and pedestrians; and, perhaps, no circumstance that strikes the attention of a stranger, makes so strong an impression on his mind as the general expression he observes of languor and debility in the looks of every individual he meets of European birth (with perhaps two or three exceptions) in the colony. The young and old, the acclimated even as they are deemed, who have had their seasoning, either in one fever, or the periodical return of that malady, and have survived these attacks, show plainly enough the baneful influence of the climate, which leaves the features without vivacity, the frame without vigour, and the whole constitution apparently deficient in vitality.

The settlement at Sierra Leone was formed in 1787; and the new colony occupied a tract of about 20 miles square, and was peopled, in part, by negroes from America; and was increased by various additions from the West Indies.

In 1791, the tract of land that was ceded by the native chiefs, in 1787, to the British sovereign, was made over to the Sierra Leone Company; and, in 1796, Governor Ma-

* Parliamentary Report, 1842, Part II., p. 241, &c.

caulay enlarged the limits by an additional quantity of land towards the sea-side on the western boundary, obtained from a native chief called King Tom; possession of this was finally gained in 1801. At this period the colony did not extend beyond the peninsula, which is about 18 miles long and 12 broad. In 1824, a new sovereignty of the territory was purchased of the chief of the North Bulloms, on the North side of the Sierra Leone River. We have derived this statement from Dr. Madden's report; but in Colonel Doherty's remarks upon it, he states, that the limits of the colony are strictly confined to the peninsula.

The *Middle Ground*, already mentioned, forms the North side of the channel into the river, which is half a league in breadth. The general depths in the channel are from 6 to 10 and 12 fathoms. From the cape the extremity of the Middle Ground bears N.E. ¼ N. [*N.N.E.*] 2 miles, and the bank extends thence eastward to the Bullom shore. The ground is, in general, composed of hard sand; and, in some parts, large stones. It dries, in several places, at about the middle of half ebb; and, at all times, the sea breaks over it. On its eastern part there is a channel, but it is fit for small vessels only.

The *Bullom shore*, which forms the North side of the entrance of the river, is level and covered with wood. On this shore, in lat. 8° 40′, is an islet, called *Leopard Isle*, whence the coast rounds to the south-eastward, nearly 12 miles, to *Tagrin Point*, and between are eight negro towns, of which the fourth, from the northward, is that of the King of Bullom. The edge of this coast is low, swampy, and bordered with shoals.* In the river, eastward of Tagrin Point, is *Tasso Island* and several smaller isles, the formation of which can be understood only by reference to the particular chart.

Ships from the northward, when bound to Sierra Leone, should be careful how they approach the cape. They must keep their lead going, and not approach any nearer than 6 fathoms, until they see the high land. No one should stand in for the cape until he gets that high land to bear E.S.E. ¼ E. [*East*], and, when he is 6 leagues off, he will see the cape making in a small low point, with a ridge of cocoa-nut trees close to the water's edge; and when within 3 leagues of the cape he may observe the Carpenter Rock, with the sea constantly breaking over it. You pass the cape within a quarter of a mile, in 9 or 10 fathoms. You will now open the first cove, called Cape Bay, and thence pass Pirates' and the other inlets which have been described. In all these bays excellent fish may be caught with the seine, and sometimes green turtle.

Having passed the cape as above, your course will be S.E. by E. ¼ E. [*E. ¾ S.*] up the river; this leads clear along shore to Freetown, which is 3¼ miles from the cape. The general depths will be 12 to 18, 13, and 14 fathoms. In working to the northward, advance no nearer to the Middle Ground than in 7 fathoms.

To anchor off Freetown, bring the fort (*Fort Thornton*) to bear S. by W.; the East point of the bay, S.E. ¼ E.; King Tom's or the West Point, W. by N., off shore a quarter of a mile, 15 or 16 fathoms, with mud. Moor with the best bower to the eastward. The watering-place here is very convenient, and the water excellent. You fill your casks in the boat, with a hose, which leads from a cascade. A *green light* is shown at the landing place by night.

In sailing up beyond Freetown to *Farran Point*, or further eastward, you will find regular soundings, 14 to 16 and 17 fathoms. You may make free with the shore all the way up, as it is very bold.

Farran Point is remarkable. It is elevated, and has a house on its summit. In hazy weather, several vessels, on coming in, have mistaken this point for Cape Sierra

* This swampy coast has been thought, by some, to be the origin of the unhealthiness of the opposite shore of the river, and Freetown. It has been proposed, by some one, to erect limekilns on this coast, in order that their fumes might counteract the noxious miasmata arising from the shores and mangroves! It need scarcely to be said, that the insalubrity of the colony does not arise entirely from such a cause.

Leone, although it is nearly 2 leagues eastward from the cape, and have thus touched on the Middle Ground. But Farran Point serves as a good mark for the mid-channel, between the Middle Ground and Carpenter, when kept well open to the North of the cape, and bearing S.E. by E. ½ E.

Vessels coming in more from the northward will clear the West end of the Middle Ground in 3½ fathoms, with King Tom's Point (West of Freetown) on with the central barrack, bearing S.S.E. ¾ E. [*S.E. ½ E.*]

The *tide* at Freetown flows, on the full and change days, at 7^h 50′, and rises 12½ feet.

During the rainy season the tide is very regular and strong, running 6 and 7 knots an hour, and the ebb sets rapidly on the Middle Ground. In the dry months it commonly flows on shore at 7^h 30′, with seven and a half hours' ebb, and four and a half flood. In this season the ebb runs 2½ miles an hour, the flood only 2.*

SIERRA LEONE TO CAPE ST. ANNE, &c.—From the Cape of Sierra Leone the coast, at the foot of the mountains, forms a slender sandy bay, bordered with trees, which extends more than 3 miles to the southward of the cape, where it terminates in a rocky point. At three-quarters further is another point, more conspicuous and projecting, named the *False Cape*. The last bears from Cape Sierra Leone S. by W. ½ W. [*S. ¼ E.*] distance 4 miles.

From False Cape to York, or the Sisters' River,† the coast trends irregularly S. ¾ E. [*S.S.E. ½ E.*] 12 miles; and from York to Cape Chilling, S. ½ W. [*S. by E.*] 7 miles.

At Cape Chilling the hills of Sierra Leone terminate, after having made a high double land, which is seen a great way off; the mountain near the South is of a prodigious height, its summit being perpetually covered with clouds, and can be perceived at the distance of 14 or 15 leagues. The cape itself is low, and covered with trees; and, at 4 or 5 leagues off, appears like a small island.

One of the boats, employed in the survey under Captain Owen, was driven on rocks extending from Cape Chilling, and was totally destroyed, the people, with great difficulty, being saved. Upon this cape is *Kent Town*, a village of liberated Africans and disbanded negro soldiers; but, as no sure market exists for their industry, they raise little from the soil except for their own use. This village is delightfully situate on the side of a hill, with a large house for the superintendent.—*Captain Owen*, 1826.

BANANAS.—Off Cape Chilling, and separated by a space of 2 miles in breadth, like the BANANA ISLES. The outer or S.W. end of these isles is 7 miles S.W. by W. ½ W. [*S.W. ½ S.*] from the cape. The greater part of their coast is foul and rocky.

The Bananas very much resemble the Isles de Los, but the land is more elevated. They are extremely fertile, and have plenty of water, but no running streams. Wild cattle are abundant upon the greater isle. It is a remarkable fact, that pigs are the only domestic animals that cannot be propagated here; as there appears to be some herb, of which they are inordinately fond, but which is fatal to their existence.

A few years ago H.M. ship *Tartar* anchored off Cape Chilling and to the northward of the Bananas, with the N.E. point of the isles S.S.E. ½ E., and the western part S.S.W. Between the ship and islands the water deepened to 8, 9, and 7 fathoms; but within a cable's length of the shore, between the westernmost island and the next, there was found a depth of only 2 fathoms. The westernmost islet was then inhabited by only one Frenchman, *Jean Baptiste Major*, and his four slaves.

East Point, S.S.E. ½ E. * *West Point, S.S.W.*

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* Directions for sailing from the Bight of Biafra to Sierra Leone have been given in treating on the Currents, page 286.

† Otherwise *Agaitoopant*, or River of the Twin Sisters.

The Bananas appeared as above, from the *Tartar's* anchorage, at the distance of 4 miles.

There is anchorage as well to the southward as to the northward of these isles, but the best is said to be in 5 fathoms, about 2 miles from shore, on clear clayey ground, with the N.E. point S. ½ E., and the highest hill S. by W. ½ W. There are sandy bays, which may be seen from the anchoring-place, and where you may land; but the best is at the S.W. end. Wood and water are obtainable here. The watering-place, which is close to the beach, has a very good run of water.

Mr. Woodville has said, "It is very evident that the whole chain of mountains called Sierra Leone, as well as the Isles Bananas and the Isles de Los, are the productions of volcanoes, if we are to judge from the great quantity of lava found there, and from the small pieces of it taken up by the lead, in sounding, at certain distances from the land, opposite to these islands, and nowhere else; also from the conical figure of many of the hills, and from the ferruginous soil in the country."

Yawry Bay.—At 6 leagues S.S.E. [*S.E.* ½ *S.*] from Cape Chilling is *Point Tassa.* The coast between forms *Yawry Bay,* the shore of which is bordered with a shoal 4 miles broad, having on it many oyster beds. Great part of the bank is uncovered with the ebb, and has only 4 feet over it at high water.

Off Tassa Point is a group of islets and rocks, called the *Plaintain Isles* and *Bengal Rocks,* which extend from the point 5 miles westward, on the flat between Yawry Bay and Sherboro Inlet.

Tides.—The tides divide off the False Point of Sierra Leone. To the northward of that point the flood runs to the northward; to the southward of that point it sets to the South. Hence at the Bananas the flood is from the N.W., and the ebb contrary. Here the tide flows, on the full and change days, at 8^h 15′. During the equinoxes it rises 9 or 10 feet perpendicular; other spring tides 8 or 9 feet. At the Plaintain Isles it rises about a foot and a half more than at the Bananas; but, at the Bashaw or Turtle Isles, more to the southward, the rise is 6 or 7 feet, common spring tides.

SHERBORO INLET.—The Inlet or Sound of Sherboro, commonly called Sherbro River, is between the island of that name and the main land. The westernmost headland of the island is *Cape St. Anne,* in lat. 7° 34′, and nearly on the meridian of Point Tassa, which lies in lat. 7° 55½′.

From Point Tasso the coast, forming the North side of Sherboro Inlet, trends 12½ miles S.S.E. ½ E. [*S.E.* ¼ *E.*] to the mouth of a river, the *Yallucka,* and thence it winds to the south-eastward, 6 leagues further, to the *Bagroo River.* It is bordered by a mud bank, off which are several shoals, the positions of which can be understood only by reference to the particular chart.

The South shore of Sherboro Inlet is the North shore of Sherboro Island, which is 3 leagues in extent, from *Cape St. Anne* on the West, to *Jamaica Point* on the East. On this shore, at 12½ miles eastward from Cape St. Anne, is the spot and remarkable tree called *Little Pow Grande,* and 3½ miles more to the East is *Pow Grande.* At a league and a half eastward of the Pow Grande, on the shore, is *Jenkins'* Village, off which is the general roadstead for large vessels, having 5, 6, and 7 fathoms of water. All the shore between this and Cape St. Anne is bordered with an extensive mud bank.

Bashaw or Turtle Islands.—On a great flat, which extends more than 4 leagues to the N.W. from the western end of Sherboro Island, is a group of eight or nine islets, called the *Bashaw* or *Turtle Isles,* which are evidently the remains of a considerable tract of land now submerged by the sea. The bank on which they exist also exhibits innumerable ridges, knolls, blind channels, and pools; but is navigable on almost every part by large boats at high water, and at low water by light boats and canoes.

Directions for Sherboro Inlet have been given as follow:—From off the West end of the Bananas, steer toward the Bengal Rocks S.S.E. ¾ E. [*S.E.* ½ *E.*] 14 miles, and so as to give them a berth of about a league; having rounded these rocks, steer S.E. ¾ S. [*S.E. by E.*] 5 leagues, taking care to avoid the hard sand bank on the East, which is steep-to. In running on, you may shoalen your water to 4 fathoms, on the flat of Yallucka River, upon the eastern side, and thence continue the same course, 4 leagues further, to the southern bank, making due allowance for tide, whether ebb or flood. The last course will lead to 1½ miles from shore, in about 4 fathoms of water, and without the edge of the bank. You may now run up along shore, for 2 leagues, to *Jenkins*, taking care to avoid the edge of the Middle Ground on the North, which here leaves a channel of only half a mile between it and the shore.

BANK and SHOALS of ST. ANNE, &c.—The BANK of ST. ANNE, which has not yet been thoroughly surveyed nor defined, may probably extend from the parallel of 8° to 7° 31½′ N., and from long. 13° 6′ to 13° 32′. The northern limit, as shown in the Table, p. 35, is 7° 56′; this is the limit to which the bank has been *actually surveyed;* so likewise the western limit is given in 13° 29′, where there are 10 and 12 fathoms of water; but 13 fathoms have been found at 7 leagues more to the westward, upon the general bank of soundings extending from shore; and there is a spot of 8 and 9 fathoms in about 7° 56′ N. and 13° 48′ W.*

Upon the Bank of St. Anne are a number of small and dangerous insulated shoals, separated by channels of 6, 7, 8, and 10 fathoms. The bank itself is divided from that of the Turtle Isles by a narrow swashway, having 5, 6, and 7 fathoms.

But it appears that a vessel bound from Sierra Leone to the Windward Coast will clear every danger by proceeding over the great bank S.W. ¾ W. [*S.W. by S.*] 12 leagues to the parallel of 8° N.; and thence, on the meridian of 13° 40′ to lat. 7° 30′, from which point a course S.E. by E. ½ E. [*E. ¾ S.*] 22 leagues, leads to the *Shebar*, or Bar of Sherboro River, at the S.E. extremity of Sherboro Island.

Captain Midgley recommends that "in the wet season vessels should give the St. Anne shoals a large berth to the eastward, as the current, as well as the sea, runs with great velocity into the bight of Cape Mount, and vessels which may unfortunately happen to fall in with the land to the northward of Sinou, in the wet season, will find considerable difficulty in working to the southward.†

When *Lieutenant Badgley*, with other officers and two boats, in 1826, proceeded from Great Turtle Island, in order to survey the southern part of Sherboro Inlet, they found a good channel, with about 6 fathoms, but the atmosphere was so thick that the object was totally defeated. The colonial squadron was then at anchor at the *Shebar*, where was formerly the establishment of the infamous *James Tucker;* but which, the country having been ceded to the English, by the old King of Sherboro, had been deserted, and he had removed to the River Kittam, about 26 miles from the sea. From the old establishment the French and Spaniards had been in the habit of shipping annually about 20,000 slaves, collected from the three great rivers, *Bagroo*, *Dean* or *Jong*, and *Kittam;* but as, by the occasion of this territory, the British authority extended from Sierra Leone to the *River Galinhas*, the slave trade was rooted out from the Sherboro, the most extensive mart upon the Grain Coast.‡

The *Boom Kittam River* runs in a parallel direction with the shore, at a distance from it of 1 or 2 miles. The strip of land between, called *General Turner's Peninsula*, is 8 leagues in length. and it is terminated by the Forks, in long. 12° 8½′ W. At 6½ leagues further to the S.E. is the *River Galinhus* or *Gallinas*.

GALLINAS—The bar of this river* is only passable for large boats or small

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* "Journal of the *Tartar*," by the late Mr. Finlaison.

† "Nautical Magazine."—Captain Midgley, "On a voyage to the Gold Coast," Jan., 1843, p. 27.

‡ On Christmas-day, 1852, Capt. Philips, in the Polyphemus, destroyed a barracoon (belonging to Crispo), at Babbah, 17 miles E. of Kittam; and in January, 1853, they ascended the Kittam for 50 miles to Damma.

* Description by Captain the Hon. *J. Denman*, R.N., H.M. sloop *Wanderer*, December, 1840. Parliamentary Report, Appendix, pp. 460, 461.

coasting craft, and is very dangerous during the rains, when it is frequently impassable. During the dry season it may be generally passed with safety, excepting occasionally at the full and change of the moon, which has a very marked effect upon the surf on the whole of this coast.

After passing the bar, the river opens out into a spacious sheet of water, about 3 miles across in every direction, which is studded with islands lately occupied by the slave dealers, and affording very favourable situations for trading factories.

From hence the river runs, in three branches, to the north-westward, to the northward, and to the N.E. The first, during the rainy season, joins the Boom Kittam River, thus affording a direct inland water communication with Sierra Leone; but, in the dry season, about 8 miles, is too shallow for canoes to pass. The next branch runs past the town of Ghindamar (where the king resides), 9 miles from the sea, and is navigable about 5 leagues for large canoes. The third branch runs close inside the sea-beach to the S.E., about 4 miles, and then turns suddenly to the N.E. at a place called Soolimane; from hence it is navigable for large canoes about 7 miles. This branch forms the S.E. boundary of the Gallinas territory. To the N.W. it terminates at a place called Casi, on the banks of the first branch, known by two conspicuous round trees, which form the principal landmarks in this quarter. These limits comprise about 12 miles of sea-coast.

The coast here is very low and remarkably uniform, and for this reason three large baobab trees near the mouth of the Gallinas are an excellent landmark. At about 6 leagues south-eastward from the mouth of the Gallinas is that of another small river, the *Manna*, off which you may anchor in 9 or 8 fathoms: this mouth is shut up by the beach, on which there is always a great surf. It is sometimes called Roc-Manna, from the unusual circumstance of the shore being covered with blocks of black rocks. At 8 miles further eastward, passing several villages or factories, you find the little *River Sugury*, beyond which is the bight formed by *Cape Mount*, having from 10 to 14 fathoms of water, with a bottom of black mud.

From the River Gallinas to Cape Mount the coast is very low, and covered with trees. It has a fine sandy beach all the way. At 5 or 6 miles off are regular soundings, from 15 to 18 fathoms, mud and sand, until you arrive at Cape Mount. H.M.S. *Tartar*, Sir George Collier, anchored in 15 fathoms, muddy bottom, Cape Mount bearing S. by E., and a remarkable large clump of trees North. Merchantmen anchor further in, at 9 and 10 fathoms.

CAPE MOUNT, which may be seen at 9 or 10 leagues off, is a promontory of high hills, projecting into the sea, the highest peak being 1,066 feet above the sea; on each side the land is low, rather highest on the North side, with a flat sandy beach to the eastward. The Cape itself is distinguished by cliffs, which may be seen 4 leagues off. It is very remarkable, especially in coming from the westward, when it first makes like an island, and contrasts greatly with the low and uniform coast to the West of it.

To fall in with Cape Mount, you ought to keep in the latitude of 6° 40′, having, on account of the current which sets toward the shore, frequent recourse to the lead, when you think yourself near the land. In the night you may not approach nearer than to 26 fathoms, unless well acquainted.

To the westward of the Cape lies the Road, into which you may run, until the point of the Cape bears South and S. by E. There, in the summer season, that is, between October and May, when the weather is generally fair, is anchorage in 9, 8, 7, and 6 fathoms, sandy ground; but it is more common to lie in 15, 14, 13, 12, and 10 fathoms, because the tornadoes and southerly winds sometimes make a very hollow sea. The watering place is near a large tree in front of the outer point of the cape; and here, in the fine season, you may take in water with great facility.

In coming ashore with your boat, you must bring a hawser with you, and fasten one end of it to the land, the other being dropped with the anchor to seaward, so that you may prevent the breakers by it; for you run directly against the flat beach below the town, without any shelter of banks or cliffs; in the morning, you may easily get ashore with smooth water.

To the northward of Cape Mount there is a river of the same name, which has been celebrated for its trade. There is 7 feet water on the bar at low water, and 13 at high water; the current runs very strongly out, and the best time for crossing the narrow bar is at half flood. Between the Cape and the entrance of the River there is good riding in the Bay, during fine weather, in from 15 to 6 fathoms; but from 14 to 12 fathoms should be preferred in the rainy season, and even there it is hazardous, unless provided with the best ground tackle; for southerly and S.W. winds, in that season, set into the Bight with a tremendous sea and heavy gusts, which raise a violent surf on the shore, that may be heard at a great distance.

Those approaching from the westward by night, without a previous sight of land, must take the precaution of sounding in time, in order to avoid the danger arising from the velocity of the current. As there are 15 fathoms close in-shore, you should not advance by dark nearer than in 20 or 25 fathoms. The same precaution should be taken during the *Harmattan*, when the sun is obscured by haze for days together, and the current varies.

CAPE MESURADO lies about 14 leagues S.E. by S. [*S.E. by E.*] from Cape Mount. Hence its latitude is 6° 19′ N., in longitude 10° 49′. Between the two Capes the coast is very low, with a white sandy beach, above which the land is covered with trees of varying colours. About 3 leagues to the northward of the cape is the *River of St. Paul*, navigable for boats only; but ships may lie off it at pleasure, in from 16 to 6 fathoms, good ground. The depth of 10 fathoms is nearly two miles from shore.

Cape Mesurado, though not so high as Cape Mount, is an elevated promontory, almost perpendicular on the North side, but with a gradual declivity toward the sea on the South. There are regular soundings, of 20 to 15 fathoms, muddy bottom, at 8 miles off-shore, along which the current sets strongly. At 2 or 3 miles off-shore, with the Cape S.E. by S., is a depth of 15 to 10 fathoms, muddy bottom, and a common anchorage. With the Cape bearing N.E., the land appears like an island, with trees rising out of the water to the North; and at 7 leagues off it appears in its insular form, the land on each side being very low.

The *lighthouse*, a red tower 40 feet high, shows a fixed light, at an elevation of 240 feet, and consequently ought to be visible at 15 miles off.

MONROVIA, the capital of Liberia, contains about 300 houses, and 2,000 inhabitants, and is built on a depression of the ridge which sweeps inland from the Cape.

From its fine situation it is evidently salubrious, and is far preferable to Sierra Leone. It is the outlet of the products of the St. Paul to the North, to which it is connected by *Stockton Creek*. The settlements of *Caldwell*, &c., on the St. Paul, showed every indication of comfort and prosperity; far more so than in Monrovia. Coffee, apparently, will be the great staple of this part of the country.

THE DESCRIPTION OF THE COAST OF GUINEA, from the River Gallinas eastward, with directions for the same, is given in the *Sailing Directory for the Ethiopic or Southern Atlantic Ocean*, Fifth Edition, p. 375, &c.

THE ISLANDS OF THE NORTH ATLANTIC OCEAN.

3.—THE AZORES, OR WESTERN ISLANDS.

THE AZORES, or Western Islands, are nine in number, and named Santa Maria or St. Mary's, St. Miguel or St. Michael's, Terceira or Tercera, St. Jorge or St. George's, Graciosa, Fayal, Pico, Flores, and Corvo. The land is, in general, high; the coasts steep and rocky.

These islands are said to have been discovered about the middle of the fifteenth century by Joshua Vandenberg, of Bruges, in Flanders, who, in a voyage to Lisbon, was driven to them by stress of weather. At Lisbon, he boasted of his discovery; on which the Portuguese, in that spirit of enterprise so strongly manifested by them at this period, set sail and took possession of them, calling them *Açores*, or *Isles of Hawks*, from the many hawks and falcons found amongst them. It appears that they were entirely destitute of inhabitants, and of every animal excepting birds. The latter were numerous and of various species.

Antonio Gonzalo says, that the great Don Henry, Prince of Portugal, considered these isles as so considerable an acquisition, that he went in person to take possession, in 1449. This was forty-three years before Colombo landed in America. And, it has been affirmed, that the Flemish merchants, on the part of their countrymen, sent a colony thither, many of whose descendants continue in Fayal to this day. Hence the isles have been also called *Flamingos*, or *Flemish Islands*.

The capital of the Azores is *Angra*, in Terceira, the residence of the civil governor but the general residence of the bishop is in the Island of St. Michael.

The climate is delightful; the air generally clear and serene; the soil so prolific, that both European and tropical plants arrive at the greatest perfection: the face of the earth is, however, so diversified, as in some places to exhibit, within a small extent, volcanic hills and productions, gardens of aromatic plants, pastures, vineyards, orangeries, &c. The greatest inconvenience of these isles is, their having been subject to eruptions and earthquakes; and, in some parts, where the coasts are low, the sea has, at times, overflowed the land, and occasioned considerable mischief. Yet, in the cultivated parts, the lava, once a stream of fire, is planted with oranges, lemons, and vines; and the land, formed from the decomposition of volcanic substances, is sown with Indian corn, small beans, and wheat. The islands still abound in waste lands, fit for the cultivation of hemp, the vine, &c.

Being generally mountainous, they may be descried from a considerable distance; particularly the peak on the Isle of Pico, noticed hereafter, which may be seen more than 20 leagues off.

It cannot be doubted that this archipelago must be considered as an immense ridge, on which craters are thrown up so as to form islands. The Island of St. Mary, the only one not situated in the general direction of the others, is not volcanic; no part of its surface appears to have suffered from heat or eruption, subsequent to its formation. The Island of Pico is elongated from S.E. to N.W. in the same manner as all the other islands, St. George, St. Michael, and Terceira; and Flores and Corvo lie exactly in the same direction. Fayal appears to be nothing more than a part of Pico, for the general direction of these islands and their shores perfectly corresponds; and St. Michael's and Terceira appear to be connected by an intermediate range of volcanic formations, as will be subsequently seen. Few places offer such a variety of volcanic phenomena as St. Michael's; and the history of the eruptions and earthquakes on and near it give ample proof of the violence of the subterraneous forces over which it lies. In the descriptions of the separate islands will be found notices of the principal volcanic phenomena that have been recorded. The reader is directed, for a more complete description of the volcanoes, &c., of the Azores, to an article in the "Nautical Magazine" for 1841, page 752, consisting of extracts from the "Philosophical Transactions," and "Von Buch's Descripcion Phisique" of these islands.

The population of the Archipelago from the census of 1857 amounts to 241,646.

WINDS AT THE AZORES.—In the former part of this work, in the section treating on the subject, we have given descriptions of the general phenomena of the winds and hurricanes of the Atlantic, and the laws by which they appear to be governed, as deduced from the numerous and careful observations that have been made at various times. In connexion with that system of aerial currents, and their perturbations, we have reserved the consideration of that part of the subject which is connected with the Azores, and their vicinity. It will not be necessary to recapitulate any of the principles or statements which have been before given, but must refer the reader to that division of the subject, as detailed in page 214, and following.

The following Table shows the mean duration in days of the winds from each quarter, from the results of 10 years' observations made by Thomas Carew Hunt, Esq., between Jan. 1, 1840, and Dec. 31, 1849 *:—

Winds.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Summer. ½ Year.	Winter. ½ Year.	Whole Year.
N. ..	1·32	1·12	1·18	1·27	1·52	0·15	2·11	0·14	1·40	2·15	2·78	3·52	7·29	11·07	18·36
N.E. .	7·64	6·13	6·73	8·89	10·9	10·1	13·7	15·1	11·6	10·9	6·84	7·71	69·04	46·0	115·04
E. ..	1·07	0·53	0·66	1·80	1·28	0·76	1·17	0·30	1·20	0·62	0·59	1·72	6·51	5·19	11·70
S.E. .	4·45	3·90	8·03	2·44	2·44	3·13	2·73	4·71	4·94	4·45	3·74	3·60	20·98	23·17	44·15
S....	2·88	0·95	2·25	0·79	0·95	0·67	0·11	0·08	0·12	1·51	1·54	2·0	2·72	11·13	13·35
S.W. .	6·46	6·60	9·01	4·08	3·73	4·43	4·63	2·89	8·44	4·13	6·94	5·32	23·20	38·46	61·66
W. ..	1·16	1·17	1·58	1·51	2·38	1·51	2·09	1·73	1·01	1·35	1·39	1·52	10·23	8·17	18·40
N.W. .	5·86	7·04	6·44	8·06	[illegible]	8·29	[illegible]	4·73	5·53	5·19	6·03	6·53	39·52	37·11	76·63
Calm .	0·19	0·56	0·12	[illegible]	[illegible]	[illegible]	[illegible]	1·29	0·74	0·65	0·10	0·08	3·51	1·70	5·21
Surf on shore.	1·13	7·0	6·49	2·70	1·15	0·50	0·03	0·20	2·07	4·42	6·42	7·38	6·65	38·85	45·50

Similar hurricanes to those described in the section devoted to the subject seem to be prevalent at the Azores, and in some measure to be governed by the same laws. This it will be very important for the mariner to know, and therefore the following

* Report of the British Association, 1850, page 135.

observations, by *T. C. Hunt, Esq.*, the British consul at St. Michael's, will be very interesting :—

"The regularity with which gales enter these seas in the north-west quarter, and, after crossing them, disappear at the south-east, is a circumstance the knowledge of which may be highly serviceable to the commanders of ships sailing across the Atlantic.

"The centre of a gale, in its approach, always effects a descent on the barometer, and a change in the fall of rain. In its actual passage over the instrument, the descent generally reaches 28·50, from which a rise of one-tenth appears to take place for every 10 miles' removal of the centre; so that the number of miles' distance from the centre of an approaching gale might, perhaps, be indicated by the number of hundredths shown by the barometer over the extreme of 28·50.

"The difference in the *fall of rain** has also its regularity, the approach of the centre bringing a temporary increase, and then a cessation of the rain, which is renewed, and, in a reversed order, diminished on the removal of the centre. According to the observations made at this office, there appears to be in every gale of wind a zone of rain about 120 miles in breadth, heaviest on the inner edge, which is about 60 miles distant from the centre; that the fall of rain decreases in proportion to the distance from this line; and that the fall on the inner edge, being about twelve-hundredth of an inch per hour, the decrease is about one-hundredth for every 10 miles of removal.

"In order to follow out the views of *Colonel* (*Sir W.*) *Reid*, the British consul and the vice-consuls at the Azores kept regular daily tables of the direction and force of winds, between May, 1840, and Nov., 1841; and the courses of twenty gales which occurred were compiled from them, and the details of them are given in the 'Nautical Magazine,' as before quoted."

From the particulars of these twenty gales, of which the courses have been accurately observed during the years 1840-41,† there apppears to be some general conclusions which may be deduced. The first circumstance developed by the inquiry is the general direction of storms passing across the Azores. The coincidence of this course with the Great Atlantic Current, which is a continuation of the Gulf Stream, which may every day be traced to the neighbourhood of the Azores, and which the sudden rise of water in those islands (where, having been hastened by a gale, it is suddenly checked in any locality by the operation of the wind, accompanied by a diminution of atmospheric pressure) proves to be sensibly carried beyond them, goes very far to identify the Azorean streams with the tropical gales and hurricanes traced in the able work of Colonel Reid, from the South American coast, along the course of the Gulf Stream to Cape Hatteras, in North America. There is a further resemblance in their their diameters. In the chart which Colonel Reid has composed of the great hurricane of October the 10th, 1780, the diameter given to it, in the latitude of the Azores, is about 550 miles. Of the Azorean gales under consideration, four were about this diameter, eleven of about or under 650, and five under 900.

With respect to navigators, for whose benefit these inquiries are chiefly intended, the use which may be made of this knowledge of the courses, taken by storms across the Azores, is in the direction of vessels which may be reached by them. It seems probable that if a ship were caught by a violent gale in the current of the Gulf Stream, near the Azores, her best course would be to steer, so far as the veering of the wind would allow, due North or South; that if she steered to the eastward, she would accompany the gale, and be overtaken by the greater violence of its centre,

* In the Azores a southerly wind creates great humidity in the atmosphere; a northerly wind removes it. Under the former influence, there is frequently two per cent. of water in the air; under the latter, less than one.

† The commencement of these gales was on the following days. viz. :—1840, June 4th, Aug. 19th, Oct. 3rd, Oct. 7th, Oct. 9th, Nov. 2nd, Nov. 11th, Nov. 14th, Nov. 28th, Dec. 1st, Dec. 6th, Dec. 11th, Dec. 15th, Dec. 27th; 1841, Jan. 11th, Feb. 3rd, Feb. 11th, March 6th, March 19th, Sept. 8th, and Sept. 18th.

and that by steering to the West she would sooner meet the centre, or run into a new gale.

Whatever may be the cause of the occasional deflection of the Azorean storms, whether it arises from collision with another storm, or from atmospheric gravitation (the radiation of heat from the islands being always very great), the uniform effect appears to be a diminution of their progressive velocity, and frequently an increase of their rotatory force.

But as far as these effects can be foreseen, from a knowledge of the deflection (presuming it always to be accompanied by a slower progression), it is worthy of observation, that the deflection never appears to take a turn to the northward, but always to the South. If this be true, the safest course for a ship in these gales is to the North, unless there are very cogent reasons for a departure from this presumed rule.

ST. MICHAEL'S.—The Island of St. Michael consists of a number of mountains, hills, and declivities, which are evidently the production of volcanic eruptions. The mountains and hills clearly indicate, by their conical figure, and the cavity at their summits, their being the production of fire, and bear unequivocal marks of the effects of this destructive agent, in an accumulation of lava, scoriæ, and volcanic sand.

Externally, the volcanoes appear extinguished, but they are supposed still to burn internally and invisibly. Of this, *Caldeiras*, or fountains of boiling water, in the Valley of Furnas and other parts, are evident symptoms. There have existed three principal craters, whose vertices now form three great lakes, situate toward the centre and the northern and southern portions of the island. From those craters vast mountains have been thrown up; and, in proportion as these ceased to vomit forth matter, partial eruptions burst out, and formed the lateral hills and declivities, which extend themselves in every direction from the mountains surrounding the lakes. The cessation of fire from the different craters has been attributed to water, which appears to have gained access to each, and suddenly extinguished the effervescence of its mineral contents; and the fire now seems confined to stations, where it operates only in boiling the water with various degrees of activity and force.

The island, at length, seems to be of such a structure and confirmation, that the waters pass freely throughout its volcanic caverns, and are easily forced out without shaking or disturbing the earth. Of these extinguished craters, that (the *Sette Cidades*) in the N.W. part of the island is the largest, and is about 3½ miles long by 2 miles broad. The interior is occupied by two lakes, and the ridge bounding it is nearly of equal height throughout, except where it rises into peaks, and on the N.W. presents a gap between two hills, 1,620 and 1,770 feet high. The second crater is about 3,060 feet high, and is called the *Agoa de Pao;* it is in the middle of the island, and situated in a large mass of pumice stones. *Agoa das Furnas* is the third crater, 995 feet high, and in it are the hot-water springs, but it is not so high as that of *Alagoa Grande*. From Agoa das Furnas the mountains of pumice-stone continue higher, forming a continual range as far as the *Pico de Vara*, the highest of which is 3,560 feet above the sea, and is the only summit on the island where snow is found.

After Gonzalo Velho Cabral had succeeded in establishing a colony in the Island of St. Mary, discovered in 1431, he landed on the N.W. coast of St. Michael, in 1444, and the extensive plains he saw appeared to him to be so capable of being highly cultivated that he returned immediately to St. Mary to make preparations for colonizing his newly-discovered country. But when he went there the following year, with everything necessary for the establishment of his colony, what was his surprise when, in the place of the plains, he found an enormous mountain, which had been elevated on them, with an immense crater. This mountain is called the *Alagoa de los Sette Cidades*, on which are the two lakes *Lagoa Grande* and *Lago Azul*, as mentioned before. After the elevation of this great mountain, the island remained tranquil until 1522, when an eruption overturned the two hills *Sorical* and *Rubical*, and entirely destroyed the town of Villa Franca, and 4,000 inhabitants also lost their lives. In 1563, an eruption occurred of the *Pico Sapadeiro*, and a large current of lava ran into the sea on the North side. In 1591, seven shocks of earthquakes occurred, and Villa Franca was again destroyded. In 1638, the island to the West was found as as described elsewhere. In 1652, some hills near Ponta del Gada threw up an immense quantity of stones and cinders, spreading destruction around. In 1691, after some very violent earthquakes, several small islets appeared not far from the coast. In November, 1707, a torrent, attributed to the breaking of a waterspout, fell on Ponta del Gada, and caused great damage. In 1719, a new island appeared in the West, also mentioned hereafter. In 1720, a succession of violent earthquakes injured the towns and villages, and shook down great rocks from the cliffs, &c. In 1744, October 5, another fall of water occurred, washing down the valleys of Povoaçao and Fayal de Leira, carrying away great parts of two villages. The cause of these floods, not now unknown, is still unexplained. The great Lisbon earthquake in 1754 was also felt here, but there was no eruption. In 1806, a mass of rock slipped from the valley of the Furnas, leaving a chasm 100 yards in diameter; and in 1811 a similar fall occurred close to the same place. The eruptions of August 11, 1810, and of Sabrina Island, June 13, 1811, are described below. In 1838, another landslip occurred at the Furnas. In 1839, December 5, a rise of the sea, like that in 1755, washed down several houses, &c., on the South coast. The last earthquake which was felt here was that which devastated Terceira, in June, 1841, of which a description is given in the notice of that island.

The circumstances attending the formation of Sabrina Island are described as follows: the island had previously been apparently quiescent.* In the early part of the year 1811, a most awful and tremendous explosion of smoke and flames issued from the sea at the distance of half a league from the shore at the western end of the island. From the depth of about 40 fathoms, in the ocean, issued smoke, fire, cinders, ashes, and stones of an immense size. Innumerable quantities of fish, some nearly roasted, and others as if broiled, floated on the surface of the sea toward the shore. Thus a dangerous shoal gradually formed.† On the 10th of June, the crew of the *Sabrina*, British sloop of war, observed two columns of white smoke arising from the sea, which they supposed to arise from an engagement, and made sail toward it, but were disappointed by the wind's dying away. The smoke continued to ascend, with volumes of flame, and they then concluded it was a volcano. Next day they were close in with the land of St. Michael, and found the volcano still raging. They learned, on the island, that smoke was first observed on the 13th of June; two or three days previous to which there had been felt repeated shocks of earthquake in the capital of St. Michael, which threw down several cottages and portions of the cliff toward the N.W., so that destruction was feared on the island; but these ceased so soon as the volcano broke out. On the 18th, the *Sabrina* went so near to the volcano as she could with safety, and found it still raging with unabated violence, throwing up, from under the water, large stones, cinders, ashes, &c., accompanied with several severe concussions. About noon on the same day they observed the mouth of the crater just showing itself above the surface of the sea, where there were formerly 40 fathoms of water. At three p.m., same day, it was about 30 feet above the surface of the water, and about a furlong in length. On the 19th they were within 5

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* The approximation to an eruption has, however, at times appeared to have been very close. On the 11th of August, 1813, at the hour of ten p.m., slight shocks of an earthquake were felt, which continued, at intervals of a few minutes, for four hours. Between two and three o'clock next morning, a dreadful rocking was experienced throughout the whole island; several houses. unable to resist its violence, were thrown down, and many others were greatly damaged; and such persons as sought safety in the open air were dashed to the ground. On the eastern side of the island an orifice was discovered, resembling the crater of a volcano, and out of which flames occasionally burst forth; but they do not appear to have been accompanied by any ejection of vocanic matter.

† The flames were first seen in the night of the 1st of February, but invisible indications of its operations had been felt in shocks on the island from the middle of the preceding year. Its observed situation was S.W. of Point Ferraria, and due West from the Pico de Ginotes, at about 1¼ miles from the nearest shore. The brig *Swift*, with all her crew, were lost on this spot, before the existence of the shoal was known.

or 6 miles of the volcano, and found it about 50 feet in height, and two-thirds of a mile in length, still raging as before, and throwing up large quantities of stones, some of which fell a mile distant from the volcano. The smoke drew up several waterspouts, which, spreading in the air, fell in heavy rain, accompanied with vast quantities of fine black sand, that completely covered the *Sabrina's* decks, at the distance of 3 or 4 miles. On the 30th they proceeded on a cruise, leaving the volcano about 150 feet high, and still raging as formerly, and continuing to increase in size. On the 4th of July they again visited it, and found that a complete island was formed, and perfectly quiet. The captain and several officers landed upon it, and found it very steep, and its height from 200 to 300 feet. It was with difficulty they were able to reach the top.

On the 17th of June, Captain Tillard, of the *Sabrina*, accompanied by Mr. Reid, the British consul, with two other gentlemen, proceeded overland to the cliff nearest to the volcano; and which was between 300 and 400 feet above the level of the sea. The first appearance it presented was that of an immense body of smoke revolving in the water almost horizontally, in varied involutions; when suddenly would shoot up a column of the blackest cinders, ashes, and stones, in form like a spire, and rising to windward at an angle of from 10° to 20° from a perpendicular line. This was rapidly succeeded by a second, third, and fourth, each having great velocity, and overtopping the preceding one till they had attained an altitude as much above the level of the eye on the cliff as the sea was below it. These bursts were accompanied by explosions of the most vivid lightning, with a noise like the continual firing of cannon and musketry intermixed; and, as the cloud of smoke rolled off to leeward, it drew up the waterspouts, above mentioned, which formed a beautiful and striking addition to the seen.

Subsequently the islet fell by degrees into the sea; and, in the middle of October, no part was left above water; but a dangerous shoal remained in the place which it had occupied. In February, 1812, smoke was discovered still issuing out of the sea near the spot.* In June, 1841, Captain Vidal, in H.M.S. *Styx*, anchored in 16 fathoms, on the site of Sabrina Island, and found that the least water thereon was 15 fathoms.

St. Michael's contains one city, five principal towns, fifty-four parishes, and about, in 1840, 39,098 males and 41,711 females, total 80,809, living in 19,726 houses. The coast is very bold, and may be approached without fear in almost every part, the N.W. side excepted. Its military strength consists of 300 or 400 troops, with a militia of several thousand peasantry, whose arms are the pikes with which they drive their cattle. The principal fortification is the castle of St. Bras, which is close to the sea, and the western end of the city of Ponta del Gada. It is mounted with 24 pieces of canon, but few of which are capable of service. A league to the eastward are two small three-gun forts, insufficient from decay and neglect. The island, notwithstanding, has many strong local holds; and several of the hills and passes, if judiciously fortified, would be impregnable.

The landed rental is estimated (1851) at £160,000 a year: it exports 38,000 quarters of corn, one-half to Ireland, valued at £60,000; and 100,000 London size boxes of oranges to England (with the exception of about four cargoes sent to the United States), valued at £40,000. In 1801 the value of the fruit exported was £10,000, and in 1850 at about 65,000. In 1852 the orange crop is expected to amount to 150,000 boxes; value, £60,000. The number of vessels calling to trade annually is 250 British, 150 Portuguese, and 10 foreigners.

The City of Ponta del Gada is the chief seat of commerce, and contains 20,000 inhabitants. This town appears exceedingly pleasant from the offing. There is a mole for the protection of small vessels, but those of greater burden compelled

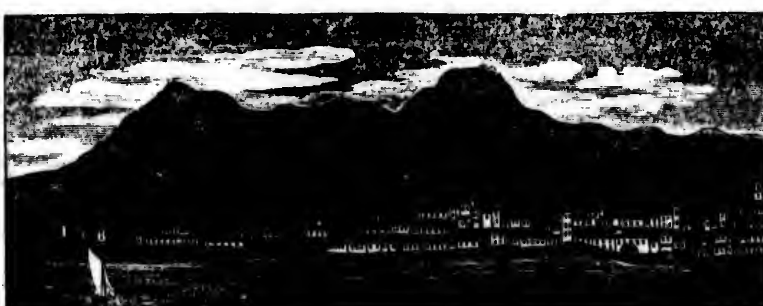
* About 15 leagues to the westward, a volcano, which had appeared in 1638, broke out from the sea in 1719, and disappeared in 1723. A depth of 80 fathoms was afterwards found on the spot which it had occupied. But see the description of Terceira for this volcanic shoal.

to ride in an open roadstead. By deepening and enlarging the harbour, it might be rendered capable of receiving vessels of a considerable draught; and, by excavating the square of St. Francis, and cutting a canal between it and the mole, a large number of vessels might be accommodated. As it is, vessels of burden cannot safety use it; for they would risk the danger of slipping their cables, while loading or unloading, and, perhaps, not be able to recover their station for several weeks; or, at least, not dare to attempt its recovery during the prevalence of strong southerly gales. It has been said in former years that a light was shown here, but it was not the case, and it is now stated that a light is *proposed* for South Clara fort.

The roadstead and harbour of Ponta del Gada are, however, the best that the island affords. The place next consequence is that called RIBEIRA GRANDE, one the North side of the island; but here is no anchorage; and, having no harbour, it is dependent for its commercial supplies on the towns on the South side, VILLA FRANCA, which is on the latter, has a very inferior anchorage, and that for small vessels only.

ST. MICHAEL, bold all round, may be approached without fear, as there are no rocks or dangers more than a furlong from the shore, excepting some rocks at the N.W. end, and the volcanic shoal, already described. The former extend about half a mile from the Bay of Mosteiros, near the north-western point. The winds most prevalent, from October to April, are from S.W. to N.W., which frequently come in heavy squalls, particularly from the northward. In approaching from the eastward, Ponta de Galera, the southernmost point, should have a good offing, as the high land above it ofton occasions a calm, and there are some rocks off the point.

On approaching the N.W. end of the island from the westward, the appearance is very unpromising, as it presents barren mountains of stupendous bulk, with a coast like many ramified pillars of basalt, exhibiting, at top, a few trees of stinted growth. The impression made by a scene of rough and craggy cliffs is, however, soon dissipated by a pleasing contrast on the southern coast, as this presents a beautiful acclivity, adorned by luxuriant vegetation. Open pastures, bounded by woods, vineyards, and corn-fields, interspersed with orange and lemon trees, everywhere meet the eye, and afford a landscape, extensive and various, that will always, in clear weather, be seen with delight.*



Outline of the land over Ponta del Gada.

THE ROAD OF PONTA DEL GADA, off the principal city, has good holding-ground, on which ships may ride safely, excepting during gales. from W.N.W. to S.S.E. Should a vessel be forced to quit the anchorage in winter, by a southerly

* An excellent and detailed account of St. Michael's, its geological formation, its natural productions and general particulars, is given by H.M. consul, Mr. Hunt, in the "Journal of the Royal Geographical Society, vol. xv., 1846, p. 268, *et seq.*

gale, it will be best to round the western end of the island, and await a shift of wind from the N.W., which commonly succeeds a S.W. wind. Thus may the roadstead be easily regained; but, by running to the south-eastward, it may be ten days, or more, before you can beat back to the road. In beating up, keep close in shore, only avoiding some rocks, which lie near Ponta de Galera. Fresh water is easily procured in the craft of the island.

In 1846, it was announced that the following signals had been established and shown from a flagstaff at the custom-house quay:—1. A *red flag*—vessels at anchor should immediately weigh, on account of the weater. 2. A *white flag*—vessels in sight may safely make for the anchorage. 3. A *red flag with white border*—vessels must not send their boats on shore, landing being dangerous.

It was also stated, that *four buoys* had been laid down in the anchorage, which would considerably reduce the risk of vessels leaving their anchors and chains behind them when they leave the roads.

Those coming in on the northern side of the island, must be cautious of not getting embayed near Ribeira Grande, as there is no good anchorage on that side in case of a shift of wind.

THE ROAD OF VILLA FRANCA is sheltered by the *Porto do Ilheo*, a remarkable volcanic rock, having a circular basin in its centre, with an entrance to it on the N.E., fronting the town of Villa Franca. The entrance of this basin has 7 feet of water, and is just broad enough to admit a small vessel. The basin is about 100 fathoms in breadth, and has had a depth of from 8 to 18 feet; the bottom of sand and small stones. This place is resorted to by small vessels for the purpose of careening, &c. It affords shelter from gales between West aad South; but, as a part of the S.E. side is low, the wind from that direction throws a heavy swell into into it, and renders it dangerous; and vessels caught with this wind must be scuttled, as the only way to save them. Not more than four vessels can lie with safety on the outside, in winter, under shelter of the rock on the N.E., where there are 4 and 5 fathoms of water. The ground near the town is foul and dangerous; but it is stated, that a ship may lie in 8 or 9 fathoms, between the town and islet, by fastening a hawser on shore.*

The Porto do Ilheo is a great natural curiosity; it having been originally a volcano of great height, whose apex has fallen into the caverns beneath, and forms the basin. Its appearance is extremely rugged and irregular. On its South side is a remarkable detached rock, distinguished by the name of the *Pyramid*.†

Of VILLA FRANCA, Tofiño says:—"It is situated on a beach, which forms but a very small bight. The channel between the islet (*Ilheo*) and coast is of the width of 3 cables' length, or thereabout, and is its principal anchorage; it has 10 and 11 fathoms of water, sandy bottom, and vessels moor North and South, with a hawser on shore, on the islet; but the latter, owing to its diminutive size, does not shelter a vessel from the wind sea, between E.S.E. by South, to S.S.W. The town is capacious; and water, with all kinds of provisions, may be had here."

The breakers seen to the N.E. of St. Michael's will be found described in the next section.

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* There is a rock and reef (the *Lobeira Rock*) lying S.W. by S., three-fourths of a mile off Point Albufeira (which is 4½ miles East of Villa Franca). It is not volcanic, but has always been known. It is not on the early charts.

† In a letter to the editor, dated 28th of May, 1828, Captain Livingston says:—"The *Ilheo* seems to be filling up with sand. The most of the rock is a kind of conglomerate of lava, in detached pieces, sand, debris, and pumice-stone, and on the East side it seems gradually wearing away. The highest part appears about 80 feet high. There are cultivated terraces on it, with cane-reeds, planted for shelter, and they grow not only potatoes and maize on it, but there are even a few poor vines, and some fine heath 3 to 4 feet in height.

"The singular volcanic *Peak of Camarinhas*, on the West end of the island, was the last active volcano in St. Michael's."

Don Vincente Tofiño, in his description of St. Michael's, states that POINT FERRARIA, the westernmost point of the island, is high and sloped, but a low point projects from it into the sea, so as to form a rocky ridge to the S.W. At the distance of a league from land this ridge has over it from 7 to 10 fathoms of water, and a heavy sea rises over it, very high.* The little harbour of MOSTEIROS, to the N.E., serves for boats only. Of the islets here, the largest is high, sloped, and smooth at its summit, with an aperture, through which the sea passes from one side to the other.

NORTH SIDE OF THE ISLAND.—Between the Ponta dos Mosteiros and Ponta da Bretanha the land of the coast is high and rocky, and it forms the Bay of *Joam Bom;* at the bottom of which appears a very sharp-pointed mountain, called the *Pico de Maffa,* which serves as a very useful mark for ascertaining the coast.

Within the Ponta da Bretanha, and extending eastward, is the long village of Bretanha. The country here is highly cultivated, and pasture land.

The *Villa da Ribeira Grande,* already noticed, is rich, stored with all kinds of provisions, and abounds with good water, but landing is practicable only when the sea is very smooth.

PORT CAPELLAS.—The following description of this small harbour on the North side of St. Michael's is by Mr. Hunt, the British consul:—"Persons having stated that the bottom of the North side of St. Michael is foul in the anchoring depths, and that no vessel would be likely to recover her anchor if she brought up there, I thought it may duty to take the earliest opportunity of proceeding thither, with the agent for Lloyd's at this port, for the purpose of ascertaining the truth of these assertions.

"The result of our survey was, that at about half a mile distant from the shore, between Ribeira Grande and Capellas, there is a line, which, with occasional projections towards the land, separates the foul and stony bottom of the coast from a perfectly smooth and firm bed of fine sand, sloping to seaward; that, along this line, the depth varies from 25 to 35 fathoms; and that, from the rugged nature of the coast itself, the small port of Capellas is the only part at which it would be safe for boats to disembark." In a small plan, also by Mr. Hunt, the marks for anchoring are, first, the outer point of the port on with the Morro of Rio Grande, bearing E. by S.; and, second, *Point St. Antonio* on with *Point Minho.*

The N.E. POINT of the island is *Ponta da Ribeira;* at 1¾ miles to the S. by W. [*S. by E.*] from this is the *Ponta del Arnel,* having a small port of the same name, but it is unsheltered, and the bottom rocky. The two points are of equal height, but between them is a slender bay, with sloped rocky land, in the middle of which is a very remarkable glen, wherein is a small river.

The distant view of St. Michael's is sometimes deceiving, in consequence of the haze which frequently covers the land; and the following observations will be useful in explaining any uncertainty which may be felt in making this island. Captain Midgley says:—"On the 26th of September, 1840, at daylight, I hauled up on a N.E. by E. course, by compass, to make *St. Michael's,* with a moderate S.S.E. breeze and fine clear weather. At noon saw the West end of the island bearing N.E. ½ E., and although the weather was apparently clear in every other part, a small portion of the land could only be seen, the remainder being covered with clouds and haze. The above bearing and observed latitude placed the ship 31 miles from the West end of the island. At three p.m. saw the eastern extremity of the land distinctly, but could not make out the land in the centre of the island; indeed, the haze which hung over it so completely deceived me for some time, that I considered TWO islands were in sight, and that I must have made some mistake in my observations; but, on drawing nearer to the land, as the sun approached the horizon, the fog dispersed, and I had a good sight of the centre of the island also. After sunset, the evening was fine, with

* There is a similar ridge, with islets on it, extending about a league from Point Matogos, the N.W. point of the island: it has from 2 to 6 and 7 fathoms over it.

serene clear weather. At eight p.m. the light of Ponta Ferraria was seen at 10 miles off—but such a light! had it not been marked on the Chart, I could not have believed it reflected from a lighthouse established for the direction of shipping—the light was really miserable: and, as it was not shown until long after every trace of daylight had disappeared (for the weather was quite clear, and a careful look-out kept for it), the light which was seen might have been reasonably supposed to be that of some fisherman or passing vessel. (It has since been stated that no lights are exhibited.)

"On December 31st, 1841, I intended to pass to the southward of St. Michael's, but a scant wind obliged me to bear up for the West end of that island, on passing which it had again the appearance of two separate islands, with well-defined extremities to each, the land in the centre being covered with fog and haze. When seen from the northward, on the following day, it had again the same appearance, that of two separate and apparently well-defined islands."

ISLE OF ST. MARY.—The preceding description of the appearances of St. Michael's will apply generally to St. Mary's, and the other islands. The town is on the South side, toward the West, on a bay, in which there is an islet; and between this island and the land is the anchorage, with a depth of 6 and 5 fathoms. For the position of the town and the chief points of the isle, see the Table.*

St. Mary's has a town and three villages, with about 4,500 inhabitants. Its chief productions are wheat and barley, of the first quality, with wine and cattle; but only sufficient for its own consumption. It has water in abundance, but of wood little, and a scanty proportion of fruit and vegetables.

"The Island of St. Mary is about 7 miles in its greatest, and 5 miles in its smallest, diameter. It has nearly in the centre the double-peaked mountain of Pico Alto, 1,889 feet in height, which falls on the East and West sides to a shelving base of about a mile in breadth, and 850 feet above the sea. To the North and South it throws out a range of undulating heights, which terminate at the sea in lofty mural cliffs of more than 200 feet elevation. The East side of this range is covered with hills, diminishing in altitude as they recede from the centre, and intersected by numerous gorges of increasing width and depth, the channels by which the heavy rains of winter reach their points of discharge. The West side is a slightly inclining and undulating plain, also cut by ravines, terminating in cliffs more than 100 feet high. The aspect of St. Mary's is therefore on all sides perfectly bold; the central peak distinct; the subordinate range high and of varied outline; and the coast abrupt, precipitous, and based by the usual accompaniment of fallen masses.

"In its geology, St. Mary's is not like the other islands, where the surface of recent volcanic matter conceals whatever may have been their original constitution, or the progress of their growth. It is of trap formation, and contains in its beds of marine shells proofs of its elevation from the sea, but there are some points of similarity in its structure to that of St. Michael's; this is also the case with respect to Madeira, and still more to Sicily."†

"On the 31st of December, 1841," says Captain *Midgley*, "at sunrise, with very clear weather, I made 'St. Mary's,' bearing E.N.E. by compass, distant 45 miles, at which time the land appeared from the deck to be like two small well-defined paps, rising out of the water close together; but on a nearer approach on the same bearing it appeared like a saddle land, which appearance it retained until the summits of some of the lower hills became visible."

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* Immense quantities of molluscæ, or sea-worms, are certain signs of the proximity of St. Mary's. Some of them are of a white colour, or of arrow-root mixed with hot water, and are about 18 inches long, with orange spots on them, like the eyes of a peacock's tail. —*A. Livingston.*

† From a description of St. Mary's by Mr. consul C. Hunt, in Journal of the Royal Geographical Society, vol. xv., 1845, p. 260, *et seq.*

PONTA DO CASTELLO, the S.E. point, is high, and has a break, which forms a peak, in the shape of a sentry-box. A vessel may anchor with this point S.W. by S. [*S. by W.*], and close to it in 10 fathoms, bottom of sand.

On the EASTERN COAST, at 2¼ miles N.N.E. [*N. 2° W.*] from Pta de Castello, is the *Ponta dos Cedros*, which is likewise high; between these is a small point, off which is a low rock, at 3 or 4 cables' length from the coast, called *Mulha Rock*, but between it and the coast is a clear passage of 12 fathoms, in mid-channel, at half-flood.

At N. by W. [*N.W. by N.*] 4¾ miles from Pta dos Cedros is *Ponta dos Matos*: between is the *Pta. de la Feiteira*, with the Islet and Port of *San Lourenzo*. The point is is high and remarkable, when near the coast: the islet is likewise high, and, on the eastern side of it, has a cave, into which the sea enters, and where a boat may be sheltered.

The Port of SAN LOURENZO is formed by the Islet and Ponta dos Matos, which are a full mile distant from each other. The bottom is sandy, and between the points is a depth of 10 fathoms, increasing gradually outward, but the depth of anchorage should not be less than twenty fathoms. Water may be readily obtained here by making hollows, or small pits, in the sand on the beach, where the least excavation produces water of the best quality. There are several houses and a church close to the beach.

The PONTA DAS LAGOINHAS is the N.E. point of the island. The Islet Lagoinhas, which lies off this point, is high, and sloped like a mitre; and, on being seen, in an East or West direction, exhibits a small level point, extending a little way into the sea. A rock, lying between the islet and land, obstructs the passage to large vessels.

The NORTH SIDE of the island affords neither shelter nor anchorage; the whole of the western side is low and uniform.

The PORT and TOWN are situated, as already noticed, on the S.W. side of the island. The bottom here is sandy, and in some parts rocky, with from 10 to 4 fathoms of water. The rocky part is on the western side, and the eastern is the clearest. The *Ponta da Marbao* is the easternmost part of the bay, and this, with the next point to the eastward, *Malbusca*, form a larger bay, divided into two parts by a black point, *Pedrera*. The coast hither, from Point Marbao, is the most regular, and is called *Figueral*; on the top of it is a remarkable rugged mountain, but it is not so high as those on the North side of the island. Ponta de Malbusca is high, and stands at a distance of two miles to the westward of Ponta de Castello, the S.E. point of the island.

The ROAD OF ST. MARY is open, and exposed to southern gales. On this account it is resorted to, in summer, by small vessels only. In order to be ready for a start, it is proper to anchor to the S.E. of Marbao Point, opposite Figueral, already described. The best, anchorage, known to the pilots, is about a mile from the coast, in a line with Malbusca Point, and with the castle at the S.W. part of the town of St. Mary entirely open of Marbao Point. Here is a depth of 36 fathoms, bottom of sand; but, at a short distance eastward, the ground is foul. Hence it is that Port San Lourenzo, on the N.E. side, is considered as the best anchorage about the island. At either place refreshments may be obtained, as at the other islands, with the addition of partridges, which abound here.

THE FORMIGAS BANK AND ROCKS lie N.E., *true*, from the N.E., and nearest, point of Santa Maria, 19¾ miles distant.* It is formed by a submarine

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* Captain A. T. E. Vidal, who has surveyed these islands, says, with respect to Tofino's representations of the Formigas:—"It is with regret and vexation I have to state that I find Tofino considerably in error in that celebrated hydrographer's work relative to this locality. The true bearings of Punto Castello, as ascertained by Captain Vidal, differ from those of Tofino 4° 34′ more westerly, and Pico Alto 6° 18′ more westerly. This difference in bearing is on a distance of 22 miles. Although my observations on board the vessel with

mountain of very irregular elevation, and which, traced to the depth of 200 fathoms, was found to extend 6½ miles N.W. to S.E., by about 3 miles in greatest breadth.

Near its western margin there is a narrow cluster of black rocks, known as the Formigas, (or *Ants*), which are about 800 yards in length by 150 in extreme breadth, their relative direction being N. 25° E. and S. 25° W., or *North* and *South, true*. The southernmost of them, for about 350 yards, forms rather a closely connected mass, having a small bay on the West. The northern ones are more separated from each other, and all are of comparatively little elevation, but the profile exhibits a few hummocks. That on the southern extremity, which is 27 feet above low-water springs, and is in lat. 37° 16′ 14″ N., long. 27° 47′ 6″ W. Variation, August 17th and 18th, 1843, 25° 17′ W.

The most elevated rock of the group, named *Hormigon*, by Tofiño, is 35 feet in height, and stands on the eastern side, about 200 yards from the northernmost rock, and somewhat more isolated than the others, and having an inclination to the southward.

With smooth water there is no difficulty in landing, particularly on the southern rocks; but in strong winds or a high swell the sea rolls over them all, leaving a blank naked surface entirely devoid of vegetation. At 130 yards South of the southern Formiga is another small rocky shoal patch, visible at low water, the channel between having 5 to 15 fathoms. Again, 600 yards South of the South Formiga is another small rocky patch, having 4½ fathoms on it at low water. It is steep-to on all sides but the North, where it is connected with the rest by irregular depths of 8 to 14 fathoms.

On the North the Formigas may be approached within a few yards, but a narrow ridge runs out 400 yards with varying depths, but no danger. It has 18 fathoms on its outer end, and immediately drops on to 30 and 50 fathoms. On the East and West the Formigas are quite clear, with deep water close up to them; on the West the bank extends half a mile, but all very deep water.*

Tofiño thus describes them:—"The FORMIGAS are some rocks which navigators have considered as extremely dangerous, imagining a great part of the space hereabout to be strewed with sunken rocks, and therefore to be avoided; but, having examined these dangers, it is proved that the whole of them are visible, concentrated, and clear, and that vessels of any burden may steer for them, in order to pass on the North and South side, as may be most convenient."

Other rocks also exist, as shown in the next paragraph, at the distance from them of about 3½ miles to the north-eastward. We derive our knowledge of the latter through the favour of Captain Livingston.

Dollabarats' Shoal.—*To the S.S.E. of the Formiga* there is a danger, which was shown on a chart of the Atlantic Ocean, 1766, but afterward omitted in other charts, from want of positive information as to its existence. This shoal was seen by *P. Dollabarats*, commander of the ship *La Marie de Seboure*, in 1788, on his return from Martinique to Bayonne. On the 7th of March, at 3 p.m., when about to double the Formigas, at the distance of three-quarters of a league, he descried a breaker to the S.E. of his ship, which appeared to extend a league *true North and South*. He observed, that it lies *S.E.* 5° *S.* (*true*), at the distance of 1½ leagues from the Formigas.

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sextants perfectly confirmed the true bearing obtained with the theodolite, I was unwilling to think Tofino could be in error. I therefore landed again the next afternoon a little later, to have a lower altitude, and that second day's result was Punta Castello S. 29° 2′ W., and Pico Alto S. 40° 36′ W.; Tofino or his people are therefore in error." This correction will place the danger about 3′ of longitude to the eastward of its assumed position, and in the same latitude.

* Account of the Formigas Bank, by Captain Alex. Vidal, R.N., Journal of the Royal Geographical Society, vol. xix., 1848, p. 160.

A new and very beautiful brig, the *Zillah*, Martin, of Dundee, bound to Hayti, struck on a sunken rock "off the Formigas," at 10 o'clock in the night of the 9th of April, 1832, and was abandoned at 3 p.m. of the next day, having then 7 feet of water in the hold. About midnight she was seen to go down. Crew picked up and saved by the *Morley*, of London.

Captain J. D. Markland, of H.M.S. *Briton*, in a letter dated 20th February, 1832, writes:—"I hove-to for the night between St. Michael's and St. Mary's, being anxious to see the Formigas Rocks; and soon after daylight, with a thick morning, we fell in with a very dangerous shoal breaking heavily, and as the fog cleared away we saw the Formigas. When the rocks and the shoal were in one, the shoal bore from the rocks S.S.E. about 3 miles. This must be the *Dollabarats' Shoal*. The Formigas are properly placed."

In confirmation of this statement, the following appeared in the *Shipping Gazette;—Notice to Mariners*.—Lisbon, Dec. 6th, 1843. A notice has been issued by the Minister of Marine, to the effect that a shoal, with 11½ feet of water on it, has been discovered about 4 miles to the south-eastward of the "Formigas," or Great Formiga Rock, in the vicinity of the Azore Islands.

Captain Vidal has set the question at rest, and has accurately fixed its position. "Dollabarats' Shoal bears (*S.* 44° *E.*), *true*, from the Formigas, distant 3½ miles, and is in lat. 37° 13′ 30″ N. We anchored close to it, and scoured the ground with our boats. It is a fearful danger: the least depth we found on it was 11 feet at low water. "It consists of two or three rocky heads or knolls, which at low-water springs have only 11 feet of water on them. At that time of tide their position is marked by several large white patches, which may be distinctly seen, especially so in bright sunny weather. The shoal is near the southern edge of a rocky ridge, which extends from it N. 15½° E. 1 6-10th miles. The soundings over it are most irregular, varying from 14 to 50 fathoms at its edges, but there are no actual dangers on it. The Dollabarats' Shoal is a very insidious danger in smooth water, but in stormy weather the sea breaks over it with great violence."

Tulloch Reefs.—In 1808 Captain William Tulloch, of the brig *Equator*, of Portsmouth, New Hampshire, on a voyage from Madeira to St. Michael's, was alarmed by some of his crew seeing breakers. He counted distinctly twenty-one heads of rocks, none of which appeared to have much water over them, and two of the rocks show occasionally above water in the wash of the sea. Their extent, the captain thinks, did not exceed half a mile from North to South, and was still less from East to West. They bore E.N.E. by compass from the highest rock of the Formigas, then in sight, distant about 10 miles, and appeared very black below water.

The breakers on the Tulloch Rocks have been stated to have been several times seen since 1808; among others, by the *Ayrshire*, bound from the Clyde to Demerara. Mr. Ferguson, the mate of that ship, gives their situation as about *nine* miles E.N.E., by compass, from the Formigas.

Captain J. Henderson, commanding the ship *Fortescue*, from Mauritius to London, states that he saw the Tulloch Cocks on the 17th of April, 1829. Breakers were observed for half a mile East and West. The Greater Formiga and breakers in one bore. W.S.W. (by compass), the former about 4 leagues, and the latter 2 miles distant. There appeared to be several heads near the surface of the water.

Notwithstanding all that has been asserted as to the existence of this reef, it was not found by Captain Wilkes, U.S.N., in 1838; and Captain Vidal, R.N., in order to set the question of its existence in some better light, sought minutely for it. In the first instance, the steamer was started E.N.E. from the Formigas, and carried out 14½ miles in that direction, sounding, at frequent intervals, with 200 fathoms, without reaching the bottom. She returned, traversing *across* this bearing. On three subsequent trials, with all caution and look-out, no signs of shoal water or soundings were obtained. "We must express our opinion," says Captain Vidal, "upon this reputed danger, as formerly upon the apparently well-authenticated statements relative to the Aitkin Rock. It looks very like a whale, but, seeing the difficulty there is in discovering small rocks beneath the surface of the ocean, we by no means presume to assert that Tulloch Reef does *not* exist, but we entertain a very decided opinion that it will not be found in the position which has been assigned to it." It is again noticed hereafter, among the shoals of this part of the ocean.

VOLCANOES BETWEEN TERCEIRA AND ST. MICHAEL'S.—It is stated that, in 1719, a volcano appeared at 15 leagues to the westward (query, north-west) of St. Michael's, and disappeared in 1723, and was supposed to occupy the situation of that which had appeared in 1638. It is also stated, that in 1720 an island appeared at the S.W. extreme of St. Michael's, about a mile from shore; this, perhaps, is connected with the other statement, but is not very circumstantial. But we have the following accounts of this occurrence:—Mons. Ségur Dupreyon has found some documents relating to it in the French colonial archives; the first states that at the end of 1720, a volcano broke out at 28 leagues off St. Michael's, towards Terceira, which formed two shoals. A second statement affirms, that it ejected large quantities of pumice. A plan was also forwarded to France of the new islanded, though it could not be approached, in consequence of the jets of boiling water which were thrown upwards of 120 feet high. The consul announced that, on July the 7th, 1722, this new island had sunk down, and could only be distinguished by breakers.*

In the "Philosophical Transactions" is a much more complete account of this volcano. It is dated May 12th, 1722. In that communication, it is described as lying 17 leagues S.E. from Terceira. "The fire broke out on November 20th, 1720, in the night, and the prodigious noise it made caused an earthquake, which shattered down many houses in the town of Angra and places adjacent, to the great terror of the inhabitants." The governor went to the island a month afterwards. "In the afternoon, we made an island all fire and smoke; we continued our course till the ashes fell on our deck like hail or snow all night. We bore from it, the smoke and fire roared like thunder or great guns." "Prodigious quantities of pumice-stone, and half-broiled fish, were found floating on the sea for many leagues round the island, and abundance of sea birds hovering about it." "This island is almost round, and supposed to be about 2 leagues in diameter. By good observation, it is 38° 20'; its long. 26° 33'.†

More recently a dangerous shoal has also been reported to exist between Saint Michael's and Terceira, seen at the latter end of 1848. These notices were transmitted by H.M. consul, T. C. Hunt, Esq., to Lloyd's. In substance they are as follow:—Benjamin Pratt, of the *William*, on December 31, 1848, saw breakers, mast high, evidently caused by a shoal, and not by a floating mass. The observations then taken place it in lat. 38° 16' N., and long. 26° 41' W. The next is the declaration of Victorino Falcao, of the *Tres Amigos*;—On December 31, 1848, saw a shoal where the sea broke the height of a ship, at intervals of about ten minutes. By calculation it is in lat. 38° 18' N., and long. 26° 50' W. The third is the declaration of George Perkins, of the *Plymouth*:—On December 25, 1848, I saw the sea breaking heavy at the distance of 2½ or 3 miles to N.N.W. A heavy sea was running, and the water broke 60 feet high in different places, at intervals of about ten minutes, as if on an extended shoal, having several heads. It was certainly not a floating obstruction; I consider it a narrow reef, about a mile in length, running from N.N.E. to S.S.W., about 40 miles W.N.W. ½ W. (by compass?) from the N.W. point of St. Michael's.

In Mr. Hunt's observations on the earthquake of 1841, presently alluded to, he says:—"It is by no means a great stretch of hypothesis to suppose that the late earthquake has, like some former ones, been accompanied by the ejection of submarine volcanic matter, which may have been thrown up within a short distance of the surface: so that, in fact, in that part of the sea where there was previously 200 fathoms of water, there may at this moment exist a most dangerous shoal.

"As in navigation the extreme of safety should always be chosen, the commanders

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* Comptes Rendus de l'Academie Française, 1838, p. 302.

† "Part of a Letter from T. Forster, Esq., F.R.S., to Mr. Machin, Sec. R.S." Phil. Trans., 1722. To this description are attached several views of the island, which were taken at the time.

of vessels approaching Terceira would do well to keep a good look-out, and be prepared for indications of shoal water, at from 15 to 20 miles to the eastward of it."

Another announcement is, no doubt, connected with the same volcanic centre. It is in the "Nautical Magazine," July, 1843, p. 482, entitled "Malabar Bank." Extract of a letter from Capt. Sartorius:—" In lat. 38° 57′ from the observations at noon, and long. 26° 5′ by chronometer, and from supposed most correct bearing of the land, the north-east end of Terceira, taken at 8 a.m., given lat. 38° 57′, long. 26° 56′, the ship grazed over, apparently, a shoal of about her own length. There was no sudden shock, no appearance of discoloured water, or any other indication of the vicinity of rocks or shoals; and at the time the motion was felt the ship was going 8 knots, wind aft, and studding-sails set.

"I immediately shortened sail, and sounded with 180 fathoms; no bottom. There was too much swell to risk a boat for examination. My own individual opinion is, that it is as likely to have been the shock of an earthquake as passing over a shoal."

This spot will be about 30 miles to the north-east of the reported situation of the submarine volcano above described, and if the reader will turn to the Ethiopic Memoir, 1844, p. 80, he will find that a submarine shock and grounding on a shoal give precisely the same sensation in a ship. That this was a shock that Captain Sartorius felt, there can be but very little doubt, and it is most probable from the same volcano. We must, therefore, recommend to the seaman's notice the cautions of Mr. Hunt, as given above.

But notwithstanding all this evidence, there has been no indication of any shoal or elevation found in a search all over this channel, as no bottom has been found with from 180 to 200 fathoms of line. This, however, only proves that there is no present danger, but it is quite possible that the volcanic action hidden here is capable of raising the bottom to the elevation above described.

TERCEIRA.—This island is fertile, pleasant, and healthy; the lava districts here, as at St. Michael's, produce excellent vines, although not equal to those of the Canaries and Madeira. The land yields large crops of wheat and other grain, pasture for cattle, and a prodigious quantity of lemons, oranges, and all those fruits of hot and cold climates which are propagated to the greatest advantage in temperate countries. The capital, as already noticed, is ANGRA, on the South side of the island, having a harbour, defended by a fortress, in which resides the governor of the Azores. Angra is distinguished by several handsome churches, convents, &c. Besides this, there is another town, *Praya*, and fifteen villages, all of which contain about 30,000 inhabitants. In the bay of Angra, and around the island, fish, of a good quality, is abundant.

The coasts of Terceira are high, and so surrounded with craggy rocks, as to render the island almost impregnable. The interior is, in general, moderately high, but the western side is higher than the eastern, and is distinguished by a rugged mountain, extending nearly East and West, and of which the western extremity, *Pico de la Serreta*, is the most elevated. This peak may be known by a great break on the eastern side, at a short distance.

DESCRIPTIONS, &c.—The part of the island* in which Praya is situated, is the most fertile of the whole; on which account it was the part selected by the first discoverers for their residence, and its population was entirely agricultural. It is the part from which levies were principally made to resist the landing of an expedition in favour of Don Miguel, in August, 1829; when a small military force, with their assistance, and the possession of the strong forts on the Bay of Praya, beat off the much superior force of Don Miguel.

The town of Praya had, in the year 1614, been totally destroyed by an earthquake, which considerably injured the town of Angra, and was severely felt in the Island of

* The following account of the island, and the great earthquake of 1841, we have taken from a communication, by Mr. T. C. Hunt, the British consul at St. Michael's, to the "Nautical Magazine," September, 1841, pp. 631—633.

St. Michael. Since that time it had escaped injury, although menaced by many severe shocks of earthquakes.

On the 12th of June, 1841, at 4 p.m., a violent shock of earthquake was felt at Praya, extending with diminished violence to the westward. At $5^h 25'$, a second and more violent one was felt; the trembling continued throughout the 13th, and on the 14th an undulation destroyed all the buildings which had been weakened by the former shocks. The inhabitants of Praya then retreated to the fields for safety. During the 14th the motions were slight; but on the 15th, at 3 a.m., a violent trembling and horizontal undulation commenced, and continued, with intervals of about ten minutes, until $3^h 30'$ a.m., when a strong vibratory and distinctly visible rocking motion of the surface threw down the entire town of Praya, and injured many other parts of the island. The ground remained comparatively quiet until $2^h 40'$ a.m. of the 16th, when another violent shock did further damage. After this no further damage was done, but the island did not become perfectly quiescent until the 26th of June.

It was observed, with respect to the whole progress of these phenomena, that the motion was greatest at Praya, where a rent has been left in the ground of about an English mile in length, from the edge of the water stretching westward; and that every convulsion was preceded by a loud subterraneous noise, resembling thunder, so exactly varying in intensity according to the severity of the succeeding shocks of earthquake, that the first became the harbinger and gauge of the other.

The number of houses destroyed was estimated at 800, besides other considerable damage, amounting to the value of £180,000.

The less severe shocks did not extend beyond the Island of Terceira, others were experienced of apparently equal force at St. George and Graciosa, and only that which destroyed Praya was felt (but not severely) at the capitals of Pico and St. Michael's. At Fayal, and at the eastern end of St. Michael's, no motion was perceived.

It is therefore probable that the origin of this earthquake was a submarine volcanic eruption, and that its position or centre was about 17 *miles due East from the eastern end of Terceira.** This has been practically confirmed by the accounts of the volcanic shoals before described.

Angra lies on the South side of Terceira; it is the capital of the island. At the town provisions are cheap, and in plenty. The bay may be readily known by means of a remarkable forked hill, near the sea, on the West side, named *Monte Brasil*,† and by two steep little islets, called the *Cabras*, or *Goats*, which lie about 4 miles to the eastward of the mount. About 2 miles to the south-eastward of these islets is another, called *Los Frayles*, with breakers near it.

In approaching from the S.W., South, or S.E., steer directly for Monte Brasil. Should the wind be adverse, when approaching the land, tack boldly without the bay, as there is a sufficient depth over it, and up to the shore.

But beware of a calm, as the currents are very strong and variable. If you have not a leading wind, when sailing up toward the mount, avoid too near an approach to the coast, between it and the westernmost part of the island; as it would in a calm be attended with the utmost danger; the coast being iron-bound, a ship driven on it would be in a most perilous situation.

The Bay of Angra is open to all winds from S.S.W. by the South to the East. The swell from the S.W., in particular, which sets round Mount Brasil, on the western side of the bay, is tremendous. The ground at the entrance is foul, and

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* This proposition has been ingeniously argued out by Mr. Hunt, from the various degrees of intensity that the shocks were felt in the different bearings and distances; by arranging these together, it fixes the centre of the action as above.

† See the particular plan of the Road of Angra, on the Chart.

ships should always moor to the northward of Fort St. Antonio, which is on the West side of the bay.

Vessels may safely remain in the road in June, July, August, and September, when the winds are light, and prevail from between West and N.W. But, on the commencement of winter, the winds from the offing rage so violently, that, upon the least appearance of bad weather, it is requisite to put off to sea, the coast affording no shelter.

Porto Praya, or PRAYA BAY, on the eastern side of Terceira, has been described as the largest and safest bay in the Azores. "This bay," says M. Fleurieu, "has the form of a crescent; the point toward the North has, at its extremity, a small islet to the N.E. To lie in the best place, this islet must shut in with the point, and the two towers seen on the bottom of the bay must be brought together; you will then be in 24 fathoms, sandy ground, the town bearing N.N.W. and North. You may also anchor nearer to the shore, in 20 and 16 fathoms. The boats must not attempt to land at the bottom of the bay toward the S.W., on account of a sand-bank, upon which they would ground; but they will find a good landing-place near the castle."

The FOLLOWING is a more PARTICULAR DETAIL of the COASTS of TERCEIRA, abridged from Tofiño.

The *Mount of Brasil*, near Angra, is moderately high, and has two small columns, or pillars, at the top, which serve as look-out places. The hill descends gently toward the North, and at its base, on that side, is the *Citadel or Fort of St. Juan*, the chief defence of the island, and particularly of the city of Angra, which stands to the northward and N.E. of it. From the citadel, a line of wall and batteries extend to *Fort S. Antonio*, on the East side of Mount Brasil; the opposite, or N.E. side of the bay, is defended by *Fort S. Sebastian*.

Merchant vessels regularly anchor in the line of the forts S. Antonio and S. Sebastian, or rather further in, mooring with the four anchors. This is necessary, the bay being open to the sea from S.S.W. by South to East, and therefore extremely unsafe when winds from those quarters may be expected, the coast being mostly of sharp rocks. Large ships anchor to the eastward of Mount Brasil, in from 30 to 40 fathoms of water, sandy bottom, and they must be ready to get under way in the instant that the wind appears to be coming on from the south-eastward or south-westward.

On the western side of the castle of S. Sebastian is a little beach, slightly sheltered by a wall of the castle. It is called *Puerto de Pipas*, and is the spot wherein fishing-vessels are secured, by grounding them on the sand. It may serve as a landing-place when the wind will not allow you to land at the mole.*

The boats of the island come out so soon as any vessel is seen to anchor, and by them supplies may easily be obtained, even while keeping under way, tacking in and out, as they will bring water, wood, and all kinds of provisions.

The *Ponta de las Continendos* is the S.E. point of the island. It presents an eminence, having three peaks on its summit. At about halfway between this and Angra are the *Cabras* or *Goats*, already noticed, which lie S.E. by E. [*E. by S.*] 4 miles from the summit of Mount Brasil, and two-thirds of a mile from the nearest part of the coast. Of the two islets, the eastern is the largest and highest: when seen from the East or West, it appears like a wedge. Between the islets is a channel for row-boats, with from 8 to 10 fathoms of water: between them and the coast a ship may pass, as there are 9, 12, and 13 fathoms of water, with sandy bottom, and rocks near shore only.

The *Frayles*, or Friar's Isle, before mentioned, is a low islet, having two pyramidal peaks. A shoal extends from the S.E. side of it, about a cable's length, over which

* It is sometimes much easier to land on the rocks under the cliff, on the Mount Brasil side of the bay, than at Puerta da Pipas. A footpath, of difficult ascent, marks the proper spot to attempt landing at.—*A. L.*

the sea breaks. Several cliffs on the islet give it the appearance, at a distance, of several isles. A ship may pass, with all safety, in the channel between this and the Cabras, the depths being from 60 to 75 fathoms, gravelly bottom, and clear ground.

The eastern coasts of Terceira is generally broken, rocky, and dangerous. The easternmost point is that named *Malmeranda*, which is high and oblique, with a large shoal near to it, which shows itself at low water. To the south-westward of this point is the town of PRAYA, defended by batteries. The bay on which this town is situate is of great depth, with good holding-ground, and a fleet may anchor here, sheltered from the South, by the West, round to the North, but entirely exposed to the eastward: the safest anchorage, therefore, is with Point Malmeranda in a line with the northern islet, Cameiros, and the highest tower or steeple of the town, which is the northernmost, open to the West. Here is a depth of 25 fathoms, with sandy bottom; and, as at Angra, supplies may be obtained from the boats of the place.

REMARKS ON TERCEIRA, *by Captain Livingston*, 1822.—" At about 6½ or 7 miles North of Angra, in a valley near the summit of the mountains, a great deal of steam issues from crevices of the earth, or rather clay, which clay, I am informed by a scientific gentleman here, is actually lava, decomposed by the action of sulphuric acid. Some of the clay looks, when cut by a knife, much like Castile soap: it is of various hues, and the natives of Terceira use it as paint. There are small quantities of sulphur formed around some of the apertures. The steam which rises is very hot: we cooked some eggs by laying them among the clay, at mere cracks whence steam issued. My thermometer ranged only to 152° of Fahrenheit's scale. I exposed it to the steam at the first aperture I reached, but the mercury rose so rapidly, that, from fear of bursting the tube, I was obliged to withdraw it, I think, about three or four seconds. Persons visiting Angra, who have any curiosity in their composition, should see this *furnaso* or *souffriere*. The access to it is by no means very difficult, though, if you ask any of the Portuguese, they will describe it as accessible only at some periods of the year. One may ride to within less than half a mile of it. Ponies, or asses, and guides, may readily be hired.

" Some vessels, mistaking Praya for Angra, have stupidly run in there; but the Goats and Mount Brasil are sufficient to show the most entire stranger the difference: I annex a sketch of the former.

The GOAT ROCKS, as sketched at nine a.m., 25th January, 1822, when about 2 miles distant, the weather being hazy, and the tops of the mountains of Terceira covered with dense masses of clouds. Point at the left bearing N. by E. by compass, and that at the right hand N.E. ½ N. also by compass.

" Bloody flux is very frequent both among strangers and natives, and is often fatal. A Scottish surgeon there told me, it was the worst disease he met in the island.*

" Vegetables are excellent and cheap. Poultry and eggs good and reasonable;

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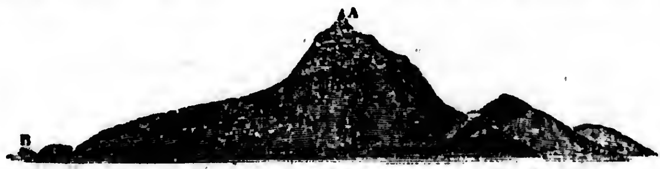
* It deserves to be known, that the size of a hazel-nut of Castile soap, scraped fine and dissolved in about three wine-glasses of boiling water, to which add half a wine-glass of good spirits, and a few lumps of white sugar, scarcely ever fails of curing bloody flux. Two or three doses may be required. I have tried it on myself and others with great success. —*A. L.*

beef and mutton tolerable, the former about threepence per pound. Some of the island wine is tolerably good.

The North Coast of Terceira should not be approached by a stranger, as it is rocky and dangerous. The western coast is also inaccessible.

PICO.—This island derives its name from the remarkable peak or volcanic mountain which stands upon it. The summit of this mountain, whose sides are neither very steep nor uneven, is terminated by a small sugar-loaf, so very regular, that one would think it had been made by art. The height of the peak, above the level of the sea, according to the geometrical operation of the French astronomers, is about 1,172 English fathoms; by the survey of Capt. Vidal it is 7,613 feet: and, consequently, in clear weather, it can be seen 24 or 25 leagues off; but it is frequently so obscured by clouds, as not to be seen at any distance. When the southernmost point of Fayal is in a line with the peak, E. by S., this mount appears as shown before.

The peak has been described as filled with dark volcanic caverns, which have frequently emitted smoke, flames, and ashes, to a considerable distance. At the foot of the mountain, toward the East, is a spring of fresh water, generally cold, but sometimes so heated with the subterraneous fire, as to rush forth in torrents, in a boiling state, and sending forth a stream of sulphureous vapours, vitrified stones, &c.



Pico, when the Peak (A) *bears E.S.E. by compass*—(B) *E. by S.*

Pico contains about 22,000 inhabitants, who occupy three towns and eleven villages. The soil being stony, little grain is produced, and the greater part of the wheat and maize, for consumption, is imported from the neighbouring islands. The wine is the staple commodity, and is reputed the best in the Azores. This, with brandy, is exported in considerable quantities. The cattle are various, numerous, and excellent; fruit is abundant, and equally fine. Besides these, they have cedar and other timber, including a beautiful kind of yew, called *Teixo*, which is remarkably solid and fine.

The S.E. point of the island, which is rather low and sloping, is named *Ponta de la Ilha*; a ridge extends from it to the eastward, 1 cable's length. The next projection, on the South coast, is *Pta. de Calheta*, or Nesquin, distant 5 miles, W. $\frac{3}{4}$ S., *true*; between are the little harbours *Muelle de Manana* and *Nesquin*, fit only for coasters, which may ground on the sand, the bottom being generally rocky. At N.W. by W. [*W. by N.*] $6\frac{3}{4}$ miles from the Pta. de Caleta is the *Pta. de Arrife*, which is rather more elevated: the coast between continues rocky, and is not to be approached by strangers. Eight miles N.W. by W. [*W. by N.*] from Pta. de Arrife, is that of Santa Catalina; the coast between forms a slender bay, in which, at $2\frac{1}{4}$ miles from the former, are the town and lagoon of Lagens; the latter communicates with the sea by means of a bar, over which the coasters pass at high water. The fishermen have another place of shelter, in *Puerto Pruima*, which is on the N.E. of the point Sta. Catalina.

On the S.W. and West sides of the island is nothing remarkable, but its rocky coast and islets. From the Pta. de los Baxios, on the N.W. side, breakers extend outward, to the distance of nearly a league, during a gale.

Off the most prominent part of the western coast are the little Port and Isle of La Magdalena. From the town, which stands here, the greater part of the produce of the island, for exportation, is shipped off for Fayal in small row-boats. The islets are surrounded by rocks; but very near the latter the depths are 6, 7, and 8 fathoms, rocky ground.

The North coast, from Pta. de los Baxios to the East end of the island, is altogether rugged, and may be considered as inaccessible.

FAYAL.—This island has been celebrated for its excellent pastures, fish, wood, &c. The air is always mild and pure; the cold of winter never felt, and the heat of summer always tempered by refreshing winds. Its inhabitants are computed at about 17,000. The island produces wheat and maize, sufficient for itself and a part of Pico. The cattle reared here are not sufficient for the consumption of the island, and supplies are, therefore, sent from the neighbouring Island of St. George, which produces a great number. The annual produce of wine is also scanty; for that which is exported here is mostly from Pico.

Fayal, when the point (A) *bears N.E. by E. ½ E. by compass, and* (B) *E. by S.*

The chief town is HORTA, on the S.E. side;* and there are, besides, nine villages on the island. The name Fayal is understood to be derived from *Faya*, the beech tree, with which, and other wood, the island abounds.

In the journal of Mr. Keilor, an intelligent master of the Royal Navy, it is stated that those who run for Fayal should not depend on the peak of the next island as a guide, because it is sometimes covered for five or six days successively.

Mr. Keilor adds, Fayal has a good bay, opposite to Pico, which is formed by an isthmus, extending to the S.E., and a point about 1½ miles to the north-eastward. Water, in general, is bad and scarce.

The S.E. point of Fayal is a mount, with a hermitage on its summit, dedicated to *Our Lady of Guia.* (*N.S. de la Guia.*) The North side of this is connected by a neck of land to a smaller mount, of a black colour, *Caimado*, at the foot of which the town of HORTA commences. Near the mount, on the West, is a sandy cove, *Port Pim*, where, in fine weather, some small vessels load and discharge their cargoes, but it is quite open to the S.W.

The northern point of the Bay of Horta is named *Espalamaca:* its bearing and distance from that of La Guia are N.E. ½ E. [*N.N.E. ½ E.*] 1¾ miles nearly. At the bottom of the bay is a beach of black sand, which commences near Point Espalamaca, and terminates at Mount Caimado. Within it is the town, facing the sea. In the latter are two very remarkable buildings, nearly alike: one of these is close to the sea-side, and was formerly called the Company's College; the other is in the most westerly part of the city, upon an eminence, and near the Carmelite Convent. These objects in a line bear nearly N.N.W. [*N.* 42° *W.*]

Nearly in mid-channel, between Fayal and Pico, is a rocky shoal, the *Chapman Rode*, of 3½ fathoms; it is about 20 fathoms in extent from N.E. to S.W. [*N.N.E.* to *S.S.W.*] and 10 broad. The marks for it are the Company's College and Carmelite Convent, above mentioned, in one; Point de Espalamanca, N. by E. [*N. by W.*] 2 1-10 miles; and the hermitage of Guia, N.W. ¼ N. [*N.W. by ¾ W.*] 1 6-1 miles. See, further, the particular Plan in the large Chart.

The regular anchorage of FAYAL is in the bay opposite to the town of Horta. It is the best anchorage in the Azores, on every account, excepting that it is open to the

* See the particular plan of the channel between Fayal and Pico, on the Chart. For a further description of these islands, see hereafter.

winds from North to N.E., and from S.E. to S.W., and these winds are frequent in winter. That from S.E. is very destructive, it blowing right in. Those who anchor should, therefore, always be prepared for a start, on a shift of wind. The safest method is to let go the anchor in 35 or 40 fathoms, where the bottom is of sand, at about 1½ miles from the town, which will be with the Point of *Joao Diaz* a little open to the right of Point Espalamaca, and the Company's College in the town a little to the southward of the Carmelite Convent, already described. From this spot a ship may depart with any wind.

In the summer season and favourable weather, the general anchorage is with the two buildings in the town as above described, but nearer to the town, in 25 fathoms, sandy bottom; small vessels proceed further in, to 20 or 15 fathoms.*

To SAIL in for the ROAD, if from the *northward*, no further direction is requisite, as the way is perfectly clear. If coming in from the S.W., with a free wind, the regular passage is between the mid-channel shoal and Mount de Guia; or if more agreeable, between the same shore and Pico, according to circumstances. With the wind from the West or N.W., take especial care to avoid the shoal, by observing the marks for it, above described.

If, on approaching the road from the S.W., the wind should be dying away from the eastward, and you intend to tack, so as to gain the anchorage, keep over toward Pico, within the distance of a mile or a mile and a half; because at a little further out the bottom is rocky, and you cannot anchor, in case of necessity; besides, by proceeding thus, you will be free from variable eddy winds and calms, which are caused the mountains; and the coast is sufficiently clear.

SOUTHERN COAST OF FAYAL.—The Point of *Santa Catalina*, which is 3¾ miles nearly W.N.W. [*W.* ½ *N.*] from Guia Point, is of low and black rocky land, and it likewise has a hermitage; between these points is the cove of *Feteira*, with its beach and village. Near it are several islets.

The Point *Castelo Bianco* is the S.W. point of Fayal. It appears like a little round mountain of moderate height, sloped on every side, so that at a distance it appears like an island. The coast hereabout is rocky, and affords no anchorage.

At the West end of Fayal are the two islets named *Capelinos*, lying in a South [*S.S.E.*] direction. Between them and the coast is a channel, which in fine weather admits fishing boats.

The Point of *Jorge Lourenzo* is the northern point of Fayal. Its upper part is high and sloping. From this point to the N.E. point *Riveirina*, the coast trends S.E. [*E.S.E.*] Point Riveirina is high and sloped, and forms a round front of about half a mile; at the foot of it is a low point, with three islets. S.W. by S. [*S. by W.*] from this point, at 2 3-10th miles, is that of *Joao Diaz*, which is low, black, and rocky, with rocks at its extremity. Between the points the coast forms a slender bay; the land is high and oblique, and it presents, near the middle, a remarkable slope of a red colour, which may be seen from the mid-channel shoal, called the Shoal of Fayal.

At nine-tenths of a mile to the southward from Point Joao Diaz is that of *Espalamaca*, on the North side of Horta Bay. It is high and sloping, with a small round front, having a vigia, or look-out, on its summit. Between these points the coast is a little indented, and has a beach, with a church at the bottom of it. Trading vessels at Port Magdalena, on the opposite side, when assailed by violent winds from the southward, frequently bear up, and find good shelter here.

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* Mr. Wm. Lane, agent to Lloyd's, in November, 1832, gave notice that, for the use of vessels passing through the channel between Fayal and Pico, or those requiring assistance from the shore, he had erected a flagstaff behind the *Castle of St. Cruz*, Fayal, and provided the telegraph flags of Captain Marryat, so as to enable them to communicate any information they wish to be reported, or to acquire immediate assistance in case of distress.

ST. GEORGE.—This island lies at the distance of 10 miles from Pico, and is separated from Graciosa by a channel 20 miles broad. It is a long, narrow island, about 29 miles long, and a little more than 3 in its average breadth. On its South coast is the little town called *Villa das Velas*, or *Vellas*, with a port where small vessels may lie sheltered from all winds.

This island, when Tofiño described it, contained more than 11,000 persons, in three towns and seven villages. He says that it produces much wine of a good quality, which it exports to Terceira and America. The island has been famous for its cattle, with which it supplied other islands, and its cheese is said to be fine. The produce of wheat and maize is equal only to the consumption of a part of the inhabitants, as the lower class substitute the root of the yam. Wood and fresh water are abundant.

On the 1st of May, 1808, a dreadful volcano, seen from Fayal, burst out about the centre of this island, in the midst of fertile pastures, about 3 leagues S.F. of Vellas. On the 3rd a crater was formed. In two days it had thrown out cinders, or small pumice-stones, which a strong N.E. wind had propelled southerly; and which, independent of the mass accumulated around the crater, had covered the earth from 1 to 4 feet in depth, half a league in width, and 3 leagues in length; then, passing the channel, had done some injury to the eastern end of Pico. The fire of this large crater had nearly subsided on the 3rd of May; but, in the preceding evening, another small crater had opened, 1 league to the northward of the large one, and only 2 leagues from Vellas. In a short time the island, heretofore rich in cattle, corn, and wine, was nearly ruined; and a scene of greater desolation and distress had seldom been witnessed in any country.

The CHANNELS among the AZORES are in general clear and deep, and may be navigated at all times: that, however, between St. George and Pico, should not be attempted, unless in settled weather, or with a steady breeze, for a sudden calm may prove fatal; as a strong current runs through the channel, according to the state of the tide.

The PONTA DEL TOPO is the easternmost point of St. George's Island. This point lies W. ¾ N. [*W.S.W.* ¾ *W.*] 27 miles from the summit of Mount Brasil, in Terceira. It is of moderate height, with rocks around it, and near its eastern part is a low islet, likewise surrounded by rocks.

From Pta. del Topo to *Pta. del Norte Grand*, the North coast presents nothing remarkable. There are several breaks on it, but it is mostly low and regular. Hence to the West end of the island, *Pta. de Rosales*, it is more rugged and barren. Off the point last mentioned are several islets, of which two very high pyramidal ones are remarkable; one of these is at the foot of the point, and the other half a mile to the S.W. of it. To the *W. by S.*, *true*, of Point Rosales, the pilots say that there is a rocky shoal of 7 fathoms. The sea may break over it in a storm.

From Pta. de Rosales to the *Morro Grande* (Great Hill), near the Port of Vellas, the coast trends S.E. by S. [*S.E. by E.*] The Morro is high, of a blackish colour, and has a vigia, or look-out, on its summit. To the N.W. of the Morro, and on its skirt is an indent of the coast, wherein several vessels have been lost, by mistaking it for the Port of Vellas, the bottom being all rocky, and a vessel, once in, cannot leave it without a change of wind.

PUERTO DE LAS VELLAS.—At 1¼ miles S.E. by E. [*E. by S.*] from the outer point of the Morro Grande is *Pta. la Caimaida*, rather low, with a small castle. Between the two points is the Bay or Port of Vellas, sheltered from winds from N.W., by the N. to S.E.

In the bottom of the bay, on the shore, is the town of VELAS or VELLAS, the chief town of the island, and on the S.E. side of this is a small mole, having 3 fathoms within it, but with rocky bottom. The regular anchorage is to the South [*S.S.E.*] of the mole, in 9 fathoms, fine black sand. Vessels moor with two anchors to the N.W. and S.E. This is a place of little consideration.

From Point Calmada, on the eastern side of Post Vellas, the coast by the sea continues low and rocky, but the land within rises to a good height. Thus it continues to the Pta. de los Monteros, the S.E. point of the island, which is high and sloped. Four leagues from the Bay of Vellas is the *Point de Caleta*, whence a high mountain rises, with a gentle acclivity, and close to it, on the East, is a town of the same name, whence much wood is exported to the neighbouring islands.

GRACIOSA.—Graciosa is said to take its name from its beauty and fertility in corn, fruit, pasture, and cattle; supplying Terceira and several of the other islands with a great part of its produce. It is the most fertile of all the Azores, and has about 8,000 inhabitants, distributed in two towns and two villages. The greatest extent of the island is only 8½ miles, but in this extent the quantity of barley which is produced is almost incredible, together with wheat, maize, wine, all kinds of fruit and vegetables. Of sheep, hogs, and fowls, the inhabitants have more than they can consume. The only scarce article is wood, for this is obtained from St. George's and Pico. The chief town is *Santa Cruz*, on the N.E. side.

Ponta Blanca is the S.W. point, and Carapacho the S.E. The mountains over these points appear at a great distance like islands, particularly on approaching the South side from the S.W. Point Carapacho is low toward the sea, and has several islets about it; but at a little distance inland it is high and craggy. At two cables' length S.E. [*E.S.E.*] from the point is the Islet *Abajo*, with others in its vicinity; but between it and the point the largest ship may pass, should it be necessary, to the anchorage of *Praya*, on the eastern coast.

Between the Point Carapacho and the Ponta dos Fanaes, 1½ miles N.E. ¾ N. [*N. 14° E.*] the coast is almost uniform and clear. At the last, the Bay of Praya commences, the North side of which is *Pta. Negra;* the bearing and distance between are N. ½ E. [*N. 15° W.*] 1½ miles. Pta. Negra is low and rocky, and near it stands the town of PRAYA.

An islet, called the *Isle of Praya*, lies at half a mile East [*E.N.E.*] from Point Negra; it is low on the West side, but rather higher on the East, and there is a passage between it and the point. At the distance of a cable and a half to the southward of the islet is the anchorage.

At 3 miles North [*N.N.W.*] from Point Negra is the Point of Josef Ferrer, which is very low, being even with the water, and having a dangerous shoal, at about 2 cables' distance to the East [*E.N.E.*] The coast between these points is rather regular than otherwise, with a few little bights; of these bights, the first is close to Point Negra.

The best anchorage about the island is with the Islet Abajo, lying near the S.E. point, in a line with the westernmost part of Praya Isle, or rather a little open; this is off the southern extremity of a great slope of land, extending toward the Point of Josef Ferrer. The depths are from 30 to 40 fathoms, sandy bottom. Here vessels load and unload, and are ready to be off with any winds; but they lie sheltered only from South by the West, nearly to North. All the goods from the town of Santa Cruz are brought to this anchorage to be shipped, as they have no other.

On the West of the Point of Josef Ferrer are the bay and town of SANTA CRUZ. The coast is low, and the land rocky, with scattered fragments of rock about it. Close to the town, on the S.W. side, are three small hills near each other, and a church is on the highest part of every one of them. These, therefore, are good marks for the North side of the island.

The *Ponta do Pico Negro* is the North point of the island; it is high, oblique, and of a very black colour. The coast hence to the S.W. continues high and rocky. From the *Pta. de Fozzo de Porco*, the western poimt, half a mile S.W. by S. [*S. 10° W.*], is the *Point of Jorge Gomez*, low and rocky, with a church near it. There is landing here. At 3¾ miles from that point is *Point Blanca*, very high and sloping, within which, at a short distance, is the highest mountain on the island, 1378 feet high. The coast between is of high rock. On the summit of Pta. Frayle, northward of Point Blanca, is a stone that resembles a man.

At S.E. ¾ S. [*S.E. by E. ¼ E.*] 2½ miles from Point Blanca is the low and rocky

Point of Folgo; the coast between forms a bay, and the village of Folgo is at the bottom of it.

FLORES.—This island contains about 7,000 inhabitants. It has two towns, both on the eastern side, *Sta. Cruz and Lagens*, and four villages. The chief productions are yams, wheat of excellent quality cattle, sheep, and hogs. The exports are wheat, cloths, bacon, with the weed or moss called orchilla, used for a dye, as already noticed. The latter is found clinging to the rocks and declivities, and is not obtainable without great trouble and danger.

The island is very mountainous, but much more so towards the South than the North. The Fort of the town of Santa Cruz is in lat. 39° 27', and long. 31° 8' 37"; and to the West of it, in the interior of the island, is a remarkable peak, the Morro Grande, 3,687 feet high. The land is well cultivated, and has abundance of water, falling down, in numerous cascades, from the heights.*

PONTA DEL GADA, the North Point of Flores, is of moderate height, smooth on its summit, not very projecting; but at its base is a cluster of islets, extending outward a quarter of a mile; the ground around them is clear.

PONTA RUIVA, the N.E. point of Flores, is high, sloped, rugged, and obtuse. At the foot of it is an islet, called the *Pan de Azucar*, or Sugar-loaf: a fishing-boat may pass between. In the bay to the westward of Pt. Ruiva there is anchorage in 25 fathoms, sandy ground, sheltered from winds from S.E. by the South to W.S.W. It is frequently resorted to for water, or by vessels that are compelled by the wind to quit the eastern side of the island.

The *Point of Santa Cruz* is 2¾ miles S. ¾ E. [*S.S.E. ½ E.*] from Point Ruiva. It is low and rocky, with several rocks about it. In the interval is the Islet of Alvaro Rodriguez, very near to the coast; and to the S.E. [*E.S.E.*] of this is anchorage, in 36 fathoms, sandy bottom, sheltered from the West and S.W. At *true* South, three-quarters of a mile from the point, is the castle of SANTA CRUZ, which is very near to the town, the principal port of the island.

At 1¾ miles southward from the castle of Santa Cruz is *Ponta Cabeira*, low and rocky land, which rises with a gentle acclivity to the distance of a mile. Between these points the coast forms a bay, with a beach and a small river at the bottom of it. This bay is the best anchoring place about the island, and is sheltered from all points between N.N.E. by the West to S.W. The proper depths are in from 35 to 40 fathoms, sandy ground. This is the nearest anchorage to Santa Cruz, and therefore the most frequented.

At 1¼ miles S.W. ½ W. [*S.S.W.* ¾ *W.*] from Point Cabeira is that of Lomba, which is high and oblique; between these points the coast forms a bay, with a beach and small river at the end of it. A vessel may anchor in this bay, in 25 fathoms, sandy bottom, but it is not so well sheltered as that to the northward, being open to easterly and southerly winds.

From the *Point of Lagens*, which is 4 miles to the south-westward of Point Loma, a ridge of rocks extends to the distance of a cable and a half to the S.S.E. At 2¼ miles S. ½ W. [*S. by E.* ½ *E.*] from Point Lagens is a rock or shoal, of 4½ fathoms: its size is about that of two ships, and appears, when near to it, like a large flagstone. Between it and the coast is a great depth of water, and the same about it.

In the little bay, on the North side of Lagens Point, is the town of LAGENS, having a large church, which is a useful mark for this part of the coast. A vessel may anchor very well in this with a wind between North by the West to S.W. by W., in 25 fathoms, sandy ground. This anchorage is much frequented, because a vessel can here get under way more easily than at Santa Cruz, having better room for working out.

* The anchoring ground about the island is generally at beyond the distance of a mile from land. Within that distance the ground is rocky, and much further out it is the same.

From Lagens Point westward, the coast rises in height to the *Point de Roca Alta*, at a little distance from which, toward the North, is the highest part of the island. The Point of Lope Bas, which is nearly a mile W.N.W. ¾ W. [*W. ¼ S.*] from Lagens Point, is low by the sea, but within, high and sloping. That of Roca is 1½ miles farther, is obtuse, very high, sloping, and black. The coast here is nearly straight, high, and rugged.

The Ponta de los Ilheos Agua Caliente, which is low and rocky, is so called from a mineral spring which exists here, and of which the water is hot. Between this and the Point Roca Alta is a bay, with anchoring ground in 25 fathoms, sandy bottom. There are several islets at the foot of the former point.

The Pta. de Catarinas, with its islets, lie 1¼ miles more to the northward. The coast between is wholly rocky. At 1¾ miles further to the N.N.E. is *Pta. dos Bredos*, high, sloping land of a whitish colour, with islets at its base. One of the latter, on the South side of the point, resembles a column. The coast between affords anchorage, in 20 or 25 fathoms, sandy ground.

The Pta. del Baxio, which is very low, is 2¾ miles to the northward of Pta. dos Bredos. The coast between is rocky, but you may anchor off it in 32 fathoms of water, sandy ground, and sheltered from N.N.E., East and South. Close to Bixio or Shoal Point is a very remarkable church, that of S. Pedro, or St. Peter.

Fanaes.—At 2¼ miles N.N.E. ¼ E. [*N. 6° E.*] from Baxio Point is that of Fanaes, which is not very high by the sea, but it forms abruptly like a mountain, and is of a black colour. The bay in the interval is that of San Pedro, which has anchoring ground, in 25 or 30 fathoms, bottom of sand; and here water may be readily obtained from a cascade that falls from the mountains, by means of a hose, so as to fill the casks without taking them out of the boat. The Islet Monchique lies at rather more than a mile N.W. ¾ W. [*W.N.W. ½ W.*] from Point Fanaes. The depth between is sufficient for any ship.

The following observations upon this place are by Mr. E. May, Master of H.M.S. *Skylark*:—

At daylight, bore up for the Bay of Fanaes; at 5^h 10′, shortened sail and sent a boat for water. The beach consists of large stones, none smaller than a man's head. These stones extend from the beach 2 or 3 boats' length, making it dangerous for boats to land.

"The best landing-place is a passage between a point of rocks that lies to the South of the beach. From thence you may procure water, from a fountain, about half a mile from the beach, employing small casks, and at the rate of three to five tons per day, by employing natives, if the weather is fine, and the wind between S.S.E. and N.E. With any other wind, particularly if blowing hard, there would be too much surf, and the passage too narrow, in such weather, to enter. This place may be known by a very high, steep mountain, a little to the left of the landing-place, from whence the Island Monchique bears N.W. 1½ miles. Between the island and the shore is a clear passage for any ship; but she should borrow towards the rock, as a reef projects about a cable's length from thence, although there are no hidden dangers in the passage.

Refreshments.—"At this place, by the assistance of shore-boats, about four tons of water were obtained in ten hours. The place abounds in poultry, bullocks, sheep, pigs, vegetables, of all kinds, and eggs, all very cheap. Those who came off to the ship were well-dressed, clean, healthy people. The shore of the island is bold, and may be approached to the distance of a quarter of a mile. Leaving Fanaes, I would recommend vessels to run due West for 2 or 3 miles, to get clear of the high land to the North of the landing-place, by which they would avoid being becalmed under this land when the wind is from N.E. to S.E., and would be enabled to run clear of the island. Corvo has also a bold shore, and can be seen off deck 55 miles distant, as was proved by us the day after leaving the island, both by log and observation. Flores may be seen still further off, as it is higher than Corvo."

It is important to know that such useful refreshments can be so readily procured.

A tedious homeward passage may make this place of the greatest benefit. This has been confirmed by Captain Henry Toynbee in 1859. Captain Toynbee says:—"Twice have I hove-to for a few hours off Sta. Cruz and taken in as many bullocks, pigs, sheep, fowls, &c., as were required for a few days fresh mess for the invalid troops on board my ship." In July, 1859, the *Fitzjames* put in here in a distressed condition at Captain Toynbee's recommendation, and was received with every kindness by Mr. M'Kay and his family. The captain procured all he required. Bullocks, £4.; potatoes, 3s. the bushel; eggs, 5½d. a dozen; fowls, 12s. a dozen. This knowledge may be the saving of much misery to a homeward bound ship after a protracted voyage.

Ponta Albernas is the N.W. point of Flores. It is moderately high, sloped, and of a red colour. Between it and Point Fanaes is the islet of *Maria Gadella*, which is high and round. W. ¾ N. [*W. by S.*] from this islet is anchorage, in 30 or 40 fathoms, sandy ground. From the point eastward to Pta. del Gada, already described, the coast is entirely rocky.

The bank of soundings is nearly of the same form as the island, except that to the North, it extends further off than elsewhere. From the depth of 200 fathoms which is met with 5 miles off on the meridian of Ponta del Gada, the soundings diminish gradually up to the point, near which the depth is 22 fathoms. The same may be said of all the coasts, only that the narrower the bank, the more more rapid the descent.

To the E. the mean breadth of the bank is 2 miles; at this distance the depths are above 100 fathoms; at the outer edge on this side the bottom is uniformly sand, or coral and sand, sometimes to the northward sand and shells. To the south on the parallel of Pta. Lagens the bank is not more than a mile and two-thirds in breadth, but its edge trends a W. by S. direction, so that at Pta. Ilheos it is nearly 4 miles broad. The bottom is sand as far as this. On the west coast the medium breadth is about 2½ miles. The quality of the bottom on this margin is sand, but sometimes rock, or sand and coral. Excepting the two shoals, *Escolar* with 27 feet water off the south side, and the *Penra de Laranjeira* with 11 fathoms at 1½ miles *S.* 16° *W., true*, from the S.W. point, there is no danger on the surrounding bank. But here and there are rocky patches, which it is best to avoid in anchoring. A general remark on the anchorage of Flores is, that a position should be taken at more than a mile from the land, as nearer than that a rocky bottom is more frequently met with.

Reported Reefs.—Between Fayal and Flores, and off the latter, it is stated that some rocks exist. They were announced by M. M. Ferreira, of the Brazilian brig *Constante*. The first showed above water, at low water, in lat. 37° 56′ 20″ N., long. 33° 4′ 8″ W., and has been named *Constante Reef*. The second, *Ferreira's Reef*, is nearer the islands, and in lat. 38° 26′ 44″, long. 30° 25′ 10″; the sea broke on this. Nearly on the same reported position as the first reef, another announcement, under the name of the *Rhoon Rocks*, was issued, in the "Nautical Magazine," July, 1844. This was an extensive group of rocks, some of them more than 16 feet above water; lat. 38° 32′, long. 33° 16′. Again, a rock, called the *Atila Rock*, was announced in 1857 to lie in 36° 31′ N., and 32° 24′ E., or 200 miles W.S.W. of Fayal, and a singular warm mist and boiling sea was passed through on Nov. 15th, 1857, by the *Estremadura* in 39° 57′ N., and 25° 50′ W. All these reports seem to to indicate a series of dangers which are very perplexing to deal with, for after repeated searches, they have not been again met with. But the notice of them here will attract attention and induce caution. These reefs are noticed hereafter, in the Descriptions of the Shoals, &c., of the Atlantic.

CORVO is the northernmost of the Azores, and is formed by a single volcanic mountain, 3½ miles long, North and South, and 2¼ East and West, or 9¾ miles in circuit. The extinct crater of this mountain is called the *Caldeira*, and occupies all the N.W. part of it, and is 3¼ miles in circumference. The highest part of the ridge surrounding the Caldeira is on the S.W. side, and is 2,548 feet in height. The East and West margins are lower, in some places not exceeding 1,434 feet. Its bottom is occupied by two small lagoons, the surface of which is 1,273 feet above the sea, and

1,275 below the highest peak. The bottom is cultivated and used for pasturage, as indeed the greater part of the island is. The summit, even in summer, is so frequently capped with clouds, that rills of water were running down the mountain in the month of August.

The lower land of the S.W. end of the island has all the appearance of being added to the original portion by an eruption of lava, and is diligently cultivated. The only habitations on the island are comprised in the village of Corvo, standing on the East side of the South point, on a rising ground close to the coast, and containing 160 or 173 thatched stone houses. They are dirty, and have an uncomfortable appearance, separated from each other by filthy lanes. At the South end of the village stands the church, a small stone building with a square tower and short spire, which, being kept well whitewashed, is a good seamark. About 250 yards S.W. by W. from it there is a little rocky hill, surmounted by an antique horizontal mill. The population in 1843 was 784 persons; 383 males, 401 females. They are poor, primitive, and contented. The church is in lat. 39° 40′ 9″ N., long. 31° 7′ 16″ W.; variation, in 1842, 27° 30′ W. It is high water, full and change, at 12^h 25′, and the rise of tide 3 feet 6 inches.

Ponta de Pesqueiro-alto is the South end of the island. On its eastern side, facing the village, is a small stony beach, where a few fishing-boats are hauled up. *Ponta de Casa* bears *N.* 52° *E.* 1½ miles from it. It is a sharp, well-defined point; and at the distance of 60 or 70 yards from it there is a rock just visible above water, on which the sea at times breaks violently, and there is a similar rock a quarter of a mile N.N.E. of it. *Ponta de l'Este* is the next point, and is *N.* 16° *E.*, distant 1 mile; and the next is *Ponta de N.E.*, a bold bluff, 760 feet high, 1¼ miles *N.* 16° *W.* from the last. The cliffs increase in altitude as you proceed northerly; and to seaward of the Ponta de N.E., bearing *N.* 51° *E.*, one-third of a mile off, is a small block of rock, steep-to on all sides, with 3 or 4 feet over it at low water. Proceeding north-westward, the next point is *Joao de Moira*, *N.* 57° *W.* two-thirds of a mile, and thence to the North extremes, *Ponta de Norte*, *N.* 79° *W.*, about the same distance. The coast between these two points presents a series of high inaccessible cliffs, fronted, as before, by a narrow belt of stones. From the top of the cliffs the land rises with great abruptness to the margin of the Caldeira, a height of 2,200 feet, where the horizontal distance from the sea does not exceed 2,500 feet. Ponta de Norte is a high rock, 368 feet high, jutting out 150 yards from the coast, inaccessible from the sea, and, when seen from East or West, shows an overhanging face to northward. About West from this, one-third of a mile, is a small elevated islet of naked lava, and S. 47° W. one-fifth of a mile from this, is *Ponta de Turrais*, the N.W. extreme of the island. It is very remarkable; it runs directly down from the North edge of the crater into the sea, a sharp, serrated ridge of dark lava. At 300 yards North of it, with Ponta de Norte bearing *East*, there is a sunken rock, on which the sea breaks violently. In rounding the island it will be advisable not to near this point in less than 20 fathoms.

The next extreme point, South of Ponta Turrais, is *Ponta d'Oueste*, bearing *S.* 14° *W.* 1¾ miles, the coast between being partly a steep declivity, covered with shrubs and wild vegetation. To the southward of this the coast consists of lofty cliffs, and at nearly three-quarters of a mile South of it is a small, low, detached rock, named *Ilheo de Mulher*, 50 yards off the beach. From this the coast runs *S.* 27° *E.*, a mile to the *Sugar-loaf Rock*, a mass of lava standing at the base of a bold cliffy point. Hence to the southward the coast consists of a ragged outline of steep cliffs, and then a low coast of very broken outline, fronted by innumerable rocks, to the meridian of the old horizontal mill previously mentioned. This portion of the coast is fronted by innumerable rocks, projecting from the shore in narrow ridges of broken lava to an average distance of 200 yards. In strong winds the sea rolls over them in enormous breakers, but the danger is not so wide as they appear to be.

The bank surrounding the island is generally steep, and very abrupt on its outer edge. At Ponta de Casa it is 1 mile from the point. At Ponta de Norte, 1½ miles;

or a quarter of a mile, 12 fathoms; half a mile, 30 fathoms; three-quarters of a mile, 40 fathoms; 1 mile, 40 fathoms. Along the N.W. side the bank is comparatively shallow and rocky, to the extent of half a mile from the land, where there are 15 fathoms, and the edge of the bank is $1\frac{3}{4}$ miles off. Off the South point it does not reach to 1 mile off.

A short distance to seaward of the rocks in front of the cliffs near the village, and with the church bearing N. 31° W., three-tenths of a mile distant, lie three patches of sunken rocks, on which are 3 and 4 fathoms water. They are steep-to. There are no dangerous rocks before the stony beach in front of the village, but the surf which usually plays upon it makes the cove to the westward of the mill a preferable landing-place.

The best anchorages at Corvo (mentioned by Tofiño) are on the westward side, between the parallels of the Iiheo de Mulher and the Sugar-loaf Rock; 30 to 35 fathoms, fine brown sand, about 1 mile off shore; and on the eastern side, in 25 to 30 fathoms, sandy bottom, about half a mile due East of Ponta de Casa. Captain Vidal cannot advise the adoption of these anchorages, nor of any others the island may afford, except as a matter of necessity.

It has no fuel to spare, no facility for watering, nor, indeed, anything to offer which cannot be most abundantly and conveniently obtained at Flores; whilst from its size and form it affords little shelter from wind or sea.

The flood tide sets upon the island N. 30° E., and the ebb in the opposite direction, at an ordinary velocity, in springs, of $1\frac{1}{2}$ miles per hour. When this is opposed by a gale it occasions a very high, confused sea, as it sweeps over the rocky, uneven bottom at the North and South points.—*Captain A. T. E. Vidal, R.N.*

The bank of soundings around Corvo is nearly of a circular form, and extends with some regularity on the East side to the distance of 1 mile and a third; on the West side, a mile and two-thirds; the same to the North. It is narrowest to the South near Point Pesquiero Alto, where it is only two-thirds of a mile.

To the eastward it is generally of sand, sometimes with coral, and rocky patches. To the West the prevalent bottom is also sand, with some gravel and rocks. A vessel should not anchor till she is assured beforehand of the quality of the ground and depth of the water, which increases regularly from the shore to 50 or 60 fathoms, and then suddenly falls to above 200 fathoms.

It is high water on full and change days at Flores and Corvo at $12^h\ 20'$, and the rise and fall is about $3\frac{1}{2}$ feet. The tidal hour and range is nearly the same, or a quarter of an hour later at the other islands.

Flores and Corvo form a separate group from the rest, and the channel, 120 miles broad, has no known danger, and therefore is probably the best to use in passing through the archipelago. The current sometimes sets to the N.E. through this channel with varying strength according to the wind. But, as a general rule, the continuation of the drift from the Gulf Stream bears to the S.E. and S., rarely to the S.S.W. This is more usual to the North of the islands.

4.—THE ISLANDS OF MADEIRA AND PORTO SANTO.

PORTO SANTO, etc.—Ships are recommended to make, in the first instance, the Isle of Porto Santo, and thence proceed for the Road of Funchal, on the track shown upon the particular plan given in the Chart. The land of Porto Santo is very remarkable, and may be seen, in fine weather, 15 or 20 leagues off. It first appears in two or three very high hummocks, by which it is distinguished from Madeira, and the little isles named the *Desertas*.

Porto Santo (a) bearing South, 14 miles, as taken by Captain J. W. Monteath.

It is said that it was discovered by two Spaniards in a voyage to explore the coast of Africa, but being driven off in a storm, they here found shelter, and named it, in consequence, Porto Santo. At present it is a dependency of Madeira, and in 1838 its population amounted to 1,618 persons. It is 6 4-10ths miles in length from N.E. to S.W. Its mean breadth is 2½ miles, and its circuit 17 miles. The surrounding bank of soundings is more considerable than has been supposed. The N.E. part consists of numerous rocky pointed mountains, some nearly 1,700 feet in height, and all its North coast is generally high inaccessible cliffs, with detached rocks at their bases. The central part is much lower than the extremities, but on the North and N.W. coasts rises to 700 feet; from whence it slopes to the South, and terminates in a beautiful white sandy beach, which forms its entire S.E. shore. On this central part are several sandfields, covered with what appear co be fossil heath-stems, probably coral formation. The S.W. end of the island is also rocky and elevated, some of the hills exceeding 900 feet in height. The town, *Villa Baleira*, is situated near the centre of the bay on the S.E. side, about 300 yards from the beach. The church and court-house on it are conspicuous; and a little to the West of them is a small battery, in lat. 33° 3′ 30″ N., long. 16° 20′ 14″ W.; variation in 1843, 24° 30′ W.

The Pico de Castello, 1,447 feet high, is N. 4½° E. from the church; and on its summit are the ruins of several water tanks and stone buildings. The two peaks immediately to the East, called Fachio and Guadaya, are the highest in the island, the former being 1,660 feet high.

The island is chiefly used for pasture, cultivation extending along the shore of the bay and the low land. The island suffers grievously for the want of water, but producing wine, grain, and vegetables; also plenty of live stock and poultry. The banks around abound with fish.

The landing at Porto Santo is usually made upon the beach in front of the town, though there are no artificial facilities for so doing. It is high water at full and change, at $12^h\ 50^m$; the rise of the tide is 7 feet. Generally, vessels should not anchor in the bay within the line joining the South extreme of Ilheo Baixo and the low extreme of Ponta de Incao, bearing S. 49½° W., and N. 49½° E., and the South point of Ilheo de Cima N. 73° E., 2 miles distant. In this position, which is 1 3-10ths miles from the landing-place, there will be 17 fathoms water, over a bottom of small gravel and broken shells. The edge of the bank is rather less than half a mile to the South of it; the depth of water increasing rapidly. During the settled weather in summer vessels may anchor nearer the shore, but care should be taken not to be caught in the bay. In the present condition of the island it is of little service to the navigation, as Madeira itself offers superior advantages.

Ponta de Incao, the S.E. point, is composed of high rocky cliffs. Off it lies the *Ilheo de Cima*, a table-topped island, 360 feet high. There is a boat passage inside it. Off it is a good fishing station. *Ponta dos Frades*, a bold point, steep-to, is 1 mile N. by E. from Ponta de Incao, and between them is the small sandy bay of *Ponta dos Frades*. *Ponta Branca*, the N,E. point of the island, is composed of three bluffs, the northern one of which forms a fine a fine, bold promontory, the peak of which is 1,390 feet high. These rocky islets, steep-to, with navigable channels between, lie off the Ponta Bronca. The outer, or *N.E. Rock*, is 330 feet high; the rocky bank, on which they stand, has a patch of 10 fathoms at 2½ miles N. 32° W. from the N.E. rock.

Off the S.W. point is *Ilheo de Ferro*, 380 feet above the sea, almost inaccessible, and having a narrow but safe channel inside it. *Baixo Island*, off the South point, *Ponta de Calheta*, is 1½ miles in length, and is only visited for its limestone quarries, a singular feature. They are national property.

Off the N.W. coast of Porto Santo the bank of soundings extend for 8 miles, with a general depth of from 25 to 35 fathoms, fine white sand. Near its N.E. margin is the Falcon Rock, the position of which was first ascertained by the officers of H.M.S. *Falcon*, Eieutenant J. Bowen, in January, 1802. It is a mere knoll, on which there are 4½ fathoms at low water. It is said to break at times. When on the rock the highest land of the N.E. rock bears S. 60° E. 6¼ miles; of Ilheo de Fonte, S. 13° 10′ E. 4 6-10ths miles; and of Ilheo de Ferro, S. 5° 30′ W. 8 4-10ths miles. Vessels coming from the N.E., with a fair wind, may pass it, keeping the Ilheo de Fonte (off the middle of the North coast) in line with the high land at the S.W. end of Porto Santo. At nine-tenths of a mile N. 37° W. from Falcon Rock is a shoal patch of 11 fathoms, named the *Styx Bank*.

Porto Santo (a) N. by E. 12 miles; taken by Captain Monteath.

DESERTAS.—To the S.E. of Madeira, the Desertas, a line of narrow rocky islets, extend nearly in a North and South direction by compass, the North extremity of which bears S. 34° 8′ E. 10 miles distant from its East point. Between them in this space is a bank of soundings of from 45 to 75 fathoms, about 2 miles broad, on which, in settled weather, fishing-boats frequently anchor. This bank continues quite round the Desertas.

Chao, the northernmost, is nine-tenths of a mile in length, and one-quarter of a mile in width at its North end. It is tabled land; the highest point to the North is 336 feet, and is surrounded by high rocky cliffs. Off the bold bluff at the North extreme is a remarkable detached rock, called by the Portuguese the *Furrilhao*, but known to navigators as the *Sail Rock*. It lies due North of the point, 100 yards distant, and is 160 feet high. At 300 yards N. 65° W. from it is a breaking rock, and a narrow ridge of irregular soundings extends from it N. 30° W. nine-tenths of a mile. The surface of Chao is composed of light soil, with rocks and stones, covered with long coarse grass, and a few aromatic herbs. Near its centre is a pond of turbid water. The highest land is near the North point, and is 336 feet in height.

The *Deserta Grande* is the largest and most elevated of the three islands. It is 6½ miles in length by 1 broad at the widest part. From *Ponta de Pedregal*, on the West side, to its South extreme, it consists of a continous chain of rocky heights, the highest peak of which, 1,610 feet, lies 1 1-10th miles *E.S.E.* of the point. The width of the passage between Chao and the North point of Deserta Grande is but little more than 300 yards between the rocks, and this is further contracted by a breaking rock in the centre, so that it is only practicable for boats in fine weather. *Ponta de Pedregal* is 2 miles from the North end. It is a detached rock, with high land towering above it to more than 1,200 feet in height. Between this point and the next to it to the North is the little cove of *Castanheira*, where there is a boat

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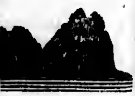

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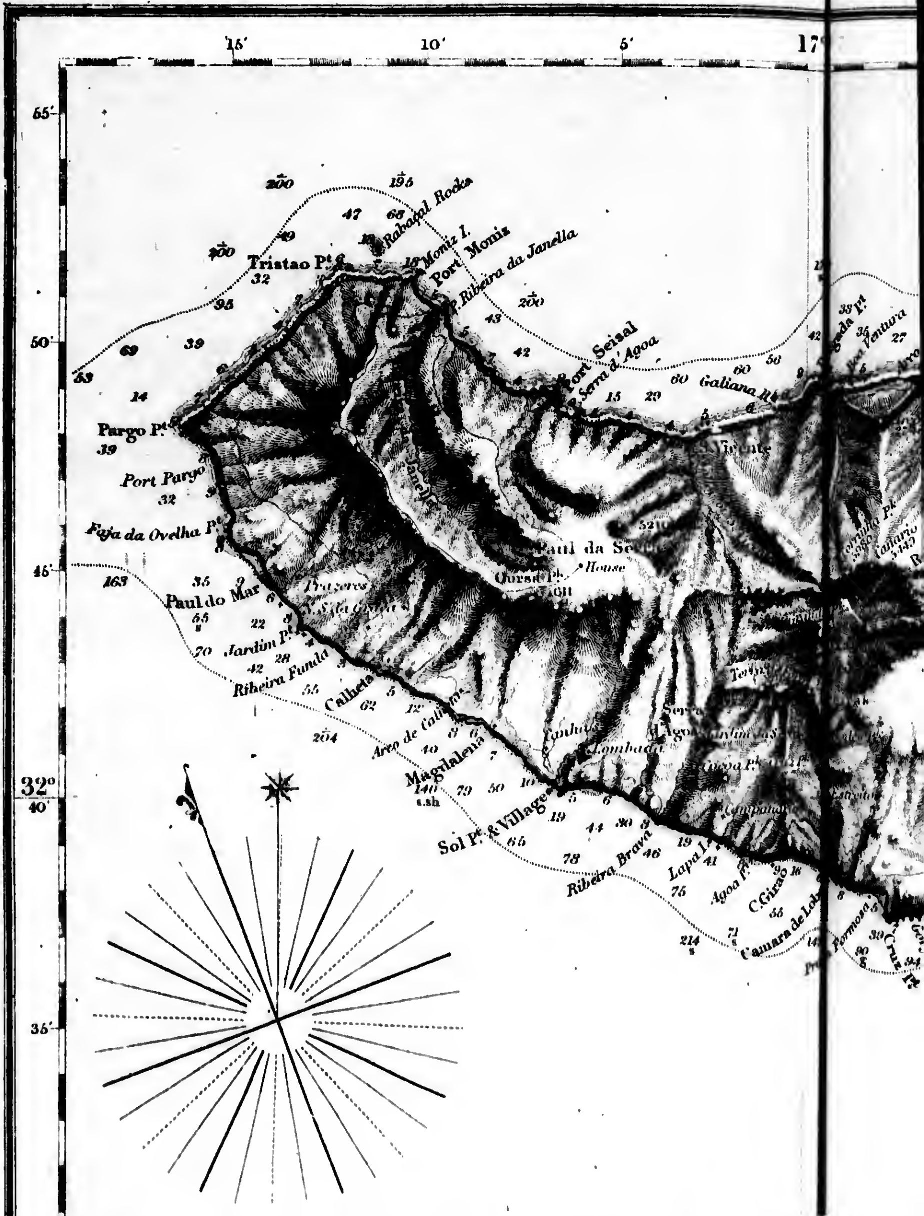15'
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Jardim Pt.
Ribeira Funda
Calheta
Arco de Calheta
Magdalena
Sol Pt. & Village
Ribeira Brava
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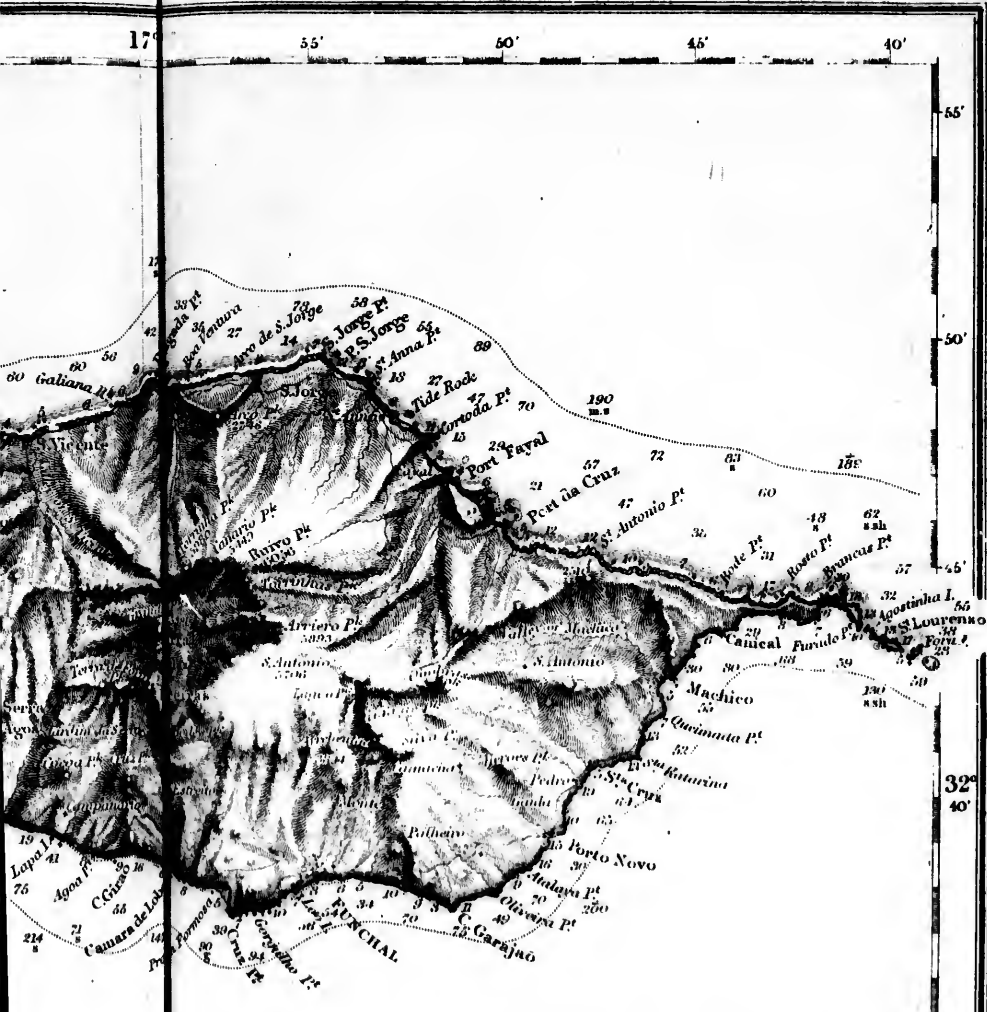
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landing-place, marked by a detached rock. *Ponta de Boqueirao*, the South point, is 4½ miles *S.* 30° *E.* from Pedregal, with a rock close to it, but the point is steep-to and clear. The East coast is a rugged, broken, irregular line of cliffs. Northward of Point Pedregal the island is differently formed to what it is southward, consisting here of two ridges, with a ravine between them. At the head of this valley or ravine, at the foot of a green hill near the centre of the island, about East of Pta. Pedregal, is a small house, and near it two ponds or reservoirs of turbid water; and a few yards down the valley is a delicious spring, though yielding but a limited supply.

The *Bugio*, or *South Deserta*, is about 4½ miles in length. Its greatest breadth is not half a mile. The passage to the North of it is two-thirds of a mile in width, and is perfectly clear; depth 19 to 20 fathoms, and 7 fathoms within 30 yards of either point. Both shores are rocky cliffs, of less altitude than the Deserta Grande, surmounted by a very sharp serrated rocky ridge of hills, which runs the whole length of the island. There is a gap in this ridge, near the centre of it, which at a distance gives it the appearance of two islands. The highest peak on the North part is 1,349 feet, and on the southern part, 1,070 feet, in height. *Ponta d'Agalha*, the South extreme, has a few rocks, quite close to it, but 5 fathoms at 130 yards off. It is in lat. 32° 23′ 15″ N., and long. 16° 27′ 37″ W.

The bank of soundings round these singular islands is tolerably regular, extending 1½ miles from the East side, and 2 miles on the West side; and in a narrow ridge to Madeira as before mentioned.

The islands have no permanent inhabitants. They are frequented for orchilla; and on the centre one some cattle and sheep are pastured, and attended by a few casual visitors.

There is much danger to vessels passing close under the lee of these islands with strong breezes, in the violence of the gusts from the high land, which are most variable, both in direction and strength. It is no uncommon thing to see the water whirled into the air, and then precipitated on the vessel's masts and decks.

The tide sets by these islands at springs at the rate of 1½ to 2 miles per hour. The flood *N.* 31° *E.*, and the ebb *S.* 31° *W.*, and its rise is 7 feet.

MADEIRA.—The date and manner of the discovery of this beautiful island are involved in some obscurity. The most probable is the romantic tale of Robert Machim and Anna D'Arfet, two lovers, who, fleeing from the wrath of the lady's friends to the shores of France, were driven by a storm far away to sea, and at length met with this unknown and uninhabited island. Here they landed, and both died, the crew again departing. There are some variations in this story, both in date and particulars, but about 1344 is mentioned as the time. There is great probability of its accuracy; and in the present little church of Machico is said to be preserved a portion of the cross found over their graves, on their re-discovery between 1417 and 1419. This latter discovery arose from the cirumstance of a dark cloud being constantly seen in the S.W. by the settlers at Porto Santo, who had gone from Spain to the conquest of the Canaries. They sailed towards it, and on June 1, 1849, they discovered the point now called, after their vessel, Cape San Lorenzo.

Madeira is of volcanic origin, though the only sign of a crater is upon San Antonio (5,076 feet), near Machico, at the East end of the island. It is a collection of mountains, the highest of which, the *Pico Ruivo*, is near its centre, and is 6,056 feet high.* To the West of it the ridge of the *Lomba Grande*, nearly of equal elevation, extends for 2½ miles, and forms the North edge of the stupendous ravine of the *Curral*, one of

* The distance to which the mountains of Madeira ought to be seen from a vessel's deck is about 90 miles; but, of course, at this low elevation it would require a very clear atmosphere. Sir Andrew Lang says, that on leaving Madeira for the West Indies, December 26th, 1822, the Pico Ruivo was distinctly visible when the ship had reached 75 sea miles from the anchorage at Funchal, bearing N. 40° E., at 2h. p.m.; lost sight of it soon afterwards, from the thickening atmosphere.—*Naut. Mag.*, 1841, p. 261.

the wonders of Madeira. The western side of this is formed by a ridge of which the rocky summit of the *Pico Grande* is 5,391 feet high. South of Ruivo is a ridge of peaks of nearly equal elevation, amongst which the three remarkable peaks of the *Torrinhas* are 5,980 feet high. South of these, three-quarters of a mile, is *Pico Sidrao*, and half a mile further S.E. is *Pico Arriero*, 5,893 feet high. These may be considered to form the axis of the island, from which the mountains generally slope gradually to the South coast, and on the North, with few exceptions, they drop precipitously on to the bold high coast.

The cultivation is confined to the coast, or to the bottoms of some of the valleys, and occupies altogether a very small proportion of the surface. Vines form the chief feature; for the corn grown annually scarcely supplies a two months' consumption to the inhabitants.

In the island may be found almost every European and tropical luxury. The myrtle, the geranium, the rose, and the violet, may be seen on every side. The geranium, in particular, is so common, that the honey of the bees is strongly impregnated with its odour.

Captain Wilkes, in command of the U.S. Exploring Expedition, arrived at this island September 16, 1838, on his outward voyage; from his fine work we extract the following:—

" The first appearance of Madeira did not come up to the idea we had formed of its beauties, from the glowing descriptions of travellers. It exhibited nothing to the distant view but a bare and broken rock, of huge dimensions, which, though grand and imposing, is peculiarly dark and gloomy, and it was not until we made the land that we could discover the green patches which are everywhere scattered over its dark red soil, even to the tops of the highest peaks.

" The mountain verdure was afterwards discovered to be owing to groves of heath and broom, which grow to an extraordinary height, aspiring to the stature of forest trees. In addition to these groves, the terraced acclivities, covered with a luxuriant tropical vegetation, change, on a closer approach, its distant barren aspect into one of extreme beauty and fertility.

" The shores of the island are mostly lofty cliffs, occasionally facing the water with a perpendicular front, one or two thousand feet in height. The cliffs are interrupted by a few small bays, where a richly cultivated valley approaches the water between abrupt precipices, or surrounded by an amphitheatre of rugged hills. These narrow bays are the sites of the villages of Madeira.

" Off the eastern cape of the island many isolated rocks were seen separated from the land, with bold abrupt sides, and broken outlines. The character of these rocks is remarkable: they stand quite detached from the adjoining cliffs, and some of them rise to a great height in a slender form, with extremely rugged surfaces, and broken edges. Through some, the waters have worn arched ways of large dimensions, which afford a passage to the breaking surf, and would seem to threaten, ere long, their destrnction.

" Similar needle-form rocks are seen off the Northern Deserta, an island lying some miles East of Madeira. One of them is often mistaken for a ship under sail, to which, when first seen, it has a considerable resemblance. It stands like a slender, broken column, several feet in height, on a base scarcely larger than its summit."

At Madeira is a wind called the *Leste*, which, as its name implies, comes from the East, although all East winds are by no means *Lestes*. It appears to be of the same kind as the *Harmattan* of Western Africa, and is of a hot, close, drying nature, particularly oppressive to some constitutions, which it affects by languor, head-ache, and a parching of the skin and lips. What is remarkable, the residents are those whom it most disorders in this way. Visitors, in general, suffer much less; and the invalids are never so well as while it lasts. A peculiar clearness and cloudlessness in the atmosphere are among the invariable indications of Leste, and the weather during its continuance is most delightful; the sky of a deep blue, so stainless that one might fancy it had never been sullied by a cloud: with a transparency in the atmosphere, which, like the effect of moisture, seems to bring out fresh hues from every object.

At times, but not frequently, the Leste is accompanied by a strong wind, but the weather is still delightfully warm and pleasant. The nights, too, are delicious; soft and balmy; and, with the moon walking in summer brightness, and the orange trees in flower, the air is loaded with perfume. With the departure of the Leste, rain almost invariably follows.

The climate, generally, is delicious, and strikes with peculiar charm to a stranger, whom a short sail has transferred to it from the very midst of the gloom and chill of an English December. Indeed, the great natural distinction of Madeira is the climate, which, perhaps, taken altogether, is the finest in the world.*

Water, of excellent quality, is abundant. Springs are found everywhere, and copious; even the streams at the bottom of the ravines, fed by the mountain mists, are never dry in the hottest season; and the height from which they descend enables the inhabitants to divert the course of the water at any elevation or in any direction; the whole cultivated region, therefore, is irrigated on all sides by these *levadas*, or water-courses. On the coast, fish is abundant, and forms an important article in the food of all classes.

The towns and villages are invariably situated on the sea-coast, and commonly at the outlet of a ravine; but where the bottom is fertile, and the surface permits, the cabins and *quintas*, or country seats, are often scattered up a considerable extent of the valley.

The extreme length of the island is 31 7-10ths miles, its greatest breadth 12 miles, and the circuit along the line of coast 79 miles. The magnetic variation in 1843 was 24° 45′ W. High water, full and change, 12^h 48′; rise 7 feet: the flood runs *N.* 30° *E.* at 1½ miles per hour on springs.

Fora is the first land neared on approaching Madeira from the eastward. It is a small uneven islet, steep-to, and with rocky cliffs. A peak near its North end, 352 feet high, is in lat. 32° 3′ 14″, long. 16° 39′ 30″ W. Off its S. E. side are some dangerous rocky patches, surrounded by deep water. The outer one lies S. 43° E. two-fifths of a mile from the peak, and is a small rock, with 4 fathoms on it; the inner one lies S. 34° E. three-tenths of a mile from the peak, and has several rocks, some with 15, and others with only 4½, feet on them. They should be cautiously rounded.

St. Lourenzo Point is formed by a rocky bluff, of small elevation; above the cliffs is a narrow ridge of hills, the highest being 348 feet above the sea. It is in reality an island, for at high water it is quite separated from Ponta Furada, and by the action of the sea may become permanently so.

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* The mean temperature, from observations during eighteen years, has been given as follows:—January, 64°. 18; Feb. 64°. 3; March, 65°.8; April, 65°. 5; May, 65°. 53; June, 69°. 74; July, 73°. 45; Aug. 75°. 2; Sept. 75°. 76; Oct. 72°. 5; Nov. 69°. 8; Dec. 65°. The year is, therefore, one summer, with comparatively little alteration, either of temperature or hue.

"In fine weather,—and it is fine at Madeira nine months in the year,—the view of this steep and lofty island, covered with bright verdure, and enlivened by numerous scattered houses, as white as snow, is very striking to a stranger who arrives from the low and tame-looking shores of the South coast of England.

"Seamen are often deceived, when about to anchor in Funchal Roads, in consequence of the sudden transition which they have probably made from a low shelving coast to an abrupt and high mountain side; for the bottom of the anchorage slopes away as suddenly as the heights overlooking it, and the anchor must, indeed, be let go upon the side of a mountain. Hence ships seldom go close enough, unless guided by a person who knows the place; and many a chain cable ran out to the clinch, when chains were first used, owing to an incorrect estimate of the vessel's distance from shore, and not taking time to sound accurately.

"Closing the land quickly, after passing some time at sea—approaching high cliffs or hilly shores, after being, for a time, accustomed to low coasts—or nearing a flat shore, after the eye has been used to precipices and mountains—almost always is a cause of error in estimating distance, however experienced a seaman may be."—*Captain FitzRoy*, vol. ii., p. 46.

PONTA FURADA is a bold, basaltic point, surmounted by a hill 550 feet high, and through it is a fine lofty arch, made by the waves. Half a mile West of it is *Ponta de Piedade*, crowned by a rocky hill, surmounted by a small but very conspicuous white chapel. North of this, quite across the narrow neck which forms the East extreme of Madeira, occur those curious fields of fossils, similar to those described at Porto Santo. *Caniçal Point* and village are 1¼ miles W. by S. of this, the coast being lower. To the S.W. of it the cliffs are bold and high, as far as *Machico Bay*, 1¾ miles S.W. of Caniçal.

Machico Bay is a most romantic spot, celebrated in tradition as the place where the first discoverer, Robert Machim, landed with Anna D'Arfet. The village church is supposed to cover their graves. The village has a considerable number of fishing-boats. Between Machico and *Ponta Queimada* the distance is half a mile, and thence to *Ponta de Santa Catarina* 1 1-6th miles; off the latter is a steep rock, but the whole coast is bold, and no outlying dangers. *Ponta Guindante* is the next projection; between them there is a bay, at the North end of which is the valley of *Santa Cruz*. Close around Guindante, to the S.W., is the village of *Porto Novo*, in a small shingle bay, where a considerable ribeira has its outlet.

Atalaya Point is nine-tenths of a mile *S.* 40° *W.* of Pta. Guindante, and has a singular small pointed peak on the cliff, close to it. From this *Ponta Oliveira* bears *S.* 51° *W.* 1 mile; it is a clean rocky point, steep-to, upon which you can land, and the ascent from it is easy.

Cabo Garajao, the *Brazen Head*, the East point of the Bay of Funchal, is 1 mile S. 75° W. from Ponta Oliveira. It is a bold rocky headland, jutting out at right angles to the line of coast. It is formed by perpendicular cliffs of reddish-yellow tufs, and above them is a narrow hilly ridge of land, crowned with a rocky knob or knoll, 420 feet above the sea, on which is a telegraph. This knoll particularly distinguishes the head when seen from the westward. The cape is steep-to.

THE BAY OF FUNCHAL is bounded to the East by the Brazen Head, and on the West by *Ponta da Cruz*, bearing from it *S.* 87° 40′ *W.*, distant 4 9-10ths miles. The coast to the West of Cape Garajao is a series of rocky cliffs and small stony points to Santiago Fort, which is exactly midway between the two extremes of the bay. It is also at the East end of the town of Funchal.

FUNCHAL, the capital of Madeira, was named thus by Gonçalves Zarco, on July 3rd, 1419, when first landed on, from the quantities of fennel growing here.

"Funchal," says Captain Wilkes, "has a very pleasing appearance from the sea, and its situation, in a kind of amphitheatre formed by the mountains, adds to its beauty. The contrast of the white buildings and villas with the green mountains forms a picture, which is much heightened by the bold quadrangular Loo Rock, with its embattled summit, commanding the harbour in the foreground.

"The streets of the town are very narrow, without side-walks, and, to our view, like alleys; but their narrowness produces no inconvenience. They are well paved, and wheel carriages are unknown. The only vehicle, if so it may be called, is a sledge of some 6 feet in length, about 20 inches wide, and only 6 or 8 inches high, on which are transported the pipes of wine. Two strips of hard wood are fastened together for runners.

The town of Funchal stretches along the margin of the bay for nearly a mile. The cathedral is a fine building: before its western door is a *parvis* or open space, and beyond that the *Terreiro da Se*, a very pleasant promenade, under four or five parallel rows of trees, and enclosed by a wall, a few feet in height.

The church of *Nossa Senhora do Monte* is the neatest in the island. It is seated on a terrace just half-way up the mountain, and commands one of the most enchanting views in the world.

The *Corral* or *Curral* of Madeira, a few miles north-westward from Funchal, is one of the grandest scenes in the world. Admiral W. F. Owen says, that the *Curral* means simply a sheepfold, and is an immense valley, completely surrounded by hills, whose sides are literally perpendicular, in no part being less than 1,000 feet high.

Round a part of these cliffs is a narrow road, leading to the garden houses and country plantations, cut out of the rock, about 10 or 12 feet wide. On riding along the road over the Curral, it seems like an unfathomable abyss, filled only by clouds and vapours rolling in a constant motion over each other.

Although MADEIRA is so elevated, excepting the eastern end, which is a low, rugged point, yet it is often so entirely clouded over, as not to be visible at the distance of 5 leagues. But, when abreast of Porto Santo, the island commonly appears as one great mountain, with its summit hidden in the clouds. Shortly after appear the Desertas. Having passed those islands, you will soon perceive the ships in the Road of Funchal; and, from their riding, it will be seen how the wind is in the road, as it is common to have a strong breeze from the N.E. or East, on passing the Desertas, when, at the same time, the wind in the road is from the S.W. or W.S.W.

When sailing in toward Funchal Road, a large rock, named the Loo Rock, with a fort on it, will be seen on the West side of the road, a little to the westward of the town. With this rock N. by E., when in 38 or 36 fathoms, let go the port anchor, with two cables on it; for, should there be a fresh breeze from the eastward, it will be scarcely possible to bring up, until the splice is veered a good way out. It is requisite to ride in the road with a whole cable, and with a splice so situated, that you may be able to cut near it, should circumstances unfortunately compel you to put to sea, without weighing anchor. While riding, keep a slip-buoy on the cable, have a kedge-anchor and a nine-ich hawser to the westward, to keep the ship steady, with the hawser on the starboard bow, as the wind generally veers from the eastward to S.W. and West. When the land-wind makes a cross, the end of the hawer may be shifted.

The general anchorage is from 30 to 35 fathoms, with the citadel (called the *Peak Castle,* a brown square fort on a hill over the N.W. part of the town) a little open to the eastward of the Loo Rock; the latter at the distance of half a mile.

With the Loo Rock and citadel in one, bearing nearly N.N.E. ¼ E., and Funchal Steeple N.E. ¼ N., the anchorage appears equally good, in 35 fathoms, stiff ground. With the same marks, with the Loo about a mile off, there is good ground in 45 fathoms. To the westward, the ground changes to sand and rock, and to the eastward it has a sudden declivity from 50 to 55 fathoms, stiff clay ground, to 100 fathoms, rock, and then no ground.

In case of a S.W. gale, which may be frequently expected in winter, the situation with the Loo and citadel in one, or the citadel just open to the westward of the Loo, will be found most convenient. On the contrary, the citadel, well open to the eastward of the Loo is the best situation when a south-easter may be expected.

When coming into the road, with a brisk wind, sail should be reduced and secured in time, to prevent having too much way through the water, at the moment of anchoring; and ships should be brought up with their heads to seaward; for thus, in case of any accident in bringing up, sails may be had off shore, or otherwise, as required.

Those riding in Funchal Roads should be very active when they observe a swell coming in from the S.W.; at this moment, no time is to be lost in getting under way, for the swell indicates that a gale is certainly coming on; particularly so in the months of December and January, generally the commencement of the rainy season. Should it come on to blow very hard from the westward, the best mode is to run to leeward of Desertas, where shelter from the wind may be found, and water perfectly smooth; thus you avoid the risk of losing sails, by heaving to windward."*

* Some of the old inhabitants affirm that there is no danger in attempting to ride out a gale from the southward, as it rarely continues long. It is said that no vessels with good ground tackle have ever been lost by pursuing this method, and that many, in attempting to get away at the commencement of the gale, have been driven on shore.—"Voyage of the Chanticleer, vol. i. p. 10.

The best way for ships, however large and numerous, when bound into Funchal Road from the eastward, with the wind north-easterly, is through the passage between the Desertas and Madeira. The north-easter will carry them to the offing of the Brazen Head, the East point of the Bay of Funchal. In the night, a single ship may keep over toward that bluff point, and, with her boats towing ahead, when becalmed, luff up into the stream of the land-wind, and by that means fetch the anchorage. Ships must show a light at their ensign-staff in the night, to prevent being fired at from the forts at Loo Castle. In the day, they should keep further distant from the land than in the night, to avoid being becalmed under it, and to gain the stream of the sea-breeze. If, from over caution, or other reasons, they fall 2 or 3 leagues to the leeward of the road, they should then keep plying up in the stream of the valley, until they gain the vein of the sea-breeze. In working in with a land-breeze, it is best to make short tacks, opposite the valley; as here both the land and sea-breezes are most regular.

Small vessels, from North America and the Western Islands, come in, generally, round the West end of the island, but are frequently becalmed a considerable time under the high land there. From this season ships, on leaving Funchal, should make sail with the land-wind, and stand directly off from the road; ships bound to the southward, by taking a contrary method, having continued several days becalmed under the western part of the island.

In the winter months eddy-winds and squalls, proceeding from the high land, are frequent and severe, and the ships are often forced to put to sea from the road. Several westerly and S.W. gales, with rain, then frequently prevail, and prevent regaining it for some time. At these periods, Madeira and the Desertas are often obscured in fog. The squalls have been found so sudden and violent near the Desertas and about the S.E. end of Madeira, as nearly to overset the ships in the vicinity; and many have been driven by them far to the eastward.

It has been said, that a southerly wind never blows hard quite home to Funchal; that the south-westers and south-easters are never expected, except in January, February, and the beginning of March; and that large ships almost always ride them out; but Captain Horsburgh has stated, that "these southerly gales sometimes blow quite home to Funchal, even in November and December: and, when they are apprehended, it is common for ships of every description to put to sea. These S.W. or S.E. gales are, in general, preceded by a swell in the road, often accompanied by gloomy weather, drizzling rain, and a very unsettled breeze from the land, veering backward and forward very suddenly. Under such indications, ships generally proceed to sea;" for, should it blow strong from the southward, it would be almost impossible to clear the shore, the anchorage being so close to the land. A few years ago, several vessels were driven from the anchorage, and completely wrecked on shore.

From the Pontinha to *Ponta da Cruz* the distance is 1¼ miles; the coast between has a broken outline of rocky cliffs, points, and bays. The bay to the West of the Pontinha is half a mile across, and its shores are composed of steep cliffs, with a high bold bluff at its West extreme. Along the base is a beach of sand extending as far as the watercourse. The whole of the bay is comparatively shallow, and appears to offer the best position in Madeira for any artificial harbour works.

Admiral FitzRoy says:—"The roadstead of Funchal is well known to be unsafe in S.W. gales; and there can be no doubt that the most prudent plan is to keep at sea while they last; but I have been told by old traders to Madeira, that ships sometimes remain at anchor, about half a mile from the Loo Rock, and ride out S.W. gales without difficulty; the undertow being so considerable, that their cables are little strained."—Vol. ii. p. 46.

These statements require some modification. On October 15, 1842, Madeira was visited by one of the most dreadful storms that had occurred since the flood of 1803, which swept 400 persons in the sea. On the 26th it blew a tremendous hurricane from the South, which, with the terrific sea, drove four out of the six vessels at anchor on shore, with total destruction, and nearly all the crews were lost.

The *Gorgulho*, a detached sugar-loaf formed rocked, lies off a pretty little bay, half a mile West of this. Four-tenths of a mile North of this rock is *Monte da Cruz*, 862 feet high, with a telegraph on its summit, and hence there is a succession of rocky cliffs for another half mile to *Ponta da Cruz*, at the S.W. extremity of which there is a semi-detached pointed rock with a small iron cross on the top of it. This rock is the South extremity of Madeira, and is in lat. 32° 17′ 18″ N., long. 16° 57′ 11″ W.

Immediately to the West of Ponta da Cruz is the little bay of *Praya Formosa*, formed by a shingle beach; and at 1½ miles from it is the mouth of the *Socorridos River*, a mountain stream, perhaps the largest in Madeira, which drains the celebrated valley of the Curral. At the West side of the mouth of this is a small bold rocky part, round which are the village and little boat harbour of *Camera de Lobos*. The West side of this is a narrow wavy line of black lava, running out South at 270 yards. The little town is old and poor enough, but the sides of the mountains around are covered with quintas and vineyards, and are said to form one of the finest wine districts of the island.

CAPE GIRAO, a magnificent headland, is 3½ miles West of Ponta da Cruz. It is the termination of a ridge of mountains lying westward of the valley of the *Jardim da Serra*. The cape is nearly perpendicular for 1,600 feet above the sea, which nearly washes its base; and upon the high land which covers it is a grove of pine trees, 2,079 feet above the sea. The hills continue rising until they reach the head of the valley, at an elevation of 4,535 leet.

At 2 miles from Cape Girao is the *Ilheo de Lapa*, a conical shaped rock, in front of the village of Campanaris. The coast to the East has a continuous line of stony beach; towards the West this characteristic alternates with *clean* black rocky points.

Ponta do Sol is 5½ miles W.N.W. of Cape Girao. It is a bluff rocky cliff, with some fragments of rock lying close in front of it; the largest of these is pointed, and has a small wooden cross on it. The Ponta do Sol in a westerly gale and stormy weather appears surrounded with the colours of the rainbow, arising doubtless from the spray of the surf; hence, probably, its name has been derived. The village of Ponta do Sol is up the ravine to the West of the point; its church may be seen through the narrow gorge. Westward of this the coast is a long wavy line of narrow stony beaches, above which are cliffs of small elevation, much broken by ravines and land-slips; one remarkable piece of cliff stands 1¼ miles West of Ponta do Sol. Three-fourths of a mile beyond this is the village of Magdalena, at the outlet of a ribeira; 2 miles beyond Magdalena is another ribeira; the space between is called the *Arco da Calheta*. At 5 miles from Ponta do Sol is the town of *Calheta*, but little can be seen of it through the very narrow ravine. At a quarter of a mile West of it, above the cliffs, on a ridge of land, is a conspicuous long building like a monastery. *Ponta Galera* is seven-tenths of a mile from Calheta; it is a natural jetty of flat rocks of black basalt, 100 yards long.

Ponta Jardim is 1⅓ miles *N.W. by W.* of Ponta Galera; it appears to be a landslip; upon the top of it are a small village and a chapel. The soundings off this part of the coast are regular, over dark sand, and extend off 1½ miles, with 30 fathoms 1 mile off. *Paul do Mar*, a village on the coast, is 1 mile from Ponta Jardim. There is a waterfall here, and a great land-slip. The land is cultivated in terraced vineyards. A grove of pines above Paul do Mar is 2,030 feet (or one-third of a mile) above the sea, while its horizontal distance from it does not exceed half a mile. This will give on idea of the bold character of the scenery.

The beach of shingle and large stones extends 1 7-10th miles to *Point Fajao d'Ovelha*. Here it is broken through by a little spur of black lava; the cliffs become more elevated, and above them the land rises with a steep ascent to the highest peaks of the western mountains, 4,270 feet.

Ponta Parga is the western extremity of Madeira, and is 2⅔ miles W.N.W. of Ponta Fajao d'Ovelha. The bold rocky cliffs of the point are 935 feet high, and the smooth topped hill to the East is 1,380 feet. On the heights, 1 mile East of the point, there is a church. Some rocks and large stones lie scattered around the base of Ponta Parga, and a rocky ridge of 11 to 20 fathoms runs off it $1\frac{1}{2}$ miles, and occasions a heavy sea in westerly winds. Ponta Parga is in lat. 32° 48′ 6″ N., long. 17° 16′ 38″ W.

The bank of soundings extends $5\frac{1}{4}$ miles West of Fajao d'Ovelha Point; to the N.W. of Ponta Parga its breadth is $2\frac{3}{4}$ miles. It is flat, with 40 to 46 fathoms, light brown or a dark gray sand, and occasionally rock. From these depths it drops very suddenly to 200 fathoms.

Ponta Tristao is the next point, N.E. of Ponta Pargo, bearing *N.E.* 5 miles. The coast between it is a wavy line of coarse stony beach, with high rocky cliffs rising abruptly from it. Above the cliffs the land rises steeply to the ridge of mountains above 4,000 feet high, and 2 miles from the shore. Ponta Tristao, the North point of Madeira, is a high, bold bluff, 1,070 feet high, off the foot of which are a few sunken rocks extending 130 yards, but clear beyond. On the heights, 1 mile to the South, is the parish church of Magdalena, 1,700 feet above the sea. At nine-tenths of a mile *N.* 60° *E.* from the point, and about half a mile from the adjacent beach, is a singular cluster of flat rocks, a few feet above the sea, called the *Rochas de Rabaçal.* With any sea, the surf rolls over them, but they are steep-to, and a deep channel inside them.

Ponta Moniz is $1\frac{1}{4}$ miles from Ponta Tristao, and is formed by a mass of lava running out N.E. about 470 yards beyond the general line of coast, and looks as if it had flowed over and beyond the cliffs into the sea. The shores of the point have a very irregular and broken outline. On either side of it are detached rocks, and right off the bluff are four others in a straight line. On the East side of the point is a small fort with a round tower; and 140 yards S.W. of the outer islet off the point is another rocky point and another round tower, at which is the best landing as a jetty. The town of *Moniz* is on the higher part of the point; the chapel being one-third of a mile from the landing-place. The whole point is cultivated with vines. In front of the point, at the distance of 120 yards, is an islet of the same name, composed of yellow tufa resting on black lava. Its shores are precipitous, and it is the resort of sea-fowl; it has no channel inside it. The little bay, locally called *Porto Moniz,* is in fact a rocky bank, varying in depth from 2 to 40 fathoms.

One mile *S.* 42° *E.* from Ponta Moniz are a group of rocks called the *Janellas,* lying near the outlet of that ribeira. They are five in number the largest 133 feet in height. At $2\frac{3}{4}$ miles *S.* 52° *E.* from the outer Janella is the point and village of *Sieçal.* The point is a comparatively low rocky projecting piece of land, with a great variety of feature. The town stands on the top of the point, a short distance from the cliffs, and surrounded by vineyards. The best landing is on the largest rock at the East extremity of the point, which is on this account connected with the shore by a wooden bridge.

San Vincente is $3\frac{1}{4}$ miles from Ponta Sieçal. The outlet of the ribeira is marked by an isolated sugar-loaf rock, standing a few yards within the beach. This rock has been excavated and converted into a chapel. *Ponta Delgada* is $3\frac{1}{4}$ miles from San Vincente, the coast between lying generally similar to that West of the latter, a piece of low land at the foot of the mountains, with houses and cultivated enclosures. Ponta del Gada is a comparatively low point, composed of rocky cliffs, with a tower upon the top of it. The houses, which are numerous, and many of them pleasing and respectable, are scattered thickly among the richly cultivated vines and orchards, with a very pleasing effect. The church, large and handsome, is close to the sea. Close round the point, on its East side, is a small bay, with a little bit of fine shingle in it, which offers the best landing.

Ponta do Arco, a bold black point, is 1 2-5th miles East of Ponta del Gada. Nearly midway are a few large detached rocks, the largest called *Rocha de Boa Ventura.* A group of low rocks lie off 230 yards to the W.N.W. of it, and abreast of it are two *ribeiras,* the larger named *Entroza.* Nearly three-quarters of a mile inland from Ponta do Arco is a conspicuous sharp, wooded peak, 2,746 feet high, the summit of the Arco de San Jorge, which proved a valuable station in the survey from its unmistakable peculiarity of feature.

Ponta de San Jorge is in lat. 32° 39′ 44″ N., long. 16° 54′ 47″ W. It is a high, bold, rocky bluff, nearly 700 feet above the sea, and may be called the N.E. point of the island. A small low rock just seen above water, on which the sea commonly breaks, lies *E.* ½ *S.* three-tenths of a mile from Ponta San Jorge. The next point to the S.E. is *Santa Anna,* bearing *S.* 59° *E.*, distant 1 1-10th miles. On the same bearing is a large isolated rock, *Ilheo de San Jorge,* 134 feet in height, one-third of a mile from Santa Anna Point. The point is formed by a gradually rounding narrow beach of large stones and coarse shingle, from which the land rises very abruptly. One-fourth of a mile from the sea it attains an elevation of 1,100 feet. The country above the sea face is well wooded and extremely beautiful; and the quintas spread over it are amongst the most favourite summer retreats of this island. A detached rock lies a quarter of a mile S.E. of the point, and is about 12 or 14 feet high. At 1 1-5th miles from this point, and 400 yards off shore, is a small isolated rock, which uncovers at low water.

Ponta Cortada, a remarkable point, is 1 9-10th miles *S.* 52° *E.* from Ponta de Sta-Anna; at six-tenths of a mile to the N.W. of it there is a singular sharp peak, 1,730 feet high, standing close to the edge of the cliff overlooking a large high mass of rock at its base, called the *Rocha do Navio.* Porta Cortada has a very sharp termination, with a peak above the cliff, and deep water close up to it.

Ponta de Fayal, the next point, is comparatively low and narrow, and has a perpendicular rocky cliff extending from its outer extreme along its N.W. side Outside the point, bearing *N.* 40° *E.* one-third of a mile off, is a black basaltic rock, called the *Ilheo de Fayal,* with a sugar-loaf rock in its centre, 74 feet high. A quarter of a mile S.E. of the point there is a sharp bold rocky spar. The small town of *Fayal* lies up the bay between them. The cliffs from which this spar projects rise to a considerable elevation, and form the sea face of a singular flat-topped mountain, named *Penha d'Aguia,* or *Eagles' Rock,* whose summit is 1,915 feet high.

Ponta da Cruz is the outer extreme of a small peninsula, 1 6-10th miles S.E. of Ponta de Fayal. It is surrounded by low rocky cliffs, and in front of it there are four detached rocks, the outer one of which is 500 yards off the Point. To the S.E. of the point is a bay, three-quarters of a mile across, called *Porto da Cruz.* It has a shingle beach at its head, and here is also the little town of *Santa Cruz.* The coast beyond consists of bold rocky cliffs, of no great elevation at the sea, but the land rises above them precipitously. The last habitation seen on this part of the island was close to the coast, half a mile beyond Ponta da Cruz.

Ponta de San Antonio is 1 9-10th miles to the E.S.E., and is a bold rocky point. Two rocks lie close at the foot of it, and half a mile inland is a mountain, 2,510 feet high, densely covered with trees. A dreary iron-bound coast, without inhabitants, extends for 5½ miles to *Ponta do Castello,* the cliffs of which are of reddish tufa, 534 feet high, bold and perpendicular. At the foot of the bluff, 100 yards off, is a breaking rock. The shore throughout is broken into innumerable small coves and bold fantastic points, with a great variety of detached rocks, but in no case beyond 250 yards from the shore. A mile and three-fourths from Ponta de San Antonio, and about six-tenths of a mile inland, is a high green woody peak, named *Castanhas,* 2,058 feet above the sea. The land East of it has a steep descent to Caniçal. Three miles and a half to the East is *Ponta Bode,* a bluff, with a bay on each side of it. One mile and a half further is Ponta Rosto, with a group of rocks off it. There are other rocks off this point which need not here be particularized.

The bank of sounding extends further off this part of the coast than any other, except Ponta Pargo, and the depths over it are tolerably regular, except in front of Ponta da Cruz. Its breadth hereabout is from 2½ to 3 miles, and the depth from 20 to 80 fathoms, the bottom generally of dark gray sand, and occasionally with coral.

We have extracted many of these particulars from the excellent and detailed account given by Admiral Alexander T. E. Vidal, R.N., the Admiralty surveyor, as given in the "Nautical Magazine" for 1848.

5.—THE CANARIES, OR CANARY ISLANDS.

THIS group of islands was supposed to be known to the ancients under the name of the FORTUNATE ISLANDS. An expedition to conquer it was undertaken in 1334, by Louis de la Corda, a Castilian prince, but it was repulsed by the bravery of the original inhabitants, the Guanches. It was left until the year 1402, when Jean de Béthencourt, a baron of Normandy, took possession of Fortaventura and Lanzarote, for John, King of Castile. By the treaty of peace between Ferdinand, King of Castile, and Alphonso, King of Portugal, it was agreed that these islands should belong to Spain, in lieu of the settlements on the continent of Africa, ceded to Portugal.*

The land of the Canary Islands is generally high, being variegated by volcanic mountains, among which that called the Pic, or Peak, of Tenerife, is supereminent. The inequality of height is, however, so great as to produce differences in the temperature of the di rent islands. For eight months in the year the summits, excepting those of Lanzarote and Fortaventura, are covered with snow; yet in the valleys, and on the shores, the cold is seldom so great as to render fires necessary. A great proportion of the surface of the islands is covered with lava, calcined stones, and ashes, formerly emitted by volcanoes, the remains of which are still visible in all the islands; and some of them, among which is the Peak of Tenerife, are not yet entirely extinguished. The number of inhabitants, according to the census of May, 1857, was 134,046. The productions, exports, and imports, may be found correctly described in most geographic works. The first discoverers found neither corn nor wine; though, at present, there is plenty of both. Variation of the compass, 20½° to 21° West.

Vessels may pass between the Canaries, and through their principal channels; as there is no known danger but what may be plainly discerned, excepting a sunken rock, laid down in some charts, in the southern part of the channel, between Tenerife in the Grand Canary, about 8 leagues E.S.E. of the South point of Tenerife, and 4 leagues westward of the centre of Canary, but which is not shown in the survey of Admiral Vidal, and another off the E. point of Tenerife.

In sailing from Funchal to Tenerife keep well to the westward, steering S. by W. ½ W. [*nearly South*] in order to avoid the *Salvages*, which are very dangerous in the night.

If prevented from weathering the Salvages or the Piton (described hereafter) by prevalent westerly and S.W. winds, common in the months of January and February, when a heavy swell may set the ship much to leeward, you may safely bear up and run to leeward of the Great Salvage; only observing that, if the swell be very heavy you must cautiously avoid three shoal spots, lying to the northward and eastward of that isle. Of these, the northern one is about three-quarters of a mile to the northward [*N.N.W.*] of the isle; the inner one on the N.E., 250 fathoms from it; and the outer, in the same direction, 1 1-10th miles. Two others, with 3 and 3½ fathoms, lie at about half a mile from the eastern shore.

The SALVAGES consist of an island, named *Ilha Grande*, or the *Great Salvage*, a larger islet named *Great Piton*, and a smaller one called the *Little Piton*, together with numerous rocks. The *Great Salvage* lies in lat. 30° 8′, long. 15° 55′. It is of very irregular shape, and has a number of rocks about it within the distance of a mile. It is much intersected, and has several deep inlets, the most accessible of which

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* ALLEGRANZA (the northern isle) is synonymous with *joyous*, a name given it by the first conquerors of the islands, Jean de Bethencourt, and Gadife de Salle. This was the first point on which they landed. After remaining several days at Graciosa, they conceived the project of taking possession of the neighbouring isle of Lanzarote, where they were welcomed by *Guardarfia*, sovereign of the Gaunches with the same hospitality that Cortes found in the palace of Montezuma. The shepherd king, who had no other riches than his goats, became the *victim of coward treachery*, like the sovereign of Mexico!—*Humboldt.*

is on the East side. It is covered with bushes, amongst which the thousands of sea-fowl make their nests. It is surrounded on all sides with dangers, most of which show, but many require all caution in approaching.

The Great Piton lies at the distance of 8¼ miles W.S.W. ¾ W. [*S.W. by W.*] from Ilha Grande. This isle is 2¾ miles long, N.E. ¾ E. and S.W. ¾ W. [*N.E. by N. and S.W. by S.*] and has a hill or peak near its centre. The *Little Piton* lies at a mile from the western side of the former, and is three-quarters of a mile long, nearly in the same direction; both are comparatively narrow. These isles are seated upon, and surrounded by, one dangerous rocky bank, which extends from the western side of the little isle half a league to the westward.

It has been said of the Great Piton, that, in some respects, it resembles the largest Needle Rock at the West end of the Isle of Wight; and, at a great distance, looks like a sail. Its southern part appears green, its northern part barren. It may be seen 5 or 6 leagues off. The *Little Piton* is very flat, and is connected to the South point of the greater one by a continued ledge of rocks. The whole of the eastern side of the Great Piton is rocky and dangerous.*

LANZAROTE is above 3,000 feet high, and its mountains may be discerned at a great distance. On approaching, it appears black, rocky, and barren, and it has many extinct volcanoes. From its northern extremity, in lat. 29° 14′, a barrier of precipitous cliffs rise to the height of 1,500 feet, extend in a S.W. dirertion 7 miles, and terminate in a sandy plain, where, in 1825, a volcanic eruption took place, and two considerable hills were thrown up, which were burn in 1835; a stream of lava, from 200 to 300 yards broad, found its way to the sea in the bay. The shore along all the N.W. side to the S.W. extremity of the island is high and precipitous, with the exception of a cove, called *Januvia* or *Janubio*, once a harbour for small vessels, but converted into a salt-water lake by an eruption in the year 1765.

On the eastern side of the island the shore is much lower than the western; near the middle of it is the Port of *Naos*, a small but secure harbour, formed by several rocky islets, and having two entrances, the northern with a depth of 12, and the southern of 17½ feet at low water, with a tidal rise of 9 feet. During winter, nearly all the vessels of the island resort to this place. Two bomb-proof forts, the one mounting 11, and the other 12, heavy guns, defend the respective entrances. The town of *Arecife* is situate immediately to the southward of the port; many of its houses are large, and the streets are capacious; inhabitants about 2,500. The entire population of the island is estimated at 17,500.

The greater part of the inhabitants of Arecife are engaged in the fishery on the opposite coast of Africa, which gives employment to between 400 and 500 men from this island alone, about 250 from Fuertaventura, and proportionably from the other islands.

The highest land in Lanzarote is *Montana Blanca*, above 2,000 feet in height above the sea, situate nearly in the centre of the island, and cultivated to the summit. The wine of this island is very superior to that of the other islands; the grapes are superior in flavour; the soil selected for their cultivation is decomposed scoriæ.† Camels are used in Lanzarote as beasts of burden, on account of the scarcity of water.

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* See "Nautical Magazine," October, 1851, pp. 509—517. The occasion and result of a visit by Rear-Admiral Hercules Robinson in 1813 is there amusingly related. In substance it is, that, in 1804, the crew of a South American Spanish ship, bound to Cadiz with produce, and about two millions of dollars in chests, rose upon and murdered the captain, off some islands corresponding exactly in description and site with the Salvages. The treasure was carried on shore, and buried in the white sand above high-water mark in a snug little bay on the South side of the island, and over it was buried also the body of the murdered captain. This tale was told to an English sailor by one of the two survivors, whose tale led to the unsuccessful search by the *Prometheus*. Still the tale appears credible.

† The preceding description of Lanzarote is chiefly that of Lieutenant Arlott, 1835.

PUERTO DE NAOS.—Any vessel, not drawing more than 18 feet, may enter this port at high water, spring tides, and lie secure from all winds and weather: although, in sailing along the coast, the shipping appears as if at anchor in an open road, the harbour being formed by a ridge of rocks, not perceivable at any distance, as most of them are under water; these break off the swell of the sea, so that the inside is as smooth as a mill-pond. As there is no other convenient place in the Canaries for cleaning or repairing large vessels, it is much frequented for that purpose by the shipping trading to the islands.

On the West side of Arecife lies another port called PUERTO DE CAVALLOS. This is also an excellent harbour, formed, like Puerto de Naos, by a ridge of rocks; but its entrance is shallow, there being no more than 12 feet of water in it, with spring tides. A square castle, built of stone, stands upon a small island between the two harbours, and so defends them both; this island is joined to the land by a bridge, under which boats go from one port to the other, or from Puerto de Cavallos to Puerto de Naos.

At the North end of Lanzarote is a spacious channel, called EL RIO, which is the strait dividing this island from the uninhabited one, called *Graciosa.* A ship of any burden may pass through this strait; for, if she keeps in the midway, between the two islands, she will have 6 or 7 fathoms of water all along.

The Rio is, in general, rather more than a mile wide, and forms the only safe harbour in the Canaries for large ships; but the extreme difficulty of communication with Lanzarote presents an insuperable obstacle to its being resorted to as a harbour for trade. Here basaltic cliffs rise almost perpendicularly to the height of 1,500 feet, and can be climbed only by a narrow path which winds along the face of the precipice; halfway up the cliff is the only spring of fresh water in the island, but rendered useless from its situation, except to a few goatherds. From the bottom of the cliff to the shore of Lanzarote is about two musket-shots distance. The ground in the space is low; and here was a salina, or salt work. The fishermen of Lanzarote have constructed a small stone pier, where boats can land under some shelter; and on the Graciosa side there is a small bay where landing can always be effected. There are no resources here, nor any inhabitants. Some indifferent water may be got by digging in the sand at some distance from the sea. Fish is abundant and good.—*Lieut. du Marais, French Marine,* 1857.

On the N.E. extremity of Lanzarote are two remarkable rocks, composed of black vitrified matter, but in shape resembling the "Needles," at the western extremity of the Isle of Wight.

If a smooth place to lie in, while the trade-wind blows, be required, a ship coming into this harbour from the eastward must run a good way in, and double a shallow point, which lies on the starboard hand, taking care to give it a good berth; and this is easily done by approaching no nearer than in 4 fathoms; when past it, edge toward Graciosa, and anchor in any convenient depth; for it shoalens gradually toward the shore, close to which there are 2 fathoms.

This is a commodious place in the summer season for careening large ships; they may come here and unload all her stores, &c., on the Isle of Graciosa, and heel and scrub. Or, if two vessels chance to come together, the one may heave down by the other; in doing which, they need not fear any opposition from the inhabitants, for there is neither castle nor habitation near this spot.

The water, however, is not so smooth here as at Puerto de Naos, especially if the trade-wind happens to blow hard from the East, which sends in a swell that makes it troublesome, if not impossible, to careen a ship properly. But the wind here does not often blow from that quarter, those winds which mostly prevail being from North and N.N.E. In mooring here, great care must be taken to have a good anchor, with a large scope of cable toward Lanzarote; for in East and S.E. winds heavy gusts or squalls come from the high land of that isle. In the winter the wind sometimes shifts to the S.W.; then it is necessary to weigh, and run back to the eastward, round the shallow point before mentioned, until the ship be sheltered from that wind, and there anchor.*

The Isle Allegranza, the northernmost of the Canary Islands, is composed of lava and cinders, the remains of an extinct volcano. It rises to the height of 939 feet above the sea. The edge of the crater is well defined, and two-thirds of a mile across; its bottom is cultivated for barilla. The western cliffs are precipitous, and 700 feet in height. About 40 persons were resident on the island in 1835, principally employed in collecting orchilla.

The only landing-place is on the South side, where a cavern extends about 500 paces, slanting from the sea, and terminates in a little sandy bay, open above. At the entrance, the rocks form a natural jetty. The village is situate immediately above, and abreast is the only anchorage, half a mile from shore.

Graciosa, forming the North side of the Rio of Lanzarote, is about 5 miles in length and 2 in breadth; and, as may be inferred from its appearance, it is destitute of water. Allegranza is 7 miles to the northward of it.

Near *Clara* is a dangerous rock, 3 or 4 fathoms high, and covered with scoriæ, resembling coke. In the old charts it is called the *Infierno* or Hell Rock, and may have been higher. It is now called the *West Rock*, or *Roca de Ouest*.

Eight miles to the eastward of Graciosa stands the *Roca del Este*, or the East Rock, the craggy summit of an extinct volcano. Many ships have been wrecked upon these islets in the night, being misled by errors in their reckoning and by the currents.

FUERTAVENTURA, or FORTAVENTURA.—This island is divided from Lanzarote by the channel named *Canal de Bocayna*, which is 6 miles in breadth: the island as shown by chart, is singularly formed and variegated; it is less mountainous than the other islands, yet both the northern and southern extremities rise to 2,500 feet above the sea.

It has two ports of trade; *Cabras* on the East, and *Tarajalejo* on the S.E.; but Cabras contains little more than 1,000 inhabitants. The anchorage at the latter is indifferent, and at the landing-place, a beach of shingles, still worse.

Lieutenant Arlett says that, although the general feature of Fuertaventura is extreme barrenness, still there are many spots of great fertility; the most conspicuous of these is the valley of *Oliva*, toward the North end, where there is a village of the same name, the residence of the lieutenant-governor, a descendant of the Baron Bethencourt, who possesses a very considerable portion of the island. The valley of Oliva is about 15 miles long, and generally from 2 to 3 wide. The only two streams of pure water in the island have their rise in the mountain of the Atalaya, or watch-tower; they are husbanded with great care, and irrigate the whole of the valley.

A paved road across the island, from Cabras to Betancuria, is the only one existing; the other ways being mere tracks following the direction of the valley, where the ground is less encumbered with stones, and softer to the camel's feet. The population is from 17,000 to 18,000 scattered in small villages over every part of the island.

The interior formation of Fuertaventura is as follows: to the North is a group of extinct volcanoes; some of them, as *Monte Mudo*, on the N.E., rise to the height of 2,160 feet; and they branch to the southward of Port Cabras, East and West to the sea, thence following the direction of the coast on each side for about 30 miles; again uniting, they encircle an extensive and arid plain and several detached villages. From the summit of the hills, the course of some brackish streams may be traced by the verdure they impart. There are also date palms, the only trees, excepting the fig, on the island.

From the southern point of junction of the mountains, one of which, *Chilegua*, on

* Particular plans of this strait, and of the harbours of Naos and Cavallos, are given in our Chart of the Azores, &c.

the western coast, reaches the height of 2,160 feet, a narrow sandy isthmus, about 5 miles long and 2½ broad, projects, connecting it with the southern extremity of the island, a peninsula, occupied by the *Monte Jandia,* a mountain which presents the most remarkable features; from the N.W., its precipitous face is seen to rise to the height of 2,820 feet; and spurs, or buttresses, diverge from its centre to the N.E., East, and S.E., by any of which it may be ascended to a frightful ridge on the summit.

On the South side of the eastern entrance of the Bocayna, very near the N.E. shore of Fuertaventura, lies the little island of *Lobos,* or Seal's Isle, which is about 1¼ leagues in circumference, uninhabited, and destitute of water. Near this isle is a good road for shipping; the mark for which is, to bring the East point of Labos to bear nearly N.E. by N., and anchor halfway between it and Fuertaventura, or rather nearest to the latter. Although this road seems to be open and exposed, yet it is very safe with the trade-wind, for the water is smooth, and the ground everywhere clean, being a fine sandy bottom. Directly ashore from the road, on Fuertaventura, is a well of good water, of easy access.

Through the broad channel, *La Bocayna,* ships sail very safely, as it is deep in the middle, and shoalens gradually toward Lanzarote, near to which are 5 fathoms of water; but very near or close to Lobos, the ground is foul and rocky. In this passage vessels of any burden may find room enough to ply to windward, and there is no necessity of approaching too near to Lobos.

When a vessel comes from the eastward, with the trade-wind, and is passing through the Bocayno, to the westward, so soon as she brings a high hill on Lanzarote directly to windward of her, she will be becalmed, and soon have the wind at S.W. Should this happen, make short tacks until you obtain the trade again, or a constant northerly wind, the first puff of which will come from West or W.N.W. So soon as this is perceived, you must not stand to the northward, otherwise you will immediately lose it again, but must steer toward Lobos; for the nearer you approach this isle the more will you have the wind; so that, before you are two-thirds over, you will meet with a steady wind at North, or N.N.E.

When there is a great westerly swell hereabout, the sea breaks horribly on the rocks at the N.W. end of Lobos. Captain Glas affirms, that he has seen breakers there nearly 60 feet high; of which, were one to strike the strongest ship, she would be staved to pieces in a moment. "When I first saw," says Captain Glass, "those mighty breakers, our ship had just passed through the channel, between Fuertaventura and Lobos; we had a fine brisk trade-wind at N.N.E.; and although there were no less than 10 fathoms of water, when we came into the westerly swell, yet we trembled lest the waves should have broken, and thought ourselves happy when we got out of soundings. We heard the noise of these breakers, like distant thunder, after we were past them 6 or 7 leagues."

Point Jandia, or HANDIA, the south-western extremity of Fuertaventura, is a low rocky point, placed by the Chevalier de Borda in lat. 28° 4′ long. 14° 31′, and by Lieutenant Arlett in 28° 3′, and 14° 32′. A rock lies at half a mile from it to the S.W.

CANARIA, or GRAND CANARY.—The Isleta, or N.E. point of this island, lies 18 leagues N.W. by W. ½ W. [*W. by N.*] from Point Handia, the S.W. end of Fuertaventura; and, in clear weather, either of these islands may be seen from the other. The centre of Canaria is exceedingly high, and full of lofty mountains, which tower so far above the clouds as to stop the current of the N.E. wind that generally prevails here; so that when this wind blows hard on the North side of the mountains, it is either quite calm on the other side, or a gentle breeze blows upon it from the S.W.* This island is the granary of the Canarian Archipelago, and has, in some districts, two wheat harvests in the year—one in February, the other in June.

* A description of these calms is subjoined to the present section.

On the N.E. end of Canaria is the peninsula called the *Isleta*, 2 or 3 leagues in circumference; the isthmus, by which it is connected with the main island, is low and sandy, about 2 miles long, and a quarter of a mile broad at the narrowest part. On each side of this isthmus is a bay, which, being exposed on the N.W. side to the swell of the sea, is, therefore, an unfit road for shipping; but small barks get in between a ledge of rocks and the shore, and lie there smooth and secure from all winds and weather. Here the natives repair their small vessels.

On the other side of the isthmus is a spacious sandy bay, called by some *Puerta de Luz*, and by others *Puerta de las Isletas*, from some steep rocks, or islets, at the entrance of the bay, toward the N.E. This is a good road for shipping of any burden, with all winds, except from S.E., to which it is exposed; but that wind, which is not common here, seldom blows so hard as to endanger a ship.

The landing-place is in the very bight, or bottom, of the bay, where the water is generally so smooth, that a boat may lie broadside to the shore, without danger. Thence, along shore, about a league to the southward, is the city of PALMAS, the capital of the island. Shipping, that discharge their cargoes at Palmas, generally anchor, in good weather, within half a mile of the town, for the quicker despatch; but that place is not a good road.

The next port of any consequence in Canaria is *Gando*, situated in the middle of the East side of the island. It is a good place for shipping with all winds, except from the southward; and there good water, with other refreshments, may be had.†

Las Palmas is a large handsome town, containing 18,000 inhabitants: it has a cathedral, hospital, and college. It is well supplied with water, having fountains in all the principal streets; and its market, likewise, is well supplied. The city appears to great advantage from the sea, the streets rising regularly above each other, which gives it a very commanding aspect. It extends at least a mile in length. There is another large town, with a lofty church, about 4 or 5 miles to the southward, which stands considerably higher and more inland than Palmas. From the number of houses seen, while sailing along the island, it has the appearance of a considerable population, and of being well cultivated. A fixed light is shown from the mole.

CANARY affords more anchorages than any of the other islands: the bank almost everywhere extending further. During summer there is here a constant N.E. wind; the land, obstructing its course, causes the calms which prevail off the S.W. shore to the distance of 8 or 9 miles, when the aerial currents again unite. Within this space a westerly current runs close in-shore, which is advantageous to the coasters.

El Cumbre, or the summit of the highest peak of Canary, has been stated by Lieut. Arlett to be 6,648 feet above the level of the sea: the mountain *Sancillo*, near the centre of the island, which has a large wooden cross on its summit, 6,070 feet.

TENERIFE, or TENERIFFE.—Point Naga, the N.E. end of Tenerife, bears N.W. ¾ N. [*N. W. by W.*] 15½ leagues from the N.E. point of Canaria; but, from the western part of Canaria to the nearest part of Tenerife, the distance is 10 leagues. In the centre of the island is the famous peak, called, by the ancient and present inhabitants, the *Peak of Teyde*.

The Bay, or Roadstead, of SANTA CRUZ, on the N.E. coast, is the most frequented of any in the Canaries.

On coming toward the island, in clear weather, the peak may be clearly discerned at a great distance;* it first appears like a thin blue vapour or smoke, very little darker

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* The pilots of Tenerife assert that a rock, with only 12 feet of water over it, lies W.N.W 2½ leagues from Point Aldea, the western point of the Grand Canary, and that the sea breaks on it in rough weather. Its precise situation appears to be unknown.

† They say, in the Canaries, that the peak, in very clear weather, is seen from La Bocayna, or the channel between the Isles of Lanzarote and Fuertaventura, at the distance of about 50 leagues.

"The Peak of Tenerife is probably the most striking monument of nature in the world;

than the sky; at a further distance the shade disappears, and is not distinguishable from the azure of the firmament. Before you lose sight of this towering mountain, it seems at a considerable height above the horizon, although, by its distance, and the sperical figure of the earth, all the rest of the island, the upper part of which is exceedingly high, is sunk beneath the horizon. But, in general, in sailing toward Tenerife, when the trade-wind blows, the island appears as a haziness of the sky, or as a cloud, till within the distance of 5 or 6 leagues, and then the headlands show like land, and are first conspicuous.

Tenerife presents to the curious eye the most singular object, perhaps, in the northern hemisphere. The island appears, on sailing along the coast, from North to South, to have once been a complete cinder; and presents to view a great deal of the brokenness and irregularity of half-consumed coke. The resemblance, however, contrary to expectation, becomes less perfect as we approach the peak, the great chimney of the fiery caldrons boiling beneath. The island is of a triangular form, its North and South sides being about 45 miles long, and its West end about 24 miles. Some very interesting particulars of it, with photographic views, are given by Professor C. Piazzi Smyth's account of his astronomical visit in 1856.†

In Baron Humboldt's ascent of the peak, it is stated, that the volcano has not been active at the summit for thousands of years, its eruptions having been from the sides; the depth of the crater being only about 120 feet. The peak forms a pyramidal mass, having a circumference at the base of more than 57,105 fathoms, and a height of 12,176 feet, or rather more than 2 geographic miles. Two-thirds of the mass are covered with vegetation, the remaining part being sterile, and occupying about 10 square leagues of surface. The cone is very small in proportion to the size of the mountain, it having a height of only 537 feet. The lower part of the island is composed of basalt and other igneous rocks of ancient formation, and is separated from the more recent lavas and the products of the present volcano by strata of tufa, puzzolana, and clay.

Captain Beechy, in his narrative of the voyage of the *Blossom*, observes:—"As I purposed touching at Santa Cruz, we immediately hauled up for the land, and it was a fortunate circumstance that we did so; for so strong a current set to the southward during the night, that, had we trusted to our reckoning, the port would have been passed, and there would have been much difficulty in regaining it. I mention the circumstance, with a view of bringing into notice the great southerly set that usually

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for, though the Chimborazo (in South America) soars to the height of 22,000, and the Himalayan Dewalgiri)in Asia) to the astonishing height of 27,000, while Tenerife is but 12,176, yet the latter, by its arising directly from the level of the sea, is seen more conspicuously, and stands at a more magnificent elevation. The view from the summit, which it requires a whole day to ascend, is unspeakably grand. On the top of this vast pyramid of basalt is a crater, 40 yards deep, from which vapour continually ascends, and specimens of finely crystallized sulphur are gathered round its lips. From this summit, when the sky is unobscured, the whole island is seen like a model. Rising around it, at a distance, are seen the Canaries, glittering on the horizon, lheir peaks and pinnacles coloured by every change of day. At favourable times, Madeira and the African coast are visible."—*Captain Alexander*, 1837.

Baron Humboldt says:—"It may be admitted in general that the Peak of Tenerife is seldom seen at a great distance in the warm and dry months of July and August; and that, on the contrary, it is seen at very extraordinary distances in the months of January and February, when the sky is slightly covered, and immediately after a heavy rain, or a few hours before it falls."

† "Tenerife, on astronomer's experiment, or specialties of a residence above the clouds, by C. Piazzi Smyth, F.R.S., 1858." Professor Smyth and a party of scientific men went in Robert Stephenson's yacht, *Titania*, to Tenerife, in June and July, 1856, and carried the instruments up to the flanks of the peak to Guajara, 8,903 feet above the sea, on the South side, and Alta Vista, near the edge of the crater, at 10,702 feet above the sea. The results of these observations were very remarkable, and the expectation was fulfilled that the astronomical objects would be seen with much greater clearness and brilliancy when the lower strata of cloud and vapour was passed.

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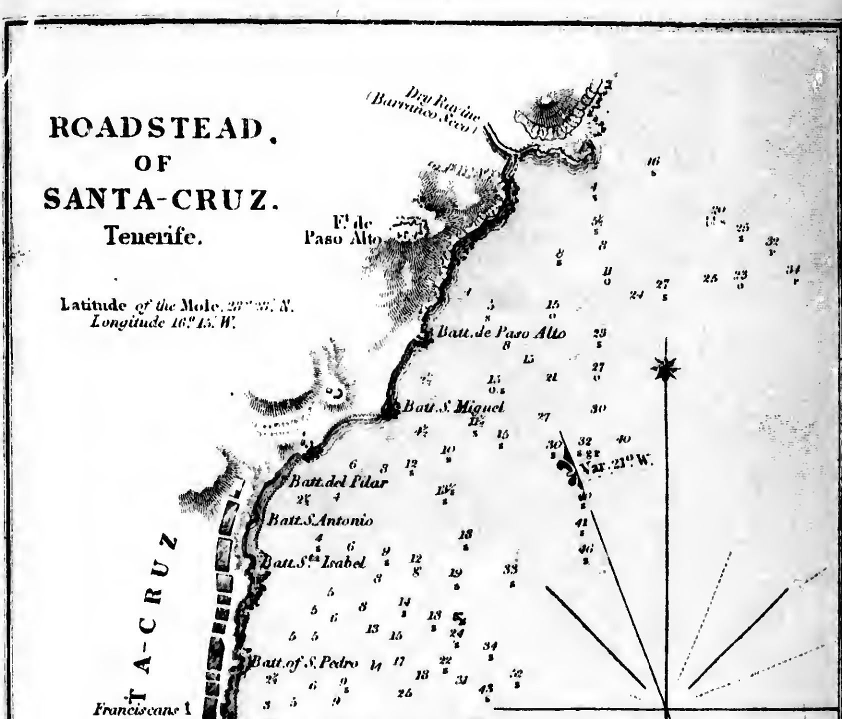
Mancha Blanco
Pta de Anaga
Roquete
Taganana
Pta del Hidalgo
Pta del Viento
Pt Madera
Tacoront
Matanza
Vittoria
Pto de Orotava
S. Juan de Rambla
Garachico
Pta de Buenavista
Pta de Bom Jesus
Pta de Teno
Bco de Juan Lopez
Bco Seco
Playa de S. Juan
Adexe
Pto de Adexe
Pta de la Camiza
Pto de Chistianos
Chasna
Grenadilla
Las Canadas
Guimar
Realejo
Candelaria
Bar.co Hondo
Pta del Socorro
Barr.o de Badajos
Roca
Pto de Abona
B.no del Rio
Pto del Medano
Pelada
STA CRUZ
Red Light


ROADSTEAD OF SANTA-CRUZ.
Tenerife.
Latitude of the Mole,
Longitude 16° 15' W.
Dry Ravine (Barranco Seco)
Ft. de Paso Alto
Batt. de Paso Alto
Batt. S. Miguel
Var. 21° W.
Batt. del Pilar
Batt. S. Antonio
Batt. Sta. Isabel
Batt. of S. Pedro
SANTA-CRUZ
Franciscans
Mole
Red Lt.
S. Christoval
Ch.
Barranco Santus
Batt. of S. Telmo
Batt. of S. Francisco
Tower of S. Juan
Half a Mile
On the inclining ground which forms the Anchorage the bottom is generally tenacious, and ships lie safely by mooring S.E. and N.W. by compass, with a good warp to the offing: thus, also, they may resist the heavy sea, raised at times by adverse winds: but it is essential to buoy up the cables; for, without this precaution, they incur the risk of spoiling them and losing the anchors, not only by foul ground but by anchors at the bottom, which are numerous.

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attends the passage of ships from Cape Finisterre southward. From this cape to Point Naga, our error in that direction, or more correctly *S.* 33° *W.* (*true*), was not less than 90 miles."

PUNTA DE ANAGA, the eastern point of Tenerife, is in lat. 28° 28′ 33″ N., and long. 16° 6′ W. It is proposed to establish a light near it.

To the northward of the N.E. point of Tenerife is a chain of black rocks called the *Anagas*, which are steep-to, but dangerous. To the South of the N.E. point is a high conical rock close to the shore, called the *Mancha Blancha*, though it is usually of a dark colour.

A *dangerous sunken rock* lies off the East point, which is omitted in the last survey, though it appears in the older charts. It was seen by the mail steamer *Cleopatra*, in December, 1859. It is known to the pilots as the *Bajo de la Mancha*, and bears 1½ miles *East, true*, from Anaga Point, and *E.* by *S.* from the rock described above, as La Mancha Blanca. It has 18 feet at low water, and 21 feet at high water. It only breaks occasionally.

Santa Cruz.—At a short distance from Point Anaga, the East point of Tenerife, are the high perpendicular rocks above described; and 4 or 5 leagues thence, on the S.E. side of the island, is the bay or roadstead of SANTA CRUZ. The best road for shipping here is between the middle of the town and a fort, or castle, about a mile to the northward of it. In all that space ships anchor, from a cable's length distance from the shore, in 6, 7, and 8 fathoms of water, to half a mile, in 25 or 30 fathoms. Particular care must be taken, in going in, not to bring any part of the town to the northward of West, lest calms should be occasioned by the high land under the peak; otherwise you will be in danger of driving upon the shore; and, when ashore, will have no ground on the opposite side of the ship, with 200 fathoms of line, so that anchors and cables are of no use.

Here vessels, if moored with good cables and anchors, may lie securely in all winds, although the bay is exposed and open to those which blow to the N.E., East, and S.E.; however, it is not above once in the space of four or five years that they blow so hard as to cause any considerable damage. The surf frequently beats on shore, with great violence, for several days together, and the pier is ill-contrived for shelter.*

A *red light* was placed on the extreme end of the Mole, on July 1st, 1857. The lamp will be kept lighted from dusk until dawn, and moved forward as the mole is prolonged. The light is 20 feet above high water mark, and is visible at the distance of 4 miles. In steering from the South, the light ought to be kept in sight, the coast out of the range of the light being dangerous.

The following directions for the anchorage at Santa Cruz were issued in August, 1842, by *Mr. Richard Bartlett*, the British consul at that place.

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* "The BAY of SANTA CRUZ is much exposed to all winds between E.N.E. and S.W. by W.; and, as the easterly winds are very prevalent, there is generally a great swell setting in, although it seldom blows hard from that quarter of the compass.

"In 17½ fathoms, fine sand and blue clay, directly off the jetty, with the end thereof on with the gateway leading into the town, bearing about N.W., is a convenient berth for watering, and good ground.

"The jetty is built on a curve, to break off the swell, for the convenience of boats, being the only landing-place, where all goods are landed and shipped. Ships generally lie off the jetty, in from 17 to 35 fathoms, good holding-ground. The best mark is the high square building, like a lighthouse, just over, and in one with, the mole or jetty head.

"Tide rises about 4 feet; sets round the bay. H. W. 4h 30′ (?)"—*Mr. William Wood, H.M.S. Tartar*, 18[illegible]3.

"The Chamber of Commerce at Santa Cruz notified July 12th, 1850, that the works of the mole had sufficiently advanced to permit the embarkation of coals, at all hours, independent of tide, and that coals were abundantly provided.

"While running for the anchorage keep both leads going, and bring up to the northward of the Mole Head; or, bring the clock front of the square church with a cupola to bear W.N.W., and anchor with this mark on, or to the northward of it.

"Ships may anchor when in less than 30 fathoms. Give a large scope of chain cable. When the northernmost fort (Fort Paso Alto) bears N.N.E., the depth of water will be about 25 fathoms on the lines pointed out. The shore may be neared without risk, the water being deep, and no dangers that are not apparent. The anchorage to the South of the lines indicated is reserved for vessels in quarantine." The foregoing will be sufficient; but another good anchoring mark is, *not to bring the Mole Head anything North of W.N.W.* Variation, 22° 41' West.

Lieutenant Church, of H.M.S. *Ætna*, makes the following observations on the anchorage of Santa Cruz:—"Whilst surveying the Canary Islands in the *Ætna*, we had, of course, considerable experience of Santa Cruz, and had no reason to consider it an unsafe anchorage. During the very many times that the *Ætna* was there, in only one instance did we experience a gale from the south-eastward. Most of the shipping slipped at the commencement, and got into the offing; but we remained at our anchors, and rode it out well. Although a heavy sea tumbled in, there was much less strain on the cables than might have been expected, arising, as it appeared to us, from an offset, which, together with there being a great uphill drag for the anchor, diminishes the chance of driving.

"The church tower with the cupola (San Francisco) open a little to the right of the Mole Head, is considered the usual anchorage, and vessels congregate here to be near the landing-place. But, in a man-of-war, I would (especially if there are many vessels here) anchor considerably to the north-eastward or windward of this resort, the bank of soundings being wider, and so avoid having merchant ships in the hawser; indeed, I see no reason why ships should not anchor nearly as far North as the Paso Alto Battery, the most northern battery, in case the roads are crowded with shipping.

"I have noticed that ships, coming from the north-eastward to Santa-Cruz, run down at too great a distance from the land, and do not haul in till they get nearly abreast of the town. They get a cast or two of the lead with no bottom, and immediately they get into soundings, the anchor is let go in a hurry, the bank being narrow, and the ship's head in-shore, there being little time for consideration.

"Instead of this method of proceeding, I think it would be advisable, on making the N.E. end of Tenerife, Punta de Anaga, to haul in upon the bank of soundings immediately on passing Punta de Antiquerra, as from this point to Santa Cruz the bank extends as far out from the land as at the town, and the anchorage is just as good and as safe anywhere when abreast of the Barrancos. I would get into the depth nearly that I wished to anchor in, and then run down with the light wind parallel to the shore. Besides having time to anchor leisurely, there is the advantage of being enabled to let go the anchor under foot, wherever you may be.

"Should it fall calm while the ship is outside soundings, she may be taken away to leeward by the southerly set, which once caused us twenty-four hours' trouble to get back again. From experience, we latterly adopted the system I have mentioned."

Commander T. L. Barnard, in H.M.S. st. *Vixen*, says:—"With the wind on shore I should recommend a steamer to steer boldly under the sterns of the vessels at anchor off the Molehead, and bring the head to wind with the Molehead on with the Church tower, in from 25 to 30 fathoms."

The water is easily procured when the surf is not great on the beach. It is sent alongside in butts. A good supply of wine may also be readily had.

The aspect of Santa Cruz is gloomy, and the heat is commonly excessive. On a narrow and sandy beach, houses of dazzling whiteness, with flat roofs, are stuck against a wall of black perpendicular rocks, stripped of vegetation. A fine mole, built of freestone, and the public walk, planted with poplars, are the only objects which break the sameness of the landscape.

Orotava.—The next best port to that of Santa Cruz is the port of *Orotava*, on the northern side of the island, and which lies about 8½ leagues to the westward of Point Anaga. Here the riches and fertility of the island are chiefly to be found, for here the wine is mostly made, and shipped when the weather allows. It is a good harbour in the summer season, or from the beginning of May to the end of October; but in winter, ships are often obliged to slip their cables, and put to sea, lest they should be surprised by a N.W. wind, which throws in a heavy sea: luckily, these winds rarely happen; and, in general, give warning, so that a vessel has time to get away. Straggling rocks project about 2 ships' length from shore, on which the sea breaks furiously. It is commonly calm in the road, but there is almost always a long northerly swell, that causes ships to roll very much.

The anchorage is in 50 fathoms, about 1½ miles from shore, with the peak bearing S.W.; and it is proper to continue a pilot on board whilst lying here.

Orotava stands upon a gentle slope at the foot of the mountain, and is surrounded by fields of corn, gardens, and vineyards. The culture of the soil is here promoted to a very great degree, particularly in some patches so elevated and so secluded as to appear inaccessible to the husbandman. But the plain is very forbidding; and the beach is composed of naked, pointed, and cinereous, or scorched rocks.

PALMA.—From Point Teno, the western end of Tenerife, to the nearest part of the Island of Palma, the distance is about 15 leagues. The summit of this island is higher than the general level of Tenerife, its peak excepted; hence some navigators run toward it with great confidence in the night.

The chief port is that of *Santa Cruz*, on the East side of the island. The mark by which a stranger may find it is the following:—When he approaches the East side of the island, Palma will appear shaped exactly like a saddle. Let him steer so as to fall in a little to windward of the lowest place, or middle of the saddle, till he comes within a mile of the land; then, running along shore to the southward, he will perceive the town close by the sea shore, and the shipping lying in the road; but, as the land behind the town is high and steep, one cannot discern the shipping till within a mile of them. The road is within a musket-shot of the shore, where vessels commonly ride in 15 or 20 fathoms of water, and are exposed to easterly winds; yet, with good anchors and cables, they may remain with great safety in all winds; for the ground is clean and good, and the great elevation of the island, with the perpendicular height of the land facing the road, repels the wind that blows upon it, though ever so strong.

When there is a great N.E. wind at sea, it comes rolling into the bay, but the want of wind and the deepness of the water deprive it of strength and power; so that ships, in such a case, ride here with a slack cable. These circumstances render the road of Santa Cruz, in Palma, more secure than any of those of Canaria or Tenerife; but, in the winter, the rolling swell which comes into the bay, breaks high upon the beach, and prevents boats from going off, or landing, for the space of three or four days together.

Santa Cruz de la Palma is a large town, but not so good as that of Palmas, in Canary, or the towns of Tenerife In coming to it from the offing, a church on one of the heights and some windmills are the first objects seen. It has several forts, and near the mole is a castle, or battery, mounted with a few cannon. In the middle of the town, near the great church, is a fountain, filled by a rivulet, which plentifully supplies the inhabitants with good water.*

* The following notice, which appeared in the *Shipping Gazette*, in March, 1840, will be useful to vessels touching at Palma:—"Several English vessels having lately sent ashore their boats at Tassacorte, without receiving the succour they required, I beg, through you, to inform the shipping interest in general, that the orders from the Spanish Government are, that no communication be held, or refreshments given, at any other place, except this and the town of Santa Cruz, on the N.E. side of Palma."—*Canaries*, January 10th, 1840.

Taxacorta or Tassacorta, the port next in consideration to that of Santa Cruz, is on the S.W. part of the island; it is exposed to westerly winds, and little frequented by any vessels, excepting boats.

In all the island there is no town of any note, excepting Santa Cruz; but many villages, the chief of which are St. Andres, and Tassacorta. In the north-eastern part, inland, is a remarkable high mountain, called La Caldera, or the Caldron, being hollow, like the Peak of Tenerife.

GOMERA is divided from Tenerife by a perfectly safe channel 15 miles wide. The island is very rugged and uneven, the middle being a plateau, above which the mountain *Alta Garaone* rises to 4,440 feet. The shores are everywhere rugged, and nearly perpendicular to the sea. A few rocks lie off it, and there are some small sandy beaches, at one of which, on the East side, is the principal town.

The Port of Gomera lies S.W., about 17 miles from Point Teno, of Tenerife. St. Sebastian, the principal town, is situated close by the sea shore, in the bottom of a bay, on the eastern side, where shipping lie land-locked from all winds, except the S.E. Here you may anchor at a convenient distance from the shore, in from 15 to 7 fathoms; but as the land-wind frequently blows hard, it is necessary for a ship to moor with a large scope of cable, otherwise she will be in dangers of being blown out of the bay. The sea here is generally so smooth, that boats may land on the beach without danger. On the North side of the bay is a cove, where ships of any burden may haul close to the shore, which is a high perpendicular cliff, and there heave down, clean, or repair. When boats cannot land on the beach, on account of the surf, they put ashore on this cove, from whence there is a pathway along the cliff to the town.

The town has plenty of good water, which is drawn from wells in every part of it; and in the winter, a large rivulet from the mountains empties itself into the port. On the South side of the mouth of this rivulet stands an old round tower; and on the top of its perpendicular cliff, on the North side of the cove, is a chapel and a battery, with a few pieces of cannon.

Care must be taken in passing round the East end of Gomera, as a *sunken rock*, the *Bermeja Shoal*, lies 100 yards off shore at a mile northward of the North point of the bay.

To the best of my remembrance, says Captain Glas, the land that forms the North point of the bay is the most southerly point of land, on the East side of Gomera, that can be seen from Point Teno, on Tenerife. That land, when one is to the northward of it, at about a league distant, bears a great resemblance to Rame Head, near Plymouth Sound. In going into the bay, it is necessary to stand close in with this point, for the land-wind is commonly too scanty for a ship to fetch the proper anchoring-place; from that reason, it is better to come in with the sea-breeze, which generally begins to blow here about noon.

The best place for a ship to lie in here is, where a full view may be had along through the main street of the town, and at about the distance of a cable's length from the beach: it is necessary to moor as soon as possible, because of eddy wind that sometimes blow in the bay.

FERRO, or HIERRO.—This island, the westernmost of the Canaries, has neither road nor harbour worthy of particular description. The land rises steeply from the sea, and is craggy on all sides for about a league, so as to render the ascent very difficult. Its summit is an uneven plateau, the highest points of which are 4,580 and 4,990 feet above the sea. At the northern part of the island the sides of these mountains are nearly perpendicular cliffs, commencing at *Point Salmone*, and extending round to the N.W. point, *Pta. de la Dehesa*, and are called *Risco de Taretai*. The only roadsteads are at *Naos*, at the south end, where there are no inhabitants nor shelter; and at *Puerto del Hierro*, on the East side. The latter is only a slight inlet, with a sandy beach between two rocky points, off the northernmost of which is a detached islet, which has a shoal running off for one-third of a mile. In the interior of the island at the North end is *Valverde*, the chief town, surrounded by high peaks. It produces, however, many trees and shrubs, with better grass, herbage, and flowers, than any of the other islands, so that bees, and honey abound. The wine is poor, and there are only three fountains or springs of water on the island.

DIRECTIONS FOR SAILING AMONG THE CANARY ISLANDS, BY CAPTAIN GLAS.

If a ship, lying at Palma, wants to go Lanzarote, and will not wait for a fair wind (which, indeed, seldom blows there, especially in the summer season), let her stand over to the N.W. side of Tenerife, and beat up along shore until she weathers Point Naga; thence, with the wind that generally prevails in these parts, she will be able to weather Canaria, and fetch the Point of Jandia, of Fuertaventura, or perhaps Morro Jable, the southern point, whence it is easy to beat up to Pozonegro, along the East side of the island, because the sea there is always smooth. It is not quite so easy to beat up from Pozonegro to the Isle of Lobos; yet it may be done without difficulty, when the weather is moderate; if the wind should happen to blow hard, she may stop in the Bay of Las Playas, until it proves more favourable.

From the Isle of Lobos, she will find no difficulty in beating up to Porto de Naos, in Lanzarote. It is not advisable, for those who are not perfectly well acquainted with that harbour, to attempt to conduct a ship in, because the entrances are very narrow.

It is common for ships that come loaded from Europe to Santa Cruz, Tenerife, &c., to have part of their cargoes to unload at Port Orotava: these ships, when the trade-wind blows hard, will sometimes find it impracticable to weather Point Naga; when this is the case, bear away to the leeward point of the island, and keep near the shore, where, if you do not meet with a southerly wind, you will be carried by the current, in the space of twenty-four hours, from the S.W. point of the island to Point Teno, whence you may easily beat up to Porto Orotava; for, when the wind blows excessively strong at Point Naga, it is moderate weather all the way from Point Teno until within 2 or 3 leagues of Point Naga. But I would not advise a ship to bear away as above directed, unless when the trade-wind blows so fresh that she cannot weather Point Naga; because, in moderate weather, there is little or no wind stirring on the coast between Teno and Port Orotava.

In rounding Point Naga or Anaga, the *sunken rock* alluded to should be guarded against.

The Coast of Africa, East of the Canaries, is level, and is rendered inaccessible by a heavy surf, which breaks on it continually. The Canarians, in the sea between this coast and the islands, employ a number of vessels to fish for bream and cod.

OF THE CALMS OF THE CANARY ISLANDS.

(By the same.)

It has been already noticed, in the description of the Island of Canaria, that its mountains tower so far above the clouds, as to stop the current of the N.E. wind that generally blows here; so that, when this wind blows hard on the North side of the mountains, it is either quite calm on the other side, or a gentle breeze blows upon it from the S.W. These calms and eddy-winds, occasioned by the height of the mountains above the atmosphere, extend 20 or 25 leagues beyond them to the S.W. There are calms beyond, or to leeward of, some of the rest of the islands, as well as Canaria; for those of Tenerife extend 15 leagues over the ocean, the calms of Gomera 10, and those of Palma 30. "I have," says Captain Glas, "been frequently in all the calms of the islands, excepting those of Palma; and, from my experience of them, I may venture to say, that it is extremely dangerous for small vessels, or open boats, to venture within them when the wind blows hard without. It is true, indeed, the wind raises the waves of the sea to a mountainous height: yet those waves follow each other in regular succession; for, were they to fall confusedly one against another, no ship would be able to sail on the ocean. But, in a storm, the wind driving the sea before it, each wave gives place to the one which follows; whereas, in the calms in the Canary Islands, the sea, not moving forward in the same direction with the sea without, but being, as it were, stagnant, or at rest, resists the waves that fall in upon it from without; and this resistance causes them to break just in the same manner as the billows break upon the sea-shore, but with less violence, on account of the different nature of the resistance. This breaking of the waves in only on the very verge of, or just entering into the calms; for within them the water is smooth and pleasant.

"Upon first coming into the calms, the waves may be seen foaming and boiling like a pot, and breaking in all directions. When a vessel comes amongst them, she is shaken and beaten by the waves, on all sides, in such a manner, that one would imagine that she could not withstand their force; however, this confusion does not last long. The best way to manage a ship entering the calm is immediately to haul up the courses, and diligently attend the braces, to catch every puff of wind that offers, in order to impel the ship into them as soon as possible. The crew must not think it strange to be obliged to brace about the yards every two or three minutes, according as the wind veers and hauls; but, after a ship is once fairly into the calms, she will either find a dead calm and smooth water, or a pleasant and constant breeze at South or S.W. according as the wind blows without, to which this eddy-wind, as it may be called, always blows in an opposite direction."

7.—THE CAPE VERDE ISLANDS.

The CAPE VERDE ISLANDS derive their name from the nearest point of the coast of Africa, and were discovered, it is said, in 1450 by Antonio Noli, a Genoese, in the service of Portugal. They consist of the Ilha de Sal, or Salt Island; Boavista; Maio, or the Isle of May; St. Iago; Fuego, or Fogo; Brava; San Nicolao; Sta. Lucia; St. Vicente, and San Antonio; besides several small islets. Of these isles, the most considerable is St. Iago, the chief town of which is the seat of government. The population was estimated at 85,393 persons in 1851. Salt is the principal article of commerce. The first port in the archipelago is Porto Grande on the North side of San Vincente. For the positions of the chief points, see pages 44, 45.

We have already shown (pages 391—394) the usual courses and allowances to be made in sailing to these islands; and have there noticed the fogs by which they are frequently surrounded. The estimated limits of the N.E. trade-winds in the vicinity may be seen in pages 186 and 188. Thus much premised, we immediately proceed to the description of the isles.*

ILHA de SAL.—The Isle of Sal lies between lat. 16° 34′ and 16° 51′, and on the meridian of 23° W. The northern part of the isle is mountainous; the southern very low and sandy. Both the eastern and western sides are irregular; and the former has almost continued reef, along shore, from North to South.

SAL derives its name from the salt ponds upon it, wherein the water crystallizes into a beautiful salt, the chief production of the isle, as the land is so barren as to bear no trees nor verdure, excepting a few inconsiderable shrubs.

On approaching the island from the North, it will be found in general that the currents are very irregular, You may, on approaching, see the high land at 14 leagues off; sometimes at a greater distance. The land makes in three hillocks, of which the northernmost is the highest. This is the *Peak of Martinez*, in the N.E., the summit of which is 1,340 feet above the level of the sea.

The best roadsteads of Sal are on the western side of the island; but there are three small bays on the eastern side, and one on the South. The middle bay on the eastern side, where a ship may lie, is apparently sheltered from the N.E. by a sandy reef stretching out to the eastward, and here salt may be obtained.† The other bays on this side are open to the N.E. trade-wind, which makes a very heavy sea on the beach.

Great caution is required on approaching the South end of the island in the night, it being so low as hardly to be seen 10 miles off in the day. Keep your lead going, and approach no nearer than in 30 fathoms, unless bound into the *South Bay*, which lies between the S.E. and South points of the island.‡

The S.E. point of Sal is called *Wreck Point*, H.M. sloop *Erne* having been wrecked near it in 1819; this is surrounded by a reef. From *South Point*, forming the West side of the bay, a dangerous sandy spit extends about 1 mile into the sea, If coming into the bay between these points, after rounding Wreck Point in 8 or 9 fathoms, bringing that point to bear E. by S. and the opposite point W. ¾ N., and anchor in 9

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* Mr. Finlaison has said that, "In leaving Tenerife for the Cape Verde Islands, you will certainly have the wind from E. by S. to N.E. as you approach the islands." He also adds, that in the passage a current was generally found setting *from S.S.W.* at the rate of half a mile an hour, which is contrary to the current on the African coast.—(See page 280.)

† *Firestone Hill.*—A promontory, on the eastern coast, stands at 2 leagues from the North Point. At the back of this is the Salt-pond Hill, a natural curiosity, as upon this is the salt pond, 150 feet above the level of the sea. The surface of the pond, in a circular form, is 45 feet below the top of the hill.

‡ Hearkening for the noise of the surf will often give ample warning in approaching land, either during a fog or by night, and ought to be attended to, if heard; but no one ought to run rashly, making certain of hearing it.—*A. L.*

fathoms, sandy bottom. Here you will be sheltered from the N.E. trade, and lie in perfect safety.

At 5 miles to the West, from the *North Point* of Sal, is *Manuel* or the *N.W. Point.* Nearly true South, $8\frac{1}{4}$ miles from the latter, is a little islet, called *Bird Isle*, near a promontory, *Lion's Head*, which is 620 feet high. At a league to the northward of Bird Isle is a small bay, called *Palmyra Bay*, and immediately to the south-eastward of the Lion's Head is *Mordeira Bay*, which is one of the best in the Cape Verde Islands.

Mordeira Bay is in a semicircular shape, 1 league in extent between its outer points, *Lion's Head* and *Turtle Point.* It is a safe anchorage during the N.E. breezes. Captain Bartholomew says, that it has plenty of fish and turtle, but has no watering-place; nor could water be procured by sinking casks in the sand.

H.M. ships *Leven* and *Barracouta* anchored in this bay in 1822, and caught a great many most delicious fish; yet the place produces little else but salt and orchilla; a few goats contrive to pick up a scanty subsistence, but eagles abound.

The principal mark for anchoring in Mordeira Bay is Bird Island just shut in with the foot of Lion's Head, at $1\frac{1}{2}$ miles from the Bluff land; there are several foul spots; therefore, the ground should be examined before the anchor be dropped.

From Turtle Point, the South point of Mordeira Bay, to the South point of Sal, the distance is $1\frac{1}{2}$ leagues. The ground between is smooth, and has 7 fathoms over it, at half a mile from shore, which is sandy; but be careful, if you anchor, that the ground is clear. In rounding the South point, with the spit extending from it, approach no nearer than in 10 or 8 fathoms, as the latter is steep.

The latitude of the Lion's Head, according to the Admiralty survey, is 16° 41′; long. 23° 0′ 15″. *Variation*, observed on shore, 15° 20′ W.; it is now 18° 20′. High water, $7^h\ 15^m$; rise, 5 feet.

Between Sal and Bonavista there is generally a strong current.

BONAVISTA.—The Island of Bonavista, properly *Boavista*, has been so called from the beautiful appearance it made to the first discoverers, in the year 1450. The face of it is variegated; partly low, partly rocky and mountainous; formerly fertile, now more barren. Salt is the principal article of trade, which the inhabitants readily exchange for old clothes, biscuits, meal, and raw silk. The principal place is English Road, on the N.W.

The eastern side of Bonavista is partly environed by a reef; and on the N.E. are the reefs on which the *Hartwell*, East Indiaman, was lost, in 1787; and on which the *Resolution*, Captain Cook, was nearly driven by a southerly current. Half a league nearly from the West end is a coral reef, on which the sea breaks; and at times the current sets on it very rapidly.

From the South end of Sal, the N.W. point of Bonavista lies *true* South, or S. by W. $\frac{1}{4}$ W. by compass, distant 7 leagues; and, from the same end of Sal, to clear the N.E. reefs, the course, by compass, is S.E. by S. 11 leagues, in order to allow for the current that sets to the S.W. on Bonavista; be sure to make this course, and it will bring you to the eastward of these reefs, the easternmost part of which lies in lat. 16° 10′.

Bonavista is of an irregular shape, but nearly octagonal, and each way 3 leagues in extent. Its eastern side is low, but the interior is mountainous, and a ridge of high land from N.W. to S.E. divides the island into two unequal parts. Of this inland chain, *Mount Juan Fernandez* is the northern part, and the southern is called the *South Mountain.* Two miles from the N.E. end are two conical hills, *Mounts Ochel*, or *Ochello*, and *Broyal;* at the N.W. end is the *Peak Reshee*, and in the S.W. is the *Platform Hill*, with an elevation within it called the *Man Mountain. English Road*, on which the town is situate, forms a bay of 5 miles in extent from N.E. to S.W., and its northern part is protected by an islet, called by the English *Small Island.* The South point of this bay is *Coral Point;* and off this point, which is foul, at the distance of half a league, is a coral reef.

Off the N.E. coast, as already shown, are the Hartwell Reefs, and three kays, called *Dutch*, *Braithwaite*, and *North Kays*. Between these is sufficient depth of water for ships, in case of necessity, and proper depths for anchorage, under the lee of the reefs; but many rocks are here scattered, with only 12 ar 13 feet over them, and 4 fathoms close along them, on which, with a wind, the sea breaks very high. Of the channels between these reefs, the best lies between a ledge to the E.S.E. of Braithwaite or the Middle Kay, which is always visible, and Dutch or the South Kay. This channel is three-quarters of a mile broad, and has regular soundings, from 15 to 5 fathoms; having been tried by H,M. sloop *Bulldog*, which often sailed in and out of it, and several times anchored under Braithwaite Kay, with that kay N.E. by E., Dutch Kay S. ½ W.

Braithwaite Kay is about 2 miles from the shore. The passage to the north-westward, between this and North Kay, is half a mile broad, and its least water is 7 and 8 fathoms. The passage between Dutch Kay and Bonavista is narrow, but in the best water are 7 fathoms. Dutch Kay bears from Braithwaite Kay S. ½ W. [*S. by E.*] 2¼ miles.

The *North Kay* is connected to the shore by a reef, having over it only 5 feet of water. When this kay is in a line with the summit of Mount Ochel, or the N.E. high mountain in Bonavista, it bears about W.S.W. ½ W.

In sailing out to the south-westward, with the wind easterly, stand well to the southward, taking advantage of the current here setting easterly, and take care not to borrow too near the back of the reefs.

BONETTA ROCK (?).—A ship, the *Madeline*, bound to New South Wales, was reported to have struck and been wrecked on a reef, at about 8 leagues E.N.E. from Bonavista, in April, 1835, as shown in the "Nautical Magazine," February, 1837, and "Brazilian Navigator," 1838. Some smart but justifiable remarks upon this report were afterwards given in the "Nautical" (December, 1839), the writer of which represents the case as a matter "very nicely cooked up for the edification of seamen," and the benefit of a certain "market." He adds, that Captain Vidal has, by his researches in the *Ætna*, satisfactorily proved that no such danger as the Madeline or Bonetta Reefs have any existence.

These imaginary dangers were also sought for by the American exploring squadron, as shown hereafter, and the result seems to be, that the *Madeline* was impelled to the S.W. by the current, and wrecked on the *Hartwell Reef* of Bonavista. The tracks of the *Ætna* and *Raven*, in search of the two reefs, are shown in a chart prefixed to the "Nautical Magazine" of December, 1839, above mentioned.

Notwithstanding all the investigations that had been made, and which might have been considered as having set the question at rest, of non-existence of the Bonetta and Madeline Reefs, a notice was given, that the British ship *Charlotte* was wrecked, April 18th, 1841, on a reef 23 miles N.E. by E. from the N.E. end of Bonavista. In a subsequent discussion on the *Charlotte's* log, in the "Nautical Magazine," the conclusion is again arrived at, that it was a portion of the Hartwell Reef on which she was lost. In July, in the following year, the *Phœnix* steamer struck on a rock, which was declared to be the Sunbeam Shoal, and the same on which the *Charlotte* was lost (*Times*, August 2nd, 1842); but this also was found, from her log, to be inconsistent; and that it must have been the Hartwell Reef. After that, the iron ship *Guide*, belonging to the East India Company, was wrecked on the Hartwell Reef (7th March, 1843), and went to pieces; and on September 20th, 1844, the brig *Nine*, from Newcastle, outwards, was totally lost on the same place. The long list of wrecks, and the fact of so many vessels being to the *westward* of their reckonings, and that in the short run from Madeira or the Canaries, will give great weight to the fact of the westward tendency of the currents, which, as has been stated before, tend directly towards this formidable danger, and therefore will call for all the vigilance and care so imperatively necessary for the safety of ships passing this place.*

* See "Nautical Magazine, August, 1841, p. 56; December, 1841, p. 816; January, 1842, p. 45; September, 1842, p. 6[illegible]; November, 1842, p. 753; and July, 1843, p. 492.

In another part of this Work we give an announcement made in 1845 of the discovery of a shoal by the brig *Emily* of London, very nearly in the position of the presumed Bonetta Rock, or 16° 59′ N., and 21° 30′ W., which position was not passed within 17 or 18 miles by Captain Vidal, in his search for it in 1839; but the question has been definitively settled by Lieut. Lee, U.S.N., on the cruise of the *Dolphin*, as he found a depth of 1,580 fathoms on the spot, and great depths close up to the islands, as shown hereafter.

The *Brazen Hill* and *Point* (otherwise *Brazen Head*), in lat. 16° 2′, on the S.E. coast, is the first high land to the southward of *East Sand Head*, which is the easternmost point of Bonavista. The Head is remarkable, being very bluff and perpendicular on each side. The beach is sandy. *Point Urrateo*, or the *South Point*, which is nearly 3 leagues more to the south-westward, is low and foul, and an islet, of the same description, lies at three-quarters of a mile to the eastward. To the westward of the point is anchorage, in what is called *Portuguese Road*, with the Platform Hill bearing about N.N.W. and nearer in-shore, in from 13 and 14 to 8 and 6 fathoms. In the latter depths, the landing-place will bear N.E. by N. more than a mile distant.†

NORTH and WEST COASTS.—From the *North Kay*, off Mount Ochel, already described, the coast is foul to *Broyal Point*, on the North coast; and there are several reefs between the latter and the N.W. end of the island, which is called the *North Point and Reef*. Small Island, which forms the N.W. side of English Road, is 4 miles hence to the S.S.W. [*S. by W. ¼ W.*]

ENGLISH ROAD is a safe anchorage during the summer months, while you have the N.E. breezes, but there are three reefs in it, as shown on the new charts. Vessels generally haul close round Small Island, in 6 and 7 fathoms, and pass within the first reef (of 10 feet) in order to avoid the necessity of making a tack to get to the anchorage. The best mark for the latter is, the town open with the N.E. end of Small Island, and the highest part of that isle about N.E. by E. The Ten-feet Reef generally shows itself; but when this is not the case, a stranger will do well to stand outside, rounding it at about 1½ or 2 miles from Small Island, approaching it no nearer than in 6 fathoms, and, after once opening the town, taking care not to shut it in again.

The new town is on the middle of the bay, and the second reef (*New Town Reef*) lies to the westward of it, at a short distance from the beach. The *Inner Reef* lies, in like manner, half a league more to the northward. The Ten-feet Reef is about 100 fathoms in length, and extends nearly East and West, at rather more than a quarter of a mile from Small Island.

Mr. Keilor has said—"We experienced, in a calm, a very large sea, breaking in every part of the bay, and were, at the same time, riding with a very short scope of cable, by reason of a strong current setting out of the bay, against the sea: this current runs so high as to frequently break on the deck."

In the rainy season, which is during the months of July, August, and September, the Island of Bonavista is subject to light airs and changeable winds, with heavy swells in the bay and roadsteads.

The tide flows, in English Road, at 7 o'clock, on full and change days, and the sea rises 5 feet. Observe that there is no fresh water for shipping at Bonavista. There is water, but not plenty of it, near the Portuguese Road.

Leton Rock, or JOHN LETON'S ROCK, a dangerous reef, lies, as shown in the Table, p. 45. This shoal has heretofore been variously represented, and described as just even with the surface of the sea, which breaks upon it with great violence. The bottom about it is rocky, and swarms with fish. Its extent from North to South is about a mile.

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* Mr. Finlaison says, that it is requisite to give the point under Platform Hill a good berth, as there is a reef extending from it. In the day, you may see the sea breaking on it. The mountain E.N.E. clears the danger.

From the centre of the reef, the North point of Bonavista bears N.E. ½ N. [*N.* 26° *E.*] 9½ leagues, and the South point of the same E. by N. [*N.* 64° *E.*] 7 leagues.

The lamentable wreck of the *Lady Burgess*, East India ship, one of the outward-bound fleet of 1806, was caused by striking on the Leton Rock. This ship struck among the breakers on the rock, at 2 in the morning of the 19th of April, 1806. The *Alexander*, *Sovereign*, *Lord Nelson*, and other ships, narrowly escaped. The *Lord Melville* struck three times, and slipped off the rock into 25 fathoms, at the time the *Lady Burgess* was standing directly among the breakers. It appeared, from the observations subsequently made, that the Leton Reef is composed of coral; no part above water. Captain Swinton, of the *Lady Burgess*, conjectured that the extent on which a ship would strike is not above a cable's length, and that there are no breakers on it in fine weather. To the northward, it appeared to be steep-to.

This danger appears to be on the central part of an extensive bank of coral soundings, extending 4 or 5 miles to the southward, and considerably to the eastward and westward. Some ships had soundings of 25 to 50 fathoms to the West and S.W. of the reef, at from 2 to 5 miles from the breakers. Immediately after striking, the *Lord Melville* had 25 fathoms, its head being to the eastward; shortly after, 30 fathoms. This ship hove-to, with her head easterly, until daylight, and had from 30 to 40 fathoms, all coral soundings. Others had soundings 10 or 12 miles to the southward of the reef, generally coral, sometimes intermixed with sand and shells, and not less than 20 fathoms. The mean of the observations and chronometers of the fleet gave 15° 49′ N., and 23° 14′ W., as the situation of the reef, which is on the meridian of the Isle of Mayo: its situation, according to the Admiralty survey, is 15° 48′ N., and 23° 13′ W.

ISLE OF MAYO.—This island is raised considerably above the sea, but a great part is level, excepting three inland mountains of considerable height; but these show as hummocks, and are not conspicuous. On the S.W. side is a sandy bay, called ENGLISH ROAD, within which is the town and extensive salt-pans. The soil of this isle is generally dry and unproductive, and there is but one spring of water in the island. The coast is, however, plentifully stocked with fish, which supply, with a few vegetable productions, subsistence to the poor inhabitants.

From the S.W. end of Bonavista to the Island of Mayo, the course is S.W. by S., distant 15 leagues; Maio is about 4 leagues in length from North to South, rising most toward the middle. On approaching the island from the S.E., the appearance is very different; you may descry, in the North part, two hummocks, which appear like two islands; but, when nearer, the land is perceived by which they are connected. Southward of these is a mountain (*Monte Maio*), with very low ground to the South, over which two hillocks are seen.

At half a league from the middle of the North side of the island is a *dangerous reef*, the *Galhao*, extending N.N.E. and S.S.W. three-quarters of a mile, which must be cautiously avoided.

In English Road, ships may anchor in 7 or 8 fathoms of water. The landing is very indifferent, no good water to be had, and the place is quite defenceless. The shore to the eastward of and abreast the town is steep, bluff, and rocky; but, to the westward, a low white sandy beach extends to a rounding point, from which a spit of sand and coral stretches outward, at a short distance from the extremity of which there is no ground at 45 fathoms. The spit may be rounded in about 16 fathoms, and a ship should not anchor further out than in that depth, the edge of the bank being steep. At half a mile West from the town, there is anchorage in 12 fathoms, latitude, according to particular plan, 15° 16′ 10″, long. 23° 15′. By general chart, 15° 7′ 30″ N., and 23° 17′ W.

ST. IAGO.—Ships running from Bonavista to St. Iago, and being obliged to ply to windward during the night, must be cautious how they approach Maio, on account of the reef, before mentioned, off the North point of that island; having doubled that point, they may steer S.W. to make the land of St. Iago, and thence southward until they make the Road of Praya, the common place of anchorage.

The land of St. Iago is very high, the peak of San Antonio, the highest point of the ridge, being 4,720 feet, and the eastern coast is bordered with rocks, lying very near the land, along which you may sail very safely, at the distance of 2 miles. The S.E. part, which is in reality the *East* point, appears as a long low point, when you are to the northward or southward of it; and, from this point, *S. W. by S., true,* about 6 miles, lies the East point of Porto Praya. Between the two, and near the former, lies a bay, which so much resembles that of Port Praya, that many vessels, deceived by the likeness, have run the hazard of being lost in this dangerous place; at the bottom of it are several cocoa-nut trees, and a few houses. The land between this and the point of Port Praya is mostly perpendicular, appearing, in some places, like the *Berry Head,* in Torbay; and though the fort of Port Praya, which stands on a small cliff, is a mark by which the true bay may be distinguished from the false one, yet the surest mark is, that the North or East point of the false bay is surrounded with breakers; whereas the point of Port Praya is high, steep, and free from shoals: you must haul close round the point, and keep within a cable's length of the shore to go to the anchoring-place. It may, also, be noticed that there is a look-out on the cliff, at half a league to the northward of the entrance of Port Praya.

PORT PRAYA is a fine bay, which lies between two points, bearing from each other *W. by S. and E. by N., true,* about 1½ miles. As you sail round the East point, you will soon open the forts at the bottom of the bay, to the westward of which, in a valley, are several cocoa-nut trees and several houses.

The winds, except in the tornado season, are generally in the N.E. quarter, and frequently blow fresh and squally; there are, also, frequent puffs from over the high land; therefore, as you haul into the bay, it is necessary to have the top-gallant sails furled, and to take one reef or more in the topsails. The cliffs, from the East part of the fort, are those above described: you may easily sail within a cable's length of the East land, where you will have 7 or 8 fathoms of water, and, in many places, see the ground at that depth.

On the western side of the bay lies a small black island, called the *Isle of Quails,* or *Frenchman's Island;* it is almost even to the top, but rugged at each end, and some rocks lie off each end to about half a cable's length: there is also a rocky ledge off the North end, where the water is, in general, shallow; you will not have more than 3 fathoms of water between this and the fort; inside, or to the westward of the island, it is navigable for boats only.

Commander Dunsterville says;—"This island, bearing W.N.W. ¼ W. 8 leagues, appears very high. *Mount St. Antonio,* rising out of its centre, is of a conical form, and terminates in a peak, which peak, bearing N.N.W. (by compass) leads to Port Praya Road; and, as you advance westward, you will see the East end, which is very low. As a further guide, you will see an opening, several miles north-eastward of the harbour, on *Signal-post Hill,* which gradually slopes to the westward; also, *Red Hill* which is on the port side of the bay, N. by W.

"The town is situate on an eminence rather high, and perfectly white, the houses being visible from S. by E. to S.W. by W.

"In sailing into the bay, keep well to the eastward, as the ground to the westward is foul. Anchor in from 10 to 7 fathoms, with the Red Hill W. by N., outer eastern entrance E.S.E. Latitude of the anchorage, 14° 53′ 10″.

"A heavy swell sets into the bay and the prevailing winds are from N.E. to East. On the 22nd of October the weather was sultry, with heavy rains. Fruit, cattle, and water may be obtained here. The two latter not very good. The watering-place is at the back of the town, and at some distance from the beach. Small casks are the most convenient in foul weather; but, otherwise, you raft the casks off from the ship to the beach.

"Quail Island, though centrically situated, is too near the main land to assist any one in finding the anchorage. Do not approach it, on any point, nearer than half a mile, as the vicinity is rocky, and some rocks do not appear above the surface. Saluted the governor with thirteen guns, which were returned with an equal number, and every officer was treated with respect."—*Oct.* 1825.

Captain Grant, in the relation of his voyage to New South Wales, has stated that, "After rounding the E. point of St. Iago, there is a small bay to the East, about 4 miles, called by the inhabitants after St. Francis. This bay," he says, "may be always known by its having, at the back of it, and nearly close down to the water's edge, a high flat-topped table-land, standing between two monntains, which cannot be mistaken. Port Praya has, at the bottom of it, besides the houses already mentioned, a long, low valley, running inland to a considerable extent, the mountains behind which are sharp and peaked. Near the landing-place there are two remarkable forts on the East side, which you must open before you come to anchor, and on the West side is Quail's Island, which is readily seen as you enter. But the surest mark is that, from the S.E. end of the Island of St. Iago, the shore is low and rocky in general, until you reach the Bay of St. Francis; thence to Port Praya the shore is of high clayey cliffs, which round into the harbour, forming the East side of it.

It seldom rains here, but a dry haze is very prevalent. This is a remarkable contrast to the climate of Senegal, in the same parallel, when there is always some rain during the winter season. In December and January the wind is frequently far to the eastward, veering at times to the northward in the same season. In settled weather there are often regular land and sea breezes in the bay; the sea breeze setting in near noon, with a great surf on the shore, and ending at 4 or 5 o'clock in the afternoon. The N.E. wind sets in toward evening, and continues during the night. As there is generally some surf on the beach, boats should lie at their grapnels; and the casks of water be hoisted into them, after being filled at the well, and rolled down and floated through the surf.

A spirited individual, however, at considerable expense, conducted the water to the beach at this place, so that it can be filled with great facility, and be obtained in a good state for ships' use. Formerly it was, as above mentioned, a service of much difficulty and toil to water a vessel at Port Praya, as the casks had to be rolled up to the well, not the cleanest in the world, and the water to be baled up in buckets. The *Vindictive*, of fifty guns, in April, 1842, obtained sixty tons, and she was only in the anchorage twenty-four hours. Merchant vessels are supplied, by rafting, by the boatmen, who charge 3d. for a large cask. The cost of the water is about 320 reis the hogshead.

For sailing into Port Praya Bay, you may borrow on the eastern point (*Ponta das Bicudas*) to 7 or 8 fathoms of water, and thence proceed, north-westward, to the anchorage. It is to be noticed that the ground is foul in different parts, particularly on the western side.

The best anchorage is, to bring the flagstaff on the fort N.W. by N. [*N.W.*] about three-quarters of a mile, the body of Quail's Island West, and the point of the bay opposite Quail's Island E. by S., in 7 and 8 fathoms. Many commanders prefer anchoring nearer the N.E. side of the bay than the Isle of Quails, for the sake of more easily getting under sail, without running the risk of being carried by the currents upon the points of rocks to leeward, before the vessel has gained fresh way enough to steer clear of them; and it has been observed, that vessels may anchor anywhere in the bay, from 9 to 11 fathoms, good bottom, but nearer to the eastern shore than to the Isle of Quails, as the wind, except in the months of August, September, and October, generally blows from the N.E.

H.M. ship *Tartar*, Sir George Collier, anchored with the best bower in 11 fathoms nearly in a line with, or a little within, the two other points, ground of sand and bits of coral. Quail Island then bore N.W., the flagstaff of the fort N.N.W., and East point of the bay E. ½ S. A salute of thirteen guns was returned. Stock of all kinds was in great plenty.

"The Bay of Praya being under the South end of St. Iago, should you be to the leeward of it, you will find it difficult in beating to windward against so strong a current as there is here. In the months of July, August, and September, the rains are frequent, and the southerly winds which then prevail cause a great sea in the bay, with a great surf on shore. The inhabitants in these months are subject to dangerous fevers."

The sandy cove, on the East side of the bay, is an excellent place to haul the seine in; as is also the head of the bay. The principal fish are the mullet, gray and red, rock-fish, snappers, cavalla, and a variety of small fish.

The governor-general of the Cape Verde Islands resided formerly at St. Iago, an episcopal city, and the capital of the island; but foreign ships having totally abandoned the road of St. Iago, which is very bad, and of difficult access, to come to that of Praya, tha governor now resides at this bay during the dry season.

To those bound from Praya Bay to Bonavista, Mr. Keilor recommends that they should endeavour to sail in the evening, as the current will be favourable. He adds, do not stand too far over toward the African shore, nor work between Mayo and St. Iago, and you will find the ship get to the eastward very fast.

A visitor, in 1852, complains of the want of clearness in the directions for Porto Praya, as he says there is some confusion in the names of the S.E. and East points. The *East* point is that to the North of St. Francis Bay, and the S.E. point is that on the East side of Porto Praya. The peaks which are sometimes pointed out as good marks are so frequently obscured by haze as to be of little service. He therefore suggests the following brief directions as sufficient:—After making the island of St. Iago (outward bound), steer to the S.W. till the South extreme of the road bears W. by N., when the South point will be distinctly in view, having Red Hill behind upon the same bearing; haul up then to the westward, and pass the point about ¾ of a mile off; Quail Island (having a very black appearance) will then be seen to the N.W.; steer up for the North end of it till you fairly open the bay; then luff up to about N.N.W., and anchor midway between Quail Island and the eastern shore of the bay, in 7 fathoms, leaving Red Hill just open to the northward of the island.

Remarks on St. Iago, etc., by Captain J. W. Monteath, 1824.

November 20, 1824, at 4^{h} $20'$ p.m., Mount Ochel, on the N.E. end of Bonavista, was indistinctly seen through the haze (which generally prevail among these islands) bearing N. 80° W. From this position we shaped our course so as to pass well to the eastward of the Island Mayo, in case there should be any westerly current.

The wind during the night continued fresh, and steady from the N.E., the vessel making a S.S.W. ¾ W. course (by compass), at the average rate of 6 miles an hour. At four a.m., estimating ourselves (by the distance run) to be in the latitude of the South point of Mayo, we hauled by the wind on the port tack, under easy sail; at daybreak, bore up, under all sail, on a W. ½ N. course. Notwithstanding our vicinity to the island, the haze prevented our seeing it until with five leagues of it; the high hill on the centre then bearing W.N.W., and the North point N.W. by compass; the course until eleven was W. by S. ¾ S., *true*, distance 14 miles; at the same time, English Road bore N. by W. ¾ W., *true*, distant 4 miles.

From the coloured appearance of the water (dirty green) this morning, it is my opinion that an extensive bank lies at least 20 miles to the eastward of Mayo, and had I observed it previous to making sail, I would have sounded it, in order to ascertain the depth of water on it; but, being anxious to get into Port Praya as early as possible, I did not heave-to for that purpose.*

In running from Mayo toward St. Iago, I would advise vessels to steer directly for the most southerly point of the latter island; this will carry you about 4 miles clear of the S.E. point, which is low and rocky; between it and St. Francis's Bay are a number of black patches of rocks, a considerable way inland, and which, at that distance, have the appearance of low bushy trees.

The *Bay of St. Francis* may easily be distinguished from that of *Port Praya*, from the West point of the former being high, while that of the latter, *Cape Tubaron*, is very low and rocky; it has also a fort with a flagstaff, which is distinctly seen

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* The soundings obtained by Lieut. Lee in the U.S. brig *Dolphin*, have since demonstrated that the water is very deep here, 1,386 fathoms eastward of Maio, and 1,120, and 797 fathoms close to the island. See hereafter.

before you open the Bay of Praya; this, of itself, is a sufficient mark for the harbour.

The beach in St. Francis's Bay is sandy, and has a great number of palm trees growing close to it; there were only two houses in the bay,—the one on the western, and the other on the eastern, side. The flat, as mentioned by Captain Grant is also a very good mark for this bay.

November 21, at three p.m., we rounded the East point of, and anchored in, *Praya Bay*, in 5 fathoms of water, black mud and sand, the eastern point of the bay bearing E.S.E.; fort at the town N.N.W., in a line with a high peaked mountain, and Point Tubaron in a line with the South end of Quail Island, S.W. by S. It is necessary to mention that, in anchoring, you should endeavour to shut in (or nearly so) Point Tubaron with the South end of Quail Island, as outside of this line the ground is very rocky, and you may have difficulty in purchasing your anchor.

The town of Praya stands on a hill at the bottom of the bay, and consists of three streets, extending in an East and West direction. The *Plaza*, or square, is in the N.W. quarter of the town, and contains the custom-house, barracks, jail, and other public buildings. The magazine and church stand on the western side of the fort. There are two other forts on the heights on the eastern side of the bay, which command the road.

The landing-place for goods is on the N.W. part of the bay, from which there is a road to the town; this road is, however, very steep, and all the goods are carried up the hill by negroes, which incurs a considerable expense to the owners. The well is situated in a valley at the back of the town, and is nearly half a mile from the landing-place.

H.M.S. *Beagle* visited Port Praya, in *January*, 1832, and Captain FitzRoy's remarks on this place, as *then* conditioned, are as follow:—

"The wind being always from the North or East during this season of the year (December to June), a ship can moor as close to the weather shore as may be convenient; but during July, August, September, and October, no vessel should deem the bay secure, or anchor near the shore, because southerly gales sometimes blow with great strength, and the *rollers*, or heavy sea sent in by them, are dangerous to ships which have bad ground tackle, or are lying near the land. As I have myself experienced the force of these gales, in the vicinity of the Cape Verde Islands, and witnessed the sea raised by them, I can confidently warned those who are inclined to be incredulous about a gale of wind being found in 15° of North latitude, beyond the limits of the hurricane regions.

"Strong gusts come over the land into the bay during the fine season, when the breeze is fresh; therefore, a ship entering, with intent to anchor, ought to have a reef in her topsails, and be ready to clew up the top-gallant sails at a moment's warning.

"The vicinity of Port Praya offers little that is agreeable to the eye of an ordinary visitor. A desolate and hilly country, sun-burnt and stony, with but few trees, even in the valleys, and those only the withering spectre-like trunks of old palms, surround the harbour. The distant and higher parts of the island, however, present a striking outline; and no person, who has visited the Port of Praya only, can form the slightest idea of the beauty of the interior country.

"Fruit was abundant; there were oranges, grapes, plaintains, bananas, sour-sops, mammee apples, guavas, quinces, sapodillas, papaw apples, pines, citrons, medlars, figs, and, occasionally, apples.

"From August to October is the rainy and sickly season. In September, a S.W. gale is usually experienced; but from five to ten hours before its commencement, a dark bank of clouds is seen in the southern horizon, which is a sure forerunner of the gale. Should a vessel be at anchor in the port at such a time, she ought to weigh and put to sea until the storm has ceased, and the swell subsided. In the month of September preceding our visit, an American merchant brig and a Portuguese slaver were at anchor in Port Praya. A bank of clouds was seen during the day in the

S.W., and the American went to sea; but the slaver remained at anchor. A storm arose at night, drove the slave-vessel ashore, and dashed her to pieces in less than half an hour, yet did the American no damage whatever, and the next day she anchored again in the port.

"Except during the rainy season, the wind is always north-easterly, and then the sky is clear and the sun very powerful; but a dry haze hangs over the island in a peculiar manner, and a quantity of fine dust, quite an impalpable powder, frequently settles on every exposed surface, even on the sails and rigging of a vessel, when passing near the islands."

The town of *Santiago*, or *Ribeira Grande*, commonly called *La Cidade*, stands at the bottom of a ravine at 6 miles to the West of Praya. Vessels of any size can anchor before it in the fine season. The best place is said to be with the fort flagstaff in one with the episcopal palace. From hence to the S.W. point of St. Iago there is no anchorage; between this and the North point of the island, *Ponta Bighuda*, there are *Ribeira Barca* and *Ribeira Prata*. These two beaches are 6 miles apart, and between them is a projecting point, near which are some houses. Water may be got at these anchoring places in the fine season. *Tarrafal Bay* on the same coast is about is about 6 miles North of Ribeira Prata. It is large and, according to the people of the place, safe at all seasons. There are no houses except a custom house post, but provisions and water are brought down from the interior.

Point Bighuda is very high and abrupt, and is 3 miles North of Tarrafal Bay. The eastern side of St. Iago is dangerous from the calms produced by the high lands, which reflect the N.E. winds, and by the currents and bad sea which are found on it. The only place worth mentioning is the little harbour of *Santiago*, which will scarcely hold 4 vessels of 100 tons. It lies about the middle of the coast, and may be known by some clumps of cocoa-nut trees and a small church to the S.

FOGO, or FUEGO.—This island, much higher than any other of the Cape Verde Islands, is only a continued mountain, rising into a peak of 9,700 feet in height, which has been in activity in recent times. This island has, nevertheless, about 7,500 inhabitants, whom the eruptions of the volcano have forced sometimes to quit the island. The ground is clear within a mile of the shore, on the N.W., West, and South parts; but, on the S.E., East, and N.E. parts, it is rocky. At about 4 miles from the North end of Fogo lies a rock, with 12 or 14 feet of water on it, over which the sea breaks when it blows hard, but not else, and the bottom is clean all round it,*

The town is that of *Nossa Senhora da Luz*, on the western side. The roadstead is open, and the anchoring ground off the town very close in, being only half a mile from the shore. In 25 fathoms, rocky bottom, the northern extremity bears N. 20° E. [*N.* 4° *W.*[; the southern extremity, S. 68° E.; the northern flagstaff, N. 35° E.; the southern, N. 21° E.

No other soundings are to be obtained near either Fogo or Brava, with a line of 130 fathoms, at three-quarters of a mile from shore.

The marks, says Mr. Keilor, when a brig was at anchor off the town, in 10 fathoms of water, were, the town bearing E. by N., a quarter of a mile; the mount, E.N.E.; the South end of Brava, S.E. by S. The bay is open, with foul ground, and a bad landing for boats. Corn, fruit, and cattle may be purchased at Fogo, but water is scarce.

BRAVA.—Brava is very high, and might be seen at a great distance, were it not constantly covered by a dense atmosphere. Its climate is temperate and healthy, and for this reason the Governor of the islands sometimes resides here. The winds here prevail at N.E. or East, most part of the year, excepting in July, August, and September. The channel between Fogo and Brava is 9 leagues in breadth. Five miles to the N.N.E. of Brava are the *Rombos*, or *Romes*, two small rocky isles, nearly

* Not inserted in the Admiralty Survey; its existence is, therefore, questionable.

connected by smaller rocks, forming a crescent. The westernmost isle is lofty, and has a peak on it. Between these islets and the North end of Brava is a clear passage. Brava has, heretofore, had plenty of corn, live stock, and fruit; but bad landing for boats, except in the harbour on the N.E.

Although Brava is very high, its mountains rising one above the other, like pyramids, yet, being so near the Isle of Fogo, it seems, in comparison, to be but low. It produces plenty of salt, and abounds most with saltpetre of any of the islands. According to Captain Roberts, it has several bays, or roads, where a ship may anchor, the best of which, called *Furna*, or the *Oven*, lies toward the N.E. end of the island; if you haul in near the rock, which is a very good quay, having water enough by the side for [illegible] man [illegible] war, you will lie land-locked from all winds, nor does any wind bl[illegible]w [illegible]cept from the S. by E. to the S.W., which [illegible] sea into the bay, an[illegible] very well deserve the name of a harbour.

ST. NI[illegible] [illegible] land is high, and the coasts, therefore, subject to heavy squalls, &[illegible]

There are tw[illegible]able mountains which may be seen from a distance of 15 leagues; one in [illegible]ape of a sugar-loaf, called the *Peak of Trade*, which is near the middle of the island; the other, *Monto Gordo*, near the West end.

From English Road, in Bonavista, to the East point of St. Nicolas, the *true* bearing is W.N.W., and the distance 22 leagues; the course must be regulated according to the set of the sea. The East end of the island may be known by its being a platform point, having a pyramidal rock, which appears like a sail, at a short distance.

On the South side, at 1½ leagues from this end of the island, is a bay, having a black sandy beach and a pond of fresh water, supplied from the mountains, and hence called, by the English, *Freshwater Bay*, properly *Preguizo Bay*. To anchor in this bay, shut all the land to the eastward within the East point of the bay; you will then lie in 7 fathoms of water, within half a mile from the shore. There is good landing for the boats, with plenty of good water in fine weather, and at neap tides; for, as the tides rise here 5 or 6 feet on the new and full moon, the pond is then overflowed. At this time you are subject to heavy squalls; and, notwithstanding the wind blows off shore, the sea is very high close to the beach.

At about 4 leagues to the westward, from the middle of Freshwater Bay, lies *San Jorge*, or *St. George's Bay*, where a ship can get refreshments; but there is no water. This bay is known by a sugar-loaf mount, and a flagstaff on the hill above the bay. There is tolerably good anchoring in 7 fathoms, close to the shore; but, without that depth, or in 9 or 10 fathoms, the ground is rocky. There is a shelf stretching S.E. by S. from the N.E. point of the bay, on which less water is found than within it; so that, should your anchor start, which will happen if you are not careful, the bank being very steep, and the squalls very sudden, it may hook this shelf and be lost. The marks to anchor are, the cove, or landing-place for boats, N.W., distant a quarter of a mile; Sugar-loaf Mount N.E. by E., and the flagstaff N.W. by N.

Terrafal Bay.—*On the S.W. side of St. Nicolas* is *Terrafal Bay*, where you may anchor in from 20 to 10 fathoms, with the coast to the southward bearing S. by E., and the Islands Raza and Branco in a line bearing N.W. by W. ¼ W. [*W.N.W. ¼ W.*], and the landing-place E. ½ N. a quarter of a mile.

The custom-house is situate on the S.E. angle or corner of this bay. From this to the West point of St. Nicolas there is a bank of soundings, with from 40 to 20 and 35 fathoms at half a mile from shore. In the last depth is anchorage, in sandy ground, at a mile S. by W. from the West point, but sheltered only from the N.E.

There is, in Terrafal Bay, a high bluff rocky point, nearly a quarter of a mile short of the sea-side; in which place it is low, stony, gravelly, and in some places, shingly ground, the shore being a pebbly beach. On each side of this point is a very deep gully, out of which come violent flaws or gusts of wind; and, therefore, when anything of a hard gale blows, it is very difficult to turn up into this bay. To avoid these flaws, you much anchor right against the point, between the gullies, where you may ride very easy under its lee, in from 16 to 3 fathoms.

Within this bay the depths are 12, 13, and 14 fathoms, soft ground; and then they shoalen gradually to the shore, to the depths of 4 to 5 fathoms, where you have again sand to the pebbly beach.

By digging a well, almost anywhere on the low land, you may water here, unless the rainy season has failed; but there is always water in the valley, about half a mile from the sea, whence the natives will bring it down on asses for a trifle. From this road you may see, in clear weather, all the leeward islands; but, if it be in the least hazy, the Isle Raza is not discernible.

The only anchorages are on the South side of the island. The northern coast is not frequented.

RAZA, BRANCO, AND STA. LUCIA.—These islands lie between those of St. Nicolas and St. Vincent, as shown on the charts. Rugged and mountainous, they partake of the general character of the other islands. RAZA lies *true* West 8 miles from the West point of St. Nicolas, and appears in the old charts under the name of *Chaon*, or *Dog's Isle*. It is nearly 2 miles long, from East to West, and 1½ broad. The landing-place is under the N.W. point, facing the West. This island is low and uninhabited. The edge of its coast is steep and rocky, and landing is difficult when there is any wind. Between it and Branco, at about one-third from Raza, is a coral reef, extending S.S.W. and N.N.E., and having on its shallow part 6 fathoms of water, but deepening gradually on the West to 15, and on the East to 18 and 20 fathoms. The sea continually breaks over the reef, owing to a strong tide, or current, setting through between the isles.

BRANCO, the Redonda of the old charts, is a league to the N.W. of Raza, and much higher. In the passage between are soundings of 6 to 18 in the middle, and decreasing near Branco to 7 fathoms. The latter is a narrow island, 2½ miles long from S.E. to N.W. A spit of sand stretches from its S.E. end, on which the rollers or break are violent, and its shore is altogether rocky.

Praya Branca, on the N.W. side of the island, has a small village of about thirty stone-built houses, thatched with reeds. The scenery here, being on the side of a stupendous mountain, is picturesque and magnificent; a small stream of water supplies the village; bananas and papayas are planted on the borders of the brook; cassada and vines on the banks of the valley. The bread is made from maize, or Indian corn, and from farina, or flour of cassada. The natives are, in general, poor, but very courteous.

Monte Gordo is in the central part of the island, toward the West. It summit is 4,200 feet above the level of the sea. The mountain is composed entirely of volcanic matter, very fragile and porous, and does not form a peak like many of the smaller ones on the island. It is well clothed with vegetation, even to the summit. The *Euphorbium balsamifera* flourishes to about 3,700 feet above the level of the sea. The prospect hence is very extensive, calm, and beautiful.—*Mr. Forbes; Captain Owen*, vol. i., p. 27.

ST. LUCIA lies at the distance of 3½ miles to the northward of Branco, and the Bank of Soundings extends to this island. The bank here forms a regular flat of 10 to 13 fathoms. The South coast trends nearly East and West 4 miles, and in the middle of it is a good landing-place. A steep bank, half a mile broad, stretches from it, having on its edge 2 to 4 fathoms. In the bay formed by the S.W. coast are the ruins of a village, at three-quarters of a mile from the South point. To the westward of this is a little islet, named *Leon*. The N.W. part of St. Lucia into high mountains.

Captain Bartholomew describes St. Lucia as of moderate height, with a bay on the S.W., where small vessels may anchor, being sheltered from all points but South and S.E. The beach is sandy; the anchorage, small pebbles and sand. In the middle of the bay is an islet, named *Leon*, with the ruins of a village on it, and frequented by fishermen only. There are many turtle here, and much orchilla is gathered, with some cotton, in a wild state.

SAN VICENTE, or St. Vincent's.—The Island of St. Vincent is separated by a channel, 4 miles broad, from that of St. Lucia, and by one of 7 miles from that of St. Antonio. This island is 11 miles long, from East to West, and about 6 broad. It has two chains of mountains, the N.E. and S.W., which from a central valley that terminates in the bay called *Porto Grande*, upon the N.W. side of the island. The N.E. coast forms two bays, separated by a low peninsula, of 2 miles on either side, and this coast has been described as altogether dangerous.

The general aspect of it is mountainous, with sharp peaks; the coast is rocky, and rises abruptly, but the tide, ebbing, leaves a sandy beach. No doubt can be entertained that the general character of the island is volcanic; the interior is formed by ranges of hills of different heights. The surface of the country is undulating, and, in the interior and loftier parts, has a tendency to table-lands.

With regard to the physical divisions of the island, it is divided by a valley running from West to East; in the southern division, one range of mountains proceeds from West to East; another from North to South, but both connected by a hill. The northern part of the island consists of mountain chains, lying N.E. and S.W., and N.W. and S.E.

The water runs from the elevated parts to the sea coast, and loses itself in the sand, but the quantity of it is not capable to form, in the dry season, a river; the principal valley is divided by a hill, which connected the northern and southern division. The watercourse, running West, takes its rise 520 feet above the level of the sea; the bed is gravel, covered with mud, united by chalk. The coast forms a great number of little bays, in general capable of containing vessels; the chief port is named Porto Grande, situated on the West side of the island, and is a good anchorage for about 300 vessels; water and provisions cannot easily be procured; the former defect might be remedied. The wind blows generally from the N.E.; in the rainy season the S.E. wind prevails, which commences in the month of July, and ends on the 15th of October. During the last years the rains have been regular in point of time, but sometimes not in quantity.

PORTO GRANDE is the largest and best bay in the Cape Verde Islands: it is capable of holding 300 sail of large ships, well sheltered under the high lands, and has a fine appearance. *Captains Vidal and Mudge*, who surveyed this place in 1820, say of it, that it now forms a good and safe anchorage, where you may strip and refit your ship, as it is sheltered both from wind and sea. The wind generally blows from the N.E. over a part of the land, and seaward it is protected by the Island of St. Antonio.

Wood is plentiful, and sufficient water may be obtained from the well, on the eastern shore, for daily consumption. After a refit here, a complete supply of the latter may be found in the Bay of Terrafal, St. Antonio, which is 6 leagues to the westward, and reckoned the best watering-place among the Cape Verde Islands. Cattle may be had at Porto Grande, but they are not very good. The church of *Leopoldina* and custom-house are situate in the bottom of the bay on the East, and a signal-post may be seen, erected upon a hill, at a short distance from the anchorage, which gives notice of whatever may be passing or approaching the island.*

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* March 30, 1822.—"On the *Leven's* arrival in Porto Grande, we sent on shore to a few houses called a town, at the bottom of the bay, to inform the governor who we were, and what were our wishes. We could find only one miserable Portuguese, the rest being all negroes; but most of them appeared to be free. The whole population did not exceed 100, without any plantations near their houses, as the soil is so very dry and sterile; but, on the sides of the mountains, in parts where there is water, they are said to have some good gardens. Indigo grows everywhere wild; and with it they dye their coarse cloths which they manufacture from cotton, and which, if ever planted by them, appears to be left entirely to nature's cultivation and care.

"We pitched a tent upon the beach; cleaned a well in the ravine, which, during the rainy season, is a water-course; then landed the women and a party to wash. During our stay the sea breeze every day blew furiously over the hills to the N.E. of our anchorage;

Porto Grande is well adapted for refitting in, as well as acclimatizing the crews of vessels going to the African station. There is no endemic disease there, as at St. Iago; the climate resembles that of Ascension, without being so hot; and though there is scarcely any vegetation on the island during the greater part of the year, yet a sufficient quantity of live stock, vegetables, &c., for several vessels, can be always obtained there, and at the neighbouring island, San Antonio. It is deficient of water, as before stated, except for daily consumption.

The variation in June, 1841, was 17° 17′ W.; dip, 49° 10′. It is now about 15° ¾ W.

Without the entrance of the bay, at nearly three-quarters of a mile from its N.W. point, is a remarkable steep islet, called *Bird Isle*, which, at a distance, appears round like a sugar-loaf. *Mr. Finlaison* says, "You may run on either side of it, and will find regular soundings thence to the shore; depths from 30 to 10, 8, 6, 4, and 2 fathoms, to the beach. The ground is good in most parts of the bay, and you may anchor anywhere in 7 or 6 fathoms of water, sandy bottom, with coral branches. The water is very clear, so that you may pick out a clear spot for the anchor.

"Ships should moor with a kedge, as a very strong current commonly sets to the N.E. between Bird Island and the shore: and, as the N.E. wind is variable, at night it is impossible to keep a clear anchor, without this precaution; for the wind, at times, comes in strong gusts from off the land."*

Mr. Finlaison adds, "In running between St. Antonio and St. Vincent we sounded in 42 fathoms, bits of coral mixed with sand and small stones. Within half a mile of Bird Island we had 42 fathoms.

"Having proceeded about 8 miles to the southward of St. Vincent's, 40 fathoms of water were found; and, on approaching *Still Bay*, at the S.W. side of the island, found regular soundings, ooze and sand, to 20 fathoms, nearly in the centre of that bay. We anchored in this depth, with the West point of the bay W. by N., and its East point E.S.E.: the distance between the two points is 2½ miles; regular soundings from the ship to the shore, and very good landing on the beach. The ground is perfectly clear of rocks, but the bay is open to the S.W. Water is also to be got by digging for."

Captain Bartholomew describes the bay on the S.W. side as the *Bay of S. Pedro*, having a fine sandy beach, and he says that vessels may anchor in 10 fathoms, near the middle of the bay, or rather more to the westward. The anchorage is good in the dry season, and the inhabitants say there is plenty of wood and water. The American whalers frequent this place.

On the eastern side of the island is another anchorage, the *Praya da Gatta*, with a sandy beach, near which vessels may anchor in 6 fathoms; the bottom is clear, but a sea sets directly in when the wind is either N.E. or S.E., the Island of Sta. Lucia sheltering between these points. This bay and coast are without wood, water, and inhabitants.

ST. ANTONIO.—This island, as already shown, lies at the distance of 8 miles to the N.W. of St. Vincent, and it appears, altogether, like an assemblage of high mountains, particularly to the West. It is 22 miles in length, from East to West, and about 11 in breadth, and its highest peak is estimated at 7,100 feet above the level of the sea.

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and although the whole bay is nearly land-locked, yet the surf is very high all round, except in one spot near the town. We therefore embarked only a tun and a half of bad water, and caught a few fish."—*Captain W. F. Owen*, vol. i. p. 28.

* In working between St. Antonio and St. Vincent, to Porto Grande, you may stand to a mile off St. Antonio, and as near as you please to St. Vincent, as the current generally sets strongly through to the N.E.—*R. Keilor*.

Mr. Finlaison says that ships bound through this channel should keep over toward the latter, as no danger whatever is to be apprehended on that side.

Of the two highest mountains in the West, the *Sugar Loaf* is the most elevated, and both are commonly covered with clouds. According to the Admiralty survey, the Sugar Loaf stands in 17° 4′ N., and 25° 20½′ W. The island is very woody, but has plenty of goats, fruits, and salts; it produces wine, cotton, indigo, &c. There is a village, *Santa Cruz*, on its S.E. side, but the ground is not fit for anchorage.

TERRAFAL BAY, which is only half a league to the northward of the S.W. end of the island, has been already noticed (p. 615) as the best watering-place in the Cape Verde Islands, and other refreshments may be here purchased. The edge of the bank, with 40 fathoms, is about one-third of a mile from shore. At a cable's length within are 50 fathoms, and it then shoalens inward to 20, 8, and 4 fathoms; the latter near the beach. Latitude of the landing and watering-place, 16° 57′ long. 25° 24′ 48″. Variation, in 1820, 16° W.

"This watering-place of Terrafal Bay is one of the most convenient for the purpose amongst the Cape Verde Islands. The bay is spacious and has a black sandy bottom. Vessels anchor at 20 fathoms, at three-quarters of a cable's length from the shore, sheltered from the N.E. and South winds and sea: and when the wind comes to the westward of South or North there is always, from the extreme high land, a calm in the bay, the wind never blowing home, but only occasioning a swell to set in.

"From the high mountains over the bay a small stream descends, which is never dry; on the first level spot a large pond has been formed as a reservoir to receive the stream, with a sluice to conduct it to the sands between the flat and the beach, which is a gradual descent; the flat may be about 60 or 70 feet above the level of the sea, and is generally moist and cool. In the vicinity of the pool is a fine plantation of bananas, papayas, &c., and in the lower sandy grounds a cotton plantation, with some trees of the *asclepias procera*. Just above the beach is a well; and when the water is let off from the pool, all the soil between it and the well must be saturated before any can arrive at the latter.

After passing St. Antonio, as above, Captain Monteath, between the parallels of 3 and 2 degrees North, found the current to set S.E. by E. in the twenty-four hours; but, between 4° and 14° S., the ship was set, by the Equatorial Current, 80 miles westerly in five days.

Captain Monteath adds, "*On approaching St. Antonio*, which is very high, and may be discerned in clear weather at a great distance, it appears black, rocky, and barren; consisting of immense rocks or mountains, heaped on each other, and rising far above the clouds, which, in general, cover a great portion of their summits. On the N.E. part of the island the mountains are divided by deep ravines and gullies, which have every appearance of deep water having passed down them: on rounding the N.E. point you will perceive to the S.W. large white patches from near the shore until about halfway up the mountains; at this distance they are not unlike ripe fields of corn; but, on nearing them, they are found to consist only of large white rocks, like pumice, and are entirely destitute of verdure; the mountains toward the centre of the island are composed of rocks of stratified basalt, in thick and perpendicular columns, to their very summits; it also rises more gently, for a considerable elevation, than either the N.E. or N.W. ends, but without verdure, excepting a few tufts of brushwood near the shore, and patches of brown heath, with which this island is generally covered. Prom the N.E. point, until rounding the point of Sta. Cruz, the only habitations I could discern were two or three miserable looking huts built upon the shore, about a mile distant from each other.

"The S.W. point is pretty well covered with brushwood, but I saw no signs of cultivation, nor inhabitants. The channel between this island and St. Vincent's is quite clear of danger; and within a short distance of the shore on each side (except off the point of Sta. Cruz, where the breakers run out about a mile) is bold-to, and I should apprehend that a vessel might work through this passage with little risk, either by day or night."

8.—BERMUDAS OR SOMERS' ISLANDS.

The first discoverer of these islands was Juan Bermudez, a native of Galicia, in Spain, whose name they still retain, about the beginning of the 16th century.

In 1609, Sir George Somers, an Englishman, was drove thither by the violence of the wind, and some of his men returning to England so much commended these islands, then called Somers' Islands, from Sir George Somers, that in the year 1612, a society of English gentlemen and merchants, having obtained a grant from King James the First, sent over 60 men to begin a colony, under the direction of Richard More, who built eight forts, and several places.

The group of islands and the surrounding reef are of an oval form, the longest diameter lying N.E. by E. and S.W. by W. 25 miles, and the breadth 10 to 12 nautic miles. The islands themselves are on the S.E. side of the reef, and are shaped in the most irregular manner imaginable; they extend about 15 miles in length in the general direction of the reef given above. The breadth is very various, the greatest about 1¼ miles. The chief island is Bermuda, containing the town of *Hamilton*, St. George's, with its town of the same name, Somerset Island, and Ireland Island, on which is the dockyard; these are the principal: besides these are St. David's, Longbird, Paget's, Smith's, Cooper's, Nonsuch, Castle, and many inferior islands and rocks.

The climate, being moist, is favourable to vegetation at all seasons, except during the droughts of summer, and the storms of winter.

Hurricanes and tempests are very frequent, as is to be expected from the proximity of the isles to the variable limit of the Trade and other prevailing winds. Few autumns pass without hurricanes of more or less violence.

The BERMUDA SQUALLS are sudden and violent tempests, occurring particularly in the winteer season.

As the day closes, the whole horizon becomes obscured by dark and heavy clouds, and the thunder and lightning, which precedes the first squall, give notice of its approach. After the commencement, the wind, gradually shifting, blows in tremendous gusts at intervals of every 20 or 30 minutes, a dead calm intervening; and the sea, rising in confused and breaking waves, renders the situation of a vessel, particularly a small one, very dangerous.

The conduct pursued by seamen, and which appears to be the most advisable under such circumstances, is to furl the ship's sails, and endeavour to get before the wind; by which means she may ultimately run clear of these local squalls into a steady breeze. It is an observation made by seamen who are familiar with the Bermudas Islands, that the various winds which blow meet there, and contend for superiority; and the inhabitants themselves remark, that the currents about their rocks are as variable as the winds, and as numerous as their islets.

The LIGHTHOUSE.—The most useful mark to mariners is the new IRON LIGHTHOUSE on Gibbs' Hill, on the South side of the island. This will very materially add to the security of vessels approaching by night. The official description and directions are as follow:—

A lighthouse has been erected on the southern part of Bermuda, in lat. 32° 14′ 4″ N., and long. 64° 51′ 36″ West of Greenwich. A revolving light, visible every minute, was exhibited on the 1st of May, 1846, and will be continued every night from sunset to sunrise.

It is elevated 362 feet above the level of the sea; and in clear weather may be seen from the deck of a frigate 7 or 8 leagues. It is higher than the adjoining land, and in day-time will appear like a sail. The light is intercepted between *N.* 43° 24 *E.*, *true*, or N.E. ¼ E. by compass, and *N.* 47° 34′ *E.*, or N.E. ¾ E. mag. nearly, by the hills at St. George's; and also, between *N.* 49° 7′ *E.*, *true*, N.E. by E. mag. and *N.* 57° 35′ *E.*, or N.E. by E. ¾ E. by compass, by the hills on the South side of the island. (These bearings differ 10° from those given in the public Notice.)

Bermuda is always approached with more safety from the southward; and in running for it at night, or in thick weather, care should be taken not to get to the northward of lat. 32° 8′ before seeing the light or the land.

In coming from the S.E. the light should not be brought to the southward of W. by S., or approached nearer than 6 or 7 miles during the night. Coming from the westward, it should not be approached nearer than 10 or 12 miles, until it bears to the northward of N.E. by E. With the light between N.E. and West, the coast is free from danger, and may be safely approached within 3 miles. Any vessel getting sight of the Light from the northward had better haul off immediately, as the reefs extend all round from the S.W. to the North and N.E. from 15 to 16 miles.

Gibbs' Hill Lighthouse and Telegraph, on the S.W. coast, bearing N.E. by N.

The light will show a bright flash, continuing for 6 or 8 seconds, and repeated once in every minute.

The situation of the lighthouse has been objected to by some, inasmuch as it is not visibie at the chief entrance at St. George's. The light appears on an are of a few degrees in the direction of Mills' Breaker; but, of course, a vessel will not depend upon making the light within the bearings given above.

There are four SIGNAL STATIONS on the islands. One on Fort George, at St. George's; central at Mount Langton, near the governor's house, near Hamilton; another on Gibbs' Hill, near the lighthouse; and another at the dockyard, on Ireland Island. By means of these, signals are transmitted from one part of the island to another, and vessels requiring pilots, &c., will be telegraphed to that effect.

THE REEF.—This singular tract, extending 25 miles in length, N.E. by E. and S.W. by W., with a breadth of 10 or 12 miles, forms at once an effectual barrier against the fury of the Atlantic storms, and, with the exception of the few narrow and intricate entrances, an impenetrable line of reefs and breakers, over which no vessel can pass.

It is composed of whitish limestones and sandstones, in many parts as if composed entirely of minutely pounded shells, and calcareous clay, resembling pipe-clay. Upon this, coralline structures grow in innumerable patches, and in every variety. It is to this circumstance that the great danger in navigating within the reef consists.

The water on the reef is remarkably clear, so that even small objects are readily distinguishable at considerable depths. A dollar may be discerned at 16 or 18 feet; and the appearance of the bottom, in many parts, and in clear weather, is very beautiful, from the varied growth and structure of the coralline productions. To this circumstance of the transparency of the water the pilots owe their talent of conducting vessels through the mazes of the reef. Taking an elevated position in the ship, up the shrouds, in the top, or on the forecastle, and by the appearance of the bottom, they direct the course of the vessel. Brown or discoloured patches indicate coral and reefs. And it must be insisted on, that only the practised eye of the Bermudian pilots can be depended on for conducting a ship safely. The pilots are regulated by a legislative enactment passed during Colonel Reid's government, in 1843.

The outer border of the reef is shallower than the centre, many parts having less than a fathom over them, and the others varying from 3 to 4 fathoms. Within this external and rocky barrier, which is about a mile in breadth, the coral and rocks raise their heads in countless numbers; the intervals having a depth of 5 to 10 fathoms. There are some large tracts clear from shoals, as that to the N. and W. of Murray Anchorage; these have a nearly uniform depth of 7, 8, or 9 fathoms.

Round the West, N.W., and North sides, it is a continued and very dangerous ledge of rocks, beginning at the *Long Bar*, the South part of which lies 6 miles W.S.W. from Gibbs' Hill: trending then N.E., it is called the *Chub Heads*, which, off Wreck Hill, lies 9 miles from the shore: the ledge hence rounds to E.N.E., and joins the North Rock, which is always above water, and lies N.N.W. 12 miles from Catherine Point. From the North Rock the reef rounds East and E.S.E., and ends in *Mills' Breaker*, which dries at low water, and lies at N.E. 6 miles from Catherine Point, and N.N.E. from St. David's Head. On the south-eastern side of the island the reef bordering the group does not extend more than a quarter of a mile off shore; the outer edge is one continued line of breakers, many of which are dry at low water. Within the external and narrow border of rocks, on this face, the water increases considerably in depth nearly to the shore. At the S.W. corner of the reef, and on its outer edge, is a spot that always breaks, callled the *South-west Breaker*. It lies 1½ miles off shore, and is nearly South, true, from Wreck Hill. Round the outer edge of the ledge is a margin of soundings, of from 1 to 2 miles broad, having from 9 to 14 fathoms on it; there are, likewise, soundings for 2 miles from the shore round the N.E., East, and S.E. sides of the island; but, as the water here is deeper, it would be prudent for those who suspect themselves near the longitude of Bermudas in the night, or in thick weather, while between the latitudes of 32° and 32° 40′, to keep a lead constantly going, being assured that, at 14 fathoms, they will strike the ground in time to avoid danger. The lead might be incased with tallow, for the greater certainty of striking the ground; this precaution would prevent many of the wrecks that constantly happen here.

The CHANNELS through the outer edge of the reef, commencing at St. George's at the eastern extremity, are the *Narrows*, or channel into Murray Anchorage, sometimes called *Hurd's Channel*. This is regularly boyed, and may be considered as the principal entrance to the interior of the reef.

South of this is the channel over the *Bar* to St. George's Harbour, hereafter described.

There is another channel running East and West to St. George's, called the *Boiler Channel*, passing North of, and close to, Jenkin's Boiler Shoal, with a depth of 12 to 18 feet.

Still further South is an entrance sometimes used by small vessels running under St. David's Head, but has not more than 9 feet at low water. This leads in a N.W. direction.

Proceeding northward, the next channel is *Mills' Breaker Channel*, the entrance to which is half a mile North of the Mills' Breaker. Its direction inwards is S.W. towards the Narrows, and is only used by Bermudian vessels in and out.

Continuing in the same direction, the north-eastern face of the reef presents an impenetrable and continuous reef, often breaking, until we come to the *North Rock Channels*, having a southerly direction.

There are two channels by the North Rock: that on the eastern side of the rock is called the N.E., and the western, the North-west Channel. They are known only to a few of the pilots, and from that cause but seldom used, although it is said that the north eastern Channel is one of the best through the edge of the reef. The north-eastern Channel is narrow and intricate at its entrance; the general depth is 6, 7, and 8 fathoms, but in one spot but 5. At 3½ miles in the direct line from the entrance, toward Murray Anchorage, there lies a cluster of rocks, which render a circuit to the westward advisable. The mark for clearing the West end of these, the *Three Hill Shoals*, is Painter's Hill, over a hill on the western side of the Ferry at St. George's Island, bearing S.S.E. There is also a channel through the shoals, which is more direct; the mark for which is Painter's Hill in the Hollow or Saddle of Two Hills (hence their name), at the West end of St. George's Island, bearing S. ½ E. As soon as the shoals are cleared in either case, which will be when 3½ miles from the shore, you can bear round to the S.E. to Murraw Anchorage, this part of the reef being clear.

The next is the *Blue Cut*, on the western side of the reef, but can be used only by small vessels. It is exceedingly narrow and intricate, and has only 8 feet water in places. Its direction is to the East of South.

The *Chub Cut* is the next channel southward; this is also narrow and dangerous. It leads southerly to Wreck Hill, or first southerly and then easterly to Ireland Island.

Hog Fish Cut lies at the south-western angle of the islands. For half a mile in a north-easterly direction it lies through numerous rocky shoals, and then turns to the N.W. It leads to Ireland Island and to Ellis Harbour.

The Hog Fish Cut, which has recently been examined with a view to its improvement, is the most convenient at the West end of the islands, particularly in the winter season, when the winds prevail at N.W., and the danger of being at sea and about the islands is the greatest.

The Hog Fish Cut, though not far from the land, is an entrance from the ocean, through the outer barrier of rocks. Before arriving at the Cut, there are the *Bream Shoals* to be carefully avoided. The course through what are called the Chops of the Cut is nearly at a right angle; the turn is very sudden and sharp, and the greatest nicety must be observed by the pilots in navigating it. The course in from the ocean to Hog Fish Cut is N.E., and from the Cut to the *Kitvhen Shoals* N.W.; and the passage is so narrow that it does not afford sufficient space for vessels to tack in, and when a passage through them shall be attempted, it must be without a change of tack. These difficulties are felt more especially in the winter season, when the winds are generally unfavourable for passing the Kitchen Shoals. To remedy this evil, the committee appointed for the purpose (August, 1846) recommended the removal of the centre Kitchen Shoal, of coral (8 feet on it at high water), by the same means now employed at St. George's Harbour, when a passage sufficiently capacious would be opened, and vessels now often compelled to remain at sea, or make the circuit of the island in search of shelter, would find an easy and ready access to port.

The various channels here mentioned, having different directions, are available according to the wind; that which is fair for one being the reverse for others; but they must not be attempted without a pilot, who will immediately come off from St. David's Head, upon a signal being given to that effect; and a vessel in the offing requiring a pilot, it is telegraphed from one part of the island to the other by the chain of signals established thereon. They will be best understood by referring to the Chart of these Islands.*

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* A New Chart of the Bermudas or Somers' Islands, with Plans of the Narrows and Murray Anchorage, and St. George's Harbour, &c., by A. G. Findlay, F.R.G.S., published by Mr. Laurie, accompanied by a description of the Islands.

The south-eastern face of the reef forms nearly a continuous line of breakers, about 2 cables' length from the shore, and has no entrance or shelter till we come to *Castle Harbour*, the entrance to which, past the King's Castle, is in a N.W. direction. There is no other opening through the reef between this and the channel under St. David's Head, before described.

The SOUTH-WESTERN BANKS.—There is a rocky fishing bank lying from S.S.W. to S.W. from Gibbs' Hill (or S.W. part of Bermudas), from 3 to 5 leagues distant, and having 22 to 40 fathoms. These banks were surveyed in 1829 by the officers of H.M. sloop *Columbine*, according to whom the northern extremity of the *Inner Bank* lies in 32° 6′ N., and 64° 53′ W.; the S.W. in 32° N. and 65° W. The least water found was 29 fathoms, corally and rocky bottom. On the edges are 40 fathoms. To the S.W. of this bank is another, called the *Outer Bank*, the N.E. end of which was in lat. 31° 59½′, long. 65° 2½′; the S.W. end in 31° 57′, and 65° 5′. The least water found on this bank was from 33 to 47 fathoms, rocks and coral. From this Outer Bank the land is not visible.

THE ISLANDS.—IRELAND ISLAND is the north-westernmost of the group. The flagstaff, which is the highest point of the fortification, and stands above the break-water, is in lat. 32° 19′ 30″, and long. 64° 51′ 40″ W. It is one of the four telegraphic signal stations established on the island. The site of the Royal Dockyard and Naval Establishment is on the North extremity of the island, from the rest of which it is separated by a deep dry ditch.

Ireland Island is about one mile in length and perhaps a quarter broad, and is nearly all occupied by the buildings required for the officers, artisans, and for storehouses. The hospital is situated on the highest part of the island, and is very large and commodious. The officers' residences are built in the English style, and are very comfortable. The most important work is the breakwater, similar to that at Plymouth. Several hundred convicts are employed on it. The dockyard is kept in fine order.

Between Ireland and Somerset Islands there are several smaller ones, the chief of which is *Boaz's Island*, but there is no passage whatever between them.

SOMERSET ISLAND is the next in order. Its western point is Daniel's Head, off which is a small island.

Ellis or *Elies Harbour* lies between its southern extremity and Wreck Hill. This small harbour may be reached from the Hog Fish Cut, from Ireland Point, or by the Chub Cut. Between Somerset Island and the N.W. side of the reef the ground is all rocky, so that the channels to the harbours are very circuitous, and no directions can be given for them.

GREAT BERMUDA ISLAND.—This, the chief of the group, is about 12 or 13 miles in length. About the centre of it is the town of HAMILTON, standing on the North side of the harbour, an inlet of the island; it is a free port, and the seat of the legislature. North of the town, which consists principally of one street 1¼ miles long, parallel with the shore in an East and West direction, and about midway between the ferry at the West end of the island, and the dockyard, is one of the houses appropriated to the governor for the time being; it is scarcely seen from the water; but near it is a hill called *Monnt Langton*, on which is a flagstaff, by means of which communication is kept up between St. George, Somerset, and the dockyard. A few miles beyond this is the residence of the admiral, *King's Hill* or *Clarence Lodge*. Between this and Ireland Island is *Grassy Bay*, the anchoring place of men-of-war.

From *Spanish Point* to Ireland Island a ledge of rocks divides the *Great Sound* from Grassy Bay. There are two passages through this; one called the *Stag Channel*, near Sober Island, the North entrance; and one nearer to Spanish Point. Through these is the channel to Hamilton Harbour. There is also another line of reefs running between the North point of Somerset Island and the chain of islets

* *Montgomery Martin's* Colonies, p. 112.

South of Hamilton Harbour; this reef has also to be passed to enter the Great Sound South of which is *Port Royal Bay*, which has a depth across it for boats only.

The eastern end of Bermuda Island is occupied by the *Little*, or, as it is more, commonly called, *Harrington Sound*, a sheet of water only communicating with the sea by a narrow channel, called the Sound's Mouth, over which is a bridge at *Flatts Village*. Through this passage the tide ebbs and flows with great velocity, but does not pass in sufficient quantity to sensibly affect the level of the water within.

Wreck Hill, on the western extremity of the Isles, bearing N. ¾ E.

The southern shore of Bermuda is the boldest among the islands, and vessels may come in some places within half gun-shot of the shore.

East of Mount Langton is Brackish Point, near which is "*The Wells*," a government establishment for supplying water to the navy, should there be no water at the naval tanks on St. George's Island.*

(The following description of the coasts is principally by *Lieutenant John Evans*, (a) R.N.; commencing with the West.)

The westernmost projecting headland is *Wreck Hill*; it stands insulated on its base, is cone-shaped, and very dark coloured. When seen from the S.W. it appears flattened at its summit, but from the South as peaked; it is the land looked for, and first seen, when approaching the isles from the West.

GIBBS' HILL.—The next particular guide is *Gibbs's Hill*, which is the highest and most conspicuous eminence observable near the S.W. part of the coast; it is a smooth mount, entirely clear of trees, with the lighthouse previously described and a telegraphic post on its summit. To the westward, and contiguous to it, is a table-land, crowned with a grove of dark tall cedars.

Between Gibbs' Hill and Castle Island, to the E.N.E., there are several sandy mounts, having the appearance of white cliffs, and at moonlight may be mistaken for breakers. These are very remarkable, and are called the "*Sand Hills*." One of these is much more conspicuous than the others, being of greater extent, and without any verdure upon the summit. At 2 miles East of the great sand-hill is *Castle Harbour*, in the entrance to which are several islets and rocks: on the largest of these is an old castle, which gives name to the harbour. These islets are remarkable for the colour of the cliffs and the dark verdure of the turf which covers them.

The coast here presents a very picturesque appearance of land and water; the tele-

* Large fleets could not, as yet, find sufficient water at Bermuda.—*Governor Reid*, 1846.

graphic hill over St. George's is a pleasing object in the perspective. This may be termed the S.E. face of the islands, and is considered as in the best parallel to make them in from the eastward.

In the winter, with the wind from the N.E. there is a strong set of the water to the S.W. on the South side, and it is very tedious and unpleasant to turn to windward, the wind blowing in heavy squalls at intervals. I have, however, known South and S.W. winds to prevail during most part of the winter months.

CASTLE HARBOUR.—In Castle Harbour there is good anchorage; but it is not used by men-of-war. A frigate, many years ago, was wrecked in her endeavour to get out.

The southern channel to the harbour is narrow and intricate; the mark to lead across the outer edge of the reef is *Minor's Hill*, on the North side of St. George's Island, midway between Castle Island and Southampton Island. As soon as this is crossed, bear to the eastward and steer close to the eastern side of Castle Island, which is steep-to, and then pass between the banks which border the channel for about one-third of a mile North of Castle Island; then bear round to the eastward, and anchor in 5½ fathoms, one-quarter of a mile North of *Nonsuch Island.*

In working up from the S.W. end to Castle Harbour ships may stand within a mile of the shore; and small craft until the bottom is seen. There are some small reefs and ledges along the line of shore, but they are very near the beach.

St. David's Head is next seen, in the form of a round bluff, covered with foliage, and, when the land is opened to the northward, a large cave will appear to view beneath the head. A reef extends from this bluff, about half a mile off shore; the sea generally breaks over it.

Vessels waiting for pilots may run in to the N.E. of the bluff, and heave to with their heads off shore; the bottom is hereabouts visible, but no danger need be apprehended on that account.

The pilots are the most expert I ever met with. A good look-out is kept by the artillerymen stationed at the telegraphic hill, and delay seldom takes place.

Beyond St. David's Head the land trends to the N.W. *St. George's Harbour* (the best among the islands) is formed by several islands, and a curve in the larger island of the same name; its entrance lies between Fort Paget and a small kay to the eastward; the harbour is land-locked, well sheltered from the stormy West and N.W. winds, with a good depth of water over a bottom of stiff pipe-clay. The vicinity to the open sea alone gives it a decided superiority to the anchorage at Grassy Bay, if there were nothing else to recommend it.

ST. GEORGE'S ISLAND is "the military station of the colony, and formerly the seat of government; is about 3 miles long, and at no part exceeding half a mile broad; it lies at the entrance of the only channel for ships of burden. The harbour of St. George, when once entered, is said to be one of the finest in the world, and capable of containing the whole British navy. It is completely land-locked. The entrance to the harbour is narrow, and is protected by Cunningham Fort. After passing this entrance, the town presents one of the most beautiful landscapes the eye ever rested upon."

The ROADSTEAD, from whence ships proceed to St. George's Harbour, is called the *Five Fathom* or *Outer Hole;* within this is the *Inner Hole*, having a fairway buoy, *chequered black and white*, marking the entrance to the Narrows or Channel to Murray Anchorage, as well as being in the proper direction for crossing the bar. This buoy bears N. by W. from the rock under St. David's Head.

The *Five Fathom* or *Outer Hole*, where ships wait with winds not fair for going to Murray Anchorage, has from 5 to 10 fathoms. The mark for anchoring is the Cherry-stone or Sugarloaf Hill (at the head of Mullet Bay) open of the old battery on the point of St. George's Island, bearing East by compass; St. Catherine's Point about W.N.W., and the rocks off Cooper's Island open to St. David's Head, S. ½ W.; but in letting go your anchor look out for a clear spot.

From the chequered buoy before mentioned, the passage over the bar to St.

George's Harbour bears S. by E. ½ E.; the bar marks are, "a stone pillar and a white stake in a line, bearing about S. 20½ W. by compass (1851);" they lie on the slope on the North side of St. David's Island. Carry on this course until Smith's Fort on an island, which forms the South side of the entrance, bears S.W. by W. ½ W. and then steer for it, and when nearly up to it, bear round between it and the point, when the town will open on the starboard bow; whence you may proceed to the anchorage, keeping the N.W. shore on board. The passage over the bar is between two poles on the North side, and two on the South side. Four other poles mark the channel S.W. of this.

The depth on the bar is 16 to 18 feet; within it, and in the channel, 4 and 5 fathoms.

"At the entrance to, or on the bar of, St. George's Harbour, there lay a rock exactly in mid-channel, which was a great impediment to vessels entering. The reefs at the outer bar, half a mile from shore, are of a different nature to those in the narrowest part, which consists of a conglomerate of broken shells and sand, cemented by a limestone; it is here all of recent coralline formation. The greatest part are hemispherical masses, called here brain-stones (*meandrina labyrinthica*), in the cavities between which the diver places a canister of powder (usually 50lbs.), which is fired by the galvanic battery. The greatest labour is in removing the fragments This is done partly by the diver descending and slinging the broken rock, and partly by nippers used from boats. These operations are superintended by Lieut.-Col. Barry, Commanding R.E." — *Gov. Reid's Report*, Bermuda, March 16th, 1846.

High water, full and change, at St. George's, VIII¼h. Common tides rise to about 4 feet, but springs, or in gales of wind, they frequently rise 6 or 7. The floods in the offing set to the N.E., and ebbs to the S.W., but near the shore they run in various directions.

"*St. Catherine's Bluff* is the north-eastern extremity of St. George's Island and of the isles in general. There is a fort upon it, and a battery for point blank shot. Beyond this head, to the westward, is *Murray Anchorage*, one of the most unpleasant places in the world to ride in during the winter season. I have been for several weeks riding out a N.W. gale in a frigate here, pitching bows under; and the *Driver*, sloop of war, is said to

The Entrance of St. George's Harbour, bearing West.

have carried away her bowsprit, in consequence of its getting under the cable, when she was in the act of plunging during a gale here. The *North Rock*, at about 8 miles in the offing, appears from this anchorage through a telescope like a ship's boat, with three lug sails; there is a passage of egress for large ships through the reefs near the rock; but it cannot be attempted without a fixed leading wind; boats are then placed on either side of the channel to guide the pilot."—*Lieutenant Evans*.

MURRAY ANCHORAGE "lies on the S.W. side of Catherine Point, extending from Tobacco Bay to the Ferry, between St. George's and the Great Bermudas; whence, after going through a passage to the westward, there is secure anchorage from abreast of Brackish Pond, across the entry of the Great Sound, as far as Ireland. The common entry into Murray Anchorage is through an intricate and narrow passage round Catherine Point, called the *Narrows;* for the particulars of which see the Chart, as no description can be given here that will be of any use to a stranger. The ground in the entry, as well as all over the anchorage, consists of stone, of the soft dripstone kind, ground as fine as flour, mixed with a shelly substance, and a chalky clay; it is very heavy, therefore the anchors do not sink deep in it, and they loosen immediately when a-peak; but it is rarely that ships drive in it. I have, in the *Resolution*, a 74-gun ship, rode many heavy gales in this anchorage, but never started an anchor; although, in Hampton Road, Virginia, which has remarkably tough ground, the anchor has often come home. Ships bound for Murray Anchorage will generally get a pilot off Castle Harbour, or they may run as far as St. David's Head. When to the eastward of St. David's Head stand no further to the northward than to bring the Head N.E., or you will see a white sandy bay to the southward of the Head, between it and Castle Harbour. In standing to the northward, care must be taken to shut no part of this bay in behind St. David's Head. The West land of Bermudas will be shut in behind the land, over this bay, before this mark comes on. In the night, when waiting here for a pilot, the best precaution is the lead; for, if care be taken, and the ship is not running too fast through the water, you will be sure of striking ground in time to avoid danger."—*Mr. Murdo Downie*. 1803.

St. George's Island and Signal Station, from Murray Anchorage.

The naval tanks lie abreast of Murray Anchorage, just above a small cove (*Tobacco Bay*), wherein is the landing-place. There is not a spring in the isles, and ducks are abundant. I had to remark at Nice (in Italy), where the earth is saturated with springs, that there was not a duck to be seen.

From the anchorage of Grassy Bay ships, unless they happened to be favoured with a leading wind, are generally one day working up to Murray Anchorage, a distance of 9 miles; and there they must wait until the wind proves fair before they can get to sea round St. Catherine's Bluff, and through the intricate channel which leads to St. David's Head. Even with a fair wind to or from Ireland Island (on which the new dockyard is situated) ships are liable to strike upon the heads of rocks everywhere scattered about; this happened to a ship I was in, with a most expert pilot on board; the weather being cloudy, the rocky spots did not show themselves sufficiently clear to be altogether avoided.—*Lieutenant Evans.*

Directions for makind the Bermudas, by Mr. Murdo Downie, 1803.

Vessels in hazy weather, or in the night, must be very cautious in approaching, lest the winds or currents should set them on the reefs, or into some inextricabte channel. Be particularly cautious in coming from the S.W., as upon the rocks off this end of the island, from S.W. to W.N.W., many ships have been lost. No stranger should attempt any of the anchorages without a pilot, many of whom are always on the look-out, and put to sea when a vessel heaves in sight. Their boats may be readily known, being of a peculiar construction and rig; of a light draught of water forward, with a long heel or deep sternpost; rigged with one mast and bowsprit, carrying a triangular mainsail, a foresail, and jib, and, occasionally, a gaff topsail and square-sail.

The prevailing winds with fine weather in these seas being from between the South and West, vessels from the West Indies and America generally make these islands by running in their latitude from the westward. The best latitude for that purpose is 32° 8′, always having regard to a small probable current in the direction the wind blows; steering East, you will first see the land a little on the port bow, being two small sand-hills, close together, having a white house on the top of one, and cedar wood on the other (these are called Gibbs' Hills, now distinguished by the lighthouse before mentioned); as you near the land, you will see Wreck Hill further to the northward, appearing peaked, and joined by low land to that first seen; steer to bring Gibbs' Hill to bear E.N.E., and, when within 6 miles of the land, take care it is not to the eastward of that bearing, because of the rocks called the Long Bar. Then steer so as to pass within 2 miles of the S.E. land; and, when Wreck Hill shuts in behind the South land, you are clear of the S.W. breaker, and may steer along the S.E. side of the island, at a mile distant from the shore, until abreast of St. David's Head, there being nothing to hurt a ship but what is in sight.

In running for Bermudas *from the eastward*, the best parallel is between latitudes 32° 10′ and 32° 20′; in which a ship may run boldly, as there are no rocks at any distance from the land.

When running down a parallel for Bermudas, with a large wind, and not making the land toward night, but expecting to be near it, no vessel in this situation ought to lie-to, but should rather turn to windward, under an easy sail, until daylight, because of a probable current, as before mentioned, which has deceived many by bringing them unexpectedly among the rocks. The land not being high (Gibbs' Hill, on which is the lighthouse, is the highest land in the islands), it cannot be seen at any great distance from a small vessel; add to this, the thick haze that frequently prevails here, particularly in fine weather, renders making the land somewhat difficult, and at times precarious, unless the latitude be accurately ascertained; for instances have happened of vessels missing the islands, and after a fruitless search steering for the American coast in order to take a fresh departure for running down the latitude again.

Instructions for Sailing to Bermudas Islands, by Admiral Murray.

Within the Gulf Stream steer well to the southward, perhaps as much as S.S.E., until you get within 3 or 4 miles of the latitude of Cape Hatteras; and then steer S.E. by E. until you get into the latitude of 32° 5′. Thus you will avoid crossing the Gulf Stream where it is very broad, and its direction far to the eastward, and pass it where it affects your latitude more than your longitude; and, of course, be of less consequence to the ship's reckoning; and, by steering thence so far to the southward as S.E. by E., you will fall into the latitude of the Bermudas at 4 or 5 degrees of longitude to the westward.

You should by no means run for these islands unless sure of your latitude; and always make them from the S.W., if possible, looking out in time for the land, as, owing to the set of the Gulf Stream, and the general tendency of the currents to the eastward, ships from the coast of America will almost always be far ahead of their reckoning.

Having ascertained your latitude, and being well to the westward, get into the parallel of 32° 5′, and steer due East; this course will bring you to the islands, passing about 4 miles clear of the South end of *Chub Heads*, a very dangerous shoal, lying across the West end, about 8 miles from the land, with not more than 12 feet on it at low water; as well as the S.W. breakers, which lie about 1¼ miles S.S.W. from the southernmost land, being the shoalest part of a ledge of rocks of considerable length, lying parallel with the shore. Should the wind in the night incline to the northward, keep in 32° 7′ N.; but if to the southward, in 32° 2′.

The soundings do not extend more than 1½ miles from the shore on the South side; therefore, you have only a strict look-out to depend on for safety; and as for the East, West, and North sides, the breakers lie from 3 to 4 and 5 leagues off. You must avoid, by all means, running in the night, without having a good observation the preceding day, and being pretty sure of your longitude. Follow these directions, and will first make Wreck Hill (which is high land on the western extreme of the islands), and the land trending from it to the S.E. Having passed the S.W. breakers, the land lies about E.N.E. and W.S.W., having danger no more than half a mile off, and that generally visible; you may run safely along shore at a mile, until you pass Castle Harbour, which is easily known by the castle on an island on the starboard hand. You should bring-to off the eastern point of this harbour, and wait for a pilot, who will soon come off, and carry you into St. George's Harbour. But should you be pressed for time, or the pilot not come off, you may haul round by the breakers, after having passed the islands which form the South part of Castle Harbour, into St. George's Road, bringing on the following marks:—

A high island, next to the N.E. part of the small ones off Castle Harbour, has, at its eastern extremity, a bluff rocky point, called St. David's Head, having breakers off it about half a mile; the northernmost land in sight, after you haul round St. David's Head, is called St. Catherine's Point; bring this point to bear W.N.W., and St. David's Head S. ½ W., and you will be in as good a berth as any in the road, with 7 or 8 fathoms of water; but in every part of these roads you must be guided by the eye where to drop your anchor clear of foul ground, which is everywhere easily seen, owing to the clearness of the water and the whiteness of the sand where the anchorage is safe.

In case you have been driven to the eastward of the islands (a situation, however, which you are to avoid with the utmost care), you may run for them in lat. 32° 14′ N., which will bring you to them 5 or 6 miles to the southward of St. David's Head, for which you may haul up upon making the land; but you are not to run till you are far enough to the S.W. to follow the directions before given for coming from the westward, should you make sail for Bermudas from any part of the Gulf Stream, or without it.

I recommend you to make great allowance for your being to the eastward of your reckoning, and try to fall into the parallel of latitude above mentioned, in longitude 70° or 71° W.

High water at St. George's, full and change, 8½ hours. Spring tides rise about 6 feet; common, 4 feet. The tides are various, both in height and time, at different parts of the islands. The Bermudas bear from Cape Henry S. 63° 35′ E., distant 210 leagues.

Navigation to the Bermudas. (Lieut. Evans.)

"On the 12th of April, 1811, having left the frigate, I took charge of a prize schooner for Bermudas, and anchored at St. George's on the 6th of May following. On the 4th, at noon, in lat. 31° 44′, longitude by account 62° 10′, considering that we might be set to the West by current, I determined to get into the parallel of 32°, and then put the vessel's head to the eastward until daylight. By midnight we had run up a course N. 79° 45′ W. 43 miles; which gave our situation, by account, 31° 52′ N., and 63° 3′ W. I left directions with the mid of the watch to tack at 12ʰ 30′; and at that time the sand-hills were seen N.N.W. 9 or 10 miles; which showed that we were, by *account*, 1½° to the East of the true longitude; the southern part of the land being in 64° 33′. I have no doubt we were set to the West by current, but something must be admitted for erroneous allowances, as we had often contrary gales and heavy seas to contend with. In a dark and dismal night, with very severe lightning and thunder (the schooner full of gunpowder), I recollect, whilst the wind was blowing a storm at North, that it shifted in a second to South, and nearly set us down; the gaff of the reefed foresail having caught between the ratlines of the rigging. We were lying-to on the starboard tack. I was, therefore, most happy when we dropped anchor in the snug harbour of St. George."

Remarks on the Bermudas, and Passages to and fro, by Commander Dunsterville, 1830-31.

In July, 1830, from the Maternillo Bank, on the N.W. of the Bahamas, to the Bermudas, the winds prevailed from the S.E. to S.W. Light breezes and cloudy, with heavy rain at times. Found no current.

The Bermudas, from the S.W., at 5 leagues distant, appear as an assemblage of detached high islets, on the South part of which the signal-post on Gibbs' Hill is seen, being erected on the highest land in the islands. Hence we ran along shore, at 1½ to 2 miles off.

During our stay at these islands the winds prevailed for seven weeks from S.S.E. to S.W., which is invariably the case here during the summer months. Rise of spring tides about 3 feet 6 inches. High water at 6ʰ.

When a signal for a pilot is made from ships in the offing, it is telegraphed by the signal-posts throughout the island.

To lay through the Narrows, near St. George's, it is requisite to steer from N.W. to W.N.W., and from St. Catherine's Point (the N.W. point of St. George) S.W. by S. and S.W., till Ireland Island bears about W. by N., whence haul to that course. In every course avoid all brown or dark patches, which are corally rocks, with little water on them. In the channel are from 6 to 7 fathoms. The buoys invariably point out all the rocky heads, which in some parts are numerous. In the latter end of September fine North and N.E. winds: the thermometer at 74°, which had been for the last two months from 80° to 84°. The *Ranger* anchored at Murray Anchorage in 10 fathoms, chalky bottom. St. Catherine's Point, E. ¼ N. about 1¼ miles.

The *Ranger* sailed for Bermudas from Jamaica on the 5th of October. Winds prevailing from the N.N.E. Fresh breezes and fine weather.

Winds light from the eastward until we arrived at Bermuda, when it blew strongly from the southward and westward for a fortnight. On the 11th of April anchored off Ireland Island. Vertical rise of spring tides here about 5 feet; neaps, 2 or 3 feet. Highwater at 8ʰ.

Going through the Narrows at Bermuda.—In going in, the white buoys lie on the starboard side; the black on the port: of course, in going out, *vice versâ*. Fairway buoys are chequered, one at each entrance. The courses through are from W.N.W. to N.N.W. ½ W. The best anchorage at Murray Anchorage is in 9¼ fathoms, off St. Catharine's Point, with the East signal-staff in St. George's S. by E. ½ E., off shore one-quarter of a mile. Between St. Catharine's Point and Mount Langton (the governor's house) keep the shore well on board; say one-quarter of a mile or less, passing in-shore of the buoys: but, when going through the Narrows, off the admimiral's house, going betwixt the buoys. In clear weather the dangers show themselves.

With these remarks on the islands by Mr. Dunsterville, the following, since made may be included:—

"The land, generally, of these islands is low; yet there are many parts, as *Gibbs' Hill, Mount Langton*, the North part of *St. George's* and *St. David's*, that may be seen in clear weather 5 leagues off. The isles, as shown hereafter, are surrounded by most dangerous reefs, the S.E. side excepted, which may be approached within a mile, until abreast of the N.E. point, called *St. David's Head*. Off this Head pilots are readily obtained by displaying the usual signal. The government pilots may be known by a narrow blue burgee, with a broad arrow in white therein.

There is anchorage without the *Narrows*, on a spot called *Five Fathom Hole*, with St. Catharine's Point about W.N.W., and St. David's Head S. ½ W.; but, in letting go the anchor, look out for a clear spot.

In proceeding for the Narrows, the first buoy seen, which is chequered, is the leading buoy for the fairway. In the Narrows are 6 and 7 fathoms of water; here you leave the white buoys on the starboard, and the black on the port side.

If you intend anchoring in *Murray Anchorage*, bring St. Catharine's Point to bear East; the signal staff at St. George's, S. by E. ½ E., in 9½ fathoms, chalk bottom, at a quarter of a mile off shore, From this anchorage to *Ireland Island*, where the men-of-war lie, is about S.W. by S. to abreast of Mount Langton, the governor's country residence, keeping the shore about one-quarter of a mile distant, and going with a leading wind in-shore of the buoys, which are placed on shoal corally spots. When Ireland bears about W. by N., you then haul for the island, passing betwixt two corally spots, nearly abreast the Admiral's house, which are both buoyed. In clear weather all the reefs are readily discerned, and may be avoided with a common degree of care. From Murray Anchorage to Ireland you have, in the channel, 7 and 6 fathoms.

During the summer months, from April to September, the winds prevail from S.S.E. to S.W. Thermometer, 80° to 84°. About the latter end of September the northerly winds set in, when the thermometer falls to 70° and 74°; quite a bracer for the constitution. The rise of tides at springs is about 5 feet, neaps 2 or 3 feet. High water at Ireland, full and change, at eight o'clock. The tide at the narrows sets from 1 to 2 miles in the hour.

The height of Gibbs' Hill signal station is about 200 feet: of Wreck Hill about 150. On the S.E. side is a large space of sand, called *Sand Hills*, which is very remarkable. The North Rock is about 16 feet high, 20 feet long, and 6 feet wide: here the currents are strong and very variable, but mostly to the eastward in the offing.

A branch pilot has 3*s*. per day, with allowance of provision, and one dollar per foot for any government ship.

Directions for Sailing near the Bermudas, on coming from the Westward.

"On coming from the westward, the S.W. points of the land ought to bear E.N.E. before you come within 4 leagues of the land, when you may steer directly for it, without danger. The breakers, on the South side, always show themselves; so that a ship may safely approach within gun-shot from the S.W. end to the S.E., and, when getting to the eastward of the castle, round into St. George's. Do not go further to the northward than to keep Cooper's Island open within St. David's Head, till you take a pilot; and the subscriber engages no ship will ever strike, if this be attended to."—*Thomas Lean*, 1808.

On the Winds and Navigation of the Bermudas, by His Excellency Colonel (Sir W.) Reid,* Governor of Bermuda.

The first half of a revolving gale is a fair wind from Bermuda to New York, because in it the wind blows from the *East;* but the last half is a fair wind from New York to Bermuda.

During the winter season most of the gales which pass along the coast of North America are revolving gales. Vessels from Bermuda bound to New York should put to sea when the N.W. wind, which is the conclusion of a passing gale, is becoming moderate, and the barometer is rising to its usual level. The probability is, more, particularly in the winter season, that, after a short calm, the next succeeding wihd will be easterly, the first part of a fresh revolving wind coming up from the S.W. quarter.

A ship at Bermuda, bound to New York or the Chesapeake, might sail whilst the wind is still *West,* and blowing hard, providing the barometer indicate that this West wind is owing to a revolving gale, which will veer to the *northward.* But as the usual track which gales follow in this hemisphere is northerly, or north-easterly, such a ship should be steered to the southward. As the wind at *West* veers towards *N. W.* and *N.*, the vessel would come up, and at last make a course to the westward, ready to take advantage of the *East* wind at the setting in of the next revolving gale.

A vessel at New York, and bound to Bermuda at the time when a revolving wind is passing along the North American coast, should not wait in port for the westerly wind, but sail as soon as the first portion of the gale has passed by, and the N.E. wind is veering towards the *North;* provided it should not blow too hard. For the *North* wind will veer to the *westward,* and become every hour fairer for the voyage to Bermuda.

A great number of gales pass along the coasts of North America, following nearly similar tracks, and in the winter season make the voyage between Bermuda and Halifax very boisterous. These gales, by revolving as extended whirlwinds, give a *northerly* wind along the shore of the American continent, and a *southerly* wind on the whirlwinds' opposite side far out in the Atlantic. In sailing from Halifax to Bermuda it is desirable for this reason to keep to the westward, as affording a better chance of having a wind blowing at *North,* instead of one at *South;* as well as because the current of the Gulf Stream sets vessels to the eastward.

When vessels from Barbadoes, or its neighbouring West India Islands, sail to Bermuda on a direct course, they sometimes fall to the eastward of it, and find it very difficult to make Bermuda when westerly winds prevail.

They should therefore take advantage of the trade-wind to make the 68° or 70° of West longitude, before they leave the 25° of latitude.

On a ship leaving England for Bermuda, instead of steering a direct course for the destined port, or following the usual practice of seeking for the trade-winds, it may be found a better course, on the setting of an *easterly* wind, to steer West, and if this wind should veer by the *South* towards the West, to continue on the port-tack, until, by changing, the ship could lie in its course. If the wind should continue to veer to *North,* and, as it does sometimes, even to the *eastward of North,* a ship upon the starboard tack might be allowed to come up with her head to the westward of her direct

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* "On the Winds as influencing the Tracks sailed by Bermuda Vessels; and on the Advantage which may be derived from sailing on curved Courses, when meeting with progressive revolving Winds, *by Governor Reid, of Bermuda* (Author of the 'Law of Storms')." —*Edin. New Phil. Journal,* July, 1846, p. 192.

course. On both tacks she would have sailed on *curved lines*, the object of which would be to carry her to the westward against the prevailing wind and currents. There is reason for believing that many of the revolving winds of the winter season originate within the tropics; and that ships seeking for the steady trade-winds, even further South than the tropic, at that period of the year, will frequently be disappointed. How near to the equator the revolving winds originate in the winter season, is an important point not yet sufficiently observed. The quickest voyage from England to Bermuda, therefore, may perhaps be made by sailing on a course composed of many curved lines, which cannot be previously laid down, but which must be determined by the winds met with on the voyage. This principle of taking advantage of changes of revolving winds, by sailing on curved lines, is applicable to high latitudes on both hemispheres, when ships are sailing westerly.—*Government House, Bermuda*, 21*st March*, 1846.

9.—ROCKALL, OR ROKOL.

This is a large and high rock, of a conical or sugar-loaf shape, the summit, or upper part of which is perfectly white, from an immense quantity of bird's dung, with which it is covered. The rock had been seen many times, but its true situation was unknown till the year 1810, when it was ascertained by Mr. T. Harvey, master, and the other officers of the *Endymion* frigate, commanded by the Hon. T. B. Capel. In Captain Vidal's survey of the western banks it is represented in 57° 36′ N., and 13° 41′ W. There appears to be dangers both to the N.E. and to the S.W. of the rock.

Rokol, 2 miles distant, as taken by Mr. Harvey.

N.E. Dangers.—With the rock bearing N. by W., broken water appeared to the N.E. of it; and, on approaching nearer, a rock, on which the water broke, appeared just at the water's edge. When due South of Rokol, the breakers were in a line with the eastern part of it. The sunken rock bears N. 73° E. from it, at least 1¾ mile distant. This rock may be named the *Helen Rock*, as it is probably that on which the vessel was wrecked as recorded below, unless there exists another rock further off in the same direction.

On the N.E. rock just mentioned, until then unknown, and lying about 2 leagues, or less, E.N.E. ½ E. (by compass) from Rokol, the brigantine *Helen*, of and from Dundee, struck fatally, on the 19th of April, 1824. This vessel, commanded by Mr. Thomas Erskine, was bound to Quebec and Montreal, with a general cargo, and after she had struck, the crew and passengers continued at the pumps for 13 hours; but, being overcome with fatigue, were at length compelled to abandon the vessel. The crew, at that period twelve in number, embarked in two boats, with one passenger, and soon after they had left the vessel she sunk, when sixteen passengers perished, of whom seven were women, and six children. The crew were picked up at sea by the bark *Flora*, Captain Baker, and safely landed on the Isle of Tiree, one of the Hebrides.

It appears, from Captain Erskine's narrative, that he estimated Rokol to lie in 13° 40′ W. That the vessel struck twice on a clump of rocks, apparently not much bigger than a ship's length, and on which the sea broke occasionally. No other breakers were in sight at the time. Rokol at this time bore, by compass, W.S.W. ½ W., he thinks about 6 miles distant; but, as the weather was hazy, probably something less.

Extract from the log-book of the *Emperor Alexander*, of Aberdeen, L. M'Kinnon, master.—April 8th, 1832, saw Rockall [Rokol] bearing W.N.W., distant 4 leagues; and Long Reef, breaking occasionally, bearing from the ship N.W. by W. ½ W. (by compass), distant 8 miles, and about 4 miles from Rockall. At intervals the sea did not break on the reef, but it broke frequently very heavily, and with long rolling white seas, like breach upon a bar, for about 6 or 7 ship's lengths. The sea broke in no other place at that time within sight.—"Nautical Magazine," December, 1833, p. 697.

Breakers were again seen, in 1844, by Mr. R. Bartlett, of the *Guide*. The following particulars appeared in the *Shipping Gazette*:—"On 15th April, 1844, at 4 a.m., sighted Rockall, bearing N.W., ship lying N.W. by W., strong gales from the S.W. by W., clear weather; was desirous to keep my reach to the N.W.; not being able to weather Rockall, bore away to round the North end: had my mate aloft and myself on deck to look for breakers; suddenly I found the vessel between the outer rock and the main one, at least 8 miles distant; with difficulty I cleared, by hauling the ship suddenly on the starboard tack, being not more than one sea from the broken water; breaks occasionally. They are bad to discern aloft, but their locality may be seen much more readily off deck by the colour of the water. The morning being clear, I was able to obtain the bearing and distance pretty correctly." This reported clump of hidden rocks, about 80 or 90 feet in length, and 30 feet in breadth, the main rock on Rockall, bearing from the outer one, W. by N., by compass, distance 8 miles, may perhaps have the same origin as the previous account. Captain Vidal has minutely surveyed the whole of that part, and no shoal or rock was discovered by them, but the above accounts are certainly circumstantial and deserving of attention.

S. W. Dangers.—There is another reef or line of reefs extending to the south-eastward, which does not appear to have been completely examined, for we have had repeated notices of its having been observed, as may be seen by the following remarks on Rokol, which were communicated to the public by Mr. Richard Peacock, as early as 1809:—"This rock appears almost like a ship at a distance, and is steep close-to on the North side. I have passed at the distance of about 50 fathoms; but, to the southward, or nearly S.E. by E. from the rock, there lies a long reef of rocks for about 3 miles. On this reef, with gales of wind, the sea breaks very heavily.

Captain Osborn, of Workington, told me that, on his passage from Quebec, in 1806, it was with the utmost difficulty he escaped getting amongst the breakers. Captain Magee, of Greenock, also informed me, that he had seen the sea break to the distance of nearly 3 miles in a S.E. direction from the rock.

An intelligent person has also related that he had, about two years before the disaster occurred to the *Helen* to the N.E. in 1824, fallen in with the breakers to the S.E. of Rokol, which appeared to extend outward 3 or 4 miles, in clumps, at some distance from each other.

Still more recently (June, 1860), the Admiralty gave notice that a *breaker*, lying E.S.E., from 5 to 10 miles from Rockall had been observed, and that it had appeared in a chart made by H.M.S. *Leonidas* in 1802, perhaps from the information of the officers of the *Endymion* above given.

The Rokol Bank has been surveyed by Captain Vidal, R.N. The edge of the bank of soundings, comprehending less depth than 100 fathoms, is 20 miles to the northward, and 35 miles to the southward of the rock; and the least depth expressed, which is on the S.W. of the rock, is 54 fathoms. The whole extent of soundings from N.E. to S.W., within the depth of 200 fathoms, is 55 leagues.

The greatest breadth, which is on the parallel of 57° 30′, is 18 leagues. The North end of the bank, with 163 fathoms of water, is in lat. 58° 19′, long. 13° 40′; and the S.W. end, with 180 fathoms, is in lat. 56° 3′, long. 15° 59′.

10.—SABLE ISLAND, OFF NOVA SCOTIA.

In a former page, 351, there are some remarks on this singular and dangerous island, lying in the strength of the Gulf Stream, and apparently formed by conflicting currents.

The island is formed of two nearly parallel ridges of sand, shaped like a bow, concave to the northward, and meeting in a point at either end. Its whole length, following the curve, and including the dry parts of the bars, is 22 miles; or E. ¾ S. 20½ miles, in a direct line across the curve; its greatest breadth is exactly one mile. In some parts it is wholly or partially covered with grass, in others scooped out by the winds into crater-shaped hollows, or thrown up into sand-hills, not exceeding the height of 75 feet above high water. Between these ridges a long pond, named Salt-water lake, said to be gradually filling with blown sand, but still in some parts 12 feet deep, extends from the west end to the distance of 11 miles; and a low valley continues from it 6½ miles more to the north-east of the island. The entrances to this pond have been for some time closed, the sea flowing in over the low sandy beach on the south side, and at the west end only in high tides and heavy gales.

Fresh water is to be had almost everywhere, by digging down a few feet into the sand.

The West Flagstaff, which points out the position of the principal establishment, stands on a sand-hill 40 feet high; and with its Crow's Nest, or look-out, 100 feet above the sea, is a conspicuous object on the north side of the island, and was distant (in 1852) 4,215 fathoms from the west end of the grassy sand-hills.

The East Flagstaff, 40 feet high, is also a conspicuous object, standing on a sand-hill on the north side of the island, and distant, at the same date, 2,280 fathoms from the north-east end of the grassy sand-hills.

The Middle Flagstaff was further inland, and was about to be removed to a more advantageous position on the south side of the island. Besides the buildings at these flagstaffs, there was an unoccupied house on the north side, distant 3½ cables from the west end of the grassy sandy-hills.

Sable Island and its submerged bars form a crescent concave towards the north, and extend over more than 50 miles of sea. Vessels should be careful not to be caught within this crescent in a strong gale from the northward, when the accelerated ebb-tide, setting directly towards and over the bars, would render her situation extremely dangerous. Both the bars are extremely steep on the north side, the East bar especially so, having 30 fathoms water close to it. To the southward, on the contrary, the water deepens gradually out for so many miles as to render it difficult to account for the greater number of shipwrecks having occurred on that side of the island and its bars, excepting by a neglect of the lead.

In approaching the anchorage off Sable island from the northward at night, or in thick weather, the lead should be kept constantly going, and after passing the Middle Ground, distant about 25 miles to the northward of the island, great caution should be used, and the vessel should be certain of her position; for the east end of the island and the East bar are very steep on that side.

The Middle Ground, and the ridge of sand reported to continue from it to the west and south, till it joins the West bar, require to be surveyed, before more precise directions can be safely given.

Vessels seldom anchor off the south side of the island, because of the prevailing heavy swell from the southward; but they may safely approach by the lead on that side, taking care not to become becalmed in the heavy swell, and in the strong and uncertain tides and currents near the bars.

The landing is in general impracticable on the south side, excepting after a long continuance of northerly winds; and on the north side boats can land only in southerly winds and fine weather; but there are surf boats at the establishment, which can land when ordinary boats would swamp instantly.

The positions of the various points are given in the table on pp. 61, 62.

11.—PEÑEDO DE ST. PEDRO, OR ST. PAUL'S ISLETS.

A cluster of five steep, craggy rocks, without verdure, covered with birds' dung, and having no place for anchoring, or convenient for landing. They are about a quarter of a mile in extent each way, and the highest part is about 100 feet above the sea. With a line of 100 fathoms, no bottom was found within 2 miles of the islets. The appearance annexed has been communicated by the intelligent master of a merchant ship.

The rocks change materially in their appearance, according to their bearing. The *Tellicherry*, East Indiaman, passed in sight in 1802, and found that the appearance, between N. 30° W. and N. 37° W., 6 or 7 miles distant, was that of a heap of rugged rocks, with low gaps between some of them. The northernmost, a small pyramidal rock, rather lower than the rest.

Penedo de St. Pedro, West, as taken by Captain Monteath.

Commodore Brou, of the French frigate *Hermione*, in 1825, describes Peñedo de San Pedro as a mile in extent, in a N.E. and S.W. direction; seen in fine weather 4 or 5 leagues off; when bearing N.W. appearing in the form of three pinnacles of sharp naked rocks of a remarkable shape. The S.W. pinnacle separated a short distance from the others. The latter appears safe to approach, and no breakers were seen, to indicate sunken rocks. The *Hermione* sailed round on the eastern side at the distance of 5 miles; did not try for soundings, but from the colour of the water it was presumed that bottom would not be found.

The Equatorial current set the ship to the westward at the mean rate of 18 miles, and to the North 6 miles, in the twenty-four hours, between the parallel of 8° N. and the equator, and the medidians of 28° and 30° W. At the islets the direction of the current changed, and set more to the northward, at three-quarters of a mile in the hour.

The best description of this isle is that of Captain Amasa Delano, who, in the American ship *Perseverance*, from Boston toward Cape Horn, 23rd December, 1799, at two p.m. saw three small islands bearing W. by S., 2 or 3 leagues distant. The vessel bore away, and at three p.m. was abreast of them; Hoisted the small boat out, went on shore, and found them to be nothing more than a cluster of craggy rocks, about one-fourth of a mile in extent from North to South, and nearly as much from East to West. No sort of vegetation existed upon them. The rocks were found to be five in number, but only two of any considerable magnitude. Their greatest extent was from N.N.E. to S.S.W. The two largest nearly connect with each other, and form a kind of harbour, or place of shelter for a boat, on the N.W. side. Here they managed to land, but obtained nothing except a number of boobies. On shore the aspect was most dreary, the sea roaring and surging on all sides. Two smaller rocks were lying off to the S.S.W. of the large ones, and one very small to the N.E. When on the highest part, which was at least 100 feet above the surface of the sea, no dangers could be seen but what showed themselves above water; nor could any be discovered from the ship. Plenty of fish were caught in the harbour or basin. At six p.m. returned on board. Sharks were numerous about the ship, but in attempting to take them a number of hooks and lines were lost, and several pairs of graines broken. On sounding within 2 miles of the islet, no ground could be found with a line of 200 fathoms.

Captain Delano states that the islets may be seen at the distance of 4 leagues, and always make like three sail when first seen. They are very dangerous if fallen in with by night. The current near them set N.W. by N., true, 1 mile an hour. The parts above the reach of the surf are covered with birds' dung. The birds were hatching their young at the time. The month of November would be the season for procuring eggs at this place, as they may be obtained at that time in abundance; but being the eggs of oceanic birds, they are rather fishy than sweet. We have seen a different latitude assigned to the rocks, but consider it is incorrect.*

Admiral Fitz Roy, from his observations, places the summit of the Peñedo in lat. 0° 55′ 30″, long. 29° 22′. The variation here, on the 16th of February, 1832, was 9½° W. Temperature of the air and water, 82°. Wind, S.E. The rocks were seen on the horizon at sunset of the 15th. They appeared extremely small at about 8 miles distant. At daylight next morning two boats were sent to land upon and examine them, while the *Beagle* sailed round, sounding and taking angles. Good observations were made during the day, as the sky was clear and the water smooth.

The multitude of birds which covered the rocks was astonishing, and they suffered themselves to be kicked about and killed with sticks; at the same time, those on the wing even darkened the sky. While one party were scrambling over the rock, a determined struggle was going on in the water between the boats' crews and sharks. Numbers of fine fish, like the groupars (or garopas) of the Bermuda Islands, bit eagerly at baited hooks put overboard by the men; but so soon as a fish was caught, a rush of voracious sharks was made at him, and notwithstanding blows of oars and boathooks, the ravenous monsters could not be deterred from seizing and taking away more than half the fish that were hooked.

At short intervals the men beat the water with their oars all round the boats, in order to drive away the sharks; and, for a few minutes afterward, the groupars swarmed about the baited hooks, and were caught as fast as the lines could be hauled up,—then another rush of sharks drove them away; those just caught were snatched off the hooks; and again the men were obliged to beat the water. When the boats returned, they were deeply laden with birds and fish, both welcome to those who had been living on salted provisions.

"From the highest point of the rocks, which is 64 feet above the sea, no discoloured water, nor any breaking of the sea could be discerned, apart from the place itself; and from the soundings taken in the boats, as well as on board the ship, I conclude that it is unconnected with any shoal, being merely the summit of a steep-sided mountain rising from the bottom of the ocean. A slight current was setting to the westward, not amounting to a mile an hour."—(Vol. ii. p. 56.)

* The late Captain Henry Forster gave the position as 0° 58′ N., and 29° 16′ 40″ W.

12.—THE ROCAS, ETC.

Although this dangerous spot is not strictly within the North Atlantic Ocean, yet it has of late assumed a much greater importance in respect to navigation, since the western route across the equator has been advocated and followed. It is also the more necessary to allude to it here, as a singular error in its position has been perpetuated till the present time, and which must have led to much embarrassment, and probably loss and danger. Yet the apathy of the seaman is exemplified in this, that among the thousands who must have passed it, and suspected the error, not one should have thought it worth while to question the accuracy.

The group was examined, and their position accurately ascertained, by M. Lartigue, under the Baron Roussin, in 1825. Yet from an erroneous estimate in Horsburgh's directory, the *first* edition, in 1809, they are placed in longitude 33° 31′ W., or from *fifteen* to *eighteen miles too far East.* This error has been continued in all the editions of Horsburgh down to the last in 1855, and has doubtless misled many.

It was first pointed out by Lieut. Lee, U.S.N., who visited it in the *Dolphin*, in April, 1852. He gives the following description of them.

The centre of this low and dangerous reef is in lat. 3° 51′ 27″ S., long. 33° 48′ 57″ and is 84 miles due West of the peak of Fernando Noronha. The reef extends about 1¼ miles in latitude, and nearly 1⅔ miles in longitude, and is covered at high water, with the exception of Grass and Sand Island on the West, and the scattered rocks on the South and East sides. These objects are from 10 to 15 feet above the reef, which is formed of coral, generally level, though with many holes in it. In case of a vessel striking on the weather side of it (S.E.), the chance of saving life would be but small. When about 10 miles off, the breakers were first seen from aloft. Then the two low islands and the black rock soon appear. Sea birds abound, but there is no guano owing to the rains. The eggs of the gulls were plentiful and good (March, 1851.) There is no wood, nor fresh water. There is bad anchorage from one to two miles northwest of Sand Island, is from 15 to 18 fathoms coral bottom. We found coral bottom at 15 fathoms 6 miles East of the reef, but no bottom at 30 fathoms 2½ miles N.N.E., nor at 70 fathoms 4 miles S.E. of it.

The tide rises about 5 feet. The lagoon, in which we saw many turtle, has from 1 to 4 feet water at low tide, and shows white from the mast head at 4 or 5 miles distance. The anchors and cable on the S.W. part of the reef, and the remains of a wrecked vessel on the N.E. side of Grass Island, appear to have been on the reef for a long time. A lighthouse on the reef would be very useful to vessels.

The *current* in the vicinity of this reef sets from between S.E. by East, and East by North, at the rate of from 8-10ths to 1½ miles per hour, as found by the patent log. The surface current found by trials on 4 different days, sets from between S.E. and East by North, from 9-10ths to 1 4-10th miles per hour. At the anchorage under the lee of Sandy Island, the tide ran from 2-10ths to 8-10ths knot per hour, setting from between S.S.E. and East by North toward the northward and westward.*

They were again partially surveyed by Lieut. J. E. Parish, in H.M.S. *Sharpshooter*, in March, 1856. He gives the position of the centre of the South Sand Island as 3° 51′ 25″ S., long. 33° 46′ 23″ W., or about 2 miles further East. Captain Lartigues' longitude agrees with that of Lieutenant Lee, and should therefore be preferred.

Lieut. Lee saw the remains of many wrecks on various parts of the banks, and a hut on the western edge; numerous cotton bales lie scattered about. A bank carrying 14 or 15 fathoms affords anchorage as far as 5 miles to the N.E. of the banks. Lieut. Lee planted some cocoa nut trees on the eastern sand bank, which would afford a useful mark if they grow.

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* Cruise of the U.S. brig *Dolphin*, p. 82.

Fernan do Noronha and the adjacent coast of Brazil* are described in our directory for the South Atlantic Ocean.

Lieut. Lee, U.S.N. brig *Dolphin*, says:—We were three days (March 29—31, 1852) within from 20 to 30 miles north of the flats, of S. Roque, off Cape Toiro, when the N.E. and S.E. trade seem to meet and form a region of calm and rains, with an oppressive atmosphere resembling that of the equatorial calms. Outside of this region our track shows that the S.E. trades, though light, generally prevailed between the Rocas and the main to within a degree of Point Tairo, and that when we were a degree and a half North of this Cape, and in the parallel of the Rocas, the light variable winds, leaving the S.L. quadrant, came out to the eastward, soon got northing on them, and turned into gentle N.E. trades in 2° S. The direction of the winds around this Cape, outside the influence of the land-breeze, and also outside of the belt of calms and rains, appears to be modified by the form of the Continent. They come from the southward and eastward upon the eastern shore, which bends to the northward; whilst around the elbow of the Cape they draw more easterly (interrupted at this season, when the sun is near the equinox and going North, by small squalls of wind and rain from all around the compass), and on the northern coast, which trends to the westward, they come from the N.E.

The *current* between the Rocas and the main sets generally from the southward and eastward, from 1 to 1½ knots, until near the flats, where we experienced indications of a counter current or tide. Learned at Pará that their coasting vessels were generally 4 weeks going from there to Pernambuco. It is more from the failing of the wind there than from the current, that it is so difficult to double Cape San Roque.

13.—THE COASTS AND ISLANDS OF AMERICA, IN GENERAL.

For a complete and correct description of the Coasts of Newfoundland, of the Gulf and River of St. Lawrence, the Coast of Nova Scotia, &c., to Cape Cod, the reader is referred to the "British American Navigator," published by the Proprietor of the present Work. The navigation thence to the southward, including the whole of the West Indies and Mexican Sea, is described in "The Colombian Navigator."

The American navigation, in general, requires details so minute, and explanations so copious, as to render it impracticable to do justice to the subject in an abridgement. It will, therefore, not be attempted. A few remarks on the principal ports only will be added.

In the preceding pages the various phenomena which control the passages across the Atlantic are recited, and with those remarks are many concerning the proper mode of approaching any port. In connection, therefore, with what follows, these previous directions may be incorporated.

The following descriptions only of the chief points of interest, and of the principal ports, are therefore added:—

The *List of Lighthouses* and the *Table of Positions*, in the earlier part of this Work, may be consulted in connexion with them.

The NEWFOUNDLAND BANKS, which have been, in their fisheries, the source of all the opulence in the island, are vast submarine elevations, of various

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* It is said that a reef or some rocks lie 3¾ miles E.N.E. of Cape San Roque, (Verhandelingen, &c., 1860, p. 551). We have no further information on this important point, which, if correct, will require all caution in passing the cape.

depths and very unequal figures. The depths on the Great Bank vary from 15 to 80 fathoms. The quality of the bottom varies considerably, but it generally consists of sand, or sand mixed with shells and gravel, rarely with stones. The eastern face of the Bank is a clear sand, white or whitish, and often sparkling. In the gullies and deeps which separate the banks, and more particularly in the Whale Deep or Trou de la Baleine, the bottom is found to consist of mud or oaze with a fetid smell, and abounds with different sorts of fish; but more particularly with cod, which is inconceivably numerous; for, although from 200 to 400 vessels have been annually freighted with this article of commerce for nearly two centuries, there appears to be no sensible decrease of the former plenty. A great swell and thick fog usually indicate the place of the bank.

There are, generally, in the spring, within 125 or 130 leagues of the land, and between the Outer and Grand Banks, numerous ice-bergs, or ice-islands, that float down with the current from the north-westward, and which, during the foggy weather, are very dangerous: even in the months of June, July, and August, there are frequently a number of them: some of which may be seen aground, in 40 or 50 fathoms of water. In thick weather, the place of these may commonly be distinguished by the *ice-blink*, a brightness of the sky above them; or by the breaking of the sea against them, which may also be heard at a considerable distance; or by the decrease of the temperature of the water, as shown on page 359.

On approaching the banks, there will generally be found a number of sea-fowls, as *malimauks, roaches*, and *divers*. The last-mentioned are seldom found at more than 30 leagues from the banks; but malimauks, and several other kinds, are frequently seen during the whole passage, although not so numerously elsewhere as in the vicinity of the banks.

In approaching toward Cape Race (the S.E. point of Newfoundland), be careful to avoid the *Virgin Rocks*, a dangerous reef, lying 29 leagues S.E. $\frac{3}{4}$ E. [*E. by S.*] from that cape. In gales of wind a heavy sea breaks over them; and a strong current, which sets about them, often increases the danger.

The bank in which the shoal is situated, extends E. by N. and W. by S. $4\frac{1}{4}$ miles; its broadest part is about $2\frac{3}{4}$ miles. The soundings are regular from 28 to 30 fathoms, until they deepen suddenly on the outer edge to 39 and 43.

The rocks themselves are in 46° 26′ 30″ N., and 50° 51′ 30″ W. They extend in an irregular chain, S.W. by W. and N.E. by E. 800 yards, varying from 200 to 300 yards in breadth. The least depth of water is on a white rock, in $4\frac{1}{2}$ fathoms, with 5 to $6\frac{1}{2}$ fathoms all round it; the bottom distinctly visible. Toward the extremities of the shoal are several detached rocks in from 7 to 9 fathoms, with deep water between, and with a current setting over them W.S.W. one mile an hour; and with also a very confused heavy swell.

It is said that "A shoal with only 21 feet water upon it, was discovered by Jesse Ryder, master of the fishing schooner *Bethel*, on the Grand Bank of Newfoundland, in lat. 46° 30′, a rock of about 100 or 200 feet surface; about 50 miles East of the Virgin Rocks. Shoal bears from the Nine Fathom Bank S. by W. by compass about $1\frac{1}{2}$ mile: discovered it accidentally while searching for the Nine Fathom Bank, to fish on. I afterwards saw the Virgin Rocks." Page 574

SHIPS BOUND TO ST. JOHN'S are, therefore, recommended to keep on the parallel of 46°, or a degree and a half to the southward of the parallel of that port, and until they approach the outer edge of the Great Bank; and, when they obtain soundings, to steer directly to the north-westward for Cape Spear, the position of which is given as 47° 31′ N. and 50° $36\frac{1}{2}$′ W.; but see also pages 436—440.

ST. JOHN'S, the principal harbour of NEWFOUNDLAND, is an excellent one. The entrance is through the "Narrows," a strait running in a N.W. by W. direction about half a mile long, and 220 yards across in the narrowest part, with rocky precipitous heights of 500 feet on each side. There are from 9 to 12 fathoms of water in the middle of the channel, with tolerably good anchorage ground. The harbour then opens by a turn at right angles, and runs in a S.W. direction for a mile and a quarter, and in front of the City of St. John appears climbing up a hill, from Fort William to *Fort Towsend.* The ridge of the hills on the S.E. side of the harbour is 750 feet, and on the opposite side of the Narrows is a continuation of the same ridge, called *Signal Hill,* 510 feet high, on which is the citadel, to which place all vessels are telegraphed from Cape Spear on their first appearance off that place. On Fort Amherst on the South Head, at the entrance of the Narrows, is a brilliant fixed light. At two-thirds the distance from the entrance to the harbour itself, is a rock, on the north side, called the *Chain Rock,* which, with *Pancake Island* on the opposite shore, contract the entrance at this part; and between them a chain can be stretched when required, to prevent the entrance of any hostile fleet. In addition to this, the fortifications before mentioned, other batteries which command the entrance, and the *Crow's Nest,* a small battery perched on the top of pyramidal mount on the North of the entrance of the harbour, render the place perfectly secure against any sudden attack.

The entrance, as above stated, lies N.W. by W., and within will be found to narrow; as, in the inner part, there is a rock on each side, but above water. Here the breadth of the channel is only 95 fathoms, and the depth 9. When past these rocks you may run on boldly, without any fear of danger, only avoiding a rock on the south side, called Prosser's Rock, on which there are only 9 feet of water.

About 20 fathoms to the southward of the China Rock, which is always above water, is the Roby or Salisbury Rock, on which the U.S. steam-frigate *Niagara* struck after landing the electric cable in Trinity Bay. It is about to be or is deepened. The same with the Merlin Rock inside the entrance, which has been blasted to 27 feet least water.

Within the harbour you may anchor in any depth from 4 to 10 fathoms, landlocked from all winds, as the harbour within the Narrows lies W.S.W. It is, however, to be noticed, that there is no possibility of sailing in, unless with the wind from S.W. by S. to East. The wind from S.W. to N.E. by N., blows out of the Narrows. Here ships must then anchor, and warp in, for which purpose there are rings in the rocks on both sides.

" The entrance of St. John's Harbour is readily known by the block-house on Signal-hill on the North Head, and Amherst Fort (from which is shown a fixed light) on the South Head. There is a sunken rock, called the Vestal, 50 fathoms without South Head, with only 25 feet of water on it. This rock is about 10 fathoms long and 7 broad; the marks for it are, Fort William (which stands within the harbour on the north side) open of South Head, bearing N. 39° W.; and the outer Wash-ball Rock open with Cuckold's Head, bearing N. 47° E. The Wash-ball Rocks join the North Head; they are all above water and steep-to, therefore not dangerous. The course in the Narrows is N.W. by distance 370 fathoms, to *Chain Rock* on the North, and the *Pancake* on the South, side. Both these rocks are above water, and steep-to. Sixty-five fathoms within the Pancake Rock, on the South shore, lies the Little Pancake, a rocky shoal, dry at low water; and 80 fathoms within the latter lies like a sunken rock, called Prosser's Rock, running off 30 fathoms from a rock above water, in form of a saddle, with 18 feet of water in the hollow, and only 5 feet on the outside. It is steep-to, with 5 fathoms close to it. After you have passed Prosser's Rock, you may stand to either shore, as they are clear and steep-to. You may anchor in what water you please, from 8 to 4 fathoms, muddy bottom.

" The *tide* of *St. John's* sometimes rises 7 or 8 feet; it is not regular, but greatly influenced by the wind."—Mr. *Owen.*

NOTE.—" At half a mile S.E. ½ S. from Fort Amherst is the centre of a narrow bank, having 14 fathoms over it, and which breaks in rough weather. It extends nearly a quarter of a mile N.E. and S.W. and has on it, near each end, a depth of 20 fathoms.

" It is high water in the harbour, on the full and change, at $7^h. 30^m$. Spring tides rise 5, neaps 3½ feet."

Be very cautious, if unacquainted with the coast, that you mistake not the place called Quidi Vidi, or Kitty Vitty, a mile to the northward, for the harbour of St.

John's, as it shows an opening like a good harbour, but is fit only for boats, and not safe even for these at low water. Fort Amherst, which stands on the South head of St. John's, appears white, and it shows a brilliant fixed light by night, and the flag-staffs on the hill, over the North head, will point to the harbour of St. John's: besides these, the course from *CapeSpear* is N.N.W., and the distance about 4 miles. Cape Spear is indicated by a *revolving* light.

CAPE RACE LIGHTHOUSE is 40 feet high, and is striped red and white vertically. The light is a brilliant fixed light at 180 feet, visible 17 miles off. It is visible to seaward from N.E. by E. round southward to west. It stands close to the site of the old beacon, which has been cut down.

The land about Cape Race is comparatively low, and bare of wood, with a steep cliff of about 50 feet in height.

The lighthouse on Cape Race has and will doubtless prevent many wrecks, and remove the uncertainty of reckoning so often felt in approaching this land. It is, therefore, an important and safe landfall.

Cape Pine, with its iron lighthouse and revolving light, stands as is shown in the table in lat. 46° 37′, long. 53° 32′, and at a short distance westward of it is the famous (in former times) *St. Shot's Bay*, alluded to in the account of the wrecks in (271.) page 350.

The *currents* hereabout are described on pages 347—351; the *winds*, on pages 212, 213; and the *tides*, pages 249, 257.

A general description of the *Passages* and Sailing Directions towards Newfoundland, and past its South coast into the Gulf of St. Lawrence, are given on pages 437—440.

Full and complete directions for approaching the South-east coast of Nova Scotia, including Breton island, cannot well be given until the extensive banks which lie off it shall have been surveyed.

The aspect and nature of the different parts of the coast eastward of Halifax have been stated in the preceding chapters; but the distinctive features are often not easily perceived in the usual weather, and at the distance which the outlying dangers render it prudent for a vessel, uncertain of her position, to be kept from the shore. The lighthouses, however, on Cranberry and White Head Islands the beacon on Wedge Island, and the lighthouse on Beaver Island, afford great additional assistance to a stranger in ascertaining his position, when first making the land; as would also a lighthouse if placed on Egg Island. Vessels approaching Sambro Island lighthouse in a fog, and firing a gun, will be answered from the island, where a heavy gun, and a party of artillery are stationed for the purpose.

In the present imperfect state of our knowledge of the banks which lie off this coast, of the depth and nature of the soundings on them and between them and the shore, no further directions can be safely given to vessels approaching the land during a dark night, or in a thick fog, than not to go into a less depth than 40 fathoms, at the same time bearing in mind that there is that depth at a less distance than 3 miles from some of the most formidable of the dangers between Cape Canso and Halifax, as for instance the Jedore ledges; whilst 50 fathoms is near enough to the Sambro ledges, which have more than 40 fathoms water at distances of half a mile and one mile to the East and South of them respectively.

The principal banks lying off the south-east coast of Nova Scotia are the *Banquereau* and *Sable Island Banks*, which are each about 150 miles in length, and extend to an equal distance from the coast; but it has not yet been ascertained whether these may not be united, and form a single bank of double that extent, in a direction nearly parallel to the coast. Our knowledge of the extent, shape, and position of the smaller banks nearer the coast, including the Canso Bank, and of the nature of the soundings on and between them, is equally uncertain and incomplete.

Sable Island and its *Banks* have been described on page 636.

HALIFAX HARBOUR, one of the finest in the world, affords space and depth of water sufficient for any number of the largest ships with safety; and although the dangers off its entrance are such as to render great caution necessary, especially in the fogs which usually accompany all winds from the sea, it is yet easier of access and egress than any other large harbour on the coast. It is 5½ miles wide at its entrance, from Chebucto head on the south-west to Devil Island on the north-east, and it continues inland 15 miles, in a northerly direction, to the head of Bedford basin. The city of Halifax, the capital of Nova Scotia, containing in 1853 about 25,000 inhabitants, stands on the declivity of a peninsula on the western side of the harbour, and 9 miles within its entrance. The citadel, immediately in rear of the city, is elevated 227 feet above the sea at high water, and with its flagstaff forms a leading mark easily recognised from a vessel off the entrance of the harbour.

LIGHTS.—Two lighthouses stand on the eastern side of the entrance of Halifax harbour, one on the south-west point of Devil Island, at the eastern point of the entrance, and the other, named Sherbrook tower, on the West extremity of Maugher beach, at 4½ miles within the entrance.

The lighthouse on Devil Island is octagonal, built of wood, and painted brown with a white belt. It exhibits at 45 feet above high water a *fixed red* light, visible in clear weather from a distance of about 8 miles,

Sherbrook tower, on the west end of Maugher beach, is 48 feet high, circular, and painted white with red roof. It exhibits at an elevation of 58 feet above high water a *fixed white light*, visible in clear weather at 12 miles. It bears from the Thrumcap buoy N. by W. 2¼ miles.

PILOTS are stationed on Devil Island, and several families reside there.

DIRECTIONS.—The coast in the vicinity of Halifax is of moderate height, the hills near the shore being seldom 200 feet above the sea. To the eastward of the harbour, as far as Jedore, almost all the headlands present cliffs of reddish sand, clay, and boulders to the wasting action of the waves; whilst to the westward, as far as Mars head, granite rocks nearly white predominate. Hence the remark, that, "in standing in for the land, you may know on which side of Halifax harbour you are, by a remarkable difference that exists in the colour of the shores, which, if red, denotes that you are to the eastward, and if white, to the westward of the entrance."

The bank off Sambro Island, terminating in a point, and at the depth of 30 fathoms, 5 miles South of the Sambro ledges, offers considerable assistance to vessels approaching Halifax from the westward in the thick fogs which so frequently prevail. From the eastward the approach is rendered comparatively easy, by the absence of outlying dangers after passing Shut-in Island, and by the soundings deepening out with tolerable regularity to 30 fathoms, at distances varying from 4 to 6 miles from the shore, until within 2 miles of Chebucto and White Heads, where the depth exceeds 30 fathoms, until within one-third of a mile from the shore. Attention to these soundings, combined with the guns fired from Sambro lighthouse island, may enable steamers at times to enter the harbour notwithstanding the fog, but it is seldom prudent for a large sailing vessel to attempt it under such circumstances.

From the Westward at Night.—In approaching Halifax harbour from the westward at night, shape a course to pass not less than 3 miles to the southward of the Sambro Island light, steering E.N.E., and in not less than 30 fathoms water, until the light bears North; when, if not more than 6 miles from it, the vessel will have arrived at the southern prolongation of the Sambro Bank. Having crossed the bank into deep water, haul up N.N.E., until the light on Maugher beach opens out East of Chebucto head, bearing N. by E., when steer for it, or so as to pass within a mile or less from Chebucto head, which is quite bold. Having done so, keep the light bearing between North and N. by N. as the vessel runs towards it, and all the dangers will be avoided excepting the Neverfail shoal, on which there is not less than 4¼ fathoms.

Having arrived abreast the Thrumcap, or brought Devil Island light in line with its South extremity bearing E.S.E., alter course to N. by W., or as may be necessary, to avoid the Lighthouse bank; and as soon as the light on Maugher beach bears East, steer N. by E. for Ive's Point (or N.N.E., if necessary, to avoid the Middle ground, on which, however, there are not less than 4½ fathoms), until the light bears S. by E.; then a N. by W. course, keeping the light astern, will lead between the Pleasant shoal and Reed rock white buoys on the one side, and Ive's knoll red buoy on the other into the harbour. Having passed Ive's knoll, the vessel may proceed in on either side of George Island, or may anchor in the stream of Macnab Island until daylight, according to circumstances. The light on Maugher beach disappearing behind Ive's point, will show the vessel's distance from George Island, as she runs in to the eastward of that island, which is the wider and preferable channel in a dark night.

Within George Island there is nothing in the way, excepting the Dockyard shoal, and the shallow water off Dartmouth.

By Day.—Approaching from the westward in the daytime, passing Sambro lighthouse island at the distance of 3 or 4 miles, and when Sandwich point opens out East of Chebucto head, stand in N. by E. or N.N.E., according to the wind, until the citadel flagstaff opens East of Sandwich point, bearing N. ½ W. Keep the citadel flagstaff only just open, running towards it, and it will lead between the Lichfield and Neverfail shoals, and up to Mars rock white buoy, which leave to the westward. Having passed Sandwich point, from which the shallow water does not extend beyond a cable's length, steer towards George Island, keeping Chebucto head only just in sight East of Sandwich point until the vessel has passed close to the westward of the Middle ground; then open out the head more, so as to leave the Pleasant shoal and Reed rock white buoys to the westward, in running towards George Island: or, if it be preferred, the steeple at Dartmouth in one with the eastern side of George Island, bearing North, will lead to the eastward of the Middle ground. Either of the marks just given will lead clear up to George Island, on either side of which the vessel may pass into the harbour, leaving the Belleisle and Leopard buoys to the westward, if she passes between them and the island, and choosing her anchorage off the wharves of the city, or off the dockyard, where the Commissioner's buoy will point out the Dockyard shoal.

From the Eastward by Night.—Approaching from the eastward by night, and being to the westward of the Jedore ledges, run along the land in a depth not less than 30 fathoms, until the *fixed white* light on Sambro Island is seen; then, if it be intended to pass to the southward of the Rock Head and Portuguese shoal, steer for Chebucto head (remembering that, to clear the Rock head, the light on Sambro Island must be kept wide open to the south-east of White head, bearing nothing to the southward of S.W. by W.; and the *fixed red* light on Devil Island nothing to the eastward of N.E. by N.), until the light on Maugher beach bears North; when steer for it, keeping it bearing between North and N. by E., and proceeding as already directed.

By Day steer for Chebucto head until the citadel flagstaff is only just open East of Sandwich point, bearing N. ½ W.: then steer for it, and proceed as before.—*Admiral Bayfield.*

If the wind should make it advisable to enter between the *Rock Head* and *Thrum Cap Shoals*, and having passed Shut-in Island, steer W. ½ S. from ½ to 1 mile South of the *red* light on Devil Island, until Maugher Beach light bears N., then steer for it until abreast the Thrum Cap; then alter course to N. by W., or as may be necessary. *By day*, pass the same way, keeping Graham Head well open South of Devil Island until George Island opens out West of Maugher Beach lighthouse, then steer for it N. ½ W. until abreast of the Thrum Cap, then edge away westward.

From Halifax, westward, to Margaret Bay, the country appears, from the offing, very rocky and broken; the shore is steep-to, and bounded with white rocky cliffs. The high lands of Aspotogon, on the eastern side of Mahone Bay, are most remarkable; the summit is very conspicuous; it is 483 feet high, and may be seen at the distance of 7 or 8 leagues. Proceeding westward from Mahone Bay, the rocks which surrounded the shore are black, with some banks of red earth. *Cape le Have* is an abrupt cliff, 107 feet high above the sea; it is bald on the top, with a red bank under it, facing the south-westward. Between this Cape and Port Metway there are some hummocks within land, about which the country appears low and level from the sea; and on the shore, white rocks and stony beaches, with several low bald points; hence to Shelburne Harbour the land is woody. About the entrance of Port Latour, and within land, are several barren spots, which, from the offing, are easily discerned; thence, to Cape Sable, the land appears level and low, and on the shore are some cliffs of exceedingly white sand, particularly in the entrance of Port Latour, and on Cape Sable, where they are very conspicuous from sea.

Baccaro Point, which is the western point of Port Latour, with its *revolving light*, is useful by night in indicating the vicinity of the dangerous Brazil Rock, presently noticed.

From Sambro' lighthouse to Cape Sable extremity, the bearing and distance are W. by S. ¾ S. 112 miles.

Cape Sable is the cliff of a sandy islet, distinct from the former; it is white, broken, evidently diminishing, and may be seen at the distance of 5 leagues. From this islet ledges extend outward, both to the East and West; the eastern ledge, called the *Horse-shoe*, extends 2½ miles S.E. by S.; the western, or *Cape Ledge*, extends three miles to the S.W. The tide, both ebb and flood, sets directly across these ledges, the flood westward. The ebb, setting with rapidity to the N.E., causes a strong break to a considerable distance from shore. This coast should not be approached without a commanding breeze and clear weather. Here the tide runs at the rate of three, and sometimes four, knots; and when the wind blows fresh, a rippling extends from the breakers southerly to the distance of nearly three leagues, and shifts its direction with the tide; with the flood it is more westerly, and inclines to the eastward with the ebb. This ripple may be dangerous to pass through in a gale, as it has all the appearance of high breakers, although there is no less than 8, 10, 12, and 20, fathoms of water, rocky ground. At the Cape, the tide, on full and change, flows at 8^h., and rises 9 feet.

Brasil Rock is a flat rock, covering an area of about ten yards, and having 8 feet over it, at low water, in calm weather; within a hundred yards from its base are from 6 to 8 fathoms of water. To the southward, at about a mile from the rock, the depths are from 30 to 55 fathoms; but toward the shore the soundings are regular, 15 and 19 to 20 and 24 fathoms, sandy bottom. The tide, by running strongly over the shoal ground, causes a great ripple, and makes the rock appear larger than it really is. From Cape Negro the bearing and distance to the rock are *S.S.W.*, *true*, or or S.W. ½ S. by compass, 10 miles; from the rock, Cape Sable bears *W. by N. ½ N.*, *true*, or N.W. by W. by compass, 8½ miles, and from Cape Baccaro lighthouse it bears *N. ¾ W.*, *true*, or N. by E., magnetic, 5 miles. Its given position is, latitude 43° 21′ 30″, longitude 65° 27′.

Seal Island.—The southernmost point bears from Cape Sable nearly W.N.W. ½ W. 16 miles. The *lighthouse* stands half a mile from the South end, showing a fixed light at 98 feet.

At about two miles S.S.W. from the lighthouse on Seal Island lies the *Blonde*, a rock uncovered at low water, on which the frigate of that name was lost in 1777. Close around it are from 7 to 10 fathoms. Within a mile westward from the Blonde are heavy and dangerous overfalls, which present an alarming aspect. At 4½ miles north from these is a bed of shoal ground, of 16 feet, causing a violent ripple.

Off the West side of Seal Island is the rocky islet called the *Devil's Limb*, which may at all times be seen.

The navigation of the Bay of Fundy, with its furious tides, requires extraordinary caution, and any space we could afford here would be of little service in explaining its nature.

The Coast of Maine, also, is so intricate, its inlets so numerous, and fronted by almost innumerable rocks and islets, that a lengthened description would only suffice to explain its character. The outlying rocks of *Mount Desert* and *Mutinicus*, marked by lighthouses, will well show the outer limit of this labyrinth, and further description will be found in the "Colombian Navigator," vol. 1.

BOSTON.—From Seal Island lighthouse to the entrance of Boston Harbour, the direction and distance are W. ¼ S. 220 miles, but it should be remembered that the dangerous rock on *Cashe's Ledge* is just to the northward of this course.

The lighthouses of Cape Anne, and those on the Cape Cod peninsula, described in the list, are the most prominent points in approaching Boston.

From about a league off Cape Cod, the course to the granite lighthouse on the outer Minots Ledge is N.W. by W. ¼ W., and the distance 28 miles, and from thence to Boston lighthouse N.W. ¼ W. 5 miles. The lighthouse, which is 82 high, stands on a small island at the north side of the entrance of the channel. Those making the Light, and unable to obtain a pilot, may bring it to bear W.N.W., and run boldly for it, until within a cable's length, then steer W. by S. until in 5 fathoms, where there is safe anchorage.

When you make the light with a fair wind, bring it to bear W. by N. or W.N.W., then steer for it until you are within two cables' length distance. Come no nearer to it, but run in until it bears N. by E.

With adverse weather, and you cannot get a pilot from the lighthouse, after bringing it to bear N. by E. as above, you may run W. by S. two miles, until the *light* on the N.E. end of Long Island bears N.W. by N. Then steer N.W. about one mile, or until the outer lighthouse is hid by George's Island, where you may anchor in safety, in *Nantasket Road*, and in from 5 to 7 fathoms.

If the wind be contrary, you may stand to the southward till you bring the outer light to bear W.N.W., and to the northward till it bears W.S.W., until you come 3 miles of it; then you must not stand to the northward any further than to bring the light to bear W. by N., nor to the southward than till it bears W.N.W.; you may safely anchor in the bay, if the wind be off the shore.

From off Cape Anne to Boston lighthouse on Great Brewster Island, your course is S.W., and the distance nearly 8 leagues. The Lighthouses at Cape Anne stand on Thatcher's Island. To go clear without Thatcher's Island Ledge, you must keep about 3 miles distant from the lighthouse. In thick weather a gun will be fired from the lighthouse, to answer any signal which may then be made.

When you proceed from Cape Cod to Boston Bay, with a flood-tide, you should steer about one point to the northward of the course already described, because the fluid sets into Barnstaple Bay. This precaution is the more necessary when the wind is northerly. Similar care is requisite in steering from Boston Bay to Cape Cod.

Until you advance to within two leagues of Boston Lighthouse, you shoalen your water from 35 to 19 fathoms. The soundings are irregular. On the Cape Anne shore the bottom is rocky; but, towards Cape Cod, it is of fine sand.

On the days of the full and change of the moon, it is high water off Boston Lighthouse at ten o'clock. It flows off the town till a quarter of an hour after eleven. The spring-tides rise 16 feet perpendicularly; neap-tides, 12 feet.

To Sail in during the Night, or turn within the Lighthouse Anchorage.—Coming from sea in the night, bring the lighthouse to bear West, and steer for it observing to incline your course southerly as you approach, in order to give a berth of two cables' length to the Lighthouse Island. When you are abreast of the light, shape your course West, until it bears from N.N.E. to N.E. Here, if not acquainted with the harbour, you may anchor till daylight. With the wind between the S.W. and N.W. quarters, a ship may, in great safety, turn up within the Lighthouse anchorage, taking care not to stand further southward than to bring the light to bear W.S.W., nor further northward than N.N.W.

Boston Harbour.—Off the entrance of the harbour is a small shoal, called the *Cod Bank*, which lies E. by S. nearly three miles from the lighthouse, and in the fairway of the harbour, with Point Alderton and the north sides of the two islands within it nearly in a line, W. ½ S., and the S.W. ends of the two outer islands on the north side, in a line, bearing N.W. ¼ W.

On the South, or port side of the entrance, are *Harding's Rocks*, a cluster steep-to, and which lie at the distance of 2¼ miles S.E. from the lighthouse. At low water the largest rock shows itself about twenty feet long and four feet high. It is surrounded by smaller blind rocks, extending about 140 fathoms on all sides. The marks for the largest are the S.W. point of the Lighthouse Island and western point of Great Brewster Island in one, and Nahant Rock, nearly N. by E. a small ship's length open with the S.W. end of the rocks called the Graves. A *white boy* is now laid on the N.E. side of the Harding's, which is, on entering, to be left on the port hand.

Alderton Shoal extends in a northern direction from the bluff head of Point Alderton, on the South side, and about one-third over. There is a *red buoy* on the outer part of this shoal, which bears from the white buoy of the Hardings N.W. by W. ¼ W. one mile and a half.

The *Egg Rocks* are a cluster, above water, on the North side, at the distance of half a mile E. by N. from the lighthouse on Brewster Island.

The *Beacon* on the S.W. end of the Spit of Great Brewster Island stands at the distance of a mile and a quarter W. ¾ S. from the lighthouse. It marks the entrance of the NARROWS*, which lie between Lovell's Island on the East, and George's Island, with Gallop and Nick's Mate Island. on the West. On the north side of the Narrows is a *red* beacon light.

The *Centurion*, a rock of eleven feet at low water, lies at nearly half a mile S, ¾ W. from the bacon, and is left, on entering the Narrows, on the West or port side. It lies with the S.E. points of Great Brewster and outward Brewster Isles in a line, and one-third of Nick's Mate Island shut in with the east side of George's Island.

From the S.E. side of George's Island a rocky bank extends to the distance of more than a quarter of a mile, and has on its extremity a black buoy. The entrance of the Narrows lies between this buoy and the Beacon Point.

On *Nick's Mate Island*, at the other end of the Narrows, upon the western side, is a *baacon*, or monument; and upon the northern part *Long Island*, nearly a mile to the westward of Nick's Mate Island, is a *lighthouse*.

On coming inward, direct from the East, for Boston Harbour, the proper parallel, if it can be kept, is 42° 20′ N. The Cod Bank, already described, lies in 42° 19′ 40″. If a ship should happen to fall to the southward of the harbour, care must be taken to avoid the *Cohasset Rocks*, which lie at some distance from the land, five miles to the south-eastward of Point Alderton. On the outer one, called *Minot's Ledge*, as the lighthouse on it as above described. From this lighthouse the course to Boston Harbour is N.W., distance two leagues. In running thus, you will pass the white buoy on Harding's Rocks, and may thence haul up to the westward, passing between the Lighthouse Island and the red buoy on Alderton Shoal.

From the middle of the Lighthouse Channel steer W. by N. one mile, to the beacon on the Spit, to which you may approach within one quarter of a cable's length, leaving it on the starboard hand, while the Centurion Rock and black buoy on the shoal ground of George's Island are left on the port. Having thus entered the Narrows, the Course up to Gallop Island Point is N.W. by N. three quarters of a mile; and thence through, by Nick's Mate, N.N.W. half a mile. The beacon on Nick's Mate may be left on the port hand, at the distance of a cable's length.

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* In 1830 a singular discovery of a *dangerous sunken rock* was made nearly in mid-channel of the Narrows. It has from 15¼ to 17 feet at low water, and doubtless has picked up many vessels. False Spit beacon bears E. ½ N. from it: The Narrows Lighthouse N.E. ¼ N., and Nick's Mate beacon N.W. ½ W., and are one with Boston Lighthouse.

From Nick's Mate, the course for Castle Island, through the main channel is W. by N. three miles. In running thus you will first leave a *white spar buoy* on the Lower Middle Ground upon the starboard hand, which buoy is a mile below Castle Island.* You will next see a *white buoy* upon the Castle Rocks, which lies in 2 fathoms, on the port.

When abreast of the castle, steer N.N.W. one quarter of a mile, to clear the Upper Middle Ground, which has a black buoy on it, in 2 fathoms, to be left on the port hand. Should this buoy happen to be taken up, run N.N.W. until the two northernmost steeples in Boston are a handspike's length open; a course then N.W. by W. 2 miles, will bring you up to the town.

Broad Sound is the northern entrance of Boston Harbour, but is not a proper channel for large vessels. Without its entrance are the *Graves*, a cluster of rocks appearing white, and which lie in latitude 42° 22′ 30″: these may be left on the port hand, at the distance of two cables' length. Bring them to bear S.E., and run on S.W. by W. This course, for four miles, leads up to the lighthouse on the north point of Long Island, described above.

Nantucket Shoals.—These very dangerous shoals, lying immediately in the line of traffic of the coasting trade of the United States, have been but very little known till within a very few years; and then their limits were first more exactly defined at the expense of a private individual, Mr. E. M. Blunt, of New York. These "Goodwin Sands" of the United States now, however, appear tolerably well examined, though still some doubt has been expressed as to whether their entire extent has been ascertained, by the United States Coast Survey, chiefly by Lieutenant Charles H. Davis, United States Navy. The danger of these formidable shoals is much reduced by the new lighthouse on *Sankaty Head*, completed in 1849. This tower is 70 feet high, painted in three horizontal rings, and shows a dioptric flashing light every 1½, 1½, and 3 minutes, at an elevation of 150 feet, consequently visible from Davis South Shoal.

The Old South Shoal has from 6 to 18 feet water on it, and is 2½ miles in exteut. From its centre Sankaty Head bears *N.* 22° *W.*, *true*, or N. by W. ¼ W. by compass; distant 12½ miles.

From the middle of the *New, or Davis' South Shoal*, discovered in 1846 (8 to 18 feet, 1½ miles in extent), the middle of the Old South Shoals bears *N.* 4° *E.*, *true*, or N. by E., mag., distant 6¾ miles. No part of Nantucket Island is visible from it in the clearest weather, but the Sankaty light may be seen.

The Light-vessel which lies nearly 2 miles to the south of Davis' South Shoal marks the limit of dangers in this direction. She lies in 14 fathoms, in latitude 40° 56′ 30″ N., long. 69° 52′ 30″ W. The shoal soundings, however, do not cease here for a spit with 8 to 10 fathoms extends for about 7 miles further South.

Within the Old North Shoal there are very many dangerous patches, which can be best described in the chart, but to the eastward of Nantucket Island, in October, 1849, six shoals, of small extent, but not the less dangerous, having from 9 to 14 feet, were discovered and placed by Lieutenant-Comm. M'Blair to the northward of these. They lie generally about *East, true*, from the Great Point light of Nantucket Island, at distances varying from 9½ to 11½ miles off. They are sharp, abrupt ridges of fine white sand, which are readily discovered by the rip of the tides at all times, except at slack water, but by daylight the exhibit the usual discoloration.

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* The American Coast Pilot also says, The Lower Middle Ground, which lies on the north side of the channel, a little above Spectacle Island, and which is in part dry at low water, has on its eastern part a red buoy, and on the western point a black buoy, in two fathoms; to be left on the port hand.

To the southward of M'Blair Shoals, a line of breakers and shoal patches, called the *Great Rip*, extends to lat. 41° 2'. To the East of the southernmost of these patches, with 9 feet water, a buoy-boat is moored. At 2½ miles East of this is another long shoal, *Davis' Bank*, discovered in 1848, on which there are only 3¾, 4, and 5 fathoms for 5 miles. Beyond this the depths are 15 to 20 fathoms till we reach the outermost shoal known at present, the *Fishing Rip*, a line of shoal paches, with 4 to 9 fathoms on it, between 41° and 41° 10'.

It would seem as if this labyrinth of shoals would scarcely ever be known, for in 1860 the *Asia* discovered a line a line of 10 fathom patches 15 miles S.S.E. of the tail of the Fishing Rip, where the water was supposed to be deep.

The main body of the flood tide runs to the eastward, the ebb to the westward. The currents always run across the line of directions of the shoals, and are much more rapid during their passage. This makes a near approach particularly dangerous on the side toward which the tidal current is setting.

The current is never still. During what is called slack-water, the velocity is rarely less than half, sometimes more than 1 mile. A careful attention to currents is important in this vicinity.

It is high-water, full and change, at XII^{h} 4^{m}, mean rise and fall 3 feet 2 inches.

From the Nantucket Lightship to *Montauk Point Lighthouse*, at the East point of Long Island, the bearing and distance are W. by N. 91 miles. From Montauk Point, the South coast of Long Island trends W. by S. ½ S. for 32 miles, to Shinnecock Bay, in the rear of which is a high lighthouse, 150 feet high, showing a fixed light. From hence to the Fire Island inlet, at which there is another high lighthouse, with revolving light, is W. by S. ¼ S. 34 miles, and from hence to Sandy Hook is W. ¾ S. 37 miles.

NEW YORK.—The lighthouses and light-vessel which indicate the entrance to New York Harbour, are described in the table. The chart of the approaches is the best guide, both for the depth and quality of bottom, and Lieutenant Maury has founded an elaborate description on its indications which cannot be quoted here. The water shoalens gradually towards Long Island, but is deepest at the East end, where 20 fathoms is found at 9 miles off, while at its west end this depth is only to be got at 25 miles off. This circumstance is a good guide. There is another singular feature which may mislead if not known. There are about seven deep holes lying in a south-east direction from Sandy Hook, which have from 10 to 15 fathoms more water than immediately around them; but the outermost is in lat. 39° 37' N., long. 72° 25', and has 145 fathoms, nearly 100 fathoms more than surrounds it, and 15 miles within the 100 fathom line. The others are known as the 38, 37, 37, 32, 21, and 23 fathom holes. This range of holes, with the light-boat at one end, and the 38 fathom hole at the other, is 55 miles long and 14 miles broad at the outer end, and 2 miles at the inner end. This will, by careful attention, afford a good guide.

When Block Island bears N., distant 4 or 5 leagues, you cannot see any land to the northward or eastward; but as you approach the island, you see Montauk Point to the westward, making a low point to the eastward, on which is a lighthouse. In sailing W.S.W., you will make no remarkable land on Long Island, from the eastward of said island to the westward, its broken land appearing at a distance like islands; but may discover Fire Island light-house, which shows a revolving light. From Fire Island light, a shoal extends south three-fourths of a mile, on which the flood tide sets very strong. It is not safe to approach the shore nearer than 2 miles when the light bears to the E. of N. To the eastward of the light the shore is bold. When Fire Island light bears N.. in 10 fathoms water, you may steer W. by S., which will carry you up with Sandy Hook light. The quality of the bottom is various, viz., yellow, red, brown, blue, and grey sand, within short distances. About South from Fire Island, 33 miles distant, and 40 miles S.E. by E. from the Highlands, lies a bank, extending from N.E. by E. to S. W. by W., having on it from 10 to 14 fathoms, pebbles. Within this, a short distance, you will get 20 fathoms, when it shoals into fathoms, grey sand, which depth you will carry till you get into what is called the Mud Hole, where are from 20 to 36 fathoms water, marl or green ooze, and sometimes pebbles, the deepest part of which bears East from the northernmost part of the Woodland, 10 miles; and S.E. ½ S., 15 miles from Sandy Hook light. From the Mud Hole to the bar of Sandy Hook the water shoals gradually, as laid down on the chart.

You will have 20 or 22 fathoms water out of sight of the land, sandy bottom in some, and clay in other places. Before you come in sight of Sandy Hook lighthouse, you see the Highlands of Neversink, with its lighthouses, which lie W.S.W. from Sandy Hook, and is the most remarkable land on that shore.

If you fall in to the southward, and make Cape May, on which is a lighthouse exhibiting a flashing light, it would be prudent to keep about three leagues off, to avoid Hereford Bar, which lies from 4 to 6 leagues from the cape to the northward, and 8 miles from the inlet of that name. This inlet is frequented by the Delaware pilots, having no other harbour to the northward until they reach Egg Harbour. After passing Hereford Bar, you may steer N.E. when in 10 fathoms water, taking care that the flood tide, which sets very strong into the inlet, does not draw you too close; this course continued will carry you up with Egg Harbour; you will then have fine white and black sand, intermixed with small broken shells; by continuing the same course, you will deepen your water, and so continue till you draw near Barnegat Inlet. [In running along the shore, do not steer to the northward of N.E., if in 10 fathoms water or less, as you will be apt to get on Absecom Shoals, or Egg Harbour Bar.] On the South side of Barnegat Inlet, a lighthouse, showing a revolving light, is erected, off which you will get bright coarse yellow gravel. The shoal off Barnegat does not extend beyond two miles from the beach, and is steep-to; you may turn this shoal in 6 fathoms water, within pistol shot of the outer breaker. It would always be prudent to keep in 9 or 10 fathoms water during the night, and not steer to the north of north-east, unless certain of being to the north of the shoal.

The soundings are so much to be depended on, that the moment you lose the above soundings you are past the shoal, when you will have fine black and white sand, and very hard bottom; you may then haul in for the land N. by E., which course will bring you along shore in from 15 to 17 fathoms water, but if the wind and weather permit, I would recommend hauling in N.N.W., which will bring you in with the southernmost part of the Woodlands, which is very remarkable, having no other such land in the distance from Cape May up to the Highlands, and can be distinguished by its being very near the beach, and extending to Long Branch.

In passing from Barnegat to Sandy Hook, when to the southward of the lights on the Highlands, you must not open the northern light (which is a fixed light) to the westward of the southern light (which shows a revolving light), as that will bring you too near the Jersey shore.

As a number of vessels have been lost, bound into New York, from heaving to with their head on shore, we cannot too strongly urge on the shipmasters the necessity, *if he is in doubt of his position, of heaving to with the head off shore.*

Directions for proceeding onwards into New York Bay must be left for more extended works and to the assistance of pilots.

SANDY HOOK to the DELAWARE.—To the valley at the foot of the Highlands of Navesink succeeds a tract of low table land, and southward of this is a considerable and remarkable tract of Woodland, which terminates at 6 leagues S. by W. from the Navesink lighthouses; next follows an extensive lagoon, named Barnegat Sound, which is fronted by a narrow strip of low land. The coast from the Highlands of Navesink to the elbow of an island, called *Barnegat Long Beach*, trends nearly *S. by W. true* 38 miles, and the soundings regularly decrease toward shore from 12 to 7 and 5 fathoms.

In the parallel of 39° 48' is the *Inlet of Barnegat*, or the entrance of Barnegat Sound. On the South side of it is a red and white lighthouse, 160 feet high, with a *revolving light.* A shoal bar extends outward from this place to the distance of two miles, and the bottom is an admixture of mud, shells, and gravel. The outer edge of the shoal is steep-to, and you may pass it in 6 fathoms within a short distance from the outer breaker; but, during night, keep at least in 9 or 13 fathoms. The soundings more to the northward in these depths are fine white sand, with very hard bottom.

Barnegat may be readily known in the day, even when the breakers are not seen, as there is a long grove of wood, back in the country, apparently 3 or 4 miles long, directly within the Inlet, and commonly called the *Little Swamp*. With the North end of this land directly abreast, you will be to the northward of Barnegat.

Between the elbow of Barnegat Long Beach and Cape May, at the mouth of the Delaware, the coast forms a gentle concavity, but its general trend is nearly S.W. ½ S. and the distance 18 leagues. The land is, generally, low and broken, forming several islets and inlets. The soundings are regular, commonly 8 to 10 fathoms at 2 leagues from shore; but there is a sand bar at every inlet, several of which extend off to a considerable distance.

LITTLE EGG HARBOUR, in the parallel of 39° 28′, long. 74° 19′, is a small harbour formed by low isles or beaches on the east, and by salt marshes on the west. It is known as the port of *Tuckerton.* To a stranger this harbour cannot be recommended, unless as a retreat in case of emergency, several shoals about the entrance being dangerous; yet it has frequently served as a place of shelter in the winter, when violent N.W. winds have prevented vessels from entering the Delaware or New York Harbour.

Absecum Inlet, at the distance of six miles S.W. from Little Egg Harbour, is another harbour which affords shelter to vessels of easy draught. A lofty tower, 150 feet high, on the south side of the inlet, shows a *bright fixed light.*

The shoal water extends at least 2 miles off shore at Absecum Inlet and at 2½ miles E.S.E. of the lighthouse is a 3 fathom shoal.

In sailing between New York and the capes, if the wind should be in the northwest quarter, with which, in general, is clear weather, keep no further off than to 10 fathoms; the nearer in-shore the stronger the current, which sets about one mile in an hour. The tide of flood runs W. by S., and the ebb E. by N., but you will have no tide till further off than in 8 or 9 fathoms.

If you are turning, with the wind to the westward, stand off no further than to 18 or 20 fathoms of water. You may venture to stand in-shore into 6 fathoms, until you advance towards Hereford Creek, or about two leagues to the northward of Cape May.

The greatest danger to a ship cruising hereabout is the shoal called the *Five Fathom,* or *Cape May Bank,* and lying at the distance of 4 to 5 leagues East to E.S.E. from Cape May. Much of the danger is averted by the *Lightvessel,* showing fixed lights, which is moored in 12 fathoms outside of it.

DELAWARE BAY.—CAPE MAY and CAPE HENLOPEN, the two extremities of the estuary called the DELAWARE RIVER, bear from each other S.W. by S. and N.E. by N., 10 miles distant. Each is distinguished by lights at night. A great tract of Overfalls and broken ground, southward of Cape May, is two leagues in extent; the depths over them are from 5 to 15 feet. These shoals form the two channels into the river, of which the chief, between the shoals and Cape Henlopen, is nearly 5 miles in breadth.

CAPE MAY Lighthouse is on the extreme S.W. point of the cape. At present it shows a fixed and flashing light, but a new tower intended, of 150 feet high, will show a revolving light, and bears N.E. by N. about 11 miles from Cape Henlopen light.

CAPE HENLOPEN Lighthouse is of an octagonal form, handsomely built of stone, 72 feet high, and its foundation is 118 feet above the level of the sea. The lantern is between 7 and 8 feet square; the light is *fixed*, and may be seen at 20 miles off, if the weather be clear.

At the distance of three-quarters of a mile from the Cape Henlopen high light, and near the sea, is a *fixed* beacon light, of small power, 35 feet high. The two lights in range is the leading mark for carrying vessels into the Roads, within the cape.

To Enter the Channel by Cape Henlopen.—The course in the fairway between Cape May and the light-vessel, which has been described, is S.W. until the lighthouse on Cape Henlopen bears West. Then steer for it in the latter direction, and within two miles from it you will have 14 or 15 fathoms of water; having passed it, you may steer W.N.W. until you bring it to bear E.S.E., when you may anchor in *Oldkiln* Road, in 3 or 4 fathoms.

The Beacon Light on Cape Henlopen, already noticed, exhibits a brilliant light that can be seen at six leagues off. It stands on the extreme north end of the cape, very near the beach, and bears N. ¾ W. three-quarters of a mile from the high light. Vessels running in for Oldkiln Roads, may, when the beacon light and lighthouse are in one, approach the former within a cable's length, then steer W.N.W. until the high light bears S.E. and anchor in 4 fathoms, good holding ground.

The estuary of the Delaware for 70 miles from the sea, has no safe natural harbour, and to remedy this defect the General Government of the United States have constructed a magnificent *breakwater* within Cape Henlopen, forming a safe artificial harbour. On the N.W. end of the breakwater there is a lighthouse, showing a fixed light, with a flash every ¾ of a minute.

In approaching from sea, and going in by the south passage, give the beacon-light on the pitch of the cape a berth of from 4 to 500 yards, and when you bring the west end of the breakwater to bear N.W., steer for it, and anchor in a line between it and the government house on the beach, as close to the works as you can with safety; the light on the west end bearing about N. or N. by W. There is no difficulty, with common attention, in running into the anchorage to the south of the breakwater, even in a gale of wind, either between the two works, or by the passage to the S.E. of both.

Vessels bound from the Delaware to the Chesapeake should, in order to avoid the *Hen and Chicken*, &c., which run to the S.W. of Cape Henlopen, steer out with the lighthouse of Cape Henlopen E. by S., to the distance of ten miles, (the beacon light in range with the light on the breakwater will lead you on the edge of the Hen and Chicken). They may thence, with an off-shore wind, pursue a S. by W. course for 13 leagues, which will clear the Gull Banks on the west. Thence S.S.W. ½ W., 20 leagues, leads to the parallel of the light on Smith's Island; and the same course continued, eight leagues further, brings you in sight of the light on Cape Henry, presently described, and bearing W.N.W. In order to avoid the tail of the *Middle Ground*, you run in with the light in that direction, and round the point into *Lynhaven Bay*, or proceed upward, as hereafter directed.

In proceeding along these coasts, during easterly winds, great caution is requisite; as with such winds the weather is generally hazy, and the coast obscured. The current will generally be found setting to the S.S.W., in the direction of the shore. The drift of several current bottles have demonstrated this.

On the courses above prescribed, the soundings will be found to vary from 11 to 15 and 16 fathoms, until approaching Cape Charles, where from 9 to 8 fathoms may be found. At ten miles E.S.E. from Cape Henry, are from 10 to 12 fathoms, which depths continue in a W.N.W. direction to the Cape.

The Coast of Delaware, south of Cape Henlopen, is nearly a straight line running due *South, true*, for 11 miles, to *Indian River Inlet*, and 10 miles further to the boundary between Delaware and Maryland. It is very low, broken into long narrow islands, with off-lying shoals to the distance of 1 to 1½ miles.

Fenwick Island Lighthouse, which stands on the state boundary, in lat. 38° 27′ shows a bright fixed light, with a flash every two minutes, from White Brick tower.

South of the parallel of 38°, the shores appear in numerous islets, drowned land, and inlets, into which craft only can be admitted; and it so continues to Cape Charles, at the mouth of the Chesapeake. There appear, in all this extent, no other distinguishing marks which can be useful to a stranger, until we arrive in latitude 37° 13′, where a revolving light marks the north end of *Smith's Island,* as will be presently noticed.

Matomkin and *Machi-Pongo* are very dangerous harbours in a gale of wind; but you may ride along shore with the wind from N.W. to S.W. When the wind blows hard at N.E. or E.N.E., and you are in sight of Chincoteague Shoals, your only chance for safety is to stand to the southward, for you cannot clear the land to the northward.

The COAST of MARYLAND, south of this as far as Chincoteague Inlet, in lat. 37° 54′, is still a low, straight coast, curving towards the west, and off it are some *dangerous shoals,* whose character and position have been ascertained by the U. S. coast Survey in 1852.

Fenwick's Island Shoal.—The centre of this shoal is in 38° 27′ 30″ N. latitude, and in 74° 56′ 09″ W. longitude. It is about 2 miles long, running from S.W. to N.E. The least water on it is 15 feet. It bears (S.E. by S.) distant 11 miles from Indian River Inlet, and E. $\frac{1}{2}$ N. from Fenwick's Island Lighthouse. On the seaward side, the soundings change suddenly from 10 to $2\frac{1}{2}$ fathoms, and there are 10 fathoms about 2 miles West of this shoal which appears to be extending on the West side and towards the North.

Isle of Wight Shoal, on which there are but 3 fathoms water, lies 4 miles S. $\frac{1}{2}$ E. from the centre of Fenwick's Island Shoal. It is nearly $6\frac{1}{2}$ miles East of the beach, and bears East from Isle of Wight woods. There are 10 fathoms water within a mile on either side of this shoal.

Midway between these two shoals there is a spot with $3\frac{1}{2}$ fathoms water on it.

At 9 and 11 miles South of the lighthouse, are two shoals, *Little and Great Gull Banks,* with 12 and 18 feet water over them, lying 2 and 5 miles off shore. South of the latter 10 miles, and 8 miles off shore, is a small patch of 21 feet. At 30 miles southward of Fenwick's lighthouse is Winter Quarter Shoal.

Winter Quarter Shoal is $1\frac{1}{2}$ miles long and one-third of a mile wide, running in a direction E. by N. $\frac{3}{4}$ N. and W. by S. $\frac{3}{4}$ S. (E.N.E. and W.S.W.) with not over $3\frac{1}{2}$ fathoms water upon it.

The least water is 12 feet in several places, at low tide. On the seaward side the soundings change suddenly from 2 to 4, and then to 2 fathoms. It is $6\frac{1}{4}$ miles distant from the nearest land, with 10 fathoms water between it and the shore.

In clear weather the lantern of Assateague Lighthouse is just visible from it. The centre of the shoal bears from Assateague light E. by N. $\frac{1}{2}$ N. (E. by N. $\frac{3}{4}$ N.) distant $11\frac{1}{2}$ miles.

This is a highly dangerous shoal, as the soundings change suddenly, and it lies directly in the track of vessels. The sea breaks upon it in heavy weather.

Black Fish Banks form a long narrow bank or ridge, running in a direction N.E. $\frac{1}{2}$ E. and S.W. $\frac{1}{2}$ W. (N.E. $\frac{1}{4}$ E. and S.W. $\frac{1}{4}$ W.) $4\frac{3}{4}$ miles long, with an average width of one-quarter of a mile, and distant from $4\frac{1}{2}$ to 6 miles from the shore, with from $3\frac{1}{4}$ to 5 fathoms water upon it. The north end bears E. by S. (E. $\frac{3}{4}$ S.) distant $7\frac{1}{4}$ miles, and its south end S.E. $\frac{1}{2}$ S. (S.E. $\frac{1}{4}$ S.) distant $5\frac{3}{4}$ miles from Assateague Lighthouse.

Chincoteague Shoals are the outer shoals off Assateague Lighthouse, and bearing from it from S. $\frac{1}{4}$ W. (South) to S.E. by E. (E.S.E.) comprising six points of the compass and at a distance from it of from $3\frac{3}{4}$ to $4\frac{1}{4}$ miles. They have from 9 to 17 feet water upon them.

ASSATEAGUE LIGHTHOUSE stands on an elevation about one mile distant from the beach. It is a fixed light and at night in clear weather can be seen at a distance of about 15 miles.

Within a semicircle of this distance the light being the centre, the bottom is very uneven and broken. The general direction of the current is to the southward and westward.

THE CHESAPEAKE, one of the finest estuaries on the globe, being 160 miles in extent from North to South, is the recipient of many important rivers, which fall into it on all sides, but especially on the north and west. At its head is the *Susquehanna*, which pervades Pennsylvania; on the N.W. the *Patapsco*, falling from Baltimore; at a degree further south is the *Patuxent;* then the *Potomac*, which passes the federal city of WASHINGTON; the *Rappahanock*, running downward from Fredericsburg; *York River*, on which are situated York Town and Gloucester; *James River*, on which stands the town of Richmond; and, in the south, *Elizabeth River*, the harbours of Norfolk, &c.

Its entrance lies between Cape Charles on the North and Cape Henry on the South, being about 10 miles in width, but owing, as it appears, to the southward drift, the northern side of the entrance, like the Delaware, is embarrassed by shoals.

Cape Charles Lighthouse, which at present stands on the N.E. end of Smith Island, or above 4 miles eastward of Cape Charles itself, marks the northern side. It shows a revolving light, but a new tower, 150 feet high is building—(*see Table*).

Cape Henry Lighthouse marks the southern entrance, and shows a fixed light.

Ships falling in with the land to the northward of the entrance, should not stand inwards to a less depth than 7 fathoms, until they come into the latitude of Smith's Island and Cape Charles, whence they may stand with safety into 5 fathoms. In coming along shore from the southward, 7 fathoms will be a proper depth to keep in, until up with Cape Henry; whence, falling into 8 or 9 fathoms, with a stiff or sticky bottom, you will be in the channel-way.

When you come in towards the land, to the southward of Cape Henry, you will have deeper water than when you are in the latitude thereof; as 21 fathoms, reddish sand, and pretty large: 9 leagues off it there are 35 and 40 fathoms, fine grey sand.

The land is low and sandy; you cannot see it above 7 leagues off. Cape Henry is low, but bluff, with a few trees to the sea side, at a little distance from the water: it moderately steep-to, excepting that a small shoal stretches about two cables' length from the shore east of the lighthouse, and there is nothing to hinder a ship from passing into Lynnhaven Bay, where there is soft ground, and from 4 to 6 fathoms of water. The bank called the Middle Ground is about 4 miles from the Cape.

When coming in from sea, in the latitude of Cape Henry, 36° 56,, you will meet with soundings, as above described. You may readily ascertain when in soundings by the muddy colour of the water. In clear weather, the land of Cape Henry may be seen from the depth of 10 or 11 fathoms, regular soundings, which extend 5 or 6 leagues to the southward of the Cape: more to the northward, the soundings are irregular and coarser, as above described.

In coming in for the Chesapeake, you may advance to Cape Henry, but cautiously avoiding the *Middle Ground*, which occupies so large a portion of the entrance, and which may be still increasing. With a northerly wind you may approach this bank to the depth of 5 fathoms. To the southward of it you find 12 and 13 fathoms, as well as in the channel between it and Cape Henry. This channel has a depth of 8 fathoms close to the Cape.

With a fair wind, you may run in with the lighthouse bearing W. by N.; and, with a turning wind, you may stand to the southward until it bears N.W. by N., and to the northward until it bears West.

If requisite, you may run in with the lighthouse bearing West, as this course will lead to the channel-way, in from 7 to 10 fathoms, sticky bottom, as before mentioned. It is then proper to take soundings towards the southern shore; and, in order to this, steer West, until you have advanced to a short distance from the lighthouse; then, rounding the point, you may haul into *Lynn Haven Roads*, and drop an anchor as most convenient, in from 7 to 4 fathoms.

From Cape Henry, in latitude 36° 55′, to Cape Hatteras, in 35° 14′, the coast forms a concavity in the greater part of its length, to the latitude of 35° 40′, trending nearly S.S.E.; and the rest inclines a little to the westward of south to the extremity of the cape, now represented in longitude 75° 30′ W. It is all low, and bordered with narrow isles, at the back of which are *Currituck Sound, Albemarle Sound, Pamlico Sound, &c.*

The Wimble Shoals lie between the latitudes of 35° 30′, and 35° 34′. They extend two leagues out from the shore, but there is a passage between them and the land. The sea always breaks over them in a gale.

To the southward of the Wimble Shoals, there is a large muscle-bank, intermixed with cockles and small pebbles, having 5, 4½, and 4 fathoms of water: it outer ledge is about 4 miles from land, and there is a depth of 9 fathoms between it and the shore.

Cape Hatteras, although not conspicuous for its elevation, being only a low sandy spit, gradually extending to the southward, is very remarkable as being a turning point in the coast of the United States. The shores on either side are purely diluvial, formed and extended by the action of the currents which drift past them. Lying upon the line of junction between the two wind and current systems, where the East and West tendencies divide, we here meet with the first evidence of the conflict between them in the singular line of shoals which project at right angles to the line of coast; an evidence of the conflict between the Gulf Stream and the southerly current coming from high northern latitudes.*

THE LIGHTHOUSE on Cape Hatteras now stands 2 miles North of the point it was built to indicate. It shows a revolving light at 150 feet. Near the extremity of the point a fixed beacon light is shown, which bears S. ½ W. from the high light.

THE HATTERAS SHOALS are most dangerous. The outer shoals, 3½ miles in extent, have from 9 to 15 feet water. Between them and the *Diamond Shoals* is a 6 fathom channel 2½ miles wide. These shoals have 12 feet least water. A spit runs off for 1½ miles S.S.E. of the beacon light.

Cape Hatteras Light bears N. 37° W., distant about 8½ nautical miles from the south-eastern edge of the 9 feet or Outer Shoals.

To clear the *Outer Shoals*, in approaching them from the northward and eastward, bring the lighthouse to bear West in 12 to 10 fathoms water, when run South keeping in not less than 10 fathoms water, until the lighthouse bears N.W. ½ N., when any course South of West may be steered with safety.

In coming from the southward and westward keep in not less than 10 fathoms water, until the lighthouse bears N.W., when any course eastward of North may be steered. The beacon light and the high light in one clears all to westward.

In bad weather, and especially at night, do not approach the Outer Shoals nearer than 15 fathoms water from the northward and eastward, and 12 to 11 fathoms from the southward and westward.

It is necessary to watch the bearings of the lighthouse, and keep the lead going in beating around or between the shoals. In approaching the shoals at night or in bad weather, if the lights have not been seen before night, it will not be prudent to run in for it.

As 10 or 11 fathoms water may be found to the westward of the shoals, in going outside of them from the southward and westward do not approach the land to the southward of the Cape nearer than 8½ to 10 miles.

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* See pages 185, 186; 332, 335, &c., *ante*.

Between Cape Hatteras and Cape Lookout, the next projecting point, a long sweep of narrow banks which separate the ocean from *Pamlico Sound*, extend in a curve for 64 miles.

The narrow beachy isles which form the coast between the two capes, form an inlet into Pamlico Sound, named *Ocracoke Inlet;* the shoal bar of which (extending two miles seaward) is 9 leagues S.W. by W. ½ W. from the lighthouse on Cape Hatteras, and 13 leagues N.E. ¾ E. from Cape Lookout. On the eastern side of the inlet is a *lighthouse*, exhibiting a *fixed light*, which bears from the middle of the Bar, in 13 feet water, N. ½ E. 3¼ miles, whence the course in is N.W. by N. ½ N.

The soundings all along, between the shoals extending from the two capes, are regular, gradually diminishing from 14 and 15 fathoms to 5 and 6 fathoms near shore, all sandy ground.

CAPE LOOKOUT is marked by a red tower 96 feet high, showing a fixed light. It stands 2½ miles N.N.E. of the point of the cape.

The light may be seen from the outer end of Cape Lookout Shoals; but vessels passing are recommended rather to trust to the lead than to making the light.

From Cape Lookout the shoals extend, nearly in a S.S.E. direction, to the distance of 3 leagues from the lighthouse. The broken ground extends to latitude 34° 28′; in this parallel are 10 fathoms of water, and thence to the edge of the Gulf-Stream the soundings gradually increase to 25 fathoms. From Cape Hatteras lighthouse the outer part of Cape Lookout Shoals bears S.W. ¼ W. 22½ leagues; and from the outer part of Cape Hatteras Shoals S.W. by W. at the same distance.

From the lighthouse the coast trends to the northward of West, but the low spit stretches out, as above said, for 2½ miles to the S.S.E. of this direction.

Beaufort Harbour is about 8½ miles W.N. from the South spit of Cape Lookout, and affords shelter from all winds, and is easy of access, carrying 17 feet over the bar at low-water. It can be entered with all winds except between N. and West. On the N.W. side is *Fort Macon*, on making which, the breakers will be seen, and with the flagstaff of the Fort bearing N.W. ¼ W., or by night the two lights, on the Bogue Banks inside in one, bearing N.W. ½ W., steer N.W. by W. ¾ W. for the bar buoy, passing close to it, and bear northwards when rounding Shackleford Point on the starboard hand.

CAPE FEAR is the south-western extremity of another of those long beaches which characterise this portion of the American coast. Its extremity bears S.W. by W. ¼ W. from the spit of Cape Lookout, distant 84 miles, but the shore recedes 18 miles from the direct line.

The low sandy point known by the name of *Cape Fear*, is the S.E. extremity of a marshy island called *Smith's Island*, which forms the two entrances of Cape Fear River and the port of Wilmington. Near *Bald Head*, the western extremity of this island, is a *lighthouse*, upon the eastern side of the southern inlet; and there is another upon the north side of the *New Inlet*, at three leagues north from the extremity of the cape.

The Frying Pan Shoals, a very remarkable line of reefs, runs in S.S.E. direction from Cape Fear. They are not more than a mile in breadth, and at their outer end there is a *light-vessel* showing two lights.

In passing Frying Pan Shoals, which extend to nearly 20 miles from Bald Head Lighthouse, *sailing vessels of heavy draft* should keep in from 15 to 18 fathoms, especially in threatening weather, and under no circumstances run into less than 10 fathoms. Steamers in good weather may cross the outer end of the shoals in 10 fathoms. The *light-vessel* marks their outer end, as above said.

To clear these shoals, vessels from the eastward approaching Cape Fear River should bring Bald Head light to bear S. by W., and then steer N.N.W. for the mouth of the river; or bound to the eastward from Cape Fear River, should steer S. by E. to the distance of 15 miles from the bar in 8 and 10 fathoms water, when an East course will pass over the outer end of the shoal in from 7 to 10 fathoms.

Vessels drawing not more than from 9 to 10 feet, can cross the shoal at the distance of 4 miles from the point of Cape Fear, steering from E. to E.N.E. or W. to W.S.W.

Vessels drawing 10½ to 11 feet can cross the shoal at the distance of 5½ to 8 miles from the point of the Cape, steering N.E. to E.N.E. or S.W. to W.S.W.

There is a channel of not less than 13 feet running N.E. by E. and S.W. by W. 11 miles S. by E. ¾ E. from Bald Head lighthouse. Thirteen miles S.S.E. from Bald Head lighthouse there is a shoal with 7 feet water on it; and to the eastward of it 14½ miles S.S.E. ¼ E. from Bald Head lighthouse, a shoal having 10 feet water on it. The sea breaks on these shoals in moderate weather. Between them is a channel about three quarters of a mile wide, with not less than 3½ fathoms.

These channels over the shoals should not be attempted by strangers in vessels drawing more 7 feet.

There are two shoal spots with 16 to 18 feet water on them bearing S.S.E. ½ E. to S.E. by S. distant 16 to 17½ miles from Bald Head lighthouse.

From Cape Fear the coast again forms a sweep of curved beach, called the Long Bay, and at 81½ miles S.W. ½ W. from its extremity is Cape Roman, or *Romain*, lighthouse.

CAPE ROMAN is very improperly so called, it being a very low land, without either tree or bush, and appears, at a distance, like a sand left dry by the tide. To the W.S.W., about two miles from this cape, on the isle called the *Great Racoon Kay*, there is a lighthouse, 150 feet high, which exhibits a bright revolving light every minute, visible 23 miles off. The tower is painted in horizon stripes, alternately red and white. With the light bearing from N.W. by N. to N.E. by N. there is good anchorage on the flats, in 3 fathoms, to the east of the mouth of the inlet called *Bull's Bay*.

Cape Roman Shoals extend for 5½ miles E.S.E from the lighthouse, or 3½ from the South Spit of the Cape Island. A *striped nun buoy* was moored near there on the edge in December, 1855.

Vessels of heavy draught should not approach Cape Roman within eight fathoms water, there being a five fathom bank outside of the shoals.

Vessels of light draught coming from the southward, and intending to run inside the shoals, will, when in 4¾ fathoms water, bring Cape Roman lighthouse and the old mill in range, the South point of Cape Island bearing N. by E. (N. 9° 15′ E), then steer N.E. (N. 43° E.), passing directly through the slue.

These shoals are of a dangerous character, lying directly in the track of coasters, 6 miles distant from the lighthouse; they are about one mile in extent, and have but 6 feet water upon them, and shoal very rapidly from 6 fathoms to 3 feet. With moderate winds from N.E. or West, the sea does not break upon them, but with winds from S.W. around by South to the East, they are shown by the breakers on the seaward side.

Inside the shoals there is a good 15 feet channel nearly 2 miles in width.

A 6 feet channel extends from the south-west, leading to the harbour inside the Cape.

There is good anchorage during northerly winds S.W. of the lighthouse, with not less than 3 fathoms water.

A lighthouse, which marks the entrance of Charleston harbour, bears S.W. ½ W. 35 miles from that of Cape Roman. The land between is alluvial, and forms numerous low islands—an extension of the famous Sea Islands—the principal of which are named Bull's, Capers, Devies, Long, and Sullivan's Islands. Flats extend from all these isles, along which the soundings are regular. Bull's Island appears very bluff, with red sand-hills, and a spit from the outer end of it extends eastward, about 5½ miles.

A spit called the *Rattlesnake* also extends to the distance of five miles E. by S. from Sullivan's Island, which forms the North side of the entrance to Charleston, and you will be on the edge of it in $5\frac{1}{2}$ fathoms. Its outer extreme is marked by the *lightvessel* in 6 fathoms, and showing two lights.

When Charleston churches are seen to the northward of Sullivan's Island, you will be on the edge of the Rattlesnake; and when the churches are open to the southward of Sullivan's Island, you are clear of that shoal, or Fort Moultrie bearing W. $\frac{3}{4}$ N. clears them to the southward. You should approach no nearer to this bank than in 5 fathoms of water.

CHARLESTON HARBOUR.—The entrance of Charleston Harbour is distinguished by its lighthouse, situate in latitude 32° 44′, on a low sandy point of Morris's or Lighthouse Island. The lantern is 123 feet above the sea, and exhibits a *revolving* light, which may be seen 8 or 9 leagues off.

St. Michael's Church, at Charleston, is now, also, an excellent mark, it having been painted with pure white, and may be seen, in clear weather, 20 miles off.

The *entrance* to Charleston is between Sullivan and Morris Island. The main ship channel runs northward past Morris Island, at a mile distant, in a North direction, and the *bar* is 6 miles South of the West end of Sullivans's Island. At this part (near *Fort Moultrie*) there are two beacons, one bearing N. $\frac{3}{4}$ W. leading up the channel.

The LIGHTHOUSE on the South end of Morris Island is nearly half a mile from its South extreme, and shows a bright fixed light; at 300 yards S.E. of it is a *beacon*, which also shows a fixed light. These in line are a mark for the *bell buoy* outside the bar 4 miles distant.

On the flat to the North of Morris Island is the now famous *Fort Sumter*, which shows a bright fixed light, and here the main channel bears to the N.W. into *Rebellion Road.*

Main Ship Channel.—In approaching Charleston Bar for main ship channel keep in 6 fathoms water till up with the Bell Boat and the light bears nearly N.W. open the Charleston beacon 5° to the northward of Charleston light, and follow this range, passing to port of the three bar buoys,

Having passed the inner buoy, the North or further channel beacon by Fort Moultrie being open about its width to the westward of the South or near Channel Beacon, steer North until the two Channel Beacons are in range. This range leads up the channel on a course of N. $\frac{3}{4}$ W. (N. 6° W,), keeping Haddrell's Beacon a little open to the eastward of the range.

When Fort Sumter bears W. $\frac{1}{8}$ N. and Charleston light is open midway between the two Morris Beacons, steer N.W. by W. (N. 54° W·) $1\frac{1}{4}$ miles to Rebellion Roads.

The shifting character of the sands which compose Charles Bar prevents anything like permanence in the channels, which are subject to frequent and very considerable changes in depth and location, particularly after a south-easterly gale.

Directions for the ports of the United States South of this are given in the Colombian Navigator, vol. i., and for the Islands and Coasts of the West Indies in vols. ii. and iii. Instructions for the navigation of the West Indies generally are given in pages 411—436. To these the reader is referred for further and more complete information.

SECTION V.

ACCOUNT OF THE ROCKS, SHOALS, AND VIGIAS,* IN THE ATLANTIC; AND OF THE AUTHORITIES ON WHICH THEY HAVE BEEN INSERTED IN THE CHART.

The present section is in many respects the most unsatisfactory portion of our work. To deal with the conflicting and imperfect accounts which so often arise of the discovery of new shoals and dangers is most perplexing. But of late these doubts have been dispelled in very many instances by the direct test of the deep sounding machine, and the testimony thus afforded as to the non-existence (at least, in the assigned position) of many of the formidable reefs described, in perfect good faith, has led many to doubt the authenticity of the whole range of reported rocks. And this disbelief is unquestionably a growing one, but the subject cannot be dismissed until a satisfactory and systematic examination of the whole bed of the ocean, now so readily done, is made.

In a subsequent section the subject of deep sea soundings will be discussed. Its great importance in relation to the present topic, of doubtful rocks and shoals is manifest, as it is almost the only test which is conclusive, and those trials which bear directly upon each shoal will be specially alluded to in this part of our work.

But while we may dismiss those dangers which have been absolutely disproved, we may also have some doubts on the correctness of some of the soundings which have been cited to show that great depths exist in their neighbourhood. In the earlier experiments which were made with small line, quite incapable of bringing back the lead, it is evident that at times the indicatiou of them having reached the bottom by the line ceasing to run, is not altogether satisfactory.

The chief expedition which has been undertaken to disprove these numerous dangers in the Nortn Atlantic, is that sent out by the United States Government in 1851—2, in the brig *Dolphin*, Lieutenant Commander Lee, whose labours will be quoted hereafter.

It is gratifyiug to us to find that a former edition of this work, the *Atlantic Memoir*, of 1845, was made the basis of these experiments, and we give with pleasure the disproof of many of the shoals and rocks which had been announced in this work, shown to have been given from erroneous information, or imperfect observation.

But until a perfect and systematic survey of the depth of the sea is made, we cannot pronounce absolutely that it is free from isolated dangers. The enumeration of them, therefore, will be continued for the present, not with the idea of inducing too much caution, but as a reference to show that they have not been overlooked.

An isolated rock is a very difficult matter to detect; and even the most laborious

* VIGIA is a Spanish word, literally signifying Watch, or Look-out. It is generally, in the charts, attached to spots supposed to be dangerous, and which should, therefore, be approached with caution.

surveys have failed sometimes to detect such. More examples might be cited of this. Thus the dangerous rock in the entrance of Milford Haven occupies what was supposed to be deep water, till accident made it known. A similar very dangerous pinnacle, the *Pin Rock*, is of recent discovery in the entrance of Dartmouth Harbour; another the Lee Rock, lies off the South end of Lundy Island, in the anchorage. A man-of-war has lately been very nearly wrecked on an unknown rock in the centre of Braye Roads, Alderney, where our Government are expending enormous sums in making shelter. The ship in which the Prince of Wales visited Canada struck on an unknown rock outside a buoy in the St. Lawrence. Another rock was overlooked in the survey of Tenerife, at its East end. All these, and many others, show the difficulty of pronouncing absolutely, on the non-existence of an isolated shoal, if a pinnacle of rock may not be seen with very close search, and pass quite unnoticed in a channel way.

The accounts frequently given are very vague and ambiguous, and in some cases evidently refer to floating objects.

"It is, moreover, possible that navigators, at a certain distance, may have mistaken whales for shoals. M. de Chabert, in his voyage to America, in 1741, for the purpose of making astronomical observations, being at the distance of 70 leagues from Corvo, one of the Azores, descried a dusky body, over which hovered a number of gulls, a bird seldom seen at such a distance from land; at first he imagined it to be a rock, but on coming near, in order to observe it, he found it to be the carcase of a whale of monstrous bulk. Besides, some of those vigias may have ceased to exist, after having appeared for some time; as, for instance, the island which rose out of the sea in the year 1720, to the westward of St. Michaels, of the Azores, and which disappeared again on the 17th of November, 1723."

As a monition against too hastily forming conclusions from mere appearances, we here add, that an old friend of ours, in crossing the Atlantic, was once alarmed by the sight of breakers at no great distance. Instead of coming home with an imperfect report, he very properly sent out a boat to examine them, and found that they were caused by a floating body, thickly covered with barnacles, &c., to which a hatchet was applied, and soon disclosed a cask of wine, which proved to be excellent Burgundy. It had, no doubt, been floating many years, and during the time had probably been the prolific parent of a number of *vigias*, &c. On the 4th of August, 1822, Captain Hamlin, in the brig *Revovery*, likewise picked up a hogshead of claret wine, that had been a long time in the water, and worm-eaten nearly through, lat. 34° 51′, long. 24° 51′.

We have shown in another work how easily an animated as well as a lifeless being may be mistaken for a rock. In 1818, the *Northampton*, Captain Tebbut, on her passage to India, had passed the meridian of the Cape. On the 1st of August, at noon, the ship was in lat. 40° 45′ S., and long. 24° 32′ E. On the next day an object appeared right ahead, like a boat; on nearing it looked like the wreck of a vessel, *two parts being above water*, at two ships' lengths from the lee-bow. The barnacles could be distinguished by the naked eye; but, when abeam, the creature *went down*. It proved to be a *thrasher*. Captain Tebbut says, "Being forward at the time we came up with the animal, the two parts above water seemed to me like a wreck, bottom upward. When I first saw the barnacles, the part covered with them looked rugged, and I was firmly of opinion that it was a rock above water; so much so, that I looked over the lee-bow to see that we were clear of it, ordering the man to starboard the helm."

A similar instance has been recorded in the *Journal of the Royal Geographic Society*. "A frigate was one day running into the Rio de la Plata, with her studding sails set, when the look-out man at the mast-head reported breakers on the bow. The captain, believing that such a danger could not have escaped the notice of the Spaniards, and having, also, a tolerable chart of the river, suspected it must be some floating object, and ordered the ship to be steered directly for it. The officers were on the alert; glasses were frequently directed to the spot, and all concurred in representing it as a rock a little above water. Anxious looks were directed to the captain, whom they now considered as unnecessarily running into danger; but that officer kept carefully watching his approach, and, as the studding-sail boom was just over it, the cetaceous monster (for such it was) hastily made off; and, rising again to blow, finally disappeared. It was observed to have an excrescence on its back, covered with shell-fish. The sea broke gently on its weather side, and appeared becalmed to leeward; and so perfectly did it resemble a rock, that, had the vessel passed at a distance without disturbing it, there can be little doubt but it would now have had a place upon the list of vigias.

"It is to be observed, in this case, that there was only a little ripple about the body, but no breakers; and this circumstance had not escaped the intelligent eye of the commander."

The *dead* carcase ot a whale may even approach nearer in appearance to a permanent danger than a living one. Captain Vidal, in H.M.S. *Styx*, while passing from Terceira to St. Michael's, on July 20th, 1844, the mast-head man reported the appearance of breakers on the starboard bow; the Wind was West, and there was a little swell. "With our glasses we saw what appeared to be a small sand-bank, such as forms the crowns of some of the coral banks in the eastern ocean, and there appeared particularly on its southern margin, to be a few breakers. Finding the vessel could not fetch it, I sent the master in the gig to ascertain what it really was; and it proved to be the carcase of a whale, from which much of the blubber had been taken, but some, only partially severed, lay floating by the side, and, by the undulation of the waves, presenting the appearance of breakers. Now, I have no hesitation in stating, that this object so much resembled a sand-bank, or, it might be, a tide-rock at low water, that had I left it unexamined I should certainly have reported the probability of its being either one or the other, and, in so doing, I should have added another vigia to those which disfigure the charts of the North Atlantic Ocean."

Captain Wilkes, of the United States Expedition, gives the following instance:—

"The 5th of September, 1838, being near the reported shoal of St. Anne, I determined to pass over its position.

"On the 6th, we passed over it; the sea was smooth, the horizon clear, and the day beautiful. At eight, a.m., the look-out cried out, 'Rocks, or a wreck, on the starboard bow!' which at once created an excitement on board. We stood for it. It had, at first, every appearance of a rock, then that of a wreck with the masts gone. It proved, however, to be a large tree of cotton-wood, 120 feet in length, and 14 feet in circumference, at the height of 5 feet from the roots. It had been a long time in the water, was full of barnacles, and much eaten by the teredo navalis. Great quantities of fish were about it, consisting of dolphins, sharks, &c. We did not, however, succeed in taking any. In rough weather it might easily have been mistaken for a rock, particularly if passed in twilight, or at night. There is little doubt in my mind that many of the numerous vigias that appear in our charts have as little foundation. No current was experienced hereabouts, and I am led to the conclusion, that a sort of eddy or still water is here found, wherein most of the wood carried by the Gulf Stream becomes deposited for a time. On the 8th, we were in long. 34° 8′ W., lat. 37° 17′ N."

In every event, however, it is always the safer course, in matters of this nature, to err rather by marking too many than too few; especially when we make known, as we have done, the authority that we rely on for the existence of each. Every one, of course, is free to act according to his own judgment.

But on *all future announcements* of the discovery of rocks or shoals, it is absolutely necessary that they should be verified by the test of the *sounding lead*. Without this they will not be considered as authentic.

The *reported* shoals, the existence of which have been apparently disproved, are marked hereafter in italics, and have the signs (?) attached.

They are here recited to show upon what grounds they are disclaimed. *In future editions they will be omitted.*

1.—TO THE NORTHWARD OF LATITUDE 50° DEGREES.

NUN ROCK, off Cape Wrath, in lat. 58° 52½′, long. 4° 56′ W.

This rock, with the adjacent bank, was surveyed, under an Admiralty order, by Captain Ramage, in the *Cherokee* sloop of war, 1817. It is a very dangerous isolated shoal, bearing N.E. by N. mag. or *N. 5° E, true,* from Cape Wrath, the N.W. part of Scotland, 15 miles distant. It is of small extent, not half a mile in diameter, with deep water all around it, and with 3¼, or, as some say, not more than 2½ fathoms over it. It has been seen to break very high at half tide.

Lion's Bank, in lat. 56° 40′, long. 17° 45′.

This bank was sounded by Lieutenant Richard Pickersgill, in the brig *Lion*, in 1776. Dr. Forster, in his "History of Voyages made in the North," says, "On the 20th of June, with 320 and 290 fathoms, Pickersgill found a sandy bottom, in 56° 38′ N., and 17° 44′ W., which induced him to call that spot *Lion's Bank*; and particularly so, as he found there what is usually seen on all banks at sea, a vast quantity of sea-fowl, such as gulls, dumdivers, &c. Soon after this, he could no longer get any soundings, nor were there any more fowls to be seen. This bank is said to have been sounded on a few years ago, by Captain Richmond, of Greenock. It is a continuation of the Rockall Bank, which has been shown by the Survey to extend thus far.

NORTH SHOAL, West of Orkney, lat. 59° 13′ 23″, long. 3° 34′ W.

One of the most dangerous shoals around the British Isles, as it is singularly isolated. It has but 7 feet least water, is not larger than half the size of a boat, and with 30 to 40 fathoms around it. It bears from Noup Head, Westra, W. ½ N. 17 miles; Brough of Birsa N.N.W. 9 miles; the Old Man of Hoy, N. by E. ¼ E. 2¾ miles.

Aitkin's Rock, to the West of the *N.W. of Ireland.* (?)

The original notice relative to this *imaginary danger*, was published at Whitehaven, 12th of September, 1740. On the 16th of July, at seven o'clock at night, in a passage from Virginia, on board the *Friendship*, of Ayr, John Aitkin, master, coming in at the N.W. channel of Ireland, saw a rock under water, about 4 feet, distant 40 or 50 yards; all hands being on deck saw it plainly. Supposed to lie in the latitude of 55° 18′ N., and longitude, from the meridian of London, 11° 14′ W. From Tory Island, West, distant 64 miles.

A second advertisement, relative to this rock, was published by Mr. F. Cumming, of New York, in the year 1793. "On Thursday, August 9th, 1792, ship *Nestor*, of Greenock, from New York, bound to Greenock, being in latitude, per observation, of 55° 19′ N., and longitude, per account, of 9° 53′ W. of Greenwich. The ship's company perceived a rock about 4 feet below the surface of the water, not 5 fathoms from the weather-beam of the ship, in the form of a horseshoe, with one side longer than the other. The Rev. Mr. Stewart, then a passenger in the *Nestor*, saw the rock plainly, with the tangle growing on it.

We have other accounts of this rock, and of these, one states its position at 55° 15′ N., and 10° 40′ W.; a part appearing at 3 feet out of the water, with sounding of 30 to 40 feet a short distance; at 30 fathoms off, no soundings with a line of 150 fathoms. In or about the year 1804, Captain Clarke, since of the *Harmony*, of Ayr, believes that he saw the rock very distinctly; by his run, it appeared to lie 20 leagues nearly true West from Tory Island. The tangle appeared about 1 foot below the surface, at about dead low water, and the ship rubbed alongside the rock.

In the *True Briton*, J. Reid, commander, Wednesday, the 27th of September, 1826, when steering E.S.E., a man at the mast-head called out that there were breakers close to our port bow. A rock appeared a little above the water, nearly flat, about 90 feet long, and 40 broad; saw no breakers, excepting round the rock, and could distinctly see the sea working over the rock.

Iver M'Iver, a rigger in Greenock, stated (in 1820) that many years before, while he was seaman on board a vessel, they fell in with Aitkin's Rock in fine weather. The captain caused the boat to be got out, and M'Iver was one the men in the boat. He said the rock was not much under water, had seaweed on it, and was about the size of a ship's launch.

Several other accounts of this rock have been given, as seen from different vessels; and in consequence of all, the Chamber of Commerce of Glasgow addressed a letter to the Admiralty in 1821, stating that no less than six vessels were missing from that port, and soliciting their lordships to cause an examination of the danger. The application was renewed in 1826 and 1827. In consequence H.M.S. *Gannet* was on this service in 1824, the *Harrier* and *Badger* in 1827, and the *Pylades* and *Dispatch* in 1829; but the rock was not discovered.

Again, in 1830, the *Onyx* and *Leveret*, two gun-brigs, commanded by Lieutenants Dawson and Worth, and directed by Captain A. T. E. Vidal, were engaged on this service. "They put to sea on the 6th of June, when the moon was at the full; and, commencing their examination at Tory Island, proceeded nearly along its parallel of latitude to the westward of all the given positions of the rock. The two vessels were always in companny, and the general practice was to sail on parallel lines, distant from each other from 1 mile to 1½ miles by day, and closing at night to half a mile, or as much less as the state of the weather rendered necessary. During the few hours of darkness experienced at that season of the year, the vessels were hove-to, that no part of the suspected ground might be passed unseen, and the leads were kept going, both day and night, from the depth of 150 to 200 fathoms. Their distances from each other were determined every hour by the angle of elevation subtended by their respective masts, at the heads of which balls had been placed to facilitate the measurement. Their mutual bearings were taken at the same time; and men were kept constantly at the mast-heads during the day, and a vigilant look-out preserved through the night.

"This system of crossing and re-crossing over every part of the suspected ground was persevered in until the 31st of August; when, having visited every position assigned to this danger, and indeed the whole space comprehended by them, without seeing any rock, or discovering any detached bank, which could indicate its having existed, the search was relinquished, and the vessels returned to England."

To those, hereafter, who may have to make similar researches, it may be important to know that Captain Beaufort (Hydrographer to the Admiralty), in his instructions, had recommended that the vessels should sweep for the rock by laying out a large scope of hawsers between them, and drifting with it over the suspected ground. To effect this, he suggested two methods—the one, when the two vessels should be on the same tack, the leading brig keeping a little off the wind, with her main-topsail occasionally lifting; the hawsers fast to her quarter, with a spring to them from her weather-bow; the sternmost brig lying-to, with her main-topsail to the mast, the hawsers from her weather-bow, and a spring to them from her weather-quarter. The other method Captain Beaufort proposed was, drifting on opposite tacks, the hawsers fastened to their sterns, with springs to them from the weather-bow of each vessel.

An additional number of hawsers were accordingly provided for the purpose; and, upon the principles described, a line of them, amounting to more than 700 fathoms, was laid out, and a large portion of the suspected ground subjected to this mode of examination. To prevent the central part of this long scope from descending to too great a depth, and to relieve the vessels and hawsers as much as possible from the strain required to keep so much heavy rope in proper tension, the hawsers near the middle of the line were buoyed at intervals with empty water-casks.

During the month of June many of the mast-head men and others were momentarily deceived by the blowing of whales, which at that time were numerous; and in August a small black object, a little above the surface of the sea, was productive of similar hope and disappointment. It was first seen from the *Leveret*, and on examination, proved to be the trunk of a very large tree, with its roots projecting two or three feet out of the water. They were covered with weeds, barnacles, and other marine productions; corresponded very minutely with one of the descriptions of the rock.—*Journal of the Royal Geographical Society*, vol. I, pp. 51 to 58. We have thus quoted largely to show that great troubles are given from imperfect accounts of dangers like this *supposed* Aitkin's Rock.

Brazil Rock, in lat, 51° 10′, long. 16°. (?)

M. Bellin, in his Memoir of 1742, states that this rock is marked in lat. 51°, and long. 19° 30′ from Paris, according to Brouage, hydrographer, and Laisne, a pilot. It has been variously represented in different charts, although its existence has been doubted. Messrs. Verdun and Borda have added to their remarks upon this rock, that they do not believe it to exist. It was, however, said to have been seen in the year 1791, by the company and master of an English merchant ship, stating that it is really a high rock, or islet, apparently bold-to, and to which he passed so near, that he could have cast a biscuit on shore. The longitude, according to his computation, was about 16° W. It is highly improbable that a rock of this class should exist, which improbability is increased by the deep soundings got by Lieutenant Berryman, 1905 fathoms, about 160 miles to the N.N.W. of it.

Kramer's Bank, in about 60° 57′ N., and 16° 40′ W. (?)

This bank appeared in M. Bellin's Chart of 1751; and was probably copied from the Dutch charts of the Greenland seas. It is said to have been discovered by Captain *Alof Kramer*. Captain John Ross sought for this bank, but unsuccessfully, in 1818. He could find no soundings in 130 fathoms, anywhere on or near the place.

BETWEEN LATITUDES 40° AND 50° N.

Roche Bonne and the Banche Verte in the Bay of Biscay.

These are two reefs, lying within a short distance of each other, East of the Isle of Ré. Their position will be found already noticed, in the description of the coasts, &c., p. 481.

The Chapelle Rock, in lat. 47° 43′, long. 8° 4′ 30″ W.

In the Analysis of the French Chart of the Atlantic, of 1786, it was remarked that a rock, denominated *La Chapelle*, on the chart of 1766, in lat. 47° 24′, and long. 7° 12′, was said to have been in 1764.

But, on the 27th of September, 1822, the sloop *Favorite* was returning from Malaga toward Liverpool, at daylight, the water appeared green, as if on soundings; at 10 a.m. the water seemed greener, also at noon, in lat. 47° 26′ 1″, long. 7° 41′.

28th, at 8 p.m., sounded, and got rocky bottom in 65 fathoms, the arming of the lead bringing up a bit of shell and three small black specks. At 8h 21′, again sounded, in the same depth of water, 65 fathoms, and rocky bottom; but this time the arming had only two small specks, and a very minute one; made sail, and kept away to clear the land. As midnight, sounded; no bottom at 80 fathoms. At six a.m., no appearance of land; hauled up: the daylight increasing, perceive the water is less discoloured; and by noon the water is quite blue again.

"At noon, latitude, 47° 49′ 38″; 47° 49′ 49″. Longitude, 9° 15′ 59″.

"We have really passed over a bank, which may extend, in longitude, from about 7° 24′ to 8° 29′ W. of Greenwich. I am aware, however, that this can be considered as a rough guess only. At all events the latitude, in which we got soundings in 65 fathoms, may fairly and surely be taken at about 47° 37′ 12″.

"The *Chapelle Bank*, as we may call it, will at any rate be found in lat. 47° 37′, somewhere between the meridians of 7° 24′ and 8° 29.

The French surveyors have since said that the Chapelle Rock, which is traced on several old charts, has long been the object of our ineffectual researches. We have found only, in the situation assigned to this rock, an insulated bottom of small extent, having over not less than 80 fathoms, and on which the sea may break in rough weather, but have little reason for believing that a danger exists hereabout.

Notwithstanding this uncertainty, we have another statement of a different character,—a rock *awash:* 9th of August, 1842:—"At 1^h 30′ p.m. breakers seen close to the vessel, and a sunken rock observed distinctly and repeatedly above water, in the hollow of the sea, which clashed together and broke much. Supposed the rock might be about 4 feet below the usual sea level: its circumference appeared to be about 40 feet; it was of a sandy colour, like freestone, and no weed appeared on it. Latitude, 47° 43′ N., long. 8° 4′ 30″ W.—*James Tasker*, master of the *Grace Darling*." We must leave the reader to form his own opinion on this. The last communication is, perhaps, worse than worthless; there was no sounding.

Devil's Rocks, in lat. 46° 35′, long. 13° 7′. (?)

We have here a most mischievous announcement, which has only lately been disproved by Capt. Pullen, as depths exceeding 1,500 and 1,800 fathoms exist near the positions named. The following are the announcements of this bugbear:—

M. Bellin, in his *Memoir*, of 1742, noticed, that in lat. 46° 55′, about 110 leagues W.S.W, of Ushant, there is a rock, even with the surface of the water, discovered by Capt. Brignon, of the *Constance*, of St. Malo, in 1737. The *Devil's Rocks*, in lat. 46° 35′, and long. 13° 10′, according to M. Delise, might be the same danger. They were particularly observed in 1764, by Capt. Thomas, of Havre de Grace, from whose communication to M. L'Abbé Diquemare, we find that, on the 23rd of May, 1764, Capt. Thomas observed, at noon, the lat. 46° 24′. The rock was seen, at a short distance, 3 feet above water, of a gray colour, covered with moss, and about 40 feet in diameter, in lat. 46° 24′, longitude about 13° 10′.

Again:—"The *Brothock*, of Arbroath, Capt. William Peter, 13th of November [1818], at noon observed a rock about 10 feet from the starboard quarter, about 2 feet under the surface of the water, in lat. 46° 35′ N., and the longitude, by mean of two well-regulated chronometers, 13° 7′ W. The sea recoiled around it, and broke on the top. Its circumference appeared to be about 40 feet.

This rock was said to have been afterwards seen by Captain Scott, of the cutter *Voast;* and again, on 25th of April, 1829, by Captain Henderson, of the *Fortescue*. The appearance, according to the latter, was that of a rock, of a brown colour, about 12 feet long, nearly as much in breadth, and about 2 feet above water. The latitude 46° 33′, and longitude 13° 2′ W. Captain Scott was of opinion that there are more heads of rocks than one; that which he saw was like the point of a sugar-loaf.

It was supposed to be seen, in 1829, by Captain Swainson, in the *Fortitude*, of Dublin, and described as in lat. 46° 35′, long. 13° 8′. They were subsequently sought for and seen by a commander, who has said, that the water was seen breaking upon them very high, and as it receded the rocks were discernible.

Lieutenant Sprigg, commanding H.M.S. *Brisk*, says:—"On the 6th of August, 1842, we were distant from the Devil's Rock, at noon, 35 miles, and, doubting its existence, I shaped a course directly for it. At seven p.m., my attention was suddenly attracted by a change in the colour of the water under the ship's counter, which had been of a blackish green; the change to whitish green was more vivid, extending in a N.N.W. and S.S.E. direction for 1½ miles, its greatest width close to our wake, about three-quarters of a mile, having very irregular and indented sides, in bold outline with the dark water surrounding it. A heavy swell from N.W. seemed smoother over the patch, without any visible break; but that it was a shoal no doubt exists on my mind, or on many that saw it. Our dead reckoning places the spot in lat. 46° 12′ N., long. 15° 3′ 30″ W."

On passing this way in the *Friends*, 17th of August, 1820, Captain Livingston says:—"At about 2^h 20′ p.m., supposed to be certainly to the southward of the *Devil's Rocks*, and looking over the lee-quarter, I saw what, at first sight, appeared to be a bottle, about 30 fathoms to leeward. The sea immediately covered it, and on its emerging again, it seemed like the back fin of a shark, in the wash of the sea, about 4 inches above water, and of a triangular form. A few moments afterwards, as I was attempting to point out the place I had seen it in to the mate, he remarked that he saw breakers off the boom-end; and, on paying attention to it, I plainly saw a light curl and break of the water for fully half a mile; but as the water was very smooth, the break was not great, though still plain enough, while no part of the surrounding sea broke. The result was an impression, that we had passed a large and very dangerous shoal, situated in about 46° 9′ 30″ N., and 12° 50′ W." *

Here are *ten* announcements of this supposed rock, *but not a single sounding.*

Capt. W. J. S. Pullen, in H.M.S. *Cyclops*, sounded with 1,500 fathoms, no bottom, in 46° 42′ N., long. 13° 5′ W.; and again in 46° 12′, long., 13° 3′ W., with 2,220 fathoms; but, from the unfavorable weather, it was considered that only 1,800 fathoms was the vertical depth without bottom.

This is negative evidence, but we have positive proof in the sounding obtained by Commander Dayman, of H.M.S, *Gorgon*, in Oct. 1858, when he got a good cast of 2,350 fathoms in 47° 6′ N., 125° 7′ W.: and again, by Lieut. Berryman, in the *Dolphin*, who got bottom with 2,190 fathoms, 60 miles to the South.

These settle the question of the Devil Rock.

Smith Rock, lat. 49° 36′ N., long. 16° 17′ W. (?)

The barque *Port Wallace*, J. W. Smith commander, June 27, 1856, states that he saw a small rock, 6 or 8 feet under water, and another with more water near it, lat. 49° 36′ 36″, long. 16° 17′ 15″.† This is impossible, both from its position, and from the fact of the U.S. ship *Dolphin* finding 2,700 fathoms, at 55 miles to the West of it.

Esmeralda Rock, lat. 45° 13′ N., long. 16° 48′ W.

The barque *Esmeralda* passed a supposed rock, lat. 45° 13′, long. 16° 48′, by imperfect D. R. It was thought to be 4 feet out of water by Captain Henderson, who was a passenger.‡ But Commander Dayman, in the *Gorgon*, in 1858, fonnd 2,250 fathoms at 45 miles N.N.E. of it, and 2,100 fathoms at 35 miles.

DVINA ROCK, off Cape Finisterre, lat. 44° 45′ N. long. 9° 40′ W. (?)

This announcement we received from Capt. Grote, of the Russian Imp. Navy, when in command of the *Dvina*, the vessel which was hardly chased by our men-of-war in the Pacific during the last Russian war.

"On Jan. 14—26, 1853, the foretop look-out descried breakers right ahead, and we discovered it to be a rock, It is on a level with the water. Our observations gave us lat. 44° 43′ 6″, and long. 9° 37′ 23″ W. The sea was perfectly white with foam for about 200 fathoms." Capt. Bessarabski made it to be in lat. 44° 48′, long. 9° 43′.

We have nothing to disprove the existence of this, but the position is remarkable. It must be left for future test.

The charts of Van Keulen, of the last century, showed a rock in 44° 43′ N., and 11° 22′ W.; but it has long been omitted as not authentic.

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* In the "United Service Journal," October, 1834, p. 199, is a lively description of a moonlight night at sea, during a gale, which concludes with that of a dreadful reef, supposed to be the *Devil's Rocks*. The communication is more in the style of a novelist than of a seaman, and there is not a word on the *situation* of the reef.—See, further, Capt. Livingston's communication upon this subject, "Nautical Magazine," December, 1834, p. 737.

† Naut. Mag., April, 1857, p. 221. ‡ Ibid., Dec., 1857, p. 675.

Lean Shoal, 45° 32′ N., long. 11° 57 W. (?)

"July 4, 1854, 6 p.m., perceived a shoal rock with heavy breakers right ahead; appeared to extend about an inch to the north-eastward."—Capt. *Lean*, schooner *Mary.—Shipping Gazette.*

The remarks on the Devil Rock and the Dvina Rock, in this quarter, are also applicable to this.

Mayda (?) 1705.—*Clark's Rock* (?) 1842, lat. 45° 40′ long. 10° 17′ W. (?)

Mayda (?)—This vigia appears, on the French chart of 1766, in lat. 46° 48′, and long. 19° 50′. The latitude, according to Bellin, is uncertain, and its longitude more so. A report, made to the Admiralty of Bordeaux by Pierre Nau, in October, 1705, states it to be a *little white island.* There is a note concerning it in the French Depot, but it disagrees with the report of Pierre Nau. Captain Baden, in the ship *Marie*, when returning from Martinique, April 10th, 1738, discovered Mayda, which, according to his observation, he found in lat. 46° 10′. He remarked *five heads of rocks*, and a breaker of 6 or 7 feet high on the danger.

This is the original information on this spot. But it was revived by the following: —"On board the bark *Hartley*, W. B. Bradford, master, bound from Sierra Leone to Plymouth, passed, on Friday, 26th August, 1842, at half-past 5 o'clock, p.m., in lat. 45° 40′, long. 19° 17′ W., at the distance of three-fourths of a mile from the ship, a *double-headed rock*, which, during the fall of the sea, was uncovered to the height of 6 or 8 feet. The sea broke over it with a gentle spray, and during the rising and falling of the water it was observed to be of a *dirty white colour*, interspersed with dark coloured patches. *Robert Clark*, Senior Assistant-Surgeon to the Colony of Sierra Leone."—*Nautical Magazine*, 1842, p. 852.

This might, possibly, have been the carcase of a whale, but here is another:—"When going out to the West Indies, in 1840, in lat. 46° 36′ N., long. 19° 30′ W., I saw a rock within 100 yards, of a conical shape; it appeared about 4 feet out of water, in the trough of the sea. I should think it would be under water in a smooth sea.—*D. England.*

The general depth of the ocean hereabout, above 2,000 fathoms, throws every doubt upon these statements, unsupported by soundings.

The Five Heads, in lat. 44° 15′, long. 19° 25′ (?).

Under this denomination the French chart of 1766 has a rocky shoal some part above water, in lat. 44° 10′, and long. 19° 25′. It is marked some minutes more to the North on the charts of M. Van Keulen. No account of it is, however, given either by him or Bellin; nor, although sought after, has any account of it yet been found. Capt. Dayman found 2,375 fathoms near the spot.

Chaderton Reef, lat. 44° 56′ N., long. 23° 51′ West. (?)

"On my passage from Caldera to Liverpool, April 20th, 1858, passed a reef of rock covered with water. Owing to the strong breeze blowing at the time, I was unable to make further observation." T. H. Chaderton, commanding the barque *Salween.*

At 30 miles S.SE. of this, the *Dolphin* found the depth of 1,500 fathoms.

Laidman Rock, lat. 46° 0′ N., 26° 0′ W. (?)

Probably a volcanic shock.

Isle Verte, (?) or *Green Rock*, (?) 44° 52′ N., and lon. 26° 25′ W. (?)

This *imaginary* rock, the *Green Island* of the old charts, has been omitted in others, on the authority of Messrs. Verdun and Borda, who have said, "On M. Bellin's chart of 1766, in lat. 44° 52′, and long. 26° 35′, is an *imaginary* island, named the Islé Verte, or Green Island. In the memoir of 1742 we find nothing concerning this island, but that the 'Isle Verte is marked according to *Le Boccage.*' It appears on the English chart of Jeffery's, in lat. 44° 45′, and long. 26° 10′, and is supported by no better authority.

Captain Tulloch, of New Hampshire, stated that an acquaintance of his, Captain Coombs, of the ship *Pallas*, of Bath, in Maine, keeping a look-out for Green Island, actually saw it, being a very fine day, and the water remarkably smooth. He went out in his boat, examined it, and found it to be a large rock or stone, covered with green herbage, or moss, *some of which he pulled off*. The rock did not seem much larger than a vessel with the bottom up, and it was very smooth around. The summit was higher than a vessel's bottom would appear out of the water, being about 20 feet high above the sea. Captain Coombs remarked that if it had not been so high, he should, when he first saw it, have supposed it to be a vessel which had been upset. But a depth of 1,500 fathoms has been found near the spot.

Greeve's Ledge, in lat, 44° 15′, long. 25° 5′. (?)

This is stated to have been seen by the Dutch ship *Anna Catharine*, Captain J. Greeve, July 7, 1745, and to be nearly level with the sea. It is said to have been seen by Captain Currie, of the brig *Diana*, of Port Glasgow, 1811. Captain H. T. D. Sickens, of the Dutch Marine, sailed over the spot in 1846, without seeing anything of it, with a good look-out. It lies midway between two soundings of 1,500 and 1,850 fathoms.

MIDGLEY SHOAL. in lat. 44° 9′ 30″, long. 22° 57′ 45″.

This shoal was discovered by Captain Thomas Midgley, in 1838, who describes it as follows:—"On the 14th of June, 1838, at 2h 40′ p.m., on my passage from Africa to Liverpool, I suddenly fell in with a large patch or belt of discoloured water, of a dirty gray appearance, much resembling river water, and *rippling very much*, as if upon a shoal bank. No rock nor danger could be seen from the mast-head, but the water appeared very much discoloured for more than half a mile in breadth, as far as the eye could reach, in a direction N.W. and S.E. by compass.

"The vessel passed at a quarter to half a mile from the S.E. point or extremity of it, which lies in lat. 44° 9′ 30″ N., long., by an excellent chronometer, 22° 57′ 45″ W. of Greenwich, and by account from Flores, 23° 5′ W.; the latitude deduced from the sun's meridian altitude, taken on the same day, with two excellent sextants, and the chronometer ascertained to be correct off Flores four days previously, and subsequently when off Holyhead in St. George's Channel. The altitudes for the time were taken a few minutes after passing the danger, and when it was still within 1 mile from the vessel.

"In appearance this water very much reminded me of the shoal ground near Nantucket, and those on George's Bank; had it been caused by ice, some would have been seen upon the surface; if by fish, there would have doubtless been many birds hovering about, which was not the case.

"At the time I saw this danger, I was running with a favourable breeze and clear weather, and the contrast between the deep blue colour of the water, in which the vessel was sailing, and that of the danger I allude to, was noticed by every one on board.

"I sincerely regret my inability of closely examining the shoal, owing to my crew being on short allowance of provisions and water, in consequence of a long prevalence of light and adverse winds."

The late Captain Midgley was a man of perfect veracity, but the appearance might have arisen from other causes. At present we have nothing ts contradict it.

Woodall's Rock, near lat. 43° 20′, long. 25° 10′. (?)

"Ship *Indemnity*, from Demerara to England, 1829, at 30′ p.m., discovered a rock on her starboard beam, distant about three ships' length; a heavy swell from the N.W. With each succeeding swell the rock was entirely covered, but at intervals it showed several feet above water, and perfectly perpendicular. From the mast-head it was seen to a great depth below the water, and appeared to be in the shape of a cone. At the preceding noon the latitude, by observation, was 43° 20′ N., longitude, by chronometer, 25° 10′ W. At 28 miles N.N.W. 1,850 fathoms have been found."

AMPLIMONT ROCKS, in lat. 42° 51′, long. 24°.

In M. Bellin's Memoir of 1742, a danger is mentioned in lat. 42° 30′, long. 24° 5′, which was seen in 1735 by M. Guichardi, commander of the ship *Dauphin*, of Nantes. It has two points of rocks separated, and 30 feet above water. He ascertained the height within a league of the danger, which appears to be the same as that called *La Basse d'Amplimont*, stated to be nearly in the same latitude and longitude. We have given it the position originally assigned by the Memoir. Some Englishman has called it by the name of *Edmund Knowles's Rock*, by whom it is supposed to have been seen.

These rocks, appearing like the two masts of a brig, and nearly in the position assigned, were seen by Captain Mills, in the brig *Tamer*, early in 1829.

"On the 13th of May, 1842, I sailed from Paimbœuf for Quebec, with the wind at N.E. We had a fine run to long. 19° 44′ W. On the 23rd of May (at noon, in lat. 42° 31′ N., by two good observations, and long. 24° 3′ W.), at 7^h 20′ p.m., I passed a rocg within two ships' length. When I first saw it, it was a little before the larboard beam, and appeared like a ship's anchor buoy. When it came upon the quarter, I saw the sea-weed quite plain upon it, as did also the watch on deck. Another part of the rock we saw under water, about 8 or 10 feet from the rock we saw above water; at intervals it was covered and uncovered. We had not much swell on at the time, fine pleasant weather. At the time of passing the rock the ship was in lat 42° 51′ N., long. 24° 15′ W. The rock was seen a considerable time after we passed it. Wind at the time W.N.W. Ship's head, North, going 3 and 3½ knots per hour."—*Captain Thomas Alderson, of the Morning Star.*

It was also said to be seen by *Captain L. W. Duff*, of the *Esperance*, on his voyage from Valparaiso to Swansea, on Nov. 19th, 1846. He was looking out for the Amplimont Rocks, scarcely expecting to meet with them, when he was startled by a large and dangerous rock, with two pointed summits in the hollow of the sea, not ten yards off on the larboard beam. He could see no more of it after passing, nor the sea breaking on it, which it would do in bad weather. He had the day before passed Corvo, and found his chronometer accurate, and also the same on making Lundy Island. His position of it is lat. 42° 56′ N., long. 24° 30′ W. We have given the mean of this and that by Captain Alderson as the position.

We have no direct evidence to contradict this, and therefore it must be left for future decision. In all the cases cited there was no attempt at *verification*.

Henderson or Chaucer Bank, lat. 42° 45′ N., long. 29° 0′ W. (?)

The ship *Chaucer*, Captain Robert Henderson, from the Mauritius to Glasgow, states that:—

"On October 28th, 1850, at noon, we were in lat 42° 4[illegible]′ N., long. 28° 45′ W., steering N.W. by W. (*true*), with light variable winds from the eastward, and fine clear weather. Having previously observed that the water had changed colour about 10 a.m., and since that there was a sensible ripple, at 2 p.m. I sounded, and found hard bottom at 48 fathoms; the distance run since noon about 6 miles.

"At 4 p.m., having steered the same course, in lat. 42° 49′ N., long. 29° 4′, sounded and found 50 fathoms, and at 6 p.m., having run about 6 miles, found 70 fathoms, rocky bottom.

"From observing the change of colour and ripple at the surface of the water, at 10 a.m., and having sailed from that time up to 6 p.m. nearly N.W., the bank may probably extend considerably to the S.E. of the position where I took my first sounding at 2 p.m."—*Shipping Gazette*, November 10th, 1850.

This appears quite circumstantial, but yet 1210 fathoms was found, by U.S.S. *Dolphin*, at its S.E. extremity.

The Three Chimneys, in lat. 47° 54′, long. 29° 40′. (?)

This vigia is said to have been seen on the 10th July, 1829, by Captain de Clas

Fernel, who approached within 2 leagues of it, and who remained two hours in sight of it, and appears to be one which a M. de Merry has mentioned. The charts vary with regard to its position.

Thus much we have stated in our former editions; but Mr. Heron, of Greenock, in 1824, adds, "I am informed by the master of a merchant-vessel, that the Chimneys actually exist; for a whole watch, as well as himself, saw them. They were seen about twilight, and three heads were distinguished."

Captain Roallons, in the brig *Eagle*, says that he passed a rock above water, at the distance of about 4 miles, on the outward passage from Hamburgh to Newfoundland, on July 29th, 1842, "in 47° 37′ 22″, long. 28° 51′; it formed *three distinct points;* the highest to the westward appeared to be about 80 feet high, the sea breaking violently over the lower part, near the eastern extremity, but no appearance of shoal water around it."

This must have been *ice*. A depth of 1900 fathoms has been found in the first-named position by the *Dolphin*.

Mariner Rock, 46° N., 29° 35′ W. (?)

This rock, said to have been seen in 1831, by Mr. Swinton, is also placed 25 miles further West; but it lies between two soundings of 1760 fathoms.

Gough's Rocks, or Harrison's, in lat. 40° 28′, long. 30° 0′. (?)

These rocks appeared in the chart of M. Rochette, 1778, with the words, "Rocks seen by Captains Gough and Birch." Vankeulen and Bellin have indicated several dangers in the vicinity to the N.E., but their existence has been denied by the pilots of the Azores.

Captain Livingston says:—"Captain Beauford, of the brig *Concord*, of North Yarmouth, told me at Malaga, in 1820, that he twice saw Gough and Birch's Rocks, when bound from Newfoundland to Lisbon; that one of them is about 12, and the other 3, feet above water; and that they lie nearly in the longitude originally assigned them in the charts, but 5′ more to the northward."

Another report states, that Gough's Rocks were seen by Captain Harrison, in the brig *Hope*, from the Sierra Leone to Cork, 17th April, 1830, lat. 40° 16′, long. 33°. At 11 a.m. two rock appeared close under the lee-quarter. In smooth water these rocks would be even with the water's edge, and in the hollow of the sea Captain Harrison could distinctly see six or eight down in the water.

These statements are vague, and it is improbable that they should have escaped detection by the pilots and others frequenting the Azores. The bottom, however, is not so deep here as elsewhere, for 830 fathoms fathoms only was found 20 miles to the North of Gough's position.

Beazley Shoal, in about lat. 40° 45′ N., long. 36° 47′ W. (?)

In the chart of the Atlantic Ocean, drawn up by M. Rochette, and published by him in 1778, there is a shoal of 5 fathoms, stated to have been seen in 1769 by a Spanish ship in lat. 40° 26′, long. 36° 5′.

"Captain E. W. Beazley, then commanding the bark *Castries*, from the West Indies to London, on Sunday, June 20th, 1841, at 6h 20′ p.m., passed a shoal half a cable's length to the northward of the ship; it appeared about the size of a large ship's quarter-deck, with the sea-weed almost awash with the water's edge; the sea rolled over it, but *did not break*. The latitude and longitude places it in lat. 40° 45′ N., long. 36° 47′ W."

This statement, which certainly does not appear to be lightly made, but it seems to have probably been a floating *wreck*.

Spanish Shoal, 1769. (?) *Wahlstein Breakers*, 1857. (?)

A shoal was inscribed vaguely in the old charts in 40° 26′, long. 36° 5′, as having been seen in 1769 by a Spanish ship.—"Atlantic Memoir" 1812, p. 131.

Captain C. J. Wahlstein, commanding the Russian barque *Runeberg*, on September 6th, 1857, was in 40° 26', long. 36° 13', passed through a very rough sea, which in a moment commenced breaking over the vessel, and continued for 20 minutes. The water also changed colour for the same period, with all appearances of shoal water.—"Nautical Magazine," p. 565.

There is at present nothing to contradict this statement.

Jaquet Island, in lat. 46° 55', long. 30° 30'. (?)

Stated to have been seen again in 1789, but disbelieved.

A letter from Jersey, 3rd of April, 1838, states that *Jaquet Isle*, in about 46° 55' N., long. 32° 29' W., was seen by the brig *Sea-flower*, of Jersey, at 5 a.m., on the 25th of April, 1836: the weather fine and clear; but no bottom was found at 100 fathoms. The isle appeared to be half a mile in length, and about 300 feet, or 100 yards, high above the surface of the sea. This must have been an *iceberg*, although Mr. Le Gros, mate of the *Sea-flower*, declares that it was *not*. The depth hereabout is 2,000 fathoms.

Beaufort Bank, lat. 42° 37', long. 41° 45'.

Lieutenant A. Sainthill, R.N., commander of the ship *Beaufort*, on returning from Jamaica, August 3, 1832, when in lat. 42° 37', long. 41° 45', observed the water to be discoloured; in consequence of which he twice tried for soundings, and found rocky ground at the depth of 100 fathoms. But Commander Dayman found no bottom with 3,000 fathoms up and down in 42° 07' N. and 41° 28' W., about 32 miles off in September, 1858.

Notwithstanding that Commander Dayman's sounding of 3,000 fathoms so near Lieutenant Sainthill's position (which, however, he is not confident to half a degree of longitude), would apparently disprove its existence, yet Lieut. Sainthill has repeated his statement:—"I can only tell you that I am perfectly convinced that we touched bottom, which Captain Dayman would call an excellent up and down cast. The arming of the lead showed sharp rocky bottom of fine bluish ashes, and my opinion is that we were over a submarine volcano in a state of eruption.—("Naut. Mag.," 1851, 209.)

We must leave these two statements to be reconciled by future investigations.

Druid's Reef, in lat. 41° 19', long. 41° 25. (?)

On the 12th of April, 1831, Captain Treadwell, in the *Druid*, of London, passed this reef on his starboard hand, at not more than 30 yards distant. The reef had the appearance of from 7 to 10 sugar-loaf heads, and its length, from E.N.E. to W.S.W. was estimated at 10 to 14 feet. It was about 3 feet above water.

A reef was heretofore inserted from the Spanish chart, as seen in 1803, lat. 41° 24', long. 41° 26'; but we are not acquainted with the authority under which it has been there introduced. It may possibly be a rock, said to be seen by *Desmaires*, a pilot, in 1683, who reported that it appeared at the height of a sloop above the water. Bellin assigned to this danger lat. 42° 0', long. 41° 10'. The Spanish chart also exhibits another *vigia*, said to have been seen in 1798, lat. 43° 30', long. 37° 35'. All these were more likely to be of *ice* only.

Hervagault's Breakers, in lat. 41° 2', long. 49° 23'. (?)

They were inserted originally upon the authority of M. Hervagault, commander of *Le Conquerant*, of Nantes, 26th of June, 1723, who described them as composed of two parts, between which he was forced to pas. The sea between was very clear, and broke heavily upon the dangers.

Again, on the 12th of May, 1827, Captain Maxwell, of the ship *Home*, on his passage from Liverpool to New York, fell in with three sunken rocks, with a tremendous sea breaking on them, apparently from 4 to 6 feet under the surface, in lat 41° 2' North, long. 49° 23' West, and about 30 feet in circumference; the last of them tailed off to the north-eastward with a long ledge. It was again said to have been seen on

June 20, 1855, by *N. T. Marquand*, master of the schooner *Mentor*, of Jersey, and appeared to be about 3 feet above water, when it was passed about a mile off. Good observations made it in lat. 40° 27', long. 49° 56' W. In 1816 it was said to be seen by Captain Lourp, of the brig *Alexander Savage*, who places it in lat. 41° 6' 23" N., and long., by dead reckoning, 49° 57'.

The position is almost conclusive against its existence, but Captain Maxwell's observations demonstrate that it was ice that he saw, as is probably the case with the others.

Daraith's Rocks, in lat. 40° 50', long. 54° 53'. (?)

M. Bellin, in his Memoir, of 1742, has said that this danger was seen on the 28nd of August, 1700, by M. Daraith, who approached within 1½ leagues of it, then sailed round it, in order to observe it well, and took an altitude within sight of it. The rock is described as extending 1½ leagues, being three-quarters of a league broad. This was manifestly *ice*. Its existence is disproved by Lieut. Berryman finding 2,710 fathoms on the spot.

Watson's Rock, lat. 40° 18', long. 53° 40'. (?)

Captain T. A. Watson, of the *Harbinger*, writes:—"April 28th, 1824, at eight a.m., moderate weather, a man saw something ahead; the helm was immediately ordered a-weather to clear it; being only 15 or 20 fathoms to leeward of it, which enabled me to distinctly make it out to be a rock, just even with the water. It was covered with weed, similar to that on half-tide rocks; it was of a light green, with some branches of a red colour. It was at times, on the top of a sea, invisible; but in the hollow of a sea, several feet uncovered. I observed the sea to break on it twice, causing a spray, as any pinnacle-like substance, with deep water around it, might be expected to do. The lead was hove as soon as it could be got forward, but there was no bottom at 90 fathoms perpendicular. From an excellent observation at noon I consider it to lie in lat. 40° 18' N., long., by dead reckoning, 53° 40' W. The water for several miles around it was dark, as if on soundings."

It is very improbable that this can exist in the fairway between Europe and America without having been frequently seen.*

THE VIRGIN ROCKS, to the E. by S. of CAPE RACE; lat. 46° 26' 30", long. 50° 55' 20".

These rocks form a dangerous reef, lying about 30 leagues *E. by S., true*, from Cape Race; in gales of wind a heavy sea breaks over them, and a strong current, which sets about them, often increases the danger.

The existence of the Virgin Rocks having been questioned, it is proper to communicate the following extract of a letter, addressed by Arthur Kemp, master of the brig *Indiana*, of Dartmouth, to the publisher of the *Newfoundland Gazette*:—"On the 23rd of October, 1823, at noon, I left Cape Broyle, after a strong gale from S.E., with the wind at W.N.W., steering S.E. by S. The following morning, at eight a.m., having run 84 miles, I was alarmed with the cry of 'Breakers a-head!' and almost immediately saw them to such an alarming extent as obliged me to alter the course from S.E. by S. to E. by N., it not being possible to clear them on the other tack. After giving the breakers a good berth, and leaving them to the southward, distant 4 miles, I hove the main-topsail to the mast, and lay by from ten o'clock till noon, and observed in lat 46° 35, long. 50° 51'; the extent of breakers appeared to be

* Marco Carmelich, commanding the Sicilian brig *Anna*, at three p.m., June 8th, 1841, observed a shoal to the South, distance about 2 miles, appearing like a ship with three masts of equal height, and inclining toward the South, and about 50 feet high, surrounded by shoals level with the water; lat. 39° 32' N., long. 50° 50' W.—("Nautical Magazine," November, 1841, p. 781.) This is manifestly an *iceberg*, worn into pinnacles in its southern progress; but perhaps it is necessary to notice it here, as it has been placed on a recent chart as a permanent danger.

about 2 miles, and were more tremendously alarming than I have ever experienced during the 23 years that I have (chiefly in this trade) commanded a vessel."

The reef has since been surveyed by Mr. Rose, master of H.M.S. *Tyne*, who, with Captain Bishop, of H.M. brig *Manly*, has ascertained its situation. The following are the particulars:—

The bank on which the shoal is situated extends E. by N. and W. by S. 4½ miles; its broadest part is about 2¼ miles. The soundings are regular from 28 to 30 fathoms, until they deepen suddenly on the outer edge to 39 and 43.

The rocks themselves are in 46° 26′ 30″ N., and 50° 55′ 20″ W. They extend in an irregular chain S.W. by W. and N.E. by E. 800 yards, varying from 200 to 300 yards in breadth. The least depth of water is on a white rock, in 4½ fathoms, with 5 to 6½ fathoms all round it; the bottom distinctly visible. Toward the extremities of the shoal are several detached rocks of from 7 to 9 fathoms, with deep water between, and with a current setting over them W.S.W. 1 mile an hour; and with also a very confused heavy swell.

The vessels were anchored upon the rocks for the space of two days, during which the weather was extremely pleasant, and every way favourable for taking the most accurate observations. The surrounding bank has been noted as a good fishery. Variation, 26° 30′ W.

SHOAL on the BANK of NEWFOUNDLAND, East of the VIRGIN ROCKS, lat 46° 30′.

A shoal, with only 21 feet water on it, was discovered by Jesse Ryder, master of the fishing schooner *Bethel* (belonging to Province Town, Massachusetts), on the Grand Bank of Newfoundland. In lat. 46° 30′, having observed on the shoal, saw it distinctly, it being a rock of about 100 or 203 feet surface; supposed it to be about 50 miles East of the Virgin Rocks. Shoal bears from Nine-fathom Bank S. by W., by compass, about 1½ miles; discovered it accidentally while searching for the Nine-fathom Bank to fish on. Was certain it was not any part of the Virgins, for I afterwards saw them, and, from my experience of the different fishing grounds, know this shoal to exist.

Pass by

CASHE'S LEDGE, in lat. 42° 56′ N., long. 68° 51′ 30″ W.

"This is a dangerous reef, about half a mile in extent each way. Its soundings are very irregular, having from 10 to 4 fathoms in the length of a boat. There are 17 fathoms within a cable's length of it, deepening a short distance to 90 fathoms, on the western side. On approaching the shoal you may find 60 to 35 fathoms, brown sand, with black stones and broken shells; then 30 fathoms, where it becomes rocky. The currents on the ledge are exceedingly rapid and devious. On the shoalest part there are said to be only 12 feet at low water. By observations made, on four successive days, by the master of H.M. sloop *Beaver*, the latitude is 43° 1′ 0″. The longitude has been deduced from that of Cape Anne as from 69° 6′ to 69° 12′."

Such is the statement, exactly as it appeared in this Work since the year 1815, respecting this dangerous rock. Yet by a recent examination by the United States' coast survey, by Passed Midshipman Ammen, it is recommended to be called *Ammen's Rock*. As we see not the slightest reason for such change, notwithstanding the difficulty and perseverance shown in its exploration, the original name certainly must remain.

The latitude of the rock, deduced from the two days' observations, June 5th and 6th, 1849, is 42° 56′; the longitude 68° 51 ¼′ W. The least water on this rock is 26 feet; a less depth has been reported by the fishermen, but they sound with their fishing lines, perhaps not accurately marked, and with a lead insufficient to press down or pass through the thick kelp that covers the rock. The extent, having less than 10 fathoms, is about half a mile in a N.W. by W. and S.E. by E. direction, and very narrow. It is surrounded by deep water at a short distance, particularly on the S.E. side, where the depth increases suddenly to 60 fathoms.

SHOAL GROUNDS on GEORGE'S BANK.

These shoals were formerly described under the respective names of *Brown's Bank* and the *Malabar Shoal*, by neither of which names are they now recognised. A copy of the report of an actual survey of them, made under the orders of Commodore Isaac Hull, by Mr. Felch, of the U.S. navy, and Mr. Edmund Blunt, jun., is contained in the "Colombian Navigator," vol. i. p. 56. From this report it appears that there are, properly, four shoals on the bank, the whole of them included between latitudes 41° 34′ N. and 41° 53′ 30″ N., and longitudes 67° 18′ W., and 67° 59′ W. The largest, which is toward the S.W., is also the most dangerous. Between the shoals are from 15 to 35 fathoms of water.

But these shoals have been accurately surveyed by *Lieutenant Charles Wilkes*, of the U.S. navy, and the officers under his direction.

It appears by this survey that the general direction of the shoal ground is N,W. by N., and S.E. by S., and it extends 13 miles in length, and from 1 to 2 miles in width; the depth of water within this space being 10 fathoms and less, but very irregular. The two shoalest places are between 41° 40′ 13″ and 41° 40′ 33″ N., and 67° 44′ 10″ and 67° 40′ 30″ W., and are knolls of hard sand, having upon them, at low tide, 15 feet of water. With the exception of these two places, the shoal may be crossed in any part by an ordinary sized vessel without danger. There is a rip usually the whole length of the shoal, and, at times, heavy breakers in the shoalest places.

Some other shoal patches of 5 fathoms lie at 28 miles to the S.W. by S., and 44 miles S.W. by W. of the shoalest spot, and are called the *Little George Bank.*

NANTUCKET SHOALS, extending from NANTUCKET ISLAND.

These very dangerous shoals, lying immediately in the line of traffic of the coasting trade of the United States, have been but very little known till within a very few years; and then their limits were more exactly defined at the expense of a private individual, Mr. E. M. Blunt, of New York. These "Goodwin Sands" of the United States now, however, appear to be tolerably well examined, though still some doubt has been expressed as to whether their entire extent has been ascertained.

They have been surveyed by Lieutenant Charles H. Davis, U.S. navy, superintending the hydrographic parts of this portion of the coast survey. The danger of these formidable shoals are reduced by the new lighthouse on *Sankaty Head*, completed in 1849. This tower is 70 feet high, painted in three horizontal rings, and shows a dioptric flashing light; and also by the *Light-vessel*, which lies 2 miles to the S. of Davis' South Shoal, showing two fixed lights. Some particulars are given of them on page 649.

America Rock, lat. 40° 20′ N., long. 63° 50′ W. (?)

The commander of the bark *America*, of Baltimore, thought he had discovered a rock projecting from 25 to 30 feet above water, and about 300 feet in circumference, September 1, 1846: lat. 40° 20′, long. 63° 50′. It is very improbable indeed that this could have been a rock; it looks more like a *wreck*, from the fact of its being in the highway of shipping, and its locality having been crossed at least four times by the *Great Liverpool* steamer alone, in 1838-39. It may have been a large tree, perhaps brought down by the Mississippi, and launched into the Mexican Gulf. An example of this is given by Captain G. P. Lock, of the *Martha Shalla*, of Liverpool, who, being becalmed in the neighbourhood of Munn's Reef (or lat. 39° 45′ N., long. 64° 10′ W.), was surprised to hear the announcement of a boat's approach; but, on referring, it was supposed to be Munn's Reef. A boat was got out to survey, when it was found to be a very large tree, roots upward, and 40 feet in circumference, and surrounded with shoals of fish. Had it not been so closely examined, it would have been again announced as Munn's Reef.

IMAGINARY SHOALS.

Land of Bus, to the S. of Iceland, in lat. 58°, long. 30° W. *Vigia* of 1746, lat. 55° 24′, long. 24° 40′ W. *Ramigeau's Vigia*, 1750, 40° 42′ N., 37° 30′ W.; and another vigia half a degree northward. *Barencthy's Rock*, 1726, lat. 45° 50′, long. 37° 25′. *Negres Rocks*, 1722, lat. 48° 7′, long. 21° W.

BETWEEN THE LATITUDES OF 30 AND 40 DEGREES.

DÆDALUS ROCK, off CAPE ST. VINCENT, in about 36° 30′ N., and 9° 16′ W.

The old charts of the Atlantic indicated a danger at the distance of 12 or 15 leagues to the S.W. of Cape St. Vincent. This danger was omitted in the French chart of 1786, and subsequently in other charts, from the supposition that, if it really existed, it must have received some modern confirmation. But it seems, from information communicated by Captain Taylor, of the brig *Laurel*, of Whitby, that, in about 1813, the *Dædalus*, transport, struck on this rock, and received so much damage as rendered it necessary for her to put into Lisbon for repairs. Captain Taylor was in the fleet when the *Dædalus* struck.

Added to this, the brig *Briton*, Captain Stokes, was lost, in consequence of striking upon the rock, in December, 1821. After she struck she swung off, and then immediately tried for soundings, but got none. On finding the vessel striking, the people took to the boat, and were picked up by another vessel. Captain Stokes had not seen Cape St. Vincent, but supposed it, at the time, to bear N.N.E. ¾ E. 28 or 30 miles. This information has been communicated by Captain Livingston, who says, "This information was given to me in Malaga, in September, 1822, by Captain T. Tankersly, of the schooner *Lord Mulgrave*, of London. Captain Tankersly added, that he had met with another master (name forgotten), who said he had observed the sea-weed on this rock; got out of his boat, and held on by some of the weed. He supposed the rock to be about 50 yards in circumference."

The preceding information is from Captain Livingston, who also says, "I was some years since informed by an old man of colour, a native of Goa, who was steward of a vessel I then commanded, that, while he was cabin-steward to Sir Edward Pellew, while captain of H.M.S. *Indefatigable*, she struck on a rock off *Cape Finisterre*. This, I understand, has been denied, and it appears truly; for I have now information on which I can rely, from a very respectable naval officer, whose name I do not consider myself at liberty to mention, that the *Indefatigable*, when commanded by Sir Edward Pellew, actually struck on the rock, or a rock, off *Cape St. Vincent*, and received some damage. I had no doubt, before, that she had struck somewhere, as I had perfect confidence in my old steward's veracity: the error was in memory only."—(*Letter*, *28th October*, 1822.)

The existence of this rock was affirmed on the 6th of March, 1839, by Mr. John Aves, commander of the schooner *Tantivy*, of Plymouth. At 9h 30′ p.m., this vessel, on her voyage from Zante, passed close to the eastward of it; it was not seen till close aboard, and not avoided without difficulty. There was a swell from the N.W. breaking over it, and a sheet of foam, about 20 to 25 fathoms in circumference. The *Tantivy* stood in N.N.E. on the starboard tack, till 7 next morning, then tacked to the southward, passing the cape at the distance of about 2 miles. The rock was thus estimated to lie considerably to the eastward of its position, as shown by chart, and to bear about S.S.W., *true*, 37 or 40 miles from the cape.

We must leave this for the present. It is a blot on the charts. Its existence ought to have been set at rest many years since.

Cleveland Reef, off CAPE GHIR. (?)

This reef, or bank, said to have been discovered by Captain Cleveland, R.N., in 1795, in lat. 30° 45′, at about 9 leagues from the coast, was diligently sought for by the *Ætna* and *Raven*, on survey, in 1835, without success; and it has been accordingly erased from the charts.

FALCON ROCKS, to the Northward of PORTO SANTO.

The situation of these rocks has been already given in the description of the Madeiras, p. 582. They had previously been vaguely and erroneously described as a bank, on which Francis Doublet, of Honfleur, grounded, to the N.E. of Porto Santo; and as a ledge on which a Dutch ship was lost. It is most probable that it is the same shoal as the Eight Stones, next described.

The Eight Stones, to the Northward of MADEIRA. (?)

A very extensive and dangerous reef, according to M. D'Aprés, was supposed to have been discovered by a Captain Vobonne, of London, in 1732, and subsequently seen by a vessel going to the West Indies. Eight rocks were said to be seen, even with the surface of the water, and situate between 34° 30′ and 34° 45′ N., near the meridian of 16°.40′ W. This object, therefore, for more than a century past, was alarming the navigator; but sufficient evidence has been given to prove its non-existence in the deep sounding of 2,298 fathoms gained in the U.S. ship *Dolphin*.

The routes of the following ships and vessels of the British navy are also conclusive:—On the E. and N.E. of the assumed position, we find, in 1828, the *Southampton* and *Chanticleer*: in 1829, the *Blossom*; in 1832, the *Beagle*; in 1833, the *Ætna* and *Raven*: more to the West, beyond the meridian of 16°, in 1825, the *Martin*; and in 1828, the *Emulous*: beyond these, westward, the *Raven* and *Sulphur*, in 1836; and the *Blossom*, in 1825, which passed from the northward directly over the spot. In 1831, the *Ætna* likewise passed over it, and pursued her course thence toward Porto Santo. The *Ætna* again, in 1836, more to the West, sounded near the meridian of 17°, but found no bottom at 200 fathoms. The same ship, in 1833, passed in an East and West direction directly over the supposed centre of the shoal, but found no bottom at 70 fathoms.

MOSSMAN ROCK, lat. 43° 41′ N., long. 28° 51′ W.

The harbour master of Hartlepool announced the discovery of a rock a few feet above water, by his brother, Captain Robert Mossman, in command of the *Edward Kenny*, April 22nd, 1854, in the above position. It was confidently believed to be a rock, but no means are stated to have been tried to test it.

The repeated announcements of rocks in this neighbourhood, as is shown, although they do not hardly in any case appear to be seen again in the positions claimed for them, and the evidence of the deep soundings is against several of them, yet this repetition of discovery leads to the inference that some such rock as Mr. Mossman describes, may lurk hidden here, and has given rise to these reports.

Pronk Rocks, West of the Azores, lat. 38° 32′ N., long. 33° 16′ W. (?)

Captain A. Pronk, of the Dutch bark, *De Hoop*, reported, that on his passage from Batavia to Rotterdam, in the North Atlantic Ocean, near the Azores, April 6th, 1844, in the afternoon, sailing with a strong breeze and fine weather, being on their quarter-deck with his officers, they were much alarmed by some of his people in the foretop calling out that they saw a large rock close by on the lee-bow. The captain immediately ordered the helm to be put down, and the vessel luffed up 3 or 4 points to avoid the danger; with astonishment they saw several rocks, plainly visible from deck to every man on board. They passed them within a cable's length, and Captain Pronk says that it was an extensive group of rocks, with several points above water, some of them more than 16 feet in height, against which the sea broke furiously. The captain places this danger in 38° 32′ N., and 33° 16′ West of Greenwich, by very good observations and chronometer; the next day they saw the Western Islands, and found the longitude by chronometer very exact.

The foregoing was communicated from the Dutch newspapers to the *Nautical Magazine* by Captain F. Fohkens, of the Dutch ship *Roon and Pendrecht*.

The site was sailed over in 1845 by Captain Siekens, of the Dutch Marine. Besides the circumstance of the asserted discovery not having since been verified, there is a positive evidence of the depth of 1,500 fathoms at 25 miles N.W. of it.

Constante Reef, lat. 37° 56′ 20″, long. 33° 4′ 8″; and *Ferreira Reef*,
lat. 38° 26′ 44″, long. 30° 25′ 10″ W.

The official notice of these two reefs we find in the *Nautical Magazine*, December, 1840, p. 881, as follows:—

"I, Manoel Mariano Ferreira, pilot, while navigating from Paraiba to Lisbon, on board the Brazilian brig *Constante*, as master and chief pilot thereof, and being to the westward of the Azores, near the parallel, and not very distant from the meridian of the reported Martyrs or Azores reef; at 10 a.m., on the 26th of August, 1840, sailing in a northerly direction, with light winds from the E.S.E., saw breakers to windward, at the distance of 1 or 2 miles. Shortly after it fell calm, and my vessel remained in the same position for six hours, add in sight of the said breakers, so that I got the boats out to keep her head away, and tow her out of danger. At noon, it being then high water at that place, the surf had nearly disappeared; at 2 p.m. it again became perceptible, and at 6 p.m. a group of rocks was clearly visible above the water. By the latitude I had observed at noon, and the longitude given by a good chronometer, and the rock being about 1½ miles distant from me, I compute their situation to be in lat. 37° 56′ 20″ N., long. 33° 4′ 8″ West of Greenwich.

"As the wind freshened, at 6 p.m., I made sail again, and having arrived in three days in sight of the Island of Flores, I found that my chronometer was perfectly correct.

"The wind being East I tacked to the southward, and on the 31st of August I passed near another sunken rock, which is marked in the chart as having been seen by Captain Robson, to the northward of Fayal. At 8 a.m. I saw some rocks above water, over which the sea broke, and which I passed to leeward, at the distance of 1 to 2 miles. By observation and the chronometer I calculate this second danger to be situated in lat. 38° 26′ 44″, long. 30° 25′ 10′ W. of Greenwich, all which I certify without doubt.—*Lisbon*, 6th October, 1840."

The first of these reefs has been named the *Constante Reef*, and the second, *Ferreira Reef;* they have been previously noticed, together with the *Pronk Rocks* (Rhoon Rocks, in the *Nautical Magazine*), on p. 417.

The shoal off Flores, mentioned above, was originally copied from Van Keulen into Bellin's chart of 1742. Its position has varied from time to time. It cannot be authentic. By some it is called *Martyrs Shoal*, by the Portuguese *Vigia dos Azores* ("Atlantic Memoir," 1825, p. 252.)

Near to the asserted position of the Constante Reef, Captain J. Keyzer, of the Dutch ship Bato, on May 5th, 1845, saw a *white patch* about 100 feet in diameter. The sea smooth at the time. Lat. 37° 42′. long. 32° 57′.

We leave these asserted shoals for future investigation.

Against their authenticity we have the authority of *Captain T. D. Sickens*, of the Dutch Marine, who passed over the spot with a good look out from the rigging, without seeing anything, and then steered N.W. by N. over Constante Reef, &c., with the same result.

Again a *volcanic shock* was felt, March 13, 1853, lat. 38° 9° N., long. 31° 55′* Near to this, however, the sea is 2,000 fathoms deep.

At all events much circumspection is necessary in sailing through these parts.

Atila Rock, lat. 36° 31′ N., long. 32° 34′ W. (?)

A very vague announcement was issued by the Hydrographic Office of Madrid, in 1857, of a sunken rock of uncertain depth, seen by the Captain of the Spanish brigantine *Atila*, in lat. 36° 31′ N., long. 32° 24° W., but with no further particulars; this would be some 200 miles W.S.W. of Fayal, but it seems *very doubtful.*

HILTON ROCKS, West of the AZORES, lat. 39° 18′, long. 35° 50′.

" Bark *Secret*, Mr. Robert Hilton, master, from Valparaiso toward Liverpool, May

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* The repeated accounts which have been given of earthquake phenomena hereabout, ought to induce caution. Their range appears to be wide, for on November 25th, 1857, W. Cook, of the *Estremadura*, bound for Fayal, when in lat. 39° 57′, long. 25° 50′, saw abaft the beam what was though to be a squall, but which turned out to be a kind of mist or warm steam, which lasted half an hour; wind N.E. The waves then changed to a kind of boil, or topping sea, as if surged up from beneath, but it returned to its former state, when the mist was passed. (Lloyd's List, Jan. 11, 1858).

12th, 1845. While observing a meridian altitude breakers were reported; they were of no great extent, but Mr. H. plainly saw some objects in the hollows of the waves, which he felt perfectly certain were heads of rocks. The swell was not very heavy, and he thinks, in smooth water, they would be nearly on a level with the surface of the sea. The breakers were about $1\frac{1}{2}$ or 2 miles S.W., by compass, from the vessel, and at the time she was running $7\frac{1}{2}$ or 8 knots, with steering sails set, so that there was not much time for very particular remarks.

"The latitude stated, 39° 18′ N., long. 35° 50′ W., was from meridian observation, and the longitute from the mean of these observations; viz., their own chronometers, —the chronometer of a ship in company, and a lunar taken by Mr. H. himself, the same afternoon."—Communicated to the *Nautical Magazine* by Captain A. Livingston, August, 1845.

This reported shoal lies to the N.W. of the Pronk Rocks, but the positions ascertained would, perhaps, be conclusive against their identity. It is much to be regretted that in this and many similar cases some little trouble is not taken to place these matters beyond doubt and uncertainty; they remain, perhaps for many years, without being confirmed, and thus only "disfignre" the charts, and are a source of anxiety and annoyance to the navigator.

Jean Hamon's Rock, in lat. 36° 54′, long. 19° 49′ (?)

The existence of this distance rests solely on the authority of Jean Hamon, commander of the *Tros Amis*, of Bordeaux. On the 8th of January, 1733, according to M. Bellin, he approached it within three-quarters of a league, and carefully observed it. (*Very doubtful.*)

Keus, or *Europa Rock*, lat. 38° 15′ N., long. 22° 14′ W.

Captain D. Keus, of the Dutch ship *Europa*, stated, in a letter to H. E., the Minister of Marine, that on the morning of December 10th, 1853, he saw a "*black mass*," to the S.W. by W., steering N.E. by compass; at day break he saw that it was a rock or reef, and passed it about 2 miles distant. Its height was about 15 or 20 feet, and it was about 200 ells in length. Captain Keus places this rock in lat. 38° 15′ N., long. 22° 14′ W.*

Whale Rock, in about lat. 38° 46′, long. 25° (?)

M. Fleurieu exhibited this rock on his chart of the Azores, at about 29 leagues from St. Michael's, upon the report of a pilot, whom he knew at Angra, in Terceira. Its existence has, however, been disputed. Some breakers, which were very high, were seen by Mr. R. Gradun, commander of the ship *Harmony*, of London, on the 8th of January, 1800; their latitude by observation being 38° 46′, and longitude, by account, 24° 47′. The situation assigned by Mr. Gradun being very near that stated by M. Fleurieu.

Mr. Reid, late British consul-general at the Azores, believed it really to exist; several masters of vessels, who have been blown to sea from St. Michael's, having told him that they have actually seen it, and that in form it much *resembles a whale*. The rock has been diligently sought for, under an order of the British Admiralty, but without success; and it now seems clear that it cannot lie in the situation assigned by Mr. Gradun; and their existence is most improbable.

Tulloch Reef, in about 37° 27′ N., and 24° 45′ W. (?)

This reef was said to have been seen in 1808, by Captain William Tulloch, of the brig *Equator*, of Portsmouth, New Hampshire, on a voyage from Madeira to St. Michael's, as already shown and described in page 565.

It may be remarked that Captain Tulloch observed, from their black cindery appearance, that the rocks had risen from volcanic impulse; but as shown previously they cannot now be found.

* Verhandelingen en Berigten, 1854, No. 1, p. 171.

St. Mary's Bank to the S.W. of the Island of St. Mary, in about 35° 53′ N., and 27° 19′ W.

"On our passage, in 1819, from Havana to Barcelona, we passed over white water, apparently a shoal, to the southward and westward of St. Mary's. The captain would not allow the vessel to heave-to in order to sound; but I have no doubt in my mind of its being a very extensive bank of soundings; and I have little doubt that I have ascertained its position, tolerably accurate, from lunars, prior and subsequent. I should not be surprised if it turned out that the bank we passed over was connected with the Kutusoff Bank, marked, in the last edition of Admiral Espinosa's chart, as having been seen in 1816, and which lies to the S.W. of the one we passed over, at the distance of about a degree. We were some hours crossing the bank.

"The bank lies in lat. 35° 53′ N., as calculated by account between the observations of the noon before and noon following; long. 27° 19′ West. I have heard a French gentleman, a lieutenant de vaissean, mention what I suppose to be the same, at the table d'hote, at St. Michael's, in October, 1818." *A Livingston.* This is all we still know.

Josyna Rock, in lat. 31° 40′, and long. 23° 45′ (?)

On this danger, it has been stated that the *Josyna*, of Flushing, was lost in August, 1697. The latitude observed, and the distance 110 leagues from Madeira. In the Spanish chart it is said to have been seen in the year 1805; in lat. 31° 40′, long. 23° 45′, as above.

"*John M. Gilchrist*, master of the brig *Jewess*, of Liverpool, reports that on his passage from Bahia, on the 1st of January, 1848, at about half an hour after noon, in lat. mer. alt. of the sun that day, 23° N. (*sic*), by 24° 28′ 30″ W., by forenoon and afternoon sights for a chronometer, which on making Medeira, and arrival at Gibraltar proved correct, saw at about a quarter of a mile distant, bearing S.E. by S. by compass, something which at first appeared to be a fish sporting in the water, but upon taking the glass and looking at it, appeared like a flat rock just awash with the water. As the Josyna Rock, by some considered doubtful, is supposed to be situated somewhere thereabouts, this notice may serve to put mariners on their guard."

We copy the foregoing from the "Nautical Magazine," March, 1848, page 160, as posted at the Liverpool Underwriters' Rooms. The latitude is there stated to be 23°, but the reference to the Josyna Rock leads us to the assumption that it is an error for 32° N. The account seems very vague, but it is right to mention it, and we leave it in great doubt, for future determination.

Falconer Rock, off Fayal, lat. 38° 40′ N., long. 29° 8′ W. (?)

The bark *Johanna*, Captain W. Falconer, on July 13th, 1847, passed what was supposed to be a *rock*, of which the men were perfectly sure. The bearings place the spot in about lat. 38° 40′ N., long. 29° 8′ W., or about 12 miles N.W. of the end of Fayal.

The account in in the "Nautical Magazine," November, 1847, page 589, it is vague, and it may have been some floating object, still its nature was confidently stated, but it is very doubtful.

Candler's Rock, in about 39° 47′ N., and 34° 29′ W. (?)

This rock, to the westward of Flores, said to have been seen, a few years ago, by Captain Candler, of the *Betsy*, of Boston, who thought it to be 100 feet in height, is believed to have been an iceberg only, and therefore expunged from the charts.

Chantereau's Shoal, in lat. 38° 27′, and long. 38° 0′.

This shoal, described as a white rock, was said to have been seen by Captain Chantereau, of the ship *L'Auguste*, in lat. 38° 24′, long. 41° 35′, in coming from Martinique, 6th September, 1721, when the sea broke on it very much. It was again announced by Lieutenant Edm. Scott, commanding the *Princess Elizabeth* packet, 24th of April, 1828:—"On the 24th of 1828, at three p.m., the water round the ship very green, and with every appearance of being in soundings; and, on looking before the starboard beam, saw under water, at the distance of 2 cables, what evidently appeared, to the master and myself, to be a white sand-bank or rock, which the water did not then break on, but it appeared so very plain that there could not be much water on it. In extent it was about 1 or 1½ cables E. by N. and W. by S., *true*, and about half a cable in breadth.

"Immediately on observing the shoal, I ordered the lead and line up; but, ere it was ready, the colour of the water had changed to a deep sea-blue, when it was evidently useless to sound; at that time we were about a mile from the white spot; we had, at the time, a good breeze, but very little swell of the sea.—Lat. 39° 14′, long. 39° 49′ W.

According to a notice inserted in the late official copies of the *Derrotero de las Antillas* often quoted in this work, and dated Madrid, July 4th, 1846, a shoal, or vigia, was discovered at three p.m., May 21st, 1846, in fine weather, by D. Gabriel Perez, captain of the Spanish merchant ship *Leontina*, in lat. 38° 27′ N., long. 37° 57′ 10″ W. of Greenwich, according to observations made shortly before seeing the (*Escollo*) rock, and confirmed by chronometer in making Graciosa (Azores) soon after.

Here we have three announcements of dangers of similar character in close proximity. If it exists, they are probably the same. We have no further evidence in its favour or to contradict it. But at 74 miles eastward of it, the *Dolphin* found 2,675 fathoms.

Breton's Rock, about lat. 39° 40′, long. 41° 35′. (?)

This shoal, according to M. Bellin, was seen by Breton, a pilot of Rochelle, who marked it merely as a rock. Laisné, another pilot, has also placed it in nearly the same latitude and longitude. It is also sounded on by Roland, a pilot of Tremblade, and also seen by Jean Desmaries; there being scarcely 10′ difference in latitude, and in longitude not more than 1°. The situation originally assigned was 39° 45′ N., and 41° 25′ W.

This danger was again said to have been seen in 1816 by the ship *Tiger*, on her passage from Barbadoes to Liverpool. The letter of a passenger states that, "On the 14th of March, at ten a.m., a smart breeze from the S.W., with studding-sails set, going 7½ knots an hour, steering E. by N., *true*, in lat. 39° 40′, long. 41° 40′, we passed over a very agitated rumbling sea. Under our starboard bow, in *appearance* about a circle of a mile, was a small field of dark-brown rockweed, apparently a confirmed fixture; entangled with the weed were two pieces of spar, seemingly very much decayed." A little trouble would have settled this at the time. Its non-existence is determined by the deep sounding last mentioned, of 2675 fathoms, 20 miles to the East of it.

Columbine Shoal, lat. 35° 25′ N., long. 49° 1′ W. (?)

The *Columbine*, Robertson, from Aux Cayes, on April 2nd (1844 ?), at three p.m., being in lat. 35° 25′ N., long. 49° 1′ W., saw discoloured water to windward; it had a brown appearance, extending above 100 feet in a S.S.E. direction, and about 30 feet across. It had all the appearance of a rock under water; the vessel was then little more than her length North of it, steering E.N.E. Some other brown patches were seen. The sea did not break over these places. The discoloured water last mentioned was seen for nearly a mile.—*Shipping Gazette*, May, 1844.

We have here an instance of carelessness which is often to be deplored, and highly reprehensible. The commander of the *Columbine*, with every circumstance of wind, weather, and sea in his favour, did not attempt to decide, by a single sounding, most easily made, whether this was a real danger, or merely discoloured water, which must be supposed to abound in this centre basin of the Atlantic in the calm regions.

WESTENENK SHOAL, 31° 48′ N., 40° 28′ W.

Captain J. W. Westenenk, on board the Dutch ship *Alida Maria en Adèle*, 11th of August, 1854, about 11 o'clock in the forenoon, sailing with a light E.N.E. breeze, breakers were seen at half a mile distance. The noon observation gave the latitude as 31° 48' N., and the longitude, West of Greenwich by two chronometers, was 40° 28' 30".* We give this as related, but have nothing to contradict it at present.

Anna Rock, lat. 39° 30' N., long. 50° 30' W. (?)

Extract from the log. of the Sicilian brig *Anna*, Marco Carmelich, master:—"Tuesday, June 8th, 1841, p.m., ship sailing with all sails set. At three p.m., observed a shoal to the South, distant about 2 miles, appearing to the eye like a *ship with three masts of equal height*, and inclining towards the South, and about 50 feet high, surrounded by shoals, level with the water. Latitude, calculated from that observed at noon, 39° 32' N., long 50° 50' W."

Evidently an *iceberg*.

Munn's Reef, in about 39° N., 64° 20' W. (?)

This shoal was seen by the brig *Joseph Hume*, of which Mr. Alexander Munn was mate, 22nd of August, 1827, on her passage homeward to Liverpool. "The vessel passed close to it; they saw the white sand above the water, and sounding where the vessel then was, found 20 fathoms sandy bottom, a quarter of a mile off: then bore up, and sailed westward of it, in deep water."

This information was communicated by Mr. Munn, through the medium of Captain James Porter, of the bark *Science*, of Greenock.

In the passage of H.M.S. *Thunder* from Bermuda to Halifax, in 1835, the ship hove-to for the night, in order to search for this shoal, but it was not found. The *Sapphire* frigate had passed over the spot at noon of the day before, but likewise unsuccessfully. In a former page is an account of a large tree having been found by Captain G. P. Lock, near this position.

Field's Vigia, lat. 37° 31', long. by account, 66° 0'. (?)

An account of this vigia was published in the year 1833, but we are strongly inclined to think that it might be only a collection of weed, &c., in one of the southern eddies of the Gulf Stream, where, in abundance, it is frequently found. This was Mr. Purdy's remark, but Captain Field's negligence gave great trouble to disprove his opinion.

The U.S.S. *Dolphin* had a good sounding of 500 fathoms on the spot, another of 1,175 fathoms at 10 miles S.E. of it, and many other unsuccessful soundings in its neighbourhood, where they were for 4 days.

Anfitrite Shoal, in lat. 35° 50' N., long. 66° 4' W. (?)

An official notice from the Spanish Hydrographic Direction states that the Spanish merchant ship *Anfitrite*, in her passage from the Havana to Cadiz, in May 10-12th, 1846, discovered a patch of broken water, about a cable's length in extent from N.E. to S.W., which they placed in lat. 35° 50' N., and long., by observation, 59° 46' 38" West of Cadiz, or 66° 4' 11" West of Greenwich. As in the pseceding case this unfounded assertion gave work for 5 days to the U.S.S *Dolphin*, when 1,000 fathoms, no bottom was found on the spot.

Potomac's Soundings, lat. 38° 10', long. 67° 26'. (?)

On the southern side of the Gulf Stream, in the situation given above, soundings at 90 fathoms were found by Captain Smith, in the ship *Potomac*, of Alexandria, U.S., June, 1838. The U.S.S. *Dolphin* found 400 fathoms, no bottom, on the spot, and 300 to 430 fathoms, no bottom, for 50 miles around it, Oct. 18, 1851. Lieut. Berryman also had a doubtful sounding of 4,290 fathoms at 40 miles to the W.S.W.

* Verhanderlingen en Berigten, &c., Amsterdam, 1854, p. 511.

False Bermudas and Dyet Rocks, to the Eastward of the BERMUDAS. (?)

Former charts of the Atlantic exhibited rocks at about 100 leagues to the East of the Bermudas, upon the authority, it is probable, of Bellin, who has stated, that "about 100 leagues to the East of Bermudas there is a little shelf of brittle rocks, which has been seen by one Louis Duhal, in a corsair, or privateer, that sailed around them; and as this shelf is nearly on the parallel of the Bermudas, many have mistaken it for the rocks about those islands." M. Bellin has observed that there are some rocks on this shelf whose tops are above the water; but that many doubt their existence.

Subsequent inquiry as to these vigias showed that rocks, *supposed* to have been seen by the late Captain Bell, of the *Francis Freeland* packet, were placed in about 33° 45′ N., and 55° 25′ W.

The report of these rocks was afterwards revived by the following statement:—"On my passage from St. Kitt's to London, and when off Bermuda, May 17th, we passed within 30 or 40 feet of two sunken rocks, having 6 or 8 feet water over them, it being very smooth at the time, in lat. 32° 46′ N. at noon, long. 60° 6′ W."—*Robert Dyet*, master of the bark *Catherine Green*, of London.

The U.S.S. *Dolphin* spent 7 days in the unsuccessful search for this rock; sounded with 800 fathoms, no bottom, 12 miles East, and with 550 fathoms over the spot assigned to the Dyet Rocks, and no bottom with 800 fathoms in that of the False Bermudas.

Ashton Rock and *Orion Rock*, between the BERMUDAS and CAPE HATTERAS. (?)

Ship *William Ashton*, Captain H. B. Guy, 22nd May, 1824:—"At 11h 50′, the man at the wheel saw something on the starboard bow, distant about 1 mile. Hauled the ship toward it, when we discovered it to be a rock; passed to the westward of it, at the distance of about 2 cables' lengths. The base of the rock appeared to be about 100 yards in circumference, on which the sea broke. In the centre was a point of rock in the form of a sugar-loaf, about 8 feet above the water, with a quantity of weed about it. [*Something like a whale?*] Passed the lead forward; no ground at 80 fathoms. Latitude 33° 48′ 50″, long. 71° 41′ 20″.

"*Orion Rock, no soundings.*—We have received the following communication from Liverpool. The master of the *Orion*, belonging to our port, Luytjas, from Trinidad de Cuba, arrived in the Weser, has furnished the following particulars of a rock fallen in with:—On my voyage from Trinidad de Cuba for Bremen we perceived, May 5th, lat. 34° 51′ N., long. 72° 28′ W., a rock 2 feet above the water. It had the appearance of a water cask of two or three hogsheads. We were at a distance of only 20 feet from the rock, when we, fortunately in time, discovered it.—*Bremen*, July 17th."—"Nautical Magazine," August, 1845. *Very unlike a rock!*

Huntly's Rock, lat 30° 49′ long. 78° 27′. (?)

This danger (*if a danger*) was first made known by the following communication, addressed to Lloyd's, by Captain C. Huntly, in 1834:—

On the 30th of November, 1833, at 9 a.m., saw a coral rock. We were about 60 yards to the southward of it. I find that this rock lies in lies in lat. 30° 49′ 15″, long. 78° 27′ 30″ West. It was about 8 feet above the water, and in the fall of the sea it branched out to the N.N.W. about 30 feet in distance. This must have been some floating object.

The *Steen-ground* to the westward of Madeira, very vaguely represented in the charts of last century, 60 or 35 leagues to the West of Madeira.

BETWEEN THE LATITUDES OF 20° AND 30°.

Gombaud's Rock, in lat. 23° 15′, long. 32° 25′. (?)

According to M. Fleurieu, this danger was first seen in 1764, having been discovered by Gombaud, the commander of a merchant-vessel of Rochelle. Upon this authority it was continued, but it was annihilated by a sounding of 2,200 fathoms on the spot by the U.S.S. *Dolphin*.

Overfalls, or *Heavy Ripples*, in lat. 24° 11′, long. 61° 44′. *No Shoal.*

On Saturday, the 7th of February, 1819, at ten a.m., the schooner *Brilliant*, Capt. Tulloch, on her passage from Gibraltar to Havana, passed through very heavy overfalls, extending N.N.E. ½ E. and S.S.W. ½ W., *true*, as far as the eye could reach, with much sea-weed (*fucus natans*) in it. The breadth of the overfalls did not exceed half a mile. Latitude about 24° 11′, longitude 61° 43′ 57″ W. The preceding information was communicated by our friend Captain Livingston, who adds:—"We saw no danger." Bottom was satisfactorily obtained with 3,450 fathoms in the U.S.S. *Dolphin* on the spot, indicated by Capt. Livingston.

Gandaria Rocks, lat. 25° 30′, long. 37° 45′. (?)

The following notice of these rocks appeared in the Gaçeta de Madrid, May 28th, 1842:—"On Monday, April 18th, *Captain Gandaria*, of the Spanish merchant ship *Dolores Ugarte*, 107 days from Guayaquil, saw from the deck of that vessel a group of rocks about a cable's length in extent, and in the middle of them a large one, high and insulated, on which the sea broke violently. The latitude 25° 29′ 55″, longitude 37° 18′. But Lieut. Lee found bottom with 1,720 fathoms on the spot.

Mourand's Bank, in lat. 24° 34′, long. 65° 10′. (?)

This danger was discovered by Mourand, commander of the *Prince de Nizarre*, of Nantes, on the 6th of April, 1773. He described it to be a "bank of red sand, many parts of which are out of water, like detached islands, over which the sea breaks; it appeared to extend about a quarter of a league from North to South."

The U.S.S. *Dolphin* got bottom with 3,560 fathoms near the position of the reef, and no bottom was found with 1,000 fathoms on the spot.

Deep Soundings S.E. of Bermuda. (?)

The *New Bedford Mercury* relates an account of some soundings which were supposed to be obtained in the ship *Chaucer*, in April. 1850, but which were fallacious, as follows:—"Here, in lat. 27° 10′ N., long. 62° 45′ W., on the 20th of April, 1850, the nearest land being Bermudas, bearing N.W. by N., and distant 345 miles, water blue, with much gulf-weed, weather calm, no current, the boat was lowered; let run the lead, and got bottom in 744 fathoms. April 15th, lat. 27° 31′ N., long. 60° 3′ W., Bermudas N.W. by N., 300 miles, sounded and got bottom in 366 fathoms. April 29th, lat. 29° 20′ N., long. 64° 11′ W., Bermudas N. by W. 160 miles, sounded and got bottom in 620 fathoms.

The time occupied in running out the line varied from twenty to thirty minutes. The line was constructed thus: first 100 fathoms, five parts of shoe thread; second, four parts; third, three parts; fourth, two parts; remainder single. The lead weighed about five pounds; the whole wound upon a light reel, and held by hand. In this process of obtaining soundings the lead is not to be hauled up."—*Daily News, Aug.* 28, 1850.

There is no doubt but that the imperfect means deceived the commander as to finding bottom; for Captain Lee, U.S.S. *Dolphin*, got a good sounding of 3,828 fathoms, the deepest obtained in the cruise a degree to the South of that reported of 366 fathoms, and no bottom with 1,000 fathoms near that of 620 fathoms, and 3,080 fathoms have been got near that of 744 fathoms.

Guigou's Bank, in lat. 20° 50′, long. 66° 45′. (?)

M. Bellin, in the Memoir of his Chart, of 1742, describes this to be a "rocky bank, about 45 leagues to the northward of Porto Rico, upon which a Dutch vessel was lost in 1701, and that it had also been seen by a French versel." Another manuscript, in the Depot de la Marine, confirmed this account. It also appears, from the deposition of Christopher Whipple, commander of the *Anna*, of Rhode Island, that he was wrecked on the 27th of November, 1733, upon a shelf, from 30 to 40 leagues to the northward of Porto Rico. In the Marine Depot of Paris there is a manuscript entitled, "Plan of the Shelf which was discovered by Captain Michael Guigou, of Seine, in Prevence, in the ship *La Concorde*, February, 1688." On that plan it is placed at 45 leagues to the northward of Porto Rico, somewhat nearer to the western than to the eastern end. But a sounding by Lieut. Berryman of 2,960 fathoms at 35 miles N.N.E. of it, destroys its authenticity.

Courier Rock, off MATANILLA REEF, lat. 27° 51′ N., long. 78° 31′ W. (?)

The *Courier*, of Greenock, drawing 15 feet, William Thompson, commander, states that he rounded the Matanilla Reef at 2^h p.m., and, at 6^h 20 p.m., struck on an unknown coral reef, on January 22nd, 1849, and on tacking found 3½, 4, 5½, 7, and 10 fathoms, and no bottom at 16 fathoms. In some remarks on it (*Nautical Magazine*, 1849, p. 214), it is argued that the courses would not bring the ship to the position, and that the eddy of the Gulf Stream would also tend to vitiate the reckoning. With these views it is then contended that a 2 fathoms coral spot, at the N.W. end of the reef, marked on the chart, is the real danger. In the *Nautical Magazine*, August, 1847, p. 421, there is a statement from Captain J. Watkin, commanding the ship *Joshua Waddington*, of Liverpool, that on May 13, 1847, he discovered and touched on a spot not larger than three or four times the size of the ship, with 3 fathoms, sand and clay, which was stirred up by the ship. It was supposed to be a detached part of the Matanilla Shoal. The survey of the Matanilla Bank at this part is too complete to allow of the supposition of these shoals having been omitted.

INGLEFIELD BANK, in lat. 29° 42′ N., long. 80° 17′ W. ?

This bank, lying about 66 miles East of St. Augustin, was discovered by Captain S. Hood Inglefield, on the 26th of May, 1810, lat. 29° 42′ N., long., by account, 80° 12′; by chronometer, 80° 17′; and by lunars, 80° 18′. Sounded in 25 fathoms, black sand; hence, steering N. by W. ½ W., course made good, had regular soundings, 24, 25, and 27 fathoms, speckled sand and broken shells, until 6 p.m. on the 27th, when no bottom could be found. Noon, on the 27th, latitude 30° 5′ N., longifude, by account, 80″ 25′ W., by chronometer, 80″ 25′. On the 26th, the current set W.N.W. 1 mile an hour; at four p.m. on 27th, no current. On the 28th, in latitude 31″ 5′, longitude by chronometer, 79° 46′. Current ran N.N.E. 1¼ miles an hour.—*Communicated by Lieutenant John Evans*, R.N. It is probable that an erroneous reckoning has placed this too far off shore.

VIGIAS BETWEEN THE EQUATOR AND THE PARALLEL OF 20 DEGREES.

Hannah's Coral Shoal, lat. 10° 7′, long. 27°. 32′. (?)

This shoal was reported by Captain Thomas Fanning, of the brig *Hannah*, on the passage from Rio Janeiro to Trieste, June 25, 1824. *Sounded in 15 fathoms, granulated coral*, on the S.W. part, but supposed it much shoaler on the N.E. points, as the weed was plainly to be seen from the mast-head on the surface of the water. Its latitude was found to be 10° 7′ N., and longitude about 27° 32′ W. This would appear to be circumstantial, but Captain Pullen, in H.M.S. *Cyclops*, could get no bottom on the spot with 2,000 fathoms in Dec., 1857.

Maria Rock, Madeline Reef, Warley's Shoal, French Shoal, Bouvet's Bank, etc.. (?)

We have the grateful task of introducing extracts from a letter addressed to the Secretary of the United States' Navy, by Lieutenant Charles Wilkes, commanding the South Sea surveying and exploring expedition, and dated on board the sloop *Vincennes*, at Rio Janeiro, November 27, 1838.

It will be presently seen that the squadron effected the examination of the supposed position of ten or eleven shoals or dangers, the detailed accounts of which were formerly given in this work, their assigned positions in the charts, and the non-existence of which has apparently been *proved*.

The shoals enumerated in the ensuing paragraphs have been expunged from the charts for many years. It will be, therefore, unnecessary to repeat the particulars of their alleged discovery. They will be found in the editions of this work published before 1840.

They were unsuccessfully sought for by the United States' Exploring Expedition under Lieut. Commander Chas. Wilkes, and an account of the search was sent to the U.S. Government under date Nov. 27, 1838.

"The first reported shoal laid down on our route upon the charts was the *Maria Rock*, in lat. 19° 45′ N., long. 20° 50′ W., which we stood for, and hove-to near the position. Nothing, however, was discovered, and no bottom could be found with 300 fathoms of line.

"The next position examined was *Bom Felix Shoal*,* said to be within 30 miles of the Maria Rock; this we searched for in the same manner, but were equally unsuccessful. We then stood for the place assigned to the *Bonetta Shoal*, to the eastward of Bonavista, said to be in lat. 16° 32′ N., long. 20° 37′ W. We, in like manner, hunted for this, and after exploring the locality of its position on the chart, I steered on the course of its reported bearing, E. by N. from Bonavista, until nearly up with the *Hartwell Reef*, lying in sight of Bonavista, which has, without doubt, been taken for, and reported as, the shoal called *Bonetta*.

"From Port Praya we steered for *Patty's Overfalls*, as laid down in the chart, in lat. 11° N., long. 24° 30′ W,, and had a good opportunity of examining their locality. A few rips were observed within a degree of the situation assigned them, but little or no current was found; and I feel confident in asserting that no danger exists in this vicinity. *Warley's Shoal*, said to be in lat. 5° 4′ N., long. 21° 25′ W., was also carefully examined, but no shoal, or appearance of shoal water, or any danger, discovered.

"Our next examination was of a *French Shoal*, said to be (as laid down) in lat. 4° 5′ N., long. 20° 34′ W. This was also examined, and no danger or appearance of shoal discovered. From this point I proceeded East to 13° of West longitude, and over the position assigned to the shoal by the French hydrographers; then stood for the *Triton's Bank*, said to be in lat. 0° 32′ S., long. 17° 46′ W. We did not, however, find it in our progress, or any bottom or indication of soundings; no *discoloration* of water was visible, or change of temperature, although the line extended 30 miles East and West of its reported position; after which we again stood to the North, and ran over a *vigia* as laid down on the charts, but none such was found in existence.

"Our next examination was for *Bouvet's Sandy Island*, which was, in like manner, carefully searched after in and around its position, but our search was equally unsuccessful.

"Finally, search was made in and about lat. 2° 43′ S., and long. 20° 35′ W.; extending to the N.N.W. of this point a distance of 30 miles hereabout having been assigned as the situation of the submarine volcano reported by Admiral Krusenstern, which, it was supposed, might have left a shoal. This locality was twice run over

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* But it is stated that M. Fréminville, 1819, obtained a sounding of 164 fathoms between the assigned position of Bom Felix and the Cape Verdes, or lat. 18° 35′, long. 21° 40′ W., as mentioned hereafter.—*Annales Maratimes*, &c., vol. iv., 1834, Pt. 2, p. 236.

in different directions, and carefully examined, with the squadron in open order, but none such was found in existence.

"Lieutenant Hudson, of the *Peacock*, having separated from me on the 16th of October, proceeded on a different course in search of the same shoals which we were looking for, but was unsuccessful in finding any."

To the evidence thus afforded by Captain Wilkes's careful search we can now add that given by the deep soundings gained by Lieutenant Lee in the *Dolphin* :—

French Shoal—bottom obtained with 2,670 fathoms on the spot, which appears by 8 soundings to be the general depth hereabout.

Triton's Bank—2,840 fathoms, bottom obtained at 8 miles West of the position.

Bouvet's Island—no bottom at 1,500 fathoms.

Krusenstern's Volcano—bottom obtained with 3,450 fathoms at a few miles N.W. of the position.

To the imaginary shoals above mentioned, we may doubtless add *Dubreuil's Vigia*, lat. 14° 50', long. 29° 40'; *Vigia de 5 Palmas*, lat. 12° 0', long. 27° 20'; *Longchamps Rock*, lat. 9° 47', long. 30°; and the *Maalstrom*, in about 16° N., and 37° W.

Emily Rock, lat. 16° 59' N., long. 21° 30' W. (?)

The master of the brig *Emily*, of London, reports that they had discovered a rock and shoal in lat. 16° 59' N., long. 21° 30' W., of which no mention is made in modern charts. The rock is about *two* feet above the level of the sea, about 12 yards long, of an oblong form, and of a gray colour. The shoal extended from the rock about two cables and a half in length and one in breadth, running due East. The latitude and longitude were obtained by good observations at noon."

This is a revival of the old tale of the *Emily Rock*, but Lieutenant Lee has set the question at rest (see page 607.)

The *Dolphin* passed over the position under favourable circumstances, and sounded at moderate depths without bottom over the spot; but he got bottom with 1,580 fathoms at 8 miles due West of it. Besides this, they got bottom at 1,970 fathoms at 90 miles North of San Antonio; 1,675 fathoms the same distance North of St. Nicolas; 1,370 fathoms 40 miles North of Sal; 1,612 fathoms N.N.W. of Sal; 1,944 and 1,875 fathoms at 40 miles S.E. of the alleged position of the Emily Shoal.

Still further South and to the West of the Cape Verdes, bottom was obtained at 1,220 fathoms at 80 miles E. by N. of Mayo; 1,380 fathoms at 40 miles East of Mayo; and a depth of 1,120 fathoms within 6 miles of Maio.

Between St. Iago and Fogo, no bottom was reached with 900 fathoms.

Pryce Shoal, Cæsar Breakers, lat. 3° 7' N., long. 24° 14' W. (?)

In the early editions of this Work this danger was included among those which threatened the navigator; but from its not having been seen of late, it has been classed among the imaginary shoals. It is stated on the chart of M. de la Rochette to have been seen, in 1730, in lat. 2° N., long. 22° 18'; and on this authority it held its place, but was considered as very doubtful.

It has been again revived, by a not very clear account of it, as follows:—"The brig *Mary*, from Africa to Liverpool, on the night of the 4th of July, 1846, at 7h p.m., saw breakers, distance a quarter of a mile, strong current setting towards them: when first seen they bore by compass N.W. by N., and seemed to be a long ledge of rocks in a crescent shape; at 3h a.m., the following morning, saw the S.E. end of the reef; a strong breeze coming on prevented us making any further examination; the man, in heaving the lead, *struck it upon a hard rock* (no depth nor situation stated), but had no bottom the second cast. Their position, when seen, was lat. 3° 7' N., long. 24° 14' W."—*Charles Pryce*, supercargo.

They are also 145 miles from the previously assigned position of the Cæsar Breakers, but the early dates of the first announcement will allow great variation in position. The reader must form his own opinion as to their authority.

Blaesdale's Reefs, in about lat. 0° 57′ N., long. 41° 6′ W. (?)

On the 15th of October, 1819. the brig *Richard*, of Ulverston, Captain Blaesdale, struck on a coral reef, in about 0° 56′ or 0° 57′ long., by *account*, beyond 41° W. In fine moderate weather, the ship going at the rate of 3 knots, at 6ʰ p.m. grounded, and remained fast about ten minutes. The water was smooth, and no breakers seen. Upon sounding, a few minutes after, no bottom could be found at 150 fathoms. The vessel drew 11 feet of water, and in 1 hour there were 18 inches of water in the well. On a subsequent survey at Para three holes were found, each about the size of a man's hat, and nearly through the vessel's bottom, and several large pieces of white coral, as large as a man's hand, were found sticking in different parts. This account appears to be very circumstantial, and the reef has maintained its place on the chart.

But the U.S. ship *Dolphin* obtained a satisfactory sounding, in which bottom was got with 2,980 fathoms in its position, besides two others with no bottom with 1,000 and 2,000 fathoms in its vicinity. This decides the question.

The India Shoal, West of Cape Verde Islands (?)

This shoal is laid down from the chart of M. Rochette, 1777, 70 leagues W. by N., *true*, from St. Iago. It is more than doubtful.

Tregarthen Rock, 14° 29′ N., long. 26° 30 W. (?)

Captain James Tregarthen, of the barque *Mandarin*, of Scilly, left Liverpool in April, 1856, for San Francisco:—"We made Sant' Antonio on the 18th May, 1856, and found the chronometer not many miles out. We passed along close by a rock yesterday, not marked in the chart. It is in lat. 14° 29′ N., long. 26° 30′ W.; was four feet high and eight feet long, quite round on the top, and steep on all sides. We saw it yesterday at half-past nine in the morning. We had good sights for the chronometer at that time, and good observation at noon. We passed it within thirty yards.

We mark this as doubtful, as there was no attempt at verifying the discovery by sounding or otherwise.

Baxo das Garças, lat. 12° 30′ N., long. 29° 2′ W. (?)

Upon the authority of an old Dutch chart by Vankeulen, "which is but one shade better than no authority at all," a bank was inserted at 107 leagues W.S.W., true, from Brava, or in lat. 13° 0′ N., long. 29° 50′ W.

"On January 17th and 18th, 1848, on board H.M.F.M. brig *Villa Flor*, Lieutenant Commandant P.V.C. Loureiro e Pinho, on her way from Loanda to Lisbon, saw breakers, and a shoal in 12° 30′ N., long. 28° 56′. She afterwards sailed over the position first assigned to Garças shoal, without seeing it."

AYLEN, or PORGAS BANK, between the Cape Verde Islands and the African coast.

In the early charts of the Atlantic this bank has always been shown, as extending 50 leagues in length N. and S., with a breadth of 5 leagues. Nothing more than this appeared to be known of it except the statement that it was all deep water, and not dangerous to shipping.—(*Oriental Navigator*, p. 27.) It was unsuccessfully sought for by the *Leven* in 1819. In some later charts it has been omitted for want of some confirmation, but this seems to be revived by a cast of the lead taken in the *Birkenhead* steamer, in her voyage to Ascension, under the command of Mr. J. B. Aylen, R.N., on November 11th, 1850.

The position, carefully deduced from chronometer and observation, is 17° 0′ N., long. 20° 3′ 15″ W., and the depth 86 fathoms. The bottom appeared to consist of pieces of shells and sand, or small particles of coral. Mr. Aylen says, that "I did not like heaving the ship to, to take another cast, particularly as I considered myself on the edge of the bank only, and that at noon, when on its centre, I would again try, which I did without success, with 90 fathoms of line.—*Nautical Magazine*, 1851, p. 155.

Besides this sounding hereabout, another of 164 fathoms was obtained, in 1819, by

Captain *Fréminville*, to the N.W. of this cast of Mr. Aylen, in lat. 18° 35′, and long. 21° 40′.

Texeiro's Shoal, in lat. 12° 0′, long. 38° 28′. (?)

Breakers seen by Don Angel Texeiro, Captain in the Spanish navy, April 16, 1810, for the American ship *Topaçio*, bound for Boston. They appeared to extend about a mile North to South, and 2 cables' length from East to West; latitude, 12° 0′ N., long. 33° 28′. Again, Captain Edgar Wakeman, of the *Adelaide*, January 11th, 1856; lat. 11° 21′, long. 33° 33′ W., saw *breakers ahead*: tacked ship, the stern being within 20 feet of the reef: on nearing it again saw three discoloured patches to leeward, which looked like shoal water.

Lieutenant Maury, who records this (vol. ii., 1859, p. 162), caused the tracks of about 22 vessels which had passed near this to be examined; but there was no notice of such a reef in these journals. It is therefore presumed, that it was one of those *current-rips* so singular and frequent in this latitude, probably at the junction of waters setting in opposite directions, as Captain Wakeman states that the drift was to the *eastward*. (*See* page 283, etc., *ante.*)

Galleon's Bank, in lat. 15° 56′, long. 49° 40′. (?)

This supposed bank, or reef of rocks, was discovered on the 23rd of July, 1730, by Longueville, the pilot of the *San Fernando*, commanded by M. de Navaro, Admiral of the Spanish galleons. By the detail into which Longueville enters concerning this danger (his journal being in the Depot de la Marine at Paris), there can be no doubt of the fact. It appears that the *San Fernando* apparently struck on and passed over it, without receiving any damage. Other ships in the same fleet also struck, with more or less violence, but without actual injury. In the Depot de la Marine there is also a memorandum of the existence of a bank in 15° North latitude, and 228 leagues East of Martinique, upon which there is said to be 40 fathoms of water, bottom of fine sand; and over which Joachim Voette is said to have passed and sounded. Who this Joachim Voette was is not mentioned, nor when he ascertained its position. If, however, this last-mentioned bank really exists, it may be the same as that over which the Spanish galleons passed.

But the careful examination by Lieutenant Lee, in the *Dolphin*, of the locality, renders it highly improbable that any danger exists. He was four days in its vicinity and found no bottom with 550 fathoms in Longueville's position, nor with 250 fathoms in Voette's position, besides other soundings.

M. de Humboldt has noticed, that there exists in the parallel of the island Dominica, and very near the 55th degree of longitude, a space wherein the water seems *constantly milky*, although the sea is very deep: and he asks, "May there not be, in this place, some sunken volcanic islet?"

Betsy's Rock, in lat. 18° 7′, long. 50° 0′. (?)

This is described as a flat rock, seen by the brig *Betsy*, on her passage from Greenock to Jamaica, 17th of September, 1808.

Galisionière's Rock, 12° 20′ N., and 54° 49′ W. (?)

This vigia was exhibited, on the chart of M. Rochette, as a rock, mentioned by M. Galissionière, and some other navigators. A spot, nearly in the same situation, had previously been called the *Isle of Fonseca*. It is said to have been seen by the *Rainbow*, man-of-war. We have been vaguely informed, that the rock was again seen in 1822.

It is disproved by the sounding of 2,57[illegible] fathoms obtained by Lieutenant Lee in the *Dolphin*.

Martin's Reef, eastward of Guadaloupe (?), in 16° 42′ N., and 58° 53′ W.

A shoal was inserted hereabout on the chart of Bellin, 1742, who says that it is mentioned by many navigators. "It was again seen in July, 1816, by Captain Martin, of the ship *John Manning*. The shoal seemed to consist of yellow sand, with sea-weed upon it; to be about half a mile in length from East to West, and a quarter of a mile in breadth from North to South."

This reef was again announced by the ship *Cecilia*, of Glasgow, 19th July, 1823, by which the position assigned was, 16° 44′ N., and 58° 50′ W. To the commander of the ship it appeared to be about 1½ or 2 miles long, and only about 30 feet wide: the western part, shaped like the bulb of a thermometer, seemed dangerous.

Lastly, Captain Newbold, of the brig *Transit*, on her passage from Halifax to St. Vincent, in February, 1842, discovered a shoal to windward of the Island of Antigua, in lat. 16° 42′ N., long. 59° 6′. He examined it as carefully as circumstances would permit, and describes it to be about 200 feet long, and 80 feet wide, with 3 fathoms water in the centre, and much shallower on the edges.

Lieutenant Lee, U.S.N., examined this locality:—He says, "he sounded along its parallel from 58° 35′ to 60° 15′, with a clear radius of vision, and examined the neighbourhood of the mean position assumed by Laurie, within two miles of which Mr. Renshaw, sounding from a boat, found no bottom at 3,200 fathoms' depth. At the position where the *Transit* located this reef in 1842, we did not find bottom with 1,800 fathoms."

DELAWARE SHOAL, eastward of TRINIDAD.

Captain Ross, in the brigantine *Delaware*, from Charleston, on the 16th September, 1839, at noon, in lat. 10° 38′, struck soundings in 37 fathoms, shells and sandy bottom. At 3 *p.m.*, steering South, passed over a rocky bank, having 5, 7, and 10 fathoms, and bottom plainly seen; inferred from the distance run that the latitude of the shallow part of the bank must lie in 10° 37′ N., longitude, by chronometer, 60° 3′ W. At a quarter past 3 *p.m.* had 70 fathoms of water.

St. Esprit Reef, in lat. 14° 37′, long. 58° 59′ (?)

"On the 4th of July, 1817, the French ship *St. Esprit*, in lat. 14° 37′, long. 58° 56′, 35 leagues distant from Martinique, fell in with a chain of rocks, about 8 feet under water, extending about 500 fathoms from North to South, and being about 100 fathoms broad, and were plainly seen on the bottom from the vessel."

In the earlier editions of this work there are notices of Capt. Pierre Renault of the *Automne* seeing a danger hereabout in 1723, and of Capt. Laborde passing over a supposed sand-bank 80 or 90 leagues from the island. (*See* Edition 1825, p. 258.)

It was announced, in the year 1833, that H.M.S. *North Star*, on the 11th of February, while on her way from Antigua to Demerary, under the command of Lord William Paget, struck soundings in 7 fathoms, near the position assigned to the Esprit Reef; and, in consequence of this, Vice-Admiral Sir George Cockburn, commander-in-chief on the station, directed the ships of his squadron to search for the danger; these were the *Ariadne*, *Sapphire*, *Vestal*, *Forte*, and *Victor*, in January, 1834, and *Galatea*, in 1826; but, after a vigilant search, neither reef nor shoal have been found. —(See *Nautical Magazine*, November, 1834.) Again, on the 11th of October, 1833, H.M.S. *Despatch*, Captain Daniells, passed over or near the place where the *North Star* struck soundings; the lead was kept going for six hours, without any indication of shoal water. If it exists, it is therefore clear that the true situation of the danger has not been ascertained.

CLOWES' REEF, to the northward of PORTO RICO, lat. 19° 17′, long. 65° 50½′.

An American schooner, in 1817, struck on a rock to the northward of Porto Rico, in between 19° and 20° North. This was thought to be the same danger on which, some time after, the brig *Robert*, Captain Baxter, struck and remained several hours. The reef, which has been variously represented on the charts, was seen by Captain Clowes, in the ship *Caledonia*, on the 24th of April, 1825; and Captain Clowes assigns for its situation lat. 19° 17′, and long. 65° 50½′. It is about a quarter of a mile in extent from East to West, with a very little water on it. A quantity of sea-weed was seen at each end, which appeared to be drifting to the S.W. The ship was within a mile of the reef.

Further proof of the existence of this must be left for future investigation.

We have thus concluded the catalogue of dangers and presumed dangers which have been stated to exist to the embarrassment of navigation, and which have for so many years "disfigured our charts." As will be seen, the direct test of the sounding lead has caused the disappearance of most of them; and, as was at first stated, they are only retained in this edition to show the reasons upon which they may be ignored.

At the same time it is well to mention now, as will be also done presently, that these deep sea soundings are not altogether satisfactory; indeed, in very many instances they are more than probably erroneous. But they at least demonstrate that the ocean is very deep in their locality, and until a more satisfactory examination be made, they must suffice to remove these reported dangers.

VOLCANIC REGION.

In the neighbourhood of the Equator, and between longitudes 18° and 23° W., is a space which has been very fertile in former years in the production of supposed rocks and sand-banks. The nature of this space is now better understood, and we have now only the frequent announcements of volcanic shocks having been felt. They are indeed very numerous, and in our Memoir for the South Atlantic, pages 84—88, we have given a series of these occurrences. They need not, therefore, be repeated here.

It is now well known that the effects of an earthquake or *tremora* at sea has exactly the same effect on vessels as if they had rubbed over a reef of rocks, or the heavy cable had suddenly run out. We have many instances of this, and such effects may be looked for in crossing the Equator within these limits. It may perhaps extend as far to the West as the volcanic islets of Peñedo de San Pedro.

To the list given before, as above stated, we may had, by way of example here, the following:—

Captain Ballaird, of the ship *Rambler*, from Calcutta, on October 30th, 1850, in lat. 16° 30′ N., long. 54° 30′ W., and Captain Potter, of the bark *Millwood*, last from Rio, half an hour later on the same day, when in lat. 23° 30′ N., long. 58° W., each felt a volcanic shock. These vessels were about 520 miles apart. Supposing them to be in direct line, in which the earthquake was travelling, its rate will appear to be about 1 mile in 6 seconds, which is only a little slower than sound travels through the air.

The Russian ship *Dallas*, W. Wikander commander, March 20, 1861, at 7 p.m., lat. 0° 27′ N., long. 20° 30′ W., the ship apparently went over the ground; the ship's masts and yards were shaken. Found afterwards that the false keel had gone.

At the same moment another ship, the *Melbourne*, of Dundee, C. Cowie master, in lat. 0° 20′ N., long. 20° 35′ W. (that is 8½ miles distant from the Russian ship in company), was startled by hearing a loud rumbling noise, and at the same time felt the ship tremble from stem to stern, which lasted four or five minutes.

The ship *Florence Nightingale*, January 25th, 1859, having the St. Paul Rock, or Peñedo de San Pedro, bearing N.W. by N. 10 miles, experienced a severe shock. It commenced with a rumbling noise like distant thunder, and lasted about forty seconds. The sea had been short and irregular, but was succeeded by a *heavy swell from N.E.*, which lasted for several days.

Captain Whitmore, of the *Sea Serpent*, December 29th, 1859, struck, as he supposed, on a coral reef, in lat. 0° 29′ N., long. 28° 30′ W., in consequence of which he put into Rio. He sounded immediately, and found no bottom, but found afterwards his false keel and copper injured.

The Russian sloop of war *Passodnik* struck, as was supposed, on the same shoal, about 24 hours before the *Sea Serpent*, but this proves the nature of the occurrence.

The *Prince*, of Scilly, James Thomas commander, 11th December, 1853, in lat. 0° 54′ N., long. 26° 50′ W., smooth water, suddenly felt a grinding tremour go through the vessel, as if dragging over something rough and yielding. It continued for about a ship's length, but did not stop her way through the water. The ship did not strike.

The barque *Eleanor*, Captain G. A. Findlay, March 26th, 1861, 10 a.m., felt a shock as if something very heavy was being rolled about the decks, or as if the ship had gone over some rough ground; it made the vessel tremble only for a few seconds. A rumbling noise heard like distant heavy thunder. Weather remarkably fine; lat. 0° 44′ N., long. 21° 19′ W. Great quantities of fish and sharks around the ship.

These instances with the others will afford ample evidence of the general nature and locality of these volcanic shocks.

We have limited the instances here to this particular area on the Equator; but there appears to be either an extension of this action far to the northward, or else there is a separate area, for volcanic shocks have been felt as far North as 23° 30′ N., and long. 58° 0′ W.; and from the almost continuous line of discoloured and peculiar water that extends from the Equator to this position, as will be presently stated, we are led to infer that there is a line of volcanic action trending parallel to the range of the Antilles.

The *depth*, however, is very great, and there is not now any reason for supposing that any shoal exists. Lieutenant Lee and others have found depths exceeding 2,000 fathoms over most of the region in question; and this is another wonderful evidence of the force of these shocks which can be transmitted through a stratum of water 12,000 feet and upwards in thickness.

DISCOLOURED WATER.

At 3 p.m. on the 15th of July, 1792, Don Cosme de Churruca, then on his passage to the West Indies, discovered a boiling and breaking of the sea, so very extraordinary, that it appeared to be breakers; but they found no bottom at 150 fathoms. This phenomenon, which appeared to be in consequence of a current setting against the wind, accounts for the differences between the observations and dead reckoning.

On the 16th, at 10 a.m., they were in lat. 13° 56′, long. 54° 7′ West of Greenwich; and observed that the colour of the water changed, looking like muddy river water, or as if they were on a bank. They were 128 leagues to the eastward of the middle of St. Lucia, and 150 to the N.E. of the mouth of Orinoco. They continued their course without alteration; sounded at night and found no bottom at 120 fathoms. The captain, Churruca, says that the colour is always the same in that part of the ocean, always appearing as if on soundings in that latitude and longitude, and that it never varies the position of its limits; and, in addition to his own remarks, he had assured himself of the fact by information collected from various sources; and that, also, the English sailing directions for the year 1782, entitled the *Complete Pilot for the Leeward Islands*, in the account of Barbadoes, mentions that this phenomenon is found at the distance of 70 or 80 leagues to the eastward of that island, and that there are no soundings, though the water seems as if there were.*

The passage above quoted, from the old Book of Directions, is as follows:—

"In the latitude of Barbadoes, about 70 or 80 leagues to the eastward, you will find the water discoloured and prodigiously thick, as if there were soundings; but there are none, and you may depend on being at the distance aforesaid from the island."†

"In alluding to Mr. Luccock's remark about the patches of water which exhibit a brown and dirty appearance, and also to the note from Captain Kotzebue in the New *Sailing Directory for the Ethiopic*, page 42, I should question, with all deference, whether the depth of water in such places was tried to a sufficient degree of certainty.

"On our passage from the West Indies to Europe in July, 1837, at about four in the afternoon of the 7th, a streak was observed on the surface of the sea, exactly in the same manner as Captain K. describes, and at the moment we passed over it the lead was hove in a very proper manner without finding bottom; but, having lowered the boat, soundings were found to exist, although in more than 30 fathoms of water. The latitude computed from observations taken at noon, was 21° 12′ N., and long. by chronometer, 58° 42′ W.—*A. H. Bisschop Greevelink.*" (Lieutenant Lee found 2,800 fathoms here.)

Off the Coast of Guyana, in the morning of the 17th of September, 1835, on the track of the *Echo* from Antigua toward Surinam, there appeared at about seven o'clock, in every direction upon the surface of the ocean, several large spots of discoloured water, more or less thickly mingled as it seemed with mud. It was a fine morning; the sun rose in all its splendour, and not a single cloud was there to throw its shade upon the water, which was uncommonly smooth, although the ship ran 6 miles an hour; besides the water in some of the spots were so thick as to make the blue waves curl against their edges. Having, says M. Greevelink, the watch at the time, I gave warning of this strange occurrence to our captain (the late and much-lamented W. H. van Voss), who came on deck and ordered me to keep—not to alter—our course, by which we passed through of those spots, yet we did not heave the lead, as it was the first day in which we gained a breeze after fourteen days struggling with horrible calm and rainy weather, and two-thirds of our crew confined to their hammocks.

While in the midst of these spots I observed the latitude by the moon, then passing the meridian 11° 47′, and the longitude by chronometers, and at the same time by lunar distances, three excellent sets, 53° 47′. In about three-quarters of an hour we were clear of them, and the sea resumed its former clearness. The current, equatorial, for several days remained northerly, yet was not very strong. (Lieutenant Lee found no bottom at 2,780 fathoms.)

That we had not been in soundings we felt nearly convinced by existing circumstances; yet how came this muddy water here? The common discoloured water of Barbadoes it was not, as the latter is a large extent of water of a different but somewhat lighter hue than that of the ocean; at least, so far as we have seen it. As for my humble opinion, I seek for a cause of this appearance only in the force with which the Marañon rushes downward, but without sufficient power to strengthen the

* It seems that the appearance of soundings described above occurs in the same place where Captain Tulloch told me a bank existed, which some Americans were in the habit of making as a fresh point of departure when bound to Surinam, &c.—*A. L.* But Lieutenant Lee, in the *Dolphin*, found depths of 2,500 fathoms. See cruise of the *Dolphin*, pages 101, 102.

† In 1813, at the distance of 197 miles to the eastward of Barbadoes, we found the water discoloured: the thermometer rose here 1°. The current [Equatorial] inclines to the northward here; which, as well as the discoloured water, may be attributed to the stream discharged by the great River Orinoco, &c.—*Lieutenant Evans.*

Equatorial current. This may seem contradictory, but I think it may be found reconcileable in the manner following :—

This river impetuously pours forth its waters in a mass over a bed of some declivity, which steepens more and more towards its issue till it becomes a precipice, so as to form a cataract, whereby a part of its stream may dive beneath the stratum of undulations of the ocean. and afterward rise to the surface by its lesser specific gravity; where, driven still further off by the northerly current, it may easily remain for some days in the above-mentioned manner, especially in those months wherein continual calms prevail, and the water is rarely disturbed by the wind. (This may be the case, but it may also be attributed to a volcanic origin as stated above.)

The commander of H. (Netherlands) M. brig *Koerier*, informed Captain Stort that in the month of May, 1854, when between lats. 16° and 17° N., and in 54° W. longitude, he sailed for a whole day in dark coloured water. This was particularly remarked, inasmuch as similarly coloured sea is met with in about lat. 10° and more easterly. Purdy, in his "Atlantic Memoir," mentions that in lat. 16° N., white coloured water has been observed.*

With this knowledge and the announcements before given of the *Betsy's Rock*, *Galissionière's Rock*, *Martin's Reef*, *St. Esprit Reef*, and the singular phenomena related by Churruca, Greevelink, and Nockells, it may be inferred that a large extent of ocean, running parallel with the range of the Windward Islands, covers either a range of submarine volcanoes, or that the bed is in a state of action from the same cause.

Lieutenant Lee, in the U.S. brig *Dolphin*, also met with discoloured water in lat. 12° 22′ N., long. 54° to 55° W., but found no bottom at the East end of this, with 1,000 fathoms, and a depth of 2,570 fathoms at its West End.

He again came into discoloured water in lat. 14° 10′ to 14° 50′ N., long. 54° 30′ to 55° 0′.

Captain Nockells, in the ship *Brightman*, of London, 5th of May, 1835, observing that the sea appeared of a dirty dark green, in lat. 41°, long. 39° 19′, by chronometer, tried for soundings, but found no bottom at 240 fathoms.

Captain Nockells, in two previous voyages, found the water in the same place very much discoloured, which he supposed might originate from the melting of the ice in the northern latitudes.

A remarkable change in the colour of the sea was observed by M. Dupetit Thouars, on board the French frigate *La Venus*, in lat. 21° 50′, long. 19° 34′ W., in the same spot which Fraisier had already pointed out. The officers thought it was a bank, but no bottom was found with 550 fathoms.†

DEPTH OF THE ATLANTIC OCEAN, AND DEEP-SEA SOUNDINGS.

It was formerly considered that the lower bed of ocean-water was, from the pressure and weight of the incumbent masses, so dense as to be rather of the nature of solid matter than the natural fluid. However, a few facts will serve to dispel such a notion. The descent of the deep-sea lead is quite as rapid at a depth when the upper weight must be enormous, as at less distance from the surface, and no tendency to obstruct its downward passage can be observed at the greatest depth yet attained, ex-

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* Verhand. en Berigten, Amsterdam, 1854, p. 385.

† Voyage de la Venus, vol. iii, p. 446.

cept that which is due to the friction of the sounding-line. Again, the whale fishers frequently find their prey to descend perpendicularly to such an enormous depth, that the idea of an impenetrable density, or even of any considerable increase of it, cannot be for a moment entertained.

It is true that the pressure increases with the depth, to the amount of 15 lbs., upon square inch for every 34 feet in depth; but the density is not thereby sensibly increased owing to the incompressibility of water; so that neither the buoyant force, nor the resistance to the motion of any body, are sensibly increased from the surface to the bottom. At the depth of 3,000 fathoms, for instance, the pressure upon a square inch is nearly 8,000 lbs., but the column of water of 18,000 feet is only shortened about 160 feet; the density is then but slightly increased; but the effect of this enormous pressure upon compressible bodies, as air, wood, &c., is to condense them into a smaller bulk, by which they may be rendered *heavier than water*, and will sink of their own weight. A piece of wood cannot float at the bottom of the sea, but a very slight extraneous force will bring it to the surface.

The lead, if allowed to descend *alone*, will fall with a uniform and rapid velocity to the bottom; but if a line be attached to the lead, a few hundred feet of the line will offer a resistance to the motion nearly equal to the whole weight of the lead, and as successive lengths are drawn into the water, this resistance is increased, till at 2,000 or 3,000 fathoms depth, the weight will be almost entirely suspended in the sea by the resistance of the water along the sides of the line.*

Among the earliest experiments, perhaps the first, of these deep-sea soundings is that recorded by Captain Edward Sabine, who, on November 13th, 1822, when about midway the Caymans and Cape Antonio, in the Caribbean Sea, sunk a cylinder and obtained the temperature at a depth exceeding 1,000 fathoms. This was followed by Captain Wauchope, in H.M.S. *Eurydice*, who gained water from a depth of about 1,300 fathoms. After that, Captain (afterward Admiral Sir Francis) Beaufort thought that he attained a depth nearly the same in the Strait of Gibraltar; but his sounding is shown to be fallacious. Although the results can scarcely be said to affect navigation, still in a work like the present so interesting a feature of its subject cannot be overlooked. We shall give here the details of some of those great experiments. The first was made by Captain Barnett, of H.M.S. *Thunder*, and is related in the "Nautical Magazine" for 1849.

On July 10th, 1848, lat. 25° 55′ N., long. 66° 0′ W., between St. Thomas and Bermuda:—No current, sounded with 250lb. of pig ballast; the line broke at about 3,250 fathoms; run out in 1^h 11′ 34″.

On August 3rd, 1848, lat. 41° 19′, long. 44° 16′ W., between the Western Islands and Newfoundland Bank, same weight as before, current N.W. by W., 2 knots an hour. The whole line, 3,700 fathoms, run out in 1^h 15′ 27″, and held the boat with the reel for nearly half an hour against the current, when the line broke about 300 fathoms below the surface.

On the same day tried a line of *iron wire*, varying in size from Nos. 1 to 5, 4,000 fathoms in length, wound on a small reel, the smallest part first, with a weight attached of 61 lb., but a hand lead would have been better. It broke at 2,000 fathoms, which run out in 20′ 53″. This experiment was suggested by Lieutenant Mooney.

But the greatest length of wire line sent down is that effected by Lieutenant *J. C. Walsh*, in the U.S. schooner *Taney*, on November 15th, 1849, to a depth of more than 5,700 fathoms (32,200 feet, or more than 6 statute miles), without finding bottom, as was supposed, in lat. 31° 59′ N., long. 58° 43′ W. The wire broke at this length, 5,700 fathoms, at the reel, and was lost. It preserved the exact plumb line throughout the sounding; there was a steady, uniform increase of weight and tension; no check whatever any instant of its descent. This experiment, however, is of a negative character; for it is evident, says Professor Trowbridge, that the wire would be carried down and run out by its own weight.

* Professor Trowbridge in Silliman's Journal, vol. xxvi., 1858, p. 391.

One of the earliest specimens of bottom obtained at great depths was by Comm. C. H. Davis, U.S.N., in October, 1845, when greenish mud was brought up in the Stellwagen cup from a depth of 1350 fathoms in the Gulf Stream.

The Hydrographic Bureau of the United States, following up the investigations thus commenced, instructed Captain Platt, in the U.S. sloop of war *Albany*, to continue these experiments; and accordingly, between December, 1850, and April, 1851, besides numerous trials in the Atlantic, quoted below, she carried a line of soundings across the Gulf of Mexico.

The possibility of obtaining a knowledge of the great depth of the ocean being established, the Government of the United States first commenced utilising this knowledge, on a more extended scale, by the expedition of the brig *Dolphin*, in her well-known cruise, under the command of Lieutenant-Commanding Lee, U.S.N. The result of this voyage was the disproof of many of those shoals and dangers which had long held a place on our charts to the continual annoyance and embarrassment of navigation. These have been recited in the previous pages. This cruise of the *Dolphin* was confined to the North Atlantic, except a portion in South latitude about Fernando Noronha, and the Rocas. The *Dolphin* was again sent out under the command of Lieutenant O. H. Berryman with the same object.

The soundings taken in the *Dolphin*, most of which will be given presently, were taken with the thin sounding line, seven-hundredths of an inch in diameter, and one or two 32 lbs. shot. It has been questioned, and it certainly seems with reason, whether the evidence upon which the deeper soundings rest is quite valid, as has been before alluded to.

There are two methods of estimating the true depth obtained, the one by the rate of descent of the line, which has been carefully estimated now from the numerous experiments made, but whichich estimate of course is liable to the vitiating influence of under-currents, and also by the indications of a sounding machine such as Massey's, or another proposed by Professor Trowbridge; but hitherto these instruments have manifestly failed at great depths from some cause, either the helices not acting readily under the pressure, or the friction on the wheel-work. Errors therefore of 500 fathoms may escape detection, and therefore a series of deep soundings, apparently of similar depths, as will be seen in the ensuing tables, may pass over submarine mountains as high as Snowdon or Ben Lomond without detection.

In sounding with a line of seven-hundredths of an inch in diameter, the velocities of the descent diminish, with one 32lb. shot, from 8·83 feet per second at 50 fathoms, to 2·84 feet at 1,000, and 2·09 feet at 2,000 fathoms; and with two 32lb. shot, from 12.5 feet per second at 50 fathoms, to 3·48 feet at 1,000, or 2·99 feet at 2,000 fathoms.

Another very important consideration is—what effect would under currents have on the line in passing through it? From the remarkable trials made by Lieutenant Walsh, cited on pp. 365, 366, when in several instances unsuspected and deep-seated currents were found, and in one instance at a velocity of $1\frac{3}{4}$ knots, and in others of $1\frac{1}{2}$, $1\frac{1}{4}$, and 1 knot, and these, too, moving in quite contrary directions to that otherwise ascertained, it must be considerable. It is possible, nay, probable, also, that in the vast depths penetrated in these soundings, more than one such submarine and opposing current would have to be crossed.

Now it is certain that a current must act upon the *bight* of the sounding line after the weight has passed through it, and it may operate in swerving the weight itself from its perpendicular descent at great depths. Therefore it would be difficult to state what the exact depth was that the sounding weight would reach, and it is familiar to all, that a very great strain is required to get a towing line straight again if the bight of the line gets into the water. Therefore it would seem that such submarine currents have the effect in causing the irregularities in the times required to sink a certain quantity of line.

Again, the force exerted by a current against the *bight* of the sounding line will have the effect of taking the twine off the reel at nearly *double* its own velocity. So that supposing the ship stationary at the surface, and the shot at the bottom, such submarine streams as those recorded by Lieutenant Walsh would take off the line nearly as fast as the shot would sink it, and it would be nearly as difficult to haul it in as it would be to raise the shot itself from a great depth, with all the friction caused by the length of the twine.

From these considerations it must be supposed that the depths stated, even when it is certain that the bottom has been reached, are in excess, and this, too, in an uncertain degree, unless any judgment can be formed from the irregularity of its descent.

To obviate these sources of error or doubt, a line of fine sewing silk has been proposed, but we have not heard of any trial with this.

The most important, and most probably the most accurate soundings that have yet been taken, are those which originated in the question of connecting Europe with America by the Submarine Electric Telegraph. The first of these series was obtained by Lieutenant-Commanding O. H. Berryman, in the U.S. Steamer *Arctic*, in August, 1856. The line of deep-sea soundings, 24 in number, being on the great circle joining Valentia, Ireland, with St. John's, Newfoundland. The depths were estimated by a machine, Massey's Sounding Machine, and a similar one by M. Lecointre, and the line was wound in by a small engine on the deck.

The same ground was gone over with the same object, by Lieutenant-Commanding Jas. Dayman, R.N., in H.M.S. *Cylcops*, in June and July, 1857, and 34 soundings were obtained, the depths being estimated by the length of line and by the machine as heretofore. The sinker employed was self-detaching upon touching the bottom, and in a quill attached to the support, bottom was brought up in almost every instance in small quantities. The nature of this bottom is alluded to previously in pp. 337, 338, (245.) and (246.), and the very interesting features it first brought to light are there related.

The failure of the Atlantic Cable having suggested the necessity of a shorter sea route, Commander Dayman was despatched in H.M.S. *Gorgon*, in September and October, 1858, and obtained soundings between Newfoundland, the Azores, and England, gaining much experience as to the best methods of sounding, and and also of estimating the depths.

Another project for the telegraph cable having arisen, in July, 1860, H.M.S *Bulldog* started under the command of Captain Sir Leopold M'Clintock, of Arctic celebrity, and obtained the depths between the Færoe Islands and Iceland, and thence to Greenland and Labrador, with most satisfactory results.

The soundings were first obtained generally by cod-line, with an iron sinker of 118 lbs., the line and sinker being lost at each sounding. The depth being thus obtained, a machine for bringing up the bottom was next sent down by a stronger line, and a self-detaching tubular weight or sinker of 100 lbs. The apparatus, which brought up specimens of the bottom, was a double scoop, 5 inches in diameter, kept open so long as the weight is dependent on it, but forcibly closes by means of a vulcanized india-rubber band the moment it is detached by touching the bottom. This brought up specimens in large quantities. It was contrived by Mr. Steil, the assistant engineer, and, with some modifications proposed after their return, has been called the Bulldog Machine.

The soundings obtained in these expeditions, although of the greatest importance, but lying out of the beaten track of navigation, are not inserted in the tables hereafter, which give most of those hitherto recorded to the South of lat. 50°. They will prove useful should it be supposed that rocks or shoals are seen in their neighbourhood.

SOUNDINGS.

BETWEEN LATITUDES 40° AND 50° N.

Lat. N. ° ′	Long. W. ° ′	Depth. Fathoms.	Lat. N. ° ′	Long. W. ° ′	Depth. Fathoms.
47 12	10 0	2525 *a*	45 58	29 35	19 0 *d*
46 42	13 5	● 1500 *b*	49 59	17 35	2700 ..
46 12	13 3	1800 ..	49 57	13 16	1580 ..
40 24	25 25	1200 *c*	47 38	9 1	1800 ..
41 4	24 31	2000 ..	46 32	12 42	2190 ..
41 50	23 40	1900 ..	44 5	13 29	2560 ..
42 16	22 32	1885 ..	42 7	15 29	2500 ..
43 17	21 20	1800 ..	40 20	17 48	2650 ..
44 5	20 0	2100 ..	42 10	42 4	1850 ..
44 34	18 47	2374 ..	46 53	37 46	2000 ..
45 11	17 26	2100 ..	48 16	35 22	2100 ..
45 53	16 7	2300 ..	49 53	31 34	1900 ..
46 33	14 39	2405 ..	43 10	46 56	2760 *e*
47 6	12 57	2350 ..	42 24	43 19	2725 ..
47 48	11 12	2275 ..	42 7	41 28	● 3000 ..
46 48	21 42	2465 *d*	40 10	35 2	2775 ..
44 42	24 35	1500 ..	40 34	58 30	2750 *d*
44 43	24 35	1370 ..	41 7	54 37	2710 ..
43 47	24 24	1850 ..	41 43	51 31	3130 ..
45 7	26 8	1500 ..	42 22	50 0	1050 ..
46 26	26 55	1400 ..	41 9	43 40	1975 ..
45 13	27 38	1320 ..	40 50	64 44	2200 ..
42 44	28 20	1210 ..	41 12	62 38	2200 ..
40 49	29 0	1080 ..	41 40	59 23	2600 ..
40 48	30 2	830 ..	41 40	56 1	2595 ..
40 35	31 56	1230 ..	40 36	54 18	3450 ..
42 40	31 11	1680 ..	41 7	49 23	4580 ..
44 52	30 38	1560 ..	43 40	42 55	2700 ..
46 15	30 4	1760 ..	44 41	40 16	1800 ..

BETWEEN LATITUDES 30° AND 40° N.

Lat. N. ° ′	Long. W. ° ′	Depth. Fathoms.	Lat. N. ° ′	Long. W. ° ′	Depth. Fathoms.
33 8	16 10	● 2950 *d*	39 40	33 34	1925 *c*
34 18	16 45	2298 ..	39 12	32 32	1075 ..
36 59	19 58	2500 ..	38 54	31 2	925 ..
36 49	19 54	2750 ..	38 33	29 33	960 ..
30 49	27 25	● 1100 ..	38 23	28 50	409 ..
30 49	27 25	● 2200 ..	38 51	28 27	766 ..
39 14	19 1	2820 ..	39 17	27 46	805 ..
34 23	20 57	2150 ..	39 41	26 37	1425 ..
31 46	22 3	2850 ..	38 54	33 30	1600 *d*
37 50	32 7	2000 *e*	31 17	33 8	2400 ..
36 0	27 20	● 4000 ..	39 36	41 6	2675 ..
35 6	26 50	● 4000 ..	33 35	38 32	1800 *f*

● *No Bottom.*
a Soundings taken by Commander Dayman, in H.M.S. *Cyclops.*
b " " Captain Pullen, in H.M.S. *Cyclops*, 1858.
c " " Commander Dayman, in H.M.S. *Gorgon*, 1858.
d " " Lieutenant O. H. Berryman, U.S. brig *Dolphin.*
e " taken in U.S.S. *Jamestown.*
f " " U.S.S. *Susquehanna.*

BETWEEN LATITUDES 30° AND 40° N.—(*Continued.*)

Lat. N. ° ′	Long. W. ° ′	Depth. Fathoms.	Lat. N. ° ′	Long. W. ° ′	Depth. Fathoms.
36 16	46 52	● 5070 *g*	32 46	59 56	● 800 ..
34 11	43 21	2800 *h*	32 10	59 9	● 300 ..
38 15	45 33	2000 *e*	31 17	53 22	● 500 ..
38 50	43 49	1600 ?	38 38	66 31	● 1625 *k*
31 16	43 28	2080 *d*	33 34	61 38	● 1950 ..
32 1	44 21	2250 ..	30 5	58 52	● 1000 ..
32 29	47 2	● 1950 ..	37 24	68 52	2920 *d*
32 55	47 58	● 6600 ..	38 3	67 14	● 4920 ..
33 3	48 36	3550 ..	36 43	74 0	● 1500 *e*
32 47	50 0	3250 ..	36 33	73 0	● 1900 ..
33 50	52 34	2600 *i*	37 6	68 2	2000 ..
32 6	44 47	5500 ? ..	38 13	62 32	3700 ..
31 1	44 31	2300 ..	39 39	70 30	● 1000 *d*
35 7	25 43	1040 ..	30 38	70 10	● 600 *j*
37 28	56 22	6000 ? *h*	33 3	72 14	● 345 ..
37 26	65 48	● 1175 *j*	34 2	73 6	● 700 ..
35 52	65 56	● 2000 ..	36 4	73 59	● 1460 ..

BETWEEN LATITUDES 20° AND 30° N.

Lat. N. ° ′	Long. W. ° ′	Depth. Fathoms.	Lat. N. ° ′	Long. W. ° ′	Depth. Fathoms.
			18 32	49 48	2370 ..
29 12	22 50	2800 *d*	21 26	51 31	2300 ..
23 58	24 20	2700 ..	22 27	53 15	2390 ..
21 6	24 38	2625 ..	21 45	55 46	2800 ..
10 0	27 30	2000 *l*	12 9	55 17	2435 *n*
4 16	21 42	2700 ..	20 51	58 26	2800 *d*
2 20	28 44	1080 ..	20 2	61 2	2810 ..
27 5	21 21	1700 *d*	21 19	66 27	2960 ..
27 2	30 48	2580 ..	23 42	67 37	2940 ..
20 2	31 6	2560 ..	29 26	56 42	1480 ..
21 48	32 36	7020 ? ..	28 20	59 44	2900 ..
20 29	34 18	2850 ..	28 4	61 44	3080 ..
26 43	38 39	● 800 *j*	28 23	64 17	2518 ..
25 30	37 44	1720 ..	26 49	66 54	2710 ..
25 30	37 42	● 1560 ..	28 14	69 24	2950 ..
25 4	36 13	● 1000 ..	20 12	59 39	● 1200 *j*
23 43	32 39	● 2180 ..	22 39	59 26	● 800 ..
23 41	32 39	● 2200 ..	23 1	59 26	● 358 ..
23 15	32 24	● 2200 ..	23 36	59 25	● 600 ..
21 19	38 10	4700 *m*	24 37	59 49	● 534 ..
28 55	41 21	● 1880 *d*	25 11	60 0	● 520 ..
29 14	35 49	2270 ..	25 45	60 7	● 556 ..
21 6	42 9	2370 ..	26 32	60 7	3825 ..
23 6	44 0	1760 ..	24 11	61 44	3450 ..
21 18	46 14	1875 ..	24 27	62 55	● 460 ..

● *No Bottom.*

d Soundings taken by Lieutenant O. H. Berryman, U.S. brig *Dolphin.*
g „ „ in U.S.S. *St. Louis.*
h „ „ U.S.S. *Plymouth.*
i „ „ *John Adams.*
j „ „ by Lieut Lee in U.S. brig *Dolphin.*
k „ „ Capt. Platt, U.S. *Albany.*
l „ „ Captain Pullen, in H.M.S. *Cyclops.*
m „ „ in U.S.S. *Portsmouth.*
n „ „ U.S.S. Steamer *Saranac.*

BETWEEN LATITUDES 20° AND 30° N.—(*Continued.*)

Lat. N. ° ′	Long. W. ° ′	Depth. Fathoms.	Lat. N. ° ′	Long. W. ° ′	Depth. Fathoms.
24 28	63 30	● 1000 *j*	27 10	76 59	1180 *k*
24 34	65 32	● 1000 ..	27 10	75 6	1806 ..
24 37	65 12	● 3560 ..	26 31	74 10	1590 ..
25 14	66 57	● 2350 ..	26 28	73 50	1778 ..
26 33	67 33	● 1000 ..	25 30	72 7	4100 ..
27 21	68 6	● 1000 ..	24 48	70 22	1893 ..
28 56	69 4	● 1000 ..	24 48	69 39	3600 ?
27 19	77 18	690 *k*	22 40	69 0	2762 ..

BETWEEN THE EQUATOR AND 20° N.

Lat. N. ° ′	Long. W. ° ′	Depth. Fathoms.	Lat. N. ° ′	Long. W. ° ′	Depth. Fathoms.
0 18	18 41	● 2000 *j*	17 2	28 8	2160 *d*
0 16	18 51	● 1900 ..	18 44	29 18	2520 ..
0 45	18 29	2680 ..	18 49	36 16	2820 ..
2 17	15 45	● 900 ..	19 23	40 23	2580 ..
3 1	18 36	2725 ..	0 10	38 44	● 1000 *j*
2 36	19 22	2780 ..	0 57	41 6	2980 ..
2 10	19 57	2750 ..	1 7	42 58	● 1000 ..
		2690 ..	1 7	43 44	● 2000 ..
8 43	20 52	2270 ..	0 54	44 52	● 1000 ..
7 17	20 7	2050 ..	0 43	45 1	● 1000 ..
		1940 ..	1 10	44 11	● 500 ..
5 37	19 35	● 2019 ..	0 54	43 36	● 500 ..
4 27	19 21	2540 ?..	0 42	44 21	640 ..
4 5	19 15	2125 ?..	7 58	47 51	1970 ..
4 14	19 20	2670 ..	10 38	47 40	● 500 ..
3 42	19 6	2760 ..	11 12	47 37	● 1855 ..
3 51	19 6	2760 ..	15 0	48 58	● 250 ..
18 39	25 24	1970 ..	15 56	49 34	● 500 ..
18 19	25 5	1675 ..	15 52	49 34	● 540 ..
18 11	23 48	1612 ..		49 40	● 590 ..
17 35	22 50	1370 ..	15 56	49 39	● 500 ..
16 30	20 58	1941 ..	15 6	50 34	● 500 ..
16 34	20 47	1875 ..	14 21	51 24	● 564 ..
16 59	21 38	1580 ..	13 28	52 26	● 1960 ..
15 24	21 47	1220 ..	12 47	52 58	2780 ..
15 9	22 29	1380 ..	11 47	53 49	● 1000 ..
15 8	22 57	1120 ..	12 20	54 49	2570 ..
15 3	23 13	790 ..	15 25	55 1	3020 ..
14 48	23 50	● 900 ..	15 54	56 45	● 1000 ..
13 1	22 59	● 680 ..	16 43	58 6	● 345 ..
11 7	21 57	1160 ..	16 43	58 55	● 3200 ..
		1120 ..	16 42	59 6	● 1000 ..
18 10	24 51	2080 *d*	19 2	59 33	3300 ..

● *No Bottom.*

d Soundings taken by Lieutenant O. H. Berryman, U.S. brig *Dolphin.*

j ,, ,, by Lieut Lee in U.S. brig *Dolphin.*

k ,, ,, Capt. Platt, U.S. *Albany.*

AN ACCOUNT OF THE FINE DUST WHICH OFTEN FALLS ON VESSELS IN THE ATLANTIC OCEAN.

By Charles Darwin, Esq., F.R.S., F.S.S.

Many scattered accounts have appeared concerning the dust which has fallen in considerable quantities on vessels on the African side of the Atlantic Ocean. It has appeared to me desirable to collect these accounts, more especially since Professor Ehrenberg's remarkable discovery that the dust consists, in considerable part, of Infusoria and Phytolitharia. I have found fifteen distinct statements of dust having fallen; and several of these refer to a period of more than one day, and some to a considerably longer time. Other less distinct accounts have also appeared. At the end of this paper I will give the particular cases, and will here only refer to the more striking ones and make a few general remarks.

The phenomenon has been most frequently observed in the neighbourhood of the Cape Verde Archipelago. The most southern point at which dust is recorded to have fallen is noticed by Captain Hayward,* on whose vessel it fell whilst sailing from lat. 10° N. to 2° 56′ N.; the distance from the nearest of the Cape Verde Islands being between 450 and 850 miles. Respecting the northern limit, the water for a great distance on both sides of Cape Noon (in lat. 38° 45′) is discoloured, owing in part, according to Lieutenant Arlett,† to the quantities of falling dust. Hence the phenomenon has been observed over a space of at least 1,600 miles of latitude. This dust has several times fallen on vessels when between 300 and 600 miles from the coast of Aftrica: it fell, in May, 1840, on the Princess Louise ‡ (in lat. 14° 21′ N., long. 35° 24′ W.), when 1,030 miles from Cape Verde, the nearest point of the continent, and therefore half-way between Cayenne in South America and the dry country North of the Senegal in Africa.

On the 16th of January, 1833, when the *Beagle* was 10 miles off the N.W. end of St. Jago, some very fine dust was found adhering to the under side of the horizontal wind-vane at the mast-head; it appeared to have been filtered by the gauze from the air, as the ship lay inclined to the wind. The wind had been for twenty-four hours previously E.N.E., and hence, from the position of the ship, the dust probably came from the coast of Africa. The atmosphere was so hazy, that the visible horizon was only 1 mile distant. During our stay of three weeks at St. Jago, (to February 8th) the wind was N.E., as is always the case during this time of the year; the atmosphere was often hazy, and very fine dust was almost constantly falling, so that that the astronomical instruments were roughened, and a little injured. The dust collected on the *Beagle* was excessively fine-grained, and of a reddish-brown colour; it does not effervesce with acids; it easily fuses under the blow-pipe into a black or gray bead.

In 1838, from the 7th to the 10th of March, whilst Lieutenant James, in H.M.S. *Spey*, was sailing, at the distance of from 330 to 380 miles from the continent, between lat. 21° 10′ N., long. 22° 14′ W., and lat. 17° 43′ N., long. 25° 54′ W., considerable quantities of dust fell on his vessel, four packets of which, together with a written communication, I owe to the kindness of Mr. Lyell. The dust which fell on the first day (or the 7th) was preceded by a thick haze, and it is coarser than that which fell on the succeeding days; it contains numerous irregular, transparent, variously-coloured particles of stone about the 1-1000th of an inch square, with some few a little larger, and much fine matter. The fact of particles of this size having been brought at least 330 miles from the land, is interesting, as bearing on the distribution of the sporules of cryptogamic plants and the ovules of Infusoria. The dust which fell on

* Nautical Magazine, 1839, p. 364. † Geographical Journal, vol. vi. p. 296.

‡ Edinburgh New Philosophical Journal, vol. xxxii. p. 134.

the three succeeding days resembles in appearance and in its action under the blowpipe, that collected by myself off St. Jago, and is so excessively fine, that Lieutenant James was obliged to collect it with a sponge moistened with fresh water. As the wind continued nearly in the same direction during the four above-mentioned days, and the distance from the land was only a little increased after the first day, it would appear probable that the coarser dust was raised by a squall with which the breezes on this coast so often begin blowing.

With respect to the direction of the wind during the falls of dust, in every instance where recorded, it has been between N.E. and S.E.; generally between N.E. and E. In the case, however, given by the Rev. W. Clarke,* a hazy wind which had blown for some time from E. and S.E. first fell calm, and was succeeded for a few hours by a S.W. wind, and then returned strongly to the East; during this whole time dust fell. With respect to the time of year, the falls have always occurred in the months of January, February, March, and April; but in the case of the Princess Louise in 1840, as late as on the 9th of May. In the one year of 1839, it has chanced that dust has been recorded as having fallen in the Atlantic (as may be seen in the references) on the 14th and 15th of January, and on the 2nd, 4th, 9th, 10th, 11th, 12th, and 13th of February. I may add, that Baron Roussin,† during his survey of the north-western African coast, found, that whilst the wind keeps parallel to the shore, the haze and dust extend seaward only a short distance; but when, during the above four specified months, the harmattan blows from the N.E. and E.N.E., accompanied by tornadoes, the dust is blown far out, and is raised on high, so that stars and all other objects within 30° of the horizon are hidden.

Another account is given by *Mr. George Peacock*, as having occurred on board H.M.S. *Winchester*, in February, 1829:—"Shortly after leaving Tenerife, when in about lat. 25° 30′ N., and some 250 miles from the coast of the Great Desert of Sahara, the weather became very hazy and sultry, and one morning, at daylight, the lays of the lower rigging were observed to be filled fine, reddish-brown dust, and the decks, whilst being washed, were in as muddy a state as the pavement of a street after a shower. This hazy unpleasant weather continued all day, and quite obscured the horizon; rendering it difficult to observe even the crest of the waves beyond a few cables' length, and the sun appeared as viewed through the red shade glass of a sextant. Towards evening it grew worse, the wind became light, and the haze was almost as dense as a London November fog, the air full of fine red dust, which made it difficult and unpleasant to breathe. So thick was it, that a young man having fallen overboard, the boats which were lowered in search of him could neither find him nor scarcely find the ship for some time afterwards, and this though guns were fired."

From the several recorded accounts,‡ it appears that the quantity of dust which falls on vessels in the open Atlantic is considerable, and that the atmosphere is often rendered quite hazy; but nearer to the African coast the quantity is still more considerable. Vessels have several times run on shore owing to the haziness of the air; and Horsburgh,§ recommends all vessels, for this reason, to avoid the passage between the Cape Verde Archipelago and the main land. Roussin, also, during his survey, was thus much impeded. Lieutenant Arlett found the water so discoloured,|| that the track left by his ship was visible for a long time; and he attributes this, in part, to the fine sand blown from the deserts, "with which everything on board soon becomes perfectly caked."¶

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* Proceedings of the Geol. Soc., vol. iv. p. 145. † Naut. Mag. 1838, p. 824.

‡ Naut. Mag., 1837, p. 291; Edinburgh Philosophical Journal, vol. vii. p. 402; Howard Malcolm's Travels, vol. ii. p. 200.

§ Horsburgh's East Indian Directory, p. 11.

|| In Tuckey's Narrative of the Congo Expedition, p. 10.

¶ Nautical Magazine, 1847, p. 354.

Professor Ehrenberg* has examined the dust collected by Lieutenant James and myself; and he finds that it is in considerable part composed of Infusoria, including no less than sixty-seven different forms. These consist of thirty-two species of silicious-shielded *Polygastrica;* of thirty-four forms of *Phytolitharia*, or the silicious tissues of plants; and of one *Polythalamia*. The little packet of dust collected by myself would not have filled a quarter of a teaspoon, yet it contains seventeen forms. Professor Ehrenberg remarks, that as thirty-seven species are common to several of the packets, the dust collected by myself, and on four successive days by Lieutenant James, must certainly have come from the same quarter; yet mine was brought by an E.N.E. wind, and Lieutenant James's by a S.E. and E.S.E. wind. The Infusoria are all old known species, excepting one allied to a Hungarian fossil; and they are of fresh water origin, with the exception of two (*Grammatophora oceanica* and *Textilaria globulosa*), which are certainly marine. Professor Ehrenberg could not detect any of the soft parts of the Infusoria, as if they had been quickly dried up, and hence it would appear that they must have been caught up by the wind some time after having been dead. The greater number of the species are of wide or mundane distribution; four species are common to Senegambia and South America, and two are peculiar to the latter country; moreover, it is a very singular fact, that out of the many forms known to Professor Ehrenberg as characteristic of Africa, and more especially of the Sahara and Senegambian regions, none were found in the dust. From these facts one might at first doubt whether the dust came from Africa; but, considering that it has invariably fallen with the wind between N.E. and S.E., that is, directly from the coast of Africa; that the first commencement of the haze has been seen to come on with these winds; that coarser particles have first fallen; that the dust and hazy atmosphere are more common near the African coast than further in the Atlantic; and lastly, that the months during which it falls coincide with those when the harmattan blows from the continent, and when it is known that clouds of dust and sand are raised by it, I think there can be no doubt that the dust which falls in the Atlantic does come from Africa. How to explain the enigma of the absence of characteristic African forms and of the presence of two species from South America, I will not pretend to conjecture. Finally, I may remark, that the circumstance of such quantities of dust being periodically blown, year after year, over so immense an area in the Atlantic Ocean, is interesting, as showing by how apparently inefficient a cause a widely-extended deposit may be in process of formation; and this deposit, it appears from the researches of Professor Ehrenberg, will in chief part consist of fresh water Polygastrica and Phytolitharia.

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* These microscopic organised bodies have been described in the "Monatsberichten der Berlih Akad. der Wissens, Mai, 1844; u. 27 Februar, 1845." In the latter paper a full list of the names is given; the column marked St. Jago includes those selected by myself.

APPENDIX;

CONTAINING

HINTS AND REMARKS ON GENERAL NAUTICAL SUBJECTS.

I.—REMARKS ON THE USE OF THE CHRONOMETERS, ETC.

1. General Rules given by Captain Rich. Owen, R.N.

1. The time for receiving chronometers on board, previous to sailing, will differ a little according to circumstances; but it is strongly recommended that they should be received on board at least a week previous to sailing, in order that a rate may be obtained for them, in the position and place they are constantly to remain, as it may be taken for an absolute maxim in general practice, that *the rate of a chronometer obtained on shore will not be the same when removed to the vessel.* There may be a few exceptions to this general rule, but it must still hold good as a practical maxim.

2. The first thing to be attended to, after the timekeepers are on board, and in their proper place, is to be regular in the time, and careful in the manner, of winding them up. Our practice on board the *Leven* was to wind up at noon, and never *pipe to dinner* until they were reported to be wound up and compared. Some method of this kind may always be adopted in men-of-war, and it would be advisable in merchant vessels to devise some plan by which the winding up of the chronometers should not depend upon the memory of any single person, the want of which must, in many instances, have caused the watch to run down; which will, at all times, alter its rate, and, not unfrequently, injure the chronometer. Our eight-day watches we wound up on Sunday, which will always be better remembered than any other day in the week. In winding up the small chronometers in watch cases, the left hand should rest against the body of the person winding it up, to prevent his giving it a rotatory motion by turning the watch *on* the key instead of the key *in* the watch. This practice is very common, and very bad. In winding up chronometers, the turns of the key should always be counted, and the last turns made gently and carefully, until it is felt to butt. It has sometimes happened to persons over careful, that they have let their chronometers run down, by having calculated the number of turns, and never winding close up, from fear of injury to the chain or works, by which they have always lost a little of the chain each day, and, after two or three months, the chronometer is found to stop just at the time it should be wound up.

3. Of all the methods used by seafaring men to ascertain the rates and errors of their chronometers, that by equal altitudes of the sun in an artificial horizon is much to be preferred, both on account of its simplicity and the very great degree of correctness attainable by it, and being likewise free from the effects of instrumental error, or wrong latitude. The observations may be made at any time, with a sextant, when the sun's altitude falls between 20° and 60°, provided it be not too near noon, as under two hours, or at least one hour and a half, the sun's motion, in high latitudes, being then very slow.

4. The method of rating chronometers by *lunar observations* obtained at sea has been by some much insisted on, but we are fully satisfied that they can never be made use of, for that purpose, in general practice. Lunar observations are of great use for detecting a *gross error* in the longitude by chronometer, from any sudden change of rate or defect in the watch, &c.; but it must be evident that, where this is discovered, it would be unsafe to trust to such a chronometer for the remainder of the voyage. We would not be understood to discourage or depreciate the lunar method of obtaining the longitude, as we are fully aware of its great utility, particularly in

long voyages; but we would strongly dissuade persons from using such means for *rating* their chronometers.*

3.—Remarks extracted from those of Captain FitzRoy, R.N.

"Frequently employing chronometers in boats and very small vessels has strengthened my conviction, that *temperature* is the chief, if not the only, cause, generally speaking, of marked changes of rate: and the balances of few watches are so well compensated as to be proof against a *long* continuance of higher or lower temperature.

"It often happens that the air in port, or near the land, is at a temperature very different from that over the open sea in the vicinity. Hence the difference sometimes found between harbour and sea rates.

"The changes so frequently noticed to take place in rates of chronometers moved from the shore to the ship, and the reverse, are well known to be caused partly by change of temperature, and partly by change of situation.

"I have never found chronometers go better than when the boxes were bedded in sawdust, and the watches moving freely in well-oiled gimbals. Suspending them in cots not only alters their rate, but makes them go less regularly.

"When fixed to a solid substance, they feel the vibrations caused by people running on the decks, by shocks, and by chain cables running out. A cushion, wool, hair, or any such substance, is preferable to a solid bed; but I can think of nothing better than plain dry sawdust.

"The *Beagle's* chronometers were suspended in gimbals, as usual, within a wooden box; each was placed in sawdust, divided and retained by partitions, upon one of two wide shelves. The sawdust was about 3 inches thick below, as well as at the sides of each box, and formed a bed for it which rose rather above the centre of gravity of the box and watch; so that they could not be displaced unless the ship were upset. The shelves, on which the sawdust and boxes were thus secured, were between decks, low down, and as near the vessel's centre of motion as could be contrived. Placed in this manner, neither the running of men upon deck, nor firing guns (forward), nor the running out of chain cables, caused the slightest vibration in the chronometers, as was often proved by scattering powder upon their glasses, and watching it with a magnifying glass, while the vessel herself was vibrating to some jar or shock.

"All the watches were in one small cabin, into which no person entered, except to compare or wind them, and in which nothing else was kept. The greater number were never moved from their first places, after being secured there in 1831, until finally landed at Greenwich in 1836."—*Captain FitzRoy's Appendix*, pp. 325, 326.

5.—The following easy method *of comparing the* time *indicated by any number of chronometers, with the* given *time at a certain station, was published by the* Rev. F. Fallows, astronomer at the Cape of Good Hope, in 1824:—

"Let a transit instrument, or even a sextant with an artificial horizon, be established in a *conspicuous* situation on shore, where a clock can always be regulated to true time: then provide a powerful Argand's lamp, with a shutter, so as to be able to darken the lamp instantaneously: a few minutes before a certain hour in the evening, notice being previously given to the ships, let the lamp be lighted, and at the proper instant of time let it be darkened: this may be repeated several times at short known intervals. Then the errors of every chronometer on board of all the ships, from which the lamp can be seen, are immediately found. After a certain number of days let the same be repeated, when the daily *ship rates* will be given, since they are only the

* "Essay on the Management and Use of Chronometers," by Richard Owen, Commander R.N. Prefixed to the volume of Latitudes and Longitudes of the Points of Africa, &c., by Captain W. F. Owen, 4to., 1827.

differences of these errors divided by the number of days elapsed between the two sets of observations. It is evident that, for greater truth, these observations may be repeated at pleasure. No objection can be made from the chronometer's being generally below deck, as one person might have his eye upon it, and another immediately above him, on the upper deck, might give a stamp with his foot the instant the lamp is darkened." But the superior method is by the time-ball lately established in various places.

6.—Sir J. Herschel gives the following very simple and efficient means of ascertaining the rate of a chronometer or clock, a most important desideratum, where apparatus is wanting, and which is available at any time or place on shore:—"An observer need only station himself to the North of some well defined vertical object, as the angle of a building, and, placing his eye exactly at a certain fixed point (such as a small hole in a plate of metal, nailed to some immoveable support), notice the successive disappearances of any star behind the building by a watch. When he observes the sun, he must shade his eye with a dark-coloured or smoked glass, and notice when its western and eastern edges successively come up to the wall, from which, by taking half the interval, he will ascertain (what he cannot directly *observe*) the moment of disappearance of its centre. This is an excellent practical method of ascertaining the rate of a clock or watch, being exceedingly accurate if a few precautions are attended to; the chief of which is, to take care, that that part of the edge, behind which the star (a bright one, *not a planet*) disappears, shall be quite smooth; as, otherwise, variable refraction may transfer the point of disappearance from a protuberance to a notch, and thus vary the moment of observation unduly; this is easily secured, by nailing up a smooth-edged board."—*Astronomy*, p. 74. It need scarcely be remarked, that the interval between the two appearances of a star is a sidereal day, or $23^h\ 56'\ 4{\cdot}09''$; with the equation, for solar time, every sailor is acquainted.

II.—ON THE ARTIFICIAL HORIZON.

It is of the utmost importance to the sailor that he should at all times be enabled, by astronomical observations, to verify his position, and avoid all uncertainty as to his locality or course, which he must inevitably labour under if he has to depend for any lengthened period entirely on his dead-reckoning. Now it must have occurred to the experience of every one that such observations may have been had, perhaps at very critical times, but for one impediment,—that of the *horizon* being obscured by fog or haze. It is true, that the common reflecting horizon of mercury, or other substitute, will obviate this *on shore;* but even this frequently fails in low latitudes from the fact of the great angle, formed by the height of the sun being beyond the limits of the instrument. A substitute for the natural horizon is proposed in an instrument, that can be attached to the sextant, the invention of Commander A. B. Becher, R.N., which may be used at *all* times on shore or at sea, provided the motion be not too violent, and the observer have sufficient experience in its use.

In the construction of this appendage to the sextant, it was assumed that the line of the sea horizon forms a horizontal diameter to the field of the telescope, at right angles to the plane of the instrument. Accordingly, a place was assumed for this line, so as to appear, when seen through the telescope, to be in the middle of the field of view, beyond the horizon glass. A point was next assumed beyond it from which a pendulum was suspended, carrying an arm, at the extremity of which is a small slip of metal, which we will call the horizon vane. The upper edge of this vane, when made to coincide with the horizon line on the glass, and seen to do so through the telescope, completes the horizon for observation. In the middle of the upper edge of this horizon vane a small aperture is made, as, when the axis of the telescope is directed below the horizon, the vane would, but for this, entirely conceal the horizon line, by rising above it. These parts are arranged in a tube to be affixed, when required, to the sextant, the axis of the tube of the horizon corresponding exactly with that of the telescope of the sextant.

III.—ON THE PROPER METHOD OF LAYING DOWN A SHIP'S TRACK ON SEA-CHARTS; WITH SOME REMARKS ON THE IMPORTANCE OF TIMEKEEPERS IN NAVIGATION. BY CAPTAIN BASIL HALL, R.N., F.R.S.

There is no point in practical navigation of more importance than the allowance for the direction and velocity of currents; and, although the introduction of chronometers and lunar observations has led to much more accurate methods of making this estimate, yet there is unquestionably still much obscurity belonging to this branch of the subject.

The mode proposed in this notice is quite as easy in practice as that in most general use. It is so obvious that I cannot help being sure that it must have occurred to many practical navigators; but as I have never met with it in any treatise on navigation, and have never seen a single chart in which the tracks were so laid down, I trust this notice will not be superfluous.

The common method is as follows:—The ship's place of each day, as estimated from the log-board, is noted on the chart; and also the place, as deduced from chronometers and lunar observations. The first is called the place by dead-reckoning, the other the true place. The line joining the true places at noon is called the true track; and that joining the others is called the track or course by dead reckoning. As it happens invariably that these two tracks separate very early in the voyage, and never afterward come together unless by accident, it is obvious that, upon inspecting the chart, no information will be afforded as to the point where the current began, or where it ceased, or what was its set or its velocity; all that we see is two tracks wandering apart from one another, and it always requires some calculation and measurement to come to anything like an estimate of the true effect of the current.

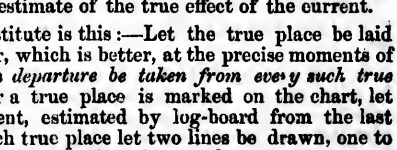
The method which it is proposed to substitute is this:—Let the true place be laid down each day as before, either at noon, or, which is better, at the precise moments of observation for the longitude. *Let a fresh departure be taken from every such true place*, so noted in the chart: and whenever a true place is marked on the chart, let the place by dead reckoning at that moment, estimated by log-board from the last true place, be also noted down. From each true place let two lines be drawn, one to the next true place, and the other to the dead reckoning place at the same moment.

It will follow from this, that the true course of the ship will be one continued unbroken line, but the dead reckoning course will be a series of terminated lines running off from the successive true places. The advantages of this method are these: in the first place, it will be evident that, as long as there is no current, the true and dead reckoning places will coincide, and there will be but one line on the chart; but the instant that a current begins to act, the true and dead reckoning places will be different, and consequently the lines will separate; and whenever the current ceases, there will again be but one line. These distinctions catch the attention at once; but the plan has this further great advantage, that the line joining the dead reckoning place and the true place, at any given hour, will express correctly the direction and the set of the current, in the interval between the moment under consideration and the instant of the last preceding observation.*

It is useful, in practice, to have the line expressing the true course distinguished in some way from those marking the dead reckoning courses; one may be a strong black

* EXAMPLE.—Let the ship's true place, on the first day, be assumed as at A. Let a fresh departure be thence taken, and the next true place, or place by observation, be noted as B. Let the ship's place by dead reckoning, be noted at the same moment, as at C.

From the true place (A), let two lines be drawn, as A B and A C.

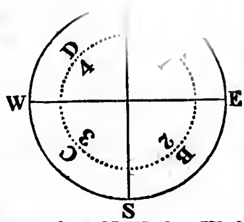


line, the others dotted lines, or when a chart is much covered with tracks, it is useful to use differently coloured lines.

It is sometimes satisfactory to join the dead reckoning places and the true places by arrows, and then rub out the whole of the tracks; so that all which is essential, as far as currents are concerned, is contained; while all that is not, and which might tend to confuse, is removed.

When one or more days elapse without an observation, the dead reckoning track may be carried on till an observation be obtained; and then the dead reckoning place and the true place at that instant being noted, a knowledge of the strength and direction of the current during the interval is at one afforded.

IV.—BRIEF MODE OF EXPRESSING THE POINTS OF THE COMPASS.



THE Spanish navigators, in describing courses, &c., commonly made use of the expression, "*Rhombs of the first, second, third, and fourth quadrant*;" or winds of the same. The first quadrant, in this expression, is that contained between *North* and *East*; the second, from *East* to *South*; the third, from *South* to *West*; and the fourth, from *West* to *North*.

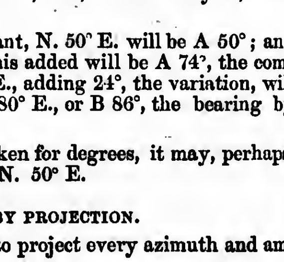
The respective quadrants may be represented algebraically by the letters A, B, C, D, as in the annexed figure; and, in keeping a journal, the points of the compass, or courses and bearings, may be expressed briefly, by adopting these letters as the representatives of the four quadrants: thus N.W. by W. ¾ W., or five points and three-quarters from the North toward the West, will be concisely expressed by D 5¾; N.E. will be A 4; S.E. by E., B 5; ond S.W. by S., C 3; &c.

So, likewise, by reckoning in degrees of the quadrant, N. 50° E. will be A 50°; and in allowing for magnetic variation, say 24° W.; this added will be A 74°, the compass bearing, &c. Should a true bearing be N. 76° E., adding 24°, the variation, will give 100°: deduct 90°, and this gives E. 10° S., or S. 80° E., or B 86°, the bearing by compass.

But that the figures for points may never be mistaken for degrees, it may, perhaps, be best to express the latter in the usual manner, as N. 50° E.

VARIATION OF THE COMPASS BY PROJECTION.

The readiest way of understanding this subject is to project every azimuth and amplitude when it is taken. If this be done properly, no confusion will remain, after a few observations. An example will best illustrate this.



Say,—latitude 0° 38′ N.; declination, 21° 32′ N.; magnetic azimuth, E. 81° 20′ N.; true azimuth, E. 68° 24′ N. In the first place, assume a point Δ, which call the observer's eye; and another O, which call the sun: join these two, and from the eye, as the angular point, lay off the magnetic azimuth = 81° 20′; then, from the same line, Δ and O, and from the eye Δ, lay off the true azimuth 68° 24′, the difference of these two angles is the variation, 12° 56′.

The difference, O B, thus shows the error in dead-reckoning, which may be the effect of current.

From B, the ship's true place on the second day, the ship's true place on the fourth day may have changed to D; while E represents her place by dead reckoning on the third, and F on the fourth day, &c.—EDITOR.

V.—ON MAGNETISM AND THE COMPASS.

Concerning the history of the magnetic needle, we have many and vague notices of its high antiquity. It is mentioned by Homer and Aristotle and by many subsequent classical writers; the first account we have of this is, that it was known, in Europe, at the time of the crusades, in about A.D. 1150, and it is very probable that the knowledge was derived from the Arabians, during those expeditions. But the Chinese were acquainted with it many years before this. We are told by the Jesuit missionary, Du Halde, that the Chinese Emperor, Hoang-ti, possessed an instrument which pointed to the South, so early as the year 2,634 B.C., or 4,479 years ago; the same author gives subsequent notices of the compass in China, proving its very great antiguiiy among that people.

It has usually been considered that Columbus, in his voyage from Portugal, on the discovery of America, first observed the variation of the needle from the true North, But it is not improbable that the variation was discovered nearly 200 years before Columbus made this change known, as it is mentioned in one of the earliest treatises on magnetism by Peter Adsiger, in 1269: the authenticity of this, however, is doubted by some. The wonderful property of the dip of the needle was first observed by our countryman Robert Norman, a maker of compasses, in 1576.

Magnetism is a principle which is evidently allied to, if it is not identical with, electricity and galvanism. For, in the causing any or either of these principles to become evident to our senses, we produce, at the same time, the others; and it may be here stated, that five apparently dissimilar effects are inevitably caused in the production of either: these are—light, heat, chemical action, electricity, and magnetism. By the production of *light* we cause heat and chemical affinity, and these will also produce *electricity*, and will cause the magnetic needle to swerve from the meridian. By the electric fluid we produce *light*, *heat*, and the other phenomena; and the magnetic needle is a measurer, by its deflections, of the most minute portions of galvanism. From the *magnet*, a spark can be produced, absolutely similar, in appearance an effect, to that of electricity and galvanism. There is a positive and negative state of electricity and galvanism; and there is a positive and negative, or North and South, pole to the magnet, and these attract or repel each other.

There is one phenomenon connected with these sciences of very great importance in practice, and that is, that of *induction;* a substance electrified *positively* will *induce* a state of *negative* electricity, or will cause a body to be negatively electrified, that is within its influence; the North pole of a magnet will induce an opposite pole in that of another piece of iron, in certain positions with respect to the magnetic meridian and itself. Thus, the iron employed in the construction of a ship, or contained in its cargo, may all become, by *induction*, temporary magnets, and have a most marked and important effect upon the compass by which it is steered; and it is this cause, which is too frequently overlooked—that of the local deviation—which has caused enormous errors in reckoning, and consequently the loss of many vessels. As scientific details is out of our province, we must refer the reader to those works more expressly treating on the subject.

Terrestrial Magnetism.—The magnetism of the earth, by which the direction, the dip, and the intensity of the force of the magnetic needle is controlled, is still involved in some obscurity, and no perfectly satisfactory system or theory has hitherto been framed to account for the multifarious changes and phenomena of the compass needle. Among the more modern inquirers into the source of this most wonderful principle are Professor Hansteen, Mr. Bain, Mr. Barlow, Mr. Christie, Sir Edward Sabine, Captain Johnston, Mr. Archibald Smith, Mr. Evans, R.N., and many others. From their labours we have arrived at a tolerably correct notion of the *general effects* of magnetic phenomena; and from these the laws by which they are governed have, in some measure, been deduced.

Now the most reasonable supposition is, that the earth itself is a magnet or that magnetic currents exist on its surface in certain directions, causing the various deflexions of the needle; whether this magnetism is *induced* from the sun, or other

source, or whether the earth is in a positive and permanently magnetic state, does not affect the present question. From certain changes in the compass, perhaps it might be inferred, that the magnetism is *induced* by temperature (heat) from the sun; or that the ferruginous portions, which enter so largely into the composition of the earth, have received an inductive magnetism from the same source.

In 1683 Dr. Edmund Halley published a theory of magnetism, in which occurs the following ideas:—that the earth's magnetism was caused by *four piles or points of attraction*, two of them near each pole of the equator; and that, in those parts of the world which lie nearly adjacent to any one of those magnetic poles, the needle is governed thereby, the nearest pole being always predominant over that more remote. This view of the earth's magnetism has been supported by the results of the labours of Professor Hansteen, one of the chief promoters of the science. From his most valuable work (*Magnetismus der Erde*, Christiania, 1817), his views may be learned. Having collected all the observations of value that had been made on the variation of the needle, he proved that there were *four points* of convergence among the lines of variation; viz., a weaker and a stronger point, in the vicinity of each pole of the globe. This, combined with the result of Sir D. Brewster's inquiries, will certainly lead to the view of the connexion between the heat of the earth and its magnetism. Professor Hansteen considers that the strongest poles, N.S., lie almost diametrically opposite to each other, and the same is true of the weaker poles *n.s.* These four poles he found to have a *regular motion* obliquely; the two northern ones N.*n*., from West to East, and the two southern ones S.*s*. from East to West. The following he found to be their periods of revolution, and their positions in 1830:—

	Lon. from Greenwich.	Time of revolution round each pole of the earth.
Pole N. 69° 30′ N.	87° 19′ W.	1,740 years.
Pole S. 68° 40′ S.	131° 47′ E.	4,609 —
Pole *n*. 85° 6′ N.	141° 17′ E.	860 —
Pole *s*. 78° 29′ S.	137° 45′ W.	1,304 —

From calculations based upon subsequent observations he slightly varied these positions and periods; but he has shown, very clearly, that the changes in the variation and dip of the needle, in both hemispheres, may be well explained by their motion.

These four magnetic poles, or points on the earth's surface, over which the dipping-needle would stand vertical, are separated by a magnetic equator, which is not coincident with the earths's equator, but is an irregular circle, which crosses it in three points, according to M. Duperrey, or in four points, according to M. Biot and Professor Hansteen; on this circle, of course, the dipping-needle stands horizontal.

Respecting the North Atlantic Ocean, we may here state, that the magnetic crosses the terrestrial equator in about long. 20° E. (in the Bight of Biafra), and proceeds westerly across the Atlantic, to the coast of Brasil, which it touches in lat. 16° S. The line of equal dip, at 70°, runs from the Bristol Channel, curving S.W. and W., to about Charleston. U.S.; between these lines, the lines of equal dip (or *Isoclinal lines*) form regular divisions.

The mariner's compass, as generally used, exhibits the direction of the magnetic meridian only; but, in treating of the magnetic needle, three points are to be inquired into: these are, the variation, or *declination*; the dip, or *inclination*; and the *intensity* of the magnetic force; and to the elucidation of these the philosophers in all quarters of the globe are at present engaged.

The Declination, or Variation.—With this branch of the subject every sailor is perfectly familiar, and any comment on its actual state is therefore unecessary. But this variation is not constant. There are several elements of change in this part of the magnetic force, for it undergoes secular, annual, mensual, diurnal, and also irregular changes. The *secular* changes is a progressive alteration, observed in the direction of the magnetic needle during a series of years. Thus, in 1576, Robert Norman found the compass at London to point 11° 15′ *East* of North; in 1656, it pointed true North; it was on the increase to 1819, when it was 24° 41′ *West* of North; and since then it has been retrograding, and in December, 1860, it was 21° 11′ 30″.

The *mensual* change is according to the season of the year. It was first noticed by Mr. Canton, about the year 1756. It amounted, in January, to 7′ 8″; in March, 11′ 17″; in June, 13′ 21″; in September, 11′ 43″; and in December, 6′ 58″. These are the diurnal changes, which vary in amount in different parts of the year.

The *diurnal* change is thus given from the recent observations of Professor Lloyd:—"The mean daily curve of the changes of declination, for the entire year, exhibits a small easterly movement of the North end of the magnet during the morning hours, which reaches its maximum about 7ʰ a.m. After that hour the North end moves rapidly westward, and it reaches its extreme westerly position at 1ʰ 10′ p.m. It then returns to the eastward, but less rapidly, the easterly deviation becoming a maximum about 10ʰ p.m.; the mean daily range equals 9·3′." These small daily and monthly changes are unimportant in a seaman's practice.

The *irregular* changes, or magnetic storms, as they have been termed, occur without any previous notice, and are of very great extent; some of them have been traced almost throughout the globe. At times this deviation amounts to 2°.

As the ascertained variation of the compass in various parts of the Atlantic are attached to Tables of Positions in the former part of this work, and are also given on the chart facing page 373.

The Dip, or Inclination.—The dip of the needle, as we have already had occasion to observe, is the angle which a well-balanced needle forms with the horizon, after it is rendered magnetic, and when it has the power of free motion in the plane of the magnetic meridian. As before stated, this angle varies in different parts of the globe, being at zero on the magnetic equator, and 90° on the magnetic poles. The dip, like the variation, undergoes a continual change, increasing in some parts of the world and diminishing in others. Thus, at Paris, in 1761, it was 75°; in 1829, only 67° 41′. At London, in 1576, it was 71° 50′; in 1837, it was 69° 20′; in 1861, it is 68° 25′. The dip is a very important element in magnetic consideration, and is too much overlooked by the sailor. The instruments for its measurement, however, are expensive and delicate, and require great nicety in their management; for these reasons, it is comparatively neglected; but as it is in some degree a measurement of the intensity of the magnetic force, and also greatly modifies the directive power of the compass, it is very important to the mariner. When the needle is perpendicular, as it is over the magnetic pole, of course its directive force vanishes, although at that time the intensity of the magnetism is greatest. The diurnal change in the dip amounts to 3′ or 4′, and is also about 15′ greater in summer than in winter.

The following table gives the result of some of the more recent and careful observations that have been made for ascertaining the dip in various parts of the Atlantic. We have extracted it from one by Major (now Sir Edward) Sabine, in the "Phil. Trans.,' 1840, p. 135:—

Place.	Dip. ° ′	Observer.	Year.	Place.	Dip. ° ′	Observer.	Year.
Montreal	76 19*	Estcourt..	1839	Bermuda	67 31	Home....	1837
Halifax	74 45	Estcourt..	1838	Nassau	56 13	Barnett ..	1839
Worcester	74 21	Loomis ..	1839	Contoy Island	49 48	Barnett ..	1838
Cambridge	74 20	Loomis ..	1839	St. Thomas ..	49 29	Zarhtman	1834
Springfield....	74 11	Bache....	1834	Antigua	48 46	Home....	1835
Providence....	74 0	Loomis ..	1839	Alta Vela	47 39	Home....	1835
Hartford	73 58	Loomis ..	1839	Jamaica	47 19	Barnett ..	1834
New Haven ..	73 27	Loomis ..	1839	Barbadoes	43 37	Home....	1835
New York	72 52	Loomis ..	1839	Cape Gracias a Dios	41 4	Barnett ..	1833
Washington ..	71 21	Loomis ..	1839				

* North End.

Place.	Dip. ° ′	Observer.	Year.	Place.	Dip. ° ′	Observer.	Year.
Curaçoa	38 39*	Zarhtman	1833	London	68 25*	Mag. Surv.	1859
Caraccas	37 16	Home	1836	Terceira	68 6	FitzRoy ..	1836
St. J. de Nicaragua	34 43	Barnett ..	1839	River Tagus ..	60 39	Lamont ..	1858
Demerara	33 57	Home	1837	Paris	67 34	Arago	1835
Chagres	32 30	Home	1834	Tenerife	57 47	Wickham	1837
Para	24 8	Home	1835	Port Praya ..	45 46	FitzRoy ..	1836
Madeira	59 42	Sabine ..	1847	Egga, on the Niger	13 51	Allen	1833
Bahia, Brasil ..	5 1	Sulivan ..	1839	Fernando Po ..	0 48	Allen	1833
Rio Janeiro ..	10 0†	Sulivan ..	1839	Ilha das Rolas	7 44†	Allen	1833

The Intensity.—The intensity of the magnetism of the earth varies also with time and place. It is the power of the earth to bring an oscillating needle to a state of rest; and it is in proportion to the squares of the number of vibrations per second. The lines of equal intensity would, at first, seem to coincide with those of equal dip, but, in consequence of the double magnetic polar axes, they differ in their relation, though they still form regular and symmetrical curves. As the magnetic latitude increases, so does the intensity, but not the directive force; for, when a needle is on the magnetic equator, it naturally preserves its horizontality, and, consequently, the whole of its magnetism is employed in directing the needle towards the poles. But, in high magnetic latitudes, where the dip is great, the means employed to keep it parallel with the horizon of course reduce very considerably its power of keeping in a North and South direction; and in the circumpolar regions the ordinary compass becomes so sluggish as to be of but little value to steer by.

Having thus very briefly sketched the general phenomena of terrestrial magnetism, the reader will understand the general principles laid down by Dr. Halley and Professor Hansteen, that in the northern hemisphere the two points of convergence of the magnetic variation or declination by revolving around the pole of the earth, will cause a local change in the variation of all places lying in North magnetic latitude, and which, in the case of London, has amounted to 35½° in 455 years. The dip, on the other hand, has changed but little, or 2½° in 260 years; this is obvious, because the two magnetic axes, while they change their terrestrial longitude in a considerable degree, do [illegible] very much in latitude, and, consequently, will not greatly affect the dip in places [illegible] distance from them.

The points then interesting to the navigator are, first, the influence of the earth's magnetism upon his compasses, and the influence the ship and her iron has upon it in neutralizing or modifying the first; the second, viz., the local deviation, is a subject which has become magnified into vast and vital importance since the introduction of so much iron into the fabric of wooden ships, and the daily increasing number of iron ships.

The North Atlantic Ocean has this peculiarity, in a magnetic sense, that it has over nearly all its area but one kind of magnetism—westerly declination (or variation) and northerly inclination (or dip). The magnetic equator passes, as before said, obliquely across the terrestrial equator from Africa to Brasil, the line of no dip being to the South of this. The line of no variation will be seen by the chart.

Now, as will be seen presently, as the force of the ship's magnetism diminishes, so does that of the earth increase in its influence on the compass, so that a ship's *corrected* compass does not hold the same relative position with respect to both with the same correction into a different magnetic latitude. Thus a vessel with a large original error in England, will find that error reduced perhaps to one half on reaching the equator; and if sailing northwards a very different relation will be found.

This is especially to be noticed on sailing into the Gulf of St. Lawrence, or anywhere in a N.W. direction towards America. Frequently a ship may be standing

* North End. † South End.

on one course to the southward of West across the Atlantic, and then suddenly bears up to N.W.; and then passing rapidly towards the magnetic pole, the relation between the earth's magnetism and that of the ship upon her compass undergoes a rapid and important change, which, unattended to, has doubtless been the cause of many embarrassments and accidents.

THE LOCAL DEVIATION OF THE COMPASS is its variation from the magnetic meridian, which may be caused, as already noticed, from a peculiar state of the atmosphere, Aurora Borealis, lightning, or the local attraction of the ship, iron, &c. This is a subject of inquiry, which was first explained by Captain Flinders, in the description of his surveys of the Australian coast. To this subject his attention was directed, not only by some anomalous differences which he found in the compasses that he used, but by others recorded by Mr. Wales, who had accompanied Captain Cook in the capacity of astronomer, and his deductions, referring as they do to wooden vessels, are still held to be correct.

But the problem of the local deviation in *iron ships* is a widely different one, and includes a large range of phenomena and considerations which have hitherto been but little understood, and even now may not be established on a firm basis in all its particulars.

This important discussion upon the magnetism of iron ships began by Professor Airy's experiments recorded in the Philosophical Transactions for 1839. His conclusions were somewhat opposed by Dr. Scoresby in 1854, which was replied to in the "Mercantile Marine Magazine," in 1854 and 1855. To further investigate the still obscure principles involved in this very important topic, Dr. Scoresby undertook his well-known voyage to Australia and back in the *Royal Charter*, between February and August, 1856.

The attention of the shipping interest to this question was strongly called, at the Meeting of the British Association at Liverpool in 1854, and the result was the formation of the Liverpool Compass Committee, who reported to the Government in 1855, and 1856, and the valuable series of observations they had collected were discussed by their able secretary, Mr. Rundell, and by Mr. Archibald Smith, Mr. Towson, and others in 1857. One important conclusion since arrived at is stated by Mr. Archibald Smith as follows:—

"Whatever difference of opinion may be entertained as to applying corrections to the steering compasses of iron ships, it can hardly admit of question that every iron ship should have at least one compass removed as much as possible from the influence of iron and *not corrected* by magnets, and should be swung at the beginning and end of every voyage of any length, and the deviation of the uncorrected and corrected compasses (if any) observed. No man is competent to command an iron ship who is not competent to make these observations."*

The more refined calculations which can be entered into for determining the relation between a ship and her compass are given in a pamphlet by Archibald Smith, Esq. "Instructions for the computation of a Table of the Deviations of a Ship's Compass," 1848, as a supplement to the "Practical Rules for ascertaining the Deviations, &c.," 1854.

Dr. Scoresby gives the following summary of leading deductions on the Character and Distribution and liability to change of the Magnetism of Iron Ships:—

(1.) *As to the sources of the intense magnetism of iron ships.*—Ships built of iron must not only be strongly magnetic, because of the vast body of this metal which is subjected to the action of terrestrial induction, but by reason of the elaborate system of hammering, as well as from the bending of the plats and bars during the progress of construction, there must be an *extremely high* development of the quality of *retentive magnetism*.

(2.) *Effect of the position of a ship when building.*—Each iron ship must have a

* Introduction to Dr. Scoresby's "Journal of a Voyage to Australia," by Archibald Smith, Esq., M.A., p. 48.

special individuality of the magnetic distribution, depending *essentially* on the position of the keel and head whilst building, such distribution having, in each individual case, a polar axis and equatorial plane conformable to those of the earth at the place where the ship is built.

(3.) *Magnetic lines of the inductive and retentive magnetism the same.*—Whilst the spontaneous influence of simple induction must be develop a transient magnetic condition, having, in each individual case, a polar axis and equatorial plane conformable to those of the earth at the place where the ship is built; so also the retentive magnetism developed during the building must have corresponding polar direction and distribution.

(4.) *Liability of original magnetic distribution to change.*—The original distribution of the magnetism, or casting of the magnetic lines, must be liable to change, after the launching, under any violent mechanical action on the ship, when lying with her head in a new direction, or sailing in remote regions of the globe, having very different directions of the earth's magnetic force.

(5.) *Sympathy of the compass with a ship's magnetic changes.*—All changes in a ship's magnetic condition must tend to produce disturbance in the action of compasses on or about the deck. And the effect must be, in however minute or insensible quantity in some particular cases, to change the amount of the original *deviations*.*

The proposition, No. 4, above recited, was fortified by the example of the loss of the *Tayleur*, a new iron ship about 2,000 tons, whose steering compass had originally a maximum deviation of 60°, which was corrected by a magnet. She met with severe weather after leaving Liverpool going down channel, and if, as Dr. Scoresby supposed, the effect was to "shake out," the magnetism of building, and give a new magnetism, this would leave the corrected magnets to produce a deviation which threw her on the Irish Coast.

It was this argument on the "retentive" condition of the magnetism of the ship induced by her building that led to the controversy between Dr. Scoresby and Professor Airy, and caused the former undertaking, at his advanced years, the voyage to Australia, from the effects of which he may be said to have fallen a martyr to science.

Dr. Scoresby, in his Letter to the Underwriters of Association of Liverpool, in 1854, draws up the following propositions, in addition to those he laid down in his later work of the "Voyage of the Royal Charter."—

Examples.

3. That the original magnetism and compass deviation are specially liable to change in *new* ships, when meeting with heavy weather on their first going to sea.

4. That a *change of course*, after long steering in one direction, is liable to produce a change in the compass.

5. That adjusted compasses are specially liable to change in the direction of over-compensation, and may dangerously mislead the navigator.

6. That a *stroke* of the sea may produce a sudden change in the compass.

7. That a stroke of lightning may change a ship's magnetism and compass deviation.

8. That a *hot* sun shining *partially* on an iron ship might change her magnetism.

9. That permanent magnets applied for the adjustment of compass deviations must, with rare exceptions, tend to aggravate the error in ships going far into another hemisphere.

10. That a compass aloft affords an easy, practical, and if duly elevated and prepared for, an effectual remedy for the ships disturbing influence.*

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* "Journal of a Voyage for Magnetical Research," 1859, pp. 71, 72

† "The Compass in Iron Ships, &c.," by Rev. W. Scoresby, D.D., pp. 67, 68.

The experience gained by the voyage of the *Royal Charter* showed that the blows and strains that she has experienced in her voyage out to Australia diminished or, so to speak, shook out the inequalities in her compasses, which were observed before her sailing, to such an extent that the standard compass, which had originally a deviation of 20° to the port side when the ship's head was north, had this deviation reduced to 3° 22′ on her return to Liverpool; while the steering compass, which originally had been rather over corrected, having an error of 1° 43′ returned with it 22° 25′; while the companion compass, having an error of 1° 48′ returned with it 17° 35′. This change was one which had evidently taken place in the retentive magnetism of the ship. This change shows the complete failures in such a voyage by *fixed* magnets.

In 1843 when the Compass Department of the Admiralty was established, the science and the instruments were in an equally bad condition. The labours of Capt. E. J. Johnson, R.N., F.R.S., however, soon put a new face on the matter, and much was done in his time towards developing the application of the principles enunciated. But the vast increase of iron shipping has caused greater requirements, as has been stated, and the sailor is very largely indebted to Mr. Fred. J. Evans, R.N., the present superintendant, who has produced an excellent series of variation charts (from which our diagram on p. 373, has been taken); and also has devoted much talent to the investigation of the problem of the magnetism in iron ships. From his Report to the Hydrographer on the Deviation in the Iron Ships of the Royal Navy, April 18, 1860, we extract the following:—

On the nature of the magnetism in iron-built ships.—The magnetic influence of steam machinery having been reviewed, the nature of the magnetism of iron-built ships can be entered on free, to a certain extent, of conditions arising from this extraneous source of compass error, and those examples fairly eliminated where it tends to embarrass the discussion.

The investigation of the disturbance arising from the horizontal induction of the soft iron in the ship, or the the coefficient D, offers several novel and suggestive points of inquiry: the chief characteristics are,—

1. That it has invariably a *positive* sign, causing an easterly deviation in the N.E. and S.W. quadrants, and a westerly deviation in the S.E. and N.W. quadrants.

2. That its amount does not appear to depend on the size or mass of the vessel, or direction when building, or on the iron beams.

3. That a gradual decrease in amount has occurred, when examined over a number of years, in nearly every vessel that has been reviewed.

4. That the value remains unchanged in sign and amount, on changes of geographic position, confirming theoretical deductions.

5. That a value for this coefficient, not exceeding 4°, and ranging between that amount and 2°, may be assumed to represent the average or normal amount in vessels of all sizes.

The opinion has been long entertained, that the original magnetism of an iron built ship, or that acquired in the process of building, undergoes a rapid change after launching, and that from this cause accidents have occurred to recently launched and hastily equipped vessels. The records of ships of the Royal Navy do not illustrate this subject.

I have alluded to the importance of the conclusions to be derived from a review of the examples and cases given in this report; for although varying conditions of compass disturbance exist, and the inference is irresistible that they arise from the nature of the iron employed in the construction of the hull of the ship, there is no doubt that, by attention to a few leading principles in the building and equipment of iron ships, the larger and uncertain sources of error may be modified and reduced within limits both of fluctuation and amount, that will not seriously compromise the safety of the ship in the hands of an ordinarily prudent seaman.

The points of practical import to which I would invite attention are:—

1st. The best direction, with reference to the magnetic meridian, for the keel and head of an iron ship to be placed for building, to ensure the least compass disturbance.

2nd. The best position and arrangement for a compass, to ensure small deviations, and permanency on changes of geograpic position.

3rd. The changes to which the compass is liable from various causes when the foregoing conditions are fulfilled.

1. *On the best Direction for Building an Iron Ship.*

In those built head N.E., East, West, and N.W., strong *south* polarity (or an *attractive* force on the north end of the compass needle) obtains on one side of the ship adjoining the compass as usually placed between the middle section and the stern; the resulting disturbance is not lessened as the compass is moved in a fore-and-aft line within these limits.

In vessels built head S.E. and S.W., *north* polarity obtains under the same conditions.

In vessels built head North or South, the conditions arise, that in the former the attraction is toward the stern (the topsides in their action being neutral to a compass in the middle line of the deck), and diminishes in force as the compass is moved towards the bow. In the latter the law is reversed, and small compass deviations are obtained as the stern is approached.

In an iron *sailing* ship, built head to South, there will be an attraction of the north point of the compass to the head, and if built head to North, a like attraction to the ship's stern; and so far there would seem to be no advantage in one direction over the other. But in the first case the topsides near the compass have weak magnetism; in the second case they are strongly magnetic: the first position seems therefore preferable.

In an iron steam-ship, built head to the South, the attraction due to machinery is added to that of the hull, whereas in one built head to the North, the attractive forces of hull and machinery are, in the northern hemisphere, antagonistic, and a position of small, or no "semicircular" deviation for the compass may generally be obtained. To iron steam-vessels engaged on the home or foreign trades in the northern hemisphere, this direction of build is therefore to be preferred.

2. *On the Position and Arrangements of the Compass.*

The position of compass, whether standard or steering, must depend, as will have been observed from the foregoing conclusions, on the direction of the ship's build; that is, in those built head North the compass must be as far removed from the stern as circumstances will permit; in those built South, placed as near to the stern as convenient, without approaching so close to the rudder-head or iron taffrail as to cause the ship's general magnetism to be overpowered by the magnetic influence of those masses.

In ships built East or West there is little choice of position, except to avoid, as a general rule, proximity to vertical masses of iron; in vessels built with their heads on the intercardinal points, a position approximating to the bow or stern respectively, where the action from the topsides (to be determined experimentally) is at a minimum, is to be preferred.

Ample elevation above the deck, and to be strictly confined to the middle line of the ship, are the primary conditions of position for every compass in an iron ship, and no compass, whether steering or standard, should be nearer the iron deck beams than 4 feet: for the steering compass this arrangement could be met by the use of a vertical card for the helmsman.

The standard compass, which as a rule I should recommend to be invariably uncompensated, requires an elevation of at least 5 or 6 feet from the deck, and to be fitted on a separate and permanent pillar or stand: it is by this superior elevation that the strong magnetic power of the iron beams and adjoining topsides are correspondingly lessened.

As every piece of iron not composing a part of, and hammered in the fabrication of the hull,—such as the rudder, funnel, boilers and machinery, tanks, cooking galleys, fastenings of deck houses, &c.,—are all of a magnetic character differing from the hull of a ship, their proximity should be avoided, and, so far as possible, the compass should be placed so that they may act as correctors of the general magnetism of the hull.

A compass placed out of the middle line of the deck is affected by the nearest topside, and its deviations must necessarily be much increased if that topside has the dominant polarity, as in the ships built East or West.

Experience has proved that the practical value of mast or elevated compasses has in some cases been overrated; they are, in fact, affected by the ship's magnetism to an amount depending on their elevation and the direction of the ship's build: thus in ships built North or South, but especially the latter—the compass being on the mizen mast—the deviations will be large comparatively. In ships built East or West the deviations will be comparatively small, from the topside, which would affect a deck compass, being more directly under the mast-compass; they may therefore be useful in the latter cases, and valueless in a ship built head to the South. The wear and tear on the pivots and agate caps of mast-compasses, from the increased motion due to their elevation, require constant attention when they are employed.

3. *On various Sources of Error affecting a Compass placed under favourable conditions.*

Errors arising from changes of geographic position, as also incidental causes of error due to anomalous rather than general conditions, have been brought under review in the general progress of this Report. There is, however, one source of compass-error—that arising from the heeling of the ship—which has not been alluded to, as the ship in all the points hereto reviewed is assumed to be on an even keel.

The few experiments made in ships of the Royal navy will be found in Table I., and they tend to prove, as also does the test of experience, that when the original compass deviations are small, the errors from heeling are generally small in proportion; and conversely, that exaggerated errors from heeling are the consequence of exaggerated errors while on an even keel. Ample elevation from the deck, in order to raise the compass above the level of the topsides and adjacent deck beams, is one of the chief conditions for reducing this source of error.

With head built	North,	on heeling,	the north end of compass needle will be *attracted* to the weather or nearest side from its *south* polarity.
„	N.E.,	„	„ the same.
„	East,	„	„ the same.
„	S.E.,	„	the north end of needle will have but little error from the balanced conditions of north and south polarity of topsides.
„	South,	„	the north end of needle will be *repelled* to the lee side by the *north* polarity of nearest or weather topside.
„	S.W.,	„	the north end of needle will have but little error, as at S.E.
„	West,	„	the north end of needle will be *attracted* to the weather or nearest side.
„	N.W.,	„	„ the same.

These laws only hold good as long as the topsides in the immediate vicinity of the compass retain their dominant polarity due to their original direction of build in Great Britain: if in south magnetic latitudes a change of polarity takes place, the conditions of healing correspond to such change.

The maximum disturbance on heeling in all these vessels is when their heads are (by disturbed compass) magnetic North or South, and this disturbance vanishes when the head is East or West. This law of disturbance may be thus explained: when the vessel's head is north or south on an even keel (by disturbed compass), the needle lies parallel to the topsides by their combined action, which neutralizes each other; on heeling, the nearest topside exercises its then dominant polarity at right angles to the direction of the needle, and hence the maximum error. With the ship's head east or west, whether on an even keel or heeling, either pole of the compass-needle points directly to the topsides, and is consequently unaffected except in a vertical plane.

As the amount of disturbance on heeling varies under the various conditions of direction of build, height of compass, and breadth of ship or distance of topsides, added to the prevailing permanent or inductive magnetic condition of the latter and the deck beams, each ship must have an individual character, to be determined only by experiment or observation at sea. There are, however, strong grounds for inferring that by a judicious position of the compass, so as to ensure small errors while on an even keel, the errors arising from the ship's heel will be so proportionally reduced as not practically to affect the navigation of the ship in the hands of a prudent seaman.*

VI.—LIGHTNING RODS AND CONDUCTORS.

"To protect a ship effectually from damage by lightning, it is essential that the conductor be as continuous and as direct as possible, from the highest point to the sea; that it be permanently fixed in the masts throughout their whole extent, so as to admit of the motion of one portion of the mast upon another; and that, in case of the removal of any part of the mast, together with the conductor attached to it, either from accident or design, the remaining portion should still be perfect, and equal to the transmission of an electrical discharge into the sea. To fulfil these conditions, pieces of sheet copper, from one-sixteenth to one-eighth of an inch thick, varying from $1\frac{1}{2}$ to 6 inches in breadth, and being about two feet long, according to the size of the masts, are inserted into the masts in two laminæ, one over the other, the butts or joints of the one being covered by the central portions of the other. The laminæ are riveted together at the butts, so as to form a long, elastic, and continuous line. The whole conductor is inserted under the edges of a neat groove, ploughed longitudinally in the aft side of the different masts, and secured in its position by wrought copper nails, so as to present a fair surface. This metallic line then passes downward from the copper spindle at the mast-head, along the aft sides of the royal mast and topgallant mast of large vessels, and is connected in its course with the copper about the sheave holes. A copper lining in the aft side of the cap, through which the topmast slides, now takes up the connection, and continues it over the cap to the aft side of the topmast, and so on, as before, to the step of the mast; here it meets a thick wide copper lining, turned round the cap, under the heel of the mast, and resting on a similar layer of copper, which is fixed to the keelson; this last is connected with some of the keelson bolts, and with three perpendicular bolts of coppor, of 2 inches diameter, which are driven into the main keel upon three transverse or horizontal bolts, brought into immediate contact with the copper expanded over the bottom. The laminæ of copper are turned over the respective mast-heads, and are secured

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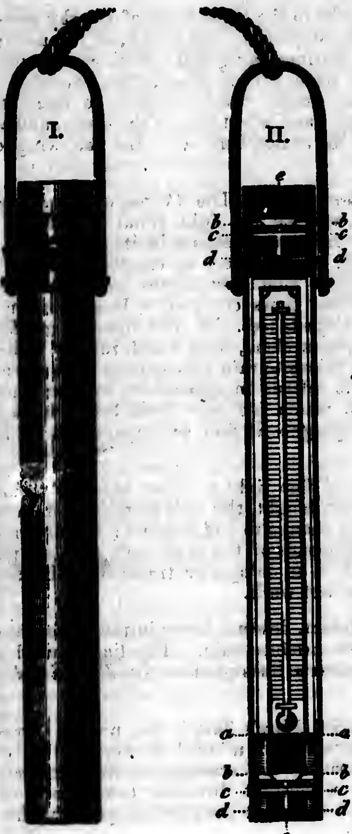
* "Reduction and Discussion of the Deviations of the Compass;" by Fred. J. Evans, Esq., R.N. Philos. Trans. 1860, part ii., pp. 334—358.

about an inch or more down on the opposite side; the cap, which corresponds, is prepared in a somewhat similar way, the copper being continued from the lining in the aft part of the round hole, over the cap, into the fore part of the square one, where it is turned down and secured as before, so that, when the cap is in its place, the contact is complete. In this way we have, under all circumstances, a continuous metallic line from the highest points to the sea, which will transmit the electric matter directly through the keel, and emit it into that non-conducting fluid, where it becomes perfectly neutralized and harmless."—*Sir William Snow Harris*, F.R.S.

VII.—MARINE THERMOMETER.

Captain Livingston says:—"In my thermometric experiments I had several thermometers broken, and I have heard objections made to the experiments, that, in the manner they were made, the thermometer was not immersed far enough to enter into water sufficiently uninfluenced by the heat of the solar rays; but it will be seen, by comparing the day and night observations, that this is a futile objection. However, to avoid it, to secure my thermometers from being broken, and to enable me to have a column of water round the thermometer, sufficient to retain its original temperature till such time as the degree indicated by the thermometer scale could be read off, keeping at the same time the bulb of the thermometer immersed in the water, I prevailed on an ingenious mechanic to to attempt the structure of such a case as I wanted, in which he has most happily succeeded."



The person here alluded to is Mr. Robert Jamieson, of Glasgow, who was honoured with the large silver medal of the Society for the Encouragement of Arts.

Description.—The first figure, hereto annexed, represents the case, a tube of copper, which encloses a thermometer: the second figure represents a thermometer, so enclosed. The length of the whole tube, including the lid, is about, 18 inches, and its external diameter 2 inches. The lid, which has a check to fit the tube, is about 2 inches deep, and has a conical or puppet valve in it, which rises upward. At the lower end of the tube is another valve of the same description, which also rises upward; and these two valves permit the water to pass freely through the tube while it descends in the water; but so soon as it stops, the valves shut, and the water admitted, at the greatest depth to which the machine is sunk, remains in the tube, around the thermometer.

Fig. I. is a back view of the case ready for use. In Fig. II., *a a* represents a ring, or collar, on which the thermometer-plate rests, to keep it clear of the lower valve: *b b*, the upper valve and valve-tube cover: *c c* a bridge on which the neck, rod, or journal, of the valve works, through a hole in a swell in the centre of the bridge: *d d*, lower part of the journal, with a screw-head, which keeps it from rising through the hole in the bridge: *e e*, ends of the journals.

VIII.—CLASSIFICATION OF THE CLOUDS, AS DEFINED IN THE NOMENCLATURE OF THE CELEBRATED METEOROLOGIST, MR. LUKE HOWARD.

Our naturalists on shore very frequently refer to the appearance of the sky according to the distinctions which have lately been established; but which, as yet, are very imperfectly understood by the generality of mariners, although sometimes introduced into the journals of the more informed. We have, beyond expectation, exceeded our intended limits in the present volume, but we cannot resist the wish to make this portion of knowledge generally understood by those who traverse the ocean. and who may, at least, be amused daily by comparing the atmosphere with the following explanation:—

The primary distinction in the classification are,—1. The *Cirrus*, or *Curl Cloud*, generally the most elevated of all the clouds, and the first light cloud that forms in the sky after fine clear weather. It is very light and delicate in its appearance, in constant motion, generally curling or waving, like feathers or extended fibres. 2. The *Stratus*, or *Fall Cloud*, is an extended sheet cloud, sometimes small, shapeless, and undefined, like a creeping mist; and at other times covering a large portion of the earth; but it does not wet leaves or other substances. 3. The *Nimbus*, or *Rain Cloud*, an horizontal, heavy looking, and shapeless cloud, from which rain is falling. Whatever shape a cloud may have retained previous to rain falling from it, at the moment of its change from vapour to water it softens in appearance, and becomes a *Nimbus*, 4. The *Cumulus*, or *Stack Cloud*, which increases from below in dense convex and conical heaps, and is the grand prognostic and accompaniment of fair weather.

The *Cirrus* is often seen after a continuance of fine light weather, as a fine whitish line of cloud, stretched across the sky at a great height, the ends seeming lost in the horizon. This is often the first indication of a change to wet weather: to this line of Cirrus others are added laterally, and at times clouds of the same sort seem to proceed from the sides of the line, and are sent off in an oblique or transverse direction, so that the whole may have the appearance of net-work.

At other times the lines of Cirrus become denser, descend lower in the atmosphere, and by uniting or conjoining with others below produce rain. The line alluded to above is called the *Linear Cirrus*, and the transverse lines produce the *Reticulated* or *Curl Cloud*.

The *Comoid*, or *Hairy Cirrus*, commonly called *Mare's Tail*, is the proper Cirrus; it resembles, in appearance, a long lock of white hair, or a bunch of wool pulled out into fine pointed ends. The appearance of Cirrus in the atmosphere often indicates wind and rain; and when the fine tails have a constant direction toward any one point of the compass, it has been frequently observed that the gale has sprung up from that quarter to which they previously pointed.

The *Stratus* comprehends fogs and all those creeping mists which in summer evenings fill the valleys, but disappear in the mornings. The best time for observing its formation is on a fine evening, after a hot summer's day; we shall then observe that, as the Cumuli of the day decrease, a white mist forms near the ground; this cloud, as the Cumuli evaporate, by degrees arrives at its density. In autumn it remains longer in the morning. In winter it often puts on a still denser appearance, and remains during the day, and even for many days successively.

The *Nimbus* always precedes a fall of snow, rain, or hail; and has received its name from a notion of the ancients, who distinguished between the *Imber*, or shower, and the *Nimbus*, or cloud, from which the rain comes.

The *Cumulus* (plural, *Cumuli*). The progressive formation of the Cumulus is seen in fine settled weather. If we then observe the sky soon after sunrise, we shall see small clouds here and there in the atmosphere, which appear to be the result of small gatherings, or concentrated parts of the evening mist, which, rising in the morning, grow into small masses of cloud, and the atmosphere becomes clear. As the sun rises, these clouds become larger, by adjacent ones coalescing, and at length a large cloud is formed, assuming a cumulated irregular hemispherical shape; this usually subsides in the evening as it formed in the morning, breaking into small masses, then fragments, and evaporating, when it is succeded by the Stratus, to the formation of which it may have contributed. In fine weather these clouds form soon after sunrise, increase during the day, and subside with more regularity, and have a more hemispherical form, than in changeable weather. When well-formed Cumuli prevail for three or four days, the weather is settled. These Cumuli reflect a strong silvery light when opposed to the sun, like Alpine mountains covered with snow.

The *Secondary distinction of Clouds* partakes, in a mixed degree, of the preceding distinctions; hence we have the *Cirro-cumulus*, the *Cirro-stratus*, and the *Cumulo-stratus.*

The *Cirro-cumulus* (cirrus and cumulus) is an assemblage of *nubeculæ*, or small roundish clouds, either detached from, or in contact with, each other, and frequently reaching, to appearance, into the azure sky, commonly attended by an increased temperature, and found to accord with a rising barometer. The most striking feature is observed in summer, before or about the time of thunder-storms. The component nubeculæ are then very dense, round in form, and in closer apposition than usual. This kind of cloud is so commonly a forerunner of storms, that it has been assumed by some as a tempestuous prognostic. In rainy and variable weather another variety of this cloud appears, contrasted very strikingly with that above mentioned, being of a light fleecy texture, without any regular form in its nubeculæ. Sometimes the latter are so small as scarcely to be discernible, but the sky seems speckled with innumerable little white transparent spots.

The Cirro-cumulus of fair summer weather is of a medium nature, not so dense as the stormy variety, nor so light as the variable one. Its nubeculæ vary in size and proximity. In fine dry weather, with light gales of North and easterly winds, small detachments rapidly form and subside again, generally in an horizontal arrangement.

When the Cirro-cumulus prevails, we may anticipate an increase of temperature in summer; and in winter the breaking up of a frost, or warmer and wet weather. In the summer time, extensive beds of this cloud, viewed by moonlight, have a very beautiful appearance, which has been compared to a flock of sheep at rest. The Cirro-cumulus subsides either slowly, as if by evaporation, or changes into some other modification.

The *Cirro-stratus* (cirrus and stratus) or *Wane Cloud*, is composed of horizontal or slightly inclined masses of small clouds, attenuated toward a part or the whole of their exterior, bent downward or undulated, separate or in groups, and generally with a sinking barometer, indicating a decrease in temperature, with wind and rain or snow.

The Cirro-stratus is characterized by great horizontal extent in proportion to vertical breadth; so that when any other cloud begins to assume that form, it generally ends in Cirro-stratus. The Cirrus more commonly becomes a Cirro-stratus than any other cloud; the Cirro-cumulus next; and then the Cumulus. The Cirro-stratus, once formed, sometimes resumes the modification from which it originated, but more frequently it gradually evaporates or conjoins with some other modification. It seldom remains long in one form, but seems to be constantly declining, and hence the term of *Wane Cloud*. It is sometimes composed of wavy bars or streaks, connected in the centre and confused, but the streaks more defined at the edges: this is common in variable weather in summer. The *Mackerel Sky*, as it is termed, is a variety of this; another variety consists of one long and plain streak, thick in the middle, and wasting away at its edges; and a third, consisting of small rows of little clouds, curved in a peculiar manner, and a sure indication of stormy weather; this is more or less regularly formed, and the irregular formation is often produced when a large Cumulus passes under a long line of Cirro-stratus, and is also a sign of stormy weather.

The last variety of Cirro-stratus is a large shallow veil of cloud, which extensively overspreads the sky, particularly in the evening and during the night, and through which the sun and moon appear dimly. It is in this cloud that those peculiar refractions of light, of the sun and moon, called *haloes*, *mock suns*, &c. usually appear, and which is a tolerably certain prognostic of rain or snow. There are minor varieties, which may frequently be observed.

The Cirro-stratus usually terminates in forming an intimate union with some other cloud, to produce rain; but, at times, it evaporates or changes into some other modification.

The *Cumulo-stratus* designates the Cirro-stratus blended with the Cumulus, and either appearing intermixed with the heaps of the latter, or super-adding a wide structure to its base. The Cumulo-stratus is most frequent during a mean or changeable state of the barometer, when the wind blows from the West, with occasional deviations from the North and South.

This cloud may be always regarded as a preliminary to the production of rain; and it frequently forms in the following manner:—the Cumulus, which, in common, passes along in the current of the wind, seems retarded in its progress, increases its density, spreads out laterally, and at length overhangs the base, in dark and irregular protuberances. The change to the Cumulo-stratus often takes place at once in all the Cumuli which are near to each other; and their bases uniting, the superstructure rises up with mountain-like or rocky summits. The change from Cumulus to Cumulo-stratus is often preceded by Cirro-stratus.

Cumulo-strata vary in appearance; those in which hail showers and thunder-storms form look extremely black before the change to rain, and have a menacing aspect, as they are seen coming slowly up with the wind. The Cumulo-stratus sometimes evaporates or changes again into cumulus; but, in general, it ends in the Nimbus and fall of rain or snow: sometimes only one part forms a Nimbus, the other remaining a Cumulo-stratus.

General Remark on the *Nimbus*.—Any of the modifications above described may increase so much as to obscure the sky, without ending in rain; before which the peculiar characteristic of the rain-cloud may always be distinguished. In order to get a clear idea of its formation, you may observe a distant shower in profile, from its formation to its fall in rain. You may then observe the Cumulus first arrested, then the Cirro-stratus or Cirrus may appear to alight on its top; the change to Cumulo-stratus then goes on rapidly, and this cloud, increasing in density, assumes that black and threatening appearance known as an indication of rain: presently this blackness is changed to a gray obscurity, and this is the criterion of the actual formation of water, which now begins to fall, and constitutes the cloud a *Nimbus*, while a Cirriform crown of fibres extends from the upper part of the clouds, and small Cumuli enter into the lower part. After the shower has spent itself, the cloud resumes its title of Cumulo-stratus, and thence probably changes into a different modification; and if Cumulo-strati appear again, they indicate a return of rain.

As connected with this subject, the indications of a change of weather, we annex a description of SQUALLS, from the work of the distinguished navigator to whom we are indebted for the leading paragraphs of the present section.

"SQUALLS are generally of THREE kinds; that called the ARCHED SQUALL is frequently experienced, and usually rises from the horizon in the form of an arch; but sometimes it assumes the appearance of a dense dark cloud, particularly when highly charged with rain, or electric matter. From the time that the arch or cloud is first seen above the horizon, its motion is sometimes very quick to the zenith, the interval being scarcely sufficient to allow a ship to reduce the necessary sail before the wind reaches her, which happens when the cloud has approached the zenith. At other times the motion of the cloud is very slow, and not unfrequently it disappears, or is dispersed, the impulse of the wind being not then sufficient to reach a ship. As a general rule, it may be observed, that if there be rain in these squalls preceding the wind, the latter will probably follow the rain in sudden severe gusts; whereas, if the wind precedes the rain, the squalls are seldom so furious, and terminate in moderate showers of rain. The general rule, however, is often interrupted by the operation of local causes.

"The DESCENDING SQUALL is not so easily discerned as the former, because it issues from clouds which are formed in the lower parts of the atmosphere, near the observer; and when clouds are thus formed, they generally produce showers of rain, and successive squalls of wind.*

"The WHITE SQUALL is not often experienced; but it sometimes happens near to, or within, the tropics, particularly in the vicinity of mountainous land. This squall generally blows very violently for a short time; and, as it is liable to happen when the weather is clear, without any appearance in the atmosphere to indicate its approach, it is consequently very dangerous. The only mark that accompanies it is the white broken water on the surface of the sea, which is torn up by the force of the wind.

"SQUALLS, and also storms, are sometimes progressive, at other times regressive, when obstructed by an opposite wind; or, according as the point of greatest rarefaction is situated.

"When a squall is opposed by an opposite wind, its motion is *greatly retarded thereby*; and a ship sometimes, in this case, outruns the squall, and overtakes other ships which are within the limits of the opposite wind."

Captain FitzRoy says:—"Undoubtedly the worst wind, next to a hurricane' which a vessel can encounter, is a violent '*White Squall*,' so called because it is accompanied by no cloud or peculiar appearance in the sky, and because of its tearing up the surface of the sea, and sweeping it along so as to make a white sheet of foam. By squalls of this description, frequent in the West Indies, and occasionally felt in other parts of the world, no notice will be given much above the horizon; but, by consulting a good barometer or simpiesometer, and frequently watching the surface of the sea itself, even a white squall may be guarded against in sufficient time.

"Dark clouds, hard mixed with soft, and inky fragments in rapid motion beneath them, accompanied, perhaps, by lightning and distant thunder, are the forerunners of a heavy squall. Soft shapeless clouds, in which it is impossible to point out a definite

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* In the Mexican Sea heavy and very sudden descending squalls come up at times from very small clouds. These are scarcely felt until the cloud is almost right over the ship's masts.—*A. L.*

edge, usually bring rain, but not wind; and, generally speaking, the more distinctly defined the edges of the clouds are, the more wind they foretell. A little attention to these simple observations, so familiar to persons who have been some time at sea, may save young officers unnecessary anxiety in one case, and prompt them to shorten sail at a proper time in the other."—("Voyage of the *Beagle*," vol. ii. p. 49.)

"Captain Reuben Bunker, an old and experienced seaman of Nantucket, has related that he has often, and sometimes for several days together, rode out a heavy gale at sea by furling all his sails, pointing his yards forward, and veering out from the bows a stream cable, with a small anchor and a spar lashed to it: thus riding, as at anchor, head to wind. He considered this mode much safer than scudding or lying-to; and in this situation, he said, his vessel seldom shipped any water.

"Mr. Owen, formerly master-attendant at Jamaica, recommended to schooners and other small vessels, when running before the wind in a gale, with a heavy sea following, to tow a hawser from the stern; as he had found, from experience, that it divided the waves, and prevented their breaking on board."—*Lieut. Evans.* "Revision of Geographic Terms," p. 134.

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