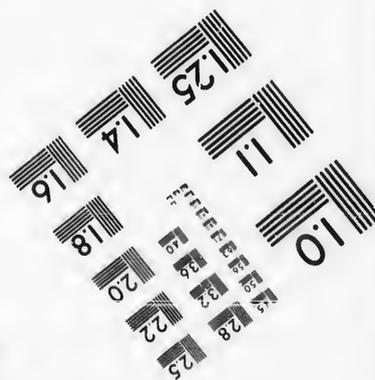
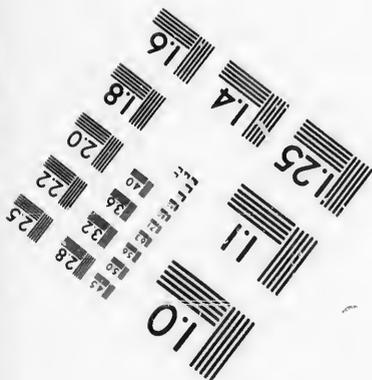
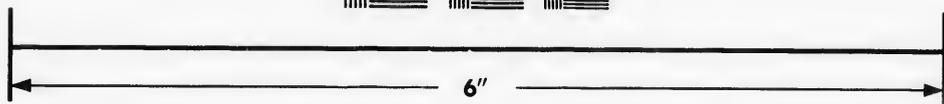
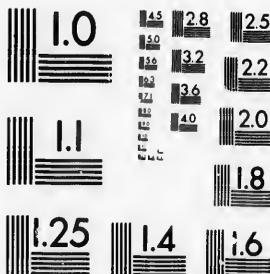


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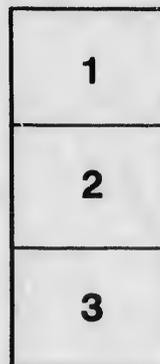
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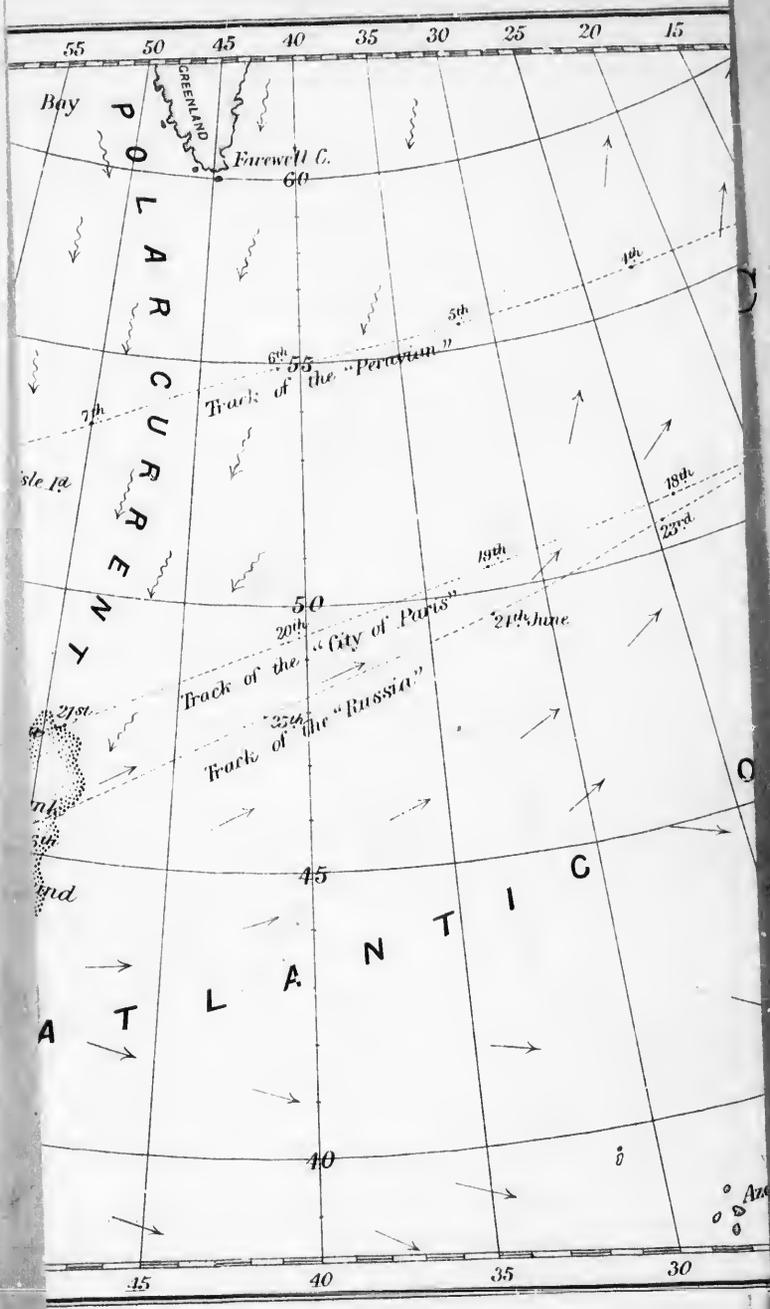
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NOTES

ON THE

NORTHERN ATLANTIC

FOR THE USE OF TRAVELLERS

COMPILED FROM AUTHENTIC SOURCES

BY

RICHARD BROWN, F.G.S., F.R.G.S.

With a Map

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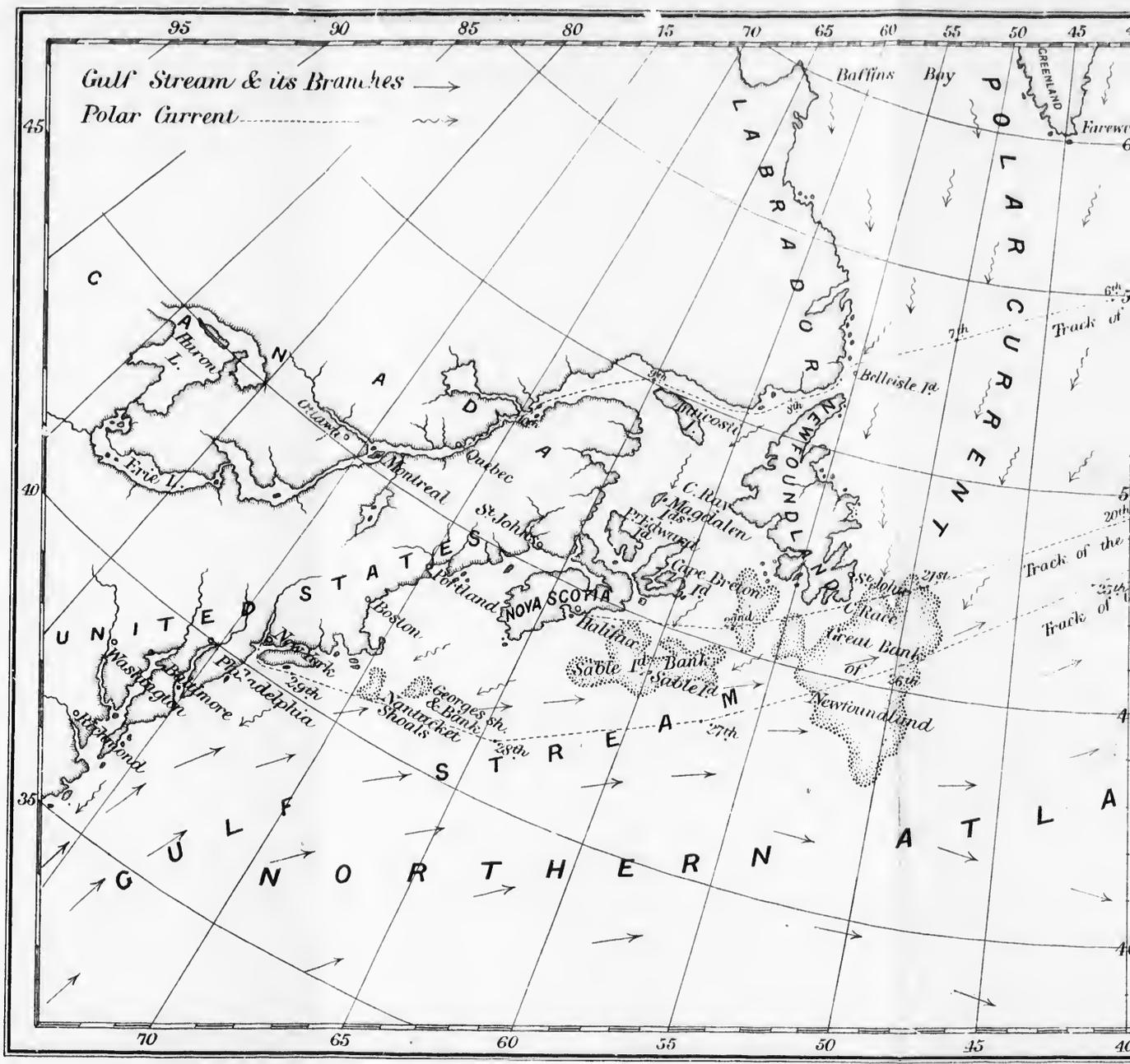
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PREFACE.

HAVING often, in crossing the Atlantic, sought in vain for information upon many subjects which naturally excite the curiosity of travellers, especially on their first voyage, it occurred to me that I might possibly render some slight assistance to future travellers by collecting, from authentic sources, such facts as might be useful to them under similar circumstances. With this object in view I carefully perused the works of several eminent writers on the navigation and physical geography of the Atlantic, from which, and from some other sources, I have compiled the following notes, adding such remarks as suggested themselves in the course of my inquiries. If I

have succeeded in placing the result before my readers in such a form as to induce them to devote their attention to the study of some of the interesting phenomena submitted in the following pages, I shall consider myself amply repaid for the time occupied in collecting and arranging the materials for this little book.

R. B.

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NOTES
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CHAPTER I.

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Discovery of the Atlantic by the Phœnicians—Their voyages to Tarshish—Form settlements in Cyprus, Rhodes, Sicily, &c.—Establish a colony at Gades—Their voyages to Britain—Greeks found the city of Syracuse—Establish the colony of Massilia—Visit Gades—Call the great ocean the Atlantic—Carthaginians form settlements in Spain—Monopolise the trade with Britain—Send expeditions along the coast of Africa and to the north of Britain—Romans settle in Spain—Visit and sail round Britain—Reach the *Ultima Thule* of the Greeks.

THE *Phœnicians*—the Canaanites of Scripture—were, according to the testimony of ancient writers, the inventors of navigation, and the first people who made voyages for trading purposes in the Mediterranean. The enterprising merchants of Tyre, ‘the Queen of the Sea,’ formed settlements in Cyprus, Rhodes, the Isles of the Grecian Archipelago, Sicily and Tartessus (modern Andalusia). Enjoying a monopoly of the commerce of

the Mediterranean, they carried on a lucrative trade with Tartessus, exchanging the products of the East for its gold, silver, copper, lead, and iron. This region, one of the most fertile of the ancient world, is called *Tarshish* in the Old Testament, and according to the Book of Genesis, chap. x., ver. 4, was peopled by the descendants of Japhet. As the knowledge of the existence of this country could only have been derived from the reports of the Phœnicians, they must have visited Tarshish, according to the chronology generally accepted, 1450 years before the Christian era, or about the same time that their country was conquered by the Israelites.

In their progress to the westward, the Phœnicians at length reached the Straits of Gibraltar and passed through into the Atlantic. Sailing along the coast in a north-westerly direction they discovered an excellent harbour where they established a colony to which they gave the name of *Gades* (Cadiz). According to Strabo, the colony of Gades was established 290 years before the foundation of Carthage, or in the twelfth century B.C.; consequently, if they had visited Tarshish in the year 1450 B.C., they must have been more than 200 years in the immediate vicinity of the Straits before they ventured to pass through into the open ocean. Once embarked on the waters of the Atlantic, they showed

no lack of courage in prosecuting their discoveries, having sailed as far as the Scilly Isles in a northern, and the Cape de Verde Islands in a southern, direction.

There is no mention in history of the date of the discovery of the Scilly Islands,¹ nor of the way by which the Phœnicians approached them. As there is no record of their having had any communication with the inhabitants of Gaul, it is probable that, having reached Cape Ortegál--the northern extremity of Spain--the adventuresome traders stood boldly out to sea, steering by the Polar star, with which they were acquainted, until they arrived at the Scilly Islands. An active trade was long maintained between the islands and the colony of Gades, from whence the Phœnicians transported large quantities of tin, copper, and lead to Tyre--the great mart from which the Eastern nations derived their supplies of these valuable products.² *Midacritus* was the first civilised man that ever visited Britain and carried a cargo of tin from thence to Tyre or Sidon. The Phœnicians con-

¹ The Scilly Islands were afterwards called the *Cassiterides* by the Greeks--a name supposed to have been derived from the Arabic word *Kastira*, signifying tin.

² 'The British tin mines mainly supplied the glorious adornment of Solomon's Temple; and hence also came the chief material of the armour of the kings and chieftains of heroic Greece.'--Creasy's *History of England*, 1869.

tinued to trade with the Scilly Islands for tin and copper, and with their settlements on the west coast of Africa for gold, ivory, ebony, and the skins of wild beasts, until the destruction of Tyre by Alexander the Great in the year 332 B.C.

The *Greeks*, who had learned the art of navigation from their old masters, the Phœnicians, soon after the Trojan war, began to embark in maritime pursuits, and carried on a considerable traffic with their neighbours in the Mediterranean. Having, in the course of time, acquired some knowledge of more remote countries, they took possession of such places as were best adapted for trading posts, and established colonies in some of the most important localities. The celebrated city of *Syracuse*, in Sicily, was founded by them in the year 732 B.C., and the colony of *Massilia* (Marseilles), on the southern coast of Gaul, was settled about 600 B.C. The native Greeks seem to have limited their voyages to the inner and well-known seas, but the descendants of the first colonists of Massilia were more venturesome, having passed through the Straits of Gibraltar,† and visited Gades and other places on the Atlantic coast. We are told by Strabo that a sea-captain of Massilia, called Pytheas, sailed along the coasts of Gaul and Britain to the northern extremity of Europe, from whence, after a voyage of

six days, he reached a country called 'Thule' by its inhabitants. This country, which was supposed by the ancients to be the utmost limit of the inhabited world, was probably one of the Faroe Islands; at any rate it seems to have been justly entitled to its name of 'Ultima Thule,' as it is quite certain that no voyage, during the next 1500 years, penetrated further into the Atlantic.

If the voyages of the Greek sailors did not add much to the geographical knowledge of the ancient world, the Greek philosophers, who were much addicted to cosmographical speculations, had the merit of inventing a fable which gave the name of *Atlantic* to the great ocean, of which nothing was then known except its eastern boundary. Aware of the spherical form of the earth, they concluded that the world might be circumnavigated by sailing westward from the Pillars of Hercules,¹ if the navigation were not obstructed by great shoals of mud and shingle—the remains of certain great islands called *Atlantides* which, as we are told by Plato, in his dialogue of *Timæus*, were destroyed by some great convulsion or overflow of the sea. 3

¹ When Hercules arrived on the shores of the great ocean he established his Pillars at Abyla and Calpe on each side of the strait.
—*Diodorus Siculus*.

2 Still when these adventures found a new
Country then was some question about it
3/ such as the overflow of the Nile, then
that created the next year

Carthage—the most illustrious colony of the Phœnicians—founded 869 B.C., soon acquired a large share of the commerce of the Mediterranean and the countries bordering on the Atlantic, gradually extending its trade as the parent state declined in power and importance. In the course of time, the Carthaginians obtained a monopoly of the trade with Britain, which they found so profitable that they jealously concealed from the Græeks and Romans the situation of the Scilly Islands, where they had formed depôts for storing the tin, copper, and other minerals collected from Cornwall and Devon. Pliny tells us that the captain of a Carthaginian trader, on a voyage from Gades to Britain, finding that he was followed by a Roman ship, purposely ran his own vessel upon a shoal, and led his pursuer to the same destruction. Saving himself on a piece of the wreck, he returned to Carthage, and was rewarded for his patriotism by the Senate, which granted him full compensation for the loss of his ship and cargo. 

We are told also by Pliny that, in the year 443 B.C., Hanno and Himilco, two sea-captains, belonging to a Carthaginian settlement in Spain, were sent by the Senate upon voyages of discovery in the Atlantic. Hanno sailed to the southward along the coast of Africa, touched at the Canary and Cape de Verde

Islands, and, it is supposed from his description of the shores of the mainland, reached the fifth degree of north latitude. A Greek translation of a part of Hanno's narrative of this voyage, entitled the 'Periplus of Hanno,' is still in existence. Himilco sailed to the northward along the coasts of Spain, Gaul, and Britain; he then passed through the Straits of Dover, and visited the coasts of Flanders and Germany. The Portuguese geographer, Antonio Galvano, who compiled an account of all known voyages, about the middle of the sixteenth century, says that Himilco continued his voyage beyond Thule to an island far to the northward, where he saw 'three mountains which threw out fire from their bases, while their summits were covered with snow.' If Galvano's statement be correct, the island seen by Himilco must have been *Iceland*, which was re-discovered by the Northmen at the end of the ninth century of the Christian era. ✓

The *Romans* made little progress in the art of navigation before the commencement of the first Punic War (264 B.C.), when, having constructed a fleet, upon the model of a Carthaginian galley, stranded on the coast of Italy, they coped so successfully with their great rivals that they soon afterwards gained a great naval victory over them near Mylæ, on the coast of Sicily. After the fall of Carthage and the reduction of

Numantia by Scipio, the Romans became firmly established in Spain, from whence they passed through the Straits of Gibraltar into the Atlantic, and sailed to the southward as far as the isle of *Ferro*, the most westerly of the Canaries. Publius Crassus, who, according to Strabo, reduced the north-western provinces of Spain about 100 B.C., was the first to show the Romans the way to the Scilly Islands and the southern coasts of Britain. Less daring navigators than their predecessors—the Carthaginians—and dreading the danger of crossing the Bay of Biscay, the Romans made little use of the way pointed out to them; notwithstanding the great cost of transportation, they continued to carry the products of Britain across the Channel to Gaul, and thence, partly by river navigation and partly by pack-horses, to the mouth of the Rhone, from whence it was reshipped to various ports in the Mediterranean. Considering their long occupation of Britain, they were very imperfectly acquainted with its geography, being not even aware that it was an island until the reign of the Emperor Domitian, when a fleet, sent by order of Agricola, A.D. 86, sailed round its northern extremity, subdued the Orkneys, and returned by the western and southern coasts through the Straits of Dover to Sandwich. Upon this voyage, an island seen at a great distance to the northward—probably one of the Shet-

lands—was supposed to be the ‘Ultima Thule’ of the Greeks. The Roman poets, inspired probably by Greek traditions, make frequent mention of a great continent in the ocean far beyond the shores of Europe and Africa. Seneca, one of their most celebrated writers, in his drama of ‘Medea,’ prophesies that in future ages, when the secrets of Oceanus should be revealed, new worlds would be discovered, and ‘Ultima Thule’ would no longer be the extremity of the habitable globe. This prophecy has been literally fulfilled, though at the time it was most likely considered a wild dream by the Roman generals and statesmen, who were too deeply engrossed in securing the vast territories they had subdued to bestow a thought upon the gloomy ocean which formed the western boundary of the Empire.

*which
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CHAPTER II.

Conquest of Rome by the Goths—Conquest of Egypt and Northern Africa by the Arabs or Moors—They found Morocco—Pass over into Spain and subdue it—Scandinavians infest the shores of Gaul and Britain—They discover the Faroe Islands and Iceland—Iceland colonised by the Danes and others—An Iceland colonist discovers Greenland—Settlements made near Cape Farewell—Supposed discovery of America by Greenland settlers—Portuguese discover the Azores—Cabot's discovery of the continent of North America—Voyages of early European navigators to America—Fisheries on the Grand Bank of Newfoundland—Settlement of Acadie by the French—War between England and France—Naval actions in the Atlantic.

AFTER the conquest of Italy by the *Goths* under Alaric, A.D. 410, the Western Empire—overrun by hordes of barbarians—was broken up into small disconnected states, without the means of forming a combination to resist the common enemy. Amidst this general confusion a cloud of darkness overspread all the civilised regions bordering on the Mediterranean; commercial relations were suspended; no attempts were made to extend the bounds of geographical knowledge. On the contrary, even much that had been acquired was lost, and the very existence of the great ocean, which

had been known for nearly twenty centuries, was almost forgotten. Fortunately, at this period another people, coming, like the Phœnicians, from the East, rescued the Atlantic from total oblivion. The *Arabs*—the fanatical followers of Mahomet and the Caliphs—‘fired by enthusiasm, and invigorated by conquest,’ having subdued Syria, Palestine, Chaldæa, and the great Persian Empire, turned their attention to the west, and brought under their subjection the whole of Northern Africa, from Egypt to the shores of the Atlantic. Here they founded the city of *Morocco*, near Mount Atlas, the capital of their African dominions. From thence the *Moors* (as they were now called) passed over into Spain, of which they soon became the masters, having, in the year 1713, gained a great and decisive victory over the Visigoths, who then had possession of the Peninsula.

Being undisputed occupants of both sides of the Straits of Gibraltar and the adjacent coasts of the Atlantic, it might have been expected that the Moors, who had successfully cultivated the sciences of astronomy and cosmogony, and were acquainted with the mariner’s compass, would have ventured upon some daring voyages of discovery upon the wide ocean spread out before them; but they do not appear to have sailed beyond the north of Spain in one direction, and

the coast of Morocco in the other, although it must be allowed that they have left behind them much better geographical descriptions of the countries they subdued than either the Greeks or Romans.

Though more than two thousand years had passed away since the Phœnicians sailed through the Straits of Gibraltar, the first attempt to penetrate the great Atlantic—'the Sea of Gloom' of the Arabs—was made by a semi-barbarous people living on the shores of Scandinavia, far away to the northward of the populous regions that sent forth the torrents of Huns, Goths, and Vandals, which overran the South of Europe in the declining years of the Roman Empire. Dwelling in huts and caves in the deep bays and fiords which intersect the rugged shores, and with no other highway than the ocean, they necessarily became expert in the arts of constructing and navigating vessels capable of withstanding the rude shocks of the enormous waves of the stormy northern seas. Pirates by profession—led by chiefs calling themselves *Vikings* or *Sea-Kings*—these fierce and adventurous rovers infested the shores of Gaul and Britain more than four hundred years, spreading terror and dismay wherever they appeared; not content with plunder only, but often carrying off men, women, and children into captivity. Emboldened by success, the chiefs, who had hitherto

acted separately, in the year 843 combined their forces, ravaged the coasts of England and France, and, ascending the Seine, burnt the city of Paris, at that remote time even a place of considerable importance. The *Faroe Islands*, which they discovered about the middle of the ninth century, soon became the favourite resort of the Vikings, as they could easily retreat thither with their booty, and find secure shelter in the numerous fiords and narrow channels of that remote archipelago.

The discovery of the *Faroe Islands*, though regarded at the time with little satisfaction by the inhabitants of Britain, France, and Spain, for the reasons just mentioned, led the way directly to further discoveries of the greatest importance to the civilised nations of Europe. One of the Vikings, called *Naddoc*—a noted pirate—having been driven out of his course by a tempest on his way from Norway to the *Faroës*, in the year 860, fell in with an unknown land far away to the north-westward, to which he gave the name of *Suæland* (Iceland). The discovery of a bleak uninhabited country, separated from their native shores by a wide and stormy ocean, was not regarded with much favour by the sea-rovers who chiefly lived by plunder; its existence probably would soon have been forgotten, had not a Swedish trader, called *Gardar*, on a voyage to the *Hebrides* about three years later, been

in like manner driven by a storm from the Pentland Frith to the eastern shores of Iceland. Gardar circumnavigated the island; and, on his return to Sweden, gave such flattering descriptions of its capabilities that, in the course of a few years, emigrants from Norway, Sweden, and Denmark flocked to its shores in great numbers. This first settlement in the great ocean—at least 600 miles from the shores of Europe—was soon followed by others of a similar character still further to the westward. About the year 980, *Gunbiorn*, an Icelandic colonist, driven off the coast in a storm, discovered a country far to the west, to which he gave the name of *Greenland*, though he did not land upon its shores. A few years afterwards *Eric*, the son of an Icelandic settler, having been condemned to banishment for three years for some act of violence, proceeded in search of the country described by *Gunbiorn*; and, having reached its coasts, sailed along until he arrived at its southern extremity (Cape Farewell), where he and his followers landed and founded a settlement, which they named *Eric's Fiord*. The Greenland colonists maintained an irregular intercourse with Iceland and Norway; and it is stated in certain ancient Icelandic manuscripts, called *Saga*, that in the tenth century they visited the coasts of *Labrador*, and extended their voyages to the south-

ward as far as *Nantucket*. Some modern historians assert that the Saga are mere fables; whilst others, on the contrary, firmly believe in their authenticity. If the Saga can be relied upon, the Atlantic was crossed by the descendants of the Norwegian pirates at least 400 years before Columbus discovered America. It must be admitted, however, that if the Greenland colonists did really discover any part of the American coast, it led to no beneficial results; having apparently been quite forgotten for a period of 400 years, when the discovery of the *Azores* by the Portuguese, in 1429, attracted the attention of the most celebrated astronomers and geographers of that day to the possibility of discovering new countries in the great Atlantic far to the westward of the *Azores*. Imaginary maps were in consequence constructed in several countries of a great ocean supposed to extend from Europe to Eastern Asia, studded with groups of islands all the way from the *Azores* even to the shores of India. All these conjectures, however, were set aside by *Columbus*, who, in the year 149³, sailed directly across the great Atlantic and determined its western limit at a point 2,000 miles to the southward of that reached by the Icelandic colonists. The great stretch of coast between these two points was, in the course of the following thirty years, examined and mapped by the *Cabots*,

father and son, who in 1497 and 1498 ran down the coast from the Straits of Belleisle to the thirty-eighth parallel; and by *Verrazano*, who in 1524 minutely explored the coasts of the United States as far south as Florida.

The most important result of the voyages of the Cabots was the discovery of the cod-fishery on the banks of Newfoundland, to which the fishermen of Normandy, Brittany, and the Basque Provinces soon found their way. In 1534, *Jaques Cartier* sailed up the St. Lawrence; in 1578 *Sir Humphrey Gilbert* visited Newfoundland; and in 1585 *Sir Walter Raleigh* attempted to establish a colony in North Carolina; but the fisheries on the Grand Bank and in its vicinity seem to have been, for nearly a hundred years, the great object of the maritime nations of Europe. Thousands of French, Spanish, Portuguese, and English fishermen regularly resorted thither, and the Atlantic, which had for ages untold been enveloped in impenetrable gloom, became the well-known highway to the fishing grounds, which annually yielded rich harvests to the hardy mariners.

In the beginning of the seventeenth century a rage for colonisation manifested itself both in England and France. Settlements were made by the former in *Virginia*, *Massachusetts*, and *Newfoundland*; and by

the latter in *Canada, Acadié*, and the islands of the Gulf of *St. Lawrence*. Hitherto, although the two nations had frequently been at war, their subjects had fished together on the Grand Bank in peace, but when the settlers in the new colonies began to acquire some strength and importance, quarrels arose in connection with the fur trade, and the merchants sent armed vessels to protect the fishermen and traders. These vessels, commanded by naval officers, often gave important aid to the national cruisers in ravaging the coasts of *Canada, Acadié*, and *Newfoundland*, during the wars of the seventeenth century. After the conquests of *Acadié* and *Newfoundland* in 1711, during a long interval of peace, the French and English colonies made rapid progress in wealth and population. The waters of the Atlantic were navigated only by traders who brought the products of other countries to the thriving colonists, and by the hardy fishermen, who pursued their vocation with great success. But this happy state of affairs was rudely interrupted by the war which broke out in the middle of the eighteenth century. The trading and fishing vessels of both countries were either captured or driven away by the swarms of English and French privateers which spread over the Atlantic, and infested every sea in the vicinity of the colonies and the fishing grounds until the re-

storation of peace in 1763, after the conquest of Canada and Cape Breton. During this period the Atlantic had not been the theatre of any great naval action, in which the opposing fleets had encountered each other in great force, but the losses in the combats of squadrons and single ships, and in frequent storms and tempests, had been very serious on both sides. The peace, which was patched up in 1763, was of short continuance; and the Atlantic, during the wars of the French Revolution, again became the scene of several great naval conflicts, in which the English fleets, under Rodney, Lord Howe, and Sir J. Jervis gained decisive victories over those of France, Spain, and Holland; and finally, at the battle of Trafalgar in 1805, under the immortal Nelson, when the combined fleets of France and Spain were nearly annihilated.

CHAPTER III.

Lines of sailing packets established between England and her North American colonies—After the War of Independence a line of packets established between Falmouth and Halifax, Nova Scotia—Proves unfit for the service—American merchants establish lines of sailing packets of large burden between New York and Liverpool, and New York and London—Prove successful—First use of steamboats in Scotland—Also in America—First passenger steamer on the Clyde—Voyage of the steamer *Savannah* from Savannah to England—*Royal William* steamer built at Quebec—Makes a successful voyage to England—Company organised in England to run steamers from Bristol to New York—Launch the *Great Western*—Makes a successful trip—Same parties employ the iron steamer *Great Britain*—Transatlantic Steamship and British and American Steam Navigation Companies formed to run steamers to New York—Both Companies send out experimental ships—Arrival of *Great Western* and *Sirius* at New York—Launch of the *British Queen* and *President*—Loss of the *President*.

SINCE the general peace in 1815 no hostile fleets have been seen in the Northern Atlantic. The maritime nations have, on the contrary, been engaged during the last forty years in the more praiseworthy contest of establishing competing lines of steamers for carrying mails, passengers, and merchandise. Some years be-

fore the American colonists issued their Declaration of Independence, the British Government had instituted a post-office service, composed of *five* sailing packets, which made regular voyages between *Falmouth* and *Boston*; but, of course, they were discontinued at the close of the War of Independence. As the remaining colonies in North America had now become of greater importance than formerly, Lord North informed the Governor of Nova Scotia in 1783 that application would be made to the Post Office to establish a regular line of packets between Halifax and Falmouth. This object, however, was not carried out until the year 1788, and then, in a most inefficient manner, the vessels selected for the service being old *ten-gun brigs*, commonly styled *coffins* by naval men, quite incapable of coping with the strong westerly gales of the Atlantic. They were chiefly distinguished for their bad sailing qualities, often occupying from forty to sixty days on the outward voyage. Being commanded by old lieutenants of the navy, long used to the rigid discipline and etiquette maintained on board ships of war, they did not find much favour with ordinary passengers. Both as mail packets and passenger ships they proved complete failures; and, although they continued to carry the mails for a period of fifty years, passengers generally made their voyages across the Atlantic in mer-

chant ships, either direct or by way of New York. The great inducement to travellers to take the New York route was the establishment of a line of ships of a superior class between that port and England, by American merchants, soon after the general peace in 1815. In the first instance ships of about 500 tons burden were employed, but, as the trade between the two countries rapidly increased, these were gradually replaced by ships of larger burden. One of these *New York Liners*, as they were called, sailed punctually at intervals of five days from New York to London or Liverpool, commonly making the voyage in eighteen or twenty days. Being provided with excellent accommodations, and commanded by skilful, courteous officers, who studied the comfort of their passengers, the New York Liners most deservedly became great favourites with travellers both from the United States and the British North American Colonies. If they had not been superseded by steamers, they would most probably have maintained their position to this day, as they certainly afforded the safest and most expeditious means of crossing the Atlantic. Many of these ships are still employed on their old routes in the transportation of emigrants and merchandise; but, of course, the steamers now carry all the first-class passengers.

Several attempts to propel vessels by steam-power were made in the latter part of the eighteenth century, but without success until the year 1788, when *Patrick Miller*, of Dalwinston, Dumfriesshire, constructed a steamer which attained a speed of five miles an hour. In the year 1801, *Mr. Symington*, an engineer, who had assisted Miller in making his experiments, built a steamboat, called the *Charlotte Dundas*, which towed two vessels upon a canal at the rate of three miles an hour against a strong breeze, but as it was found that the swell produced by the paddles injured the banks of the canal, its use was prohibited by the proprietors. *Fulton*, an American engineer, having visited Scotland and seen the *Charlotte Dundas* at work, on his return to America launched a steamboat, called the *Clermont*, upon the Hudson river, which plied regularly between New York and Albany, making the voyage of 160 miles in thirty hours. In the year 1812, a steamboat called the *Comet*, of 40 feet keel and three horse-power, was built upon the Clyde for carrying passengers, which plied regularly for some time between Glasgow and Greenock at a speed of five miles an hour. In consequence of these successful results upon a small scale, steamboats of larger dimensions and improved construction were gradually introduced, both in Europe and America, for

the carriage of mails and passengers, which made short voyages with regularity and despatch.

The practicability of crossing the Atlantic in a vessel propelled by steam was first tested in America in 1819 by the *Savannah*, of 315 tons burden, which made the voyage from Savannah to Liverpool in the month of May in twenty-six days. It was estimated on starting that the *Savannah* would make the voyage in fifteen days, but, running short of coal, she had to depend in a great measure upon her sails, which of course caused some delay. 'Several days before her arrival, the *Kite*, a revenue cutter on the Cork station, chased the *Savannah* a whole day, going ten knots, supposing her to be a ship on fire, when at length, perceiving the *Kite* in chase, she stopped her engine until the latter came up.' (*Scots Magazine*, July 1819.)

The *Savannah's* voyage having shown that a steamer of her size could not make a quicker passage than an ordinary sailing vessel, the subject of trans-Atlantic steam navigation was dropped for some time, but again revived in 1833, when an enterprising ship-builder of Quebec constructed a steamer, called the *Royal William*, of 500 tons burden and 180 horsepower, which made a voyage across the Atlantic in seventeen days. The following extract from the *Annual Register* for 1833 contains details of the voyage and its

important results :—‘ COMMUNICATION WITH AMERICA BY STEAM.—The *Royal William* steamer, of 180 horse-power, has recently arrived in London from Quebec. On her way she touched at Pictou, Nova Scotia, for fuel, where she obtained, at 15s. per chaldron, coal raised on the spot, the quality of which is pronounced by the engineers on board to be superior for generating steam even to our English coal. From Pictou she came direct to Cowes in seventeen days. The distance is about 2,500 miles, and therefore this voyage is not instanced for its speed, which was not the particular object of the voyage on this occasion, but it proves three important facts: First—That there is no more difficulty in conveying the mails by steam to our North American possessions, than to our dependencies in and about the Mediterranean, for which service steam-packets are used. Secondly—That the nine weeks post-office average allowance for the sailing-packets to and from Halifax might, by the adoption of steam, be reduced to a regular passage of five weeks out and home. Thirdly—That for the supply of the steam-packets to our North American possessions there exist, in our Colony of Nova Scotia, coal-mines yielding excellent fuel for the purpose at a cheap rate.’

The voyage of the *Royal William*, when compared with that of the *Savannah*, clearly proved that, to

insure success in navigating the Atlantic by steam, it was only necessary to employ vessels of larger tonnage with proportional power. From this point of view, therefore, the *Royal William* may be justly regarded as the pioneer of Atlantic steam navigation which, in the course of the last forty years, has been developed to an extent never contemplated by the first adventurers. Encouraged by the successful results of her voyage, other parties, provided with ample means, were induced to embark in a similar enterprise upon a much larger scale, and a Company was organised at Bristol for the purpose of establishing a direct and regular steam communication between that port and New York. The late Dr. Lardner, who was then considered a great authority in such matters, had stated that the practicability of constructing a vessel capable of affording adequate room for engines, boilers, cabins, stores, and a sufficient quantity of fuel for such a long voyage, was very questionable; and the British Association for the Advancement of Science was discussing the same subject at their meeting at Bristol at the very time that the enterprising merchants of that ancient commercial city were engaged in building their first vessel. In spite, however, of these discouragements, the Company proceeded with their enterprise, and, in the winter of 1838, launched the *Great Western*,

of 1,340 tons burden and 450 horse-power—the largest vessel that had yet been constructed for ocean steam navigation. The *Great Western* started from Bristol on her first voyage on the 7th, and reached New York on the 23rd of April, where her arrival was greeted by crowds of people closely packed on every wharf from whence a view could be obtained of her progress up the harbour. In 1843, the Bristol Company placed the iron screw steamer *Great Britain* on the same route, but this ship and the *Great Western* were soon afterwards withdrawn, as they were not able to compete with the Cunard Line, established in 1840, which received a large annual subsidy from the British Government. Though driven off the line, the Bristol Company, it must be admitted, deservedly enjoyed the credit of having solved the problem of ocean steam navigation.

About the same time two other Companies were formed in England for the same object—the Transatlantic Steamship, and the British and American Steam Navigation Companies. The first sent out two ships which made a few voyages only when they were withdrawn, as the business did not prove remunerative. The second Company, organised by the late Mr. Laird—the African explorer—launched their first ship, the *British Queen*, of 1,862 tons and 500 horse-power, at Limehouse on May 24, 1838, and the *President*, of

2,336 tons and 600 horse-power, in the following year. The *British Queen* made five, and the *President* three, voyages to New York, but the latter was lost on her homeward voyage in April 1841. In consequence of this sad disaster the *British Queen* was taken off the line, and subsequently sold to the Belgian Government.

CHAPTER IV.

British Government advertises for tenders for a monthly line of mail steamers from Liverpool to Halifax, Nova Scotia—Contract taken by the British and North American Royal Mail Steam Packet Company—Their ships commence running in 1840 to Halifax and Boston—Voyages made fortnightly—And, in 1848, weekly—The Ocean Steam Navigation Company established to carry mails and passengers between New York and Bremen—New York and Havre Company in 1850—Collins's Company contract with the United States Government—Make their first trip in 1850—Loss of two of their ships—Other ships taken off the line—Several new lines established—Table of tonnage, passengers, and merchandise carried by Atlantic steamers—Great improvements in steamers—Logs of steamers: *Russia* to New York, *City of Paris* to Halifax, and *Peruvian* to Quebec.

THE practicability of trans-Atlantic steam navigation having been clearly demonstrated, the British Government advertised for tenders for a monthly line of steamers from Liverpool to Boston, calling at Halifax, Nova Scotia. The contract was taken by the late *Sir Samuel Cunard*, who, in conjunction with Messrs. Burns and McIver of Glasgow, formed a company styled *The British and North American Royal Mail Steam Packet Company*. In the first instance four large

steamers—the *Britannia*, *Caledonia*, *Acadia*, and *Columbia*, each of 1,200 tons burden and 450 horsepower—were built on the Clyde, and commenced running in 1840. These ships, commonly called the *Cunard Line*, performed the service with such regularity, safety, and despatch, and afforded such great facility of communication between Europe and America, that it was soon found necessary, for the purpose of accommodating the rapidly increasing number of passengers, to build more ships, and to make two voyages monthly each way. As the Cunard Company, under their contract, received a liberal annual subsidy from the British Government, they were enabled to make great improvements in the size, construction, and equipment of their vessels, and, in consequence, to enjoy a comparative monopoly of the transportation of first-class passengers and valuable freight across the Atlantic. Having in 1848 received an increased subsidy, a weekly service was established, and the voyages were made to Boston and New York alternately, calling at Halifax as before. In 1850, the Company commenced a direct service fortnightly from Liverpool to New York. Since that time, other arrangements have been made from time to time; their ships do not now call at Halifax, but proceed direct to Boston and New York. It is said that the Company now (1875)

receive a subsidy of 70,000*l.* per annum from the British Government for carrying the mails twice a week from Liverpool to New York. The Cunard fleet comprises twenty-four ships of various sizes—ranging from 1,200 to 2,500 tons burden. During their long career of more than five-and-thirty years, only two ships have been wrecked, and in both cases, fortunately, without any loss of life.

Encouraged by the great success of the Cunard Company, some enterprising merchants of New York established in 1847 two lines of powerful steamers—one between New York and Bremen, the other between New York and Liverpool; but, after making a few trips, both were discontinued. In 1848 the *New York and Havre Steam Navigation Company* contracted with the United States Government to carry a fortnightly mail between those ports, touching at Southampton. In 1853, this Company unfortunately lost one of their ships—the *Humboldt*—which was wrecked in entering Halifax harbour; and in the following year another, the *Franklin*, which was wrecked on Long Island. These ships were replaced by the *Arago* and *Fulton*, which were withdrawn on the breaking out of the Civil War in 1861.

The most dangerous rival, however, of the Cunard Company was a line established by *E. K. Collins* and

others in 1849 between New York and Liverpool. Four pioneer ships—the *Atlantic*, *Pacific*, *Arctic*, and *Baltic*—each of 2,800 tons burden and 1,000 horsepower, were first built for this service. No expense whatever was spared in constructing and equipping these powerful ships, which are said to have cost 100,000*l.* each, a cost which Mr. Collins and his partners could well afford, as they received a subsidy of 170,000*l.* per annum from the United States Government. The *Atlantic* made the first trip from New York to Liverpool in May 1850. Although the ships of the Collins Line, upon an average of forty-two voyages, crossed the Atlantic in eleven days and ten hours, whilst those of the Cunard Line averaged twelve days and nineteen hours, the latter had deservedly obtained such a high reputation, during a period of ten years, that they continued to enjoy the patronage both of Americans and Europeans, to such an extent that the Collins Line, with all its advantages, after running several years at a great loss to its proprietors, was discontinued. This unfortunate result was probably due, in a great measure, to a loss of two of the Company's ships, the *Arctic* and *Pacific*; the former having foundered off Cape Race in a collision with a small French merchant steamer of little more than 100 tons burden, when nearly all the passengers and

crew perished; and the latter having been lost on her homeward voyage.

Between the years 1850 and 1860, several new lines of steamers were placed on the Atlantic, the most important of which—the Inman, Allan, and Anchor—still maintain their position, but some others have been withdrawn. Although the Cunard Company, on the failure of the Collins Line, placed more ships both on the New York and Boston routes, the trade with the United States has increased so rapidly within the last ten or twelve years that there has been a good opening for the employment of more vessels, and several new lines have been established. There are now (1880) at least a dozen lines of steamers on the Northern Atlantic, making regular voyages from the chief ports of England, France, Holland, and Germany to the United States and the British colonies. All these, however, are not sufficient for the exchange of the products of Europe and America; hundreds of private steamers are consequently engaged in the service, and it is very probable that before long they will almost entirely supersede sailing ships.

Some idea may be formed of the value and amount of work performed by the Atlantic steamers, by an inspection of the following table, compiled from an article published in the *Times* of February 28, 1871,

showing the number of passengers and tonnage carried by eight of the principal lines in the year 1870.

In comparing the business of each Company, it must be borne in mind that the French and German lines were suspended during the best part of the season, being engaged, after the outbreak of the war, in transporting arms, ammunition, and military stores.

Name of line	No. of ships	No. of passengers carried	Tons of merchandise carried
Cunard	24	55,101	450,000
Anchor	28	39,626	307,500
Hamburgh	7	28,093	69,000
North German Lloyd	12	35,319	72,800
Comp. Générale Transatlantique	4	7,030	37,500
National	10	43,152	369,145
Inman	13	58,900	170,000
Guion	8	34,928	150,293
Totals	106	302,149	1,626,238

The voyages of the Atlantic steamers are now made with such regularity and despatch, that sailing ships, except in the carriage of heavy freight, have been driven off the ocean. The former, therefore, now practically enjoy a monopoly of the transportation of passengers and the more valuable descriptions of merchandise. Such great improvements have also been made in the construction of the Atlantic steamers

during the last thirty years, that the voyage, which formerly occupied from twelve to fifteen days, is now generally made in nine or ten. By referring to the map¹ on which the tracks of the voyages of the *Russia*, *City of Paris*, and *Peruvian* are delineated, and to the abstracts of their logs on the following pages, the traveller will be able to form a tolerably good idea of the time of arrival at his destination. Travellers must not always expect to make such rapid voyages as those recorded in the logs of the above-named voyages, as they were made under very favourable conditions, with light winds or calm weather in the summer season; but there is no reason why they may not be even more fortunate, as in the cases of the *Germanic* of the White Star, and the *City of Berlin*, of the Inman Line, which, according to statements

¹ The map is constructed on the *gnomonic or cubical projection*, which supposes the eye to occupy the centre of the sphere, and the sphere itself to be inclosed by six equal faces of a cube, upon which the projection is made. The advantage of the gnomonic projection consists in its peculiar property of representing the course of spherical great circles by straight lines, so that a line drawn upon a map between any two points exactly coincides with the course of a thread stretched between the same two points upon a globe. Consequently, the shortest course of a ship from one port to another—say from Quéenstown to New York—is represented by a straight line; and the distance run from day to day can be as correctly marked from the log, making allowance for the variation of the compass, as by means of latitude and longitude.

that appeared in the *Times*, made the passage from Queenstown to New York in the months of August and September, 1875, in seven days and twenty-three hours, and seven days and eighteen hours, respectively.

ABSTRACT OF LOG OF THE STEAMSHIP 'RUSSIA' (CUNARD LINE), EDWARD G. LOTT, COMMANDER,
FROM LIVERPOOL *via* QUEENSTOWN TO NEW YORK.

Date	Winds	Courses	Dis- tances	Latitude	Longitude	Remarks
1869 June 19	Northerly	Various	—	—	—	3.0 P.M., cast off from the buoy and proceeded slow ; 3.15, received mails ; 3.22, proceeded ; 3.37, passed Rock Light ; 4.33, passed Bell Buoy.
" 20	N.N.E.	"	242	—	—	8.55 A.M., arrived at Queenstown ; 3.50 P.M., re- ceived mails ; 4.0, proceeded ; 8.0, passed Fastnet.
" 21	Variable	N. 88 W.	279	51.29 N.	15.22 W.	Moderate breeze and cloudy.
" 22	"	S. 82.23 W.	353	50.42 N.	24.43 W.	Light breeze and fine.
" 23	S.W.	S. 78.00 W.	355	49.29 N.	33.41 W.	Fresh breeze and cloudy.
" 24	Northerly	S. 73.16 W.	244	47.50 N.	42.00 W.	Moderate breeze and fine.
" 25	S.-westerly	S. 68.50 W.	349	45.44 N.	49.55 W.	Moderate breeze with dense fog.
" 26	Westerly	S. 67.15 W.	344	43.31 N.	57.21 W.	Light breeze with dense fog.
" 27	"	S. 69.28 W.	345	41.30 N.	64.39 W.	Light breeze and foggy.
" 28	Easterly	S. 81.00 W.	352	40.35 N.	72.20 W.	9.3 A.M., received pilot ; 2.30 P.M., Five Island Light- house abeam (N. by E. 6 miles) ; 5.9, passed Sandy Hook ; 5.57, arrived at Quarantine ; 6.34, arrived off Carrig Garden.
						Length of passage Apparent time Mean time Liverpool to New York . 9d. 2h. 57m. 9d. 7h. 57m. Queenstown to New York 8d. 2h. 34m. 8d. 6h. 56m.

ABSTRACT OF LOG OF THE STEAMSHIP 'CITY OF PARIS' (INMAN LINE), JAMES KENNEDY,
COMMANDER, FROM LIVERPOOL *via* QUEENSTOWN TO HALIFAX.

Date	Winds	Courses	Dis- tances	Latitude	Longitude	Remarks
1869 August 14	N.N.W.	—	—	—	—	3.20 P.M., Rock Light; 4.15, Bell Buoy; 8.20, South Stack.
" 15	Westerly	—	—	—	—	3.0 A.M., Fuskar; 7.45, Ballycotton; 8.30, Roche's Point, Queenstown, and received pilot; 3.50 P.M., passed Roche's Point.
" 16	Variable	West	218	51.24 N.	15.27 W.	7.57, passed Fastnet; noon, light airs and calm.
" 17	"	S. 88 W.	321	51.09 N.	24.02 W.	Variable winds with heavy head swell.
" 18	"	S. 82 W.	320	50.28 N.	32.24 W.	Light airs and calms with heavy head swell.
" 19	"	S. 76 W.	326	49.10 N.	40.35 W.	ditto
" 20	"	S. 74 W.	354	47.32 N.	49.06 W.	ditto
" 21	"	S. 74 W.	352	45.41 N.	57.07 W.	Light airs and calms with smooth sea. Light airs; 11.45 P.M., Cape Race abeam, distant 3 miles.
" 22	"	—	283	—	—	7.45 A.M., received pilot; 9.30, arrived at dock, Halifax.
						Mean time Passage from Queenstown to Halifax, Cd. 23h. 5m.

THE NORTHERN ATLANTIC.

ABSTRACT OF LOG OF THE STEAMSHIP 'PERUVIAN' (ALLAN LINE), WILLIAM BALLANTINE,
COMMANDER, FROM LIVERPOOL *via* MOVILLE TO QUEBEC.

Date	Winds	Courses	Dis- tances	Latitude	Long- itude	Remarks
1869 July 1	Variable	—	—	—	—	Light breeze and clear; 3 P.M., embarked mails: 3.30, passengers; 4.0, left Liverpool; 4.45, Bell Buoy; 5.0, lights; 10.0, Calf of Man.
"	"	—	190	At Moville	—	Light wind and hazy; going dead slow from 3.40 to 6 A.M. through fog; 9 A.M., Innishowen; 9.35, anchored off Moville; 5.55 P.M., received mails; 6.30, left Moville; 7.0, Innishowen; slow, 8 to 9, through fog; 10.20 Tory Island.
"	E. to S.E.	N. 82 W.	216	55.55 N.	13.03 W.	Light winds and clear throughout; all sail set.
"	N.E. to E.	S. 88 W.	310	55.43 N.	22.14 W.	Light winds and cloudy throughout; all sail set.
"	E.N.E. to E.	West	333	55.44 N.	32.02 W.	Fresh breeze and clear throughout; all sail set.
"	E. to E.N.E.	S. 80 W.	334	54.57 N.	41.29 W.	ditto
"	N. and calm	S. 72 W.	322	53.07 N.	49.56 W.	ditto
"	Calm	Various	326	51.00 N.	57.50 W.	Calm and cloudy throughout; 4 A.M., took in all sail.
"	Variable	"	300	49.50 N.	64.57 W.	Calm and cloudy throughout; 4.10 A.M., Belle Isle; 8.45, Point Amour Lighthouse; steamed only; passed several icebergs forenoon
"	W.S.W.	"	243	[raska	—	A.M.—Light breeze; 10.50, west point Anticosti abeam; P.M.—light breeze; 8.0, Point de Monts; 10.0, thick fog; slowed engines; sounded occasionally.
"	W.S.W.	"	80	Off Kanna- To Quebec	—	A.M.—Strong breeze and foggy; still going slow and sounding; 1.50, stopped off Father Point for pilot; 2.50, ahead way; 11.0, full speed; 11.20, Pilgrims; P.M.—strong breeze and clear; 2.0, passed s.s. <i>Moravian</i> off Traverse Lighthouse; 5.50, arrived at Quebec.
						Mean time Passage from Liverpool to Quebec, 9d. 6h. 26m.

CHAPTER V.

Advantages of steamers on the Atlantic—Superior class of ships—
 Coast scenery going down Channel—Port of Queenstown—
 Scenery of North Channel—Mother Carey's chickens—Wild
 birds on coast of Newfoundland—Whales and dolphins—Safety
 and comfort of passengers—Good cheer on board—Reputed
 rocks and shoals—Errors of old charts—Sable Island—Icebergs
 near the Grand Bank—Area of Atlantic infested with bergs—
 Bad look-out kept on board some ships—Its fatal consequences.

SOME forty years ago a voyage across the Atlantic was, to landsmen at any rate, a serious undertaking; even in the celebrated New York liners—the finest ships on the ocean at that time—as they depended entirely upon the inconstant wind, there was no certainty of making a passage in any definite period. Steam-propelled ships have now, however, successfully overcome this uncertainty; and there are so many fine ships sailing weekly for America, that every traveller can have no difficulty in selecting one suitable to his taste. Some particular ships have undoubtedly established such good reputations for speed and comfortable accommodation, that they are generally preferred by

persons who can choose the time of their departure ; but it may be said truly that, by whichever line the traveller makes his voyage, he will have no reason to complain of want of attention to his comforts, or want of care for his safety. The admirers of coast scenery will find much to interest them on the first day of their voyage after going through the hurry and bustle of embarkation at Liverpool ; the views of the Welsh mountains, here shrouded by dark clouds, there illuminated by the rays of the declining sun, will leave lasting impressions on the memory ; and next morning, if the horizon be clear, the rocky cliffs of the shores of Wexford and Waterford will stand out in bold relief, tinged by the beams of the rising luminary. Probably long before noon the gallant ship, after passing through the narrow channel, guarded by a strong fort on each side, will reach the usual anchorage in the spacious land-locked harbour of Queenstown, to await the arrival of the mail bags brought from England, *viâ* Holyhead and Dublin.

Having received the mails about 4 P.M., she will proceed on her voyage, passing first the lofty headland of Kinsale, and then the Fastnet Rock and Lighthouse, where the Cunard liner *Arabia* so nearly came to grief a few years ago. Or, going through the North Channel—the route of the Allan steamers on their way to

Quebec—after passing the Isle of Man and Dundrum Bay, where the *Great Britain* ran on shore thirty years ago on her first voyage to America, travellers will find themselves literally surrounded by scenery of the grandest and most varied character; the most conspicuous objects being the promontories (or mulls) of Galloway and Cantire, and the isles of Ailsa and Islay, on the right; Fair Head, the Giant's Causeway, and Malin Head, on the left. Taking their departure from Tory Island on the north-west coast of Donegal, the Allan steamers shape their course for the Straits of Belle Isle, the narrow channel which separates the island of Newfoundland from the inhospitable shores of Labrador.

Once fairly embarked on the lonely ocean, the traveller will find little to interest him beyond the immediate precincts of the ship, except occasionally the sight of a vessel rarely within hail; sometimes not even one, day after day in succession, for it is a remarkable fact how few vessels are met, considering that hundreds are continually crossing the Atlantic in various directions.

Of animal life, too, above water, after leaving the Irish coast some few leagues behind, there is a great scarcity. Gulls and Mother Carey's Chickens (*Procellaria pelagica*) are almost the only birds met with.

The former follow the track of the ship perhaps for a day or two, allured by lots of nice pickings thrown overboard; but the latter—true ocean wanderers—continue the pursuit sometimes nearly halfway across the Atlantic. As the ship approaches the Western continent, some unfortunate land bird, driven off the coast by a storm, finds a temporary resting-place in the rigging, but probably departs even long before the land is visible. Crossing the banks of Newfoundland, gulls and other sea-birds again make their appearance, and off Cape Race, about sunrise, thousands—nay millions—of the long-tailed ducks (*Fuligula glacialis*) may be seen, either sleeping on the surface of the water (where they spend their nights a few miles from land), or just starting in vast flocks for the nearest bays and harbours, their usual feeding-grounds. One fine summer morning, soon after daybreak, the writer witnessed a dreadful scene of carnage from the bridge of the Cunard steamer *Asia*, off Cape Race, as she cut her way through a great flock of sleeping ducks, killing and scattering them with her paddles in all directions.

Still fewer are the denizens of the deep which make their appearance on a voyage across the Atlantic. A shoal of dolphins may occasionally be seen crossing ahead of the ship or plunging beneath her hull; and at rare intervals, the presence of a whale may be in-

icated by a spouting jet of vapour resembling an artificial fountain in mid-ocean.

Passengers by the Atlantic steamers will find every attention paid to their safety and comfort. Ample proofs have been given of the strength and stability of the ships, and of the skill of their commanders in successfully contending with the winds and waves of one of the stormiest oceans on the face of the globe; and the casualties have been so few, during a period of forty years, in proportion to the great number of voyages, that travellers need feel no apprehensions with regard to their safety. They will also find a bountiful supply of creature comforts provided for them, served by civil and obliging waiters, at such frequent intervals that eating and drinking appear to be the order of the day: breakfast at 8.30 A.M., luncheon at noon, dinner at 4, tea at 7, and supper at 10 P.M., are so well attended, that there is every reason to conclude the passengers fully enjoy the good things set before them. The sleeping berths are as comfortable and commodious as can possibly be expected, within the narrow limits of a ship, where every available inch of space is required to find room for 200 or 300 passengers.

It must not, however, be taken for granted that, even with good ships, skilful commanders, and all the advantages of steam navigation, a voyage across the

Atlantic is wholly free from danger. The commanders of the steamers, responsible for the lives of their passengers and the safety of their ships, have often great cause for anxiety, aware of dangers of which passengers are supposed to know nothing, and which, for their own comfort, it will be well if they do not care to know. Not many years ago there were supposed to be several rocks and shoals, as may be seen by consulting charts of comparatively recent date, in the direct course of vessels bound from Europe to America, but many of these have been proved to be mere myths by modern surveyors. For this service navigators are especially indebted to *Lieut. Berryman*, of the United States Navy, who ascertained that most of those rocks and shoals, which had been the cause of much dread and anxiety to seamen, did not exist in the positions indicated on the old charts, nor anywhere near those positions. In proof of this, the following striking instances may be mentioned: On the marked sites of the *Devil's Rock*, in lat. 46.35 and long. 13.7, of the *Three Chimneys* in lat. 47.54 and long. 29.40, and of the *Hernagault's Breakers* in lat. 41.2 and long. 49.23, *Lieut. Berryman* ascertained, by careful soundings, that the depths were 2,200, 1,900, and 4,580 fathoms respectively. Of the existence of the *Virgin Rocks*, near Cape Race, and the *St. George's* and *Nantucket*

shoals near Cape Cod, there is no doubt, but their position is so well known that they can always be avoided by competent navigators. *Sable Island*, also, from which a shoal runs out thirteen miles to the westward, lies in the direct track from Liverpool to New York, but its position is so well known that a wreck seldom occurs.¹

Although all the known rocks and shoals can with common prudence and care be easily avoided, there is one source of danger, lying at certain seasons in the path of the mariner, from which the stoutest ships, navigated by most competent officers, cannot always escape—the *Icebergs*—those pests of the Atlantic, which have probably been the cause of more losses than all the storms and tempests. Hundreds of vessels which have started under the most favourable conditions, from the ports of Europe and America, even in the finest season of the year, have never reached their destination; their loss has never been accounted for, and there is every reason to believe that they have been sunk by unexpectedly coming in contact with

¹ Before the establishment of the Relief Station in this island many disastrous wrecks occurred, often attended with great loss of life. It was on the shoals near this island that Sir Humphrey Gilbert, in 1583, lost two of his ships and nearly 100 men, on his voyage to take possession of the territory granted to him by Queen Elizabeth.

icebergs. These immense masses of solid ice, sometimes as much as a mile in length, and two or three hundred feet in height, are brought from the Arctic regions by the great Polar current along the eastern coast of Newfoundland towards the Great Bank, which they generally reach in March, but occasionally as early as January. If they pass clear of the Great Bank into the warm waters of the Gulf Stream, they are generally dissolved before the end of July; but if they happen to ground upon the Great Bank, in the cold waters of the Polar current, not before the end of August. In the early part of August 1850, the writer, on a voyage from Liverpool to Halifax, in the Cunard steamship *Asia*, passed close by a great berg which was apparently more than a mile in length, and 200 feet in height. The officers of the ship stated that they passed the same berg on their homeward voyage in July, in the same position, from which it is evident that it was aground on the edge of the Great Bank, and might possibly have remained there another month before it floated off into the warm waters of the Gulf Stream.

Icebergs are met with between the parallels of 41° and 49° , and the meridians of 43° and 53° —an area of more than 200,000 square miles—but they have occasionally been seen to the eastward as far as 40° , and to

the westward as 61° , west longitude. If the atmosphere within these limits were always clear, there would be no cause for fear, but, unfortunately, the Polar current and the Gulf Stream, which meet to the southward of Newfoundland, not only, by their counteracting forces, keep the bergs within the limits above indicated; but also, by their widely different temperatures, create fogs which envelope the bergs in impenetrable clouds, so that, unless the greatest vigilance is constantly exercised by navigators, in noting the changes of the temperature of the air and the water, the proximity of icebergs can seldom be ascertained. The neglect of these precautions has undoubtedly been the cause of many a melancholy disaster. Owing to this negligence the writer, many years ago, on his first voyage across the Atlantic in one of the Falmouth packets, had a narrow escape. On the eastern edge of the Grand Bank the packet, going at the rate of seven knots per hour with a fair wind, became suddenly enveloped in a thick cold fog, clearly indicating the proximity of ice. No attempts were made to ascertain the temperature of the water, no sails were taken in, in fact no precaution whatever was taken except the appointment of an extra look-out on the forecastle! At daybreak next morning, owing to a change of wind, the fog cleared off, revealing to the astonished view of all on

board the packet, a group of eight or ten icebergs immediately in the wake of the ship, through which she had just passed—thanks rather to good luck than good management—without a collision, which would inevitably have caused a total wreck. Is it surprising, therefore, that under similar circumstances so many ships are yearly lost in crossing the Atlantic, leaving no clue whatever to their unhappy fate?

CHAPTER VI.

Boundaries of Northern Atlantic—Nature of sea bottom ascertained by soundings made by naval officers—Great valleys of Atlantic—Submergence of Europe and North America—Various depths of the Atlantic—Uniformity of contour of the sea bottom—Grand Bank of Newfoundland—Earth and rocks transported by ice—Gradual rising of the Grand Bank—Rise of land near North Cape and Nova Zembla.—Grand Bank may become an island—Nature of sea bottom—Consists of rock, volcanic ashes, gravel, and ooze—Extent of sea bottom covered by each—Composition of ooze—Chiefly consists of exuvia of Foraminifera, etc.—Professor Huxley's views.

THE North Atlantic, altogether, is a vast basin about 3,000 miles in diameter; but the portion to which our remarks will be confined in the following pages, and which we have designated the *Northern Atlantic*, is bounded by the parallels of 35 and 75 north in one direction, and by the western nations of Europe and the United States and Canada on the other. Within those limits, on its eastern and western shores, are situated 'all the most important commercial ports of the world.' This great ocean—the sea of gloom of the old navigators—is not a mere waste of waters; on the

contrary, it will furnish the diligent observer with innumerable subjects worthy of the deepest and most interesting contemplation, to which we beg to call his attention, in the hope of inducing him to devote his leisure hours to the investigation of questions now forming topics of discussion amongst men of science in almost every civilised nation.

Very little was known of the foundation which underlies the waters of the Atlantic until a very recent period. Occasional soundings had been taken at various places, from which the depth of water and the nature of the bottom, in a limited sense, were ascertained. In one place it was shown that the bottom was *rocky*, at another *sandy*, and at a third *muddy*; but nothing was known of the existence of organic life at great depths, although Humboldt had, nearly half a century ago, surmised that it would be found in abundance and variety. Nothing has contributed more to the knowledge recently acquired of the bottom of the Atlantic than the soundings made by naval officers, in endeavouring to ascertain the most suitable routes for the *submarine Telegraph cables* which have since been laid between Europe and America. No less than four lines of soundings, at close intervals, were made across the ocean: (1) by Captain Sir Leopold McClintock, between the Orkneys and Labra-

dor, by the way of the Faroe Islands, Iceland, and Greenland: (2) by Lieutenant Berryman, of the United States Navy, between St. John's, Newfoundland, and Valentia: (3) by Captain Dayman, between Valentia and Trinity Bay, Newfoundland: and (4) by Lieutenant Johnson, between Brest and Boston, by the way of the Isle of St. Pierre, on the south coast of Newfoundland.

By means of the soundings, taken by the officers just mentioned, it has been proved that the bottom of the Atlantic, to the northward of the Azores, forms two great depressions or valleys, separated by a dividing range of submarine hills, commencing at Iceland and running southwards to the Azores. This range varies considerably in height between Iceland and the Azores, its lowest point being in longitude 30° , where it is crossed by the French cable. The mean depth of the eastern valley below the surface of the sea is about 12,000, and of the western 17,000 feet. Between the dividing range and the shores of the present continents, both in an eastern and a western direction, as the soundings show, there are considerable inequalities of depth, forming several smaller valleys, and presenting a surface outline similar to those lying between two great mountain ranges in Europe and America. We are told by

geologists that upon the clearest evidence¹ the present continents were once submerged, and that the present ocean beds then constituted continents. In the lapse of time, a similar revolution may again occur, when the bottom of the Atlantic, raised above sea level, will form a new continent, bounded on the east and west by oceans covering the submerged lands of Europe and North America, and traversed from north to south by a great dividing mountain range extending from the Arctic regions to the Equator. The volcanic hills of Iceland and the Azores—raised more than 20,000 feet above sea level—will be the most conspicuous portions of the range of mountains which will form the backbone of the new continent.

The soundings taken by the officers employed by the Telegraph Companies, and more recently by the *Challenger Expedition*, have not verified the opinions formerly held respecting the depths of the Atlantic; on the contrary, it has been proved that between Bermuda and the Grand Bank, where Maury marked 5,200 fathoms, the greatest depth is only 2,500 fathoms. In fact, there are few places where the depth exceeds 3,000, and only one—about 80 miles

¹ The occurrence of organic remains of a marine character at high elevations in the Alps, Pyrenees, and other lofty mountain ranges clearly proves that they were deposited in the ancient seas when those mountains were sunk far below their surface.

to the northward of St. Thomas's—where it reaches 3,875 fathoms, the greatest depth which has yet been found.

It might naturally be expected that, over such a great area as the bed of the northern Atlantic, the contour of the sea bottom would be very irregular; but, to the westward of the dividing range running from Iceland to the Azores, it has been found, by careful soundings, that great uniformity exists, especially on the parallel of 35° N., where it forms a nearly level submarine plain, 1,500 miles in width. A remarkable exception to this uniformity, however, is met with further to the north, where the *Grand Bank of Newfoundland*, lying between the parallels of 43° and 48° N. and the meridians of 47° and 55° W., rises abruptly from the depths of the ocean, and in some places nearly reaches the surface, the soundings being sometimes as low as 22, and seldom more than 75 fathoms. The great accumulation of materials forming the Grand Bank is evidently the result of the combined action of the Polar Current and the Gulf Stream, whose movements will be explained shortly. The materials constituting the great mass of the Grand Bank have been brought, upon bergs and field ice, from the Arctic regions by the Polar Current. The same process is still in progress, and the Bank is gradually increasing

in size, both laterally and vertically. Some idea may be formed of the great amount of materials brought by ice from the northern regions from observations made by experienced navigators. Captain Scoresby, a most trustworthy observer, on one of his voyages counted 500 bergs on the east coast of Greenland, between the parallels of 69° and 70° N., many of them loaded with beds of earth and rock of such thickness that he estimated their weight at 50,000 to 100,000 tons. These bergs were all drifting to the southward; some, probably, dissolved on their way, deposited '*moraines*' on the sea bottom; others, carried on by the Polar Current, probably reached the Grand Bank, and meeting the Gulf Stream running in a contrary direction, came to rest and deposited their freight of earth and rocks upon or near the Bank itself.

The immense accumulation of materials constituting the Grand Bank gradually increased by constant arrivals of fresh supplies from the north, will in the course of time reach the surface of the sea, and form a new island as large as Newfoundland, from which it will be separated by a narrow strait, through which the waters of the Polar Current will rush with great velocity. Should this rise be accelerated by the upward movement which is now in progress in

northern regions,¹ the appearance of a new island, close to the 'Terra Nova' of the navigators of the fifteenth century, may not be far distant. As it rises gradually above the surface, its inequalities will be levelled down by the abrading action of the breakers, and the rocks, now piled in heaps or scattered in all directions, will be enveloped in sand and mud, forming a soil adapted to the support of vegetable life. Looking still further ahead to the time when the lowest depths of the Atlantic have reached the surface, the

¹ Eminent geologists have satisfactorily proved that the North Cape, in 71° N. latitude, is rising at the rate of five feet in a century. A more striking example has recently been noted on the coast of Nova Zembla. In the year 1594, Barantz, the celebrated Dutch navigator, found a sandbank on the northern coast of that island with soundings of 18 fathoms. Upon the same spot, Captain Mack (a Norwegian), in 1871, found a group of small sandy islets with rocks and débris scattered over them, just such as would be deposited by floating ice passing over the sandbank. Dr. Peterman considers this account authentic, and concludes that there has been a rise of 100 feet in 300 years—the greatest rise recorded, except in some cases of small extent due to local volcanic action. But the observations of Commander Chimmo, R.N., bear still more strongly upon this point: 'Here (at Aillik) particularly, as well as along the whole coast, it was impossible not to observe the almost visible rising of the land, by the uniform beaches of boulders, sand, and shells left to view at twenty, thirty, and forty feet above the *now* sea level. This is also the case on the coast of Newfoundland.' As Aillik, on the north-east coast of Labrador, is only eight degrees to the northward of Cape Race, there is every reason to conclude that the Grand Bank is even now subject to the same upward movement.

Grand Bank will form a vast plateau, more than 200 miles in diameter, crowning the summits of a pile of mountains rising, on the east and south by a steep slope, to a height of 18,000 feet above the adjacent plains. If the Grand Bank had been situated a few degrees further to the southward, and beyond the cooling effects of the Polar Current, it would long ere this have formed the basis or nucleus of an archipelago of Coral islands; but the waters, though warmed in some degree by the Gulf Stream, are too cool for the Coral insect, which is not found in the Atlantic to the northward of Bermuda and the Azores.

Sable Island, the crest of a large bank to the westward of the Grand Bank, has already risen above the surface of the sea. It has evidently been formed by the action of the wind upon the sand, as the bank rose above the water. When the whole of the bank, which covers an area of 1,500 square miles, rises above the sea, it will form a large island, separated by a strait about 80 miles in width from the adjacent island, formed from the Grand Bank.

Until very recently, as before stated, little was known of the nature of the sea bottom except within a few miles of the shores of the continents forming the boundaries of the Atlantic. Navigators, who had occasionally taken deep soundings in the open ocean,

reported that at one spot it was rocky, at another sandy, and at a third muddy; but since the invention of more perfect apparatus—especially one by Lieut. Brooke, of the United States Navy—considerable quantities of the materials forming the sea bottom can be brought up, and, consequently, a tolerably accurate knowledge of their nature has been obtained on several lines of soundings, at intervals widely apart, across the Atlantic. It has been ascertained by careful soundings that the bed of the Atlantic is composed of four different kinds of material: (1), though rarely, of *solid rocks*; (2), of *volcanic ashes* or *cinders*; (3), of *gravel* consisting of angular, and occasionally rounded, fragments of quartz, felspar, and hornblende; and (4), of *ooze*, which, upon the most reliable evidence, constitutes by far the greatest proportion of the sea bottom, being found at all depths in every parallel of latitude from the Equator to the Arctic Circle. A rocky bottom is rarely found in the Atlantic, except in shallow water at no great distance from land. Commodore Dayman, however, found one in 550 fathoms, about 500 miles to the westward of Valentia, which was evidently the summit of a submarine rocky eminence, as a sounding taken close to it exceeded 1,000 fathoms.

The volcanic cinders and ashes, as might naturally

be expected, are mostly found at no great distance from Iceland and the Azores, which, from the earliest times down to the present day, have been the seat of active volcanoes. They are, however, occasionally found far from those active centres, being carried to a great height in the clouds of smoke and vapour emitted by volcanoes, and thence driven by strong winds to a great distance, and deposited in the ocean.¹ In 1856 Lieut. Berryman, U.S.N., found volcanic cinders or ashes in the shape of pumice and obsidian, crystals of hornblende, and other igneous products, scattered over the sea bottom, between 16° and 38° west longitude. Volcanic forces, it is believed, are still in energetic action in the vicinity of the Azores, the island of Sabrina having been raised in 1811 from a depth of 120 feet, when pumice was ejected in great quantities, which covered the ocean to a distance of 150 miles.

The occurrence of gravel on the bottom of the Atlantic, except in the vicinity of land, is very rare. Lieut. Berryman, however, found some coarse gravel in 50° W. longitude, composed of quartz, felspar, and hornblende, of which the greater portion was sharp and

¹ It is well known that the ashes of Mount Hecla have, in this manner, been carried by the winds more than 1,500 miles, and deposited far from the shore on the continents of Europe and Africa.

angular, mixed with some rounded pebbles. This gravel was probably derived from some submarine volcano of old date at no great distance. Extensive deposits of sand, which may be considered a finer kind of gravel, are of frequent occurrence, but in all cases not far from land. They cover large areas of the sea bottom in the vicinity of the Orkney, Faroe, Sable, and St. Pierre Islands, Greenland, and the coasts of France and the United States.

The deposit generally known by the name of *ooze* is found on the bottom of the Atlantic in every parallel between Europe and America. It is described as a peculiarly soft, mealy, sticky mud, which adheres to the sounding rod and line, even when rapidly raised through the water from a depth of nearly 3,000 fathoms. 'It constitutes a floor of down-like softness into which the sounding lead appears to sink several feet.' Specimens obtained by Commodore Dayman, from depths of 1,700 to 2,400 fathoms, were submitted to Professor Huxley, who found that, when dry, its colour was white, or reddish white, closely resembling very fine chalk, but not so white. Upon careful microscopic examination, the dried ooze is found to be an impalpable powder, consisting mostly of carbonate of lime. Professor Huxley ascertained that 90 per cent. of this substance by weight consisted of the minute animal organisms called

Foraminifera, provided with thick skeletons of carbonate of lime. He also found in the ooze a multitude of very curious rounded bodies, consisting apparently of a minute, clear centre surrounded by several concentric layers, resembling somewhat the single cells of the plant *Protococcus*, to which he gave the name of *Coccoliths*, as they were clearly not organic, being easily dissolved in dilute acids. The *Foraminifera* of the ooze all belong to one genus—*Globigerina*—and are found in all stages of growth, their sizes varying from $\frac{1}{1000}$ to $\frac{1}{60}$ of an inch in diameter. About 85 per cent. belong to one single species. About 5 per cent. of these calcareous organisms belong to other species of *Foraminifera*; and the remaining 10 per cent. of the ooze is partly composed of animal, and partly of vegetable organisms, provided with siliceous skeletons and envelopes. Among the latter a large and beautiful species of *Diatomaceæ*—*coscinodiscus*—occurs in great abundance, but frustules of ordinary *Diatomaceæ* are rare. Professor Huxley, for various reasons, concluded that these animals must have lived and died where they are found, though at the same time, he says, he could not conceive how animal life could 'exist under such conditions of light, temperature, and aeration, as must obtain at these depths.'

CHAPTER VII.

Animal life on the sea bottom—Professor Forbes' and Dr. Page's opinions thereon—Living star-fishes found at a great depth—Dr. Wallich's description of them—Exploration of sea bottom conducted by Dr. Carpenter and others—Variety of organisms dredged from great depths—New species found near British Islands—Several possess eyes—Globigerinæ the chief constituent of ooze—Opinions regarding Globigerinæ—Food of animals on the sea bottom—Resemblance of ooze to the old Chalk Formation—Sir C. Lyell's objections—Skeletons of sea shells—Whence derived—Analysis of sea water—Its solid constituents not the same in every sea.

ALTHOUGH Humboldt many years ago said 'that it was not known where life was most abundant—whether on the continents or in the unfathomed depths of the ocean'—it was, until very recently, generally believed by naturalists that animal life was confined to moderate depths. In 1854, the late Professor E. Forbes, a great authority in such matters, stated that, in his opinion, the 100-fathom line approached the zero of animal life, and that it could not possibly exist at a greater depth than 300 fathoms. Dr. Page also, in his advanced 'Text Book of Geology,' published in 1856,

stated that water at a depth of 1,000 feet being compressed $\frac{1}{340}$ of its bulk, 'neither animal nor vegetable life, as known to us, could possibly exist at great depths, the extreme depression of seas being thus like the extreme elevations of the land, barren and lifeless solitudes.' On the other hand, Ehrenberg and some other naturalists maintained that animal life was possible at great depths, and that the *Globigerinæ* of the ooze lived and died on the sea bottom. The question, however, was summarily decided in 1860 by a sounding taken by Sir Leopold McClintock in latitude $59^{\circ} 27' N.$ and longitude $26^{\circ} 41' W.$, or about half way between Cape Farewell and Iceland, when several living star-fishes were brought up from a depth of 1,260 fathoms. Dr. Wallich, the naturalist of the expedition, says: 'While the sounding apparatus succeeded only in bringing up from the depth of 1,260 fathoms a number of minute shell-covered creatures, so simply organised as to render them incapable of perceiving or escaping danger, thirteen *star-fishes*, ranging in diameter from two to five inches, came up convulsively embracing a portion of the sounding line which had been paid out in excess of the already ascertained depth and rested for a sufficient period at the bottom to admit of their attaching themselves to it.' The star-fishes lived about a quarter of an hour after they were brought to the surface. It is a

remarkable fact, too, as pointed out by Dr. Wallich, that 'whereas no vegetable structures have been found in a living state below the depth of 400 fathoms, owing, it is supposed, to the absence of light which is essential to the absorption of carbonic acid and the evolution of oxygen,' yet 'the absence of light does not involve the loss of colour or even its deterioration, the star-fishes obtained from a depth of 1,260 fathoms being as brilliantly coloured as if they had lived their lives in the temperate zone and the shallowest waters.' The arguments advanced by Dr. Wallich clearly prove that the star-fishes were taken from their native home, and were not drifted, but they are too lengthy to be enumerated here.

In the autumn of the same year (1860) a *Caryophyllia borealis*, an animal of lower organisation than the star-fish, was brought under notice by Mr. F. Jenkins, C.E., who, in repairing the cable between Sardinia and Bona, discovered a specimen firmly attached to a piece recovered from a depth of 1,200 fathoms.

In the course of the six or seven years following the announcement of these unexpected discoveries, the subject of animal life at great depths of the ocean was freely discussed by men of science; and the Government was at last induced to afford valuable aid by placing at the disposal of Dr. Carpenter, Professor Wyville

Thompson, and Mr. Gwyn Jeffreys, the steamers *Lightning*, in 1868, and the *Porcupine*, in 1869, for the purpose of making a scientific exploration of the deep sea. Supplied with dredging apparatus of the most approved construction, which often brought up as much as 160 lbs. of mud at one haul from a depth of 2,500 fathoms, vast additions were soon made to the few species hitherto brought up by the sounding apparatus. Without going into detail, it may be sufficient to state that, as the depth increased the temperature gradually fell, the conditions became more rigorous, and the character of animal life more Arctic, as had been long ago suggested by Humboldt. Thus, while over the warmer area examined the bottom was covered with a *globigerina* deposit; in the colder area *siliceous sponges*, *zoophytes*, *echinoderms*, *molluscs*, *annelids*, and *crustaceans* were found in great abundance. Professor W. Thompson says that living examples of all the five invertebrate sub-kingdoms were brought up from a depth of 2,435 fathoms off the Bay of Biscay in 1869. In the seas adjacent to the British Islands, 127 species of molluscs, not previously known there, and many of them altogether new, were discovered. It is a singular fact that several of these animals possess perfect eyes—for what purpose it is hard to imagine, considering the total absence of light at great depths—unless, as suggested

by Sir Charles Lyell, they had a phosphorescent *habitat*. Two instances, specially recorded by Mr. Gwyn Jeffreys, were met with at a depth of 1,230 fathoms off the coast of Ireland, viz. a *trochus minutissimus* with two conspicuous eyes, and a species of *ampelisca* (crustacea) with four eyes.

It has now been fully proved that a great and quite unexpected number of animal forms exist in what a short time ago were considered barren uninhabited depths, no less than 427 species of the various lower classes, from *Protozoa* up to *Anthropoda*, having been found at a depth below that which the late Professor E. Forbes considered the zero of animal life in the ocean.

There is some difference of opinion amongst scientific men regarding the *habitat* of the Globigerinæ which constitute such a large proportion (90 per cent.) of the ooze of the sea bed. Professor Wyville Thompson says they pass their whole lives in the upper stratum of the superficial water,¹ and only subside to the bottom when dead; but Dr. W. B. Carpenter, whilst admitting that they pass the earlier stages of their existence in the upper waters, maintains that on reaching adult age they sink to the bottom, in consequence of the increasing thickness of their shells, and propagate there, and that

¹ This opinion has recently been verified by observations made on board the *Challenger*.

the young rising to the surface in their turn sink to the bottom. In proof of this opinion he points to the existence of enormous multitudes of very young specimens immediately overlying the sea bottom. Some objections have been raised to the possibility of animals of such a low type as the Globigerinæ living at the sea bottom in consequence of the apparent absence of suitable food. Animals of the higher orders can live upon the Globigerinæ, but the question is, 'On what do the Globigerinæ feed?' Professor Wyville Thompson, in reply to this objection, suggests that as they belong to the sub-kingdom, the Protozoa, which possess no special organs of nutrition, but absorb nourishment through the whole surface of their jelly-like bodies, they are supported by organic matter diffused through the deep sea water which, it has been proved by analysis, exists in considerable quantities, being derived from the decomposition of vegetable substances supplied by rivers, the sea weeds which fringe every shore, and the vast marine meadows of the Sargasso Sea, which cover an area of three million square miles.

The other organic bodies found in the ooze consist chiefly of the silicious shells called *Poly-cystinix*, and the silicious skeletons of the plants called *Diatomaceæ*, with occasionally some spiculæ of *Sponges* intermixed. Professor Huxley describes also a mass of living gelatinous matter which he has named *Bathybius*, which contains numerous minute bodies, termed *Coccoliths* and

Coccospheres, whose true nature has not yet been determined. Similar bodies have been found fossil in chalk.

One of the most striking features of the deposit now forming on the bottom of the Atlantic is its great resemblance, both in material and embedded animal remains, to our own well-known Chalk Formation, which, as has been shown by Ehrenberg and other accurate observers, consists of the comminuted shells of foraminiferæ, infusoriæ, and the fossil remains of marine invertebrate animals. Dr. Carpenter, Professor Wyville Thompson, and Mr. Gwyn Jeffreys, whose judgment is entitled to much consideration, all agree that the mollusca, crustacea, and echinoderms, besides abundance of silicious sponges, found in the white mud of the sea-bottom, 'form a marine fauna bearing a striking resemblance in its general character to that of the ancient chalk;' but Sir Charles Lyell, in the last edition of his 'Student's Elements of Geology,' published shortly before his death, whilst admitting this resemblance, looking from a strictly paleontological point of view, says: 'It is a popular error to consider the sea bottom a geological continuity of the cretaceous period, and that we are still living in the cretaceous epoch, as no remains of organisms of a higher character such as *Belemnites*, *Ammonites*, *Baculites*, *Hamites*, *Turritites*, and other genera of *Cephalopods*, characteristic of

the chalk, have been met with in the abysses of the ocean—nor, descending still lower, not even such characteristic cretaceous fossils as *Inoceramus*, *Hippurites*, &c.?

It is but fair to add that, thirty years ago, before anything was known of the nature of the deep sea bottom, Professor Ansted, in describing the animal remains of the chalk, said ‘that the general condition of its fauna were such as to justify a comparison with the faunas of existing seas.’

All the materials which form the coverings and skeletons of sea shells, and the tissues of animal and vegetable substances, are derived from the land. Every shower of rain that falls upon the land percolates the rocky layers, and takes up a portion of the soluble saline substances contained in all strata, which are carried by rivers into the sea. Some idea may be formed of the vast amount of materials thus carried into the sea by all the rivers of the world, by taking as an instance one river only—the Thames—which Mr. Prestwich, the President of the Geological Society in 1871, estimated carries down 548,230 tons in a year, of which about two thirds consist of carbonate and sulphate of lime. *Chloride of sodium* (common salt) constitutes by far the largest proportion of substances dissolved in sea water. The other ingredients are chiefly salts of magnesia, potash, and lime. M. Reg-

naut, who made several analyses of sea water, gives the following as the mean result of his experiments:—

Water 96.470
Chloride of sodium 2.700
" magnesium360
" potassium070
Sulphate of lime140
" magnesia230
Carbonate of lime003
Bromide of magnesium002
Loss (including iodides, silica, &c.)025
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	100.000

From this analysis it will be seen that the solid constituents of sea water amount to 3.53 per cent., being equal to about half an ounce in one pound of water. Considering that the Northern Atlantic covers an area of five million square miles, with an average depth of more than 1,600 fathoms, there can be no difficulty in indicating the source from which the lime and silica, required in the structure of the skeletons and shells of the denizens of the ocean, are derived. It must be noted here, however, that the amount of solid constituents is not everywhere the same, the waters of the Baltic and Arctic seas being much fresher than those of warmer regions where, owing to heat and evaporation, an excess of salts is found; for instance in the Gulf Stream in the latitude of Bermuda the amount is four, and south of the Tropic of Cancer four and a half per cent.

CHAPTER VIII.

Currents of the ocean—Their courses from the Eastern Archipelago to the Cape of Good Hope, the Equator, and round Cape Horn—Causes of currents—Dr. Franklin's theory—Sir C. Lyell's views—The Gulf Stream—Its course through the Caribbean Sea and Straits of Florida to the Grand Bank—Its presence is indicated by its colour and temperature—It forks near the Grand Bank—One branch passes the Azores—Its velocity—Deposits on the shores of the Azores the products of Mexico and the West Indies—Rejoins the Equatorial Current—The Sargasso Sea—Was noticed by Columbus—Northern branch of Gulf Stream passes western shores of British Islands into the Arctic Sea—Products of West Indies deposited by Gulf Stream on the shores of Ireland, Hebrides, &c.—Its temperature from Straits of Florida to Bay of Biscay—Its beneficial influence upon the climates of British Islands, Norway, Lapland, &c.—The great Polar Current—Its course from Arctic regions to Grand Bank—Thence along coast of United States to Florida—Brings down icebergs from Arctic seas.

THE surface of the ocean is never at perfect rest; the slightest breeze sets it in motion; even in a dead calm huge undulations, caused by recent and, perhaps, far distant gales, rise and fall in regular succession, although not a ripple disturbs the surface. With all this restlessness, however, the water, though apparently in motion, remains stationary, except where the waves

are broken into masses of foam in shoal water, or near the shore. Independently of these local movements, there are, nevertheless, others upon a much grander scale constantly going on, though not likely to be noticed by travellers. These are the great currents circulating round the globe from east to west, and throwing off branches, both towards the north and south in the Indian, Atlantic, and Pacific Oceans. Taking our departure from the great Eastern Archipelago, we find a powerful current setting to the westward, which, on approaching the African coast, is deflected to the southward through the Mozambique Channel; doubling the Cape of Good Hope, it then runs to the northward as far as the Equator, where it suddenly bends to the westward, and continues its course in that direction across the Atlantic, until it approaches the great promontory of St. Roque on the South American continent. At this point it bifurcates, sending one of its branches to the north-westward into the Caribbean Sea, which issues again into the Atlantic through the Straits of Florida, under the name of the Gulf Stream;—the other to the south-west along the coast of South America to Cape Horn, and thence northerly towards the Galapagos Islands under the Equator, where, resuming its westerly course, it crosses the Pacific Ocean, and proceeds in that direction

until it reaches the Eastern Archipelago—the point from which we started—and completes its circulation round the globe. Various causes have been assigned for the existence of this great westerly current. Dr. Franklin, who first pointed out the correct position of the Gulf Stream, and its origin in the Equatorial Current, was of opinion that the latter (which was discovered by Sir Humphrey Gilbert in 1560) was due to the Trade Winds, which, blowing from the north-east and the south-east, caused a surface drift of tropical waters towards the Equator, and raised them to a head which forced them into the Caribbean Sea. It is generally admitted that the Trade Winds may produce such an effect to a certain extent, but a more energetic force is required to drive such a mass of water to the westward within the tropical zone. Such a force, it is agreed by eminent men of science, can only be found in the action of the earth's rotation on its axis, which Sir Charles Lyell, in his observations on ocean currents, explains, giving as an example the current flowing from the Cape of Good Hope, where the rotatory velocity of the earth's surface is about 800, towards the Gulf of Guinea, where it is 1,000 miles per hour. As the current advances gradually into the zone where the rotation is more rapid, its velocity does not increase fast enough to keep up with the full speed.

of the locality to which it is brought, and consequently lags or hangs back in a direction opposite to the earth's rotation, that is, from east to west; and thus a current which would have run simply towards the north is, by the effects of the earth's rotation, directed towards the west until it approaches the South American continent, where it bifurcates, sending one of its branches to the south-west along the coast towards Cape Horn, the other to the north-west into the Caribbean Sea, to issue again into the Atlantic, as already stated (p. 71), through the Straits of Florida, under the name of the 'Gulf Stream.'

The Equatorial Current, as already stated, flows with a velocity of 30 miles a day, from the Gulf of Guinea, in a north-westerly direction, until it reaches the Isle of St Paul, almost immediately under the Equator; at this point it begins to bifurcate, one portion bending quickly round to the southward, the other maintaining its original course to the north-westward until it reaches the longitude of the Windward Islands, where, influenced by the north-east Trade Winds, it trends to the westward and enters the Caribbean Sea. Passing from the Caribbean Sea through the channel of Yucatan—the narrow sea between Honduras and Jamaica—it enters the Gulf of Mexico, and, after completing its circuit, issues with

great velocity through the Straits of Florida into the Atlantic, under the name of the Gulf Stream. Proceeding northerly, the Gulf Stream meets off St. Augustine (Florida) another current, called the Great Polar Current, setting to the southward. This current, which will shortly be more particularly noticed, originating in the Arctic Seas, runs along the eastern coasts of Labrador, Newfoundland, Nova Scotia, and the United States, between the Gulf Stream and the land, and finally passes under the former into the Gulf of Mexico. The width of the Gulf Stream in the Straits of Florida is about 30 miles, its depth 325 fathoms, its velocity 4 miles per hour; but, after passing the Bahama Islands and emerging into the open sea, it spreads out to the eastward and proceeds to the northward with a gradually increasing width and decreasing velocity; off Charlestown, Cape Hatteras, and Sandy Hook, its width is 67, 117, and 127 miles respectively. Obstructed in its course to the north-east by the Nantucket and St. George's Shoals, in latitude 41° N., the Gulf Stream is deflected more to the eastward, until it reaches the Grand Bank of Newfoundland, in latitude 43° N.

The water of the Gulf Stream, along the coasts of the Southern States, can easily be recognised by its deep indigo-blue colour, due to its excessive saltness,

the result of evaporation in its passage through the tropical seas. Captain Maury says: 'The line of junction with the common sea water may be traced by the eye. Often one half of a vessel may be perceived floating in Gulf Stream water, while the other half is in common water.' By this means, it is said, seamen can form a good idea of their longitude in approaching the coasts of the United States. In the winter, also, the water of the Gulf Stream can be known by the vapour constantly rising from its surface, which is condensed and rendered distinctly visible in clear cold weather.

In the longitude of the southern end of the Grand Bank the Gulf Stream bifurcates, one branch running easterly in the direction of the Azores, the other north-easterly towards the British Islands. As the velocity of the current at this point does not exceed one mile per hour, having lost three fourths of its force since issuing out of the Straits of Florida, the time occupied in its course from the Straits to the Azores—a distance of 3,000 miles—is about 78 days. On its way through the Azores, this branch of the Gulf Stream frequently deposits on their shores fragments of bamboos and other trees, the growth of Mexico and the Antilles. Humboldt tells us 'that the corpses of men of an unknown race, with unusually broad faces [cast on shore on the Azores], contributed to the

discovery of America, by confirming Columbus in the belief of the existence, to the westward, of Asiatic countries and islands at no impassable distance.' Proceeding southerly from the Azores, past the Canaries and along the west coast of Africa, to the Cape Verde Islands, this branch of the Gulf Stream unites again with the great Equatorial Current, making, as estimated by Humboldt, one complete circuit in two years and ten months, the distance travelled being 3,800 leagues. This great circuit—more than 1,000 leagues in diameter—was styled by Humboldt the '*Great Atlantic Whirlpool*,' because it brought from all sources, more especially the Gulf of Mexico, great quantities of sea weed, which, owing to its circular motion, were whirled or drawn into that part of the ocean known by the name of the Sargasso Sea. This great accumulation of floating weeds extends, in a westerly direction, from the Canaries nearly to the meridian of the Windward Islands, and in a northerly direction from the 20th to the 30th parallels of north latitude. Nearly 400 years ago Columbus, on his first voyage of discovery, found 'this sea, as far as the eye could reach, covered with weeds;' 'a phenomenon,' as Washington Irving remarks, 'often observed in this part of the ocean, which has sometimes the appearance of a vast inundated meadow.'

The northern branch of the Gulf Stream, as it approaches the British Islands, again bifurcates; one branch running to the north-eastward, close to the western coasts of Ireland and Scotland, into the Arctic Ocean, between Spitzbergen and Norway; the other, called Rennell's Current, into the Bay of Biscay. The frequent occurrence of fruits and other products of the Antilles on the shores of Ireland, the Hebrides, Norway, and Nova Zembla clearly points out the course of the first branch around the British Islands into the Polar Sea. If stronger evidence were required of the existence of this current, it will be sufficient to state that the mainmast of the ship-of-war *Tilbury*, which was destroyed by fire on the coast of St. Domingo, was found stranded on the coast of Scotland.

The most important feature of the Gulf Stream is its high temperature. In the Straits of Florida the temperature of its surface water is 86° , off Cape Hatteras 78° , and in latitude $42\frac{1}{2}^{\circ}$ N. and longitude 60° W. (where it curves round to the eastward) 75° . At these and many other places, where observations have been made, the mean temperature has been found to be 9° higher than that of the ocean, due to latitude. Even in the Bay of Biscay, where the current is barely perceptible, at a distance of 4,000 miles from the Straits of Florida, its temperature is 5° above that of the

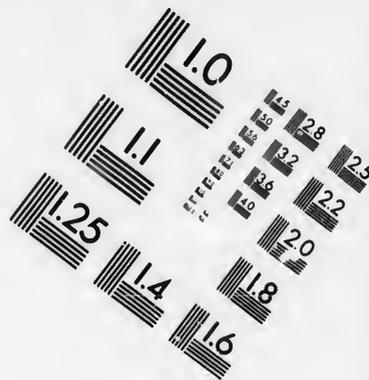
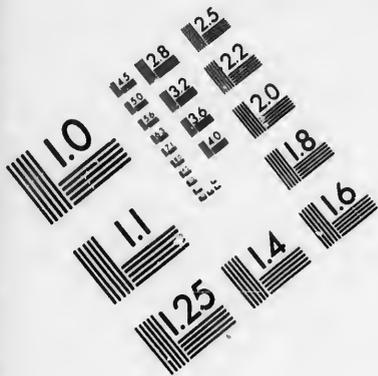
ocean. In the winter months the excess is still greater, being, according to Captain Maury, from 20° to 30° above that of the ocean. Considering the great proportion of the surface of the North Atlantic (estimated by Major Rennell at 700,000 square miles), covered by the warm waters of the Gulf Stream, there can be no doubt that western Europe—and more especially our own islands—feel the beneficial effects of the heat which they bring from the Tropics. As their temperature is 9° higher than that of the ocean, the evaporation proceeds rapidly, and the vapour, charged with the heat brought from the Gulf of Mexico, is carried by the prevailing south-west winds to the European coasts, where it is condensed, in the form either of fogs or rain, and distributed over the land.

In the process of condensation heat is given out, and though we may sometimes have reason to complain of excessive fogs and rain, we have great cause to be thankful for the mild climate we enjoy in consequence of its effects. These effects are strongly marked on the west coast of Ireland and Scotland, the mean temperature being 3° or 4° higher than in the North Sea on the other side of Great Britain. Even in the vigorous climates of Norway, Lapland, and Iceland, the severe cold is not only moderated by the warm waters of the Gulf Stream, but, by its means, a supply of drift wood is brought to

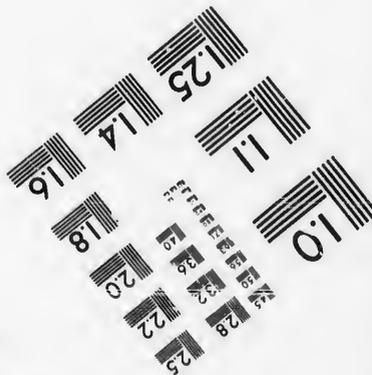
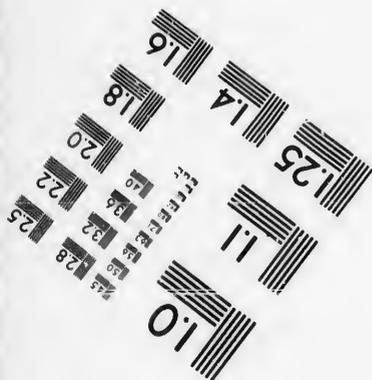
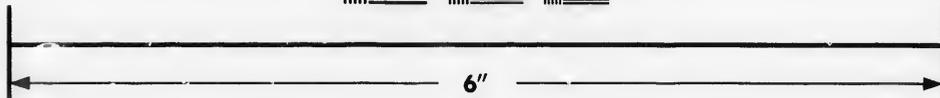
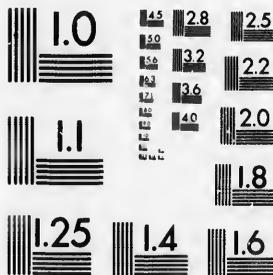
those desolate barren regions. Besides, its warm waters, in their wanderings around the shores of Spitzbergen and Nova Zembla, tend, in a great measure, to keep the seas comparatively free from ice, thereby enabling the fishermen to prosecute their calling in the higher latitudes where whales, seal, and other denizens of the cold regions abound. In proof of its beneficial influence, in ameliorating the climate of Western Europe, it need only be mentioned, that while on one side of the Atlantic the ports of Great Britain lying between the parallels of 50° and 58° N. are always open for navigation, those of Labrador between the same parallels on the other side are fast locked up by ice nearly six months in the year. This great difference, however, it must be observed, between the climates of those two regions, is not wholly due to the influence of the Gulf Stream, but, in a great measure, to the cooling effects of the waters of the *great Polar Current* on the western side of the Atlantic, to which we must now direct our attention.

It will be seen, by reference to the map, that the great Polar Current, which forms such an important feature in the geography of the Western Atlantic, is composed of two smaller currents descending from the Arctic Sea, one through Davis Straits, the other through the wide channel between Spitzbergen and the





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east coast of Greenland. From Cape Farewell, where the two currents unite, in its course to the southward the Polar Current throws off a branch in latitude 53° N. on the coast of Labrador, which passes through the Strait of Belleisle, and, after making the circuit of the Gulf of St. Lawrence, issues again into the ocean between the promontories of Cape North in the Island of Cape Breton and Cape Ray in Newfoundland. The main current runs along the eastern coast of Newfoundland as far as the Grand Bank, where it again divides, one portion continuing to proceed southerly *under* the Gulf Stream into the mid-ocean; the other bending sharply to the westward past Cape Race and maintaining that course until it reunites with the branch coming through the Strait of Belleisle and the Gulf of St. Lawrence in longitude 57° W. From this point the Polar Current sets to the south-west between Sable Island and the coast of Nova Scotia, bounded on one side by the seaboard of the United States, and on the other by the warm waters of the Gulf Stream; and, after crossing St George's and the Nantucket Shoals, continues on the same course as far as St. Augustine, where it plunges under the Gulf Stream into the Caribbean Sea. Its velocity from Cape Farewell to Cape Race is about half a mile per hour; off Sandy Hook it is about one mile per hour. Its surface width on the eastern side of

Newfoundland is about 300 miles, at Cape Cod 150, at Cape Hatteras 30, and finally, just before it plunges under the Gulf Stream near Cape Florida, only 10 miles. The course of this great current, from its sources in the Arctic Seas to the Grand Bank, are well defined by the streams of icebergs which it brings down during the winter and spring of every year; and from the Grand Bank to the Straits of Florida, by the low temperature of its water compared with that of the Gulf Stream flowing by its side in the opposite direction. Although the Polar Current, in its passage from the Arctic regions to the Strait of Florida, as will be pointed out in a future page, produces benefits of the greatest importance to the maritime nations engaged in the American Fisheries, it unfortunately also brings down the icebergs—those pests of the ocean—which, as has been pointed out (p. 45), constitute the greatest danger encountered in trans-Atlantic navigation.

CHAPTER IX.

The Gulf Stream the birthplace of icebergs—Professor Forbes on the formation of glaciers—Velocity of glaciers—Their great depth—Icebergs are detached from glaciers in Arctic seas—Remarks of Dr. Hayes and Dr. Kane on formation of icebergs—Icebergs formed in East Greenland—In Baffin's Bay and narrow seas—The Humboldt glacier—Immense berg in Baffin's Bay measured by Dr. Hayes—Field-ice—Brought down by the Polar current—Met with on Grand Bank—Its course from Arctic regions to Grand Bank—Severity of climate of eastern shores of America—Area of Atlantic infested by icebergs—Ice season of the Atlantic—Dr. Carpenter's theory of a general oceanic circulation—Cold the *primum mobile* of ocean currents—His objections to supposed influence of Gulf Stream on climate of Western Europe—His theory not universally accepted.

It may appear strange, but it is undoubtedly true, that the Gulf Stream is both the birthplace and the tomb of the icebergs brought down from the Arctic regions by the Polar Current. The fresh water, formed by their dissolution in the warm water of the Gulf Stream, being lighter than sea water, is licked up by southerly winds and carried to Greenland, where it is deposited in the form of snow. In the course of time this snow becomes part of a glacier, descends to the coast, is detached from the mass as a berg, and ulti-

mately borne back by the Polar Current to its native place—the Gulf Stream. Hence the dissolved berg is again carried in the shape of vapour to Greenland, again deposited on the surface of the glaciers moving seawards, and in the course of time launched as bergs on the Arctic seas, repeating the process for ever and ever. The formation of glaciers, from which the icebergs are derived, has been carefully studied and explained by several competent observers.

Professor Tyndal, as quoted by Dr. Hayes, says: 'The snow which falls upon high mountain eminences has often a temperature far below the freezing point of water. Such snow is dry, and if it always continued so the formation of a glacier from it would be impossible. The first action of the summer's sun is to raise the temperature of the superficial snow to 32° , and afterwards melt it. The water thus formed percolates through the colder mass underneath, and this I take to be the first active agency in expelling the air entangled in the snow. . . . Thus we see, though the sun cannot get directly at the deeper portions of the snow, by liquefying the upper layer he charges it with heat, and makes the water a messenger to the cold subjacent mass.' Professor Forbes says: 'The conversion of snow into ice is due to the effects of pressure upon the loose and porous structure of the

former; the very first effect is to annihilate the annual strata of the *Névé*,¹ and the most rapid glacification is effected by the kneading or working of the parts upon one another, by the differential motions which the semi-fluid law of glacier progression occasions, and which also necessarily takes place under intense pressure.' He concludes that the ice composing the lower portion of a glacier, thus being in a plastic or ductile condition not unlike flowing lava, its whole mass naturally follows the law of gravitation, and makes its way down from higher to lower regions, being accelerated by the hydrostatic pressure of the water contained in the crevices which intersect it in all directions. Briefly, in the words of Professor Forbes, 'a glacier is an imperfect fluid, or viscous body, which is urged down slopes of certain inclination by the natural pressure of its parts.'

As the whole of Greenland—a region truly continental in its dimensions—to the north of the seventy-fifth parallel is enveloped in ice, which is increasing from year to year, every fall of snow adding many inches, perhaps feet, to the mass, it is evident that the mountains would rapidly increase in height if their normal elevation were not regulated by the constant

¹ The great mass of snow accumulated from year to year upon the land.

flow of the glaciers towards the eastern and western coasts. As the glaciers, in their descent to the coast, naturally follow the courses of the valleys, their depth or thickness is increased by the snow drifted from the mountain ridges, and consequently we find the largest glaciers at the mouths of fiords or bays debouching on the sea coasts. The vertical thickness of these glaciers often exceeds 1,000 feet at their point of contact with the sea. Some bergs were seen aground in Baffin's Bay by Sir James Ross in a depth of 1,500 feet; the thickness, therefore, of the glaciers from which they were detached must have been at least 1,700 feet.

These enormous masses of ice descending, according to observations made by Dr. Hayes in Melville Bay, at a velocity of five to eight inches daily, impelled by the pressure from behind, on reaching the coast line are driven along the sea bottom until they reach a depth of water capable of floating them. At this point they often terminate in precipices, or what are generally called ice-walls, several hundred feet in height. It was formerly supposed that the great masses or bergs, when detached from the glaciers, fell into the sea, broken off by their own weight; but Dr. Kane, who had so many opportunities of making careful observations, says that the glacier being specifically lighter

than sea water, as soon as it attains a thickness sufficient to make it buoyant, throws off large masses, separated by their tendency to rise upwards, which float off in the form of bergs. This process is clearly explained by Dr. Hayes in his 'Land of Desolation': 'When fresh ice floats freely in sea water, there is one eighth of it above the surface to seven eighths below. If the glacier should project far enough out into the sea and deep water, to present more than seven eighths below to one eighth above, then the buoyancy of the water will lift the end of the ice stream until it attains its equilibrium. To do this of course a break must occur, as the ice will not bend. A crack beginning at the bottom is opened with a fearful crash. The crack widens, and when it is completed to the top a fragment is detached—a fragment perhaps two miles in width and many hundred feet in depth. This fragment is an iceberg. When the Esquimaux hear the cracking noise they say, "the glacier is going to *calve*." Thus an iceberg is born. The icebergs of the northern hemisphere have but one birthplace; they all come from Greenland, at least all of any magnitude.'

The glaciers of Melville Bay are mere pigmies in comparison with that giant of glaciers named by Dr. Kane *The Humboldt Glacier*. This immense mass of moving ice envelopes the entire shore line of Peabody

Bay, on the eastern side of Kennedy Channel, from Cape Agassiz to Cape Forbes, its width from north to south being about sixty miles. Dr. Kane, its discoverer, says its surface seems to follow that of the basis-country over which it flows, being undulating towards the horizon, and descending towards the sea at an angle of nine degrees. The rocky cliffs bounding it on either side are from 500 to 1,000 feet in height. The *ice-wall* or escarpment projecting into the water presents a perpendicular face varying from 300 to 500 feet in height from the water's edge. It seemed, in fact, to be a table-land, abutting with a clean precipice against the sea. It is continuous with the *mer de glace* of interior Greenland, and is the largest true glacier known to exist. Innumerable bergs, evidently newly separated from the Humboldt glacier, were observed in Peabody Bay, 'many of which were rectangular; some of them regular squares a quarter of a mile each way, others more than a mile long.'

Taking into consideration the great extent of the east and west coasts of Greenland—each more than 400 miles in length from north to south—occupied by glaciers, some idea may be formed of the immense number of bergs of all dimensions annually discharged into the sea; most of which are carried off during the open season by the Polar Currents into the Atlantic,

though many of those of large size¹ ground amongst the islands and shoals, and do not reach the warm waters of the Gulf Stream for years.

The ice brought down by the Polar Currents into the Atlantic is not entirely derived from glaciers. Every winter the whole of Baffin's Bay, with the straits and sounds connected with it, and the sea between Greenland and Spitzbergen, are frozen over with a sheet of ice varying from seven to fifteen feet in thickness. The margins of these great sheets of ice in contact with the shores, called the *ice-belt* by the Arctic navigators, loaded with rocks and débris which fall from the cliffs during the winter, are detached from the shores by the thaws of summer and tidal action, and carried off in the form of vast *ice-fields* to the southward by the Polar Currents. At starting, the surfaces of these fields of ice are tolerably level and smooth, but as they proceed they come into collision with other fields of ice during heavy gales, when large masses often forty or fifty feet in height are piled up in the greatest confusion, forming the *hummocks* which make

¹ A berg seen by Dr. Hayes in Baffin's Bay was carefully measured, and found 'to be one side—nearly straight, as if just broken off a glacier—6,500 feet in length. Its height, at one end, was 240—at the other, 190—and in the centre 160 feet.' Only one eighth being above water, the part submerged must have been 1,400 feet in depth.

sledge travelling so difficult and laborious. Most of these ice-fields are melted before they reach the east coast of Newfoundland, but many of great extent are sometimes carried even as far to the southward as the parallel of 43° N., in the track of vessels bound from Europe to America. On April 18, 1841, Captain Hoskins, of the steamship *Great Western*, fell in with a field of ice in lat. 43° N. and long. 49° W., more than sixty miles in length and forty in width; and some other ships, which about the same time fell in with similar ice-fields two degrees further to the southward, were completely stopped in their progress to the westward. During their detention the crews employed themselves in killing seals, of which there were great numbers on the ice.

As soon as the *field-ice*, or *pack* (as it is sometimes called), breaks up in the spring, it proceeds, accompanied by the bergs, to the southward, clearly indicating the courses of the great northern currents flowing from Baffin's Bay and East Greenland. The first, hugging the western shore of Davis Strait, touches Cape Chudleigh, and thence runs along the coasts of Labrador and Newfoundland, carrying field-ice and bergs, which, driven towards the shore by easterly winds, often blockade the coast of Newfoundland from Belle Isle to Cape Race. The more northerly harbours are often

closed for weeks; even St. John's, the most southerly port in the island, has often been shut up by field-ice in the month of June, and upon one occasion—July 3, 1863—was completely filled with field-ice. The branch thrown off from the main current through the Straits of Belle Isle (p. 80) sometimes carries small bergs up the Gulf of St. Lawrence as far as the eastern end of the Island of Anticosti. It is generally believed that the East Greenland current unites with that from Baffin's Bay, not far below Cape Farewell, but it is probable that a complete junction is not effected until they reach the Grand Bank, as we are told by Major Rennell that there are two distinct streams of ice below Cape Farewell, one along the coast of Newfoundland, the other at some distance to the eastward.

The harbours of Cape Breton and Nova Scotia are sometimes blocked up in early spring with field-ice, brought from the Gulf of St. Lawrence, which, though situated within the same degrees of latitude as France, is frozen over every winter to a depth of six to twelve feet. This ice, which generally breaks up in March, may be seen day after day in succession passing the north-east coast of Cape Breton, propelled by the Belle Isle current at a velocity of one to two miles an hour. Occasionally, after passing Scatari Island, it is driven upon the coast by south-east winds, and blocks up all

the harbours for weeks. A notable instance occurred in April 1745, when the expedition fitted out in the British Provinces of New England and New York for the reduction of Louisbourg, was detained four weeks in Canceau harbour, waiting the advent of a westerly wind to drive off the ice which protected that fortress from the assaults of the enemy.

Although the storms of the Atlantic, on the course of the Gulf Stream, are the cause of frequent disasters, it is evident, from the preceding facts, that the greatest danger is to be apprehended from the unwelcome presence of icebergs in a tract of ocean extending, as stated at p. 46, over an area comprised within the parallels of 41° and 49° , and the meridians 43° and 53° --an area quite as large as the whole of France. Nor is the danger confined within those limits, for bergs sometimes travel far beyond them; occasionally as far east as 40° W. long., and in one instance, in the opposite direction, a berg was seen by H. M. packet *Express*, July 7, 1836, about seventy miles south of Sable Island in long. 61° W. They have seldom been seen to the southward of the 41st parallel, though occasionally one of large dimensions, deeply submerged under the influence of that part of the Polar Current which runs under and across the Gulf Stream, is carried through the warm waters without being wholly

dissolved, below the usual limit. On April 27, 1829, Captain Couthony—the commander of one of the ‘New York Liners’—fell in with a berg, one fourth of a mile square and 90 feet in height, in lat. $36^{\circ} 10' N.$ and long. $39^{\circ} W.$, which had successfully run the gauntlet through no less than 500 miles of the warm waters of the Gulf Stream. Generally speaking, the ‘Ice Season’ begins in March and closes in July, but the bergs are often met with both before and after these dates. The earliest instance on record occurred on January 1, 1844, when the packet ship *Sully* fell in with a berg in lat. $45^{\circ} N.$ and long. $48^{\circ} W.$;—the latest in September, 1822, when Captain Couthony saw a berg in lat. $43^{\circ} 18' N.$ and long. $48^{\circ} 30' W.$, on the eastern edge of the Grand Bank.

It was stated at p. 72 that the great currents of the ocean were partly due to the earth’s rotation on its axis, and partly to the action of the Trade Winds generated by the extreme heat of the equatorial regions. Whilst admitting that a general oceanic circulation is due to differences of temperature, Dr. W. B. Carpenter contends that polar cold, rather than equatorial heat, is the *primum mobile* of this circulation. The following extracts from a paper published in the ‘Proceedings of the Royal Geographical Society’ of March 23, 1871, will, it is hoped, give the reader a

clear exposition of Dr. Carpenter's theory, which, it may be stated, is supported by many eminent men of science, though there are still a few who adhere to the old doctrine: —

‘ Suppose two basins of ocean-water, connected by a strait,¹ to be placed under such different climatic conditions that the surface of one is exposed to the heating influence of tropical sunshine, whilst the surface of the other is subjected to the extreme cold of the sunless polar winter. The effect of the surface *heat* upon the water of the tropical basin will be for the most part limited to its *uppermost stratum*, and may be here practically disregarded. But the effect of surface *cold* upon the water of the polar basin will be to reduce the temperature of its *whole mass* below the freezing-point of fresh water; the surface-stratum sinking, as it is cooled, in virtue of its diminished bulk and increased density, and being replaced by water not yet cooled to the same degree. This warmer water will not come up from below (as it must do when the entire surface of a pond or lake is acted on by atmospheric cold), but will be drawn into the basin from the surface of the surrounding area; and since that which is thus drawn

¹ Dr. Carpenter's argument is equally applicable where two basins are separated by a large body of intermediate water, the only difference being that in this case, in consequence of the large mass affected, the movement will be slower in each direction.

away must be supplied from a yet greater distance, the continual cooling of the surface-stratum in the polar basin will cause a 'set' of water towards it to be propagated backwards (so to speak) through the whole intervening ocean in communication with it, until it reaches the tropical area. But since the *weight* of the polar column undergoes no reduction with the lowering of its *level*, which results from the reduction of its temperature, the *influx* of surface water, which will take place from the tropical basin to restore that level, will impart additional weight to the polar column; and this will cause an *efflux* of its cold, deep water for the restoration of the equilibrium. So long, then, as the warm water which passes into the polar basin from the tropical is subjected to the cooling influence of its atmosphere, and is in its turn sent down to the bottom by the increase in its density, so will the continual reduction of level keep up an influx from the tropical basin; and so long as that influx is maintained, a corresponding efflux will take place from the bottom of the polar basin into the bottom of the equatorial. As the surface water of the latter is constantly drawn off into the former, the water which has entered it from below is gradually lifted up by what follows it, and thus at last comes to the surface, where it is in turn exposed to the heating influence of the tropical sun, and is

thence drawn off into the polar basin, to repeat the same circulation. If the temperature of these two basins were to be equalised, equilibrium would speedily be established through the whole system; but so long as one is heated (though only at the surface), and the other is cooled, so long will a circulation such as I have described be maintained.' In proof of this theory, Dr. Carpenter showed by experiment that, in a long trough of water heated at one end and cooled at the other, the heated water rose to the surface whilst the cold descended to the bottom; at the same time the heated water flowed along the surface towards the cold end, and the cold water along the bottom in the opposite direction, keeping up a continuous circulation; the one representing the heated surface water of the equatorial ocean, the other the cold water of the polar sea.

On referring to a former page (79) the reader will find that the amelioration of the climate of North-Western Europe is attributed wholly to the agency of the Gulf Stream. Dr. Carpenter disputes this old doctrine, and maintains that the greatest part of the warm water which flows along our coasts and passes between Iceland and Norway towards Spitzbergen, is quite independent of the agency of the Gulf Stream, being a result of the system of oceanic circulation prevailing over the whole globe as propounded in his theory. There is certainly

much to be said in favour of Dr. Carpenter's theory, but it must be added that it has not found universal acceptance, and that many men of note still adhere to the old doctrine and are loth to ignore the Gulf Stream which has long been supposed to exercise such a beneficial influence upon our climate.¹ If any of the readers of this little book should, from what has been said, be disposed to pursue this interesting subject, they will do well to peruse Dr. Carpenter's paper in the 'Proceedings of the Royal Geographical Society,' and the discussion which followed.

¹ One objection to this theory which, to the writer's knowledge, has not been noticed, is the fact that the main body of the Equatorial Current runs in a westerly direction through more than a dozen tortuous channels amongst the Windward Islands, encountering great obstruction in its passage into the Caribbean Sea, whilst there is nothing to prevent its heated waters flowing directly, by a much shorter route, across the Sargasso Sea, towards the cold Arctic regions; and, secondly, the fact that over a large area of the North Atlantic, between the coast of Portugal and the Azores, a surface current sets to the south towards the Cape Verd Islands, whereas, according to Dr. Carpenter's theory, it ought to run in an exactly opposite direction. It may be asked, also, why the great Polar Current flows upon the surface, as well as the bottom, in its course from Cape Farewell across the Grand Bank, as far south as St. Augustine.

CHAPTER X.

Animal life in the ocean—Great value of the harvest of the sea—Ocean teems with animal life—Fish generally found in shallow water—Localities of best fisheries—The cod fishery—Enormous reproductive power of the cod—Its voracity—Its abundance in British seas—On the Scotch coasts—And near Iceland—Discovery of fishery on the Grand Bank—Most valuable fisheries in the Polar Current—French and United States cod fisheries—The shore fishery—Value of fish exported from British North America—Total value of fish taken in American waters—Men employed in cod fisheries.

As a meagre catalogue of the innumerable denizens of the deep would occupy scores of pages to no good purpose—at any rate not to the purpose of this little volume—our remarks will be devoted to a few of those which contribute most largely to the wealth of the maritime nations, and through them to the maintenance and comfort of the inhabitants of countries far distant from the shores of any ocean. The wealth of the ocean is incalculable, and, practically, illimitable. Unlike the land, there is no planting or sowing, but one continued harvest ready for reaping. Unlike the land, so far as the production of food is concerned,

its harvests are not gathered from its mere superficial area, but from depths varying from a few feet, along the shores of continents and islands, to hundreds of fathoms on the fishing banks, and even at far greater depths still on the whaling grounds of the northern seas. Owing to its fluidity and floating power, the water is capable of sustaining vast monsters like the whale, comparatively as much greater than the largest land animal as the *Great Eastern* steamship, which floats like a cork on its surface, is, in bulk and weight, greater than the most powerful locomotive which has yet been introduced upon our railways. The prolific ocean teems with animal life of every size, from the whale downwards to minute organisms which can scarcely be seen with the most powerful microscopes. The latter are so abundant near the surface, that when it is agitated by a ship cleaving through the waves she seems to be sailing in a sea of fire; or when boatmen raise their oars out of the water sheets of apparent flame drip from their blades at every stroke. This luminosity of the water, it is now well known, is due to the presence of myriads of marine organisms, chiefly gelatinous worms, minute crustacea, and other phosphorescent animals which abound in every zone from the Equator to the Polar Seas.

Although marine animals of one kind or other abound in every sea, those most useful to man are,

with the exception of the whale and seal, generally found in comparatively shallow water, either on sandbanks or near the shore, where they can obtain suitable food in greater variety and abundance than in deep water. Hence we find that all the most valuable fisheries are situated not far from the shore, in shallow seas, or on the great banks in the ocean. As it would be an endless task to give even the briefest description of all the kinds of fish obtained from those sources, our remarks will be confined to those most useful to man, which, it is hoped, will be sufficient to enable the reader to form some idea of the great wealth floating in the waters of the Northern Atlantic. The cod, herring, mackerel, whale, and seal fisheries—all those comprised within our limits—are situated to the northward of the fortieth parallel, either in the cold waters of the Arctic regions and the Polar Current, or of the shallow seas surrounding the British Islands.

The common *Cod* (*Morrhua vulgaris*), which has been aptly named the 'Nomad of the Ocean,' is found in all the northern seas except the Mediterranean, at various depths ranging from 10 to 250 fathoms. It is extremely voracious, preying greedily upon all the smaller fishes, and even upon its own young. Fortunately its reproductive powers are enormous, else it would soon be exterminated, as only a small proportion

of its ova—not more than five per cent., according to the estimates of practical men—comes to maturity. The cod commonly yields three million eggs, though specimens have been taken, it is reported, containing eight millions. Taking the average at only four millions, its fecundity is marvellous; nevertheless, in some localities the production has declined in consequence of being over-fished, in addition to the destruction of the ova and the young fish by their numerous enemies.¹ Even those which survive the dangers of their infancy are never safe, being constantly subject to the risk of being devoured by some more powerful enemy. The cod, however, in his turn, shows little mercy to the weaker animals he encounters in his wanderings. It is quite a common thing to catch a codfish with six or seven herrings in his stomach, not one of which has been there long enough to be digested. Such greedy fellows cannot complain if they themselves sometimes fall victims to the voracity of still more greedy neighbours. The writer witnessed a striking instance of this sharp practice on a voyage to America in a sailing ship many

¹ It was formerly believed that the roe of the cod was deposited among sand and gravel at the bottom of the sea, where, of course, it would be comparatively safe; but it has been ascertained at the Brighton Aquarium that it floats on the surface of the water during the whole period of its development, where it is consequently entirely exposed to the ravages of its numerous enemies.

years ago. Whilst fishing on the Grand Bank, in a calm, one of the sailors hooked an immense halibut, which it was evident would break the codline if it could not be secured before it was drawn out of the water. To prevent this mishap, another sailor stuck a boat-hook into its gills just as it reached the surface, when the halibut vomited a large codfish, and at the same time made a plunge which broke the codline and allowed him to escape. The disgorged codfish was brought on board and opened, when two large herrings were found in its stomach, upon which it had apparently just breakfasted before it was swallowed by the halibut.

Cod are very abundant in all the seas surrounding the British Islands, and on the coasts of France, Spain, and Norway. London derives its principal supply of fresh cod from the Dogger Bank and the prolific fishing grounds of the German Ocean. Bertram, in his 'Harvests of the Sea,' says that in 1861, 2,400,000 cod and ling (a variety of cod) were caught on the Scotch coasts alone, which, if they had been left in the water, would have killed more herrings—their chief article of food—than all the fishermen of Scotland together. The Rockall Shoals and the banks in the vicinity of the Faroe Islands have long been frequented by English fishermen, but these places have been over-fished and do not yield anything like the 'takes' of former years.

Iceland, which was discovered more than 800 years ago, was long the seat of an active cod-fishery, conducted chiefly by Englishmen, who enjoyed several privileges on account of their trade with that island in the reigns of Henry III. and Edward III. During the fourteenth and fifteenth centuries Europe obtained its sole supply of dried cod, commonly called stockfish, from Iceland. It is recorded that in 1518 there were no less than 360 English traders in the harbour of Hafna Fiord alone. The Iceland fishery is still very productive, and we are told by Bertram that, in 1863, 285 French vessels, measuring 22,000 tons, and manned by 4,000 seamen, left the ports of France in the spring for Iceland.

When Sebastian Cabot returned from his first voyage of discovery in 1497, and reported that the fish on the Grand Bank and round the shores of Newfoundland were so numerous that they actually impeded the progress of his ships through the water, the French, Spanish, and Portuguese fishermen abandoned Iceland and resorted in great numbers to the newly discovered fishing grounds, where they gathered rich harvests from the vast stores of fish which had been accumulating without molestation from man through innumerable ages. For many years after the discovery of the new fisheries the English, in consequence of the departure

of the foreigners, had the Iceland fisheries all to themselves, and made good use of their opportunity; but when they learnt that their old competitors were doing so much better on the new grounds, which, from their right of discovery, they justly considered belonged to their own nation, they not only embarked eagerly in this new enterprise, but soon secured the lion's share of the spoil, by taking possession of the whole island of Newfoundland, and by forming settlements in the best harbours. The French, by treaty, can fish on certain coasts of the island and dry their fish on the shore, but the Grand Bank, which is free to all nations, is the scene of their most active fishery. To carry on the Bank Fishery, however, they have to depend, in a great measure, upon obtaining supplies of bait—such as *capelin*, *squids*, and *sand eels*—from the British shore fishermen.

All the most valuable fishing grounds in American waters lie in the track of the great Polar Current, along the shores of Labrador, Newfoundland, Nova Scotia, and the United States; and in the branch which passes through the Straits of Belle Isle into the Gulf of St. Lawrence. The great shoals of herring and mackerel which at certain seasons frequent the Gulf afford much more substantial food to the hungry cod than the minute organisms (their chief support) brought by the Polar Current and the Gulf Stream;

consequently, at those seasons the cod desert the Banks in pursuit of their prey, returning when winter sets in and their supply of food begins to fail.

In 1865 the French had 530 vessels of 66,000 tons burden, manned by 11,000 seamen, engaged in the Bank Fishery.¹ The value of their 'catch' was estimated at 3,500,000 dollars. In the same year the fishermen of Massachusetts alone caught cod, chiefly on the Grand and Sable Banks, of the value of 2,750,000 dollars.

Cod are so abundant on the coasts of the British provinces in America, within a few miles of the shore, that it is not necessary to go so far as the Banks, though it must be observed that of late years they have embarked more largely than formerly in the fisheries on the Grand Bank. The 'Shore Fishery,' as it is called, was first commenced by the French when they took possession of Acadie (Nova Scotia) some 250 years ago; and the great fishing grounds off the coasts of Canada and Newfoundland cover nearly an area of 150,000 square miles, and furnish the most important item of exportation from those provinces. It is impossible to ascertain the exact value of the cod fishery,

¹ Everything is turned to account by the thrifty French fishermen. The *ova*, or cod eggs, which our fishermen throw away, are carefully preserved and pickled for ground bait for the sardines caught on the coast of Brittany.

as the official returns do not specify each kind of fish separately, but, considering that herring and mackerel are mostly consumed at home—only a small proportion being exported—it may be safely estimated at nine million dollars. The value of the fish of all kinds exported from the British provinces in 1871 were:—

From Nova Scotia	\$2,852,255
„ New Brunswick	374,379
„ Quebec	678,162
„ Ontario	89,479
„ Newfoundland	7,825,159
„ Prince Edward's Island	350,000
	<u>\$12,169,434</u>

According to an estimate made by Mr. J. B. Bourinot, of Ottawa—a gentleman well qualified to form a correct idea on all matters relating to the fisheries—recently published in the ‘Proceedings of the Royal Colonial Institute,’ the value of all the fish caught in British North American waters annually is twenty-seven million dollars. To make up this quantity he credits the British North American fishermen with sixteen, the United States with eight, and the French with three million dollars.

In a money point of view the fisheries are a source of great wealth to several countries; but when we are told that more than 75,000 men are employed in catching the fish, and some hundreds of ships, with

their crews, in carrying them to market, we cannot fail to appreciate their great value as training schools for seamen, whether for commercial or warlike purposes. The produce of the cod fisheries finds a ready market in France, Spain, Portugal, Italy, Brazil, Mexico, and other Roman Catholic countries, where it constitutes one of the chief articles of sustenance of their people. Dried cod is a favourite article of food amongst the negroes of the West India Islands, and is carried many hundreds of miles up the great rivers of Brazil, where it is eagerly purchased by the Indians dwelling in the heart of that extensive region.

CHAPTER XI.

The herring fishery—Localities of best fisheries in European and American waters—Fecundity of the herring—Buffon's calculation—Dutch establish first herring fishery—First fisheries on the coasts of England, France, and Scotland—Number of vessels formerly employed by the Dutch—Scotch fisheries now take the lead—Boats and men employed—Amount and value of catch—Pilchard fishery on Cornish coasts—Sprat and sardine fisheries on coast of Brittany—Fisheries on western side of the Atlantic—The best in the British waters—The mackerel fishery—Kinds of nets used—Consumed fresh in Europe—Cured in America—United States tonnage engaged in mackerel fishery—Value of catch—Other edible fish—Annual consumption of fish in London.

THE common *Herring* (*Clupea harengus*) is found in vast abundance on the European side of the Atlantic, in the German Ocean, on the coasts of Great Britain, France, Germany, and Norway. In American waters it is most abundant in the Gulf of St. Lawrence, the Bays of Newfoundland and Labrador, and on the coasts of Nova Scotia. It never ventures far from the shore,¹ which it visits for the purpose of depositing its spawn in warm

¹ The fact of herring having been found in the stomach of a cod on the Grand Bank, mentioned at page 101, does not quite agree with this statement.

shallow water, and then returns to deeper water in the same neighbourhood. Formerly, it was generally believed that the herring migrated, when it disappeared from our coasts, to the Arctic seas, where it found an ample supply of food in the swarms of minute crustacea which abound in those waters; but it is now well known that the herring is a very rare fish in the Arctic seas; whilst, on the other hand, it is taken at all seasons of the year in European waters. During the winter the herrings keep in deep water, but in the summer and autumn make for the shore in vast numbers to deposit their spawn in shallow water, covering the sea for miles 'with a silvery appearance, from the glittering of their brilliant scales.' On their way to the spawning grounds the herrings are followed by shoals of haddock, which devour millions of the quickening ova.¹ In deep waters they fall victims to the voracity of the cod and ling. Its fecundity, however, is so great—a fish of six or seven ounces weight containing 30,000 ova—that if its accumulation were not by these means checked, all the waters of the globe would not contain a few years' increase. The eminent

¹ It has lately been ascertained that the *whitebait*, which was formerly supposed to be a distinct species—*Clupea alba*—is the fry of the common herring. Vast numbers are taken in the Thames, and on the east coast, every summer, being held in great repute with London epicures.

naturalist, Buffon, estimated that one pair of herrings, left to breed and multiply undisturbed for a period of twenty years, would yield a fish bulk equal to that of the whole globe.

The early inhabitants of the countries near the German Ocean, who had no means of following the cod and haddock into the deep water, must have reaped a rich harvest from the shoals of herring when they arrived in the shallow water to deposit their spawn. Their arrival was undoubtedly looked forward to with great anxiety, and, occurring at well-known periods, must in the course of time have led to the establishment of a regular fishery. The Dutch seem to have been the first people who established a fishery in the deep waters of the German Ocean. They were the first, also, who discovered the art of curing the herring; and it is said that more than 900 years ago they were in the habit of purchasing green fish from the Scotch fishermen, carrying them to their own country to be cured, and then re-selling them to the Scotch, whereby they made a good profit.

In the reign of Henry I. a considerable fishery was carried on at Yarmouth, which then, as at the present day, took the lead of the other eastern English ports. Yarmouth paid the king a tax of 10,000 herrings yearly. In France the first notice of a herring fishery occurs in

1088, when the Duke of Normandy allowed a special fair to be held at Fecamp during the fishing season. During the Middle Ages, the fisheries on the Scotch and English coasts increased rapidly, and became of great national importance, affording lucrative employment to thousands of hardy fishermen, and proving a valuable nursery for training seamen for the rising mercantile marine. Nevertheless, the Dutch still maintained their supremacy in the German Ocean. Considering that in 1603 they sold herrings of the value of four millions sterling, and in 1618 had no less than 12,000 vessels employed in the fishery, it is no wonder that it became a common saying that 'Amsterdam was built on herring bones.'

For some time past, however, the Scotch herring fishery has taken the lead. The chief stations are situated on the eastern and northern coasts, extending from Berwick to the Hebrides.

The Scotch Fishery Board state in their Report that during the year 1875, 5,463 boats, manned by 33,000 men and boys, have been employed within those limits, and that they have landed a total 'catch' of 652,962 crans. If to these figures the probable catch on the west coast be added, the Board estimate that the entire yield over the Scotch seaboard was not less than 930,000 barrels, representing a market value of one

millions and a half sterling, and a numerical total of 700 millions of herrings. The great importance of the Scotch fishery will be duly appreciated when it is added that a capital of several millions sterling is invested in boats and nets, that 50,000 men and boys are employed at sea, and nearly as many men, women, and children on land, in this great national industry.

The common herrings are caught mostly by means of the drift-net, but another species, called the *Pilchard* (*Clupea pilchardus*), which is very abundant on the coast of Cornwall, is taken by means of the Seine net. In the year 1873, 31,800 hogsheads, of the average value of thirty-eight shillings each, were shipped from Cornwall, chiefly to Italian ports. In the same year more than 30,000 hogsheads of fresh pilchards were sold in the local markets.

Another small species of herring, called the *Sprat* (*Clupea sprattus*), of which vast quantities are taken in all the northern European Seas, at certain seasons afford a cheap item of food. In Great Britain they are mostly eaten fresh, but in France they are cured by packing with oil in small tin boxes, and sold under the well-known name of 'sardines.'¹ In 1873, 13,000 boats

¹ A similar fish, supposed to be a distinct species (*Clupea sardina*), is taken in great quantities in the Mediterranean, but it is probably only the common sprat of northern seas.

were engaged in the sprat fishery on the coast of Brittany. Sardines are shipped from France to all parts of the world, forming, it is estimated, an aggregate of ten million boxes. Young herrings and pilchards are also cured in the same way and sold under the same name. An establishment for making sardines has recently been formed on the Firth of Forth, where there is a good sprat fishery, which it is hoped will prove the pioneer of many other enterprises of the same kind at those places on the English coasts where sprats are so abundant that they are often used by farmers as a manure.

On the western side of the Atlantic, the best herring fisheries are found in the waters traversed by the cold Arctic currents, near the shores of Labrador, Newfoundland, New Brunswick, Prince Edward's Island, and Nova Scotia. In the last three localities, herring are taken at all seasons of the year except mid-winter, being most abundant in the early spring and late autumnal months; but on the coasts of Labrador and Western Newfoundland they are also taken in large quantities in the months of December and January, by fishing schooners owned chiefly in Nova Scotia. In the first instance the herring are salted in bulk in the holds of the schooners, and subsequently packed in barrels for home sale or exportation to the United States and the

West Indies. In the maritime provinces, a large proportion of the catch is consumed by the farming and fishing population, their chief articles of diet during a great part of the year being 'herring and potatoes.'

Mackerel (*Scomber scomber*) are found on the European coasts from the North Cape to the Straits of Gibraltar. It is a wandering fish, generally supposed to be migratory, but Bertram, a very good authority, asserts that it only moves from its feeding ground in deep water to its spawning ground near the shore, living in great colonies in the sea, analogous to great seats of population on land. They are found, however, in British waters at all seasons, but not in any considerable quantity until January or February. The mackerel is a very prolific fish, often yielding 500,000 ova, which it deposits in shallow water in May and June, when it approaches the shores in vast shoals. It is mostly taken by the *drift*¹ and *Seine*² nets, but occasionally by hook and line. It is a voracious fish, feeding upon

¹ The *drift* net is about twenty feet in depth, and often a mile in length. It is set at nightfall, one end being suspended to a rope attached to a buoy, and at the other to a fishing boat. In the morning the two ends of the net are hauled together, inclosing large quantities of mackerel, which are secured by the fishermen.

² The *Seine* net, which is often also of great length, is attached at one end to the shore; the net, being put on board a large boat, is carried round the shoal of fish and hauled to the shore, by which means sometimes from 800 to 1,000 barrels of fish are taken at one draught.

the fry of larger fishes, and will greedily swallow any kind of bait, often even being taken with a piece of red rag. No reliable accounts can be obtained of the value of the mackerel 'catch,' as the fish, on being landed from the boats, are immediately despatched by rail to all parts of England and eaten fresh.

In American waters, on the contrary, where the mackerel fishery is carried on upon a large scale, all the fish, except in the vicinity of large towns, are pickled and packed in barrels of 200 lbs. each for exportation to the West Indies and South America, or retained for consumption in the Inland States of the Union. The mackerel is found on all the American coasts from the Chesapeake to the Straits of Belle Isle, but in the greatest abundance in the Gulf of St. Lawrence, especially in the waters surrounding Cape Breton and Prince Edward's Islands. It is generally believed in the British provinces that the mackerel are migratory, arriving from the south on the coasts of Nova Scotia and Cape Breton early in May on their way to the north, and returning in November. It is more probable that in May they come from deeper water to deposit their spawn, and in November in search of food. They are taken also on the coast of Cape Breton in July and August, but not in large numbers. Many years ago, St. Peter's Bay and the River inhabitants in Cape Breton and Fox

Island and Crown Harbour, in Nova Scotia, were the seats of the most productive 'shore fisheries' in North America. The mackerel arrived at those stations, generally in May and October, in such immense multitudes, that more than 1,000 barrels were often taken with the *Seine* net at a single draught. In the year 1825 it was estimated that 50,000 barrels, representing a numerical total of nine million fish, were taken between Fox Island and Crow Harbour, comprising a space of only twelve miles of coast. Of late years these shore fisheries have greatly fallen off, very few fish being now taken either at Fox Island or Crow Harbour, and a comparatively small number only in St. Peter's Bay.

The most valuable mackerel fishery on the western side of the Atlantic is now conducted by citizens of the United States, who have, by treaty, the right of fishing on the coasts of the British Provinces, in the Gulf of St. Lawrence, and the seaboard. These enterprising fishermen, who have to make a voyage of 500 to 600 miles, carry on a much more extensive business than the English colonists, who, in a great measure, reside on the shores within sight of the fishing grounds. In the beginning of November hundreds of fine fast-sailing schooners, each with a crew of thirty or forty hands, arrive on the coasts of Cape Breton and Prince

Edward's Islands, fully equipped with all needful appliances for the voyage, and often return in less than a month, with full cargoes of fish, to their own ports. As soon as the fish are discovered, a quantity of pickled herring, cut up in small pieces, is thrown overboard for the purpose of attracting the fish towards the vessel; and, though very few fish may perhaps be visible at first, the vessel is soon surrounded by myriads, which eagerly take the bait, consisting chiefly of pieces of fresh mackerel. Sometimes in the course of a single day more than 100 barrels are taken by the crew of one schooner. The fish, being split and cleaned, are salted down in bulk in the hold of the vessel, and afterwards assorted and packed in barrels. Each barrel contains 200 lbs. of mackerel, which brings from two to four pounds sterling, according to quality. About 9,000 tons of United States shipping are engaged in the mackerel fishery, chiefly on the coasts of the British Provinces. In 1865 the value of the mackerel taken by Massachusetts fishermen alone amounted to 1,886,837 dollars.

The value of *cured* cod and herring forms but a small proportion of the treasures obtained from the sea on the coasts of Europe and America. Every city, town, and village on the seaboard—and, since the general construction of railways, it may be added, in

the interior—is now regularly and abundantly supplied with a share of the rich harvests gathered by the hardy fishermen on the coasts of the maritime states. ‘London alone, according to the following table submitted by a member of Parliament some years ago, in moving for a Commission of Inquiry into the state of the Fisheries, consumes annually:—

Soles	100,000,000
Plaice	35,000,000
Oysters	500,000,000
Pewinkles	300,000,000
Cockles	70,000,000
Mussels	50,000,000
Codfish, fresh	500,000
„ dried	1,600,000
Herrings, fresh	4,000,000
„ dried	50,000,000
Salmon	203,000
Lobsters (daily)	10,000 ¹

In addition to the above, millions of haddock, whiting, flounders, turbot, halibut, skate, etc., and of crabs, prawns, shrimps, and sprats, legions innumerable, are brought to the London market annually.

¹ Bertram's *Harvests of the Sea*.

CHAPTER XII.

The whale fishery—First begun by Basque fishermen in the Bay of Biscay—Whale fisheries in Ballin's Bay, and near Spitzbergen—Arctic seas the favourite resort of the whales—Food of whales in the Atlantic—The common whale and other species—Food of whales in Arctic seas—Spouting of the whale—Chief fisheries at the present day—Steamers now used in whaling—Captain Markham's voyage to Arctic regions—Dangers of whale fishing—Value of United States fisheries—The seal fishery—Several species of seal—Food of the seal—Principal sealing grounds in northern seas—Steamers now used in sealing—Dangers of seal hunting—Newfoundland seal fishery the most productive—Seal hunting described—Great catch by steamers—Number killed in 1873—Value—Seals killed by polar bears—Great number of polar bears on coast of Greenland—The walrus—Its food—Closely allied to land mammalia—Its boldness and courage—Seldom found except in Arctic seas—Conclusion.

WHALE-FISHING—one of the most lucrative, but at the same time most dangerous, occupations—is said to have been first begun by Basque fishermen, who, in the pursuit of their vocation, frequently fell in with and captured whales in the Bay of Biscay, almost within sight of their own homes. Driven from their feeding grounds, where they had roamed undisturbed for ages, the whales gradually retired seawards,

eagerly followed as far as the Azores by the hardy Basques. De la Marre¹ says that the Basques even crossed the Atlantic in the pursuit of whales, and discovered the island of Cape Breton one hundred years before Columbus discovered the continent of America. Although the first colonists of Greenland had, in a great measure, maintained themselves chiefly by killing whales, no regular fishery was established in the northern seas until the celebrated navigators Davis, Hudson, and Baffin announced to the maritime nations the existence of whales in great abundance in the bays and straits which still bear their names. In 1553, long before the discoveries of those navigators, Sir Hugh Willoughby reported that whales were very numerous on the coast of Nova Zembla; but the discovery led to no practical results. The discovery of what is called the 'North Water,' in Baffin's Bay, by Davis, in 1585, and of Whale Sound, five degrees further north, by Baffin, in 1616, led to the establishment of extensive fisheries in both localities. Hudson's discoveries on the west coast of Spitzbergen, in 1607, soon attracted a great fleet of whalers to that inhospitable region, where, it is said, thousands of whales were killed between the years 1640 and 1650. Such wholesale slaughter soon exhausted this valuable

¹ In his *Traité de Police*.

fishing ground, and compelled the whalers to seek for 'new fields' along the borders of the Greenland ice, as far north as 79° of latitude. ✕

At the present day whales are found in every part of the Atlantic to the northward of the thirty-fourth parallel, and in every great bay or strait from the Gulf of St. Lawrence to Nova Zembla, except the shallow waters of the German Ocean. The Arctic seas, however, their favourite resort, being icebound in winter, they are compelled to come southward as far as the Azores, where, as Maury has told us, 'they feed upon the vast quantities of *Medusa* brought from the Gulf of Mexico, that gulf being the harvest-field and the Gulf Stream the gleaner which collects the fruitage planted there, and conveys it thousands of miles to the hungry whales.'

There are several species¹ of *Bale* in the Arctic

¹ The other species are: (1) the Razor-back (*B. physalis*), the largest of the tribe; (2) the Broad-nosed Whale (*B. musculus*), which frequents the coasts of Scotland and Norway, and feeds chiefly on herrings; (3) the Finner (*B. boops*), of no value, feeds on cod and other fish: 600 have been taken out of the stomach of one fish; (4) the Beaked Whale (*B. rostrata*), the smallest, being only 17 feet long, inhabits the Norwegian seas; (5) the Narwhal, or Unicorn of the Whales (*Monodon monoceros*); and (6) the Ca'ing, or Leading Whale (*Delphinus deductor*), or Bottle-nose. This is a dolphin, 24 feet in length, very abundant off the Orkney and Shetland islands, which sometimes appears in large herds in pursuit of herring. In the winter of 1810, 1,100 were captured in one fiord in Iceland.

seas, but the common, or Greenland whale (*Balæna mysticetus*)—the 'right' whale of the fishermen—is the one that supplies nine tenths of the oil and whalebone brought to our markets. The Greenland whale is generally found solitary or in pairs, but occasionally in great herds upon some favourite feeding ground. Its food consists chiefly of various species of *Medusa*, *Sepiæ*, *Actiniæ*, *Helices*, *Canceri*, *Acalephæ*, and other minute organisms which abound in the Arctic seas. On the eastern side of Greenland, in latitude 74° or 75°, whales are very numerous in that part of the sea known by the name of the 'Green Water,' which extends over an area of 20,000 square miles. The discoloration of the sea is entirely due to the presence, in vast numbers, of a small species of *Medusa*, varying from $\frac{1}{20}$ to $\frac{1}{30}$ of an inch in diameter. Captain Scoresby counted sixty-four of these small animals in a cubic inch of the olive-green water. The whale collects its food from the water 'as it swims rapidly below the surface with its jaws wide open, when a stream of water enters with large quantities of insects; the water escapes at the sides, but the food is entangled and sifted by the whalebone' (Scoresby). The whale is obliged to come to the surface to breathe at intervals of about half an hour, where it remains about two minutes. In the act of expiration, the air, when driven from the

lungs, is so highly charged with moisture that it produces the appearance of a jet or fountain of water, and it is commonly supposed that in the process of blowing, or spouting (as it is called), water is actually ejected from the blow-holes. This, however, is a popular error, as air and vapour only are expelled from the blow-holes in the act of breathing.

As the whale generally brings forth only one 'sucker' (as the young is called) at a time, the natural increase is not sufficient to keep up the stock in the localities frequented by the fishermen. Formerly whales were numerous in the Northern Atlantic, and in the gulfs and bays connected with it, but these regions have been long nearly exhausted, and the whalers are now obliged to go further to the northward. The Americans fish chiefly in the waters on the east coast of Greenland; the Danes, Swedes, and Norwegians in the seas between Iceland and Nova Zembla; and the British in Baffin's Bay and the narrow seas communicating with it, as far to the westward as Prince Regent's Inlet. Many years ago English whalers frequented the seas between Greenland and Spitzbergen, where the fish were so numerous that twenty-four were captured in a single month, in 1806, by one vessel—the *Resolution*, of Whitby—commanded by Captain Scoresby. The British whale fishery, which dates back so far as the year

1600, has greatly declined of late years; it is now carried on from the ports of Dundee and Peterhead only, which send out annually a fleet of ten steamers, averaging 350 tons burden, to Baffin's Bay, in the month of May. The cost of this fleet, fully equipped for the voyage, is estimated at 150,000*l.* to 200,000*l.* The 'catch,' depending so much on the condition of the ice and the market value of the products, under favourable circumstances amounts to 100,000*l.*¹ An average whale yields ten tons of oil, worth 40*l.* to 43*l.* per ton, and twelve hundredweight of whalebone, worth 450*l.* to 500*l.* per ton. Captain Markham, R.N., from whose recent work, called 'The Threshold of the Unknown Region,' these estimates are taken, went out some years ago in the whaling steamship *Arctic*, of 439 tons and 70 horse-power, for the express purpose of collecting information relative to the navigation of the Arctic seas. The voyage, which occupied only four months and a half from the date of sailing from Dundee, on May 3, to the return on September 19, proved highly prosperous, twenty-eight fish and two suckers having been captured, which yielded 265½ tons of oil, and 14¾ tons of whalebone, valued at 18,925*l.* A

¹ In 1860 the total value of the United States whale fishery in the Atlantic and Pacific Oceans (chiefly the latter) was 6,504,838 dollars.

perusal of Captain Markham's book will furnish the reader with graphic accounts of the difficulties and dangers of whale-fishing, of the various processes of preparing the products for market, and much interesting information relative to the navigation of the Arctic seas.

Since the introduction of steamships the business of whale-fishing has proved more successful, whilst at the same time the danger of being caught and crushed in the ice has been considerably diminished. Some idea of this danger, with sailing ships, may be formed when the reader is told that in 1871 thirty-two American whalers were so inextricably beset in the ice off the east coast of Greenland, that the crews, afraid to face an Arctic winter, abandoned their own vessels and travelled a great distance over the ice to some others which fortunately had not got entangled in the floe.

Several species of *seals* are found in the northern regions. Formerly they were very numerous on the coasts of the British Islands, and it is probable that seal hunting was a favourite occupation of the ancient Britons, who often caught them lying on the rocks basking in the sun. They are still found in unfrequented places on the coasts of Ireland and Scotland, and in most of the bays and narrow seas on both sides

of the Atlantic, but only in great profusion, at the present day, in all the northern regions between Hudson's Bay and Nova Zembla. Nearly all the products of this valuable source of marine industry are furnished by two species only¹—the Common Seal (*Phoca vitulina*), and the Greenland Seal (*P. Groenlandica*). The seal feeds chiefly upon fish, squids, cuttle-fish, shrimps, and the various small mollusca so abundant in the Arctic seas. Sea-birds also frequently fall victims to its voracity while sleeping comfortably on the surface of the water, little suspecting that the hungry seal is lurking in the depths beneath ready to pounce upon its prey.

Seal-hunting has been prosecuted with great energy and success by the northern European nations in the Arctic seas during the last two centuries. At the present time the fishing-grounds on the coasts of Spitzbergen, Iceland, and Nova Zembla are frequented by German, Danish, Swedish, and Norwegian seal-hunters, in vessels of small burden, ill adapted to withstand the pressure of the ice-floes, and consequently at great risks—risks which are seldom compensated by suc-

¹ Two other species are common in the northern seas: (1) the Great Seal (*P. barbata*), which is 8 or 10 feet in length; and (2) the Grey Seal (*Halichærus gryphus*), nearly as large, which are rather numerous on the coasts of Iceland and Norway.

cessful voyages, though now and then the hardy adventurers are amply remunerated by a large 'catch.' The British steamers now employed in the whale-fishery generally make a sealing voyage to the edge of the ice-pack in the vicinity of Jan Mayen's Island, about midway between Iceland and Spitzbergen, in the months of February and March, returning in time to fit out for the whale fishery in Baffin's Bay. In the spring of 1874 the Dundee whalers killed 46,252 seals near Jan Mayen's Island, which yielded 577 tons of oil, worth 35*l.* per ton, the skins being worth 4*s.* 6*d.* each.¹ The profit derived from seal-hunting in the above neighbourhood, before the introduction of steamers, was often a poor compensation for the dangers to which the adventurers were exposed. Sad records of frequent disasters abound in the ports to which the sealing vessels belonged in almost every European nation. On March 29, 1774, a fleet of vessels engaged in seal-hunting, about sixty miles to the eastward of Jan Mayen's Island, was overtaken by a dreadful storm whilst their boats, fully manned, were at some distance searching for seals on the ice. Several ships were lost, and nearly all the boats' crews, comprising two hundred British and four hundred foreign seamen, who were far

¹ The skins are tanned and used for making shoes, or dressed with the hair on for covering trunks.

from their ships, perished either on the ice or in their endeavours to reach their vessels.

The seal-fishery on the eastern coast of Newfoundland, which has been carried on for many years with great success, is much more productive than those above mentioned. Every spring hundreds of vessels, well adapted for the service, are fitted out by the merchants of St. John's and other ports of the island, which generally sail in the first week of March to meet the ice-fields coming down from Baffin's Bay and the east coast of Greenland. As the fields of ice are carried to the southward by the Polar Current, the seals, which have passed the winter on the coasts of Davis' Straits, Labrador, and Newfoundland, resort to the ice in vast numbers for the purpose of bringing forth their young.¹ Receiving constant accessions from the coasts, the ice-fields, before reaching the latitude of St. John's, are literally blackened for miles with seals, accompanied by their young—called 'white coats' by the hunters. Basking in the sun, with nothing in sight to alarm them, the mothers leave the blocks of ice, from time to time, to fish, whilst the lazy males sport about in the adjacent pools of open water. When a vessel has forced its way through an opening into the ice, and

¹ The female produces only a single young one.

the hunters have spread themselves over it in search of seals, the old ones keep a sharp look-out and give warning of the approach of danger; but, finding it impossible to protect their young, they shuffle along the ice and plunge into the water, leaving the helpless 'white coats' an easy prey to the clubs of the relentless hunters. The old seals are sometimes caught napping on the ice and killed in the same way, but generally they fall before the muskets of the hunters. As the spring advances and the ice begins to waste away, those which have had the good fortune to escape return towards their haunts in the far north, feeding on their way upon herring and other fish supposed to be migrating in the same direction.

Some few years ago, when sailing-vessels only were employed in the seal-fishery on the coasts of Newfoundland, a 'catch' of 7,000 or 8,000 seals, on a trip of four or five weeks, was considered a fair average, and amply rewarded all concerned in the adventure; but since steamships have been used, the 'catch' on a single trip has often exceeded 20,000 seals, and upon one occasion (the spring of 1875), the *Proteus*, owned by Messrs. J. and W. Stewart, of St. John's, actually brought in 42,000 seals on her first, and 7,400 on her second, trip. In the same year the *Greenland* brought in 25,000, the *Bear* 20,000, and the *Micmac* 27,000

seals. The profits of a sealing voyage are divided, according to an established scale, amongst the owners of the ship, the officers, and crew: the captain of the *Greenland*, on the above voyage, received 7,500 dollars for his share of the catch of 25,000. When the captain of a ship can earn 1,500*l.* sterling on a single voyage of three or four weeks, we cannot be surprised that there are always plenty, both of officers and men, ready to embark in such a dangerous occupation. The yearly catch of seals on the coasts of Newfoundland by sailing-vessels seldom exceeded 350,000; since steamers have been introduced to some extent, the catch has increased about 35 per cent., the number of seals killed in 1873 being 468,531, of the estimated value of 1,460,457 dollars. In addition to the above, about 25,000 are killed yearly in the Gulf of St. Lawrence by Canadian fishermen. No returns of the number killed on the coasts of Greenland, Jan Mayen's Island, Iceland, Spitzbergen, and Nova Zembla have been published, but there is every reason to conclude that the total catch in all the sealing grounds, including those taken by the Esquimaux (to whom the seal furnishes food, fuel, and clothing), exceeds one million annually. Man, however, is not the only destroyer of the poor seals: the polar bears (*Ursus maritimus*), which are very numerous in the Arctic

regions, feed chiefly upon seal's flesh, and capture their prey by lying in wait upon the ice near the holes where the seals come up to breathe or to bask in the sun. On the east coast of Greenland the bears swim off to the ice, as it floats past, to kill seals, and are sometimes carried away to sea by a sudden change of wind, where they miserably perish. Captain Scoresby says he has sometimes seen the bears in such numbers on the ice near the coast watching for seals that they might be compared to flocks of sheep on a common.

The walrus (*Trichecus rosmarus*), an animal closely allied to the seal, was found in great numbers in the Arctic seas when they were first visited by the whalers two or three centuries ago. This singular animal, nearly as large as an ox, has two strong canine tusks of pure ivory about twenty inches in length, which it uses to help itself in climbing on the ice. Its food is said to be chiefly seaweeds, but shrimps, crawfish, and even young seals are not refused when they come in its way. It blows like a whale, and, having both fore and hind feet, forms the connecting link between the mammalia of the land and the water. They are bold, fearless animals: 'if one is attacked the whole herd will rally round the boat and pierce its planks with their tusks' (Scoresby). In 1606 Captain Bennet killed 800

in less than six hours on Cherrie Island, and on the following voyage nearly 1,000 in seven hours. He says they attacked his boats' crews as they began to land on the island. They were formerly very numerous on the coasts of Newfoundland and the Gulf of St. Lawrence; Captain Strong, who went out in the *Marigold* from Falmouth to the Island of Ramea, on the south coast of Newfoundland, in 1593, to kill morse or sea-oxen (as they are often called), says: 'There is in this Isle so great abundance of the huge and mighty sea-oxen with great teeth, in the months of April, May, and June, that there have been 1,500 killed by one small bark in the year 1591.' The walrus is now rarely met with below the latitude of Cape Farewell, but large herds are still occasionally seen on the shores of Spitzbergen and the adjacent islands.

A few notes on the 'Wind and Weather' of the Northern Atlantic might have been added here; but, as the traveller will have ample opportunities of making his own observations on these phenomena, which exercise such a powerful influence upon the comforts of the voyage, it is not necessary to say more than that, in the summer season, he may, in all probability, pass over the whole 3,000 miles without encountering a breeze to disturb the unruffled waters; but woe betide him if he is obliged to face the furious gales and blinding

snowstorms of a mid-winter voyage on this, notoriously, the stormiest ocean on the surface of the globe.

In conclusion, the writer begs to observe that if any intelligent young travellers should be induced by a perusal of the preceding pages to direct their attention to the interesting subjects submitted to their notice, and to add the results of their studies to the great funds of information recently supplied by scientific observers in Europe and America, he will consider himself amply rewarded for the time occupied in collecting materials for this little work.

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