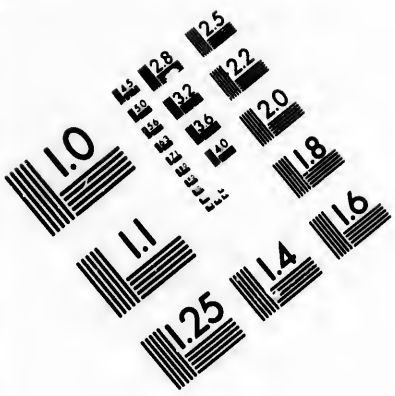

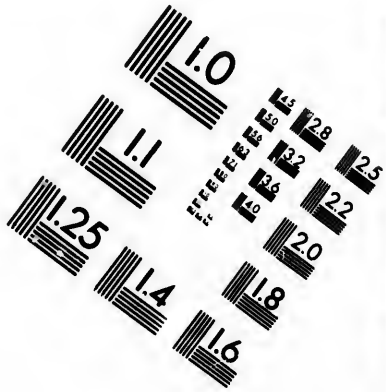

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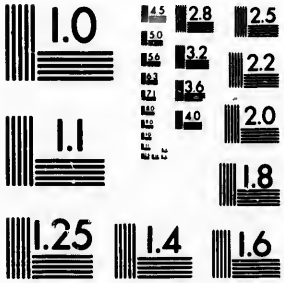

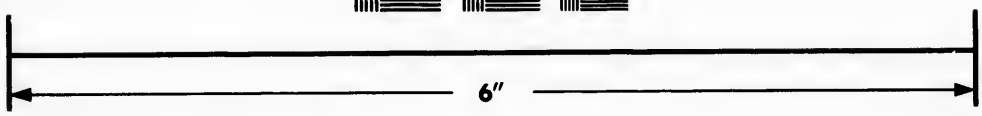

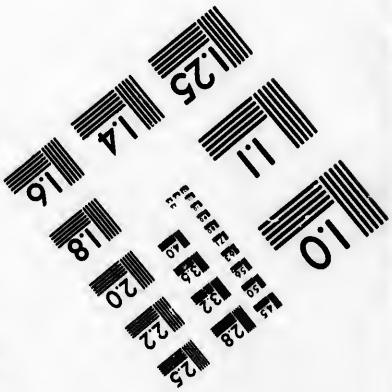

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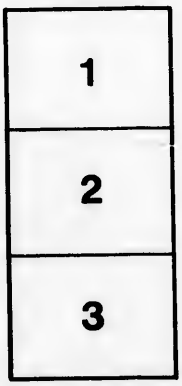

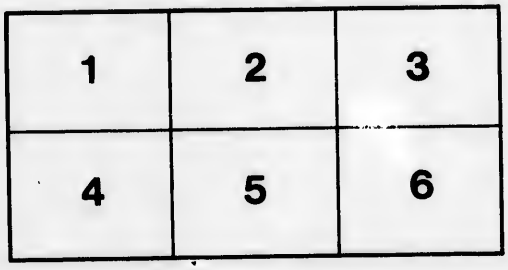

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No. 108.

U. S. HYDROGRAPHIC OFFICE.

SAILING DIRECTIONS

FOR

THE GREAT LAKES

AND

CONNECTING WATERS.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1896.

CONTENTS.

PREFACE.

The first edition, comprising four volumes, was prepared by Lieut. D. H. Mahan, United States Navy, assisted by Mr. James H. Reid, United States Navy, and Mr. R. C. Ray, United States Navy.

The present edition has been revised and corrected to date, for the latest information, by Mr. R. C. Ray, United States Navy. In this edition it has been thought best to present in one volume complete sailing directions for the Great Lakes, leaving out the several articles of information useful to mariners. As this work is necessarily incomplete, the Office must depend upon the cooperation of those who dwell near the lakes, as well as those who navigate them, for prompt information concerning any errors or omissions, or the discovery of new dangers, and such cooperation is earnestly requested.

The charts were prepared by Mr. G. W. Littlehales, in charge of the Division of Chart Construction of this Office, and printed under his direction.

It must be remembered that many changes take place in the buoys, lights, and other parts described in this volume; consequently the volume has to be corrected for the Notices to Mariners for the Great Lakes, which are published monthly by the Hydrographic Office, and which contain the latest information obtainable from all sources.

C. D. SIGSBEE,
Commander, United States Navy, Hydrographer.

UNITED STATES HYDROGRAPHIC OFFICE,
Washington, D. C., August 1, 1896.

NOTE.

The bearings, courses, and trend of the land are true, and given in points and to the nearest degree.

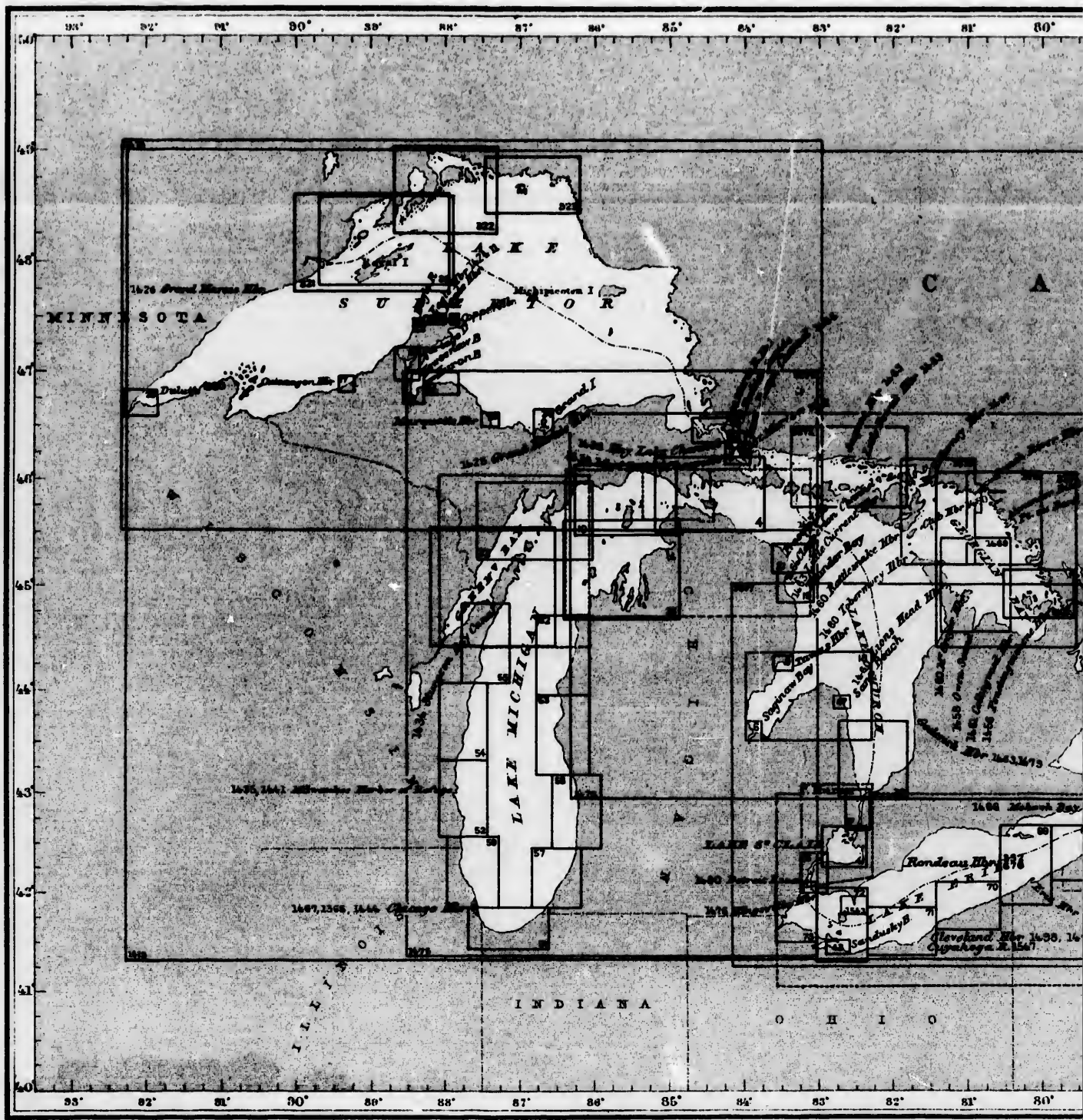
The directions of the winds, the points from which they blow; the directions of the currents, the points toward which they set.

Distances are expressed in nautical miles (the equivalent statute miles follow in parentheses).

It is well to remember that on Hydrographic Office charts for the Great Lakes bearings and courses are *true;* distances are given in *nautical* miles (the equivalent statute miles follow in parentheses).

On United States Engineer charts bearings and courses are *true;* distances are given in *statute* miles.

On British Admiralty charts bearings and courses are *magnetic;* distances are given in *nautical* miles.



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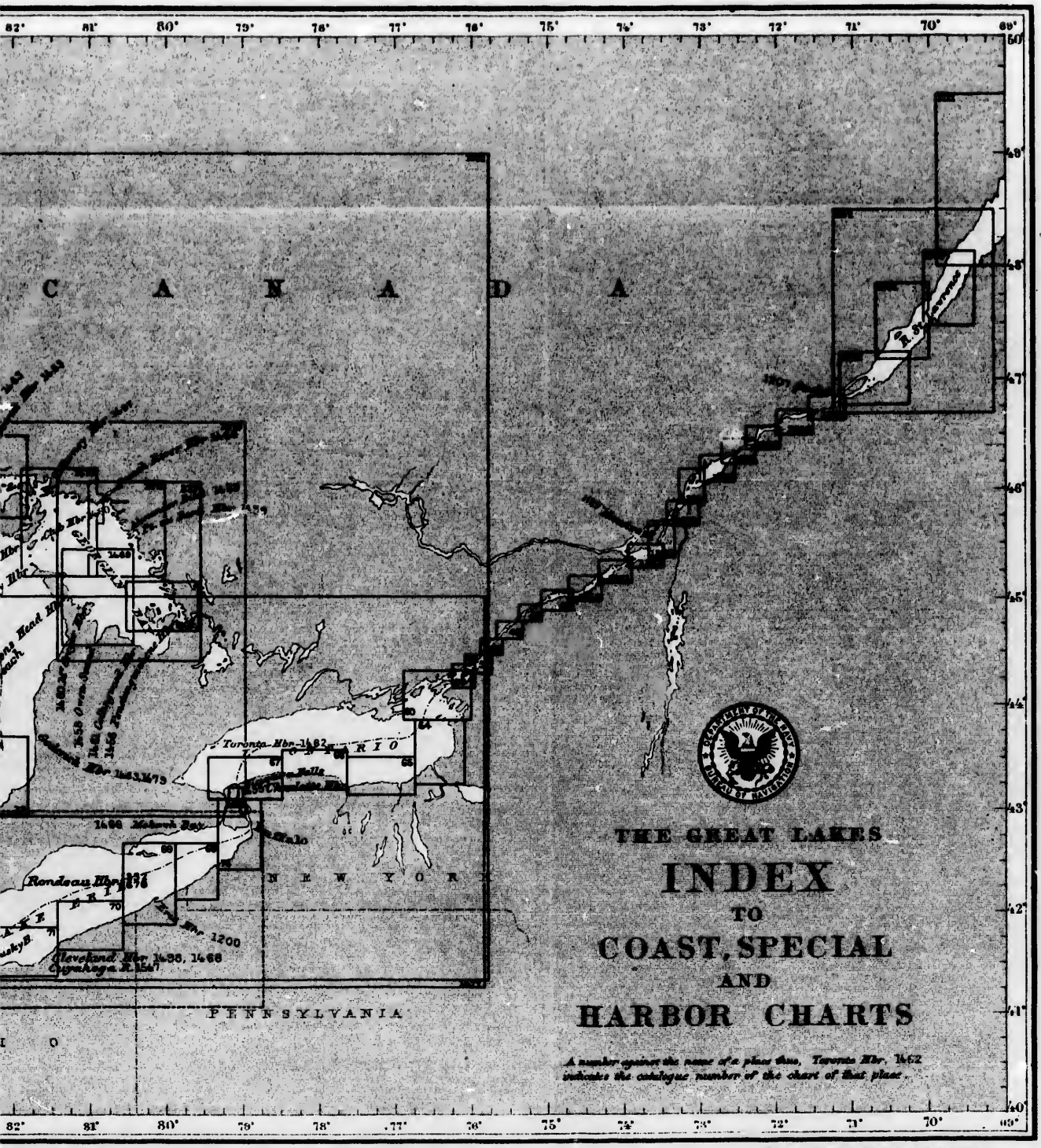
The charts referred to in blue are issued by the of the Chief of Engineers, War Department



referred to in blue are issued by the office
hief of Engineers, War Department.

The charts referred to in red are issued by the British Admiralty.

E

CHAPTER I.

CURRENTS.

EXTRACTS FROM THE "CURRENTS OF THE GREAT LAKES, AS DEDUCED FROM THE MOVEMENTS OF BOTTLE PAPERS DURING THE SEASONS OF 1892 AND 1893," BY MARK W. HARRINGTON, CHIEF OF THE WEATHER BUREAU.

The currents in the Great Lakes are grouped under three heads:

1. The main currents:

A general set of the water toward the outlet exists in each of the Great Lakes, forming a continuous current in that direction.

The outlet of lake Superior being on the southern side, this current hugs the southern shore. In lake Michigan it hugs the eastern shore, the readiest access to the outlet being on that side, owing to the position of the islands at its northern end. The same rule holds good in lake Huron as regards the western shore. In lakes Erie and Ontario this phenomenon is not so plainly marked.

2. Surface currents:

These are due to the prevailing winds which have always been recognized as influencing the motion of currents in large bodies of water.

3. Return currents:

The outlets of the lakes being small and insufficient for the escape of all the water banked up by the wind, return currents are inevitable.

The theory has often been propounded that many ocean currents arise from the above cause; the water driven before the wind making the current, and the piled-up water seeking an escape, forming the return current.

OTHER FEATURES.

Barometric changes, as well as other meteorological phenomena, may have an influence on the currents of the Great Lakes. A high pressure of the barometer lying over the southern end of lake Michigan, for instance, will lower the water at that point, causing a difference of surface level between the two ends of the lake and a resulting flow of water to the southward. Such conditions, however, could hardly endure for any great length of time.

There also occurs occasionally on the Great Lakes a phenomenon which is called a "seiche."

"These seiches[1] are uninodal, stationary vibrations of lake water. They appear in the form of waves, which alternately raise and depress the water of the lake on each side of the nodal line of the oscillation. * * *

"As the area of the Great Lakes is so large, the uninodal seiche would naturally be of infrequent occurrence, as a powerful blow must be struck on a comparatively large area to produce it.

"But this uninodal vibration does exist on the Great Lakes. Gen. C. B. Comstock states in the United States Chief of Engineer's Report for 1872, page 1040, that there is a wave constantly passing between Milwaukee and Grand Haven on lake Michigan. The tide gauges show that there are eleven great waves per day at each of these places, and the waves have a period of a trifle over two hours.

* * * * * * *

"A tracing of the tide gauge at Grand Haven, Mich., for the month of April, 1893, shows a two-hour-and-twelve-minute period with great exactness. Every day in the month this period can be distinguished, although on some days it is almost obliterated by minute seiches, or 'embroidery,' while a crest is often marked by another superposed seiche in stormy weather; but the succeeding crest appears after the two-hour period. * * *

"In his report for 1872, General Comstock cites some remarkable seiches observed by Major Wilson at Oswego. The first one occurred on June 13, 1872. Its period was from twenty to thirty minutes, and during its continuance a white squall passed to the north, over the lake, accompanied by a small waterspout. An employee of the survey, who happened to be out on the lake, reported that he heard strange noises, bubbles came to the top of the water, and the fish rose to the surface as if stunned. * * *

"On Friday morning, April 7, 1893, the port of Chicago was visited by a tidal wave, bore, a phenomenon called seiches, or, in plain terms, a sudden vertical motion of the water in the southern portion of lake Michigan, for it appears the wave swept over the beach at St. Joseph, Mich., 700 feet back from the high-water mark, the vertical rise at that point being given as 4 feet, a report which is duly authenticated from Chicago. At the latter port a recurring wave, which also characterized the St. Joseph phenomenon, caused great damage to the shipping and called forth the assistance of tugs and port officials to secure the disabled vessels broken adrift through the force of the tidal wave. * * *

"The following extract from a letter of H. C. Frankenfield, local forecast official at Chicago, will, perhaps, give a good idea of the weather conditions there on April 7, the date of the above-mentioned seiche:

"'High winds commenced about 2.30 p. m., April 6, blowing steadily from the SE. until 1.30 a. m., April 7, when they shifted to NNE., blow-

[1]Extracts from an article on "The Seiche in America," by E. A. Perkins. Published in the American Meteorological Journal, October, 1893.

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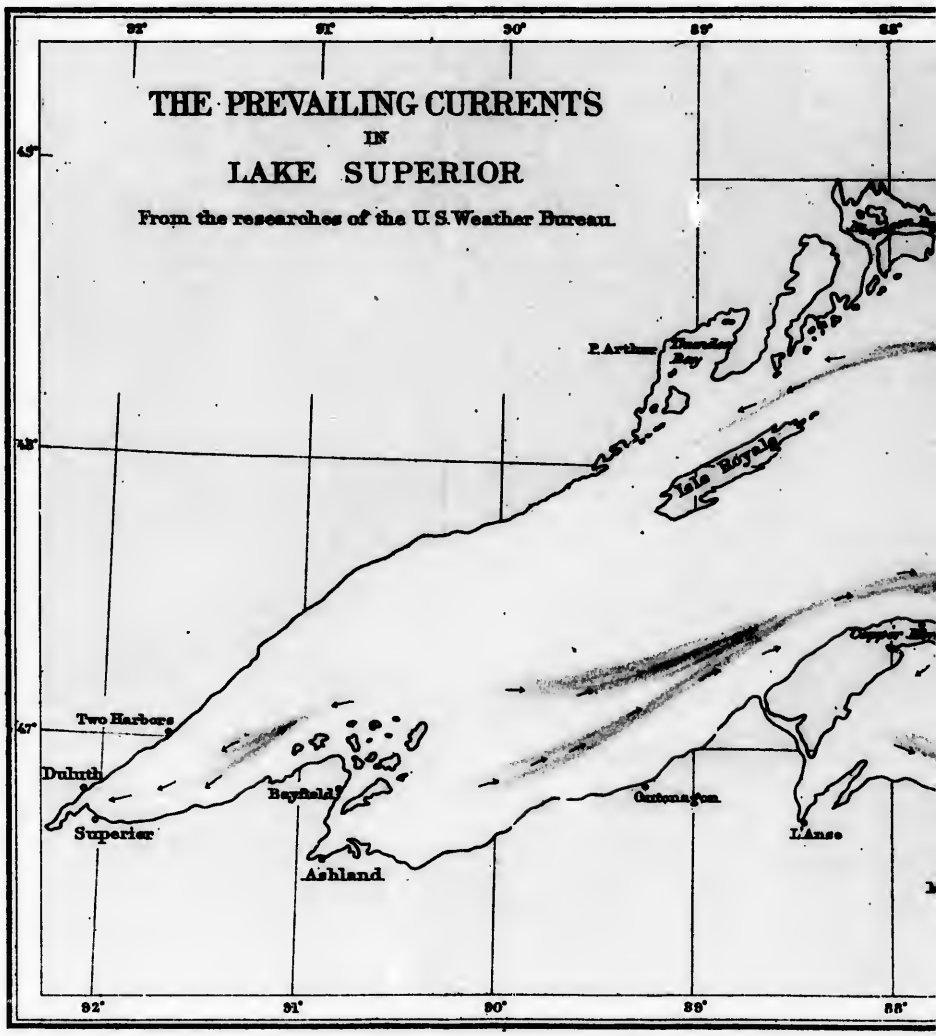
THE PREVAILING CURRENTS
IN
LAKE SUPERIOR
From the researches of the U.S. Weather Bureau.
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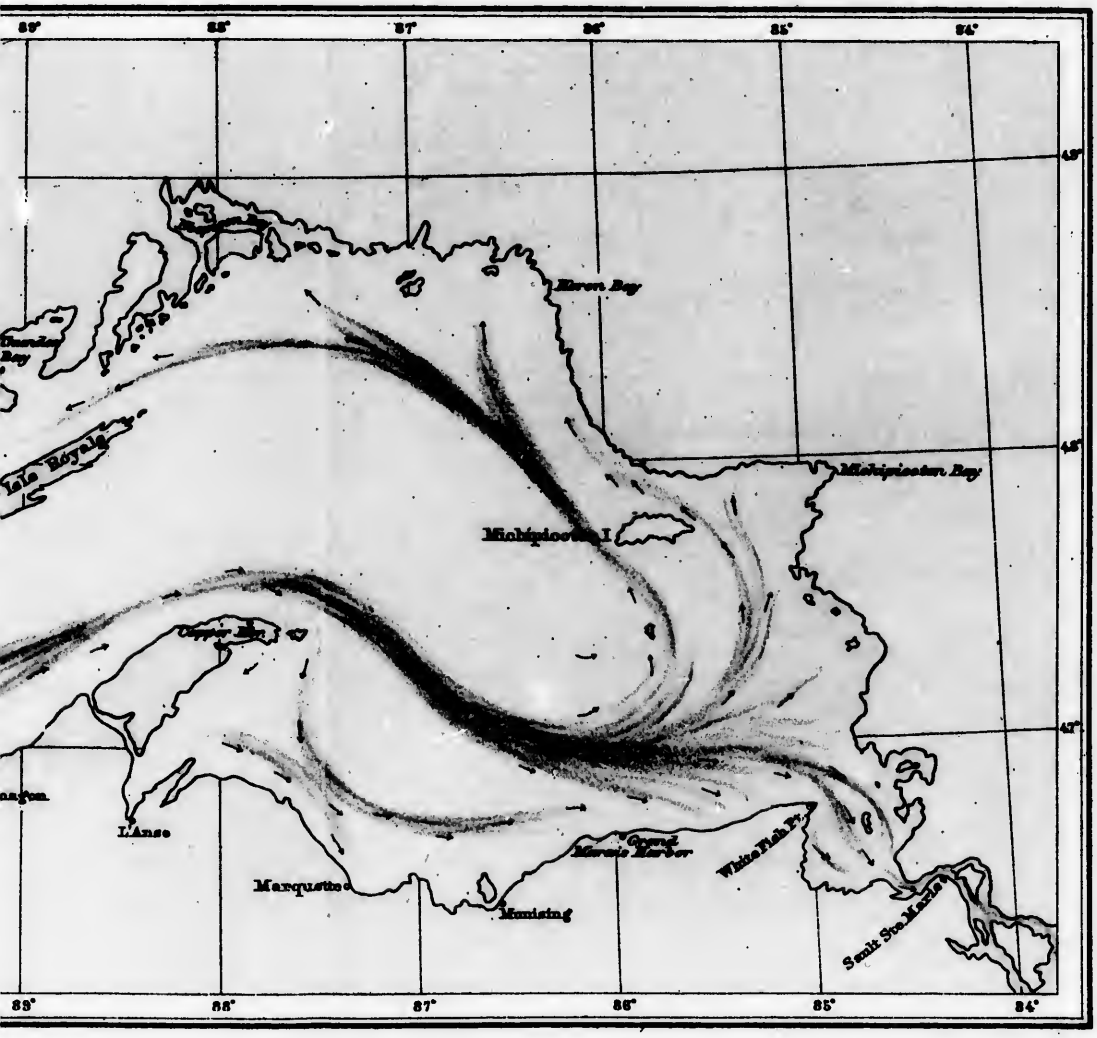
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Copper Bay
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Marquette
Munising
Grand Marais Harbor
White Fish Pt.
Sault Ste Marie
Lake Superior

ing from that quarter until 4 a. m., when they again went to SE. The velocity varied from 30 miles per hour at 2.30 p. m., April 6, to 43 miles per hour at 1.50 a. m., April 7.

"'The wave occurred between 1.30 and 1.45 a. m., April 7, and its height was from 4 to 6 feet. The damage done was principally to vessels anchored in the river. Several were torn from their moorings and carried toward the lake, causing numerous collisions with other vessels. Some were carried out into the lake. I do not think the wave was preceded by smaller ones, but, judging from the barometric oscillations after the principal wave, there must have been several smaller ones during the next two hours. These waves occur from time to time, and I have observed that they always occur at the time of a sudden and decided rise or fall in the barometer.' * * *

"I have received accounts of several minor seiches on the Great Lakes, but nothing that will bear comparison with the great seiche of April 7, 1893. This seems to be one of the largest oscillations ever observed on the lakes. It is to be regretted that synchronous observations of this phenomenon were not taken by tide gauges at different points on the shore.

"As to the forecasting of seiches, this can not be done with accuracy until we obtain further knowledge of the bore, and ascertain by numerous barographs the advance of sudden changes in the pressure of the atmosphere."

From the preceding remarks it will be seen that the steadiness and persistence of the lake currents have not yet been determined accurately. Their velocities have been found to vary in speed from 4 to 12 miles a day.

The prevalence of westerly and southwesterly winds favors the strength and persistence of these currents, and it must be remembered that when the motion of the surface water has been communicated to the strata below, a brief change of wind, while affecting the surface, is not so soon communicated to the underlying water.

CURRENTS IN LAKE SUPERIOR.

As has been stated, the main current of lake Superior is to the eastward, along the south shore. From the Apostle islands to the eastward of Keweenaw point this current has great width, and toward the eastern end of the lake spreads out in the shape of a fan, while a branch passing to the northward and westward reaches the extreme northern coast of the lake.

Another branch turns to the southward, around Keweenaw point, reaches the south coast, moves to the eastward, and again joins the main current east of Marquette, Mich. In Whitefish bay there are evidences of a whirl, and to the westward of the Apostle islands a distinct westerly set exists.

Along the NW. coast the current moves to the westward, turning, apparently, to the eastward near Two Harbors, Minn.

An interesting confirmation of the main current is found in the drift from wrecks. From the "Currents of the Great Lakes, as deduced from the movements of Bottle Papers during the seasons of 1892 and 1893," published by the Weather Bureau, it is learned that a considerable portion of oil jettisoned from the steamer *Northerner*, stranded on Keweenaw point in November, 1892, was recovered at Deer Park, between Grand Marais, Mich., and Whitefish point, on the south shore of the lake, distant over 200 miles. Many barrels of oil were chopped out of the ice by the life-saving crew and fishermen at Deer Park.

Isle Royale furnishes indications of a current from the NE. in the sand spits extending to the SW. This is very distinctly shown along several small islands on the south shore.

CURRENTS IN LAKE MICHIGAN.

A fresh wind of several days' duration is well known to be of importance to the generally shallow harbors of the lake. Such a wind has a well-recognized effect on the depth of water in the Chicago river.

As a result of experiments, it has been found that a main current exists in lake Michigan, setting down the west coast about 10 miles offshore, sweeping around the south end, and stretching to the northward close to the east coast. Hugging the east shore, the current sweeps through the narrow passage east of the Manitou islands, and thence by the Strait of Mackinac into lake Huron, forming a whirl around the Beaver island group on its way to this outlet.

This current is more clearly and strongly marked on the east shore than elsewhere, and it is to this that the freedom from extensive shoals and bars off the east coast is due, while broad shallows line the west coast.

Between the margin of the current and the west shore there are varying currents, sometimes to the northward and sometimes to the southward.

There is a whirl around Beaver island in a direction contrary to the hands of a watch.

The average speed of the current was found to be 4 to 4½ miles per day. Through Manitou passage the velocity was from 6½ to 10 miles per day.

Private observations, taken with great care, showed a current of from 36 to 96 miles per day (1½ to 4 miles per hour) to the northward off Manistee, Mich.

Some confirmation of these conclusions can be obtained from the disposition of sand spits, shoals, bars, etc., the piling up of sand against the breakwaters, and the directions of the rivers after entering the lake, the eastern ones trending to the northward and western ones to the southward.

In Green and Traverse bays the currents run up the different arms, but very little is known about them.

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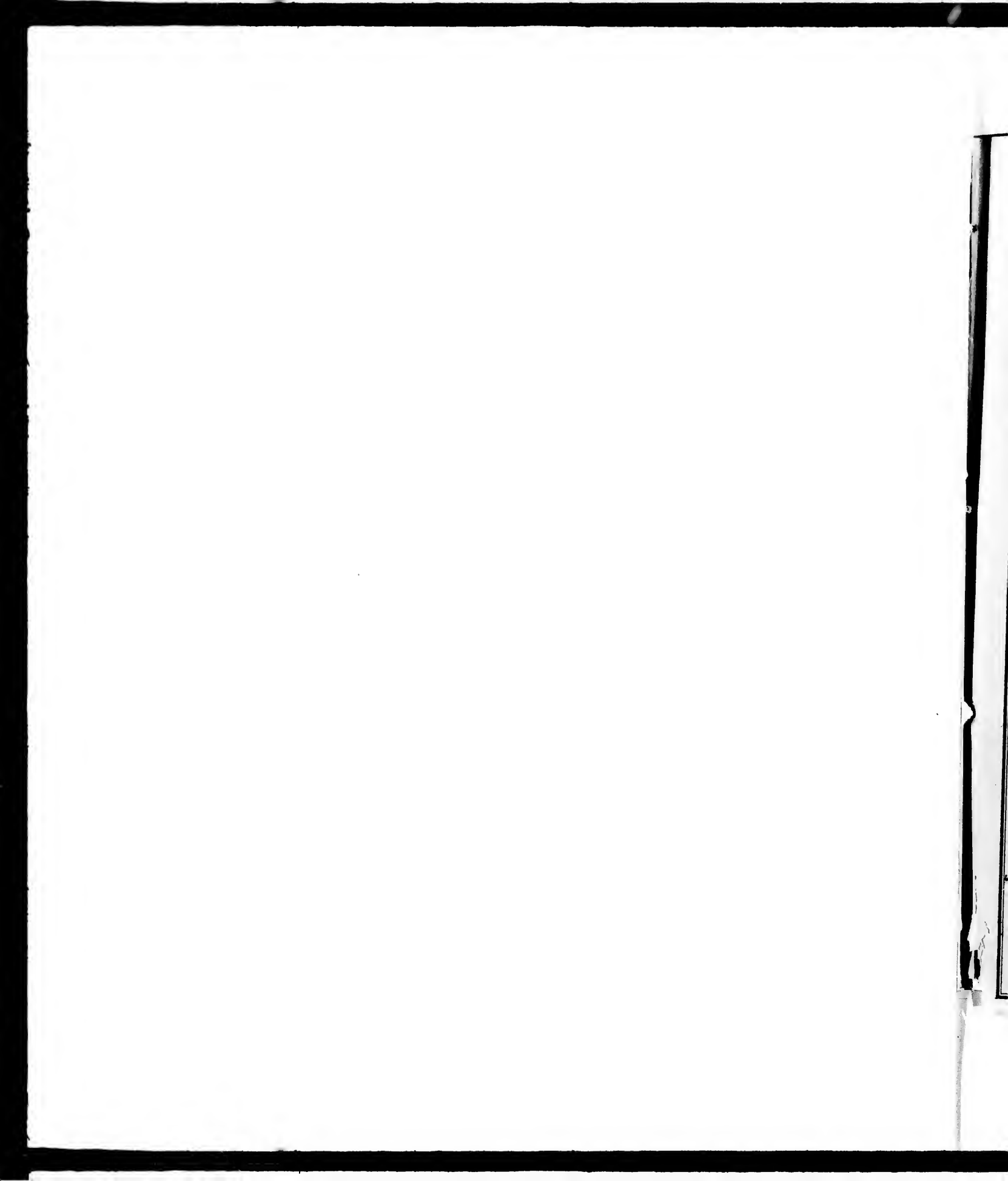

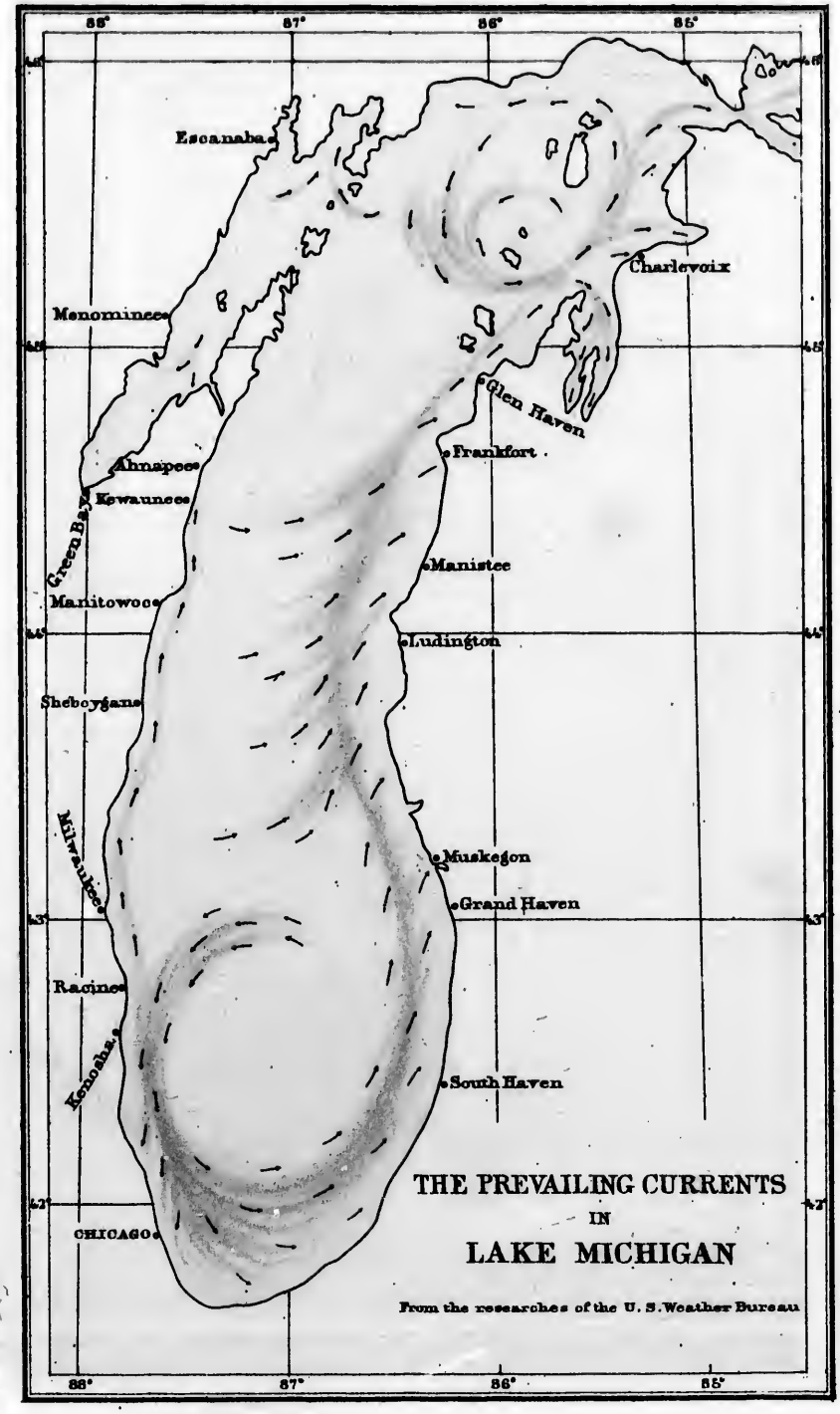
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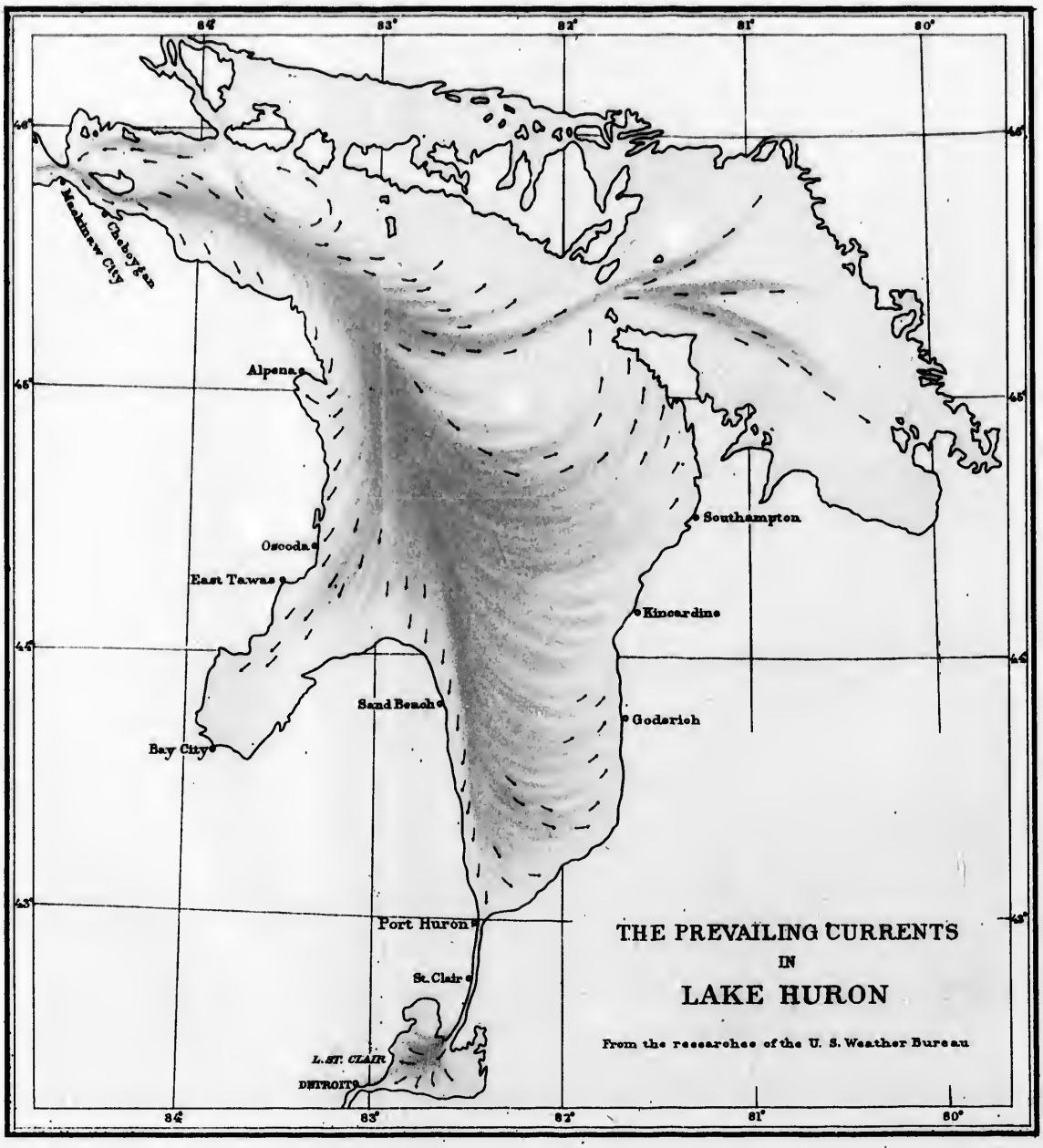
THE PREVAILING CURRENTS
IN
LAKE MICHIGAN
From the researches of the U. S. Weather Bureau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THE PREVAILING CURRENTS
IN
LAKE HURON
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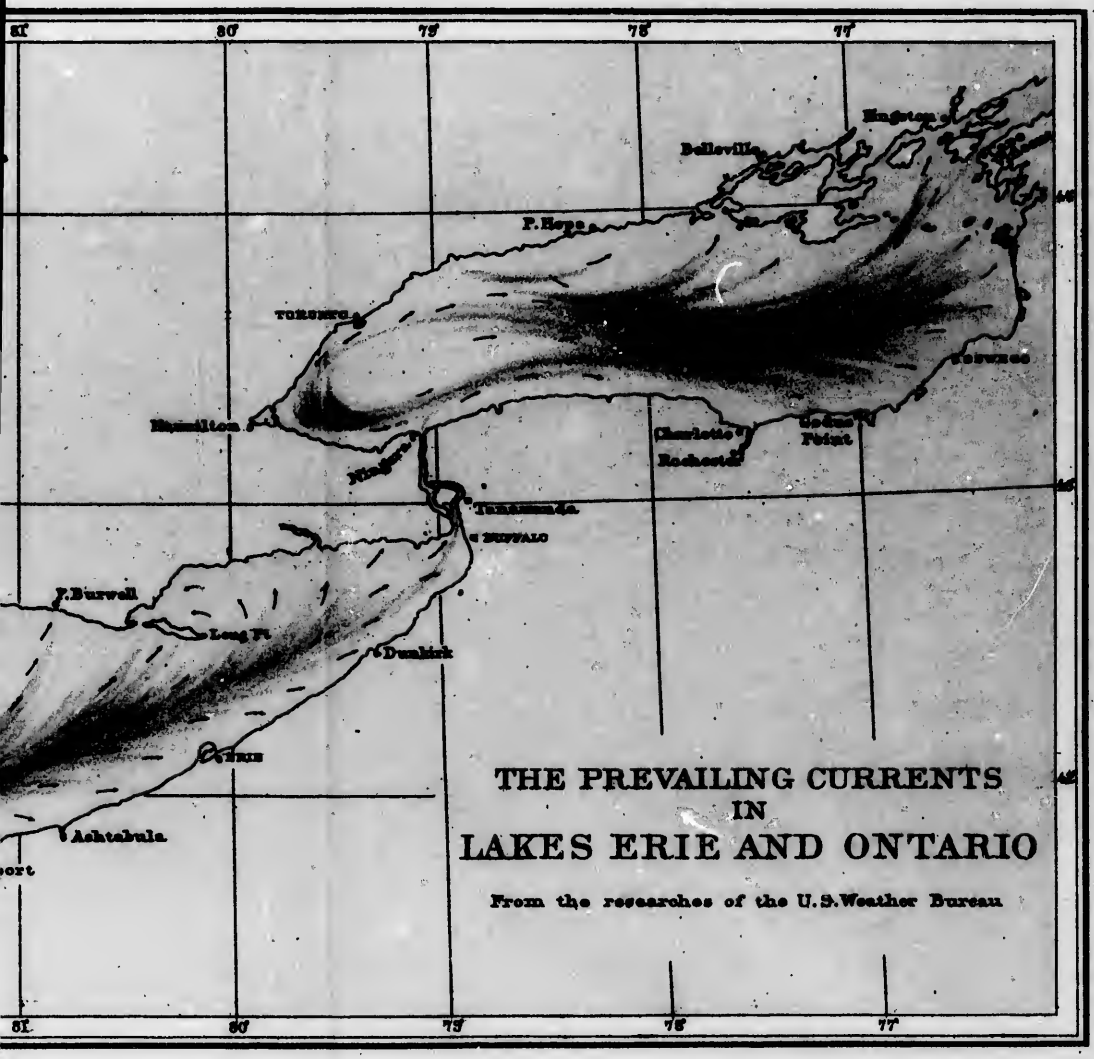

THE PREVAILING CURRENTS IN LAKES ERIE AND ONTARIO

From the researches of the U.S. Weather Bureau

CURRENTS IN LAKE HURON.

The currents in lake Huron differ from those in lake Michigan in having the main current along the west coast instead of the east coast. This current along the west coast is strong some distance out, and extends the length of the lake, turning near the south end and passing up the east coast. There is also a return current passing not far south of Manitoulin island and at some distance from the coast. At the NW. end of the lake there are also signs of a return current.

A current passes into Great Saginaw bay and a current which sometimes attains a strength of ½ knot an hour passes into Georgian bay by the main entrance.

CURRENTS IN LAKE ERIE.

A general northeasterly surface drift, rather more marked along the south coast.

A slight return current along the north coast west of Long Point island.

A series of eddies among the islands in the western end, very variable in character.

This lake being very shallow, and its axis lying nearly in the direction of the prevailing winds, great inequalities of level may be noticed, depending upon the strength of the wind.

The velocity of the main current is about 6 miles a day in calm weather, but with heavy westerly winds it has been known to run at the rate of 10 miles an hour.

CURRENTS IN LAKE ONTARIO.

The general surface current is to the eastward, strongest along the south shore. There is no noticeable return current. West of a line joining Niagara and Whitby point the currents are variable. There are seldom any great fluctuations of level in this lake. The velocity of the main current is about 8 miles a day.

CHAPTER II.

LAKE SUPERIOR.

On a map published by the Jesuits in 1771 this lake was called "Lac Tracy, or Superieur," but it was visited by Père Mesnard as early as 1660.

Lake Superior is almost everywhere noble, grand, impressive, majestic, and was called by Crowfoot, a Blackfoot chief, "The Brother to the Sea."

The ascent from the ocean to lake Superior does not average more than 6 inches to the mile, and even this ascent is not markedly noticeable till we proceed westward.

It is the largest known lake in the world, the United States Geological Survey giving it an area of 31,200 square miles, its length 412 miles, maximum breadth 167 miles, maximum depth 1,008 feet, and its height above the sea level 602 feet; but depths have been found as great as 1,386 feet. Its shore line is about 1,500 miles in length. It receives the waters of 200 rivers and drains a territory of 53,000 square miles. It practically belongs to the United States. Although Canada owns the north shore, it owns but little of the lake itself.

The water of this lake is so clear that objects may be easily distinguished at a depth of 25 feet. Mirages are frequent and very deceiving.

HARBORS OF REFUGE.

Grand Marais, Minn., is the only harbor of refuge on the north shore of the lake between Agate bay (Two harbors) and the international boundary line.

Eagle harbor, Mich., and Grand Marais harbor, Mich., both on the south shore, have been improved so as to make them harbors of refuge.

NAVIGATION.

As a rule, navigation opens the middle of April and closes the middle of December.

The two great evils to navigation are fogs and snow.

There are no tides and but light currents for the master to contend with on the lakes; and as these are the most uncertain of all elements for the navigator to calculate and allow for, it reduces very much the per cent of danger in lake navigation; hence the safe navigation of the lakes is confined to a correct compass, with a knowledge and

frequent use on the part of the master of the azimuth tables; the precaution to take cross-bearings of prominent points, and from them plotting the position frequently on the chart; also the familiar use of the chart in laying courses and correcting the same for variation and deviation.

DANGERS, SOUTH SHORE.

From Duluth to Detour station, south of Sand island, the south shore of the main can be approached with safety to one mile.

From Detour station through Apostles islands to Chequamegon bay.—From Detour point to Red Cliff, thence to Bayfield and to Chequamegon bay, there is deep water close along the shore. The NW. shore of the bay is steep-to; at the bottom of the bay the 12-foot curve extends off 1½ miles. The eastern half of the bay is shoal.

Sand island.—Shoal water extends from this island to the main shore, and the passage between should not be attempted by vessels drawing more than 6 feet. There is a shoal about a mile east of the north point of the island, and a doubtful shoal is shown halfway between Sand island and Devils island lights.

York island.—A spit extends from this island ½ mile southerly.

Rocky and South Twin islands.—These islands are connected by shoal water.

North Twin island.—A spit extends from this island ½ mile southwesterly.

Outer island.—Shoals lie one mile north of this island.

Michigan island.—Two dangerous spots lie ⅛ mile south of the lighthouse on this island.

Magdalene island.—A spit extends from the NE. end of this island ½ mile easterly, and from the SW. end of the island a 4-foot spit extends ½ mile southwesterly.

From La Pointe lighthouse to Fourteen-mile point the coast can be approached to ½ mile, but at Fourteen-mile point a spit extends off over ½ mile.

Caution.—Vessels should not approach the shore within a depth of 12 feet.

From Fourteen-mile point to Keweenaw point.—At one mile NE. of Portage a spit extends over ½ mile off shore.

From Eagle river to Eagle harbor a succession of reefs extend along the shore northeasterly from ⅛ to ¾ mile distant.

Manitou island.—A rocky flat extends from this island to Gull rock, as also ½ mile to the NW. from Manitou island.

Gull rock.—A shoal of 12 feet of water ⅞ mile S. ¼ E. (S. 3° E.) from the lighthouse. It is marked by a red spar buoy.

From Keewenaw point to Abbaye point.—At ¼ mile south of Keweenaw point is a 3-foot spot.

Isabelle point is surrounded by shoal water to the distance of a mile.

Traverse island.—Shoal water extends from the SW. end of this island for over ½ mile southwesterly.

Portage entry is almost filled up by a flat.

Pequaming point.—A spit extends SW. from this point.

Abbaye point.—A dangerous shoal lies 1 (1¼) mile east of this point. Buoyed.

Huron River point.—A large shoal extends 1½ (1¾) miles NE. from this point.

Big Bay point.—A dangerous spit with only 8 feet of water extends one mile to the northward from this point. Buoyed.

Little Iron river.—From the point east of this river a spit extends ½ mile to the northward.

Granite point.—On a line between this point and the northern point of Presque Ile are several rocks running parallel to the coast, and Middle island is in this line.

Marquette lighthouse.—East of this lighthouse, distant 1 (1¼) mile, are rocks and shoal water.

Shot point and Laughing Fish point.—A spit extends ½ mile northerly from Shot point. A spit also extends ½ mile northerly from Laughing Fish point.

Train island has shoal water extending from it about a mile to the northward and also to the westward. Between this point and the mainland are several shoals.

Train point.—Shoals also extend a mile from Train point to the NW. and for nearly 1¾ (2) miles northeasterly toward Wood island.

Wood island.—Shoal water extends ½ mile from the north point of this island, along its western side, and toward Williams island.

Williams island.—There are numerous rocks and sand spits between the south point of this island and the main shore to the south on which there are but 8 and 10 feet of water, making it dangerous for vessels drawing over 8 feet to attempt the passage between the island and the shore.

Sandy point.—From this point, opposite the beacon on Grand island, a spit extends North and NW. for ⅓ mile, with but 5 feet of water over it.

Point au Sable.—A small spit extends out about ½ mile.

Isle Royale and vicinity.—There are many detached rocky shoals lying SW. and NW. of the Rock of Ages, distant 1¼ (1½) miles. Washington island is surrounded on the South, SW., and NE. by rocky shoals which must be carefully looked out for in making Washington and Grace harbors. Siskiwit bay has a double set of islets stretching for 7 miles in the general direction of the south shore, connected by sunken reefs and having also reefs outside of the islets. Vessels should not attempt any of the channels between these islands. The north shore of Isle Royale can be approached with safety to ¾ mile. On the NW. coast from McCargoe cove to Blake point the shore should not be approached too close. Off the SW. end of Amygdaloid island there are rocks ⅛ mile

distant, and from the NE. end is a chain of small islands and interlying shoals and rocks terminated by a 4-foot shoal lying ⅓ mile ENE. from the Canoe rocks. East of Blake point, ⅔ mile, is a 4-foot patch, for which a sharp lookout should be kept. About midway between Blake point and Passage island is a shoal dangerous to deep-draft vessels. On the east coast from Blake point to Menagerie island there are no outlying dangers with the exception of a 4-foot patch ENE. ½ mile from the lighthouse on Menagerie island. From Menagerie island going south a clearance of at least a mile should be given the land. This will keep clear of several outlying patches having from 3 to 18 feet of water on them, with the deeper water close-to.

Passage island is apparently clear outside of ½ mile, but all of these islands should be approached with care, as from their conformation there may be pinnacle rocks heretofore undiscovered by the surveyors.

Gull island.—There is a reef ½ mile south of Gull island, and a dangerous 9-foot spot 2 (2¼) miles WNW. from the island.

Batteau rock (Canadian).—East of Batteau rock, ⅓ mile, is also a dangerous patch with 3 feet of water thereon.

DANGERS, NORTH SHORE.

From Duluth going north the coast can be approached to a mile.

Granite point.—Off this point is the isle aux Roches, with shoal water near and between it and the shore.

Encampment island is connected with the mainland by a shoal extending to the West and NW.

Gooseberry river.—Off this river is a dangerous reef of small area, ½ mile from shore, with 12½ feet in the shoalest spot and deep water all around it. It is a dangerous obstruction to vessels coasting.

Two Islands river.—Off this river are two rocks or islands, which should be approached with caution.

Rock island, near the entrance to Good Harbor bay, should also be approached with care.

Brule river.—One mile west, a little south, from Brule river are two rocks, one above water, the other awash.

Grand Portage bay.—From the west point of this bay to Pigeon point are several outlying islands and rocks. Wauswaugoning bay is comparatively clear, however.

Pigeon point.—From this point along the north and east coasts to Gros Cap vessels should give the coast good clearance until accurate surveys of this practically unsurveyed region can be made, the dangers specially warned against being:

Victoria islands, rocks to the southwestward.

Knob island, rocks to the southwestward.

Pie island, rocks to the southeastward.

Thunder cape, rocks to the southeastward.

Porphyry point, rocks to the westward and the shoals in center of Black bay entrance.

Slate islands (Canadian) should be approached with care, especially on the North and NE. coasts, a shoal spot, 10 feet, lying 1½ miles off the north coast, and several rocks the same distance off the NE. coast.

Michipicoten island (Canadian) is surrounded with outlying shoals and rocks, and should be approached with great caution.

Caribou island (Canadian) has shoals out from the north, west, and south sides from 2 to 4 miles. It is well to give this island a good berth.

Leach island (Canadian), Lizard island (Canadian), Montreal island (Canadian).—These islands should be approached with extreme caution, especially on the inshore sides, where there are numerous outlying rocks.

Montreal shoal.—On a line drawn from the west end of Montreal island to point aux Mines, and halfway between the two, is this very dangerous shoal, ¼ mile in diameter, having but 5 feet of water on it.

Mica shoal, 11 feet water, is 4½ ($5\frac{2}{10}$) miles northward of Coppermine point and about 4 ($4\frac{6}{10}$) miles offshore.

Coppermine point (Canadian) has many rocks near the point and to the northward.

Pancake and Outer Pancake shoals, SE. of Pancake point, are dangerous shoals and should be avoided. Pancake shoal has only 4 to 6 feet water over it and is marked by a bell buoy.

Sandy islands (Canadian) should not be approached within 2 ($2\frac{1}{3}$) miles on the north, west, and south coasts, except by vessels of small draft.

SSW. from Sandy islands 4⅓ (5) miles and N. by E. from Parisian island 2 ($2\frac{1}{3}$) miles is a shoal spot having a least depth of 8 feet thereon.

Parisian island (Canadian) should be given a berth of at least one mile on account of outlying rocks.

Superior bay.—At the western extremity the shores of lake Superior converge under a sharp angle. At a point in the angle where the opening is about 9 ($10\frac{4}{10}$) miles wide a low sandy point extends across and incloses a great natural harbor, the bay of Superior. Only one natural break occurs in it, and here the waters of the St. Louis and Nemadji rivers effect an outlet to the lake. The outlet is near the southern extremity.

Something less than a mile inside this natural breakwater, where the lake shore lines converge to an opening of about 5 miles, occurs another spit lying substantially parallel to it. Here again the opening is nearest the southern end. It furnishes an outlet for the St. Louis river. The angular opening of the lake behind this spit is a large sheet of water called St. Louis bay, the upper portion of which is the estuary of the St. Louis river, which river in this locality forms the boundary between the states of Minnesota and Wisconsin.

The exterior formation making out from the north shore is called Minnesota point. It is about 6½ (7½) miles long. That proceeding from the south shore is called Wisconsin point, and is nearly 2½ ($2\frac{9}{10}$)

miles long. The two have widths varying from 200 to 1,[illegible] feet, and rise but a few feet above the level of the lake.

MINNESOTA.

Duluth harbor.—This harbor is said to be the best for entrance of any on the chain of lakes. It is in reality an artificial harbor, having originally been closed to the lake, and only accessible by way of the opening formed by the Nemadji and St. Louis rivers.

Improvements.—1. A cut through Minnesota point, the banks being revetted with crib and timber piers. This is known as the canal.

2. The harbor, inside the canal, of over 100 acres.

3. A channel 200 feet wide along the east side of Rices point, parallel to the harbor line and 150 feet from it, with a curve 250 to 300 feet wide around the end of Rices point to the junction with the St. Louis river channel at the gate.

4. A channel along the north shore of St. Louis bay, 200 feet wide and parallel and 150 feet distant from the harbor line, with wide curves.

January, 1896: A minimum depth of 18 feet is maintained in the canal entrance and 16 feet in the older (and greater) portion of the harbor basin. The channel along Rices point leading to West Superior has a width of 200 feet, wider in the bends, and a depth of 16 feet. The north shore channel of St. Louis bay, which extends from the natural deep channel at Rices point to the deep channel at Grassy point and the West Duluth mills, has a width of 185 feet on the straight portions and 250 feet or more in the bends, and a least depth of 15 feet. A branch channel runs from the last-named channel toward the City Wharf at Twenty-first avenue west, having a width of 75 feet, depth of 15 feet, and length of 3,500 feet.

The two principal channels above mentioned are marked and lighted by range beacons. All depths given are for low water.

Latest date of opening harbor, June 12, 1861.

Earliest date of closing harbor, November 9, 1859.

Obstruction.—There is a bad obstruction in Duluth harbor, in the shape of a sunken pier, called the Dyke, which is a menace to navigation.

Buoys.—Red, even-numbered, and black, odd-numbered buoys mark the channels. A tug makes a daily inspection to keep the buoys in position.

Current.—There is no perceptible current from the St. Louis river through the canal, but an ebb and flow of water, which seems to be due to oscillations of the lake surface, as they change direction too frequently to be caused by tidal action. When heavy winds prevail from the NE. the water is forced to this end of the lake, raising the water in Superior and Duluth bays, and causing a very strong outward set through the Duluth canal. This current meeting the incoming waves, renders navigation at such times very dangerous.

Pilots.—The captains of all tugs are pilots, and pilotage is included in the towing. Rates vary from $5 to $100, according to tonnage and distance.

Lights.—On the outer end of the south pier of the canal is a light-house, from which is shown a fixed red light visible at a distance of 11¼ (13) miles. This light, in connection with a flashing red light every six seconds, on the inner end of the same pier, and 1,165 feet SW. ¼ W. (S. 48° W.) from it, furnishes a range to guide vessels through the canal. This light is visible 13½ (15½) miles.

Caution.—Give the end of the south pier a berth of at least 20 feet, to avoid the stone riprapping.

Life-saving station on Minnesota point, ½ mile south of the canal.

Ohio Central coal dock light.—A fixed red light, shown from an upright on a cluster of piles, and 13 feet above the lake level. It is in 12 feet of water, southerly of the easterly corner of the Ohio Central Coal Dock, and marks the turning point into the channel marked by the Rice Point range.

Rice Point range.—The front light is white, and is shown from an upright on a cluster of piles, and 13 feet above the lake level. It stands in 7 feet of water, southeasterly from Rice point.

The rear light is red, shown from an upright on a cluster of piles and 18 feet above the lake level, 510 feet SSE. ⅝ E. (S. 27° E.) from the front light.

These two lights in line guide through the dredged channel, east of Rice point, from the Ohio Central Coal Dock beacon to the turn round Rice point to the southwestward.

N. B.—The rear light of this range is also the rear light of Connors Point range.

Connors Point range.—The front light is white, in 7 feet of water, southeasterly from Rice point, and shown from an upright on a cluster of piles, and 13 feet above the lake level.

The rear light is 510 feet NE. by E. (N. 56° E.) from the front light.

The two lights in line guide through the dredged channel past Rice and Connors points to the Northern Pacific Railroad bridge at West Superior, crossing the South channel.

NOTE.—Wishing to make the North channel from the above range, a course of NW. ¾ W. (N. 54° W.) must be headed just before the Superior Bay channel upper light and the front light of the St. Louis Bay North channel east range come in line. This course will carry to the Northern Pacific Railroad bridge, crossing the North channel.

North Channel east range (St. Louis bay).—The front light is white, in 7 feet of water, at the easterly end of the North channel and westerly of Rice point. It is shown from an upright on a cluster of piles 13 feet above the lake level.

The rear light is also white, 600 feet NE. ⅛ E. (N. 46° E.) from the front light. It is in 7 feet of water, and shown from an upright on a cluster of piles 18 feet above the lake level.

North Channel west range (St. Louis bay.)—The front light is white, 13 feet above the lake level, and shown from an upright on a cluster of piles standing in about 7 feet of water.

The rear light is white, 18 feet above the lake level, 550 feet SW. ¼ W. (S. 46° W.) from the front light. It is shown from an upright on a cluster of piles standing in 7 feet of water.

These lights in range ahead, and the East Range lights in line astern, guide through the North channel from off Rice point nearly up to Grassy point.

N. B.—The rear light of this range is also the rear light of the South Channel range.

South Channel range (St. Louis bay).—The front light is white, 13 feet above the lake level, shown from an upright on a cluster of piles standing in 9 feet of water.

The rear light is 950 feet WSW. ¼ W. (S. 70° W.) from the front light.

These lights in line guide through the dredged channel on the south side of St. Louis bay from just above the railroad bridge off West Superior to the westward.

The clusters of piles referred to above are all square, black, pyramidal, surmounted by a wooden platform and box with an upright of natural color.

Fog signal.—In connection with the outer pier lighthouse is a 10-inch steam fog whistle, which, in thick or foggy weather, gives a blast every five second, with a silent interval of thirty seconds.

ROUTES.

Duluth to St. Marys river.—From Duluth lighthouse steer ENE. ¼ E. (N. 70° E.) for 60 (69) miles, when Devil island should bear South, thence steer ENE. ¾ E. (N. 76° E.) for 109¼ (125$\frac{8}{10}$) miles; this should bring a vessel in sight of Eagle Harbor lighthouse by day, or light at night. When the lighthouse bears South distant 5 (5¾) miles, change course to East and continue in this direction for 23¾ (27⅓) miles, until the lighthouse on eastern end of Manitou island bears South, when shape course ESE. (S. 68° E.) for 118 (135¾) miles; this should bring a vessel 2 (2⅓) miles north of Whitefish point. The point can be rounded at this distance, and when Whitefish Point light bears West, a SE. ¾ S. (S. 37° E.) course for 20 (23) miles should carry a vessel midway between Iroquois point and Gros Cap; then follow directions for St. Marys river.

Duluth to Ontonagon, passing through Apostle islands.—From Duluth lighthouse steer ENE. ½ E. (N. 73° E.) for 52 (60) miles, when the passage between York and Raspberry islands will open out; thence steer to the southeastward, keeping about in mid-channel and passing Raspberry Island light at a distance of ½ mile. When the SW. point of Oak island bears North, change course to eastward, passing north of

Hermits island and midway between Magdalene on the south and Stockton and Michigan islands on the north, remembering the shoals off NE. point of Magdalene and south shore of Michigan islands. When Michigan Island lighthouse bears North, distant not less than 1½ (1¾) miles, change course to E. ¼ N. (N. 87° E.) and continue on this course for 49 ($56\frac{4}{10}$) miles, which should bring a vessel off Ontonagon.

Duluth to Ontonagon, passing north of Apostle islands.—From Duluth lighthouse steer ENE. ½ E. (N. 70° E.) for 60 (69) miles, until Devil island bears South, distant about one mile, when steer East for 13½ (15½) miles, until the NE. point of Outer island bears South, distant about 3 (3½) miles; thence ESE. ½ E. (S. 73° E.) for 46 (53) miles should bring a vessel off Ontonagon.

Duluth to port Arthur and Silver Islet landing.—From Duluth lighthouse steer NE. by E. (N. 56° E.) for 149 ($171\frac{6}{10}$) miles, until the highest peak on the west end of Pie island bears NW. ¾ N. (N. 37° W.), distant 6½ (7½) miles, when steer NE. ¾ N. (N. 37° E.) for 10 (11½) miles, till Thunder cape bears North, thence shape course for Port Arthur or Silver Islet landing.

WISCONSIN.

Superior City is 5 (5¾) miles SE. of Duluth. The natural channel connecting Superior bay with lake Superior is at the southern extremity of the bay. It was obstructed by a bar, but has been improved by dredging and building piers, and now a depth of 15 feet is maintained.

Superior bay is quite shallow except where the waters of the St. Louis river form through it a narrow channel. Harbor room for large modern vessels has to be provided by dredging.

The channel between the piers makes an abrupt bend at the point where it enters Superior bay, consequently a vessel entering during a severe storm has great difficulty in following this channel. This can not be remedied because the Nemadji river enters the bay so near the entrance that the bar which the river maintains will not permit a change in location of the channel.

The Nemadji river is navigable for tugs and vessels of light draft for 4 (4⅔) miles from its mouth.

The channel in Superior bay has neither the directness nor width to permit vessels to reach Conners point in safety without the assistance of a tug or pilot; and in rounding from the entrance into Quebec channel in a high wind a tug is very necessary.

Buoys.—Red even-numbered and black odd-numbered buoys mark the channels. A tug makes daily inspection to keep the buoys in position.

Light.—There is a fixed white light 50 feet from end of the outer end of the south pier, which is visible 12⅛ (14¼) miles.

Fog signal.—A 6-inch steam whistle is on the outer end of the south pier, and sounds a blast of three seconds followed by a silent interval of twelve seconds during thick weather.

Superior Bay entrance range.—The front light is white, 18 feet above the lake level and shown from a white wooden upright, just inside the southeasterly entrance to Superior bay and on Wisconsin point.

The rear light is white, 24 feet above the lake level and shown from a white wooden upright, 320 feet SW. by W. ½ W. (S. 58° W.) from the front light.

This range in line guides through the natural channel from lake Superior into the southeasterly end of Superior bay.

Superior Bay range.—The front light is white, 16 feet above the lake level on a white wooden upright on Wisconsin point, close to the west end of the south pier.

The rear light is white, 21 feet above the lake level, on a wooden upright, 290 feet SE. ¾ E. (S. 53° E.) from the front light.

This range in line guides up Superior bay from inside the entrance, past the old dock on Minnesota point, to the entrance to the dredged channel to Quebec dock.

Quebec Channel light.—A fixed red light, 13 feet above the level of the lake, is shown from an upright on a cluster of piles standing in 7 feet of water in the west angle formed by the intersection of the main channel with the dredged Quebec channel.

It marks the entrance to Quebec channel.

Superior Bay Channel lower light.—A fixed white light, 13 feet above the lake level, is shown from an upright on a cluster of piles standing in 13 feet of water on the NE. side of the main channel, and 3,500 feet NW. from Quebec Channel light.

Superior Bay Channel lower middle light.—A fixed white light, 13 feet above the lake level, is shown from an upright on a cluster of piles standing in 15 feet of water on the NE. side of the main channel, and 3,800 feet NW. ¾ W. (N. 53° W.) from the lower light.

Superior Bay Channel upper middle light.—A fixed white light, 13 feet above the lake level, is shown from an upright on a cluster of piles standing in 14 feet of water on the NE. side of the main channel and 4,700 feet NW. ⅞ W. (N. 55° W.) from the lower middle light and about midway of the middle ground.

Superior Bay Channel upper light.—A fixed white light, 13 feet above the lake level, is shown from an upright on a cluster of piles standing in 12 feet of water on the NE. end of the middle ground and NE. side of the main channel. It is 2,000 feet NW. from the upper middle light.

All the above lights, excepting the pier headlight, are tubular lanterns, and the clusters of piles are square, black, pyramidal, surmounted by a wooden platform and box with an upright of natural color.

St. Louis bay.—Northwest from a line joining Rice point and Connors point lies St. Louis bay, a continuation of Superior bay and the outlet of the St. Louis river, which enters it at Grassy point.

West Duluth occupies the north shore and West Superior is now stretching up in the southern side.

Eight miles in a direct line from Grassy point is Fond du Lac, but by the river it is 15 miles. There is very little fall to the river except for the upper mile.

This portion of the river is now being improved.

Pilots.—The same as mentioned under Duluth.

Dry dock.—There is a dry dock at West Superior, 500 feet over all, with a depth over sill of 20 feet.

Routes.—The routes from Superior to the entrance of St. Marys river, as also to the different ports on the lakes, are practically the same as from Duluth.

SOUTH SHORE OF LAKE SUPERIOR.

Coast.—The coast from Superior to the NE. is low, although bold, and there are no refuges from the winds from the North and NE. Bark point with Bark bay 36 (41½) miles from Superior, offers protection from all westerly winds. The bay is 2½ (2$\frac{8}{10}$) miles deep northeasterly and southwesterly. On the east side of Bark bay a small, though high, point separates it from Siskiwit bay. Both of these bays afford protection from southerly winds.

From this point vessels of all but very light draft must run outside of Sand island on account of the bar connecting Sand island with the mainland, which has but 5 or 6 feet of water on it at extreme low water. Passing from Siskiwit bay outside of Sand island give Eagle and Steamboat islands a good berth on account of the shoal spots which surround and connect them.

Sand island is the most western of the Apostle group, which group comprises 19 islands, extending 29 miles ENE. and WSW. This island can be approached close-to on the north and west coast, but great care should be exercised when on the South and SE. sides. On its extreme north point is a lighthouse.

Light.—A fixed white light, visible 13 (15) miles in clear weather, is on top of an octagonal, red sandstone tower, which rises from a sandstone building.

Vessels taking the outside route continue their course to the NNE., passing north of Devils island.

Devils island.—This island is the extreme northern one of the group, and on its northern point is a lighthouse.

Light.—A fixed red light, visible 11¼ (13) miles in clear weather, is exhibited from a square, white, pyramidal, open-framework tower, the upper part of which is inclosed.

Fog signal.—Five hundred feet NW. of the lighthouse is a 10-inch steam whistle, which sounds a blast of five seconds' duration, followed by a silent interval of ten seconds, then a blast of five seconds' duration, followed by a silent interval of forty seconds. This occurs every minute during thick weather.

Continuing the outside course, vessels would here change their course to about East and pass to the north of Outer island.

Outer island is the northeastern of the group. A shoal lies one mile north of this island. About the middle of its northern shore is a lighthouse.

Light.—A flashing white light every ninety seconds, visible 17⅓ (20) miles in clear weather, is exhibited from the top of a conical, white, brick tower, which is connected by a covered way with a brick dwelling.

Fog signal.—A 10-inch steam whistle sounds a blast of eight seconds, followed by a silent interval of fifty-two seconds.

From Outer island vessels can shape their course to any ports to the eastward.

Sand Island light marks the turning point for vessels bound to Bayfield or Ashland, as also for those taking the route through the Apostle group and bound for ports farther to the eastward.

It is not advisable to pass to the west of York island, as shoal water extends off its SW. and South shores. Vessels therefore pass to the NE. of the island and keep close to Raspberry island.

Raspberry island.—Pass to the southward of this island, on the extreme SW. point of which is a lighthouse.

Light.—A fixed white light, varied by a white flash every minute, is visible 14⅛ (16½) miles in clear weather. It is exhibited from the top of a square tower on a white frame building.

All through these islands the shores can generally be approached close-to, but by keeping an approximate mid-channel course vessels will be sure of good water.

The south shore of Stockton island affords good anchorage from northerly winds, and all the larger islands from westerly winds.

Passing between Oak island and Red Cliff, both of which are comparatively high, vessels bound through the West channel keep a mid-channel course until off Bayfield.

Bayfield is an open roadstead, with deep water up to the docks. While protected from westerly gales, during NE. gales vessels have to run under La Pointe, Magdalene island, for anchorage.

Running south from Bayfield the coast is bold and can be approached close-to. Rounding Houghton point the town of Washburn is seen.

Washburn.—Here are two docks extending into deep water and connected by a bulkhead.

Lights.—Two private lights are here exhibited, both red; one on the end of a warehouse on one dock, and on the other dock one from a window in the elevator.

Chequamegon bay.—The eastern point of the bay, Chequamegon point, is a low, narrow spit 6 (7) miles in length and forms a partial natural breakwater to the bay, much as Minnesota point offers to Superior bay. At its NW. end is a lighthouse.

Light.—A fixed red light, visible in clear weather 11¼ (13) miles, is exhibited from a square tower on a white frame dwelling.

Fog signal.—A 10-inch steam whistle sounds a blast of five seconds, followed by a silent interval of twenty-five seconds.

This lighthouse is known as La Pointe, and serves as a guide for South channel, as also for the turning point for Chequamegon bay.

This bay has deep water along its western shore for about 2 (2⅓) miles south of Washburn, when shoaling water commences. On the east side of the bay shoaling water commences on a line joining the lighthouse and the mouth of Fish creek. Vessels should be careful of soundings when to the east of this line. Give La Pointe lighthouse a good berth.

Ashland.—The southern end or head of Chequamegon bay forms the harbor of Ashland, and as the length of the bay is considerable it was necessary to protect the wharves from the waves to enable vessels to use them at all times. When the proposed breakwater is finished it will be 8,000 feet long. It is as yet of insufficient length to give protection to all the wharves of the city, but its influence in diminishing the turbulence of the waters of the harbor is distinctly apparent. January, 1896, there was an available depth of 17 feet up to the ore docks.

Sunken cribs.—There are two cribs filled with stone about 500 feet from shore and 200 feet east from the central ore dock. There is only 4 feet of water over them.

Wreck.—There is a wreck about ¼ mile east of the fog-signal building on Chequamegon point. There is only 9 feet over it, with 18 to 20 feet close outside.

Michigan Island light.—A fixed white light, visible 17⅛ (20) miles, is shown from a conical, white, stone tower attached to a stone dwelling.

MICHIGAN.

Coast.—From Chequamegon point eastward the coast is low, commencing to rise about Clinton point and continuing until Porcupine mountains, 1,421 feet high, are reached. Beyond Union bay the coast again becomes low. Into Oronto bay, 18 (20¾) miles from Chequamegon point, empties the Montreal river, which forms part of the boundary line between Wisconsin and Michigan.

At 61½ (70¾) miles E. by N. from South channel is the mouth of the Ontonagon river. All this coast is generally steep-to. Lone rock, 9 (10⅓) miles west of Union bay, lies a short distance offshore.

Ontonagon.—The Ontonagon river, forming the harbor, has fairly deep water in it, but its mouth is obstructed by a bar with varying depths. In order to maintain a sufficient depth of water two parallel

piers have been built. During freshets large quantities of sand are carried by the river, and the bar at the entrance forms as fast as the piers are extended. The channel over the bar is shifting and uncertain. There is an available depth of 12 feet through.

Lights.—A fixed white light, visible 12⅛ (14) miles in clear weather, is exhibited from a square, yellow, brick tower rising from a dwelling at the mouth of the Ontonagon river.

A fixed red light (lantern) is shown from a square, brown, pyramidal, open-framework tower, upper part inclosed, on the west pier, 45 feet from the outer end. There is an elevated walk along the pier to the shore.

Fourteen-mile point is 12 (14) miles east from Ontonagon.

Off this point a spit makes out with 2¾ fathoms on its outer edge. Vessels should approach it with caution.

Beyond Fourteen-mile point the land rises as Keweenaw point is approached.

Fourteen-mile Point light.—A fixed white light, varied by a red flash every twenty seconds, is shown from a square red tower, rising in the center of the front of a red dwelling with a red roof. The watchroom and lantern are black. It is 60 feet above the lake level, and is visible in clear weather 13¼ (15¼) miles.

Fog signal.—A 10-inch steam whistle sounds blasts of five seconds, followed by silent intervals of twenty-five seconds.

Keweenaw point is a rocky promontory projecting into the lake in a northeasterly direction. It is 55 (63⅓) miles long and 25 (28¾) miles wide at its base, with a coast line of 120 (138) miles. The shores of this promontory are bold, with outlying reefs dangerous to navigation, and with no good harbors to afford refuge in storms.

Portage lake.—About 35¾ (41) miles from its extremity the promontory is cut in a northerly and southerly direction for 14 (16) miles by a natural navigable channel known as Portage lake, which occupies a narrow and deep chasm. It receives also from the NE. the waters of Torch lake. Its outlet is Portage river, which empties into Keweenaw bay.

Portage Lake canal connects the north end of the lake with lake Superior. The canal is 2 (2⅓) miles long, has a bottom width of 70 feet, and is to have a 16-foot depth. It has a breakwater at its entrance on lake Superior.

Portage river, formerly shallow, with a tortuous channel obstructed by bars, has been improved by having a tolerably straight channel cut.

Improvements.—January, 1896: The deep channel is narrow at places. Lily pond has been widened to 300 feet, to allow vessels to pass each other or to tie up. It should be noted that during each winter a bar forms at the lake Superior entrance to the canals, leaving only about 11½ feet of water on it, which will be removed by dredging as promptly as possible on the opening of navigation. The project calls for a 16-foot channel of 70 feet bottom width from bay to lake.

LIGHTS.

Portage Lake Ship Canal.—A fixed white light, visible 13 (15) miles, is shown at the west side of the cut from a square, red brick tower on the canal front of dwelling.

Portage Lake Ship Canal Pierhead.—A fixed red light on the end of the west pier, visible 7⅓ (8½) miles, is exhibited from a square, white, pyramidal, open-framework tower, the upper part of which is inclosed. It serves as a guide into the canal.

There is an elevated walk from the lighthouse along the pier to the end.

Fog signal.—A 10-inch steam whistle sounds blasts of three seconds, with silent intervals of seventeen seconds.

Portage Lake Ship Canal range (front).—On the south end of the pier of Portage Lake Ship canal, at the entrance from Portage lake, is shown a fixed white light from a small, square lamphouse.

Rear.—About 600 feet N. ¾ E. (N. 9° E.) of the front light is a fixed red light, shown from a wooden upright with white triangular day mark.

These lights form a range for approaching south end of ship canal.

Portage River range (north).—In the lake, from the window of a white lamphouse with pyramidal white day mark, is shown a fixed white light.

South.—In Portage river, near its head, and 1,650 feet S. by E. ⅝ E. (S. 18° E.) from the north light, is shown a fixed white light from a small, square, white lamphouse on crib.

These lights form an open range for leaving or entering the river. The lights should be left to the westward.

Portage range (front).—A fixed white light, visible 10 (11) miles, is exhibited from a white tower. This light is on the west side of the Portage river near its mouth.

Rear.—A fixed white light, visible 10½ (12) miles is shown from a square tower on white frame dwelling. It is 730 feet N. ¾ W. (N. 9° W.) from the front light.

These lights serve as a range on which vessels can run on leaving or entering the cut between Portage river and Keweenaw bay, the range for entering from the bay being N. 9° W.

A fixed white light, varied by a red flash every minute and visible 13 (15) miles, is shown a little to the eastward of the entrance to Portage river, from a cylindrical, white stone tower, connected with a red brick dwelling by a covered way.

Life-saving station, ¾ mile from the north end of the canal, on the east bank.

Directions.—The light at the outer end of the west pier, with the lighthouse at the inner end, serves as a guide to and into the west entrance of the canal. From this the canal runs in a SSE. (S. 23° E.) direction until a short distance beyond the United States life-saving station, when it changes direction to the south, passing through Lilly

pond and entering Portage lake at Monders. Here project two bulkheads, and at the extremity of the eastern one is the south light of an open range for leaving or entering.

Vessels drawing 14 feet of water can now pass through the Portage river and upper ship canal.

Keeping to the southward a general course of SSW. § W. (S. 29° W.) is made until Oscar is passed, thence S. by E. § E. (S. 18° E.) as a general course. Having rounded the bend just below Swedetown creek, Hancock and Houghton are passed. These towns lie, Hancock on the north and Houghton on the south side of Portage lake, 8½ (10) miles from the west entrance, and are the principal shipping ports of this lake. A short distance east of Houghton a course ESE. ⅛ E. (S. 69° E.) will carry clear of danger until about midway between the entrance of Pilgram river and Dollar bay. From here a course of S. by E. § E. (S. 15° E.) will carry through the wide part of the lake and to the north entrance of Portage river. Enter the river on the range S. by E. § E. (S. 18° E.) and keep a mid-channel route, passing through cuts Nos. 4, 3, and 2 and through and out of No. 1 cut on the Portage river range S. ¾ E. (S. 3° E.).

In this system there are no locks.

The improved parts of the channel will be kept well buoyed.

Torch lake.—Fourteen feet of water may be carried through the cut from Torch bay to Torch lake.

The cut is marked by three lights on cribs on the west side, and by a row of stakes on both sides.

Vessels bound from Torch bay to lake Linden follow the center of the bay, taking care to leave red stakes to port and black stakes to starboard. When the nearest two cribs are in range steer for them until the stakes can be seen, then follow them through the cut.

In coming from Torch lake to Torch bay a red barn on the south side of Torch bay is a good mark for running through the cut.

Coast.—Proceeding to the northeastward from Portage Lake canal a shoal makes out for about a mile to the northward of the harbor, another a little to the southward of Gratiot river, and from there on to Eagle river the shore should be given a good berth.

Eagle River harbor is practically abandoned as a commercial port. There is a pier which is falling to pieces and the channels are filling gradually. There are shoals, § of a mile off shore, NW. and NNE. of the mouth of the river, with from 6 to 10 feet of water on them and a channel between them and the beach. This channel is about 20 feet in depth. The shoals extend 2 (2½) miles in a NE. and SW. direction.

Directions.—Approaching from the west, head ESE. ½ E. (S. 73° E.) for the north end of the pier and run in on that heading until close to the dock, when head up to the northward. Approaching from the NE. and through the passage between the shoals head S. ¼ W. (S. 3° W.) for the end of the pier, and run down on this heading.

Light.—There is a fixed white light, shown from a square, white stone tower on a dwelling, on the west side of the mouth of the river.

Vessels coasting should keep well clear of the land running in either direction.

Eagle harbor is 6½ (7½) miles from Eagle river and is one of the harbors of refuge on the south shore of lake Superior. Through a rocky ledge, with 8½ feet of water at the shoalest part, which originally obstructed the entrance to the harbor, a channel, 130 feet wide and 14 feet deep, has been dredged.

Directions.—This channel is marked by two guiding cribs, one on either side. The course going in is SSE. ½ E. (S. 28° E.) on the range on the south shore of the bay. This course will carry clear of a shoal lying north of the entrance, about ⅓ mile distant.

Approaching by the east channel bring the lighthouse to bear WSW. (S. 68° W.) and run in on this course until on the range, when head in, passing between the cribs.

Light.—On the west point of the entrance there is a fixed white light, varied by a white flash every minute, visible 13 (15) miles in clear weather. It is shown from a red brick tower, octagonal in shape, rising from the corner of a dwelling.

Fog signal.—The building is 100 feet NNW. ⅝ W. (N. 30° W.) from the lighthouse. A 10-inch steam whistle sounds blasts as follows: Blast three seconds, silent twelve seconds, blast six seconds, silent twenty-four seconds.

Range lights.—On the south shore are two lights, which show the range at night; the towers mark it by day.

The front light is a fixed white light shown from a white frame tower, and is 20 feet above the lake level.

The rear light is 1,000 feet SSE. ½ E. (S. 28° E.) from the front light, of the same character, and is 29 feet above the lake level. It is shown from a square tower on a frame dwelling.

From Eagle harbor to Agate harbor the coast is dangerous and should be avoided, especially in the vicinity of Agate harbor.

Agate harbor.—This harbor is 4½ (5) miles from Eagle harbor, is surrounded by shoals, and when inside there are many shoal spots. It is no longer used as a harbor of refuge.

Directions.—The target, which was used as a guide, is still in existence, and to enter the harbor head for the target on a course SSE. ½ E. (S. 28° E.) until the houses on the south shore of South harbor are seen clear of Agate point, then steer E. ½ N. (N. 84° E.) to anchorage in North harbor.

Copper harbor, 8 (9½) miles nearly east of Agate harbor, is a good natural harbor, having a narrow bar with a least depth on it, when on the range, of 16 feet. It is protected from the waves by the mainland, Porters island, and the shoals, and affords good anchorage, being 2 miles long and 1,200 feet wide. The town of Copper Harbor is on the SW. side.

Light.—A fixed white light, visible 13⅜ (15¾) miles in clear weather, is on the east point of the entrance to the harbor, and is shown from a square, yellow brick tower, which rises from a dwelling.

Range lights.—On Fort Wilkins military reservation, on the south shore, a fixed white is the front light of a range for the channel in the bar. It is exhibited from a white frame tower, and is 22 feet above the lake level. At 470 feet S. by W. ⅛ W. (S. 13° W.) from the front light is a second light of the same character, exhibited from a square tower on a white dwelling and 39 feet above the lake level.

Directions.—Head in on this range S. by W. ⅛ W. (S. 13° W.) until well past the rocks which show on the west side of the range, when head for the town, anchoring nearer to the north shore for the better protection.

Copper harbor is the last port on this part of the promontory.

When rounding the promontory to the southward Manitou island and Gull rock are sighted.

Gull rock is about ½ mile from the west end of the island and is surmounted by a lighthouse.

Light.—A fixed red light, visible 11⅛ (13) miles, is shown from a square, yellow brick tower rising from a dwelling.

Buoy.—A 16-foot spar buoy, painted red, marks a gravelly shoal ⅞ mile S. ¼ E. (S. 3° E.) from Gull Rock lighthouse. This shoal has but 12 feet of water on it.

Manitou island is 2½ (3) miles long and one mile wide, and should be given a good berth, having shoal water near it, especially on its western side.

Light.—On the east point of the island a fixed white light, varied by a white flash every minute, is shown from a brown, skeleton tower, which has a cylindrical staircase and is connected with a white frame dwelling by a covered way. It is visible 14¾ (17) miles in clear weather.

Fog signal.—A little way east of the lighthouse a 10-inch steam whistle sounds a blast of three seconds, followed by a silent interval of twenty-six seconds, then a blast of five seconds followed by a silent interval of twenty-six seconds. This occurs every minute during thick weather.

Bete Grise bay.—From Keweenaw point (small) the coast trends away westwardly, and Bete Grise bay is the first anchorage on the eastern side of the promontory. This bay offers good protection to all winds from the SW. to NE. by way of west and north. At its head, 10 (11½) miles from the point, is a ship canal, which gave outlet to Lac la Belle; the town of Mendota is here, but the canal is not kept up. On the south shore there are shoals and rocks extending out over a mile from Isabelle point, the southern point of Bete Grise bay. To the southward, past Traverse point, to the mouth of the Portage river, care should be exercised in approaching the coast.

Mendota light.—At the entrance to Lac la Belle is a square red tower rising from front of dwelling, from which is shown at 44 feet

above the lake level a white light, fixed and varied by a flash every forty-five seconds. It illuminates 345° of the horizon and is visible from all points of approach.

Traverse island lies S. by W. ½ W. of Traverse point, distant 4 (4⅘) miles. There is shoal water around this island, and a spit extends SW. about one mile from it.

Portage river is on Keweenaw bay. It is described on pages 19 and 20, which see for the direction and lights. The harbor is exposed to the north and east, and there is no good anchorage within 9 (10⅓) miles.

Keweenaw bay.—The west shore of this bay trends to the south from Portage river.

Sand point.—There is no break in the shore line until Sand point is reached, 12 (14) miles away, to the west of which is an excellent harbor. When ¼ mile east of Sand point, run SW. by S. (S. 34° W.) not quite a mile, when head up for Baraga on a course of WNW. ½ W. (N. 73° W.), having due regard for a spit which makes to the southwestward about 300 or 400 yards.

Light.—A fixed red light, visible 8½ (9¾) miles, is shown from Sand Point lighthouse. The lighthouse is a square, red-brick tower rising from a dwelling.

Two miles from Sand point and at the head of Keweenaw bay lies the little town of L'Anse.

Pequaming point.—From L'Anse the shore line keeps off to the N. and NE. to Pequaming point. Around this point is the most secure anchorage near Portage River entrance, the south side giving protection from gales from the north and east, the north side from southerly gales. The only danger around the point is a spit extending a mile SSW. from the SW. point. By running in until 4 fathoms is found will give good anchorage.

From this point the coast trends NE., and 6 (7) miles from the point a spit having 18 feet on it runs out a mile. The NE. extremity is known as Abbaye point, and is surrounded by dangerous spots. Give it a wide berth. This point forms the west shore of Huron bay.

Buoys.—Two black can buoys mark the shoal off Abbaye point.

Huron bay, 10½ (12) miles long by a mile wide, affords good anchorage, and a vessel can ride out nearly all winds in it, especially if in the bay to the southward of Sand point.

There is a lighthouse on Sand point; no light is shown. With Huron light dead astern a WSW. ⅝ W. (S. 72° W.) course will carry in; a course of SW. ⅝ W. (S. 52° W.) from the first low sandy point on the east shore will carry to Sandy point, which can be approached close-to. Off Valley creek a sand bar with but 2 feet of water on it makes halfway across the bay, with a breadth of ¼ mile.

From the most NE. point of Huron bay the coast trends eastward to the Huron river, NNE. of which and distant 3½ (4) miles lies the westernmost of the Huron islands.

Huron islands.—This group consists of two islands; the shores are bold except for two small patches of rock off the east end of East Huron. There is a channel over 2 (2⅛) miles wide between the islands and the mainland, as also a channel between the two islands.

Light.—On the north side of the West Huron island, at 197 feet above the lake level, is shown a fixed white light visible 20½ (23½) miles. The lighttower is square and rises from a dwelling.

Fog signal.—On the NW. corner of the same island a 10-inch steam whistle gives a blast of eight seconds, followed by a silent interval of fifty-two seconds.

Coast.—The Huron mountains, one peak of which is 1,030 feet high, are here seen rising back from the lake. Off Huron River point is a shoal spot extending NE. 1$\frac{3}{10}$ (1½) miles; this should be carefully avoided. From here to the eastward there are no outlying dangers until Big Bay point is reached, off which a shoal, having but 7 feet on it, extends over one (1¼) mile N. by W. This shoal is marked by a black spar buoy. From Big Bay point the coast takes a general SSE. direction. A short distance from Big Bay point shoal another small shoal makes out from the land, and midway between Sauks head and Garlic point, a short distance offshore, is Garlic island. Granite point is the next point SE. of Garlic point.

Between Granite point and Presque Ile the shore recedes, forming a shallow bight, clear of danger on the NW. side, but with rocks and shoals in the remaining portion, and with Middle island as a prominent mark. To the east of Presque Ile is a large rock, 20 feet in height, the most northerly of three, showing well above water. Between these rocks and the mainland is a narrow channel. Vessels bound to the southward should keep outside of these rocks and not head down until the red light on the breakwater at Marquette is well open to the eastward of the main light.

Granite island lies 4½ (5$\frac{2}{10}$) miles ENE. of Garlic point.

Granite island light.—A fixed white light, varied by a red flash every ninety seconds, visible 15½ (17¾) miles, is shown from a square tower attached to a dwelling at 93 feet above the lake level.

Fog signal.—A bell struck by machinery every twelve seconds during thick weather.

Stannard rock, lying 29 (33$\frac{4}{10}$) miles N. by E. ½ E. (N. 17° E.) of Granite island, is a dangerous shoal spot extending N. by W. and S. by E. 2,910 feet, with a width of 1,500 feet and having deep water close-to.

Light.—On a circular pier near the northern end of Stannard rock, a flashing white light, every thirty seconds, is shown 102 feet above lake level from a conical, gray stone tower. It is visible in clear weather 16 (18½) miles.

Fog signal.—From a house on the deck of this pier a 10-inch steam whistle sounds a blast of three seconds, followed by a silent interval of ten seconds, a blast of five seconds, followed by a silent interval of forty-two seconds. This every minute during thick weather.

Beacon.—A granite beacon, 8 feet high and 9 feet in diameter at its base, with a wrought-iron shaft surmounting it, has been built 120 feet from the extreme south end, and 2,190 feet S. by E. ¾ E. (S. 20° E.) from the lighthouse.

Marquette.—This harbor is of the greatest importance, its commerce being extensive and constantly increasing, and it is also valuable as a harbor of refuge. The breakwater runs out due south from a point just north of the city, and on the Government reservation. It now extends into over a 30-foot depth.

Lights.—On the north point of the harbor a fixed white light, visible 14½ (16¾) miles in clear weather, is exhibited 77 feet above lake level from a square, yellow brick tower, rising from a dwelling; and a fixed red light is shown on the breakwater from its south end. This light is visible 7⅛ (8½) miles, and is shown from a square, brown skeleton, iron tower, with a cylindrical watchroom.

Fog signal.—Close to the lighthouse on the point a 10-inch steam whistle gives a blast of five seconds, followed by a silent interval of twenty-five seconds.

Caution.—Vessels should give the point a berth of at least ½ mile to keep clear of dangers.

Life-saving station.—There is a life-saving station near the main light, at the north end of the breakwater.

Coast.—From Marquette to Shot point the trend is eastwardly, and off Shot point a shoal makes out ½ mile with 16 feet on it. From here on past Laughing Fish point to Train island there are no outlying dangers, but vessels should keep at least ½ mile off shore.

Train island lies in the NE. part of Shelter bay. There is shoal water to the north and west of this island extending out 1¾ (2) miles, and also shoal water between it and the mainland. From the west point of Train bay a shoal extends to the northeastward about the same distance. In Train bay vessels can find anchorage from all winds except those from the northward. Skirting the shore near Train point is dangerous, and although there is a channel between Wood island and Williams island, it is well to keep to the northward of Wood island, and between it and Grand island if bound for Grand Island harbor or South bay. When near Williams island do not go to the westward of the range.

Lights.—Grand Island Harbor range consists of 2 lights. The front light, on the mainland at the west entrance, is fixed white shown from a white tower and 23 feet above the lake level. About 375 feet S. by E. ½ E. (S. 16° E.) from this front light is another of the same character shown from a square white tower on a dwelling and 41 feet above the lake level.

Directions for entering from the westward.—Bring the lights or towers in range on a course S. by E. ½ E. (S. 16° E.), continue this course until Powells point opens well clear of the red spar buoy near

Williams landing, then head E. ¼ N. (N. 85° E.) until the harbor opens, when proceed to anchorage. One-fourth of a mile off shore gives plenty of water, except on the east side, where a spit makes out with from 8 to 11 feet on it. If bound for South bay, continue course E. ¼ N. (N. 85° E.), rounding Powells point not nearer than ¼ mile. South bay is entirely free from dangers ¼ mile off shore until in the region of Sand point, when vessels should keep nearer to Grand island.

Directions for entering from the eastward.—When ¼ mile off Castle point, head SW. (S. 45° W.); this will bring Grand Island Harbor light a little on the starboard bow, and will lead clear of the shoals off Sand point. If there is any set to the southward, haul up and head for the red spar buoy until Sand point is abeam, when a course can be shaped into South bay. If bound for the harbor, continue the SW. (S. 45° W.) course until the village above Williams landing is well open of the land forming the east side of the harbor.

Buoys.—A red spar buoy, 16 feet long, is on the south point of the 12-foot curve of Williams Landing shoal. Vessels should not pass between it and Grand island.

A red spar buoy, 16 feet long, marks the extreme end of a shoal off Grand Island Harbor light. Vessels can run close to this buoy with safety, but should not pass between it and the lighthouse.

Light.—Grand Island Harbor light is fixed white, visible 12¼ (14) miles, and is on Sand point. It is shown from a square white tower at 49 feet above lake level. A shoal extends about 900 feet eastward from the lighthouse.

Grand island.—To the northward from this light, Grand island trends north, and when well clear of the entrance, vessels should not shut in the light on the island until well up with Trout point, as a shoal of 12 feet makes out a good ½ mile from shore. Trout point should not be approached on the northward nearer than ¾ mile by vessels drawing over 12 feet. To the west of Trout point lies Trout bay, which is separated from Grand Island harbor by a low strip of land ¾ mile wide. From here the coast stretches away to the northward and on its extreme north point is Grand Island lighthouse.

Grand island is surrounded by shoal water ⅛ to ¾ mile off shore. It should be approached close to with caution.

Light.—A fixed white light, varied by a white flash every ninety seconds, visible 17¼ (19¾) miles, is shown from a square yellow tower rising from a dwelling at 205 feet above the lake level.

Coast.—From Sand point east, past Grand Portal to Point au Sable, the coast is free from dangers, Sail rock, one mile SW., and Chappel rock, one mile east from Grand Portal being close to shore. The determination of the coast lines by the wearing action of the waters upon the rocks of different degrees of hardness is remarkably exemplified everywhere along the shore of lake Superior, but nowhere more so than on this stretch of the coast. Here are precipitous cliffs of red sand-

stone which have been so carved by the waves as to have received the name of "Pictured Rocks." They stand opposite the greatest width of the lake and are exposed to the tremendous force of the heavy storms from the north. The effect of the waves is seen, not only in their irregular shapes, but the sand formed by the disintegration of the rocks is swept by the wind down the coast, and raised by the same force into long lines of sandy cliffs 100 feet high.

Off Point au Sable a shoal makes out ½ mile to the northward.

Light.—On the point, a fixed white light, visible 16¼ (18¾) miles, is shown 107 feet above the lake level from a conical white tower, connected with a red-brick dwelling by a covered way.

Grand Marais harbor—Harbor of refuge.—This harbor is 7 (8) miles east of Point au Sable. Once within this harbor, there is ample depth to float large vessels, and as a harbor of refuge it is of the greatest importance to the shipping navigating the lake. The entrance to the harbor is to be 300 feet in width, protected on either side by crib piers. A channel of 175 feet in width, with a depth of 14 feet in the shoalest part, now exists. With any swell on it will not be safe for a vessel drawing over 12 feet of water to attempt the entrance. Soundings taken in December, 1895, showed a bar working in from the west across the front of entrance, on which was but 12½ feet of water. The edge of the bar having reached the axis of the channel, a pile dike for closing the natural opening to the harbor was partially constructed.

Light.—On the outer end of the west pier is a fixed white light 40 feet above the lake level and visible 11¼ (13) miles. A black lantern surmounts the square, white, pyramidal skeleton tower, and an elevation walk extends shoreward 810 feet.

Fog signal.—A bell struck by machinery, a single blow every thirty seconds.

Coast.—From Grand Marais to Whitefish point the coast is clear, excepting a reported shoal off Vermillion point.

Shoal.—This shoal is reported as having 24 feet water over it, and lying NNW. (N. 23° W.) from the life-saving station on Vermillion point. It extends east and west ¼ mile and is 200 feet wide.

The following life-saving stations are on this stretch of coast:

Muskallonge station is near the mouth of the Sucker river.

Two Heart River station is near the mouth of the river of the same name.

Crisps station, 15½ (18) miles west of Whitefish point.

Vermillion Point station, 8½ (9¾) miles west of Whitefish point.

Whitefish point is the western point of Whitefish bay and is the turning point for vessels bound into the St. Marys river. On the point is a light and fog signal. There is a good and secure anchorage, in northwesterly gales, under Whitefish point.

Light.—A fixed white light, with a white flash every five seconds, visible 14¼ (16½) miles, is shown 76 feet above the lake level from a

white skeleton tower with a stair cylinder. It is connected with a white dwelling by a covered way.

Fog signal.—A 10-inch steam whistle sounds a blast of five seconds, followed by a silent interval of thirteen seconds; then a blast of two seconds, followed by a silent interval of forty seconds. This every minute during thick weather.

Whitefish bay.—From Whitefish point the coast makes a sudden change of direction to the southward as far as the mouth of the Taquamenon river.

A bay of very shallow water makes in here, and Taquamenon island is 2 (2⅛) miles outside of a line joining the NW. and SE. points of this bay. All inshore of the island is shallow, with rocky bottom.

Off Menekaunee, at the SE. point of this shallow bay, and as far as Salt point, are numerous rocks.

All of this coast, from Whitefish point to Salt point, should be approached with caution. From Salt point to Iroquois point the shore is more bold, but 2 (2⅛) miles west, a little north from the latter point, a shoal makes out, and near its NW. end is Iroquois island. Iroquois point is the south side of the entrance to St. Marys river.

Light.—A flashing white light every thirty seconds is shown from this point. It is exhibited from a conical white tower, connected with a dwelling by a covered way. Visible 14 (16¼) miles.

Fog signal.—A 10-inch steam whistle sounds a blast of five seconds, followed by a silent interval of twenty-five seconds.

ONTARIO.

The eastern shore of the bay belongs to Canada. Gros Cap is the north entrance point to St. Marys river, and is steep-to. Goulais point, north of Gros Cap, is also steep-to. Within this point are Goulais bay and river.

Parisian island (Canadian) is almost in the center of Whitefish bay and 6 (7) miles west of Goulais point. It is 4½ ($5\frac{2}{10}$) miles north and south, about one mile wide, and surrounded with rocks which are close-to.

Shoal.—A rocky shoal, least water 8 feet, lies 2 (2⅛) miles north of Parisian island. It extends over a mile east and west, and is marked by a buoy on its NW. end.

Remarks.—The northwestern, northern, and eastern shore of lake Superior from Duluth east will now be described.

NORTHWESTERN SHORE OF LAKE SUPERIOR.

MINNESOTA.

Coast.—From Duluth north the shore is rocky and bold, with no dangerous reefs. At 16 (18½) miles from Duluth is the Knife river, and at its mouth, extending to the northeastward from Granite point, is isle aux Roches, known as Knife island in this part of the country.

Isle aux Roches is joined to the mainland by a rocky reef; vessels bound for Knife river must round it to the northeastward. From here on to Agate bay the shore can be approached close-to.

Agate bay is a small indentation on the NW. shore of lake Superior, 23½ (27) miles from Duluth, and, although it has ample depth of water, it is neither protected naturally from the SW. nor from the reverse swell of the more dangerous storms of the NE. To protect shipping at the wharves, which would otherwise be greatly exposed, it is the intention to construct two breakwater piers on a line toward each other from the eastern and western points of the bay, leaving an opening of 1,340 feet between their extremities. There is not yet perfect security from the SW. storms for vessels lying at the docks, but it is no longer necessary to put to sea and seek security elsewhere.

Two Harbors light.—On the point separating Agate and Burlington bays a fixed red light is shown 78 feet above the lake level and visible 11⅓ (13) miles. The lighttower is square, red brick, and rises from the SW. corner of a two-story dwelling.

Fog signal.—A 10-inch steam whistle, giving blasts of five seconds duration, with alternate intervals of silence of seventeen and thirty-three seconds, is sounded from a building 100 feet SW. from the lighthouse.

Two Harbors breakwater light.—On outer end of breakwater at east side of entrance is shown a fixed white light. It is suspended from a brown post 30 feet above the lake level.

Coast.—To the northward of this light lies Burlington bay, and from here on the coast is bold and can be approached to ½ mile. About 2¾ (3 3/10) miles above this bay a rock lies close to shore, and 2½ (3) miles from this rock lies Encampment island. When within ¼ mile of Gooseberry river, a good lookout must be kept for an offlying reef. This dangerous reef lies ½ mile from shore, is of small area, and has but 12½ feet of water over it at the shoalest place. There is deep water all around it. It is a dangerous obstruction to vessels coasting the north shore of the lake.

Between Beaver bay, 10 (11½) miles beyond, and Palisades, are a few shoal spots close to shore.

To the northward from these reefs the coast is clear until Two Islands river is reached, off the mouth of which are 2 islands; from these on, the only outlying danger is Rock island, ¾ mile off shore, and 1¼ (1½) miles E. by N. (N. 79° E.) from Terrace point.

Grand Marais is 3¼ (3¾) miles from Rock island, and offers the only harbor of refuge during storms between Agate bay and Pigeon river, the international boundary line, a distance of 110 (126½) miles. It is the intention to build one pier from the east point, and dredge an anchorage to a depth of at least 16 feet. The anchorage basin now is 25 acres in extent, with 16 feet at low water (January, 1896). This will make an excellent harbor of refuge. The anchorage is compact in shape and fairly well protected.

Light.—On the outer end of the breakwater a fixed white light, visible 11½ (13½) miles in clear weather, is shown from a square, white, pyramidal tower.

Fog signal.—A bell, hanging in front of the tower, is struck by machinery, a double blow every thirty seconds.

Coast.—From Grand Marais to the eastward the shore continues bold, with the exception of a shoal ENE. ½ E. (N. 69° E.) 4½ (5) miles from Grand Marais light. In Portage bay it is shoal, and a shoal spot of 7 feet lies westward of Hat point. To the east of Wauswaugoning bay many islands and shoals project south from the mainland, Lucille island being the farthest off shore, with a few rocks ½ mile off its south point.

Pigeon point forms the SE. point of Pigeon bay. Through this bay the boundary line, dividing the United States from Canada, runs to the mouth of Pigeon river. The south half of the bay belongs to the United States, the north half with the islands, lying in the center of the bay, to Canada.

NORTHERN SHORE OF LAKE SUPERIOR.

CANADA.

General remarks.—Coast.—From here on but little surveying has been done. All along this north shore the coast is bold and wild, rocky and bluff, presenting almost continuous ranges of cliffs, which vary in height from 300 to 1,500 feet, and rich in mineral wealth, native copper and silver being found. The only ore of lead met with in Canada is the sulphuret of galena. At Thunder bay, and in the Nipigon region to the north of lake Superior, very numerous and valuable veins of ore are found. Innumerable small islands and rocks extend for a short distance from the shore. Cascades without number can be seen falling down the steep cliffs, and the air is generally so clear that objects can be distinguished at a great distance. The caution must again be given not to approach this north shore too close until more accurate surveys have been made.

On account of the incomplete surveys, the outside course in making Thunder cape will only be regarded until complete information can be obtained. From the Pigeon river the land trends to the northeastward, and along the coast are found Pigeon bay, Pine River bay, and Big Trout bay. Two (2½) miles from the NE. point of the latter bay lies Victoria island, sometimes known as Knob island. There are a few islets and rocks lying off its east shore.

Victoria Island light.—A fixed white light, 89 feet above the lake level and visible 15 (17½) miles, is exhibited from a white, square tower, with a red lantern. This lighthouse is near the west side of the island.

Islands.—Passing to the NE., Spar island and Thompson island are passed, with no outlying dangers, but in the passage between are many rocks, and its passage should not be attempted.

Off the NE. end of Thompson island a chain of small islands extends for a mile, and 1½ (1¾) miles farther on are several groups of rocks awash.

Pie island is generally surrounded by reefs, and 2 (2⅛) miles off its eastern side are several rocks and reefs. It should be given a berth of 2½ (2⅛) miles. Le Pate, a hill on its SW. end, is 850 feet high.

If entering Thunder bay, it is best to get about 2 (2⅛) miles from Thunder cape before shaping course in.

Pie Island light.—On the west extremity of Pie island from a square, white tower surmounted by a red lantern is shown a fixed white light, 29 feet above the lake level and visible 10 (11½) miles. The light is intended to guide through the inside channel, west of Pie island.

Wharf.—There is a wharf 400 feet NE. of the lighthouse, which extends 500 feet in a northwesterly direction.

Thunder cape is an immense mass of trap 1,350 feet high, and on its extreme SW. point is a lighthouse from which is exhibited a light, and near the lighthouse is a fog signal station.

Light.—A revolving white light, attaining its greatest brilliancy every minute, and visible 12 (13¾) miles in clear weather. It is 45 feet above the lake level, and shows from a square, white tower with a dwelling attached.

Fog signal.—A steam horn sounds blasts of five seconds, followed by silent intervals of twenty-five seconds.

Thunder bay is an extensive diamond-shaped sheet of water surrounded by grand scenery. All around it are cliffs rising from 1,000 to 1,500 feet out of the lake. It is 30 (34½) miles NE. and SW. and 13 (15) miles NW. and SE., and narrows at its SW. and NE. ends.

Directions.—In entering Thunder bay, Thunder cape should be approached bearing N. by E. ⅜ E. (N. 15° E.), nothing to the eastward, and when the cape is 2 (2⅛) miles distant, shape a course NW. ½ W. (N. 50° W.) for Port Arthur, or until the Kaministiquia lights for Fort William come in range. This course should carry a vessel a good ½ mile clear of the Welcome islands, after passing which Fort William will open out.

Fort William is in a beautiful valley at the foot of mount McKay, which rises 900 feet above the lake level. It is near the mouth of the Kaministiquia river, on its north branch. The mouth of this river forms a delta of three branches, the Big Fork or southern, the Little Fork or center, and the main river or northern branch; all of these are navigable for small vessels, but it is on the north shore of the northern branch that the docks are situated. The channel through the slight bar that exists is indicated by six buoys, three on either hand, and on the mainland two range lights show the course at night.

Kaministiquia river.—Inside, the mouth of the river is completely sheltered, and is from 300 to 400 feet wide, having, with the exception of two or three shallow places, a depth of from 15 to 25 feet for a

distance of 3½ (4) miles. The bed is of stiff clay, and is subject to no shifting sand bars.

Lights.—On the north shore of the river, just to the eastward of the Canadian Pacific Railway docks and elevators, is exhibited a fixed white light, visible 11 (12⅔) miles, and 879 feet ENE. (N. 68° E.) from this one is a second fixed white light, visible 10 (11½) miles. These lights in range lead through the dredged channel at the mouth of the river.

Signals.—There is a signal mast near the range, the signals here made being the same as those shown at Port Arthur, from which place they are ordered.

Port Arthur.—The harbor is an open one, the docks being protected by two breakwaters. Thirty-one feet from the southwestern end of the northern breakwater, and serving as a guide to the passage between the two, is a light tower.

There is a consular agent of the United States stationed at this port.

Light.—A fixed white light, 43 feet above the lake level and visible 11 (12⅔) miles, is exhibited from a white, square tower on crib work.

Signal mast.—The signal mast is on the Canadian Pacific Railway dock, its position being 48° 26′ 05″ N. and 89° 12′ 55″ W. Elevation above the sea level 650 feet.

Harbor master.—A harbor master is stationed here who has charge over all vessels calling at the port, and who must be obeyed accordingly. Failure to comply with his orders subjects the person to penalties imposed by the Revised Statutes of Canada.

Silver islet.—A little over 5 (5¾) miles ENE. from Thunder cape lies Silver islet, a patch of rock of small extent, but from which large quantities of silver have been taken.

Continuing to the eastward, the entrance of Black bay is passed, in the middle of which lies a group of islets and rocks 2 9/10 (3) miles NE. by N. and SW. by S. The east side of the entrance is shown by a light tower on Porphyry point.

Light.—A fixed white light, 56 feet above the lake level, is here shown from a white square tower. It is visible 13 (15) miles.

Black bay is 30 (34½) miles in depth from the light tower to the mouth of the Black river. The channel between the islets and Edward island is apparently clear of dangers. Off the NW. face of Edward island are several islands with shoals between. They should be given a good berth. The point north of Pearl river has a reef extending some distance to the SE., and Granite island is connected to the shore by a reef which extends also SSW. in the direction of the above point. There are also some rock eastward of Granite island. The point abreast the Paps has a reef extending to the SW. A mid-channel course should generally be kept, but this bay, as well as all the others on this coast, has been very imperfectly surveyed, and should be navigated with great care.

The rivers emptying into these bays teem with trout, and there is a plentiful supply of feathered game.

Nipigon bay.—The entrances to this bay are the west channel and Nipigon strait, St. Ignace channel, and the east channel. There is also an entrance along the north shore. The bay from the mouth of the Nipigon river to Salter island is 27 (31) miles long, and is studded with islands. St. Ignace and Simpson islands form the south shore.

Lamb island is on the west side of the entrance to the west channel, and on its SE. end is a lighthouse.

Light.—From a white square tower, dwelling attached, is shown, 90 feet above the lake level, a fixed white light visible 15 (17¾) miles.

Rock.—About ½ mile north of the lighthouse is a dangerous rock.

Channels.—The west channel is 12 (13⅜) miles from the lighttower to its outlet into the bay. It separates St. Ignace from the mainland.

Nipigon strait leads into this channel between Fluor and St. Ignace islands. Both channels have many rocks and reefs in them.

In the channel between St. Ignace and Simpson islands several rocks and shoals are shown. Moffat harbor is at the north end of this channel.

The eastern entrance, east of Simpson island, is 4½ (5⅜) miles long from Battle Island light to the north end of Salter island. This channel is wide, bold, and free from dangers, except at its entrance north of Salter island. Unless locally acquainted it should be used in entering Nipigon bay. There is a shorter and narrower channel between Salter and Wilson islands, which also is apparently free from dangers.

Caution.—Vessels using the eastern channel are warned that east of a line tangent to the west point of Salter island and the west shore of the high bluff on the north shore are two shoal spots, one of 7 feet, ⅚ mile NW. by N. (N. 34° W.), the other of 6 feet, 1½ (1¾) miles N. by W. ¾ W. (N. 20° W.) from the NW. point of Salter island.

Battle island is at the east entrance to the eastern channel and the west entrance to the channel next east of it. On the center of the island is a lighthouse.

Light.—From a white square lighthouse, 105 feet above the lake level, is shown an alternating red and white light every half minute. It is visible 16 (18½) miles in clear weather.

Rossport is on the main shore of Nipigon bay, abreast the channel between Salter and Wilson islands.

Directions.—If bound to Rossport, use this channel. A mid-channel course N. by W. ¾ W. (N. 20° W.) will carry through the channel and into the harbor, which has shoal water at its head.

Coast.—Proceeding eastward, the north shore of the main coast has many indentations, among which are Terrace bay, Jack Fish bay, McKellars harbor, Red Sucker cove, and Peninsula harbor. This latter harbor is well protected and has deep water. Off Jack Fish bay 5 (5¾) miles are the Slate islands, a large group. North of Slate islands 1¼

(1 4/10) miles is a 10-foot shoal. Pic island, SE. of McKellars harbor, is about ½ mile off shore. East of Pic island are many outlying rocks and reefs.

Peninsula harbor.—Directions.—If from the westward pass south of Pic island, and do not head to the northward of east until the light at the entrance to the harbor bears NE., when head in on this bearing and run into the harbor through the south entrance, leaving the light ⅓ mile to port. The north entrance is foul. The peninsula, a rocky bluff, protects the harbor from the south.

Manitoba shoal of 8 feet lies in the northern entrance to Peninsula harbor, and is about midway between the island at the entrance and the main shore. Its position has not been well established.

Peninsula Harbor light.—At the south end of the island is a light revolving white every thirty seconds. It is 105 feet above the lake level and visible 16 (18½) miles. The lighthouse is white and square, with dwelling attached.

Coast.—To the south from Peninsula harbor the coast trends to the southward for 40 (46) miles to Otter head, and from here it curves gradually to the east to the head of Michipicoten harbor, about 55 (63⅓) miles. Bound to the southward, a course of S. by E. ¼ E. (S. 14° E.) from Peninsula light will carry 4 (4 8/10) miles off Otter head. North of Otter head 12½ (14 4/10) miles and 6 (6 8/10) miles is a hill 1,530 feet high, which should be a prominent landmark all along this coast.

Michipicoten harbor.—At Michipicoten, a river of the same name empties into the bay. It is navigable up to the falls, a distance of 15 miles.

The water is deep and the harbor affords protection from all northerly and easterly winds.

Brulée bay.—Brulée point is the south point of Michipicoten harbor and between this point and Grindstone point is Brulée bay, with Great Lake river at its head. Grindstone point is the north point of cape Choyye.

Cape Gargantua is the next point south, with Indian harbor small and full of rocks, just north of it. To the southward of the cape is a small bay also filled with rocks, and then is Gargantua harbor.

Gargantua Harbor light.—The tower stands on the summit of a small island in the mouth of the harbor, and is a white, hexagonal building, 43 feet high, with the lantern surmounting it painted red.

The dwelling is on the mainland on the north side of the harbor in a sheltered position.

The light is fixed white, elevated 97 feet above the level of the lake, and should be visible from all points seaward 15 (17¼) miles.

Coast.—South of Gargantua and between cape Gargantua and Coppermine point is a wide indentation, in which are several islands and shoals, and vessels navigating in this vicinity should not go inside of a line joining these points.

Gull island, Leach island, the Lizard islands, and Montreal island are all surrounded by reefs and shoals, and there are also shoals between these islands.

Montreal shoal, with 5 feet over it, lies on a line joining the west side of Montreal island and Point aux Mines, and is west of the mouth of the Montreal river.

Mica bay is between Point aux Mines and Mamainse point.

Mica shoal, with 11 feet over it, lies off Mica bay, and on a line joining cape Gargantua and Coppermine point.

Coppermine point is the NW. end of a broad point, the SW. extreme being Pancake point. North of Coppermine point is Sand bay, small, and with the Hibbards rocks in its approach. Just south of Coppermine point is an offlying rock close to the shore. Pancake point is surrounded by shoals, and east of the point is a small bay, into which Devil river empties.

Pancake shoal lies 3¼ (3⅜) miles SW. of Pancake point. It is a dangerous shoal, and has from 4 to 6 feet water over it.

Buoy.—A bell buoy marks this shoal.

Outer Pancake shoal has 11 feet over it, and lies 2 (2⅛) miles SW. of Pancake shoal.

Corboy point is the north entrance point to Batchewana bay, and on the point is a lighthouse.

Light.—From a white octagonal tower, dwelling attached, is shown 77 feet above the lake level a fixed white light, visible 16 (18½) miles.

Batchewana bay is between Corboy point and Rudder Head point. The bay is nearly landlocked, and a large island lies in the middle of it. It is separated from the north shore of the main by a narrow channel and on the south by a passage of shoal water (8 feet) 2 (2⅛) miles wide.

Goulais point is 9 (10⅛) miles south of Rudder Head point. Midway between the points and a mile offshore is Maple island, surrounded and connected to the shore by a shoal.

Sandy islands, north and south, are south of Corboy point and west of Rudder Head point. There is apparently clear water between the points and the shoals surrounding the islands.

The islands, with the surrounding shoals and reefs, extend north and south nearly 5 (5¾) miles, by 1½ (1¾) miles wide.

Parisian island is almost in the center of Whitefish bay. It is surrounded by rocks, which are close-to. See page 29.

Shoal.—A rocky shoal, least water 8 feet, lies 2 (2⅛) miles north of Parisian island. It extends over a mile east and west, and is marked by a buoy on its NW. end.

Goulais bay is within Goulais point. The Goulais river empties into the bay. The bay is deep, and affords protection from all northerly and easterly winds.

THE ISLANDS OF LAKE SUPERIOR.

Under this heading will be considered those islands in the lake which lie clear of the coast lines and which can not be regarded as forming bounds to any bays or harbors. Of these, there are: The Apostle group, nineteen in number; Isle Royale, Passage and Gull islands, Manitou island, Huron islands, and Granite island in the waters of the United States. Slate and Pic islands, Michipicoten and Caribou, Leach, Lizard, Montreal, Sandy, and Parisian islands on the Canadian side.

UNITED STATES.

The Apostle group is composed of nineteen islands, stretching E. by N. 23½ (27) miles from the NW. point of Sand island to the NE. point of Outer island, and 25 (28¾) miles SW. ½ S. from this latter point to the SW. point of Magdalene island. Sand island is the western, Devils island the northern, Outer island the northeastern, and Magdalene island the southern. There are no important ports. There are several lighthouses, which are described on pages 16 and 17. The passages through the group are generally clear of dangers, the shores bold, and the water deep. The outlying spits are described, where necessary, under Dangers.

Shoal.—The steamer *Omaha*, drawing 14 feet, struck a shoal with Devils Island light bearing W. by N. (N. 79° W.), distant about 1½ (1¾) miles.

Mariners are cautioned to look out for this shoal, as it is not marked on the charts, although the charts indicate a shoaling of the water between Devils island and North Twin island.

Anchorages.—Between Sand island and Detour station, in 4 or 5 fathoms, protected from north winds and a partial breakwater afforded by the shoal connecting Sand island with the mainland. The east side of Sand island in 4 or 5 fathoms. Between Rocky and South Twin islands in 10 fathoms. The SE. coast of Stockton island. A peninsula here projects 1½ (1¾) miles into the lake, having bays on both sides with from 4 to 10 fathoms. Under the NE. point of Cat island in 4 fathoms. Outer island affords anchorage on all sides, except near the SW. point. Magdalene island; many good anchorages along the eastern coast, and at La Pointe, protection from NE. gales.

Isle Royale is 40 (46) miles long NE. and SW. by 7¼ (8¼) miles wide, the widest part. No important ports. Dangers described in first part of this work. There are many harbors along the coast of the island, Grace and Washington harbors and Rainbow cove on the SW. end, Todd harbor and McCargoe cove on the west shore, Duncan bay, Tobin and Rock harbors on the NE. end, and Chippewa harbor and Siskiwit bay on the SE. shore. Good anchorage can also be found between Wright island and the main island on the north side of Siskiwit bay.

There is but one light, that is on Menagerie island, NE. point of this same bay.

Light.—A fixed white light, visible 14⅛ (16½) miles, is shown from an octagonal white tower, connected by a covered way, with a dark brown, stone dwelling.

Canoe rocks are nearly 2 (2⅜) miles NW. of Lock point. There is a 4-foot spot a mile NE. of the larger rock and a 3-foot spot 3 (3½) miles SW. of the same rock.

Passage island, 1½ (1¾) miles long, is 3 (3½) miles NE. from Blake point, the northeastern point of Isle Royale. The shores are bold close-to. A small bay on the east side with 3½ fathoms affords shelter from the NW.

Light.—On the SW. point of this island is a fixed red light, visible 11¼ (13) miles in clear weather. It is exhibited from an octagonal tower rising from a dwelling, both built of gray stone.

Fog signal.—In front of the lighthouse is a 10-inch steam whistle. During thick weather a blast of five seconds is sounded, each blast followed by a silent interval of twenty-five seconds.

Shoals.—East of Blake point ¾ mile is a 4-foot spot with an 18-foot spot a little NE. of it. A shoal dangerous to deep-draft vessels has been reported as lying midway between Blake point and Passage island. Its exact position is not known.

Gull islands, officially Isle Chapeau, lie 3 (3½) miles NE. from Passage island. They are a group of low-lying rocks.

Shoal.—NW. of the Gull islands 2 (2⅜) miles is a 9-foot shoal with from 11 to 31 fathoms around. South of Gull island ½ mile is a reef.

Batteau rock is 6¼ (7 9/10) miles east of the Gull islands. A little east of the rock is a 3-foot shoal.

Manitou island, 2½ (3) miles long by a mile wide, lies off Keweenaw point. See page —.

Huron islands. See page 25.

Granite island. See page 25.

CANADA.

On this side of the lake there are very few outlying islands.

Slate islands are about the middle of the north coast line, the north point being 5 (5¾) miles from Victoria cape on the main. There are eight islands of any noticeable size, the largest being 3½ (4) miles north and south by 4½ (4 8/10) miles east and west. There are numbers of outlying rocks, and a 10-foot shoal lies 1¼ (1 4/10) miles north of the group.

Pic island, 760 feet high, 8 (9¼) miles west of the peninsula, is of an irregular shape, bold with deep water, and has small islands off the NE. and south coasts.

Michipicoten island is the largest of the Canadian islands, being 15½ (17 8/10) miles long by 6 (7) miles wide. The shores should be approached cautiously on account of outlying dangers.

Quebec harbor is about the middle of the south coast. On a headland, the east point of entrance to this harbor, is a lighthouse.

Light.—A fixed white light, visible 15 (17¼) miles, is exhibited from a white, square tower, at 56 feet above the lake level.

Fog signal.—A bell rung by machinery.

Agate island is a small island in Quebec harbor, and on it is a lighthouse.

Light.—A fixed white light is shown, 32 feet above the lake level, from a white, square tower.

Shoals.—In entering Quebec harbor the first shoal encountered is south of Agate island and west of the main light. It is a solid edge with 8 feet over it.

The second shoal, of bowlders with 8 feet over them, lies in the center of the channel, opposite the SE. end of Agate island.

Buoys.—Both shoals are marked by black and white buoys. There is 18 feet on either side of the buoys.

Caribou island, 19 (21$\frac{5}{10}$) miles south of Quebec harbor, is 3 (3½) miles north and south. The whole west side of the island is lined with dangerous reefs, which extend to the SW. for 3 (3½) miles. There are also offlying reefs on the east side of the island. Vessels should give the island a wide berth.

Caribou Island light.—A revolving white light, attaining its greatest brilliancy every ten seconds, 76 feet above the lake level, is visible 15 (17¼) miles. It is not on the island proper, but on a very small island a little SW. from it. The tower, white, octagonal in shape, has a dwelling attached. The lantern is painted red.

Fog signal.—A steam horn sounds a blast of five seconds, followed by a silent interval of twenty-five seconds during thick weather.

The islands south of cape Gargantua and in Whitefish bay have been described on page 29.

CHAPTER III.

ST. MARYS RIVER AND DETOUR PASSAGE.

ST. MARYS RIVER.

This river forms the connecting link between lakes Superior and Huron. At Sault Ste. Marie navigation in the early days was interrupted by the rapids, the river here descending 22 feet in a distance of ¾ mile.

Through this river runs the boundary line between the United States and Canada. All the larger islands in the river belong to the United States, excepting St. Joseph and Squirrel islands, which belong to Canada.

From abreast of Iroquois point on the lake Superior end to Detour point on lake Huron is 71½ (82½) miles. The only places of any importance are the towns of Sault Ste. Marie, situated on either side of the river at the rapids. To facilitate navigation at this point, a canal was dug on the United States side.

St. Marys Falls canal.—This canal is 7,000 feet in length, with a least width of 108 feet at movable dam in upper end. Greatest width is 256 feet just above the lock. The depth of canal is 25 feet. The canal is lighted by arc lights.

The dimensions of the new lock are: Length 800 feet between gates, width 100 feet throughout, with 21 feet of water on sills, with a single lift of 18 feet.

Canadian canal.—The canal is cut through red sandstone rock on the north or Canadian side of Sault Ste. Marie, about 4,000 feet north of the existing United States canal. The cut is straight and is 5,900 feet long between the extremities of the crib-work approaches. The canal prism is 156 feet in width at the surface, 143 feet at the bottom, and the water is 22 feet 3 inches deep. There is one lock, which is 900 feet long by 60 feet wide, with a depth on the miter sill of 20 feet 3 inches. The lift is about 18 feet, varying somewhat as the waters above or below the canal are affected by drought, rain, wind, etc. Outside the canal, at each end, a channel 18 feet deep by 250 feet wide has been dredged, connecting with the American channels.

Buoys.—The approaches are marked by spar buoys. Above the canal there is an octagonal timber crib surmounted by a day beacon built on the starboard side of the channel off Davignon point, to mark the only turn above the canal. There are two red buoys between the end of the canal embankment and this beacon. There is a black buoy on the south side of the same stretch and two black buoys to mark the turn opposite the beacon. Off Vidal shoal there are four red buoys. The outermost of these buoys is a square platform buoy, on which stands a pyramidal slat work surmounted by an inverted cone. On the port side of the channel are four black spar buoys. The platform buoy indicates a point where vessels bound down require to take the Canadian dredged channel and where vessels upward bound can leave the dredged channel and make a course for Algoma Park light. The dredged channel east of the canal is indicated by eight red and four black spar buoys. The lowest red spar buoy, near Plummers dock, is surmounted by a slat-work cone, and the lowest black spar buoy, opposite the International dock, is surmounted by a slat-work drum. Below this easternmost black buoy there is at least 15 of feet water across to the wharves on the American side of the river, and vessels desiring to cross the river need not keep close to the red buoys any farther east.

Lights.—The canal itself is marked by electric arc lights established at regular intervals along both sides of the canal banks and crib-work approaches. The most westerly light of each row is red; the others are white.

Sault Ste. Marie upper range (front).—A group of white incandescent electric lights is shown in a wooden lantern on top of the crib-work beacon at the turn in the west approach to the canal. The light is elevated 39 feet above the level of the river, and should be visible up the river to Pointe aux Pins as well as into the canal.

Sault Ste. Marie upper range (rear).—A bright fixed white incandescent electric light is shown from a wooden lantern, surmounting a square open-framed wooden tower, the whole painted white. The tower is erected on the eastern extremity of Davigon point, 2,100 feet NE. (N. 45° E.) from the front light. The light is elevated 61 feet above the level of the river, and visible to the south shore in the line of range.

These two lights in one, NE. (N. 45° E.), will guide from the American channel past Vidal shoal through the middle of the dredged channel to the turn at the beacon.

Sault Ste. Marie lower range (front).—A red electric arc light is shown from a pole standing near the outer end of the Lake Superior Power Company's jetty, the pole being rendered more conspicuous by a target. The light is elevated 37 feet above the level of the river, and visible 3 (3½) miles from all points of approach by water.

Sault Ste. Marie lower range (rear).—A red electric arc light stands 1,300 feet NW. ⅝ N. (N. 38° W.) from the front light.

These two lights in range will lead from the American channel up the middle of the dredged approach to the east end of the canal.

Directions.—Vessels bound down, after passing the red pyramidal buoy off the west extremity of Vidal shoal should keep the range NE. (N. 45° E.) on ahead (this range leads from the American channel) until the beacon is reached; pass 125 feet south of the beacon, and steer E. $\frac{3}{4}$ N. (N. 82° E.) for the entrance to the canal.

Vessels bound upward should keep the usual course in making for the American canal until they bring the Canadian range lights below the canal in one bearing, NW. $\frac{5}{8}$ N. (N. 38° W.). They should then follow the alignment of these lights, between the red and black buoys, until they reach the axis of the canal, due west. They moor to the crib-work at the north side of the entrance while waiting to go through the lock.

Hay Lake channel is the channel cut south of Sugar island through Sugar Island rapids, passing through Hay lake, then by way of Middle Neebish, and rejoins the river at the foot of Sugar island, saving a distance of 9½ (11) miles and giving a channel easily navigated.

DISTANCES BY THE HAY LAKE CHANNEL.

	Miles.
Detour light to Anthonys dock	$2\frac{2}{10}$ ($2\frac{1}{2}$)
Anthonys dock to Lime Island dock	$7\frac{8}{10}$ (9)
Lime Island dock to can buoy, Mud lake	$8\frac{2}{3}$ (10)
Can buoy to Johnson point, Rains island	$3\frac{1}{2}$ (4)
Johnson point to intersection Hay Lake channel	$3\frac{9}{10}$ ($4\frac{1}{2}$)
Intersection of channel to Rains dock, Sugar island	$1\frac{1}{2}$ ($1\frac{3}{4}$)
Rains dock to head of cut, lake George	6 (7)
Head of cut (or flats) to Churchs point	$5\frac{1}{4}$ (6)
Churchs point to intersection of Hay Lake channel	$9\frac{1}{2}$ (11)
Intersection of channel to lower-lock gates	$1\frac{3}{4}$ (2)
Lower-lock gates to abreast point Iroquois	13 (15)
Total	63 ($72\frac{1}{2}$)

Lights.—The cuts through Hay Lake channel are regularly lighted—red lights on the east sides of the cuts and white lights on the west sides.

Buoys.—The cuts are also regularly buoyed—red even-numbered buoys on the east sides and black odd-numbered buoys on the west sides.

Directions.—A course ESE. $\frac{3}{8}$ E. (S. 72° E.) will carry from the east end of the canal (United States) to the entrance of Hay Lake channel. In making the turn into this channel vessels should pass close to the black 25-foot spar buoy at the west side of entrance to avoid being swept by the strong current on the dangerous shoal at the east side of new channel; thence through the channel between the lights and buoys and on the Six-mile Point range S. by E. $\frac{7}{8}$ E. (S. 21° E.) until the Frechette Point range comes on NW. $\frac{3}{4}$ N. (N. 37° W.), when head S. 37° E., with the range on astern, into Hay lake. When in Hay lake, with the

Middle Hay Lake range on N. by W. $\frac{7}{8}$ W. (N. 21° W.), steer S. 21° E. until Nine-mile Point light bears ESE. $\frac{3}{8}$ E. (S. 76° E.), **when change** course to SSE. $\frac{5}{8}$ E. (S. 30° E.), which leads into the cut at the foot of Hay lake and is the range for this Lower Hay Lake cut. When Middle Neebish Cut range comes on WNW. $\frac{1}{8}$ W. (N. 69° W.) steer S. 69° E. through Middle Neebish cut, between the lights and buoys. This course will carry clear until the Harwood range, at south end of Sugar island, comes on N. $\frac{1}{2}$ W. (N. 5° W.), when change course to S. 5° E. and down the St. Marys river, as directed on page 45.

Caution.—There is a very strong current abreast of the first red stake just below the dike at Middle Neebish cut which sets toward Sugar island; and about 1,000 feet farther down the channel the current sets in the opposite direction.

This part of the channel is considered the most dangerous in the whole river for vessels meeting.

In leaving Hay Lake channel vessels should avoid getting too close to the red buoys, as this current tends to carry them on the shoal.

For a description of range lights, buoys, etc., used in the St. Marys river. List of Lights and Fog Signals and List of Beacons, Buoys, and Daymarks published by the United States Lighthouse Board.

Directions, west to east.—Standing in from lake Superior bring Point Iroquois light abeam, distant $1\frac{1}{4}$ ($1\frac{1}{2}$) miles,

head a course SE. $\frac{1}{2}$ S. (S. 39° E.)

until St. Marys River upper range comes on, then

head a course, on the range, SE. by E. $\frac{1}{2}$ E. (S. 62° E.)

until St. Marys River lower range is made, then

head a course, on the range, ENE. $\frac{1}{2}$ E. (N. 73° E.)

until Pointe aux Pins light bears N. by E. $\frac{1}{2}$ E. (N. 17° E.), then

head a course NE. $\frac{3}{4}$ N. (N. 37° E.)

until Pointe aux Pins bears abeam, then

head a course NE. by E. (N. 56° E.)

until Big point bears east, when a

course ENE. $\frac{3}{8}$ E. (N. 72° E.)

will lead in for the South Pier light at entrance to the United States canal. If it is desired to use the Canadian canal, see directions on page 42.

After clearing the canal vessels should make use of Hay Lake channel, directions for which are given on page 42. Directions for the river will now be given from the east entrance of the canal.

The channel beyond is marked by many buoys, visible the one from the other excepting the bend at Garden River reach around the NE. point of Sugar island. Here it is best to keep the Canadian shore close-to.

Clearing the east entrance of the canal

head a course ESE. $\frac{3}{8}$ E. (S. 72° E.)

on Bayfield Rock range until the Sault range is made, when bring it in line astern and

head a course on the range E. by N. (N. 79° E.).

When near the spar buoy off Jenkins rock

head a course E. ½ N. (N. 85° E.)

on the Topsail Island range until the Farmers Ridge Range lights come in line, when a

course on the range, NE. by E. (N. 56° E.)

must be made until Partridge Point Range lights can be brought in line astern, when

head a course, on the range, N. by E. ⅝ E. (N. 18° E.).

(There is a dangerous current just below the cut below Topsail island. Mariners are cautioned to make due allowance for the current when passing.)

Continue this course until point Lewis is abeam, then make a

course NNE. ¾ E. (N. 31° E.),

keeping in mid-channel past Patridge point. On nearing Bells point take a mid-channel course past it and Palmers point, passing Palmers Point light near-to on a

course ESE. ¾ E. (S. 76° E.)

until close to buoys, when head on the Catholic Mission range a

course SE. ½ E. (S. 51° E.)

until Payment range can be made astern, when

head a course, on the range, ENE. ½ E. (N. 73° E.)

until close to Payment docks, thence a channel course must be carried nearer the Canadian shore, rounding the point and passing between the red spar buoy and Manhattan light.

Form this light a mid-channel course between Squirrel island and Sugar island, until abeam of Church point, when a

course S. by E. ½ E. (S. 17° E.)

will carry clear of Church Point light. Pass the black buoy, which marks the turning point to the south, on the starboard hand, then

head a course SSW. ⅛ W. (S. 24° W.)

to Upper Lake George Crib light, keeping it to port,

shape a course S. by E. ¼ E. (S. 14° E.)

through the cut, passing between the buoys, of which there are 11 pairs, as far as Middle Lake George light, then between the buoys in mid-channel to the lower light. From the lower light, the Duck Island range,

a course S. ½ E. (S. 5° E.)

will carry abeam of the red spar buoy off Duck island.

Keeping this buoy to port, head

a course SSE. (S. 23° E.)

until between Indian point and Ned point. Here the East Neebish range should be taken

on a course, on the range, S. ⅛ W. (S. 1° W.),

the United States lights ahead, the Canadian lights astern.

Carry this course until on Indian Point range, when a

course, on the range, SSE. $\frac{3}{4}$ E. (S. 31° E.)

for a distance of $1\frac{3}{4}$ (2) miles, passing west of the buoy on Merida shoal, will bring close to the buoys off Harwood point. Round the black buoys, when

shape a course SW. $\frac{1}{2}$ W. (S. 51° W.)

on the Hen and Chickens range. Run $\frac{3}{4}$ mile on this course, then change to a

course S. $\frac{3}{8}$ E. (S. 4° E.)

with the Harwood Range lights astern and Dark Hole Range lights ahead. Keep between the black and red spar buoys until the Point of Woods range comes on, when change to a

course SE. $\frac{1}{4}$ E. (S. 49° E.).

When Encampment Crib light is well open steer for it, keeping between the buoys until abeam of the light. Keeping this light to starboard, thence on the Pilot Island range a

course S. by W. $\frac{1}{4}$ W. (S. 15° W.)

carries to Mud Lake can buoy, 3 ($3\frac{3}{8}$) miles. From here a

course SE. $\frac{3}{8}$ E. (S. 49° E.),

with Winter Point Range lights in line, astern, until Point aux Frenes bears SW. by W. $\frac{1}{2}$ W. (S. 62° W.), or at night until the change from the red sector to the white light of Round island is made, then a

course south.

will carry past Round island. Continue this south course for 2 ($2\frac{1}{3}$) miles from Round island abeam, when a

course SE. by E. $\frac{1}{2}$ E. (S. 62° E.)

must be held until Sweets Point light bears abeam, when keep in mid-channel between Pipe Island light and Gaffney point on a

course SW. (S. 45° W.).

Keep this (leaving the spar buoy on reef to starboard and Hoyt Shoal buoy to port) until Point Detour light opens east of Frying Pan Island light, when a

course S. $\frac{1}{2}$ W. (S. 5° W.)

will carry into lake Huron, to a point $\frac{1}{3}$ mile distant from the black buoy, and with it in range with Point Detour lighthouse, NW. by W. $\frac{1}{8}$ W. (N. 58° W.).

DETOUR PASSAGE.

This passage is between Sweets and Dix points on the north and Detour point and the shoals off Barbed point on the south. In the middle of the northern entrance is Pipe island, with shoals extending $\frac{1}{2}$ mile to the northward, and $\frac{1}{2}$ mile in breadth, with islets and rocks at the northern and western extremes. The shoal also extends to the eastward from the island, and curves to the southward and eastward for $\frac{1}{2}$ mile, with $2\frac{3}{4}$ fathoms at its extremity.

WEST SHORE.

Sweets point, the NW. entrance point, has islets, reefs, and shoals extending northward for nearly ¾ mile, with a breadth of ½ mile. There are 6 fathoms close to the edge of the shoal, which is marked by a spar buoy. The shoal follows the shore from Sweets point to and around Gaffney point.

Sweets Point buoy marks a shoal spot, with 14 feet of water over it, to the northward and westward of Sweets Point light. It is moored in 14 feet of water, and is a 25-foot spar buoy, painted black.

Sweets Point light.—A fixed white light, visible 6 (7) miles, is shown from a white upright rising from a small white house with a red roof, built on a crib.

The crib is in 7 feet of water, off Sweets point, 2 (2¼) miles NW. ⅞ W. (N. 55° W.) of Pipe Island light.

It marks the turning point in the channel.

Pipe Island light.—About 2 ($2\frac{3}{10}$) miles from Sweets point is a fixed red light, visible 8½ (9¾) miles, on the SW. side of Pipe island. It is exhibited from an octagonal, white tower, surmounted by a black lantern. A detached frame dwelling, one and a half stories high, stands 50 feet from the tower. The tower is 37½ feet above the lake level, and marks the east side of the channel between Pipe island and the mainland.

Gaffney point.—On the west side, and nearly opposite Pipe island, is Gaffney point, a short distance SE. of which is a rocky shoal marked by a spar buoy.

Five-foot Shoal buoy is moored in 14 feet of water on the east side of the 5-foot shoal, SE. of Gaffney point. It is an 18-foot spar buoy, painted black. Vessels should pass 100 yards to the eastward of the buoy.

The shore is then steep-to to Detour P. O., where there is a pier called Newells Wood wharf. SE. of this pier is Frying Pan island and light.

Hoyt shoal, with from 13 to 18 feet over it, lies about ¾ mile SE. of Pipe Island light. This is probably an extension of the shoal extending SE. of Pipe island.

Buoy.—A red spar buoy is moored in 13½ feet of water.

Frying Pan Island light.—A fixed red light, visible 7½ (8½) miles, n Frying Pan island. It is 18½ feet above the lake level, and is shown from a conical, white tower.

It marks the west side of Detour passage, and is 1¾ (2) miles from Detour light.

This light, with Pipe Island light, forms a range N. ⅜ W. (N. 4° W.) for entering or leaving Detour passage.

From this to Detour point, the shore is bordered by rocks, reefs, and shoals, but it can be approached to ½ mile.

Detour light.—A fixed white light, visible 14⅛ (16½) miles, is shown from a white skeleton tower with a stair cylinder. The tower is connected with a white frame dwelling by a covered way. It marks the west side of the entrance to the St. Marys river.

Fog signal.—There is a fog signal building 50 feet east of the light. A 10-inch steam whistle gives a blast of eight seconds duration, followed by a silent interval of fifty-two seconds.

Detour Shoal buoy marks a shoal NE. by E. of Detour point, distant ¾ mile. It is moored in 16 feet of water, and is a 25-foot spar buoy, painted black. Leave this buoy ⅛ mile to the westward in passing.

Detour Reef buoy.—SE. by E. ⅛ E. (S. 58° E.), distant $\frac{6}{10}$ mile from Detour point, is a 3-fathom shoal marked on its eastern side by a black can buoy, moored in 18 feet of water, on the easterly side of the reef.

EAST SHORE.

Drummond island, from Dix point to point Lookout and Barbed point, forms the eastern shore of this passage.

Dix point is surrounded by reefs extending to the NW. for ⅛ mile. The whole eastern shore of the passage is bordered by shoal water and offlying rocks, but can be approached to ⅛ mile. South of Barbed point, $\frac{2}{10}$ mile distant, is an offlying reef, with a narrow channel between it and the rocky reef extending from the point.

Port Collier is to the eastward of Barbed point. There are many offlying reefs, rocks, and shoals, and several large islands off the entrance also between Barbed point and Fair island.

There are deep, narrow channels among these islands and reefs. The water in the harbor is deep, but navigable only for small craft, and by those well acquainted with this coast.

Barbed point is locally known as Crab island, the neck of land joining the point to Drummond island being covered at high water.

Reported shoal.—A dangerous shoal, ¼ mile wide and ½ mile long, with from 3 to 4 feet over parts of it, is reported as lying from ¾ to 1 mile SW. from Barbed point. As the position of the shoal, if in existence, is not established, vessels bound in or out Detour passage should give the locality a wide berth.

The detached shoal charted as lying directly south of Barbed point is reported lying about 1,000 feet farther to the eastward.

CHAPTER IV.

STRAIT OF MACKINAC.

The Strait of Mackinac on the 45° 50′ parallel, between Detour point and the NE. point of the lower peninsula of Michigan on the east, and Waugoshance light and point aux Chênes on the west, is 41¾ (48) miles long. At the eastern and western entrances between the points mentioned the Strait is, respectively, 22¾ (26¼) and 11 (12¾) miles wide, but contracted in the Strait proper to 4 (4½) miles in width between St. Ignace point on the north and Mackinac lighthouse on the south. It is here further narrowed by Graham shoals on the north shore. These shoals are marked by buoys, and are not in the direct route of vessels using the south channel. Vessels using the north channel must pass south of the red bell buoy on the south shoal.

The north shore of the Strait is much indented by bays and lined by islands. There are several offlying shoals, but the water is deep close-to, and they offer no serious obstructions to navigation, being out of the direct track.

The south shore of the Strait is comparatively free from indentations. Shoal water extends some 4 (4½) miles WNW. from the extremity of Waugoshance point; the outer extremity of this shoal being marked by Waugoshance lighthouse.

The water in the Strait is generally deep, and the shoals lying near the usually traveled routes are marked by lighthouses, lightvessels, or buoys.

ROUTES.

Detour point through Mackinac strait to lake Michigan.—With the buoy in range with Detour Point light, and distant ⅛ mile, a course WSW. ½ W. (S. 73° W.) for 23¼ (26¾) miles will pass Bois Blanc light abeam, distant 1½ (1⅞) miles; thence W. ⅜ N. (N. 86° W.) 7¾ (8⅞) miles to the channel between Mackinac and Round islands, with the red buoy in this channel abeam to starboard; here change course to WSW. ⅜ W. (S. 72° W.) for 5½ (6½) miles. This should bring Old Point Mackinac abeam, distant 1½ (1¾) miles. From this point a W. ⅛ N. (N. 89° W.) course for 16¾ (19¼) miles will bring White Shoal lightvessel abeam, distant 1 ($1\frac{2}{10}$) mile, and a WNW. ⅞ W. (N. 77° W.) course for 21 (24) miles will bring Simmons Reef lightvessel abeam, distant

1 (1⅛) mile. These two positions are used as points of departure (in next chapter) for ports in lake Michigan.

Strait of Mackinac to Thunder Bay island and lake Erie.—When N. by W. ⅝ W. (N. 18° W.) of Old Point Mackinac light, distant 1½ (1⅝) miles, shape course SE. by E. ½ E. (S. 62° E.) for 16 (18⅜) miles; this should bring a vessel abeam of Cheboygan light with the lighthouse and Cheboygan Reef buoy in line. From here change course to east for 8 (9¼) miles, when Nine-mile point should bear abeam, south; thence change again to SE. by E. ½ E. (S. 62° E.) for 36 (41½) miles, when Presque Ile light should be abeam; thence change to SE. ⅝ E. (S. 37° E.) for 24¼ (28¼) miles, when Thunder Bay Island light should be abeam, and a course shaped for the port desired.

Detour point to ports on West and SE. shores of lake Huron.—From the point of departure a SSE. ⅞ E. (S. 32° E.) course for 61½ (70⅛) miles will take a vessel 4 (4⅛) miles off Thunder Bay Island light, with the light abeam. From here a course may be shaped for port desired.

Detour point to lake Erie.—When off Thunder Bay Island light, as above directed, change course to S. by E. ¾ E. (S. 19° E.) for 77½ (89¼) miles, when Sand Beach alternating light at west entrance to Harbor of Refuge should be abeam and distant 4 (4⅛) miles; thence a S. ⅛ E. (S. 7° E.) for 49½ (57) miles will take a vessel north of St. Clair River lightvessel. The directions for St. Clair river and lake and Detroit river are given in Chapter VIII.

Detour point to Georgian bay and ports on the eastern shore of lake Huron.—From off Detour point a SE. by E. ⅜ E. (S. 60° E.) course for 44 (50⅞) miles will take a vessel 4 (4⅛) miles off Duck Island light, with the light abeam. From here shape course for the main channel of Georgian bay or ports on the east coast of the lake as desired.

NORTH SHORE.

From Detour point the north shore of the Strait of Mackinac trends in a westerly direction to the head of St. Martin bay, then it abruptly changes its direction to nearly south to St. Ignace point. From this point to La Barbe point the trend of the coast is WSW., thence to Aux Chênes point it takes a northwesterly direction.

Detour point is a long, narrow peninsula forming the SW. entrance to Detour passage. There are 18-foot patches at ¾ mile SW. and SE. of the point, the latter being marked by a buoy.

St. Vital point is 3½ (4) miles west of Detour point, the shore between receding to the northward, forms a large bay open to the southward. In the NE. corner of this bay is Carlton bay, which might afford protection to small craft from northerly winds. At 7 (8) miles from St. Vital point is Beaver Tail point. There are several outlying shoal patches here, and the shore should not be approached within 1⅓ (1½)

miles. At 1½ (1¾) miles west of St. Vital point is Saddlebag island, and 2 9/10 (3¼) miles farther westward Albany island.

Martin reef is a rocky shoal having 3 feet least water, with shoals all around. The SE. end of this reef is 3½ (4) miles S. by E. ¾ E. (S. 20° E.) from Beaver Tail point, and 6¼ (7¼) miles WSW. ¼ W. (S. 70° W.) from St. Vital point. The reef extends 1 (1¼) mile northwesterly, with deep water between the shoal patches. It is a menace to navigation, as it lies nearly in the track of vessels bound from Detour passage to the channel between Mackinac and Round islands.

Between Martin reef and the mainland, in a northwesterly direction, are Tobin reef, Surveyors reef, and other patches with channels between. None of these channels should be attempted by strangers.

Buoy.—A black can buoy is moored off the SE. end of Martin reef in 20 feet of water. Vessels should pass south of this buoy.

Coast.—Between Beaver Tail point and Fuyards point, 8¾ (10) miles to the westward, is a large indentation in which are several large and small islands, the principal ones of which are Strong, Boot, Ile la Salle, and Ile Marquette, the latter a large island with Marquette bay on its NW. side. Among these islands are many inlets, Scammon harbor being the largest, but on account of offlying shoals they are practically useless except for small craft.

Goose island, 2¼ (2½) miles WSW. of Fuyards point, is surrounded by shoals, a reef extending for over one mile SSE. from its SE. end, From the eastern side shoals extend out ¼ mile, with deep water between them and Marquette island. From the western side shoals extend off nearly ¾ mile westerly and southwesterly. This side of the island should not be approached within a mile.

Reef.—At 2 9/10 (3) miles SW. by W. ½ W. (S. 62° W.) from Goose island is a 6-foot patch with a 9-foot patch a short distance north of it. This reef is ½ mile long north and south, and ⅓ mile in breadth, being nearly circular in shape. It should be carefully avoided in navigating this part of the Strait.

Brulée point.—Between the NW. shore of Ile Marquette and Brulée point is an indentation forming Marquette and other bays; at the head of Marquette bay is the village of Hessel. There is deep water in these bays, with many shoal spots, and they are only suitable for small craft.

Search bay.—West of Brulée point the shore recedes, forming Search bay, open to the southward, its western boundary being St. Martin point. The bay has deep water, no offlying dangers, and would serve as a shelter from northerly winds.

St. Martin point is steep-to and has a deep-water channel between it and a rocky shoal extending east and west 1 (1¼) mile in a direction parallel to the face of the point.

St. Martin bay.—Between St. Martin point and Gross point is St. Martin bay, a large bay free from shoals and with deep water. It is protected from all winds from east to south by way of north, and from SE.

winds partially by Ile St. Martin and Grosse Ile St. Martin. Between these islands and the mainland are three channels into the bay, all having deep water. There are several rivers flowing into this bay at its head, the largest being the Pine and Carp rivers.

Ile St. Martin, circular in shape, over a mile in diameter, lies $1\frac{1}{8}$ ($1\frac{1}{2}$) being miles to the westward of St. Martin point, the channel between perfectly safe if a mid-channel course is kept.

From the South and SW. sides of this island shoal water extends out for nearly a mile, and these sides of the island should be given a good berth in rounding it; the rest of the island is steep-to.

Grosse Ile St. Martin is nearly $1\frac{3}{4}$ (2) miles long NNW. and SSE. and $1\frac{1}{3}$ ($1\frac{1}{2}$) miles broad at its widest part. Shoals extend off $\frac{1}{2}$ mile from the several points of the island. The channel between the islands is deep and safe. A course should be kept a little nearer to Ile St. Martin after passing the shoals extending from that island. This course will clear the spit extending $\frac{1}{2}$ mile off the low east point of Grosse Ile St. Martin.

The channel west of Grosse Ile St. Martin is also deep and safe in mid-channel. Shoal water extends to the eastward from Gross point and to the westward from the NW. point of Grosse Ile St. Martin.

Coast.—Between Gross point and Rabbits Back peak, $3\frac{1}{2}$ (4) miles to the southward, the coast recedes, forming a bay open to the eastward; south of the peak is a small bight of shoal water, open to the SE.; thence the coast trends SSE. for $3\frac{1}{2}$ (4) miles to St Ignace point, with East Moran bay, which is small and open to the eastward, $1\frac{1}{3}$ ($1\frac{1}{2}$) miles NW. of the point.

St. Ignace is on this bay, and projecting into the bay are several railroad docks.

Graham shoals.—North Graham lies $\frac{3}{4}$ mile SSE. of St. Ignace point, and has a least depth of 8 feet. South Graham lies $\frac{3}{4}$ mile SSW. of North Graham and $1\frac{1}{3}$ ($1\frac{1}{2}$) miles south of St. Ignace point, and has a least depth of 6 feet. There is a channel between the shoals and St. Ignace point, but it should not be attempted.

Currents.—The currents in the vicinity of Graham shoals and in the Strait of Mackinac are often strong and irregular. After fresh gales, vessels anchored in the Strait often tail to windward.

Buoys.—A red can buoy is moored in 15 feet of water on the south side of the center of North Graham shoal.

A red bell buoy is moored on the southeasterly edge of South Graham shoal in 24 feet of water. Vessels should pass south of this buoy.

Coast.—From St. Ignace point the coast trends WSW. for $2\frac{1}{2}$ ($2\frac{3}{4}$) miles to La Barbe point, thence it changes its direction to the NW. for $2\frac{9}{10}$ (3) miles to West Moran bay. All this coast is bordered with shoals and should not be approached within a mile.

From West Moran bay the coast is bluff, bending to the northward as far as Gros Cap, and is steep-to; thence it takes a northwesterly

direction for 3½ (4) miles to Aux Chênes point, becoming low and broken by inlets, with shoal water extending off some distance. From Aux Chênes point the coast trends northwesterly into lake Michigan, and is described in next chapter.

St. Helena island lies 1½ (1¾) miles off the bluff, between West Moran bay and Gros Cap. It is about a mile long NE. and SW., but shoal water extends from its SE. side for nearly ⅔ mile, its outer extreme being marked by a buoy.

Buoy.—On the SE. end of a shoal extending southeastward from St. Helena lighthouse a black spar buoy is moored in 18 feet of water. In entering St. Helena harbor from the westward give this buoy a berth of 100 yards.

There is deep water in mid-channel between the mainland and this island.

Light.—On the SE. point of St. Helena island is a white conical tower, 65 feet high, connected by a covered way with a red dwelling, having a red roof. From this tower a fixed red light is shown, visible 14 (16¼) miles.

This light is a guide to vessels making a lee under St. Helena island, and also a leading mark to vessels bound to the westward through the south channel of the Strait of Mackinac.

Caution.—Do not attempt to round the northwestern end of this island at night unless its appearance under Gros Cap and the position of St. Helena shoal are well defined and understood.

In rounding the SE. end of the island at night remember that the buoy marking the reef extending SE. from the island is 1,000 yards from the light.

St. Helena shoal is 1½ (1¾) miles west of the northwestern end of St. Helena island, with deep water between, and with from 8 to 15 feet of water over it.

The shoal is 750 yards in extent NW. and SE., and 500 yards NE. and SW., with 8 feet on its shoalest (southeastern) edge. The soundings are irregular, bottom rocky, with from 3 to 4 fathoms close-to. On the south side of the shoal is a buoy.

Buoy.—A can buoy, painted in red and black horizontal stripes, marks the southern edge of the shoal.

SOUTH SHORE.

Coast.—From Nine-mile point, the NE. point of the lower peninsula of Michigan, to Cheboygan lighthouse the coast takes a general WNW. direction for about 8¾ (10) miles, and can be approached to ¾ mile. West of the lighthouse is McLeod bay, extending to the SE., but almost filled with shoals, having deep-water channels among them.

In the western part of the bay shoal water extends a mile offshore. There is an 11-foot patch ⅛ mile NW. by W. (N. 56° W.) from the Crib light, and a 3-foot rock 1 (1⅛) mile NW. by W. ⅜ W. (N. 60° W.) from the same light.

Buoy.—At ⅞ mile NNE. of Cheboygan lighthouse is Cheboygan shoal, with but 14½ feet of water over it. A black nun buoy is moored in 16 feet of water on the northern side of the shoal, and should be left to the southward in passing it.

Cheboygan light.—On the north point of the land to the eastward of McLeod bay is Cheboygan light station, a square tower 33 feet high, rising from a dwelling, from which is shown a fixed white light, varied by a white flash every minute, and visible 11¼ (13) miles.

Fog signal.—The fog signal at this station is a 10-inch steam whistle giving a blast of five seconds, followed by a silent interval of twenty-five seconds. The fog-signal building is NE. of the lighthouse.

Crib light.—On an isolated crib off the west side of the dredged channel into Cheboygan river is an octagonal tower 26⅜ feet high, from which is shown a fixed red light, visible 11¼ (13) miles. Vessels bound to Cheboygan should pass the crib close-to and then take the range.

Range lights are on the west side of the Cheboygan river on the prolongation of the center line of the cut, and form a range for passing through the cut.

The front light is 42 feet above the lake level, shown from a square tower rising from a frame dwelling.

The rear light is 68 feet above the lake level, exhibited from an open framework tower. The lights are fixed red, visible 7 4/10 (8½) miles, and the towers are 1,112 feet apart. The range is SSW. ⅞ W. (S. 32° W.).

Cheboygan is at the mouth of the Cheboygan river, which drains an area of 850 square miles and empties into McLeod bay, locally known as Duncan bay. The locality is a heavy lumber producing district, and its water traffic is important.

Improvements.—A channel 200 feet wide and 15 feet deep has been dredged from the 15-foot curve to the State Road bridge, marking the upper limit of improvement. This channel has somewhat filled. In January, 1896, the channel was dredged to 18 feet and 120 feet wide from the Strait to Bakers Steamer landing.

A timber crib 40 feet square was built in 1881 on the north side of the entrance in 16 feet of water to mark the exact position of the cut and to serve as a guide for entering it. The crib is used as a foundation for the lighthouse previously described.

Directions.—When a mile off the Crib light, bring on the range SSW. ⅞ W. (S. 32° W.), and stand in.

Coast.—From Cheboygan the coast trends northwesterly for 13 (15) miles to Mackinac City, and it is safe to keep it a distance of a mile. The 4-fathom curve, excepting off the mouth of the Cheboygan river, in the western part of McLeod bay, is not more than ¾ mile offshore, but it generally follows the shore at about ½ mile.

A little NW. of Au Sable point, 4¾ (5½) miles NW. of Cheboygan Crib light, and at the village of Freedom, 3½ (4) miles farther on, the edge of the curve is ¾ mile off shore.

Mackinac City, on Old Point Mackinac, is an open roadstead, and only protected from NW. winds. The best anchorage for small craft is about ½ mile offshore SE. of the railroad pier.

Light.—On Old Point Mackinac a light, flashing red every ten seconds, is shown 62 feet above the lake level, and should be visible in clear weather 13¼ (15¼) miles.

The lighthouse is a cylindrical tower 50 feet high, and forms the NW. corner of the keeper's dwelling, both built of yellow brick. Roof of dwelling red; lantern black. Fog-signal house 80 feet east of tower; brown.

Fog signal.—A 10-inch steam whistle sounds blasts of five seconds' duration, with alternate silent intervals of seventeen and thirty-three seconds.

McGulpin point is 1¾ (2) miles to the westward of Old Point Mackinac, the shore between forming a shallow bight, with shoal water, open to the northward. The point is a bluff, steep-to, and faces the NW. for over a mile. On the north extremity of the point is the lighthouse.

Light.—The light, 102 feet above the lake level, is fixed white, visible 16 (18½) miles.

The lighthouse, on a bluff 70 feet above the lake level, is an octagonal tower attached to the NW. corner of the dwelling, both yellow, with red roofs.

Coast.—From the SW. extremity of McGulpin point the shore recedes to the southeastward for a mile, then trends SW. for 2 (2¼) miles, and then NW. for a mile, forming a bay 2 (2¼) miles wide and a mile deep, with shoal water extending out from the shore for over ½ mile.

This bay affords protection from all winds except those from north to west. From the SW. point of this bay the coast takes a general westerly direction for 8 (9¼) miles to Waugoshance point, with two shallow bights open to the NW.

This part of the coast should not be approached within a mile; and as the extremity of Waugoshance point is neared, a much wider berth should be given it.

Waugoshance point, a long, low, and narrow point, extends out from the mainland for 1¾ (2) miles, and is farther continued by several small islets. The point is the top ridge of a long shoal, which extends out from the mainland for 5½ (6¼) miles to Waugoshance lighthouse, the shoal having a mean breadth of 1¾ (2) miles. Waugoshance island, 1¾ (2) miles westward of the extremity of the point, is a mile long east and west and ½ mile broad.

Caution.—In rounding Waugoshance shoal, do not pass between Waugoshance lighthouse and the island; keep a lookout for Vienna shoal, and give it a good berth.

Waugoshance light is on the northwestern end of Waugoshance shoal, 1¾ (2) miles NW. of Waugoshance island.

The light is fixed white, varied by a flash every forty-five seconds, and is visible 14½ (16½) miles.

The lighthouse, 65 feet high, is an iron tower, with a dwelling and a fog-signal building, all surrounded by a square crib. The buildings are painted red and white in alternate horizontal bands.

Fog signal.—The fog signal is a 10-inch steam whistle, giving blasts of five seconds' duration, followed by a silent interval of twenty-five seconds.

Caution.—Vessels drawing more than 14 feet of water are recommended to pass to the northward of Waugoshance Sixteen-foot (Rose) Shoal buoy.

Under no circumstances should vessels approach Waugoshance light closer than ¾ mile, with it bearing to the westward of WSW. (S. 68° W.), nor should they bring the lighthouse to bear to the northward of NNE. (N. 23° E.) when standing to the southward, as the reefs are very foul with bowlders.

A description of the shoals outside of Waugoshance and of the eastern shore of lake Michigan is given in the following chapter.

ISLANDS AND SHOALS IN STRAIT OF MACKINAC.

Under this heading will be considered the islands and shoals in the Strait which lie clear of the coast line, and which can not be considered as forming bounds to bays or harbors. They will be described from the eastward.

Spectacle reef.—This reef lies 9 (10½) miles east of the east point of Bois Blanc island, and is almost in the track of ships bound from Detour passage to the South channel of Mackinac strait. The reef is $\frac{7}{10}$ mile long north and south and ¼ mile broad east and west, with a depth of 7 feet on its southern part. On the northwestern edge of the reef on a square crib is the lighthouse. Shoal water, less than 18 feet, extends about 1,000 feet eastward and 2,500 feet southward from the lighthouse.

Buoy.—A red can buoy is moored on the south end of Spectacle reef.

Light.—The light, 86 feet above the lake level, is flashing red and white, alternately, every thirty seconds, and is visible 15 (17¼) miles.

The lighthouse is a conical, gray tower, with dome and railings painted black, surrounded by a square wooden crib, on which are two white fog-signal houses and a white boathouse.

Fog signal.—The fog signal is a 10-inch steam whistle, sounding blasts of three seconds, with alternate silent intervals of twelve and forty-two seconds.

Raynolds reef, 3¼ (3¾) miles to the westward of Spectacle reef, is a dangerous shoal with from 12 to 13 feet of water over it. It should not be approached nearer than ¼ mile.

Buoy.—A can buoy, painted in red and black horizontal stripes, is moored in 17 feet of water, and marks the northern edge of this shoal.

Poe reef is 1½ (1⅞) miles from the SE. end of Bois Blanc island. The reef extends east and west 2,000 yards, with a least depth of 12 feet of water over it. There is a narrow channel north of it, which should not be attempted by strangers.

Lightvessel.—A lightvessel is moored in 41 feet of water to the southward and eastward of the easterly end of the reef. The vessel shows simultaneously from three lens lanterns encircling the foremast-head a fixed white light. The light is 40 feet above the lake level, and is visible $11\frac{3}{4}$ ($13\frac{1}{2}$) miles. The vessel has two masts, is schooner rigged, without a bowsprit. There is a circular black cage-work day mark at the foremasthead, with a small black smokestack, and the fog signal between the masts. The hull is red, with *Poe Reef* in large white letters on each side and *No. 62* on each bow.

Vessels should pass south of this lightvessel when using South channel.

Fog signal.—A 6-inch steam whistle sounds blasts of five seconds' duration, separated by silent intervals of ten seconds. If the whistle be disabled, a bell will be rung by hand.

Buoy.—A red can buoy is moored in 17 feet water on the SE. point of Poe reef.

Bois Blanc island forms the north boundary to the South channel, Strait of Mackinac. Its greatest length is $9\frac{1}{2}$ (11) miles WNW. and ESE. and its breadth for half this distance is 4 ($4\frac{1}{2}$) miles, narrowing to a mile at its northwestern end.

About $2\frac{1}{4}$ ($2\frac{1}{2}$) miles from its eastern end a narrow peninsula extends out from the northern shore northerly for $1\frac{1}{2}$ ($1\frac{3}{4}$) miles, tapering at its northern edge to a breadth of but $\frac{1}{4}$ mile. On the NE. point of this peninsula is a lighthouse.

Light.—The light is fixed white, 53 feet above the lake level, and visible $12\frac{3}{4}$ ($14\frac{3}{4}$) miles. The lighthouse is a square tower, 38 feet high, on a yellow dwelling.

Shoal.—NW. of the light $\frac{1}{10}$ mile is a shoal with 17 feet of water over it.

Life-saving station.—Bois Blanc station is about halfway between the East and SE. points of the island.

Coast of the island.—From the peninsula the coast of the island trends ESE. for $2\frac{1}{4}$ ($2\frac{1}{2}$) miles, and is safe to approach to $\frac{1}{3}$ mile. Shoal water extends off the east point of the island for nearly $\frac{1}{2}$ mile, and follows the southeastern side at this distance until off the SE. point, when it extends off as a spit for a mile. From the southern edge shoals extend off for nearly $\frac{3}{4}$ mile, closing in to $\frac{1}{4}$ mile at the point where the southern coast changes its direction to the northwestward. The shoal water follows the trend of the coast to the NW. end of the island except at Zela point.

Zela shoal.—Halfway between the NW. and SW. ends of Bois Blanc island a narrow spit extends out northwesterly for $1\frac{3}{4}$ (2) miles from Zela point, and is marked on its extreme NW. end by a buoy.

Buoy.—A red can buoy is moored in 18 feet water, and marks the extreme west end of the shoal. There is no channel between this buoy and the island.

The northern shore of the island for $3\frac{1}{4}$ ($3\frac{3}{4}$) miles from the north point

has shoal water extending out for ¾ mile, and Bois Blanc is connected with Round island by shoals. A rocky shoal of 3 feet lies almost on the edge of the 4-fathom curve about one mile NE. of the north point, with 76 feet close-to. This is a dangerous spot. About 3¼ (3¾) miles to the eastward from the north point the shore becomes steep-to, and continues so to the end of the peninsula. The bight formed by the peninsula gives good protection from SE. winds.

Round island is ½ mile from Bois Blanc island, with which it is connected by shoals. Shoals extend eastwardly 1¾ (2) miles from the southeastern side of the island.

The NW. point of the island extends in a long narrow point for ½ mile, with shoals on each side.

Light.—On the extreme NW. end of Round island is a light tower on a brick pier, rising 8 feet above the water. The light is shown at an elevation of 53 feet, and is visible 12 8/10 (14¾) miles. The light is fixed white, varied by a white flash every twenty seconds.

Shoal.—A 24-foot shoal lies 1¾ (2) miles NE. from the extreme NW. point of Round island almost to mid-channel.

Major shoal lies 2¼ (2½) miles SW. by W. of the NW. point of Round island.

The general direction of the shoal is NW. and SE., and it is 1,200 feet long. There is a least depth of 14 feet of water 400 feet SE. of the buoy.

Buoy.—A can buoy, painted in red and black horizontal stripes, is moored in 19 feet of water on the middle of the shoal.

Mackinac island, 2¼ (2½) miles eastward of St. Ignace point, is 2 6/10 (3) miles long and 1¾ (2) miles broad. Its southern part, on which is the town and fort of Mackinac, forms the northern shore of the narrowest part of the Strait of Mackinac. The island is of importance as a military station.

Mackinac.—The town of Mackinac, at the SE. end of the island, is on the north channel of the Strait of Mackinac. Many large passenger and transient steamers stop here. The town is a coaling station, and is a great resort for invalids and tourists.

Harbor.—The harbor is between Biddle and Mission points. It is open to the southward and exposed to the wind from east or west, which often makes such a heavy sea that landing is impossible.

The water front of Fort Mackinac comprises nearly ⅓ of the water front of the whole harbor.

Buoy.—A red can buoy is moored in 16 feet of water at the end of a spit extending off from the SW. point of Mackinac island. Vessels should pass south of it, and avoid the shoal off the NW. point of Round island.

Directions—From the eastward.—Steer for the middle of the passage until the docks are ranged, when haul up for them, giving the SE. point of the island a berth of ¼ mile.

From the westward.—Should the buoy off the SW. point of the island not be seen, open up Bois Blanc light, a point on the starboard bow, until the red light (private light) on the south pier bears North, when haul up for the docks.

For clearing the spit off the SW. point of the island, a good range is with the blockhouse on Fort Mackinac on a line with the south pier head.

Current.—During the prevalence of strong easterly or westerly winds a strong current sets through the channel between these islands, sometimes as great as 6 or 8 knots an hour. In the harbor, inside the range of the points, the current is usually contrary to that in the passage, and is caused by the eddy.

Anchorage.—Good anchorage is found in the harbor anywhere north of the range of the north pier in from 3 to 5 fathoms of water. The docks extend out about 500 feet ESE. and have 16 feet of water at their outer ends.

There are no pilots, but tugs are available. Wharfage is charged at the rate of 5 cents per 100 pounds.

CHAPTER V.

LAKE MICHIGAN.

Lake Michigan derives its name from two Indian words of the Chippewa dialect, michi (great) and sawgyegan (lake). It is the largest lake wholly within the United States and the second largest known body of fresh water in the world.

Lying in a north and south direction it extends from longitude 84° 45′ W. to longitude 88° W., and from latitude 41° 37′ N. to latitude 46° 05′ N., a length of 279 (320) miles, with an average width of about 57 (65) miles. The area of this grand sheet of water is 22,400 square miles, its circumference nearly 821 (945) miles. Its surface is 581 feet above the Atlantic ocean, and, being 1,000 feet deep, its bottom is over 400 feet below the surface of that ocean.

The Strait of Mackinac connects this lake with lake Huron. It is connected by canal with the Illinois river, and so with the gulf of Mexico.

The shores of lake Michigan are generally low and sandy, and the land slopes gradually to the lake. The northern shore of the lake is irregular and more rugged and picturesque than the other shores, the summit of the highest peak being about 1,400 feet above the sea. On the eastern side are numerous sand hills formed by the wind into innumerable fantastic shapes sometimes covered with stunted trees and scanty vegetation, but most generally bare and rising to heights of from 150 to 250 feet. The southwestern shore is generally low, with sand hills covered with shriveled pines and burr oaks. Along the western shore woods and prairie alternate, interspersed with a few high peaks. The cliffs on the east shore of Green bay form a bold escarpment, and from this ridge the land slopes gradually to the lake. On this slope there is a remarkable series of drift hills and circular depressions called potash kettles.

From the appearance of the coast lake Michigan is believed to be moving slowly westward, uncovering the eastern and encroaching upon the western shore.

With the exception of Green and Traverse bays lake Michigan has few indentations in its coast line, and, excepting the north end, it is free from islands. The waters near shore are shoal, and, having few harbors, it is dangerous navigation in heavy blows. There are a number of streams flowing into the lake, but, with the exception of the Fox

flowing into Green bay, and the Grand, Kalamazoo, and St. Joseph rivers in the east, they are unimportant.

The surface level of the lake is subject to fluctuations from one season to another as well as during the course of a season. In lake Michigan the point of the lowest low water has been falling for seven years, and has so far fallen 5 feet. The average now is 0.16 feet below the lowest average recorded. A slight variation of the surface level is also due to a lunar tidal wave of its own. Observations have shown the difference of the level due to tide to be about 0.153 feet. At spring tides the difference between high and low water is 0.245 feet. High water occurs half an hour after the meridian passage of the moon.

Around the lake the climate is quite equable for, though the winter is cold and the summer hot, the waters of the lake modify the extremes. The mean temperature around the lake varies from 46° to 54°. The average rainfall is 30 to 44 inches. The mean barometer varies from 29.5 to 30.01.

The country around lake Michigan is exceedingly rich and fertile, and an immense commerce has sprung up along this lake.

Snow falls in the north before the occurrence of the heavy frosts. The northern part of the lake only is covered with ice in winter and it never reaches as far south as Milwaukee. Milwaukee river remains closed on an average for one hundred days from the end of November to the middle of March.

The Strait of Mackinac, which longest retains the ice, is usually open between May 1 and December 1.

The finest agricultural land in the United States is near the lake, and there is an immense trade in all grains, fruits, live stock, and lumber, and their products, as flour, pork, hides, leather goods, furniture, etc. Rich lead and copper mines abound, as also salt, iron, and coal. Abundant water power promotes manufactures of all kinds. Beer and distilled liquors are made in this region, and fine building stone is obtained from numerous quarries.

NAVIGATION.

Navigation generally opens on the lake about the middle of April and closes about the middle of December.

The iron buoys are taken up every year at the close of navigation and the places marked by spar buoys of the same colors and numbers, and the lightvessels are removed about the same time. When they are replaced on the opening of navigation their positions are sometimes altered; masters of vessels are therefore cautioned to obtain the latest information on this subject and to keep their charts corrected.

See page 6.

HARBORS OF REFUGE.

Entrance of Sturgeon Bay canal.—The entrance of the Sturgeon Bay and Lake Michigan canal, on the NW. shore of the lake, has been

improved by converging piers, and is now a fair harbor of refuge for small craft. Except in northerly gales the bay at the NW. end of the canal is an excellent harbor of refuge.

Milwaukee, on the western shore of the lake, has been improved. A breakwater sheltering it from NE. to SE. gales has been half completed. At present it is a very good harbor of refuge from NE. winds.

Chicago, on the southwestern end of the lake, is, with its exterior breakwater, an excellent harbor of refuge from northerly gales.

Grand Haven, with an entrance width of 390 feet, is the best harbor along the east coast for refuge from gales, but has no exterior breakwater.

Little Traverse has an excellent and well-sheltered natural harbor, though it is small and some distance from the direct routes of travel.

DANGERS.

All the southern half of the lake is free from offlying dangers. Between and around the islands in the northern part of the lake, and in the approach to the Strait of Mackinac, are numerous shoals, which will be described as they are met with in the description of the coast.

SAILING DIRECTIONS.

In the previous chapter, page 48, directions have been given that will bring a vessel a mile south of White Shoal and Simmons Reef lightvessels; directions will now be continued from these points to the various ports of lake Michigan. These directions will take a vessel off the port desired, and special directions for entering will be found under the description of the port.

To Traverse City.—From the point of departure bring White Shoal lightvessel astern bearing N. by E. $\frac{7}{8}$ E. (N. 21° E.), and steer S. by W. $\frac{7}{8}$ W. (S. 21° W.) 44 (50$\frac{3}{8}$) miles, when the south point of Northport point should be abeam, distant 1$\frac{1}{2}$ (1$\frac{3}{4}$) miles; here change to S. by W. (S. 11° W.) for 21 (24$\frac{2}{10}$) miles; this should bring a vessel off Traverse City.

To Chicago and ports on west shore.—On the course S. by W. $\frac{7}{8}$ W. (S. 21° W.), when Ile aux Galets light is abeam, change course to SW. $\frac{3}{4}$ S. (S. 37° W.) for 51$\frac{1}{2}$ (59$\frac{1}{4}$) miles, when South Manitou Island light should bear West; here change to SW. by W. $\frac{3}{4}$ W. (S. 65° W.) for 6$\frac{1}{2}$ (7$\frac{1}{2}$) miles, when the same light should bear North; thence SW. $\frac{7}{8}$ S. (S. 35° W.) for 20 (23) miles should take a vessel 4$\frac{1}{2}$ (5) miles west of Point Betsie light, which position is the point of departure for the ports in the lake to the southward.

From this position—

To Chicago, S. by W. $\frac{5}{8}$ W. (S. 18° W.).

To Racine, SSW. $\frac{5}{8}$ W. (S. 27° W.).

To Milwaukee, SSW. $\frac{7}{8}$ W. (S. 33° W.).

To Sheboygan, SW. (S. 45° W.).

To ports on east shore of lake.—Follow the shore at a distance of at least 3 (3½) miles until off the desired port.

For deep-draft vessels and in heavy westerly weather.—When abeam of Simmons Reef lightvessel (see p. 48) shape course W. ¼ S. (S. 89° W.) for 29 ($33\frac{4}{10}$) miles, when a vessel should be abeam of Seul Choix Point light, distant 2½ ($2\frac{8}{10}$) miles; here change course to SW. ¼ W. (S. 48° W.) for 38½ (44⅓) miles; this should bring a vessel abeam of Poverty Island light, distant 5 (5¾) miles, which position is the point of departure for ports on the lake. From this position, after passing the shoals off the entrance to Green bay, the shore should be kept at a distance of about 3 (3½) miles, which will give smoother water and allow the position of the vessel to be well established at any time.

To Green bay.—Proceed as in directions for deep-draft vessels until Poverty Island light is abeam, when change course to W. by S. (S. 79° W.) and head directly for Rock Island light until within a mile of it, when round it at this distance and enter the bay.

By keeping Rock Island light bearing between W. by S. (S. 79° W.) and W. by N. (N. 79° W.), the 9-foot shoal to the northward and the rocks to the southward of this entrance to Green bay will be cleared. With the light outside of these bearings a vessel will be too near one or the other of these shoals.

A description of the islands and offlying shoals in the northern part of the lake, and the coast of the lake, will now be described in the following order:

(1) Islands and offlying shoals.
(2) North and west shores of the lake, omitting Green bay.
(3) East shore of the lake.
(4) Green bay.

ISLANDS AND SHOALS.

St. Helena shoal. See page 52.

Manitou Paymen shoal is 3¼ (3¾) miles from the north shore of the lake in longitude 85° 04′ W. The shoal is about ¾ mile in extent NE. and SW. and 800 yards NW. and SE., with a least depth of 6 feet.

Buoy.—A red and black horizontally striped nun buoy is moored in 17 feet water on the SW. point of this shoal.

Pelkie reef lies $2\frac{2}{10}$ (2½) miles WSW. of Epoufette point; it is about ⅜ mile in diameter and has 7 feet over it.

Potter reef lies 5 (5¾) miles E. by N. of Patterson point; it is about ¼ mile in diameter and has 6 feet over it. At 3 (3½) miles E. by N. of this shoal are two 10-foot spots, and nearly a mile SE. of them is a 13-foot patch. These are all rocky shoals, and as they are unmarked vessels should give this locality a wide berth.

Simmons reef lies almost in the latitude of Aux Chenes point, and its east end is 12 ($13\frac{8}{10}$) miles west of it. From its east end the shoal extends west $1\frac{8}{10}$ (1½) miles and widens out, it being about ½ mile north and south over its shoalest part, which has 6 feet over it.

Lightvessel.—The lightvessel is moored in 19 feet water southward of the reef. It has two masts, is schooner rigged, and has a red, oval cage-work day mark at each masthead. The hull is red, with *Simmons Reef* in white letters on each side and *No. 55* on the stern. The lightvessel shows two red lights, one from each masthead, 30 feet above the lake level, and visible $7\frac{4}{10}$ ($8\frac{1}{2}$) miles.

Fog signal.—A 10-inch steam whistle sounds blasts of five seconds, with silent intervals of fifty-five seconds.

White shoal lies 4 ($4\frac{6}{10}$) miles NW. of Waugoshance lighthouse and $5\frac{1}{4}$ (6) miles SSE. $\frac{1}{2}$ E. of Simmons reef (6-foot spot). The shoal is of small extent, and has 3 feet over it.

Lightvessel.—The lightvessel is moored in 42 feet of water, to the eastward of the shoal. It has two masts, is schooner rigged, with a black, oval cage-work day mark at each masthead. The hull is white, with *White shoal* in large black letters on each side, and *No. 56* on the stern.

A fixed white light is shown at each masthead, each being elevated 30 feet and visible $9\frac{3}{4}$ ($11\frac{1}{4}$) miles.

Fog signal.—The fog signal is a 6-inch steam whistle, which sounds as follows: Blast one second, silent interval ten seconds; blast one second, silent interval ten seconds; blast three seconds, silent interval thirty-five seconds.

Buoy.—A spar buoy, painted in red and black horizontal stripes, is moored at the SW. end of White shoal in 17 feet of water.

Gray reef is the eastern extremity of an extensive reef extending easterly from Hog and Hat islands. It consists of many detached rocky patches, with from 6 to 17 and 18 feet of water over them. The easternmost patch has 14 feet over it.

Lightvessel.—The lightvessel is moored in 20 feet of water off the easterly end of Gray reef. It has two masts, is schooner rigged, showing a black oval cage-work day mark at the foremasthead, and a red one at the main. Hull red, bulwarks white, with *Grays Reef* in large black letters on each side, and *No. 57* on the stern.

A fixed white light is shown at the foremasthead, and a fixed red light at the main, each 30 feet above the water, and visible (white) $9\frac{3}{4}$ ($11\frac{1}{4}$) and (red) $7\frac{4}{10}$ ($8\frac{1}{2}$) miles.

Fog signal.—The fog signal is a 6-inch steam whistle, which sounds as follows: Blast one second, silent interval twenty seconds; blast one second, silent interval twenty seconds; blast three seconds, silent interval fifteen seconds.

Rose shoal consists of several patches, of from 15 to 18 feet, lying between North and NW. by N. from Waugoshance light, distant a mile and upwards. They lie almost on a line between Waugoshance light and White Shoal lightvessel, and nearly on a line between St. Helena lighthouse and Grays Reef lightvessel. These ranges will be useful in rounding the shoal at night. Deep-draft vessels should not pass south of Rose shoal.

Buoy.—A black nun buoy is moored in 23 feet water on the north edge of the 16-foot spot.

Waugoshance light, shoal, and island. See page 54.

Vienna shoal (the shoalest spot) is $1\frac{3}{10}$ ($1\frac{1}{2}$) miles WSW. of Waugoshance lighthouse. It is nearly $\frac{1}{2}$ mile in extent east to west and $\frac{1}{4}$ mile north to south, with a least depth of 11 feet. In a southeasterly direction 1,200 yards from the 11-foot spot is an 18-foot rocky patch, and $\frac{1}{2}$ mile beyond this ESE. is a 12-foot patch on the NW. extremity of an extensive 17-foot shoal. About $1\frac{1}{4}$ ($1\frac{4}{10}$) miles west of Vienna shoal are depths of 22 and 23 feet, with deeper water in between.

Buoy.—A red and black horizontally striped can buoy is moored in 18 feet water on the NW. point of Vienna shoal.

Ile aux Galets lies $7\frac{1}{2}$ ($8\frac{6}{10}$) miles SSW. $\frac{3}{8}$ W. of Waugoshance light. The shoal extends $\frac{3}{8}$ mile NW. and the same distance easterly from the lighthouse with least water 5 feet.

Light.—On Ile aux Galets (Skilligallee) a fixed white light, visible 13 ($15\frac{1}{4}$) miles, is shown 58 feet above the lake level from an octagonal tower connected with a white dwelling.

Fog signal.—A 10-inch steam whistle, in a building near the tower, sounds blasts of five seconds' duration, with alternate silent intervals of ten and forty seconds.

Buoy.—A black nun buoy is moored in 18 feet water and marks the NW. end of the reef extending NW. from the light. Vessels must not attempt to pass between the buoy and lighthouse.

Reef.—NE. from the light 1 ($1\frac{1}{4}$) mile is a reef with from 14 to 16 feet over it.

Hat island is the NE. island of the group in the northern part of the lake. It is small, about $\frac{1}{4}$ mile square, and is on the northern part of an extensive reef which extends southward of the island 1 ($1\frac{1}{4}$) mile. On this reef is an exposed rock and very shallow water. The reef extends to the eastward in disconnected patches and terminates in Gray reef.

Hog island.—The north part of this island is $2\frac{4}{10}$ ($2\frac{3}{4}$) miles west of Hat island. It is 3 ($3\frac{1}{2}$) miles long and $1\frac{3}{10}$ ($1\frac{1}{2}$) miles wide in places. The island is low and wooded and is surrounded by shoals which extend from the island in all directions for some distance. The shoals extending eastward, with those from Hat island, terminate in Gray reef. There is no passage between Hat and Hog islands, nor between Hog and Garden islands.

Hog island reef is $2\frac{8}{10}$ ($3\frac{1}{4}$) miles SSE. from Hog island. It extends east and west $\frac{3}{8}$ mile and 220 yards north and south. There are only 6 feet on the west end of the reef.

Buoy.—A red and black horizontally striped can buoy is moored in 18 feet water on the SE. end of the reef.

Garden island.—The SE. end of this island is $2\frac{6}{10}$ (3) miles west of the SW. end of Hog island. From this end it extends $4\frac{1}{3}$ (5) miles in a

northwesterly direction, and is from 1¾ (2) to 2$\frac{3}{10}$ (2½) miles broad. It is low and wooded and surrounded by ten rocks, reefs, and shoals.

Shoals.—On the east side extensive shoals connect this island with Hog island. These extend around the south and west sides, 7 feet of water being found in spots 2$\frac{3}{10}$ (2½) miles SW. of the island. The NW. end of the island is apparently clear outside of ¾ mile, but this and all these islands should be given a wide berth.

Garden Island shoal is a small 15-foot shoal 2½ (2¾) miles NE. by N. from the NW. end of Garden island.

Buoy.—A red and black horizontally striped spar buoy is moored in 18 feet water and marks Garden Island shoal.

Squaw island is the NW. island of the group in the northern part of lake Michigan. It is a small island, low and partly wooded, and is ½ mile north and south, ⅜ mile wide at its north end and tapers to a point at its south end. It is surrounded by an extensive reef, and should not be approached nearer than 1$\frac{3}{10}$ (1½) miles.

Light.—A fixed red light, varied by a red flash every fifteen seconds, visible 13 (15) miles, is shown 57 feet above the lake level from an octagonal tower attached to a dwelling, both red, on the north end of Squaw island.

Fog signal.—A 10-inch steam whistle sounds blasts of five seconds' duration, with alternate silent intervals of twenty and forty seconds.

Buoy.—A black nun buoy is moored in 23 feet water, and marks the north end of the shoal extending to the northwestward from Squaw island, and is 1⅞ (1$\frac{7}{8}$) miles NNE. from the light.

Lansing shoal lies 4 (4$\frac{6}{10}$) miles north of Squaw Island light. It has 19½ feet on its southern end and 23 feet on its northern end.

Buoy.—A red nun buoy is moored in 28 feet water, and marks the SE. end of Lansing shoal. Vessels should pass between this and the black buoy marking Squaw Island shoal.

Whiskey island.—West of Garden island is Whiskey island, about ⅜ mile square, with a small hill on the western side.

Shoals.—Rocky shoals extend from this island a mile to the eastward, ½ mile to the westward, and ⅜ mile to the northward and southward. Between this and Garden island are numerous detached 14 and 17 foot spots, and the passage should not be attempted.

Whiskey Island shoal.—This shoal has a spot just awash one (1¼) mile SW. of Whiskey island, and from this point it extends one mile east, ½ mile north and west, and ¼ mile south.

Buoy.—A red spar buoy is moored in 17 feet, and marks the south end of this shoal.

Trout island, 3$\frac{7}{10}$ (4¼) miles SW. of Whiskey island, is of small extent. It is ¼ mile NW. and SE. and ⅜ mile north and south. It is surrounded by shoals which extend from it ¼ to ½ mile. Midway between this island and High island is a 12-foot patch.

Shoal.—West of the north end of Trout island $1\frac{3}{4}$ (2) miles is an 18-foot spot.

High island.—West of the north part of Beaver island $3\frac{1}{2}$ (4) miles is High island, 3 ($3\frac{1}{2}$) miles long north and south, $2\frac{9}{10}$ (3) miles wide at the north end, and one ($1\frac{1}{4}$) mile wide at the south end. The island has a few small hills on the W. and NE. sides, and is thinly wooded. Exposed rocks skirt the coast to the South and NW., and shoals extend from $\frac{1}{2}$ to $\frac{7}{8}$ mile from the shore. At the NE. end 5 feet of water is found 1 ($1\frac{1}{4}$) mile from shore.

Gull island.—This island lies $5\frac{3}{4}$ ($6\frac{1}{2}$) miles west of the south end of High island and is $1\frac{2}{10}$ ($1\frac{3}{8}$) miles long north and south and $\frac{3}{8}$ mile wide. Its shore is lined with low bluffs, and it is partly wooded.

Shoals.—Shoals extend nearly $\frac{1}{2}$ mile off this island, and a 16-foot spit extends SSE. for one mile.

Gull Island reef is $3\frac{1}{2}$ (4) miles SSE. of Gull island. It is about $\frac{1}{2}$ mile in length NE. and SW. and $\frac{3}{8}$ mile NW. and SE., with 6 feet of water near the center. Half mile to the eastward and southeastward are several detached spots with 16 feet of water on them.

Bowlder reef lies 17 ($19\frac{1}{2}$) miles west of Beaver Island light. It has 16 feet over it, and extends in a NW. and SE. direction.

Buoy.—A red and black horizontally striped spar buoy is moored in 19 feet water, and marks the NW. end of the reef.

Beaver island is the largest of the group. It is 11 ($12\frac{3}{4}$) miles long north and south, $5\frac{3}{4}$ ($6\frac{1}{2}$) miles broad at its southern end, and $2\frac{9}{10}$ ($3\frac{1}{4}$) miles broad at its northern end. It is well wooded, with low bluffs on the east side and higher hills on the west side. At the NE. end is Beaver harbor, a small but well-sheltered anchorage.

Shoals.—Shoal water extends $\frac{1}{2}$ to $\frac{3}{4}$ mile from shore around the island, excepting the middle of the eastern side, where the shore can be approached somewhat closer. A 10-foot shoal extends one mile NW. from the NW. end and a 4-foot spot $\frac{5}{8}$ mile NNE. from the NE. point.

Buoy.—A black spar buoy is moored in 15 feet water, and marks the outer end of this latter shoal. The buoy is 1,100 yards from shore.

Detached 16 and 17 foot spots lie E. and SE. of this buoy.

Beaver Island harbor.—The deep water in this harbor extends $\frac{5}{8}$ mile NW. and SE. and $\frac{1}{4}$ mile NE. and SW.. The entrance is very narrow, rendering it difficult for large vessels or those unacquainted with the harbor to enter.

Light.—Beaver Island Harbor light, 37 feet above the lake level, a fixed red light, visible $11\frac{1}{4}$ (13) miles, is shown from a cylindrical tower attached to the south end of a dwelling, both white, on the north side of the entrance to the harbor.

Life-saving station.—There is a life-saving station 165 feet west of the lighthouse.

Shoals.—On the north side of the entrance an 11-foot shoal extends east $\frac{3}{4}$ mile, its south edge being $\frac{1}{8}$ mile south of the lighthouse.

At $1\frac{3}{4}$ (2) miles E. by N. from the light is a 15-foot spot.

Directions.—With the lighthouse bearing NW. by W. (N. 56° W.), distant one mile, bring it a little on the starboard bow, and head NW. by W. ¾ W. (N. 65° W.) into the harbor. Give the lighthouse a good berth. Anchorage can be found on a line between the inner and outer docks.

Beaver Island light.—On the south end of Beaver island a fixed, white light, varied by a white flash every minute, visible 16 (18½) miles, is shown 103 feet above the lake level from a cylindrical tower on the west end of a dwelling, both yellow. This is a coast light and a guide between Beaver and North Fox islands.

Fog signal.—A steam siren sounds blasts of seven seconds' duration, with silent intervals of forty-two seconds.

Richards reef, with a least depth of 20 feet, lies 6½ (7½) miles W. ⅝ S. (S. 82° W.) of Beaver Island light.

North Fox island is 10 (11½) miles SW. of Beaver island, with deep water between. The island is 2 (2¼) miles north and south, and a mile wide at its northern end, tapering to a point at its southern end. At this end is a small hill. The island is wooded. Shoal water extends ¼ mile from the north and east shores and ¾ mile from its southwestern shore.

South Fox island is 3¾ (4⅓) miles SW. of North Fox. It is 4½ (5⅛) miles long NW. and SE. and 1 9/10 (1¼) miles wide, tapering to a point at the NW. and SE. extremities. The western coast consists of bluffs and hills, the eastern side being low.

Around the south end of the island shoals extend ½ mile off shore, and off the NW. end there is shoal water for ½ mile, terminating in a narrow spit off the NW. point, which extends 1 (1¼) mile to the NW.

South Fox Island light.—A fixed red light, varied by a red flash every two minutes, visible 13 9/10 (16) miles, is shown 68 feet above the lake level from a square yellow tower, attached to a yellow dwelling on the southern extremity of the island.

Fog signal.—A 10-inch steam whistle sounds blasts of three seconds, with silent intervals of seventeen seconds. The fog-signal building is brown and is 420 feet SW. by W. from the light tower.

Banks.—From the northern part of the island a bank with from 4 to 8 fathoms extends northward 3¾ (4⅓) miles. It has an average breadth of about 2⅔ (3) miles. From the southern part of the island a bank with from 3 to 8 fathoms of water over it extends south 8½ (9¾) miles, varying in width from 1 (1¼) to 1½ (1¾) miles, with depths of 12 to 50 fathoms outside. On this bank there are several small shoals.

A shoal spot, 8 feet of water over rocks, bears S. by W. (S. 11° W.) from the light, distant 4 (4 1/10) miles.

Buoy.—A red and black horizontally striped nun buoy is moored in 20 feet water and marks the south side of this shoal, which extends ¼ mile north and south. The bottom near the buoy is rocky, the soundings irregular, and vessels must be careful in this vicinity in thick weather.

Two other spots S. ¾ W. (S. 8° W.), 6 8/10 (7¼) miles from the light, have 8 feet over them. The shoals are 250 yards apart NW. and SE.

Buoy.—A red and black horizontally striped spar buoy is moored in 17 feet water and marks the south side of the NW. spot.

A shoal spot with 11 feet of water over it lies S. ½ W. (S. 5° W.), distant 6½ (7½) miles from the light.

Buoy.—A red and black horizontally striped can buoy is moored in 20 feet water and marks the south end of this shoal.

Caution.—In thick weather vessels should not shoal the water to less than 10 fathoms in this vicinity.

North Manitou island is 6½ (7½) miles north and south and 3½ (4) miles wide at its north end, 2 (2 8/10) miles at its south end. The island is generally hilly and is wooded. The north shore is steep-to, and the east and west shores are shoal for nearly ½ mile. From the SW. point a rocky spit extends ¾ mile SW. and borders the SW. face of the island for ½ mile off shore.

Life-saving station.—There is a life-saving station near Pickards wharf on the east side of the island.

Wreck.—A wreck in 26 feet water with 12 feet over it lies 4 8/10 (5⅝) miles NE. by E. ¾ E. (N. 65° E.) of South Manitou light. Vessels should give this wreck a wide berth as it is a dangerous obstruction.

South Manitou island is 3½ (4) miles SW. of North Manitou, with a clear channel between. The island is 2⅔ (3) miles north and south and not quite so wide. The western half of the island is hilly, and the eastern side lower and wooded.

Outside the distance of ¾ mile there are no shoals, excepting a rock of 3 fathoms which lies 1¾ (2) miles SSW. ½ W. (S. 28° W.) from the SW. point of the island. On the northeastern side of the island is a semicircular harbor, with deep water and good holding ground. It is a good anchorage in all westerly winds.

Light.—On the south point of Manitou harbor is a fixed white light, 104 feet above the lake level, and visible 16 (18½) miles. The light tower is conical, white, and connected by a covered way with a yellow dwelling.

Fog signal.—A 10-inch steam whistle sounds a blast of eight seconds' duration, with silent interval of fifty-two seconds every minute. The fog-signal houses (two) have red roofs, and are 100 feet NE. and 200 feet NNE. of the lighthouse.

NORTH SHORE OF LAKE MICHIGAN.

MICHIGAN.

Coast.—Epoufette point is 14 (16) miles NW. by W. ¼ W. of Aux Chênes point, the coast between receding slightly to the NE. The SE. portion of this coast is steep-to, but as Epoufette point is approached there are several patches of from 16 to 18 feet well off shore.

St. Helena shoal, south of Aux Chênes point, is described on page 52.

Manitou Paymen shoal. See page 62.

Pelkie reef. See page 62.

Epoufette point is a narrow peninsula and forms the western extremity of a narrow shoal inlet at the head of which is Epoufette.

Biddle point, next west of Epoufette, projects some distance into the lake. NE. of Biddle point is Gilchrist. Between Epoufette and Biddle points, shoal water extends from the shore for over a mile, and there is an 18-foot patch 1½ (1¾) miles SE. ¼ E. (S. 48° E.) from Biddle point.

Mille Coquins point.—Between Biddle and Mille Coquins points is a small bay, the shores of which are shoal from ½ to ¾ mile out. Naubinway is on this point.

At ¾ mile south of Mille Coquins is a small island surrounded by exposed rocks and shoals extending one mile east and west and ½ mile north and south.

SE. from this island, 1 (1¼) mile, is a 7-foot rocky spot.

Coast.—From Mille Coquins point the coast trends NW. for 2⅔ (3) miles, thence SW. 9½ (11) miles to Patterson point. There is a rock ¼ mile off shore just after the coast line changes its direction to the SW., and from this rock the flats gradually leave the shore, and midway between this rock and Patterson point extend off shore 2 1/10 (2½) miles in the direction of Potter reef, which is described on page 62. As Patterson point is approached the flats draw nearer to the shore line.

Lansing shoal, SE. of Patterson point, is described on page 65.

Scotts point, on which is the town of Orville, is 1½ (1¾) miles west of Pattersou point, and Hughes point is 5¼ (6) miles farther west. All this coast is shoal for some distance off and should not be approached within a mile. South of Hughes point, about a mile, are shoal spots of 15 and 17 feet.

Between Hughes and Seul Choix points is a bay with deep water and sandy bottom; it is protected from north and westerly winds.

Seul Choix point projects into the lake 1¾ (2) miles. Its SW. face is quite steep-to.

Light.—On the eastern extremity of Seul Choix point is a fixed white light, 83 feet above the lake level, and visible 14¾ (17) miles. The light is shown from a conical brick tower.

Fog signal.—A 10-inch steam whistle sounds blasts of four seconds, with silent intervals of twenty-six seconds. The building is red brick with red roof, and is 124 feet SE. ½ E. from the light tower.

Manistique river.—The mouth of this river is 14 (16) miles W. ½ N. from Seul Choix point. The shore between is rocky and recedes to the northward. Vessels should not go inside the line joining the two. Gulliver lake is 1 1/10 (1½) miles inshore and nearly midway between the point and the river. Manistique river is shoal, and its eastern entrance point has a rocky spit extending out for over ½ mile. Manistique is near the mouth of the river.

Coast.—At Manistique river the coast line changes its direction to the southward as far as Aux Barques point, where it again changes to about SW. to Detour point, which is $15\frac{3}{8}$ (18) miles beyond. Along this latter stretch are several small rocky bays.

Wiggins point is 4 ($4\frac{6}{10}$) miles north of Aux Barques point, with Bourassas point midway between. Rocky shoals, with 5 and 6 feet water, extend off Wiggins point $1\frac{3}{4}$ (2) miles in an easterly and southeasterly direction.

Parent bay.—This bay, to the westward of Aux Barques point, is full of rocky, dangerous shoals $1\frac{1}{2}$ ($1\frac{3}{4}$) miles from shore, and these continue to and around Aux Barques point at $\frac{3}{4}$ mile from shore.

Portage bay.—From the west side of Portage bay shoals extend for $\frac{3}{4}$ mile from shore, and east of the bay dangerous 5 and 6 foot shoals extend $1\frac{3}{4}$ (2) miles to the SE., while $1\frac{3}{10}$ ($1\frac{1}{2}$) miles to the NE. are some exposed rocks $\frac{3}{4}$ mile from shore. The shoal water at the head of this bay extends $1\frac{3}{10}$ ($1\frac{1}{2}$) miles from shore.

Detour point is the north point of entrance to Green bay. It is a narrow, wooded, peninsular point projecting to the SE. into the lake, and has shoal water projecting southward from it for $\frac{5}{8}$ mile.

The islands at the entrance to Green bay will now be described; the description of the bay will be given in the next chapter.

ISLANDS AT THE ENTRANCE TO GREEN BAY.

Summer and Little Summer islands are south and west of Detour point. They are wooded and connected by a rocky flat, over which, midway between, are only 3 feet water. This flat extends from Little Summer island to the main, leaving a very shallow and unsafe passage between. Just west of Little Summer island is Rocky island, which has shoals extending from it westward and northward for over $\frac{1}{2}$ mile. There is a detached 13-foot shoal 1 ($1\frac{1}{4}$) mile south of Rocky island. A rocky spit with 13 feet over it extends nearly $\frac{3}{4}$ mile south from the south point of Summer island.

Poverty island is a mile SSW. of Summer island. The channel between, reduced to $\frac{1}{2}$ mile in width by Summer Island spit, carries 20 feet nearer to Poverty island, but it should not be attempted except by those locally acquainted. The island is $\frac{3}{4}$ mile north and south by $\frac{1}{2}$ mile wide. There is a hill on the western side of the island. The south shore of the island is shoal for from $\frac{1}{8}$ to $\frac{1}{4}$ mile off. The NW. shore is steep-to.

Light.—A flashing red light every fifteen seconds, visible $14\frac{1}{2}$ ($16\frac{3}{4}$) miles, is shown 78 feet above the lake level from a conical tower connected with a white dwelling on the south end of Poverty island.

Fog signal.—A 10-inch steam whistle sounds a blast of five seconds' duration, followed by a silent interval of forty-five seconds; then a blast of three seconds' duration, followed by a silent interval of ten seconds.

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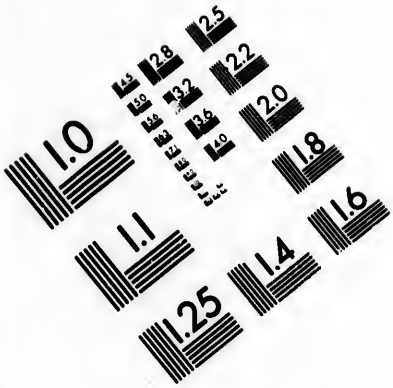

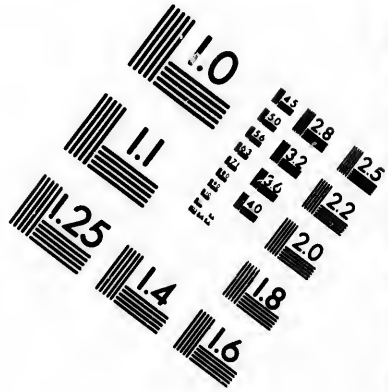

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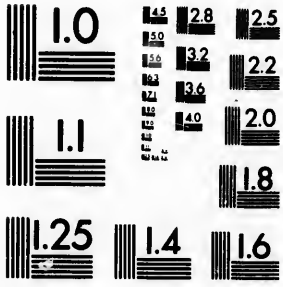

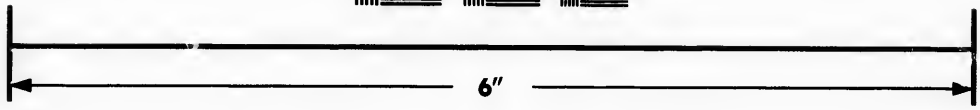

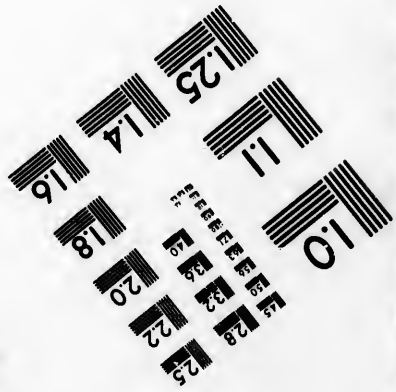

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Poverty Island shoal lies NW. ¼ W. (N. 48° W.) 2⅓ (2⅜) miles from Poverty Island light, with 14 feet of water over it.

Buoy.—It is marked by a red nun buoy moored in 20 feet water.

This buoy, ½ mile south of the shoal, marks a narrow ledge of rocks, with 23 feet of water over them, extending about 500 yards S. by E. from the buoy. There may be less water in spots over this ledge, and caution is necessary with deeply laden vessels.

Gull island is almost midway between Poverty island and St. Martin island. It is connected to Little Gull island, ⅝ mile to the southward, by a shoal with a least depth of 3 feet, which is ⅝ mile wide.

Gravelly island is ¾ mile N. by W. from Gull island. It is surrounded by shoal water, and in the channel between the island is a 13-foot shoal.

Gravelly Island shoal is one (1¼) mile north of Gravelly island. It has 16 feet over it. South of this rock ¼ mile is a 13-foot shoal.

Buoy.—A black can buoy is moored in 18 feet water to mark Gravelly Island shoal. Vessels should pass northward of the buoy.

Poverty Island passage.—If entering Green bay by this passage, keep at least one mile to the southward of Poverty Island light and between the buoys, not approaching Poverty Island Shoal buoy nearer than ½ mile.

Bring Gravelly Island buoy to bear south before keeping to the northward. The passage between Gull and Gravelly islands on the north and St. Martin island on the south is to be preferred, as it has deep water and no dangers if a vessel keeps on the St. Martin side of a mid-channel course.

St. Martin island is 2 (2⅛) miles NNW. and SSE. and 1 (1¼) mile east and west. The island is hilly and wooded. Shoals extend off the southern end of the island for a mile, with from 4 to 8 feet water over them. The rest of the island is steep-to.

Shoals.—At 1⅞ (2) miles SSW. of the SE. point of St. Martin island is a 9-foot shoal with a 15-foot spot ½ mile NNE. of it. These shoals contract the main entrance (Rock Island passage) to Green bay as they lie almost midway between St. Martin and Rock islands.

Buoy.—A red can buoy is moored in 21 feet of water on the SW. side of the small 9-foot shoal.

Vessels entering must pass south of this buoy.

WISCONSIN.

Rock island, the south entrance point of Rock Island passage, is hilly, and is connected to Washington island by shoals. The NE. and W. shores of the island are steep-to.

Light.—On the north point of Rock island is a fixed white light 137 feet above the lake level, and visible 17¼ (19¾) miles. The light tower is square, on a stone dwelling.

Rocky shoals.—From the SE. point of Rock island, between the

bearings E. by S. (S. 79° E.) and S. by E. ¾ E. (S. 20° E.), and distant 1¾ (2) and 2⅜ (3) miles, are two rocky shoals separated by clear water. The northern shoal is almost bare and the southern one has 3 feet over it. By keeping 4⅛ (5) miles off the islands, a vessel will well clear the shoals.

Rock Island passage should be preferred by vessels from the north and NE. It can be safely entered if the Rock Island light is kept between the bearings W. by S. (S. 79° W.) and W. by N. (N. 79° W.) until within about a mile of the light. All this part of Rock island is steep-to, and it can be rounded at the distance of ¼ mile, if necessary.

Washington is the largest of the islands at the entrance to Green bay. It is connected to Rock island on the NE., Hog island on the east, and Detroit island on the south by shoals. Boyer bluff is its NW. extreme, just east of which is Washington harbor.

Jacksons harbor is between Washington and Rock islands, and Detroit harbor on the south side of the island is protected by Detroit island. This harbor is shoal and only suitable for very small craft.

Hog island is ⅝ mile off the east coast of Washington island and is on a shoal which extends along this part of Washington island and ½ mile into the lake beyond Hog island.

Detroit island.—This long, narrow island, lying to the southward of Washington island, is practically part of it, as very shoal water connects the two.

Shoals.—From the southern end of Detroit island shoals extend ⅝ mile to the SE., with 6 feet of water and rocks awash ¼ mile from shore.

On the SW. side of Detroit island the flats and detached shoals extend ⅞ mile from shore, the northwestern shoal, Middle shoal, with 8 feet of water over it, being marked by a buoy. Near the SW. end of the island are two islets ⅛ mile offshore.

Buoy.—The SW. point of Middle shoal is marked by a red spar buoy moored in 11 feet water.

Wrecks.—There are two wrecks on Middle shoal, the one to the northward of the red spar buoy having but 8 feet of water over it, the one to the SW. of the same buoy having 15 feet of water over it.

Detroit Island passage.—This passage to the northward of Pilot and Plum islands can be used, but great care is necessary to avoid the shoals off Detroit and Plum islands. It is sometimes used as an anchorage during easterly gales.

Plum island lies in the center of the channel south of Washington island. Shoal water extends ¼ mile SE. from the SE. end of the island and ½ mile northward from the north coast. This shoal is apparently making out in a NE. direction. On the SW. end of Plum island are the ruins of an old lighthouse.

Buoy.—A black spar buoy is moored in 14 feet of water on the NE. point of the north shoal. It can be passed close to from the northward, but on approaching it from the westward it should be given a berth of at least ½ mile.

Pilot island lies in the entrance to the southern channel into Green bay, and separates Detroit Island passage from Porte des Morts. It is on a small shoal ¼ mile in diameter.

Light.—A fixed white light, varied by a white flash every fifteen seconds, is shown on Pilot island. It is 38 feet above the lake level and visible 11½ (13¼) miles. The light tower is square and on a yellow brick building, with red roof. The fog signal building is 200 feet S. by W. from the lighthouse.

Fog Signal.—A 10-inch steam whistle sounds blasts of five seconds, with silent intervals of thirty seconds.

Outer Shoal.—Porte des Morts entrance.—This shoal is 1¾ (2) miles off shore at the south entrance to Porte des Morts, and has 14 feet over its northern part. It is the extreme easterly shoal on this part of the coast.

Buoy.—A bell buoy is moored in 19 feet water on the SE. end of this shoal. Vessels should pass well outside of it.

Nine-foot Shoal.—The center of this shoal is ¾ mile off shore and 1¾ (2) miles WSW. ½ W. (S. 73° W.) from Pilot Island light. There is a least depth of 6 feet on this shoal. Marked by a black spar buoy.

Waverly Shoal, with a least depth of 12 feet, is about 700 yards northward of Nine-foot shoal.

Buoy.—A black can buoy is moored near the NE. end of Waverly Shoal to mark it.

Porte des Morts.—Current.—Masters of vessels are warned against the currents which run in and out through this entrance, particularly on the south sides of Pilot and Plum islands. With southerly winds the current sets about NNW., passing on both sides of Pilot island, a branch passing to the NW. and south of Plum island. Its strength depends, in a great measure, on the velocity of the wind. With the wind NW. and blowing strong the current sets out into the lake and is frequently so strong that sailing vessels can not make headway against it. Sometimes the current is against the wind.

Directions.—With strong southerly winds, vessels standing to the westward are advised to pass to the northward of Pilot island and, in all cases, to the southward of Plum island.

With any but strong southerly winds the passage to the southward of Pilot island is recommended.

Caution.—The most dangerous shoal in this vicinity is that projecting to the southwestward from Pilot island. Over this shoal the current runs with great strength and vessels from the eastward are frequently carried on the shoal. This may be avoided by watching the bearings of the lighthouse when standing in. If the bearing is not changed to the northward, it is evident that the vessel is being carried to the northward, consequently the course should be changed well to the southward of west, and not again to the northwestward until the lighthouse bears north.

Coast.—Southward of Porte des Morts, lake Michigan is separated

from Green bay by a long peninsula, which extends northeasterly 60 (69) miles from a line joining Kewaunee with Green bay. The eastern shore of this peninsula is much indented, but is safe to approach to 3 ($3\frac{1}{2}$) miles.

Rawley bay is the northernmost of the indentations in the peninsula and affords good anchorage and protection from northerly and westerly winds, but it is much obstructed by shoals both at its entrance and within the bay. Off the north entrance point to the bay are the Spider islands, which are connected with the shore by shoals, and SE. of the islands, $\frac{3}{4}$ mile, is a 13-foot patch. Vessels in navigating this part of the coast should keep well outside Outer Shoal buoy to avoid the numerous outlying shoals in this locality.

Shoal.—Directly in the entrance to Rawley bay is an extensive shoal extending north and south $2\frac{4}{10}$ ($2\frac{3}{4}$) miles. There are 3 feet on the south end of this shoal and 4 feet on the north end.

Buoy.—A red spar buoy is moored in 18 feet water and marks the southeastern point of this shoal. Should a vessel find it necessary to enter Rawley bay this buoy should be left well to starboard and the course not changed to the northward until well over to the shore of the main.

North bay, next south of Rawley bay, is small, and affords for small craft anchorage and protection from west and north winds. The anchorage is just within the entrance points of the bay, and is about $\frac{1}{4}$ mile deep, all the rest of the bay being shoal. Sand spits extend from both entrance points; the channel is between the buoys, being about $\frac{1}{3}$ mile wide.

Buoys.—A red spar buoy is moored in 24 feet water, and marks the shoal extending southward from the north entrance point.

A black spar buoy is moored in 14 feet, and marks the extreme point of the shoal extending northeastward from the south point of entrance.

Cana island is $2\frac{1}{2}$ ($2\frac{9}{10}$) miles south of the entrance to North bay. It is a small island close to shore.

Light.—A fixed white light, 88 feet above the sea level and visible $15\frac{1}{4}$ ($17\frac{1}{2}$) miles, is shown on Cana island. The light tower is conical, and connected by covered way with dwelling. Both are of yellow brick.

Mud bay is just within Cana island. It is contracted, with a shoal near the center, and having neither buoys nor lights, is not recommended.

Bailey harbor is a good and well-sheltered anchorage, but has shoals extending from both entrance points, also in the entrance to the harbor.

There is an old white tower (formerly a lighthouse) on the east side of the harbor abreast the north entrance point which serves as a good day mark, and opposite it on the other side of the harbor a shoal makes out $\frac{1}{2}$ mile. Off the center of the town on the west side the shore can be approached to $\frac{1}{4}$ mile. Elsewhere it is best to keep at least $\frac{1}{3}$ mile from shore. Hills rise from the western shore of the harbor.

Eastern shoal.—From the eastern point of Bailey harbor a shoal 1 (1¼) mile wide makes out to the southward a mile, with 13 feet of water on its southwestern and 15 on its southeastern end.

Buoy.—Its southwestern end is marked by a red spar buoy in 18 feet of water.

Middle Ground shoal is in the mouth of Bailey harbor. It is a rocky shoal with 14 feet of water over the southern end and 7 feet over the northern.

Buoy.—The southeastern end of this shoal is marked by a black spar buoy in 18 feet of water.

Range lights.—On the north shore of Bailey harbor from a white tower is shown a fixed white light. The light is 21 feet above the lake level and visible 9½ (11) miles.

The rear light, also white, is 950 feet N. by W. ½ W. (N. 17° W.) of the front light. This light is 35 feet above the lake level and visible 11¼ (13) miles.

Whitefish point is 8⅝ (10) miles SSW. of Bailey harbor. In the middle of the bight north of Cave point a spit with 6 feet near its outer end projects from shore 1 $\frac{8}{10}$ (1½) miles. Whitefish bay, north of Whitefish point, is clear of shoals and open to the eastward.

Shoal.—A shoal of 13 feet lies ½ mile SE. of Whitefish point.

Buoy.—A red spar buoy is moored in 18 feet water, and marks the SE. end of this shoal.

Coast.—From Whitefish point the coast trends 7 (8) miles SW. to Sturgeon Bay canal. This shore should not be approached to within a mile, as rocky reefs extend out in places to nearly that distance.

Harbor of refuge.—This entrance to the canal leading from lake Michigan to Sturgeon bay is a harbor of refuge, though too limited in area and too unprotected to be very efficient. The village of Portage is a short distance to the northward. In shape the harbor is triangular, being bounded by two converging piers 850 feet apart at the shore line and 335 feet apart at the outer end. Beyond the piers on either side are detached portions of crib work connected with the main piers by fender piling. The inclosed area is nearly 10 acres.

In October, 1895, 16 feet could be carried into the harbor midway between the piers. From here the depth shoals gradually toward the NW. and SW. angles of the harbor.

Sturgeon Bay canal is 100 feet wide at water surface and 65 feet at bottom, and 7,200 feet long. In April, 1895, the canal had a governing depth of 13 feet. Vessels can not tie up in the canal, but must continue on to Sturgeon bay.

For a description of the western end of the canal, see Chapter VI.

Canal Pierhead light.—A fixed red light, visible 7 $\frac{4}{10}$ (8½) miles, is shown from a square, white, pyramidal tower on the outer end of the north pier.

Fog signal.—A 10-inch steam whistle, in a house in the rear of the

light tower, sounds blasts of five seconds' duration, with silent intervals of twenty five seconds.

NOTE.—This signal has been reported as inaudible and unreliable at certain distances therefrom during the prevalence of a fog. The area of inaudibility covers a space of about 4 square miles. Straight out from the canal for nearly a mile the whistle can be heard; beyond this distance the sound becomes muffled, and is suddenly lost to hearing. This occurs for the space of about a mile, when it again becomes audible. This phenomenon extends over a space of about 2½ miles off the entrance to harbor north of SE. ½ E. (S. 50° E.) and about 1½ miles south of SE. ½ E. (S. 50° E.), and is about a mile in width, and has the same trend as the shore. Authorities differ as to the exact location of this space of inaudibility.

Life-saving station.—There is a life-saving station about ¼ mile from the light.

Directions.—When 1 $\frac{5}{10}$ (1½) miles off the entrance, bring the Pierhead light to bear NW., and stand in for it. When the piers are close-to, keep in mid-channel. In passing from the canal into Sturgeon bay remember that the channel in the bay is buoyed from Green bay in.

Coast.—Between Portage and Ahnapee the coast trends 12½ (14½) miles SSW. Near the canal the land is low, then hills 60 feet high line the coast. Along this stretch shoals extend from ½ to ¾ mile from shore. At 2 $\frac{6}{10}$ (3) miles south of the canal entrance and one mile from shore is a large 14-foot spot, with a smaller 14-foot spot ½ mile to the northward and another the same distance to the westward. South of this there is a 17-foot spot ¾ mile from shore. East, a mile from Ahnapee light, is a 17-foot spot.

Ahnapee is on both banks of the Ahnapee river at its mouth. The entrance to the river is protected by piers 200 feet wide at outer end and contracting to within 125 feet. Soundings in November, 1895, showed 14 feet at entrance and 12 feet at the shore end of the harbor piers. The bottom is rocky.

Range lights.—The front light is fixed red, and shown from a post 22 feet above the lake level on the outer end of north pier. The rear light is also red, visible 6 (7) miles. It is shown from a square, white, pyramidal tower near the outer end of the north pier.

Directions.—When 1 $\frac{5}{10}$ (1½) miles SE. of the entrance, head in on the range. When the piers are close-to, run between them in mid-channel until the shore line is reached, when keep to the southern side of the channel to the bridge.

Coast.—From Ahnapee the coast continues in a SSW. direction for 9½ (11) miles to Kewaunee. The coast has rocky shoals extending off from ¼ to ¾ mile; halfway between, a spit extends out nearly ¾ mile, with 13 feet at its outer end. There are dangerous rocks ⅛ mile north of Kewaunee entrance and ¼ mile from shore.

Kewaunee is on the south side of Kewaunee river. The entrance to the river is through a channel 300 feet wide at the point where the

river bends to the north. The lake end of the channel is protected by two piers 200 feet apart. Soundings in channel April, 1895, showed a channel midway between the piers about 80 feet wide and 13 feet deep. A basin 450 feet long and 11 to 12 feet deep, the same width as the entrance channel, has been formed in the old river bed to the northward of the entrance.

Range lights.—The front light is fixed red, and shown at outer end of the north pier. It is 24 feet above the lake level. The rear light, also red, is 42½ feet high, and visible 7 1/10 (8½) miles. It is shown from a square, white, pyramidal tower 230 feet from outer end of the north pier.

Fog signal.—A 10-inch steam whistle sounds blasts of three seconds, with silent intervals of seventeen seconds.

Life-saving station at inner end of the north pier.

Directions.—When 1 3/10 (1½) miles ESE. of the entrance head in on the range. When the piers are close-to keep in mid-channel.

Caution.—If approaching from the northward be careful of the rocks north of the entrance.

Shoal.—An 18-foot shoal has been reported as lying ⅞ mile SE. by E. ⅜ E. (S. 60° E.) of the north pierhead. It is 200 feet long, 15 feet wide, and extends NE. and SW.

Coast.—Twin River point is the easternmost part of Rawleys point and is south 14¾ (17) miles from Kewaunee. From Twin River point the coast curves around to the SW. to Two Rivers. Between Kewaunee and Twin River point the coast line recedes slightly to the westward and in the bight are Deans and Two creeks, both at the mouths of small streams. There are no shoals outside the distance of ½ mile from shore along this coast. South of Deans and ½ mile offshore is a rock with 3 feet over it, and north of Two creeks, about the same distance offshore, are several detached 17-foot spots.

Twin River light is 4½ (5) miles from Two rivers on the extremity of a low, sandy point. It is a fixed white light, varied by a white flash every thirty seconds and visible 16½ (19) miles. It is shown 111 feet above the lake level from a conical tower connected with a dwelling; both are white.

Fog signal.—A 10-inch steam whistle sounds blasts of five seconds' duration, with alternate silent intervals of ten and forty seconds. The fog signal building is on the beach 300 feet SE. from the lighthouse.

Two Rivers is on the SE. side of Rawleys point, and has an excellent harbor, formed by the junction of East and West Twin rivers. In the fall of 1893 the city dredged the inside harbor to a depth of 10 to 12 feet. The rivers are navigable for 2½ (3) miles from the mouth. The entrance is between piers 240 feet apart. Soundings taken in April, 1895, showed a governing depth of 11 feet. An 11-foot shoal projecting from the south pier makes the channel very narrow and is a serious obstruction.

Light.—A fixed red light, visible 7 1/10 (8½) miles, is shown from a

square pyramidal tower on the outer end of the north pier. It is 35½ feet above the lake level.

Life-saving station.—There is a life-saving station near the inner end of the east pier.

Tugs.—Tugs are owned by four different parties, but are so much engaged in fishing and towing rafts that they are not always obtainable.

Directions.—When 1 3/6 (1½) miles off the entrance bring the Pierhead light to bear NW. (the piers run NW. and SE.) and head in. When the piers are close-to, keep between them in mid-channel.

Manitowoc is built up on both sides of the mouth of the Manitowoc river. The entrance to the river is between piers 240 feet apart at the outer end, narrowing to 220 feet inside. A breakwater commences at the prolongation of the north pier and 500 feet from its end and extends toward shore in a northwesterly direction 400 feet. A channel midway between the piers, 150 feet wide and 15½ feet deep, was completed in June, 1895.

Dry dock.—Length over all, 350 feet; width of gate, 44 feet, and depth over sill, 13½ feet.

Lights.—On the outer end of the north pier is a square, white, pyramidal tower, upper and lower parts inclosed. A fixed red light is shown from this tower 34 feet above the lake level, and is visible 7 4/6 (8⅔) miles. On the SE. end of the breakwater, 530 feet E. ⅝ N. (N. 83° E.) from Pierhead light is a brown corrugated iron structure from which is shown a fixed red light, 34 feet above the lake level.

Fog signal.—A 10-inch steam whistle sounds as follows: Blast three seconds, silent twelve seconds; blast three seconds, silent twelve seconds, blast six seconds, silent twenty-four seconds. A reflector over this steam whistle throws the sound toward lake Michigan.

Directions.—When 1 3/6 (1½) miles off the entrance, head in on the range W. ⅝ S. (S. 83° W.), pass south of the breakwater and mid-channel in between piers.

Shoals.—Several detached 16-foot shoals are 1 (1 3/6) mile NE. from Manitowoc Pierhead light and from ½ to ¾ mile off shore. Another shoal with 16 feet on it is 1½ (1¾) miles S. by E. ½ E. from the same light and about a mile off shore. This patch is off the mouth of Silver creek.

Coast.—Sheboygan light is 20 (23) miles southward of Manitowoc. The coast between is all along shoal from ½ to ¾ mile offshore and has several detached shoal patches. Centerville is about halfway between the two points. There is a depth of 9 feet ½ mile off shore, ¾ mile SE. of Centerville.

Sheboygan light.—A fixed white light, visible 12 3/6 (14⅔) miles, is shown 80 feet above lake level from a square tower on a white dwelling. It is on a point a mile northward from the town.

Sheboygan reef.—East of Sheboygan light is a small 18-foot spot. South of this spot is a 17-foot spot, and SE. ¼ E. (S. 48° E.) ½ mile is the north part of a reef which extends south 600 yards. It has 7 feet

over its northern part and 13 feet over the southern. The passage between the reef and shore should not be attempted.

Buoys.—A red can buoy is moored in 24 feet water off the north side of the 17-foot spot. A red can buoy is moored in 24 feet water off the SE. end of the reef. The 7-foot depth is almost midway between the buoys.

Sheboygan is on the north side of the mouth of the Sheboygan river. The entrance to the river is between piers 270 feet apart outside, narrowing to 170 feet at the shore line. A channel midway between the piers, 17 feet deep with a width of about 100 feet, was completed in June, 1895. The river turns to the SW. from the entrance, and forms a deep bight south of the main portion of the city. There is a winding basin 400 feet in width at the mouth of the river, and the average width of the river is 220 feet, increasing to 269 feet at the first bridge, about 2,200 feet from the mouth.

Light.—On the north pier near the outer end is a fixed red light 32 feet above the lake level, and visible $7\frac{9}{10}$ ($8\frac{1}{2}$) miles. The light is shown from a square, white, pyramidal framework tower, upper part inclosed.

Life-saving station.—There is a life-saving station near the inner end of the north pier.

Signal-Service station.—There is a Signal-Service station on the pier.

Tugs.—The Sheboygan Tug Line charges 3 to 4 cents per ton for actual load carried.

Fog signal.—A 10-inch steam whistle sounds blasts of four seconds, followed by silent intervals of twenty-six seconds. The fog signal building is brown, and stands immediately in the rear of the light tower on the pier.

Directions.—From the northward the pierhead light can be approached on a SW. by W. $\frac{1}{2}$ W. (S. 62° W.) bearing; from the south on a NNW. $\frac{1}{2}$ W. (N. 28° W.) bearing. Nothing inshore of these bearings. The direction of the piers is about east and west.

Coast.—Port Washington is the next place of any size, and is $22\frac{1}{2}$ (26) miles to the southeastward of Sheboygan. This portion of the coast is more bold; the hills range from 60 to 140 feet in height, and outside the distance of $\frac{1}{2}$ mile there are no shoals, but vessels coasting should keep at least $\frac{3}{4}$ mile off shore.

Port Washington, at the mouth of the Sauk river, lies 22 ($25\frac{1}{4}$) miles north of Milwaukee. The harbor consists of an inclosed, dredged basin of $5\frac{3}{4}$ acres in area, with two arms, one running north, 800 feet long and 200 feet wide, and the other running west, 500 feet long and 150 feet wide. The Sauk river empties into the lake south of the south pier. The entrance is between piers 150 feet apart. The depth in the entrance channel was restored to 12 feet for a width of 90 feet in 1895. Soundings taken in April, 1895, showed a depth of 11 feet over most of the area of the north basin; north half of west basin,

average depth 11 feet; south half, average depth about 4 feet. A short distance north of the entrance is an old landing pier, now abandoned.

Port Washington light.—A fixed white light, 113 feet above the lake level and visible 10½ (19) miles, is shown from a square tower on a yellow dwelling on the bluff in the northern part of the town.

Pierhead light.—A fixed red light, visible 7$\frac{4}{5}$ (8½) miles, is shown from a square white tower on the outer end of the north pier. It is 42½ feet above the lake level.

Wharfage.—There is a city ordinance to collect dockage on freight discharged or received at the foot of streets or alleys running to the harbor.

Tugs.—There is one fishing tug which, when in port, will take vessels in and out of port for a moderate charge.

Directions.—When off the entrance, bring the Pierhead light west, and stand in for it with the piers end on. When the piers are close-to, keep between them, changing course on passing the foundry as desired.

Coast.—South of Port Washington is the highest land on the west shore of the lakes, ranging from 115 to 170 feet at Ulao. As far as Ulao the coast is comparatively steep-to. Here shoals extend out to the eastward for nearly ¾ mile, with 10 feet on the outer end. They then approach the shore again, until off Kemps ¾ mile there is a detached 16-foot patch. North of Fox point 3 (3½) miles a spit extends out ¾ mile, with 13 feet at its extremity, and off Fox point is another spit, with a depth, ⅝ mile from shore, of 8 feet. A mile north of Fox point a spit extends to the northeastward, with 16 feet ½ mile from shore, and in the north part of Whitefish bay, south of Fox point, a narrow spit extends northeastward, with 16 feet ½ mile from shore. South of Whitefish bay to Milwaukee there are no shoals outside the distance of ½ mile.

Milwaukee bay is open to the eastward, with no offlying shoals.

Milwaukee light.—A fixed white light, varied by a white flash every forty-five seconds and visible 17¼ (19¾) miles, is shown, 122 feet above the lake level, from a brown, octagonal tower connected with a white dwelling. It is on the extreme north point of Milwaukee bay.

Harbor of refuge.—This harbor will have an anchorage area when completed of 417 acres beyond the 18-foot curve, the whole inclosed by a breakwater. The present area outside of the 18-foot curve is 119 acres. The 20-foot curve is ½ mile off shore.

A lightvessel, painted red, is moored near and inside the southern end of the breakwater. Two lights are shown, one directly over the other. The upper light is white and the lower light red. The lower light is 30 feet above the water, the distance between the lights being 4 feet. This vessel is under the control of the United States Engineers.

Cribs.—North of the breakwater about ¼ mile the waterworks pile bridge pier with the old crib at the end projects from the shore, and NE. of the end is the new crib, ½ mile S. by E. from Milwaukee light.

Milwaukee is, next to Chicago, the largest city on the lake, and is at the mouth of the Milwaukee river on Milwaukee bay. It has a large commerce and steamers now call there direct from Europe.

The entrance to the river is between piers 260 feet apart.

In May, 1895, the channel between piers was 140 feet wide and 19 feet in depth. The river is 200 feet wide at the entrance and as far as the principal docks. There are no obstructions excepting the bridges, the nearest of which is 2,000 feet from the entrance. The average depth of water in the river is about 16 feet.

Pierhead light.—A fixed red light, visible 11 $\frac{1}{10}$ (13) miles, is shown 40 feet above the lake level from a square, white, pyramidal tower on the outer end of the north pier. The keeper's dwelling, with the tower of the discontinued light attached, is on the north pier inside this light.

Fog signal.—A 10-inch steam whistle in a house on the north pier in rear of the light sounds blasts of five seconds' duration, with silent intervals of fifty-five seconds.

Life-saving station.—There is a life-saving station near the inner end of the south pier.

Dry docks.—There are two docks, 365 and 312 feet over all; widths of gates, 56 and 45 feet; depths on sills, 16 and 15½ feet.

Wharfage.—There are no wharfage charges for vessels. Twenty cents per ton is charged on cargoes.

Tugs.—The Milwaukee Tug Boat Line owns six tugs and the Independent Tug Boat Line two tugs. There is a published printed scale of prices for towing in Milwaukee harbor. The charges are about 5 cents per registered ton.

Directions.—When 2$\frac{3}{4}$ (3) miles east of the entrance, head west for the Pierhead light, then in between the piers.

Entering the outer harbor bring the lightvessel to bear NW., distant one mile, when head west until the lightvessel bears N. by E. (N. 11° E.), when head north into the harbor. These directions will hold for a change of the position of the lightvessel. The distance may be shortened as the lightvessel approaches the end of the proposed breakwater.

Currents.—During fresh northerly winds there is a current along the shore setting from north to south across the harbor entrance.

Buoy.—A black can buoy is moored in 20 feet water off South point, Milwaukee bay. The bottom between the buoy and South point is rocky, with only 12 feet water.

Shoals.—There are two small shoals with 17 and 18 feet water over them, lying, respectively, S. by E. ½ E. (S. 14° E.) and S. by E. $\frac{7}{8}$ E. (S. 21° E.), distant a mile from the buoy.

South Milwaukee, at the mouth of Oak creek, is 7$\frac{3}{4}$ (9) miles south of Milwaukee. North and south of the mouth of Oak creek the lake shore is bold, rising in high clay bluffs. The shore between should not be approached within a mile, as there are several offlying shoals.

There are two piers, built by private parties, extending into the lake,

with a clear opening between the piers of 200 feet. Originally there was a depth of 12 feet between the piers, but it has shoaled considerably. It is proposed to continue the improvement and build new piers out to the 20-foot curve.

Coast.—From Oak creek the coast trends $8\frac{1}{4}$ ($9\frac{1}{2}$) miles SE. to Wind (Racine) point; it then changes its direction to the south for $2\frac{6}{10}$ (3) miles to Racine. This portion of the coast is quite bold and hilly.

Wind (Racine) Point lights.—The point projects some distance into the lake, and on the point is a flashing white light every thirty seconds. The light is 112 feet above the lake level and visible $16\frac{1}{2}$ (19) miles. The lighthouse is a conical tower, connected by covered way with dwelling, both of yellow brick. A fixed red light is shown from the watch-room windows of the same tower, immediately under the main light. It is 104 feet above the lake level, visible $7\frac{6}{10}$ ($8\frac{1}{2}$) miles between the bearings N. and N. by W. $\frac{3}{4}$ W. (N. 20° W.), covering Racine reef.

Fog signal.—A 10-inch steam whistle sounds alternate blasts of three and five seconds, with silent intervals of twenty-six seconds.

Racine reef.—This dangerous reef lies $1\frac{3}{4}$ (2) miles ESE. $\frac{1}{2}$ E. (S. 73° E.) from Racine Pierhead lighthouse. It extends ENE. and WSW. a mile, and north and south $\frac{3}{8}$ mile, with 8 feet of water over its shoalest part. There are several disconnected shoal spots of 15 and 16 feet north of the reef proper. The channel between the reef and the city has a depth of 3 to 6 fathoms.

Buoys.—A red spar buoy is moored in 18 feet and marks the eastern end of Racine reef. A black can buoy is moored in 17 feet and marks the westerly edge of the reef. Between these buoys is a depth of 8 feet.

Racine is at the mouth of Root river. The entrance to the harbor is formed by two piers, 250 feet apart at the entrance, narrowing to 160 feet at the shore line. Soundings in October, 1895, showed a channel $13\frac{1}{2}$ feet deep, with a width of about 60 feet, and a bar at the entrance projecting from the south pier about halfway across the channel, with a depth of from 12 to 13 feet over it.

Racine (Root river) light.—A fixed white light, 48 feet above the lake level, visible $12\frac{6}{10}$ ($14\frac{1}{4}$) miles, is shown from a square yellow tower attached to a yellow dwelling on the north pier, about 800 feet from the outer end.

Pierhead light.—A fixed red light, 35 feet above the lake level, is shown on the outer end of the north pier. With Racine (Root river) light (white) the light will guide clear to the northward of Racine reef by keeping the white light open to the northward of the red light.

Fog signal.—A fog bell at this station is struck by machinery during thick or foggy weather, a single blow every twenty seconds. The bell is suspended from a frame in front of the pierhead tower.

Life-saving station.—There is a life-saving station near the inner end of the north pier.

Signal-Service station.—There is a Signal-Service station about 400 feet from the Root River lighthouse.

Directions.—If coming up the coast, keep $\frac{7}{8}$ (1) mile off shore, then midway between the black buoy and the shore until on the range with the piers end on, when head in between the piers. If coming from the northward, stand in with Root River lighthouse bearing WSW. $\frac{1}{2}$ W. (S. 73° W.), but nothing to the westward of this bearing, to avoid Racine reef.

At night.—From the northward, stand in with Root River light, white, bearing WSW. $\frac{1}{2}$ W. (S. 73° W.) until Wind Point light bears north, when stand to the southward until the lights on the north pier come on, when stand in. When standing in, keep the white light open to the northward of the red light to clear Racine reef.

From the southward, bring Wind Point light to bear north and steer toward it on this bearing until the lights on the north pier come on, when stand in.

The red sector from Wind point covers Racine reef. The Root River (white) light should be bronght between the bearings WSW. $\frac{1}{2}$ W. (S. 73° W.) and NW. by W. (N. 56° W.) until Wind Point light bears north.

Kenosha is $8\frac{3}{4}$ (10) miles south of Racine, and, with the exception of Racine reef, the coast is clear of danger. The city is at the mouth of Pike creek, which here opens out into an extensive basin.

The entrance to the harbor is between piers 150 feet apart.

Soundings in August, 1895, showed a channel about 14 feet deep, with a least width of 60 feet.

Kenosha (Southport) light.—A fixed white light, varied by a white flash every forty-five seconds, visible $14\frac{5}{10}$ ($16\frac{1}{2}$) miles, is shown 76 feet above the lake level, from a conical, yellow tower on Washington island on the north side of the entrance.

Range lights.—The front light, 28 feet above the lake level, is fixed red and shown from a lantern in the outer end of an elevated conduit on the north pier.

The rear light, 100 feet distant, is also red and shown from a square, white tower on the north pier. It is 39 feet above the lake level and visible $7\frac{4}{10}$ ($8\frac{1}{2}$) miles.

These lights form a range showing the direction of the piers.

Day mark.—N. R. Allen Sons' tannery is an excellent leading mark when entering the harbor. The tall chimney can be seen for a distance of $15\frac{3}{8}$ (18) miles and is a more prominent mark than the lighthouse.

Life-saving station.—There is a life-saving station on the north bank of the river in rear of the lighthouse.

Tugs.—There are four companies owning tugs, and the charge is $5 apiece for vessels.

Directions.—When $1\frac{4}{10}$ ($1\frac{1}{2}$) miles off the entrance and on the range of the lights, head in for them with the piers end on. When the piers

are close-to, run between them, keeping the north pier as close aboard as possible, the best water being on that side. The inner harbor should not be entered by sailing vessels without the assistance of a tug. Vessels, however, can make fast to different points along these piers.

In ordinary weather vessels can anchor outside, where there is good holding ground.

Pilotage.—The captain of the life-saving station is always on duty, and can be obtained as a pilot when desired.

ILLINOIS.

Waukegan is 14¼ (16⅛) miles south of Kenosha, the coast between being clear of danger outside the 3-fathom line, which follows the coast line at a distance of about ⅜ mile. The boundary line between Wisconsin and Illinois is 6 (7) miles southward of Kenosha, just north of Spring bluff.

A basin has been inclosed by piers and double lines of piling filled in with stone. The shore line along the north pier has advanced 700 feet since 1879. The width between the piers is 236 feet. In April, 1895, the governing depth in the channel and basin was about 10 feet.

Waukegan (Little Fort) light.—A fixed white light, visible 12⅝ (14⅜) miles, is shown 75 feet above the lake level from a square tower on a white dwelling on the bluff on the south side of the mouth of the Little Fort river.

Directions.—When 1⅛ (1½) miles east of the entrance, head in for the light, with the piers end on. When the piers are close-to, run in between them and nearer the north pier.

Coast.—From Waukegan to Grosse point the coast trends S. and SE. for 18⅔ (21½) miles, then a little eastward of south for 11 (12⅔) miles to Chicago light. The coast to Grosse point is low and wooded, with numerous towns along it. There are no shoals outside the distance of ⅜ mile from shore. At Grosse point a spit extends out ENE. for ⅝ mile, with 16 feet on it, and 20 feet at 1 (1¼) mile off. South of Grosse point there are several spits extending out nearly ¾ mile. Off the city of Chicago are several shoals which will be described in detail.

Grosse Point light.—On Grosse point, Evanston, is a fixed white light, varied by a red flash every three minutes, and visible 17 (19½) miles. The light is shown 119½ feet above the lake level from a conical tower connected with dwelling; both are yellow, with red roofs.

Fog signal.—A 10-inch steam whistle, in a building east of the tower, sounds blasts of five seconds' duration, with alternate silent intervals of twenty and forty seconds.

Evanston crib.—There is a crib in 21 feet water with 12 feet over it, with Grosse Point light bearing W. by N. (N. 79° W.), distant 1,148 yards. A buoy is moored 50 feet west of the crib.

Life-saving station.—There is a life-saving station ¾ mile south of the lighthouse.

Chicago is at the mouth of the Chicago river, from which it takes its name, the original name being derived from an Indian word, Chacaqua, meaning wonder. The city is 14 feet above the lake level.

The Chicago river runs through the city from the lake, nearly one mile west, then separates into two branches, one running NW. and the other SW., dividing the city into three divisions, which are connected by many bridges and tunnels. A canal connects the main or SW. branch with the Illinois river, and so with the Mississippi and the gulf. This channel has been so deepened that the waters of the river and the lake flow through into the Illinois and Mississippi.

The water supply is drawn from cribs well out in the lake through tunnels, carrying it under the streets to widely separated parts of the city to stations, whence it is distributed by powerful pumps. There is also a system of cisterns connected with the tunnels, for use in case of fire or other emergency. The water is pure, cold, and wholesome, and the supply inexhaustible.

There are numerous hospitals and many public libraries.

The climate of Chicago is much modified by the lake; the mean temperature for seventeen years was 48.6°, varying between a mean of 24° in January and a mean of 72° in August, the mean temperature of the water for the same period being 48°, varying from 32.9° to 67.6°. There is a marked preponderance of land winds (SW.) during the winter and a slight preponderance of lake winds (NE.) in the summer, this being an average of eighteen years' observations. The mean annual rainfall in the country surrounding Chicago is 34 inches, taken from observations of forty-seven years. The death rate was lower than that of any other city of its size in 1892 and 1893.

Chicago is a port of entry, and an immense amount of traffic passes through, it being the first city in the country as far as arrivals and departures of vessels are concerned, though it is second to New York in tonnage.

Merchandise may be shipped direct from foreign ports to Chicago by being transported in bond from port of first entry. The number of vessels making direct trips to Europe is increasing. There is also a large number of railroads entering the city, which afford facilities for shipping goods to all parts of the country.

The grain elevators are great features of the city, vessels being loaded and unloaded by machinery. The principal trade is in live stock, pork packing, and other products of the farm and dairy, flour, grain, seed, manufactures of steel and iron, leather, shoes, chemicals, wines, brewing and distilling, cigars, tobacco, etc.

Harbor.—The harbor of Chicago consists of an inner and an outer harbor, the former being the Chicago river, which has been dredged and its mouth protected by piers 500 feet apart at the entrance, but the river is so filled with docks as to be very cramped and crowded for the immense commerce. Constant dredging is necessary to keep out

the accumulation of sand brought down by a NE. lake current, which has made many acres of new land on the north side of the entrance. The outer harbor is formed by the North pier, an eastern breakwater, and a southern breakwater, and incloses a basin of 270 acres to the south and east of the river entrance. A portion of this basin was dredged to a 16-foot depth prior to 1887, but since has been gradually filling up. A red and black horizontal-striped buoy marks a wreck in the harbor with but 7½ feet water over it.

The North pier reaches east in continuation of the north bank of the river and extends 200 yards beyond the eastern breakwater, which is commonly known as the Chicago North breakwater. It is 4,036.5 feet long, running perpendicularly (S. 0° 37′ W.) from the North pier, and about 3,300 feet from shore; a dock line 1,300 feet from shore and 2,000 feet from the eastern breakwater and parallel to it has been established, but the docks have not yet been built out to this line. The southern breakwater, commonly known as the Chicago South breakwater, extends SW. by S. 3,000 feet from the end of the eastern breakwater, completing the basin. There are three entrances to this harbor.

The outer breakwater, beginning at a line running north from the end of the North pier and about 5,000 feet from that pier, extends 5,413 feet, S. 59° 34′ E. with a depth of from 18 to 32 feet of water inside of it, forms an excellent harbor of refuge for vessels, and renders it easy for vessels to enter the outer harbor of Chicago.

The western half of this area has but 20 feet or less of water.

The entrance channel to the harbor has been dredged to a depth of 20 feet, with a width of 250 feet at the eastern and 200 feet at the western end. At the latest information this channel had slightly shoaled, but there was a depth of 18 feet at extreme low water. There is a depth of 18 feet of water at the entrance of the river. Three of the tunnels have but 16 to 18 feet of water over their crowns. Only a small part of the river has over a 15-foot depth of water.

The draft of vessels entering the river is limited to the depth of water over the crown of the La Salle Street tunnel, which is 16 feet 8 inches as an average. This depth is in the exact center of the river on a line between the central piers of the Clark Street bridge and Wells Street bridge.

There are no public wharves or docks. The buildings are in many cases so near the docks as to prevent dredging deeper than 16 to 18 feet close to them. There are about four bridges to the mile, which seriously interferes with navigation.

Tugs should be employed in all movements of vessels above the junction of the two branches.

The navigable length of the Chicago river is for the South branch about 4½ (5) miles from the mouth up to McCormick's Reaper factory. The North branch is navigable about 4 ($4\frac{8}{10}$) miles up to Western avenue. The stream is very crooked in places and varying in width, as

follows: Main branch, 274 feet; South branch, 205 feet; the Forks, 100 to 150 feet; North branch, 100 to 200 feet, and somewhat less beyond the Forks.

There is a harbor master to regulate the passage of vessels.

Landmark.—The new Ferris wheel, 305 feet above the lake level, is a prominent mark when approaching Chicago. It is visible some time before land is sighted. The wheel is lighted by electricity from dusk until midnight daily.

LIGHTS AND FOG SIGNALS.

Chicago Outer breakwater (NW. end).—A fixed white light is shown from a post attached to the SE. side of the building on the Emergency Intake Waterworks crib, an extension northwesterly on the outer breakwater.

Chicago breakwater—North.—A fixed white light 24 feet above the lake level is shown from the top of a white post on north end of breakwater.

Chicago breakwater.—South.—A fixed red light, 35 feet above the lake level, and visible 8½ (9¾) miles, is shown from a square, gray, pyramidal open framework tower, upper part inclosed, on south end of breakwater.

Chicago harbor.—A light, flashing alternately red and white at intervals of ten seconds, visible 13 9/10 (16) miles, and 67½ feet above the level of the lake, is shown in 30 feet water inside of and near the SE. end of outer breakwater, from a conical red tower, with black trimmings; lantern black. There are two fog-signal houses alongside the tower, one NW. and the other SE., all on a rock pier.

Fog signal.—A 10-inch steam whistle sounds blasts of five seconds; silent intervals twenty-five seconds.

Pierhead range.—A fixed white light, visible 11¼ (13) miles, is shown from a tower 40 feet from the outer end of the North pier, entrance to the river, and a fixed red light is shown from a post on the outer end of the same pier. The lights are 35½ and 30 feet above the lake level.

Fog signal.—A bell is struck by machinery a double and a single blow alternately, with silent intervals of twenty seconds. The fog bell is attached to lighttower near end of pier.

Chicago Avenue Waterworks crib.—A fixed white light, visible 13 9/10 (16) miles, is shown from a white lantern on an iron framework tower, 58 feet high, built on a stone crib. It is 4,300 feet N. by E. ⅝ E. (N. 15° E.) from the SE. end of the outer breakwater. This station is maintained by the city of Chicago.

Fog signal.—A bell is struck by machinery about twelve times every minute.

Cribs.—Off Lake View, 3½ (4) miles north of the outer breakwater, are two cribs, one temporary 1 (1 1/10) mile, and one permanent 1⅝ (1 8/10) miles from shore, marked by white lights.

There is a crib SE. of the entrance to Chicago harbor 3½ (4) miles from shore. The 2½ (2½) mile crib has been removed and there is a depth of 18 feet over the site. It is intended to increase this depth to 24 feet, and a buoy will be kept over the site until this depth is attained.

A fixed white light is shown on the 4-mile crib.

There are two cribs 1⅛ (1$\frac{3}{10}$) and 1⅞ (2$\frac{1}{10}$) miles, respectively, from the Hyde Park Waterworks; both are marked by white lights. A tower is to be erected on the outer crib.

The color of the permanent lights on these cribs is white. These lights are all maintained by the city of Chicago.

Life-saving station.—There is a life-saving station on the south side of entrance to Chicago river.

Dry docks.—Miller Bros.' Dry Dock Company has three docks, the largest being 310 feet long, with a 50-foot gate and 14 feet of water on the miter sill at ordinary stage of tide; the second is 280 feet long, 42-foot gate, with 12 feet of water on the miter sill; and the smallest is 260 feet long, 40-foot gate, and 9 feet of water on the miter sill. There is also at the yard a spar derrick capable of lifting 25 tons, besides a full outfit for making repairs of all sorts to wooden vessels.

The Chicago Shipbuilding Company has at its shipyard on the Calumet river a dry dock 470 feet long, with a gate 100 feet wide at top and 70 feet at bottom and 18 feet depth over sill.

Branch Hydrographic Office.—The United States Hydrographic Office has a branch office in the Masonic Temple. The office is supplied with all the latest information pertaining to the lakes, also nautical books and instruments, all of which are open for consultation or reference to the lake mariners or other interested parties.

Time ball.—A time ball is dropped from a flagstaff on top of the Masonic Temple, by the Branch Hydrographic Office, at Chicago, daily (Sundays excepted) at noon, central standard time.

The ball is hoisted five minutes before noon, central standard time, and is dropped by electricity exactly at noon. Should, through any accident, the time ball be dropped before the exact instant of noon, it will be hoisted again immediately, and kept up until five minutes after noon (12h. 5m.), and then slowly lowered. Should the ball fail to drop exactly at noon it will be kept mastheaded until five minutes after noon (12h. 5m.), and then slowly lowered as before.

Wharfage.—During the season of navigation, beginning April 1 and ending November 30, it is not customary to charge wharfage, so long as the owner does not wish to use his dock, but during the winter vessel owners pay from $10 to $100 for special accommodations.

Tugs.—Tugs are owned by the Chicago Towing Company, Vessel Owners' Towing Company, Dunham Towing and Wrecking Company, and the Independent Tug Line; also a number of private parties own tugs for special purposes.

Charges are moderate for the distance towed. These charges are

regulated by a tariff scale for the distance and size or tonnage of the vessel towed. Charges are on an average of $10 an hour for ground work. The average cost of towing steamers is $75 per trip, consorts or barges $130, and sailing vessels $45.

Pilotage.—Tug masters are licensed and responsible pilots. All steamboat masters who navigate the river or harbor are also licensed pilots.

Night signals.—A temporary search light has been mounted on the Auditorium tower for the purpose of giving warning to mariners of the coming of severe storms, and also to announce the approach of cold waves. This will not take the place of the present signal flags and lights, but is in addition thereto. As a rule, the time for using the search-light signal will be immediately after the receipt of the evening reports, and if these show conditions dangerous to mariners or the approach of a cold wave the search light will sweep the horizon between 8.30 and 10 p. m. The signals are as follows:

White light: Cold wave and frost warnings.

Red light: High easterly winds.

Red and white light (pencil of light half-and-half): High westerly winds.

Currents.—There is no perceptible current in the Chicago river, except when a sudden change of wind raises or lowers the lake surface or when an exceptionally high freshet occurs, setting a current out into the lake. Near the end of the piers at the entrance to the river a current has been noticed which sometimes forces vessels against the piers.

Directions.—Vessels approaching Chicago from the north or south should keep 2½ (3) miles off shore, to avoid the numerous shoals and cribs. When east from the Chicago Pierhead light a vessel may enter from the west or east end of the outer breakwater, or from either end of the eastern breakwater, these ends being marked by lights. Vessels may then come to anchor behind the breakwaters or steer for the mouth of the river, which is marked by a range of lights, where they will be taken charge of by a harbor tug in charge of a licensed pilot, who will take the vessel to the dock to which she may be consigned.

No vessel is allowed to use sails in the river.

Making the harbor from the northeastward, pass ¼ mile east of the Chicago Waterworks Crib light, on a course of south, until the North Pierhead light bears W. by S. (S. 79° W.), when run in on this course for the entrance.

To enter the outer harbor from the southward, bring the light on the south end of the eastern breakwater to bear west, stand in through the entrance, and, as you pass the light, haul up to the northward for anchorage.

Between Chicago and Calumet rivers are several offlying shoals, besides the shoal water which lines this portion of the coast, and extend out in places for a mile.

Oakland shoal.—Off Forty-first street, Chicago, 4 (4 1/10) miles from the entrance to the river, a sand spit called Oakland shoal extends out ¾ mile, with 9 feet least water near the center of the shoal.

Buoys.—The outer (easterly) end is marked by a black can buoy in 26 feet of water; the inner (westerly) end by a red spar buoy ⅛ mile from shore, in 16½ feet of water. These buoys are ⅝ mile apart, with 9 feet water about midway between.

Morgans reef.—About a mile to the southward of Oakland shoal, off the wharves at Hyde park, Morgans reef extends a mile from shore; the outer end, with 7 to 16 feet of water thereon, being rocky and the inner part with a least depth of 3 feet.

From Morgans reef to the World's Fair pier shoal water extends ¾ mile. At ½ mile east from the pier is a large 18-foot spot.

Buoys.—The outer end of Morgans reef is marked by a black spar buoy in 13 feet water and the inner end by a red spar buoy in 12 feet. Half mile south of the outer buoy are two spots with 18 feet of water on them.

There is a narrow passage with a depth of 12 feet, which small vessels can use between Chicago and Calumet, passing between the inner buoy and the shore, but closer to the buoy.

Hyde Park shoals.—Half mile to the eastward of Morgans reef is the Inner Hyde Park shoal, with 12 feet of water on the northern end; two detached spots of 17 and 18 feet depth north of it and one of 17 feet SE. of it. Nearly a mile to the eastward and 2 (2⅛) miles from shore is the Outer Hyde Park shoal, with 11 feet of water.

Buoys.—Hyde Park Outer shoal, a red and black horizontal-striped nun buoy in 18 feet water, marks the northern point of this shoal.

Hyde Park Inner shoal, a red and black horizontal-striped spar buoy in 17 feet water, marks the north side of this shoal.

Madison Park Shoal buoy.—At ¾ mile to the SW. of Hyde Park shoal is a red and black horizontal-striped spar buoy in 16 feet of water one (1⅛) mile off shore.

Vessels will clear the shoal by giving the buoy a berth of 300 feet.

South Park shoal.—One mile south of Outer Hyde Park shoal and 1¾ (2) miles from shore is South Park shoal, with 6 to 11 feet of water on its shoalest part.

Buoy.—The south side of the 6-foot shoal is marked by a red and black horizontal-striped can buoy in 28 feet of water.

Inside of this shoal and of the Hyde Park Shoal buoy there is a channel ⅞ mile wide. Vessels using it must keep ½ mile to the westward of the buoys, being careful to avoid the Madison Park shoal.

Cribs.—A mile south of this and a mile east of the World's Fair pier is the Hyde Park Waterworks inner crib, and distant ¾ mile NE. by E. ¼ E. (N. 59° E.) from this crib is the outer crib.

These cribs, marked by white lights in cupolas 50 feet high, are not yet completed. The inner crib is to be abandoned.

From the site of the World's Fair pier to Clarke point the shoal water extends ½ mile from shore.

Clarke Point shoal.—About 1⅞ (2) miles north of Calumet light Clarke Point shoal makes out ⅞ mile from shore, with 11 feet of water on its northern end and with rocky 5-foot spots ⅝ mile from shore and a 4-foot spot ½ mile from shore. A detached 18-foot spot ⅞ (1) mile from shore is off its northern end.

Buoy.—The outer end is marked by a red spar buoy just outside the 18-foot patch, in 18 feet of water.

Caution.—Vessels should not pass between this buoy and the shore.

Cheltenham shoal.—Three-quarters of a mile south of Clarke Point shoal and ⅝ mile from shore is Cheltenham shoal, with a rocky spot of 5 feet depth of water.

Calumet bar consists of several parts; one, having 19 feet of water on it, lies 1½ (1½) miles NE. by E. ⅝ E. (N. 60° E.) from Calumet Pierhead light, and extends ⅝ mile to the southward. Outside of the North pier are bars on either side of the channel with but 17 feet of water on them.

Caution.—The outer bar lies directly in the axis of the channel, consequently care should be exercised when approaching it.

On the south side of the entrance to Calumet shoal, water extends ⅝ mile from shore, and for 2½ (3) miles to the southeastward it extends ½ mile from shore.

Buoys.—A black spar buoy marks the south bank of the channel into Calumet river. It is in 18 feet of water.

A red spar buoy, in 18½ feet of water, marks the north bank.

Calumet (South Chicago).—This harbor, at the mouth of the Calumet river, is 10 1/10 (12) miles from Chicago harbor. The harbor is formed by two parallel piers, 300 feet apart, extending into the lake from the river's mouth in a NE. direction, the piers being sand tight and the channel being dredged between them. It is difficult to keep the channel clear of sand, which here has the nature of quicksand.

The channel, as far as the Illinois Steel Company's slip, has (June, 1895) a depth of 16 feet for a width of 200 feet.

A basin has been constructed by the Illinois Steel Company for its own use. It is 3,000 feet north of Calumet harbor, and consists of a slip 1,500 feet long and 200 feet wide, the mouth being contracted to 100 feet. It has a depth of 19 feet.

Three red buoys mark the north side and two black buoys the south side of the channel to this slip, the inner buoys marking the turn.

Calumet Pierhead light.—A fixed red light, visible 11 (12¾) miles, is shown from a square, gray tower on the outer end of the north pier.

Fog signal.—A tug usually lies near the end of the pier, and if incoming steamers blow four whistles the tug answers night and day.

Life-saving station.—There is a life-saving station on the north side of the entrance.

Dry dock.—The Chicago Ship Building Company have a dry dock on the Calumet river. It is 470 feet long, 100 feet wide at the top, 70 feet wide at the bottom, with a gate 70 feet wide, and 18 feet of water over the sill. There is also a 100-ton sheers here, as also all conveniences for repairing vessels.

Currents.—A current sweeps down the coast from the northward, and strong currents across the ends of the piers have been noticed at times, necessitating care in entering.

Directions.—When one mile off the entrance, with the light bearing SW. by W. ½ W. (S. 59° W.) head for the piers, end on. When the light bears SW. ½ W. (S. 51° W.) it will be on a range with the red light on the Ninety-second Street bridge. The fair-weather channel lies between the entrance buoys. Light-draft vessels can, after passing Clarke point, bring the Pierhead light to bear SSW. and head for it, rounding the north pier 100 feet distant and keeping 50 feet from the north pier after entering the channel. In heavy weather and entering at night, light-draft vessels should approach the entrance with the pier bearing south, clear the pier about 150 feet, and head into the harbor. In this way the current sweeping past the end of the north pier toward the south pier is avoided.

It is safe to enter here in ordinary blows, but not in severe gales, the NW. winds being the most dangerous. There is good anchorage outside with good holding ground of clay beneath the sand.

Caution.—There is a shoal south of the entrance on a line with the south pier and outside of the north pier. Keep the north pier closer aboard.

An electric light on the end of the Illinois Steel Company's ore dock is used by persons familiar with the harbor as a guide at night. As there is no fog signal it is not safe to attempt the entrance in thick weather.

Entering the Illinois Steel Company's new harbor.—Head for Calumet Pierhead light SSW. (S. 23° W.) until the stacks of the furnaces are opened up, then head in the channel between the buoys until the stacks are all in line, when head in on this range W. ½ S. (S. 84° W.) until abreast of the third red buoy, when haul up for the piers.

Caution.—There is a bar with 14 feet of water on it extending to the dredged channel off the SE. end of the north pier of this harbor.

The eastern shore of lake Michigan will now be described from Waugoshance point southward to South Chicago.

EASTERN SHORE OF LAKE MICHIGAN.

MICHIGAN.

Waugoshance light, island, and shoal. See page 54.

Ile aux Galets and light. See page 64.

Coast.—South of Waugoshance point is a large bay open to the westward. The northern part of this bay is all shoal, and shoals extend

1 1/10 (1 1/2) miles out from the head of the bay. Cross village is at the southern point of the bay, near which the shoals extend off nearly 3/4 mile. From here the coast takes a southwesterly direction for about 4 1/2 (5) miles and then south for 6 (7) miles to Seven-mile point. This part of the coast is hilly. Middle village is north of Seven-mile point and from this point the coast curves in to the SE. and east to the head of Little Traverse bay.

Little Traverse bay may be considered as having Seven-mile point as its north entrance point and Big Rock point as its south entrance point. From a line joining these points the bay is 10 4/10 (12) miles deep. It is wide, has deep water and good holding ground, and affords protection from all but westerly winds. Little Traverse is on the north part of the bay.

Little Traverse light.—On the extremity of Harbor point, south of Little Travers, is a fixed red light, 37 feet above the lake level, and visible 11 1/4 (13) miles. The light tower is square and attached to the south end of dwelling, both red.

Fog signal.—A bell is struck by machinery, a double blow every thirty seconds.

Charlevoix, 3 1/4 (3 3/4) miles SW. of Big Rock point, is at the mouth of the Pine river.

The harbor entrance leads through Pine river and Round lake to Pine lake, 3/4 mile back from the coast. It is formed by two piers 160 feet apart, narrowing to 100 feet at the shore line. The available depth is 12 feet. There is a depth of 40 feet in Round lake.

The channel from Round lake to Pine lake is between revetments 83 feet apart, the depth being 11 feet.

Charlevoix Pierhead light.—A fixed red light, visible 8 1/4 (9 3/4) miles, is shown 37 feet above lake level from a square white tower on the outer end of the north pier.

Directions.—When 1 3/10 (1 1/2) miles off the entrance, head for the light on a course SE. by E. (S. 56° E.) with the piers end on. When close-to, run in between the piers, keeping in mid-channel.

Fishermans island is a small island 1/2 mile off shore, and is surrounded by exposed rocks and extensive shoals.

A 12-foot shoal extends 7/8 mile north, an 11-foot shoal 5/8 mile NW., and about the same depth is found 3/8 mile to the westward of this island, while shoals connect it with the shore. SW. by W., 1 3/10 (1 1/2) miles, are two 18-foot spots.

Grand Traverse bay extends south into the mainland 27 3/4 (32) miles. A narrow, hilly peninsula extends north from the head of the bay 14 3/4 (17) miles, terminating in Old Mission point and dividing this part of the bay into East arm and West arm. Within the east shore of the bay are Torch Light and Elk lakes, and on the west shore are Suttons and Northport bays. Bowers harbor is on the west shore of the peninsula. There are no offlying shoals, although in the entrance

to the bay are several patches with from 5 to 10 fathoms over them. The bottom is almost everywhere good for anchorage, the arms affording the deepest water, and the bay is only exposed to north winds; protection from these may be found in the smaller bays.

Old Mission point has a reef extending north from it nearly 1 $\frac{8}{10}$ (1½) miles, with about the same breadth.

Light.—On the NE. end of the point is a fixed white light, 48 feet above the lake level, and visible 12 (14) miles. It is shown from a square tower on white dwelling.

Bowers harbor, on the west side of the peninsula and inside of Tuckers point and Hog island, affords good and secure anchorage.

Hog island.—There is a rocky spit extending from the south point for ¾ mile to the SW. with 11 feet of water on it, and a smaller one NE. from its northern point. This island lies near the course and must not be approached too close.

Traverse city is at the head of West arm. There is good anchorage off the town.

There is no light under Government control.

Suttons bay, inside of Suttons point, is at the west entrance to West arm. It affords good anchorage. Shoals extend ½ mile off its west shore.

Doughertys harbor, north of Suttons bay and inside of New Mission point, is a snug little anchorage in northerly winds.

Northport bay, between New Mission and Northport points, is the most extensive harbor within Grand Traverse bay. It also affords good anchorage, but there are one or two shoals to be avoided.

At ¾ mile north of Northport point is a rocky spit extending southeasterly ½ mile, with 9 feet of water on the outer end. Two dangerous shoals lie between Northport point and Northport; a small 8-foot shoal near the middle of Northport bay and a 6-foot shoal, ¾ mile long north and south, is ¾ mile NE. from it.

Bellows island.—This small island lies 2 $\frac{8}{10}$ (2½) miles S. by W. from Northport point, in the entrance to Northport bay, and shoal water extends ½ mile north and east from it.

South of Bellows island, and extending ¾ mile N. by E. from the northern point of New Mission point, is a rocky shoal with 15 feet of water over it.

General directions.—Grand Traverse bay can everywhere be safely navigated if a vessel keeps a mile off shore, excepting in rounding Old Mission point, when the lighthouse should be given a berth of 1 $\frac{8}{10}$ (2) miles; it may be approached somewhat closer if bound down the East arm.

Lighthouse point, the north point of the peninsula forming the west shoal of Grand Traverse bay, has a rocky spit extending ½ mile to the northward, with 12 feet water on its outer end. Just within the point are several hills.

Light.—On the NW. extremity of Lighthouse point is a fixed white

light 40 feet above the lake level and visible 11¾ (13½) miles. The light is shown from a square tower on yellow dwelling.

Cathead point is 3½ (3¾) miles SW. of Lighthouse point; the bight between is shoal. NE. of Cathead point ⅝ mile is a 16-foot shoal.

Coast.—From Cathead point the coast trends 12½ (14 9/10) miles SW. by S. to Carp River point. Within the point is Carp lake.

North of Carp River point the shore is bluff and wooded, with shoals extending ½ mile from shore.

At 3½ (4) miles NE. ½ N. from the dock at Carp River landing and 1 9/10 (1⅞) miles from shore are several rocky patches with 12 to 16 feet over them.

Good Harbor bay, between Carp River and Pyramid points, is exposed to northerly and northwesterly and protected from other winds. The western half of the bay has deep water over sand, the eastern half is shoal, and there are several rocky spots with 7, 8, and 10 feet over them. North Unity is in the SW. part of the bay.

North of Pyramid point about a mile are two 15-foot detached shoals.

Coast.—Between Pyramid and Sleeping Bear points is another bay open to the north and northwestward. Glen Arbor is at the head of this bay. From the shore north of Glen Arbor a rocky shoal extends out ⅝ mile. The south shore of this bay is hilly and steep-to. Within the bay is Bear lake.

Manitou islands and light. See page 68.

Coast.—From Sleeping Bear point the coast trends south 9½ (11) miles, and is bold with high bluffs. It then becomes lower and curves around to the westward to Platte River point, off which an extensive reef 1 (1¼) mile wide extends north 1 9/10 (1½) miles, with 13 and 16 feet on its outer end. From Platte River point the coast again becomes bold, with hills near the shore, and trends 4¾ (5½) miles WSW. to Betsie point. At 2 9/10 (2½) miles south of Sleeping Bear point is Sleeping bear, a hill directly on the shore, and 4¾ (5½) miles farther south are the Empire bluffs.

Betsie point is a rounding point with a prominent hill just within it. South of the hill is Crystal lake.

Light.—On Betsie point is a flashing white light every ten seconds. The light is 53 feet above the lake level, visible 12 9/10 (14¾) miles, and shown from a cylindrical tower connected to west end of dwelling by a covered way, both yellow, with red roofs. The fog-signal house is about 175 feet NE. by N. from the tower.

Fog signal.—A 10-inch steam whistle sounds blasts of five seconds, with alternate silent intervals of ten and forty seconds.

Life-saving station, ⅝ mile south of the light tower.

Frankfort, on lake Betsie, is 3¾ (4⅛) miles south of Betsie point. There is a hill 323 feet high just north of Frankfort and another 265 feet high south of it. A short channel connects lakes Michigan and Betsie, and the entrance is protected by piers.

The width between the piers is 200 feet. In June, 1895, there was a navigable depth of 13 feet between the piers. The depth in the inner lake is 20 feet.

A line of steamers ferries freight cars across from here to Kewaunee, a distance of 55 (63½) miles.

Pierhead light, a fixed red light, visible 7 4/10 (8½) miles, is shown from a square, white tower on the outer end of the south pier.

Fog bell.—A bell in a tower on the south pier, 8 feet in the rear of the light tower, is struck by machinery, a single and a double blow alternately, at intervals of twenty seconds.

Shoal.—A dangerous shoal is reported a short distance outside of the piers at this harbor, and directly in the track of vessels coming in. Its exact location is uncertain.

Life-saving station.—There is a life-saving station near the inner end of the south pier.

Directions.—When 1 3/10 (1½) miles west of the entrance, head for the light and run in between the piers, keeping close to the south pier until well inside, when keep in mid-channel.

Coast.—From Frankfort the coast takes a southerly direction for 16½ (19) miles to Portage lake. All along this stretch of coast are high hills, the highest, 400 feet, being about midway between Herring lake, (4 1/10 (4¾) miles south of Frankfort), and North Bar lake. There are no outlying shoals and the coast is everywhere safe to approach to ½ mile.

Portage lake.—This harbor was originally designed for a harbor of refuge, being favorably situated for such purpose. Portage lake, into which the entrance between the piers leads, measures 3 (3½) miles by one mile, and is close to the east coast of lake Michigan. The width at the entrance is 370 feet.

In June, 1895, there was a narrow channel with 6½ feet of water. The depth in Portage lake is ample for any vessel.

Pierhead range.—The front light is fixed red, and is shown from a post on the outer end of the north pier at a height of 23 feet.

The rear light is fixed red, visible 11 3/10 (13) miles. It is shown from a square, white tower 40 feet above the lake level.

Directions.—When 1 3/10 (1½) miles off the entrance, head in on the range. When near the piers, stand in between them, keeping in mid-channel.

Coast.—Between Portage lake and Manistee, 7 4/10 (8½) miles to the SW., the coast has the same general appearance, but the hills are not so high. Rush lake is 3 (3½) miles north of Manistee.

Manistee is on Manistee lake and river, at their lower junction, about 8,000 feet from the shore of lake Michigan. The Manistee river, a swift, narrow stream, flows through lake Manistee into lake Michigan. There are several small towns on the southern shores of Manistee lake.

The entrance to the harbor is formed by two piers 185 feet apart.

In November, 1895, the depth at entrance was 13½ feet and 11 feet in the river. The depth in Manistee lake is ample for all vessels.

Range lights.—The front light is fixed red, 23½ feet above the level of the lake. It is shown from a lantern in the outer end of elevated conduit near the outer end of the north pier.

The rear light, fixed white, varied by a red flash every forty-five seconds, and visible 12 3/10 (14) miles, is 45 feet above the lake level. It is shown from a square tower on a white dwelling on the north side of the mouth of the river. It is 2,022 feet ESE. (S. 68° E.) from the front light.

When a vessel is within 800 feet of the outer end of the north pier this light will be obscured when bearing ESE. (S. 68° E.).

Fog signal.—A 10-inch steam whistle in a house on the north pier sounds blasts of five seconds' duration, with silent intervals of twenty-five seconds.

Life-saving station.—There is a life-saving station on the inner end of the north pier.

Directions.—When 1 3/10 (1½) miles off the entrance, head in on the range and in between the piers.

Coast.—From Manistee the coast continues its southwesterly trend for 13 3/10 (16) miles to Big Point Sable light, and becomes lower and the hills more scattering. NE. of Big Point Sable light is the highest hill of 168 feet. Freesoil is nearly 6 (7) miles from Manistee, and has a pier.

Big Point Sable is a long, rounding point backed by hills, and just within is Big Sable lake, with Hamlin at its south end. This town is connected with lake Michigan by rail. Lincoln, on Little Sable lake, is 4¾ (5½) miles SE. of Sable light, and Ludington is 2 3/10 (2½) miles farther south.

Big Point Sable light.—A fixed white light, 106 feet above the lake level, and visible 16¼ (18¾) miles, is shown from a conical tower, connected with a dwelling, both of yellow brick.

Life-saving station.—There is a life-saving station one mile south of this lighthouse.

Ludington is the terminal of the Flint and Pere Marquette railroad, which maintains a fleet of lake steamers. Its inner harbor is on Pere Marquette lake, which empties into lake Michigan south of the town.

The harbor is formed by two piers 250 feet apart at the entrance, narrowing to 190 feet at the inner end of the north pier.

In October, 1895, the available depth in the channel between the piers was 13 feet. The depth in Pere Marquette lake is over 40 feet.

North Pierhead light.—A fixed white light on the outer end of the north pier is shown from a post, and is 25 feet above the lake level.

Pierhead range.—The front light is fixed red and shown from a post on the outer end of the south pier and 25 feet above the lake level.

The rear light, 106 feet distant, is a fixed red light, visible 7 4/10 (8½) miles. It is shown at a height of 36 feet above the lake level from a square, white tower.

Fog signal.—A 10-inch steam whistle gives blasts of three seconds;

silent intervals of seventeen seconds. The fog-signal building immediately in rear of tower is brown.

Life-saving station.—There is a life-saving station near the inner end of the north pier.

Directions.—When $1\frac{3}{10}$ ($1\frac{1}{2}$) miles off the entrance, head in on the range and in between the piers.

Coast.—From Ludington to Pentwater, $10\frac{4}{10}$ (12) miles to the southward, the hills become more numerous and higher, ranging from 157 to 248 feet. Bass lake, with a small outlet into lake Michigan, is 3 ($3\frac{1}{2}$) miles north of Pentwater and close to the shore.

Pentwater is on the north shore of Pentwater lake, one of the smaller of these interior lakes.

The entrance to lake Pentwater is formed by two piers 150 feet apart, extending into lake Michigan. The channel between the piers averages a depth of 9 feet. Lake Pentwater is 25 feet deep.

A bar extending from the lighthouse on the south pier in a NW. direction frequently forms during a gale.

Pierhead range.—The front light is fixed red and is shown 25 feet above the lake level from a post. It is on the outer end of the south pier.

The rear light, fixed red, is visible $7\frac{4}{10}$ ($8\frac{1}{2}$) miles. It is shown from a square, white tower, and is 33 feet above the lake level.

Life-saving station.—There is a life-saving station near the inner end of the north pier.

Tugs.—There is one tug owned by the Sands & Maxwell Lumber Company, the charges being reasonable.

Directions.—When $1\frac{3}{10}$ ($1\frac{1}{2}$) miles off the entrance, head in on the range, keeping to the NW. side of the entrance and closer to the north pier until within the entrance, when keep in mid channel.

Little Point Sable, $8\frac{3}{8}$ (10) miles SW. of Pentwater, is, from its rounding appearance and interior hills and lake (Little Sable), somewhat similar to Big Point Sable. The hills are not so high; the highest, 160 and 173 feet, are south of the lighthouse.

Light.—A fixed white light, varied by a white flash every thirty seconds, visible $16\frac{1}{4}$ ($18\frac{3}{4}$) miles, is shown from a conical tower connected with a dwelling, both of red brick, on Little Point Sable.

Coast.—South of Little Point Sable the hills become higher, with numerous bluffs. Benona, on Stoney lake, is $5\frac{8}{10}$ ($6\frac{3}{4}$) miles SE. of the light and Clay banks, a prominent bluff, 246 feet high, $3\frac{7}{10}$ ($4\frac{1}{4}$) miles farther on. The entrance to White lake is $7\frac{8}{10}$ (9) miles to the southward of the Clay banks. There are no shoals more than $\frac{5}{8}$ mile from the shore, excepting a small spit $4\frac{3}{4}$ ($5\frac{1}{2}$) miles north of White River light, which extends out nearly $\frac{1}{2}$ mile, with 14 feet water over it.

White river.—White river flows through White lake, a large body of water near the coast, into lake Michigan. Near the upper end of White lake, about $4\frac{1}{3}$ (5) miles from the entrance, there are two towns, Whitehall on the south and Montague on the north shore.

The harbor entrance is formed by two piers, with a width between of

190 feet. The sand is constantly shifting, and the entrance is liable to be barred by heavy gales. January, 1896: A depth entering alongside of south pier 10 feet, shoaling to 8 feet a short distance inside, and from 25 to 60 feet in White lake.

Light.—A fixed white light, varied by a red flash every forty seconds, visible 12 3/10 (14) miles, is shown 57 feet above the lake level from an octagonal tower on the NW. corner of a dwelling, both yellow, on the south side of the entrance to White river.

Pierhead light.—A fixed red light, visible 7 4/10 (8½) miles, is shown from a square white tower on the outer end of the south pier.

Life-saving station.—There is a life-saving station near the inner end of the north pier.

White Lake shoals.—There is a 5-foot shoal ⅛ mile east of the entrance, and one mile east of that another, none, however, on the north shore extending over ¼ mile from shore.

The south shore can be approached to ¼ mile for 2 3/10 (2½) miles, from which point shoals extend ¾ mile from the shore as far as Whitehall.

Directions.—When 1 3/10 (1½) miles west of the entrance, head in for the Pierhead light with the piers end on. When close to, keep between the piers in mid-channel. After passing the shoal at the entrance, by keeping ¼ mile off the north shore, and following its general trend, all shoals will be avoided.

Coast.—From White river the coast trends SE. by S. for 9½ (11) miles to Muskegon river, and is lined with bluffs and a few hills. Duck lake is 2 3/10 (2½) miles from White river.

Muskegon is on the south shore of Muskegon lake, the largest of the interior lakes along the east coast of lake Michigan. The Muskegon river discharges through this lake, the city being 3 (3½) miles from its mouth. This river is second only to Grand river in drainage area and volume, and its current keeps the harbor open the year round, except when ice is forced upon the shore by strong westerly winds.

The entrance to the lake is formed by two piers 300 feet apart, converging to 190 feet at the shore line.

In July, 1895, the available depth in the channel between the piers was 13 feet. The depth in Muskegon lake is 30 to 40 feet, with 15 to 20 feet at the head of the landing piers.

Muskegon light.—A fixed white light, visible 12 3/10 (14) miles, is shown from a square tower on a white dwelling on the south side of the entrance about 100 yards from the lake.

Pierhead range.—The front light is fixed red, 24 feet above the lake level, and exhibited from a lantern in the outer end of an elevated conduit.

The rear light, 580 feet distant, is fixed red, visible 7 4/10 (8½) miles. It is shown from a square white tower 36 feet above the lake level.

These two lights show the range and direction of the piers.

Fog signal.—A bell is struck by machinery, one blow every fifteen seconds.

Lake Beacon light.—On the north side of the inner entrance to the lake in line with the pierhead lights and 100 feet from the east extremity of the boom piling, from a post, is shown a fixed red light 25 feet above the lake level.

Life-saving station.—There is a life-saving station near the inner end of the north pier.

Shoals.—In Muskegon lake shoal water extends ⅛ mile from the south shore. Booms have been built to control the flow of sand.

Bank Point shoal.—In the middle of the north shore a shoal extends southward ⅛ mile, with 6 feet of water near the buoy on the outer end. It extends NE. and NW. from the buoy.

Buoy.—A black can buoy in 12 feet of water marks the extreme southern point of this shoal and also the turning point of the lake. There is no passage to the northward.

Directions.—When 1 1/10 (1½) miles of the entrance, head in on the range with the piers, end on at first, keeping to the south side of the bar until the piers are approached, when run in between them in mid-channel.

On leaving the channel, head east (nothing to the northward) passing southward of the buoy. From here head NE. ½ N. (N. 39° E.) until abreast of the docks.

Caution.—Care is necessary in entering, especially in NW. gales. Several schooners have been sunk or severely injured by colliding with the piers.

Coast.—From Muskegon lights the coast trends 4 1/10 (4¼) miles SSE. ½ E. to the entrance to Black lake, and has all along high hills close to the shore. At Black lake it becomes lower, but continues in the same direction 7 (8) miles to Grand Haven, when it again becomes hilly.

Grand Haven, lying near the mouth of Grand river on its south bank, is the principal harbor of refuge on the east coast, and, with this object in view, was designed with an entrance width of 400 feet and a depth of 18 feet. Two piers have been built. Grand river is the largest stream on this coast.

There are large sand dunes on the north side of the entrance from which quantities of sand are blown into the river, and, being carried by the current, maintain a bar opposite the middle of the entrance and outside the piers. Vegetation is being cultivated on these dunes to prevent this, and catch-sand fences are also used, but only furnish temporary relief.

On November 22, 1895, the least depth in southern crossing of the outer bar was 19 feet; shoalest depth on bar being 13½ feet; channel depth between piers near entrance, 15½ feet; farther inside, 20 feet or more, to the Grand Haven landing.

Shoal.—There is a rock and sand shoal inside of the harbor, about ⅛ mile from the pierhead, which has a least depth of 6 feet.

Grand Haven light.—A fixed white light, varied by a white flash

every minute, visible 13 9/10 (16) miles, is shown 70 feet above lake level from a conical white tower on the bluff at the south side of the mouth of the river.

Pierhead light.—At 75 feet from outer end of the south pier is a fixed white light, visible 11 3/10 (13) miles. It is 37 feet above the lake level, and shown from a square, white, pyramidal tower, upper part inclosed. Elevated walk along pier to the shore.

Fog signal.—A steam siren on the south pier in the rear of the light-house sounds blasts of five seconds' duration, with silent intervals of thirty-five seconds.

Life-saving station.—There is a life-saving station near the inner end of the north pier.

Wharfage.—Freight is charged wharfage here.

Caution.—The greatest depth of water was, at the last notice, on the southern crossing of the bar, but this and the depth may change in a short time during a gale, so great care is necessary in entering at such times.

Currents.—During the spring months the currents in the river run from 3 to 4 miles an hour. During the summer months the currents are light.

Directions.—When 1 3/10 (1½) miles off the entrance, head in on the range with the south pier end on. When close-to, head between the piers, closer to the south side of the entrance until inside, when keep mid-channel.

Coast.—From Grand Haven the coast trends almost south 17 (19½) miles to the Holland lights. Hills are scattered all along this stretch. Pigeon lake, with an outlet into lake Michigan, is about halfway between.

Holland.—Holland (or Black) lake is a large body of water near the eastern shore of lake Michigan, with which it is connected, the town of Holland being at its head some 4⅓ (5) miles from the entrance.

The entrance channel is between piers, 215 feet apart at the entrance, diminishing to 155 feet inside.

In winter the depth is usually reduced to 7 feet. The depth in Black lake is 24 to 40 feet.

Pierhead range.—A fixed red light is shown from a post on the outer end of the south pier. It is 25 feet above the lake level.

The rear light is also red, visible 8½ (9¾) miles, and 32 feet above the lake level. It is shown from a square, white tower. The lights are 102 feet apart and form a range for entering the harbor.

Life-saving station.—There is a life-saving station near the inner end of the south pier.

Directions.—When 1 3/10 (1½) miles off the entrance, head in on the range. When the piers are close-to, stand in between them, keeping in mid-channel.

If not acquainted with the waters of Black lake, it is best to anchor

and get a pilot. A system of ranges is used which is said to be easily understood.

Currents.—There are no currents save those due to fluctnations in the lake level.

Kalamazoo River entrance is 7 (8) miles south of the Holland lights. The coast is hilly all along, and can be approached with safety to $\frac{3}{4}$ mile. There is a detached 18-foot shoal halfway between, about $\frac{3}{8}$ mile off shore.

Saugatuck and Douglas are on opposite banks of Kalamazoo river $2\frac{8}{10}$ ($3\frac{1}{4}$) miles from the mouth, Saugatuck being on the north bank.

The stream is one of some capacity, draining 1,700 square miles and having a natural depth of 6 to 8 feet.

Below Saugatuck is a deep bend in the river, and bordering this is a large expanse of sand extending to the lake shore. Were the drift of sand from this vicinity into the river controlled there would be no difficulty in maintaining a channel of 10 or 12 feet depth.

In June, 1895, $6\frac{1}{2}$ feet could with difficulty be carried in. Thence to above the bend in the river are numerous bars.

Kalamazoo light.—A fixed white light, visible $12\frac{8}{10}$ ($14\frac{3}{4}$) miles, is shown 53 feet above the lake level from a square tower on a white dwelling on the north side of the mouth of the river.

Pierhead light.—A fixed red light is shown at the outer end of an elevated conduit at the outer end of the south pier.

Directions.—When $1\frac{3}{10}$ ($1\frac{1}{2}$) miles west of Kalamazoo light, head for the light and run in between the piers, keeping in mid-channel. None but small vessels can enter this harbor.

Coast.—From Kalamazoo river the coast trends $15\frac{3}{8}$ (18) miles southerly to South Haven. It is regular and lined with bluffs, being highest in the neighborhood of Saugatuck.

South Haven is at the mouth of Black river, a narrow stream.

The harbor is formed by two piers projecting into the lake from the mouth of the river, the width between the piers being 177 feet.

The main obstruction is the bar outside the piers.

Yearly dredging is necessary in the river.

In July, 1895, there was an available depth of 10 feet.

Pierhead light.—A fixed red light, 32 feet above the lake level and visible $8\frac{1}{2}$ ($9\frac{3}{4}$) miles, is shown from a square, white tower near the outer end of the south pier.

Signal-Service station.—There is a Signal-Service station on the lighthouse reservation.

Life-saving station.—There is a life-saving station near the inner end of the north pier.

Directions.—When $1\frac{3}{10}$ ($1\frac{1}{2}$) miles west of the light, head for it. As it is approached, open it a little on the starboard bow and run in between the piers, keeping in mid-channel.

Caution.—Keep the piers end on, as there is shoal water on either side of the entrance.

Coast.—From South Haven the coast trends about 19½ (22½) miles SSW. to St. Joseph. It consists of low bluffs and some few hills. There are no offlying dangers.

St. Joseph is an important harbor on the south bank of the St. Joseph river. Benton harbor, on a canal, is 1¾ (2) miles NE. A small stream, Paw Paw river, empties into this canal near its junction with the St. Joseph river ¾ mile from the lake.

Two piers have been built out from the river's mouth, the width between the piers being 263 feet. The shoaling outside the harbor has at times threatened to close it.

The Benton Harbor canal is 90 to 100 feet wide. A wing dam has been constructed at the mouth of the Paw Paw river as a protection against the sand.

In January, 1896, the available depth in St. Joseph harbor and in Benton Harbor canal was 12 feet.

St. Joseph light.—A fixed white light varied by a white flash every forty-five seconds, visible 15⅘ (18¼) miles, is shown 101 feet above the lake level from a square tower on a white dwelling on a bluff in the city SE. of the entrance.

Pierhead range.—The front light near the outer end of the north pier is fixed red and 24 feet above the lake level.

The rear light, 300 feet distant, is also fixed red, visible 8½ (9¾) miles, and 50 feet above the lake level.

The front light it shown from a lantern in an inclosed end of an elevated conduit; the rear one from a square white tower.

These lights show the direction of the outer end of the north pier and, in range, the course for entering the harbor.

Fog signal.—A bell struck by machinery every thirty seconds.

Signal-Service station.—There is a Signal-Service station 400 yards north of the lighthouse in the town.

Life-saving station.—There is a life-saving station near the inner end of the north pier.

Buoy.—A red spar buoy is moored in 20 feet of water and marks the northwestern point of the shoal on south side of entrance to harbor.

Directions.—When 1⅘ (1½) miles off the entrance, head in on the range with the piers, end on; as the piers are approached open out the north pier on the port bow.

Coast.—From St. Joseph the coast trends 13⅜ (15¾) miles SSW., the first portion of this stretch being low bluffs and the latter part hilly. At the above distance from St. Joseph and ½ mile inshore is Bald Tom, 320 feet high; it terminates this range of hills. Here the coast line trends a little more westward and runs about SW. for 17¾ (20½) miles to Michigan City. As Michigan City is approached the coast again becomes hilly. The boundary line between Michigan and Indiana comes in to the lake 4⅓ (5) miles NE. of Michigan City.

INDIANA.

Michigan City is at the SE. end of lake Michigan. Trail creek, a small stream, winds through the city, emptying into the lake.

The inner harbor is formed by two piers 100 feet apart at the shore line (the mouth of the creek) and 250 feet apart at the outer end of the eastern pier, 800 feet from shore. The western pier extends to the line of the old breakwater and 500 feet farther out than the eastern pier. The depth is from 11 to 14 feet. The east pier had an original length of 1,500 feet, but the outer 700 feet have been destroyed by the waves. A lookout for the wrecked portion should be kept when approaching the harbor.

The outer harbor is formed by a 1,200-foot pier projecting from a point on the shore 1,400 feet east of the entrance and a breakwater 1,400 feet long extending west from the end of the east pier. These, with the prolonged pier on the west side, inclose an area of 40 acres. This harbor will be of no use until dredged.

An outer breakwater is under construction.

The width of the entrance between the outer breakwater and the northern extension of the old breakwater is 400 feet, and the width of the entrance between the west pier and the old breakwater is 215 feet.

Lights.—Michigan City light, a fixed white light, visible $12\frac{8}{10}$ ($14\frac{1}{2}$) miles, is shown 52 feet above lake level from a square tower on a yellow dwelling, both with red roofs, on the east side of the entrance.

Four lanterns on posts are maintained by the United States Engineers, as follows:

A fixed red light on the breakwater pier, 54 feet from the outer end and 36 feet above the lake level.

A fixed white light on the breakwater pier, 375 feet from the outer end and 42 feet above the lake level.

These lights on range show the direction of the breakwater and the course for entering.

A fixed white light on the west pier, outer end, and 36 feet above the lake level.

A fixed red light on the outer breakwater, east end, and $15\frac{1}{2}$ feet above the lake level.

Life-saving station.—There is a life-saving station about 40 feet north of the lighthouse.

Directions.—When $1\frac{3}{10}$ ($1\frac{1}{2}$) miles off the entrance bring the lights on range and stand in, keeping the breakwater pier a little open on the port bow.

Currents.—A strong westerly current sets past the entrance to the harbor; the breakwater pier was built as a protection against it.

Coast.—From Michigan City the south shore of the lake curves to the westward to Calumet, South Chicago. The first half of this stretch is hilly; it then becomes low and marshy. The boundary between Indiana and Illinois is $1\frac{1}{2}$ ($1\frac{3}{4}$) miles SE. of Calumet.

Shoal.—A bar of sand and gravel with 5 fathoms and less extends northeastward into the lake for some distance. The center of this bar is about 6 (7) miles SE. of Calumet. The least water is [illegible] feet and is found in two detached patches 1½ (1¾) miles offshore. Natural causes probably form this bar, and as there is apt to be less water over it than shown on the charts, navigators are cautioned accordingly.

The west shore of the lake to Calumet has been described in a previous part of this chapter. Green bay will now be described.

CHAPTER VI.

GREEN BAY.

Green bay opens into the northwestern part of lake Michigan, and has a greatest length of 102 (117½) miles in a SW. ½ S. and NE. ½ N. direction from the head of Big Bay de Noquette to the entrance of Fox river. Its greatest breadth, 21 (24) miles, is abreast of Rock Island passage in a NW. ½ W. and SE. ½ E. direction. Its entrance, between Detour point and the point of the peninsula, in Portes des Morts, is 25 (28¾) miles wide. In the entrance are numerous islands which divide it into several passages, the principal of which are Poverty Island and Rock Island passages on the north and Detroit Island passage and Portes des Morts on the south. These passages and the islands have been described in the previous chapter.

MICHIGAN.

Coast.—Detour point, the north entrance point of Green bay, is the narrow termination of the peninsula bounding Big Bay de Noquette on the east. The point has shoals extending from it ¾ mile, and the shore of the peninsula to the westward of the point is connected by shoals to Little and Big Summer islands. From Detour point the coast trends 4¾ (5½) miles NW. to the head of Sag bay, and from Sag bay it trends north in a bluff point, called Burnt bluff.

Big Bay de Noquette.—A peninsula extending south from the main divides the north end of Green bay into Big Bay de Noquette and Little Bay de Noquette. The entrance to the Big bay between Burnt bluff and Peninsula point due west is 10 4/10 (12) miles. Stony and Poplar points further divide the head of Big Bay de Noquette; the western head is known as Ogontz bay, and is shoal.

East shore.—The east shore, which has several indentations, has, besides Burnt bluff, Middle, Garden, and Jacks bluffs. Vessels navigating this portion of the bay should keep close to the westward of a line joining Burnt and Garden bluffs. On this shore are South River bay, south of Garden bluff and Garden bay, between Garden bluff and Ansels point. Both these bays are shoal.

North shore.—All the north shore of the bay is shoal for some distance, and between Stony and Indian points a rocky spit extends southward 5⅝ (6½) miles. This spit separates the deep water in the east head of Big Bay de Noquette from that in Ogontz bay.

West shore.—The west shore of the bay is shoal; off St. Vital point is St. Vital island. This island is small and surrounded by shoals, which connect it with the west shore in all directions and extend eastward ½ mile, narrowing the deep-water channel in Ogontz bay.

Round island, small and triangular, is 2⅝ (3) miles off the west shore of the bay and about midway between St. Vital and Chippewa points. The island is surrounded by shoals which extend north in detached patches 1½ (1¾) miles. Midway between Round island and the main is another shoal.

Peninsula point is the narrower termination of the peninsula separating Big and Little Noquette bays. The whole point is surrounded by shoals, which extend south from the point 1 1/10 (1½) miles. This shoal is rocky, is known as Peninsula Point shoal, and has only 2 feet of water over it ⅝ mile south of the lighthouse.

Buoy.—A red spar buoy is moored in 18 feet water, and marks the south end of Peninsula Point shoal. The passage between this buoy and Eleven-foot shoal should not be attempted.

Light.—On Peninsula point from a square tower at southern end of dwelling, both yellow with red roofs, is shown a flashing white light every thirty seconds. The light is 41 feet above the lake level, and visible 11¾ (13¼) miles.

Eleven-foot shoal lies 2 (2½) miles S. by W. ⅝ W. of Point Peninsula light. It is a detached shoal, least water 9 feet, with deeper water all around, but vessels should not pass to the north of the buoy, and it is safest to pass south of Eleven-foot Shoal lightvessel before standing up Little Bay de Noquette.

There is a small spit with 14 feet over it ½ mile eastward of the Eleven-foot shoal.

Buoy.—A red nun buoy is moored in 18 feet water on the south side of Eleven-foot shoal. A line connecting the lightvessel and Peninsula Point light passes over the buoy.

Eleven-foot Shoal lightvessel is moored in about 60 feet of water to the southward and westward of Corona and Eleven-foot shoals. The lightvessel is schooner rigged, and has two masts, but no bowsprit; the hull is painted black, with Eleven-foot Shoal in large white letters on each side and No. 60 on the bows. A fixed white light is shown from the foremasthead, 40 feet above the bay level, and visible 11¾ (13¼) miles.

Fog signal.—A 6-inch steam whistle sounds blasts of five seconds, with silent intervals of ten seconds. If the whistle be disabled a bell will be rung by hand.

Corona shoal is 2⅝ (3) miles S. ½ E. from Peninsula Point light. The shoal has its greatest extent, 275 yards, in a NNE. and SSW. direction. The least water, 11 feet, is about 100 yards NE. of the buoy.

Buoy.—A red and black horizontal-striped spar buoy is moored in 18 feet, and marks the southern point of Corona shoal.

Drisco shoal is 6½ (7½) miles S. ⅝ E. from Peninsula Point light. It is nearly ¼ mile in extent NE. and SW., and has a least depth of 10 feet. From its outlying position, and being nearly in the track of vessels, the shoal is very dangerous in thick weather, as the soundings in the vicinity can not be depended upon to give warning of an approach.

Buoy.—A red and black horizontal-striped can buoy is moored in 21 feet water, and marks the northeastern point of Drisco shoal.

Little Bay de Noquette.—The east shore of the bay is comparatively steep-to until abreast of Sand point and Escanaba. North of this, and as far as Squaw point, shoals extend from the east shore and almost half fill the bay. There is a channel between Squaw and Saunders points with deep water, and north of Saunders point there is a good landlocked anchorage with ample water. The head of the bay is shoal.

Shoals extend ⅝ mile east of Sand point, and then take a southerly direction 5⅝ (6¼) miles, where they abruptly change direction to the westward.

Buoys.—A black spar buoy is moored in 18 feet water, and marks the end of the shoal extending NE. from Sand point.

A red can buoy is moored in 18 feet water, and marks the SW. end of the shoal on the east side of bay opposite Sand point.

The channel is between these buoys. A black spar buoy is moored in 18 feet water and marks the eastern point of the shore making out from Saunders point.

A black spar buoy is moored in 17 feet water, and marks the northern edge of the shoal making out from Saunders point.

Escanaba is on the west shore of Little Bay de Noquette, and affords sheltered anchorage from all but southerly winds.

Escanaba light.—A fixed red light, visible 11$\frac{7}{10}$ (13) miles, is shown 44 feet above the bay level from a square tower attached to a white dwelling, both with red roofs. It is near the end of Sand point.

Coast.—South of Escanaba, and between it and Indian Town, shoals extend off shore from 1 (1¼) to 2⅝ (3) miles. SE. of Indian Town 1$\frac{3}{10}$ (1½) miles is a detached 4-foot shoal. From here to Cedar river the shoals follow the coast line at from ½ to ⅝ mile off, excepting at 4 (4$\frac{8}{10}$) miles north of Cedar river, where there is a rocky spit extending in a southeasterly direction for nearly a mile.

Whaleback shoal lies in the center of Green bay. It extends NW. and SE. 1⅛ (1½) miles and inside of ½ mile wide. The shoalest spot, nearly awash, is midway between the ends (buoys). A line connecting Pilot Island and Cedar River lights passes almost over the middle of the shoal.

The soundings in the vicinity are very irregular, and great care should be observed in approaching the shoal.

Buoys.—Whaleback shoal, east end, a red spar buoy in 18 feet of water, marks the southeastern point of Whaleback shoal.

Whaleback shoal, west end, a black spar buoy in 18 feet of water, marks the northwestern point.

Cedar River, on the western shore of Green bay, is at the mouth of Cedar river.

The entrance to the river is between piers 200 feet apart, running nearly SSE. and NNW. Work was suspended by the Government in 1885 and has not been resumed since, though private parties have done some dredging.

In April, 1894, there was a narrow channel with a governing depth of 14 feet.

Cedar River light.—A fixed white light, visible 13 7/10 (15¾) miles, is shown 66 feet above the bay level from a square, white, pyramidal tower near the outer end of the east pier.

Cedar River range.—The front light, fixed red and 21 feet above the bay level, is shown from a lantern on the south corner of Cedar River light tower.

The rear light, fixed red and 26½ feet above the bay level, is 500 feet from the front light and shown from a post attached to an elevated walk near the light tower.

Rock.—A rock with 9 feet of water over it lies 555 yards S. ¼ W. (S. 3° W.) from the light tower.

Buoy.—A black spar buoy in 9 feet of water marks this rock.

Entrance shoals are ⅞ mile from shore, with 11 feet of water on the outer one.

Directions.—Care is necessary, as there are unmarked shoals on each side of the range in entering. By keeping Cedar River light ahead bearing NW. ¼ W. (N. 48° W.) until abreast the black buoy and then bringing the range on, a vessel will avoid the outer shoals.

Coast.—From Cedar river the west shore of the bay trends 21¼ (25) miles SW. by S. to the mouth of the Menominee river.

Shoal water extends ⅝ mile from shore. At 4¾ (5¼) miles below Cedar river there is a 10-foot spot a mile from shore, and 3½ (4) miles farther to the SW. there is a 15-foot shoal about the same distance off.

From 3½ (4) to 5¼ (6) miles north of Menominee light, and west of the southern part of Chambers island, are several detached spots about a mile offshore, the northern one having 12 feet and the southern 14 feet of water.

At 2 (2⅓) miles NW. of Menominee light and ¼ mile from shore is Bum island, small, with a 9-foot shoal extending ½ mile to the SE. and ¾ mile from shore.

From here to Menominee light, shoal water makes out ¼ mile. South and SE. of the light, flats with but one foot over them extend 1¾ (2) miles from shore.

Chambers island and light. See page 115.

Menominee is on the north side of Menominee river, the towns of Marinette and Menekaunee being on the south bank.

The river is the boundary between Michigan and Wisconsin, Menominee being in Michigan and the two other towns in Wisconsin. The river is wide at its mouth, but shallow.

Good anchorage can be found outside and NW. of the light.

The entrance to the harbor is between piers, running nearly ENE. and WSW., 400 feet apart.

There is (January, 1896) a channel 200 feet wide and 15 feet deep between the piers.

Connecting with the harbor channel, at the shore end of the north pier, for a distance of 6,800 feet up the river, the channel had a width of about 200 feet and a depth of 14 feet. Thence up the river, a distance of about 2,400 feet, the width was about 100 feet and depth 13 feet.

Menominee Pierhead light.—A fixed red light, visible $11\frac{1}{10}$ ($12\frac{3}{4}$) miles, is shown 34 feet above the bay level from an octagonal, white, pyramidal tower on the outer end of the north pier.

Shoals.—There are extensive shoals to the southeastward of the light.

Directions.—When off the entrance bring the light to bear SW. and stand in between the piers, keeping in mid-channel. If passing the bridge use the north draw.

WISCONSIN.

Green island is a small island $4\frac{1}{10}$ ($4\frac{3}{4}$) miles SE. by E. from Menominee light. It is $\frac{7}{8}$ mile long by $\frac{1}{4}$ mile wide. The island is wooded and surrounded by reefs extending $\frac{3}{4}$ mile to the westward and $\frac{1}{2}$ mile to the SE.

Green Island light.—A fixed white light, visible $12\frac{8}{10}$ ($14\frac{3}{4}$) miles, is shown 55 feet above the bay level from a square tower on a yellow dwelling near the SE. point of Green island.

Coast.—Below Menominee the west shore of Green bay is generally low, consisting of flats and offlying shoals of great extent, while the east shore is bolder and often steep-to, with numerous small offlying islands, reefs, rocks, and shoals.

Peshtigo shoals, at the mouth of the Peshtigo river, are from $1\frac{3}{10}$ ($1\frac{1}{2}$) miles wide at Peshtigo point to $\frac{3}{4}$ mile at their extremity, $2\frac{6}{10}$ (3) miles SE. from the point. There is 4 feet water near the extremity of the point.

Buoy.—A red can buoy is moored in 21 feet water off the extreme SE. point of Peshtigo shoal.

Peshtigo River directions.—Vessels should not attempt to pass between the buoy and the point, and if bound to Peshtigo river from the northward, should pass the buoy $\frac{3}{4}$ mile before heading for the mouth of the river.

Coast.—From the south point of Peshtigo River entrance the coast turns abruptly west for 7 (8) miles and then south $3\frac{9}{10}$ ($4\frac{1}{2}$) miles to the mouth of the Oconto river, the bight thus formed being filled by a shoal flat. Between Oconto and Pensaukee rivers, shoals extend off shore 3 ($3\frac{1}{2}$) miles; Pensaukee shoal off the mouth of the river having only 5 feet water at its onter end.

From Pensaukee point to the head of Green bay the western shore is

lined with rocky flats making out for 1¾ (2) to 2 9/10 (3) miles. At 7 8/10 (9) miles from the head of the bay Little Tail point, a narrow detached point, extends 1 (1¼) mile from shore, and 3½ (4) miles north of Fox River entrance Long Tail point extends 2 (2¼) miles to the SE., with a lighthouse on the outer end.

Long Tail Point light.—A fixed white light, visible 13 (15) miles, is shown 56 feet above the bay level, from a square tower on a white dwelling. It is on the south end of Long Tail point.

Fog signal.—A bell struck one blow, by machinery, every ten seconds.

Long Tail shoal.—Shoals extend a mile to the south and east from this point as well as northerly along the coast.

Buoy.—A red can buoy in 16 feet of water marks the south point of the shoal off Long Tail point, and is the first buoy as the mouth of the Fox river is approached.

Green Bay city lies at the south end of Green bay, at the mouth of the Fox river, a very important stream. The town of De Pere is about 4½ (5) miles above Green Bay city on the same river.

The head of Green bay is full of shoals, but a channel has been dredged and revetted up to the city, cutting through Grassy island. The project calls for a channel 16 feet deep, 200 feet wide, and 16,500 feet long.

In 1895 a channel 100 feet wide and 16 feet deep was completed for its entire length. In November, 1895, the channel had an actual depth of 14¼ feet.

Grassy Island Upper light.—A fixed white light, visible 11 3/10 (13) miles, is shown 37 feet above bay level, from a white tower on the piling at the south end of the east side of the new cut through Grassy island.

Grassy Island Lower light.—A fixed white ight, visible 10⅜ (12¼) miles, is shown 30 feet above bay level, from a white tower on the piling at the north end of the east side of the new cut through Grassy island.

The keeper's dwelling is on the island and between the lights.

Caution.—The distance between the two latter lights is 676 feet. They are not range lights; if used as such they will lead ashore. They only mark the position of the piling.

Sable Point buoy.—A black nun buoy is moored in 15 feet water and marks the end of the spit which extends in a westerly direction 3 (3½) miles from Sable point.

Buoys.—The following buoys mark the eastern side of the New channel at the entrance to Fox river:

A black, second-class nun buoy, in 17½ feet of water, on the following bearings: Grassy Island lights in range SSW. ½ W. (S. 24° W.), distant 2,666 yards.

A black spar buoy, in 14 feet of water, on the following bearings: Grassy Island lights in range SSW. ½ W. (S. 24° W.), distant 2,160 yards.

A black spar buoy, in 14 feet of water, on the following bearings: Grassy Island lights in range SSW. ½ W. (S. 24 W.), distant 1,580 yards.

The cut into Green bay is marked by eight even-numbered red spar buoys, all of which must be left on the starboard hand entering.

The west line of channel of Fox river between Green Bay city and De Pere is marked by twelve even-numbered spar buoys.

Directions.—From the point a mile SE. (S. 45° E.) of Long Tail Point lighthouse steer SW. by W. ½ W. (S. 62° W.), leaving Long Tail Point buoy on the starboard hand close-to, and when Sable Point buoy bears a little abaft the beam steer S. ½ W. (S. 2° W.) for the outer entrance buoy of the new cut; then as this buoy is approached, pass eastward of it and close-to, steering SSW. (S. 22° W.), which course will lead fair into the cut. Follow the buoys until the deep water at the mouth of the river is reached and the inner buoy is passed; then take mid-channel for Green Bay city.

NOTE.—NE. gales usually raise the water at the mouth of the Fox river from 1 to 2 feet and SW. gales lower it about the same.

Coast.—All along the south end of Green bay and the eastern shore as far as Red banks, a prominent bluff, is shoal. Between Red banks and Red River bluff there are no shoals outside the distance ⅝ mile, excepting a 15 to 18 foot offlying patch 2¾ (3 1/10) miles NE. of Red banks and a mile offshore; beyond this to Little Sturgeon bay the east shore is steep-to.

Little Sturgeon bay is a small bay, open to the northward and shoal. Just east of the bay is a shoal bight.

Snake island is off the east point of this bight. It is a small circular island surrounded by shoals. From the bottom of the bight a long shoal spit extends northward, and there are several detached shoals about 1 1/10 (1¼) miles offshore between Snake island and Sherwood point.

Caution.—Vessels from the southward, bound into Sturgeon bay, should give this part of the coast a berth of 1¾ (2) miles, and not change course into Sturgeon bay until Sherwood Point light bears SE. ½ S. (S. 30° E.), or to the southward of this bearing.

Sturgeon bay is of importance as having at its head the canal leading into lake Michigan. This bay runs SSE. and affords good anchorage, and is the real harbor of refuge to which the artificial harbor and canal (on the west shore of lake Michigan) give access.

The town of Sturgeon Bay is on the east shore near the head of the bay about 4½ (5) miles from the mouth and 3½ (4) miles from the SE. entrance of the canal.

A high hill, called Stevens hill, rises back of the town. At least 18 feet of water will be found in the center of the bay.

Sturgeon Bay Canal lights are under the control of the United States Lighthouse Board, and are as follows:

Northwest entrance, No. 2, light.—A fixed white lantern light, 11 feet above the bay level, on top of a square, pyramidal, unpainted wooden structure, the upper part inclosed, on the southwesterly side of the entrance to the canal from Sturgeon bay.

Northwest entrance to cut, No. 3, light.—A fixed white lantern light, 11 feet above the bay level, on top of a square, unpainted wooden skeleton structure, the upper part inclosed, on the southwesterly side of the entrance to the cut in Sturgeon bay leading to the canal, and 4,590 feet northwesterly from light No. 2.

Southeast entrance, No. 1, light.—A fixed white lantern light, 15 feet above lake level, on top of a square, pyramidal, inclosed wooden structure, painted red, on the northeasterly side of the entrance to the canal from the harbor of refuge, Lake Michigan, and 6,654 feet southeasterly from light No. 2.

Sherwood Point light.—A fixed white light, varied by a red flash every minute, visible 13½ (15⅓) miles, is shown 61 feet above the bay level from a square tower attached to the north end of the dwelling, both of red brick.

Fog signal.—A bell on Sherwood point is struck by machinery a single blow every twelve seconds.

Dunlap Reef range.—The front light is fixed white, and is shown from a red tower attached to a white house with a red roof. It is visible 9 1/10 (10⅔) miles and is 18 feet above the bay level.

The rear light, also fixed white, is shown from a square tower on a white dwelling, both with red roofs. It is visible 11½ (13¼) miles and is 39 feet above the bay level.

The lights are on Dunlap reef, and are 680 feet apart on a range SSE. ½ E. (S. 28° E.). They guide through a narrow channel abreast of Hills point.

Shoals.—There are numerous shoals in this bay, but they are marked by buoys and lights.

Quarry Point shoal is off the entrance to Sawyers harbor (south of Sherwood point); there is but 6 feet of water over it.

Buoy.—A red spar buoy marks the east side.

Hills Point shoal.—Shoal water here extends nearly across the bay from the east shore, leaving a narrow channel between it and Hills point, and is marked by the following buoys:

Hills point (outside), a black spar buoy (No. 1) in 15 feet of water, marks the western edge of the above shoal.

Hills point, a black nun buoy (No. 3) in 14 feet of water, marks the western edge of the same shoal.

Hills point (inside), a black spar buoy (No. 5) in 14 feet of water, marks the SW. point of the same shoal.

Dunlap Reef or Middle Ground shoal.—This shoal lies in midchannel NW. of the town and west of Stevens hill. Dunlap Reef lights are on this middle ground.

Buoys.—Middle ground, (NW. end), a red and black horizontally striped spar buoy, marks the NW. end of the shoal.

West channel, No. 1, a black spar buoy in 12 feet of water, marks the west point of the middle ground, and is a guide through the West channel.

East channel, No. 2, a red spar buoy in 18 feet of water, marks the NE. edge of the middle ground, and is a guide through the East channel.

Middle ground (SE. end), a red and black horizontally striped buoy, marks the SE. point of the middle ground.

Directions.—A vessel can stand toward the bay with Sherwood Point light ahead bearing anywhere between S. by W. (S. 11° W.) and SE. ½ S. (S. 39° E.). When about a mile from the light, steer so as to round the point at about ⅛ mile off, and then south, passing close east of Quarry Point buoy. Bring the Dunlap Reef lights in range, and stand on past the black buoys off Hills point (these mark the east side of the channel).

When nearly up to the Middle Ground buoy (NW. end), open the lights, and pass to the eastward of them through the drawbridge; then keep nearly in mid-channel until the entrance to the canal is reached.

There is good water in the channel to the westward of Dunlap reef, but the turn around the southern end is too sharp for vessels bound through the canal.

Caution.—Vessels from the canal must remember that the channel through the bay is buoyed in from Green bay; therefore, when passing out through Sturgeon bay to Green bay, the red buoys should be left to port and the black buoys to starboard.

Monument point is 6⅞ (7⅛) miles NNE. of Sturgeon bay, and Egg harbor is 3¼ (3¾) miles beyond. Monument point is shoal NE. and SW. for nearly ½ mile, and there are several offlying shoals along this stretch of coast.

Monument shoal, with a least depth of 8 feet, lies 1½ (1⅝) miles SE. of Monument point. The shoal is about 600 yards long ENE. and WSW. There are 7-foot shoals closer to shore, S. and NNE. of Monument shoal.

Buoy.—A black spar buoy is moored to mark the most westerly point of Monument shoal.

Caution.—Between Sturgeon bay and Egg harbor keep at least 1½ (1⅝) miles offshore west of Monument Shoal buoy, and do not head in for Egg harbor until 3 (3¼) miles beyond the buoy.

Egg harbor, 10½ (12) miles NE. of Sturgeon bay, is ½ mile wide by ¾ mile deep. It is a good harbor except in N. and NW. gales.

Hat island.—The coast between Egg and Eagle harbors is steep-to, except Fish Creek bay, which is shoal. Hat island is NNW. of Egg harbor and 2$\frac{4}{10}$ (2½) miles off shore. Shoals extend ½ mile E. and SE. from it.

Detached shoal.—A detached shoal ¼ mile square lies one mile SSW. of Hat island.

Eagle Bluff light.—A fixed white light, visible 14½ (16½) miles, is shown 76 feet above the bay level from a square tower attached to the NW. corner of a dwelling on the extreme westerly point of Eagle bluff. Both buildings are yellow, with red roofs.

Here the coast is dangerous on account of the SE. shoals from Chambers island and the Strawberry islands with their shoals.

The Strawberry Island group consists of three or four islands, the southern one being the largest. They are connected by shoals with several small detached shoals to the south. With the shoals the group is 2 9/10 (3) miles north and south and 1 (1¼) mile wide.

Buoys.—Strawberry channel, SE., a red spar buoy in 13 feet of water, marks the SE. end of this group. Pass close to the buoy.

Strawberry channel, NE., a red spar buoy in 24 feet of water, marks the NE. end of the group.

Chambers island lies near the center of Green bay. The east and west sides of the island extend nearly north and south, the east side being 3¼ (3¾) and the west side 1¾ (2) miles long.

A prominent point forms the NE. end. There is a lake back of it. There are two points at the NW. end, the lighthouse being on the most northern one.

A hill rises back of the lighthouse, with another to the SE.

The south side is almost a straight line, trending 2⅛ (2¾) miles SE. by E. ¼ E., forming a long, sharp point at the intersection with the east side.

The island is wooded, and much of its coast line consists of low bluffs.

Chambers Island light.—A fixed white light, varied by a white flash every minute, visible 13 1/10 (16) miles, is shown 68 feet above the bay level from an octagonal tower on the NW. corner of a dwelling, both being yellow, on the northern point of the NW. end of the island.

Shoals.—A reef extends ¾ mile from the north point, and the bay on the north side is full of shoals, extending ¾ mile from shore.

Standing along the west side of the island, shoal water extends about ½ mile from shore. Off the SW. point a narrow spit, with 16 to 17 feet of water on it, makes out 1 (1¼) mile west.

There are no shoals on the south shore more than ¼ mile from shore.

A spit 1¾ (2) miles long, with 8 feet least water, 1 9/10 (1½) miles from shore, makes out from the SE. point in the prolongation of the south shore. Shoal water extends ¾ mile from the east shore, and about midway is a detached 14-foot spot 1 (1¼) mile from shore.

Caution.—Do not pass between Chambers island and the Strawberries.

Horseshoe island lies off the entrance to Eagle harbor ½ mile NE. of Eagle bluff. The shoals around the island do not extend more than ⅛ mile from it.

Eagle harbor is eastward of Eagle bluff, and affords good anchorage except in N. or NW. gales.

Excepting the head of the bay, off the town of Ephraim, where shoals extend ½ mile from shore, the shore can be approached to ¼ mile.

Sister bay, next NE. of Eagle harbor, is open to the north and west. Its shores are steep-to, but it has a 15-foot shoal in the middle of its entrance.

Sister shoals lie off the south point of Sister bay. They consist of three small shoals with 3 feet over them.

Sister islands are off the north point of Sister bay. They are very small, and have shoals extending $\frac{7}{8}$ mile NW. and SE. and $\frac{1}{2}$ mile wide. They are $\frac{3}{4}$ mile from shore, but a reef extends from shore in the direction of the islands for half this distance, rendering the channel between unsafe.

Horseshoe reefs are $2\frac{9}{10}$ (3) miles westward of Sister islands. They consist of two shoal patches of 2 feet and one of 16 feet.

Buoy.—A red can buoy is moored in 36 feet water $\frac{1}{2}$ mile eastward of the northern end of Horseshoe reefs. Vessels must pass eastward of this buoy.

Sister bluff, steep-to, is 100 feet high, and is the southern entrance of Ellison bay.

Ellison bay is open to the N. and NW. Its shores are steep-to, and it affords protection from south and east winds.

Death Door bluff is the NW. extreme of the long peninsula separating Green bay from lake Michigan. It is steep-to, as is all the north coast of the peninsula.

Hedgehog harbor, between Death Door bluff and Table bluff, the north point of the peninsula, affords anchorage and protection from south winds. From Table bluff the NE. shore of the peninsula curves around to the eastward and south, is high, and forms the south shore of the Portes des Morts, which has been described in the previous chapter.

CHAPTER VII.

LAKE HURON.

Lake Huron is 192 (221) miles long from Spectacle reef to St. Clair river, and 85 (98) miles long on the forty-fifth parallel abreast of Thunder bay. It has a maximum depth of 750 feet and an altitude above the sea of 581.28 feet.

The north and NE. shores of lake Huron are mostly composed of sandstone and limestone, and where metamorphic rocks are found the surface is broken and hilly, rising to elevations of 600 feet or more above the lake, unlike in this respect the southern shores skirting the peninsula of Michigan and southwestern Ontario, which are comparatively flat and of great fertility. Georgian bay, in the northeastern part of the lake, lies entirely within the Dominion of Canada, while Thunder bay on the west and Saginaw bay on the SW. are in the State of Michigan. The chief tributaries of the lake on the United States side are Thunder Bay river, the Au Sable, and the Saginaw. On the Canadian side are the French river from lake Nipissing, the Severn from lake Simcoe, the Muskoka, and the Nottawasaga, all emptying into Georgian bay.

HARBORS OF REFUGE.

Sand Beach, 50 (57½) miles northward of the St. Clair river, on the Michigan side, is the only artificial harbor of refuge on the lake on the American side. Twenty-one feet can be taken in.

Goderich, Canada, E. by S. from Sand Beach, is also a harbor of refuge, but only for vessels drawing less than 16 feet.

NAVIGATION.

As a rule navigation opens in the middle of April and closes the middle of December. See page 6.

DANGERS.

The outlying dangers, principally at the east entrance to the Strait of Mackinac, have been described. There are no other dangers in the lake, excepting those in the different bays or near the shore line. These will be described as met with in the description of the coast.

THE COAST.

The north shore of the lake from Detour point westward is described in Chapter III, Strait of Mackinac. The routes from Detour point are given in the same chapter, as also is a description of Cheboygan.

WEST SHORE.

Coast.—From Cheboygan to Nine-mile point the coast trends ESE. for 8¾ (10) miles, and can be approached to ¾ mile. The coast then changes direction to SE. by S. for 6½ (7½) miles to the NW. point of Hammond bay.

Hammond bay is 5½ (6) miles wide between its NW. point and Forty-mile point, and 1¾ (2) miles deep. There are no dangers, and it affords shelter from all winds from E. to NW. by way of south. The Oqueoc river empties into this bay.

Life-saving station at Forty-mile point.

From Forty-mile point the coast trends 5½ (6) miles east and 5½ (6) miles SE. to the mouth of the Trout river, eastward of which is Rogers City.

Rogers City has an open roadstead. There are three piers, 500 feet apart, at which wharfage is charged at the rate of 50 cents per ton. There are no tugs or pilots.

Display station.—The United States Weather Bureau has a special display station at Rogers City.

Directions.—The center wharf has the best water. Bring this wharf to bear WSW. ½ W. (S. 73° W.) and run in for it.

At 3½ (4) miles eastward of Rogers City is the mouth of the Swan river, which offers shelter for small craft in all southerly winds, and just beyond is Adams point, where the coast again trends southwestward to the peninsula of Presque Ile. A mile SE. of Adams point is a 4-foot shoal.

Presque Ile peninsula is 1⅓ (1½) miles long NW. by N. and SE. by S. Shoals extend from both sides of the peninsula for over ¼ mile, and nearly ¼ mile east of the old light tower, on the south point of the island, is only 12 feet of water. The bay westward of Presque Ile affords shelter from southerly winds, but the bottom is of rock. Near the north end of the peninsula is a light.

Light.—A fixed white light, visible 17½ (19¾) miles in clear weather, near the north end of the peninsula, is shown 123 feet above the lake level from a conical white tower 100 feet high, connected with a yellow dwelling by a covered way.

It marks the turning point when bound through the Strait of Mackinac.

Fog signal.—A 10-inch steam whistle sounds blasts of five seconds, followed by silent intervals of twenty-five seconds.

The fog-signal house is on the beach ¼ mile N. by W. of the light.

Presque Ile harbor, south of the peninsula, forms a snug anchorage for small vessels. A bar with 14 feet, greatest depth, closes the harbor; inside the bar, in the center of the harbor, is a space ⅛ mile in diameter of 20 feet depth; the rest of the bay is shoal.

Shoal.—There is a 9-foot shoal 1,000 yards E. ¾ S. (S. 82° E.) from the old light tower.

This shoal is surrounded by 15 feet of water, and the same depth extends southeastward 200 yards.

Range lights.—Two fixed white lights are visible (front) 8½ (9¾) and (rear) 10½ (12) miles.

The front light tower white, is on the west shore of the harbor, and the light is shown 18 feet above the lake level.

The rear light is 36 feet above the lake level, on a white dwelling, 1,000 feet W. ⅝ N. (N. 86° W.) from the front light.

Directions.—When in a depth of 7 fathoms, come on the range W. ⅝ N. (N. 86° W.) and run in. This will take a vessel across the bar in the deepest (14 feet) water. When the old lighthouse bears NNE. (N. 23° E.), haul a short distance to the southward or northward of the range and anchor in 3 or 3½ fathoms of water. The anchorage is good in any weather.

To the southeastward of Presque Ile harbor is a small bight with several shoals of 5 feet and less; the most outlying, 5 feet, is 500 yards north of the south point of this bight, and 1,200 yards off shore. As it lies almost on the edge of the 4-fathom curve, vessels should give the locality a wide berth.

From this bight the coast continues SE. 4 (4 1/10) miles to False Presque Ile and can be approached to ½ mile, as also can the east and south coasts of False Presque Ile. A spit extends ENE. from the south point of the island 1,200 yards, and another SSE. 500 yards.

False Presque Ile harbor is just south of False Presque Ile. The head of this harbor extends inland ¾ mile, but is filled with flats; flats also extend 1 (1¼) mile southeastward and ½ mile off shore from the SW. point of the harbor. Three hundred yards SE. from the end of this spit is an extensive outlying shoal, with a least depth of 12 feet. East of the south end of this shoal nearly 600 yards is a detached spot of 17 feet, and south of the shoal 300 yards is a detached spot of 16 feet.

All of these shoals are avoided by keeping within ½ mile of the north shore of the harbor.

Directions.—Run in on a NW. course, keeping ⅛ mile from the north shore of the harbor, and anchor in about 3 fathoms, or smaller craft will find a snug berth farther in, in 2½ fathoms. Good shelter is found here from all winds excepting those between south and east.

Middle island lies 1½ (1¾) miles off shore 4 (4 1/10) miles SE. of False Presque Ile harbor. It is a mile long NW. and SE., and nearly ¾ mile NE. and SW. A spit extends southward from the SE. point of the island for over ½ mile, and the island is generally surrounded by shoals to the distance of ½ mile, except the north and NE. sides, which are rather more steep-to.

Life-saving station is on the NW. point of the island.

Display station.—The United States Weather Bureau has a special display station on Middle island.

Shoals.—Midway between Middle island and the mainland is an

extensive shoal with a least depth of 6 feet, and SW. of the island are patches of 16 and 17 feet.

ESE. at 1,000 yards from the SE. point of the island is a 3-foot patch in the middle of an extensive shoal, the NE. point of which is a mile eastward of the south point of the island. Discolored water marks this shoal in calm, and breakers in rough weather.

Buoy.—A nun buoy, painted red, and moored in 20 feet of water, marks the eastern edge of this shoal.

Anchorage.—The island affords a lee in all winds and there is good holding ground under the south side of the island.

Directions.—To anchor between the island and the mainland, vessels from the northward must pass ½ mile outside of the buoy, and when it is in range with the SE. point of the island haul up to WSW. (S. 68° W.), and when the west point of the island bears N. by W. (N. 11° W.) haul up for it, and anchor in 4 or 4½ fathoms about ½ mile from the island.

The coast from False Presque Ile harbor to North point trends southwesterly 14¾ (17) miles. North of North point the shore trends to the westward, forming a large bight filled with a flat and shoals. In this bight are Rond and Crooked islands and several smaller ones. The flat extends eastward 3 (3½) miles. On the northern part of it is Gull island, ¾ mile south of Gull island is Sugar island, and on the eastern edge of the flat is Thunder Bay island, 1 (1¼) mile long NW. and SE., with an average breadth of ¼ mile. The flat continues 300 yards southeastward from the SE. point of the island. Near the SE. part of the island is a lighthouse.

Light.—A flashing white light every ninety seconds, visible 13¼ (15¼) miles in clear weather, is shown 59 feet above the lake level from a conical, yellow tower, connected with a yellow dwelling by a covered way.

Fog signal.—A 10-inch steam whistle sounds a blast of eight seconds duration, followed by a silent interval of ten seconds, then a blast of two seconds and a silent interval of forty seconds.

The fog-signal house is SSE. of the lighthouse.

Life-saving station.—The life-saving station is on the SW. point of the island ¼ mile from the lighthouse.

Display station.—The United States Weather Bureau has a special display station on the island.

Anchorages.—Anchorage, clay and sand, is found north of Gull island. The harbor between Thunder Bay and Sugar islands, 13 feet of water, good holding ground, gives protection from all winds. SW. of Thunder Bay island and south of Sugar island the anchorage is not good, the bottom being rocky.

Thunder bay.—Between North and South points the bay is 8¾ (10) miles wide, and from this line in to the mouth of Thunder Bay river is nearly the same distance. The north shore is safe to approach to

½ mile, excepting south of North point, where the shoals extend 1 (1¼) mile SSE., the extreme south end being marked by a buoy.

Buoy.—A can buoy, painted red, is moored in 18 feet of water 1 (1¼) mile S. by E. ½ E. from North point. It marks the extreme end of the shoal extending southeasterly from North point. Vessels must pass to the southward of this buoy.

On the western and southern shores of the bay shoals and flats extend some distance from the various points and islands, but offer no obstacle to safe navigation if vessels keep within 2 4/10 (2⅖) miles of the northern shore.

Grass island, ⅜ mile off shore, lies on a rocky flat at the head of the bay nearly 1⅞ (2) miles northward of Partridge point. Three-fourths mile and 1 (1¼) mile, respectively, SE. of Grass island are shoal patches of 13 and 10 feet, but they offer no obstacle to navigation if the northern shore of the bay be kept aboard.

Partridge point extends from the shore 1 (1¼) mile, and is ½ mile broad. South of the point is a bight 1 3/10 (1½) miles long and wide, but filled with a flat, which extends out to and surrounds Sulphur island. The flat continues northward from Sulphur island ⅜ mile, and then curves to the NW., almost joining the spit extending ⅛ mile from Partridge point. On this flat is a 5-foot spot, ¾ mile N. by E. from the north point of Sulphur island. East of this north point 1 (1¼) mile is a small 13-foot shoal, which is the NW. point of a narrow detached shoal extending ⅜ mile, with 14 feet on the southeastern end.

South of this spot ½ mile is a small 17-foot patch.

Between the shoal and Sulphur island is a detached 14-foot patch.

The whole south shore of Thunder bay is filled with a rocky flat extending northward from South point toward Bird and Scare Crow islands nearly 2 6/10 (3) miles. The edge of the flat ½ mile north of Scare Crow island trends W. by N. to the western shore of the bay, passing 1½ (1⅞) miles outside of Hard Wood point and 1 (1¼) mile outside of Devil river. From South point a rocky spit extends northeastward a mile, and another rocky spit eastward the same distance.

Alpena.—Thunder Bay river empties into the head of Thunder bay, and at the mouth of the river is Alpena.

Improvements.—The general project calls for a channel 16 feet deep between the 16-foot curve and a point in the river a mile above its mouth, the width varying from 200 feet at the outer end to 75 feet above. Bed rock was found ⅞ mile above the mouth of the river, and the improvements were not carried farther than this point. The channel has shoaled to 13½ feet.

Light.—A fixed red light, visible 11¼ (13) miles in clear weather, is shown 53 feet above the lake level from a square, brown, pyramidal, open-framework tower, the upper part inclosed.

The lighttower is on the north side of the entrance to Thunder Bay river, on a crib 57 feet east of and in a line with Gilchrist wharf.

Fog signal.—A bell struck by machinery every ten seconds.

Signal Station.—There is a signal station two blocks NW. of the lighthouse.

Display station.—The United States Weather Bureau has a regular display station at Alpena.

Directions.—From the northward.—Round Thunder Bay island SE. point at a distance of ½ mile, then SW. by W. ½ W. (S. 63° W.) 3¼ (3¾) miles, until the buoy off North point bears north, distant ¼ mile, or the extreme eastern part of North point N. by W. ½ W. (N. 17° W.), distant 1⅛ (1½) miles, thence NW. by W. ⅞ W. (N. 66° W.) 7$\frac{6}{10}$ (8¾) miles will bring a vessel ½ mile off Thunder Bay River light.

From the southward.—When east of South point 4½ (5) miles, a NW. ½ N. (N. 39° W.) course 13⅜ (15¾) miles will bring a vessel ½ mile off Thunder Bay River light.

Coast.—Between South point and Black river, 4½ (5) miles to the southward, the shore should not be approached within 1¾ (2) miles.

Black River island, a mile NE. of Black river, is surrounded with shoals which extend ¼ mile east from it, a mile NNE. and north from it, and then west to the shore.

Black river.—Rocky shoals extend 1 (1¼) mile eastward from this river. From Black river the shore continues rocky to Alcona, 3½ (4) miles to the southward. Here the coast line bends to the westward, forming a shallow bight between Alcona and Sturgeon point, 3½ (4) miles SSE. of Alcona.

A spit extends nearly a mile ENE. from Sturgeon point and on the point is a light.

Light.—A fixed white light, visible 14 (16) miles in clear weather, is exhibited 69 feet above the lake level from a conical white tower, connected by a covered way with a dwelling.

The lighthouse is on the easternmost point between Thunder and Saginaw bays.

Life-saving station.—The station is 75 yards south of the lighthouse.

Coast.—At Sturgeon point the coast changes its direction to a little west of south and continues its rocky character. Harrisville is 3½ (4) miles from Sturgeon point, and Spring Mills 1¾ (2) miles beyond. Between these places a rocky shoal extends off shore for a mile. Greenbush is 3½ (4) miles south of Spring Mills, and from here to Au Sable light, a distance of 10 (11½) miles, the shore continues its rocky character. At 6 (7) miles northward of Au Sable river there is a 9-foot spot a mile offshore.

Oscoda and Au Sable are at the mouth of the Au Sable river. The shipments from the port are principally made from private piers built into the lake entirely outside of the harbor.

Light.—A fixed red light, visible 8½ (9¾) miles in clear weather, is exhibited 32 feet above the lake level from a square, brown, pyramidal,

open framework tower, upper part inclosed. There is an elevated walk from the lighthouse to the shore.

The tower is on the outer end of the north pier at the mouth of the river.

Display station.—The United States Weather Bureau has a special display station at Oscoda.

Coast.—The shore continues its southerly direction from Au Sable 4½ (5) miles to Point au Sable. Shoals surround this point to a distance of ¾ mile, and it is best to keep at least 1 3/16 (1½) miles off shore. At Point au Sable the coast bends more to westward to Tawas (Ottawa) point, 6¾ (7¾) miles SW. of Point au Sable. Tawas point has a sand spit extending from it for nearly a mile southwesterly and westerly. The SW. and NW. ends of this spit are marked by buoys.

Buoys.—A nun buoy, painted red, is moored in 33 feet of water 1 (1¼) miles SW. ¾ W. of Tawas (Ottawa) point. Is is placed on the extreme SW. point of the shoal. Vessels must not pass inside of this buoy.

A spar buoy, painted red, is moored in 16 feet of water 1 (1⅛) miles N. by E. of Tawas Point buoy and marks the NW. point of the shoal.

Light.—An intermittent white light with red sector is fixed for twenty-five seconds, followed by an eclipse of five seconds. The light shows red over the flat for 90°, from bearing NE. to bearing SE., and white the remaining 270°. The light is visible in clear weather 14 (16) miles, and is exhibited 70½ feet above the lake level from a conical, white tower connected with a red dwelling by a covered way. The lighthouse is near the SW. end of Tawas point.

Wreck.—A wreck with 2 feet of water over it lies in 11 feet water 950 yards SE. by E. ¾ E. (S. 65° E.) of Tawas lighthouse. It is a dangerous obstruction to coasters.

Life-saving station is 1,100 yards NE. by E. from the lighthouse.

Tawas bay is protected by Tawas point, a narrow peninsula projecting over a mile southwesterly from the mainland. It is 3½ (4) miles wide between Tawas point and the shore west of the point, and 1¾ (2) miles long northwesterly from this line.

The available anchorage grounds are contracted to a space a little over a mile in width by the flats extending from the point and the western shore of the bay. There are no dangers outside the flats and the bottom is sand and clay. The bay offers secure anchorage in all winds excepting those from the south.

Tawas and East Tawas are on the western shore of the bay.

Display station.—There is a special display station of the United States Weather Bureau at East Tawas.

Directions—From the northward or westward steer to the SW. or West until Tawas lighthouse bears north 1 3/16 (1½) miles, when change course to NW. by W. ½ W. (N. 56° W.) for the mill at Tawas. Run in

on this course, passing southward of Tawas Point buoy, until Tawas lighthouse bears E. ½ N. (N. 84° E.), when change course to NE. ⅝ E. (N. 52° E.), and run into the harbor and anchor in 3½ fathoms of water.

From the southward.—Steer north, for the middle of the harbor, and bring the lighthouse on Tawas point to bear E. ½ N. (N. 84° E.) 1¾ (2) miles, when proceed as above.

Coast.—From Tawas bay to Gravelly point the coast trends southerly for 13 (15) miles. The shore should not be approached within 1 (1½) mile, as rocky flats extend off in places for nearly that distance, especially off Mason creek and Alabaster, where the shoals are rather more offlying. There is only 5 feet of water ⅔ mile SE. of Whitestone point and a detached 16-foot shoal 1 3/10 (1½) miles south of it and a little over a mile offshore.

Gravelly point, the inner western point of entrance to Saginaw bay, projects some distance from the mainland southeasterly. It continues in the same direction for 2 2/10 (2½) miles as a sand spit. There is 11 feet of water 1½ (1¾) miles SE. of the point, and 16 feet at the SE. extreme of the spit. South of the end of the spit a short distance is a 17-foot detached patch. The spit is marked by a buoy.

Buoy.—A nun buoy, painted red, is moored in 20 feet of water 2 2/10 (2½) miles SE. by E. of Gravelly point and marks the extreme point of the shoal.

Vessels must not attempt to pass between this buoy and the shore.

Saginaw bay.—Between the outer points of the entrance, Point au Sable and Pointe aux Barques, the bay is 22 (25⅛) miles wide. It is contracted to 14 (16) miles between Gravelly and Oak points, but the entrance channel proper between Gravelly point and Charity island is only 2⅛ (2¾) miles wide between the shoals.

West Shore.—The head of the bight within Gravelly point is filled with shoals. The 3-fathom curve is nearly a mile eastward of Point aux Gres, and just within it, east of the point, is a 7-foot patch. From this patch the 3-fathom curve trends SW. by S. to the head of the bay. Outside the curve there are no dangers.

The Aux Gres, Rifle, Pine, Saginin, and Pinconning rivers empty into Saginaw bay on its western shore.

Shoal.—Off the mouth of the Saginaw river the 4-fathom curve is 3 (3½) miles offshore. A shoal with 16 feet of water, and extending east and west nearly a mile, lies 4 (4¾) miles NNE. of the mouth of the Saginaw river. It is a mile outside of the 3-fathom curve.

East shore.—The whole southern and eastern side of Saginaw bay to Sand point is filled by a flat which extends from the eastern shore 7 (8) miles. The flat extends northward from Sand point to Little Charity and Charity islands. It surrounds these islands and extends in all directions from the Charity islands for 1¾ (2) miles.

This flat has on it many rocky shoals and closes the eastern entrance to the bay. Vessels should not attempt to enter the bay southward of

the islands. On the eastern shore are Sebewaing and Pigeon rivers, and the towns of Sebewaing, Bayport, Caseville, Port Crescent, and Port Austin.

The northwestern edge of the flat is marked by a buoy.

Buoy.—A can buoy, painted black, is moored in 17 feet of water, 2¼ (2½) miles NW. by W. ¼ W. of Charity Island lighthouse. It marks the NW. end of the shoal extending from Charity island.

Charity Island light.—A fixed white light, visible 12 2/10 (14) miles in clear weather, is exhibited 45 feet above the lake level, from a conical white tower, connected with a dwelling by a covered way.

The lighthouse is on the NW. point of Charity island.

Approaching Saginaw bay from the southward.—Vessels must pass at least 1½ (1¾) miles to the northward of Port Austin light; then steer W. ¼ S. (S. 84° W.) 22¼ (25½) miles, which will lead to the northward of Charity Island buoy, being careful on approaching it to keep it well open on the port bow, to avoid the shoal extending 1½ (1¾) miles northward from Charity Island lighthouse. Vessels should not pass southward of the island. After passing the buoy, steer SW. by S. (S. 34° W.) for Saginaw river, leaving Gravelly Point buoy on the starboard hand.

Saginaw river, with its tributaries, drains a territory of some 5,800 square miles. The river proper has a length of 19 (22) miles, at which distance from the mouth the Tittabawassee and Shiawassee unite to form the main stream. The cities of East and West Saginaw are built on the upper end of the river and Bay City near the mouth. The river has a large volume and at times a strong current.

Improvements.—Prior to improvements the entrance was obstructed by an extended bar in Saginaw bay a mile from the shore and ½ mile across between the 10-foot contours, with a minimum depth of 9 feet.

On January 1, 1895, the channel across the outer bar had been dredged to a depth of 14 feet and a width of 200 feet from the mouth of the river to the 14-foot curve. It is not safe for vessels drawing over 13 feet to cross the bar. It is proposed to further increase this depth to 16 feet.

Buoys.—The entrance to the channel is marked by two buoys—a black spar buoy, No. 1, in 13 feet, on the east side, and a red nun buoy, No. 2, in 13 feet, on the west side. At 550 yards S. ½ W. from No. 1 is a black spar buoy, No. 3, in 11 feet of water, on the east bank, and opposite, on the west bank, in 11 feet of water, is a red spar buoy, No. 4. Beyond these, at intervals of 550 yards, the spar buoys are in pairs, black on the east bank and red on the west bank, all in 11 feet of water, the black buoys bearing odd numbers, the red buoys even numbers. Buoys 9 and 10 mark the commencement of deep water inside the bar; buoys 13 and 14 mark the mouth of the river, and are the last on the course S. ½ W. (S. 6° W.). A short distance beyond this pair the course is changed to S. by E. ¼ E. (S. 14° E.).

Range lights.—Two fixed red lights, visible in clear weather (front) $7\frac{4}{10}$ ($8\frac{1}{2}$) and (rear) $11\frac{1}{4}$ (13) miles. The front light is shown 37 feet above the lake level and the rear light 61 feet.

The front light tower is at the west entrance point to the Saginaw river. It is a square, red, pyramidal, open-framework tower, upper part inclosed, on a crib.

The rear light is 2,330 feet S. $\frac{1}{2}$ W. (S. 6° W.) from the front light, and is shown from a square, yellow tower attached to a dwelling.

Dry dock.—At Bay City the dry dock is 316 feet over all, 42-foot gate, and has $13\frac{1}{2}$ depth over sill.

Display station.—The United States Weather Bureau has a special display station at Bay City.

Directions for entering.—Bring the lights in range S. $\frac{1}{2}$ W. (S. 6° W.) when $2\frac{3}{10}$ ($2\frac{1}{2}$) miles from the front light, and steer in on the range, passing between the spar and nun buoys at the entrance to the cut. These buoys are about $1\frac{3}{4}$ (2) miles from the front light. Keep on the range, following the buoys to $\frac{1}{4}$ mile from the front light until Nos. 13 and 14 are about one point abaft the beam, when change course to S. by E. $\frac{1}{4}$ E. (S. 14° E.), and keep in mid-channel until off the Bay City dry dock, when haul to the south shore, to avoid the shoals in mid-channel opposite the ships at McEwan's mill, after which there is no obstruction until the Belinda Street bridge is reached.

Wreck.—About 800 feet northerly from the nun buoy (red) and 50 feet westward from the center of the channel is a wreck forming a shoal. Several vessels have struck this with their wheels. (January 31, 1895.)

Coast.—Between Oak point and Pointe aux Barques, 14 (16) miles to the ENE., the coast has several indentations, but is generally bordered by a rocky flat which extends offshore, in places $1\frac{3}{4}$ (2) miles. Off Port Crescent, at the mouth of the Partridge river, the reef is broken, and a vessel with local knowledge can approach the shore close-to; but offshore $1\frac{1}{2}$ ($1\frac{3}{4}$) miles is a narrow detached shoal, least water 5 feet, running north and south for over a mile. Midway between Flat Rock point and Pointe aux Barques is Port Austin, an open roadstead, with several piers.

Pointe aux Barques is surrounded by reefs which extend $1\frac{3}{10}$ ($1\frac{1}{2}$) miles NW. Near the NW. end is a lighthouse.

Port Austin Reef light.—A fixed white and flashing red light—fixed white for one minute, followed by five consecutive red flashes at intervals of twelve seconds during the next minute—visible $14\frac{1}{2}$ ($16\frac{3}{4}$) miles, is exhibited 80 feet above the lake level from a square, white, pyramidal, open-framework tower, upper part inclosed, with brown fog-signal building on a high crib.

The lighthouse is on Port Austin reef, $1\frac{3}{10}$ ($1\frac{1}{2}$) miles from the mainland. There is no passage between the light and the mainland, and vessels should give the light a berth of $1\frac{1}{2}$ ($1\frac{3}{4}$) miles. The light is known as Port Austin light.

Fog signal.—A 10-inch steam whistle sounds a blast of seven seconds, followed by a silent interval of eighty seconds.

Display Station.—The United States Weather Bureau has a special display station at Pointe aux Barques.

Coast.—Between Pointe aux Barques and Burnt Cabin point the reef is somewhat broken, but it extends off the latter point a mile. It follows the coast, extending out from a mile to 1½ miles, and at Pointe aux Barques lighthouse the edge of the reef is 1¾ (2) miles offshore. Just south of Burnt Cabin point is a life-saving station, and a little beyond is Grindstone City. New river is 1¾ (2) miles farther SE. and Huron City, at the mouth of Willow river, is 1 (1¼) mile beyond it. Orion rock, with 6 feet of water over it, lies 1 (1¼) mile NW. of Willow River wharf. Two miles SE. of Huron City is a lighthouse.

Pointe aux Barques light.—A flashing white light every ten seconds, visible in clear weather 15 2/10 (17½) miles, is exhibited 89 feet above the lake level from a conical tower connected by a covered way with a dwelling, both white.

Life-Saving station is 300 yards south of the lighthouse.

Buoy.—A bell buoy, black, is moored in 33 feet water 2 (2⅛) miles E. ¼ S. (S. 88° E.) of Pointe aux Barques lighthouse. It marks the reef extending offshore. Vessels must pass outside this bell buoy.

Coast.—At 1 (1¼) mile NNE. from Pointe aux Barques lighthouse is an 8 foot shoal, with deeper water between it and the shore. Between Pointe aux Barques and Sandbeach, 12 1/10 (14) miles SSE., the reef continues, and in places extends out for a mile, generally ¾ mile. Port Hope is halfway to Sand Beach. Halfway between port Hope and Sand Beach is Forest bay, off which are several dangerous ledges running north and south a mile from shore.

Sand Beach, a harbor of refuge, is just north of Cranes point. This is the only place of shelter in the vicinity of Pointe aux Barques, an exposed and stormy locality, with no other harbor or safe anchorage for 69½ (80) miles along a rocky and dangerous coast. The entire lake Huron traffic passes within sight of this harbor. This includes all through traffic to and from lakes Superior and Michigan.

Improvements.—As constructed, the harbor works are built in three sections, each consisting of heavy timber cribs, filled with stone. The west pier incloses the harbor on the north shore and, starting in shallow water 750 feet from shore, extends ESE. 1,503 feet, with a width increasing from 19 to 26 feet.

The main pier extends 4,675 feet NW. and SE., with a uniform width of 38 feet. The south pier extends north and south 1,956 feet, with a width varying from 26 to 18 feet, and protects the harbor from the eastward.

The north entrance is 300 feet and the main entrance 600 feet wide.

January, 1896: The east and north entrances have both been dredged to 21 feet below zero of gauge, but with the prevailing stage of water

the available entrance depth is not over 20 feet; equal or greater depth adjoins the main breakwater, inside, at all points between these two entrances. Vessels can reach the landing pier on a draft of about 12 feet at the present stage of water.

Directions.—Anchorage.—The main entrance is the one commonly used by all vessels. The southern margin of it is bordered by a rocky bottom of insufficient depth. There is very limited holding ground inside the harbor, most of the bottom being rocky. Steamers go directly to the main pier and make fast; sailing vessels either make fast to the pier or anchor on the west side, south of the west pier, where there is limited holding ground.

Life-saving station.—There is a railroad pier in the harbor, at the inner end of which is a life-saving station.

Display station.—The United States Weather Bureau has a special display station at Sand Beach.

North Entrance.—East light, a fixed white light, visible 11¾ (13½) miles in clear weather, is exhibited 42 feet above the lake level, from a white, pyramidal, open-framework tower, upper part inclosed, on the end of the breakwater, east side of the north entrance to the harbor.

West light.—A fixed red light, visible about 9½ (11) miles in clear weather, is shown 27½ feet above the lake level from a skeleton tripod on the end of the breakwater, west side of the north entrance to the harbor.

These lights mark the northern entrance to the harbor of refuge.

Main (east) entrance.—North (main) light.—A flashing light, alternately red and white every five seconds, visible 12⅞ (14¾) miles in clear weather, is exhibited 54½ feet above the lake level from a conical brown tower, surmounted by a black lantern.

The lighthouse, with brown fog-signal house, is on a rectangular crib just inside the north side of east entrance to the harbor.

Fog signal.—A 10-inch steam whistle sounds a blast of five seconds' duration, followed by a silent interval of twenty-five seconds.

South light.—A fixed red light, visible 9½ (11) miles in clear weather, is exhibited 27½ feet above the lake level from a skeleton tripod on the end of the breakwater, south side of the east entrance to the harbor.

These lights mark the eastern or main entrance to the harbor of refuge.

Coast.—From Cranes point to the St. Clair river the coast trends S. by E. nearly 51 (58¾) miles, and is fronted by rocky shoals the whole distance, but can be safely approached anywhere to a mile.

Barnetville is a mile southward of Cranes point, and Elm creek 4½ (5¼) miles farther on.

At Elm creek a dangerous spit extends from the shore ¾ mile NE.

Whiterock town is 1¾ (2) miles south from Elm creek. North ⅜ mile from the end of the wharf at Whiterock point is a rock out of water, known as White rock. A ledge with 4 or 5 feet of water over it extends 300 yards SE. from the rock. Forestville is halfway between Whiterock point and Indian creek, 7¾ (9) miles to the southward. Rocky

spots are found along this stretch of the coast ½ mile off shore. Richmondville is a short distance southward of Indian creek. From here to Port Sanilac, 8⅜ (10) miles farther south, the coast continues its rocky character, but can be approached somewhat nearer than that farther north. Picnic point, 3 (3½) miles north of Port Sanilac, is the south point of Fools bay, a slight, shallow indentation in the coast, with Forester at its northern end.

Port Sanilac light.—A fixed red light, visible 11¼ (13) miles, is exhibited 69 feet above the lake level, from an octagonal, pyramidal white tower, connected by a covered way with a red dwelling.

Coast.—From Port Sanilac to Lexington, 10 (11½) miles to the southward, the coast continues in the same direction, and of the same general character. At Burchville, 6 (7) miles beyond Lexington, there is a detached rocky spot of 17 feet, ⅜ mile NE. of the town and nearly the same distance off shore. At Lakeport, 3 (3½) miles south of Burchville, the coast changes its direction slightly to the eastward and trends SSE. for 7¾ (9) miles to the west entrance point of the St. Clair river.

North of this point, 1½ (1¾) miles and 1¾ (2) miles, are 16 and 17 foot shoals ¾ mile off shore.

Lake Huron, foot of channel.—January 1, 1896: Work in progress for channel 2,400 feet wide and 21 feet deep. The east half of this channel is completed.

Shoals.—Corsica shoal with 16 feet least water over it, Harlem shoal with 17 feet, and Northwest shoal with 16 feet lie off the entrance to St. Clair river.

An extensive shoal, 15 feet over it, has been reported as lying 2¼ (2 4/10) miles N. by E. of Fort Gratiot lighthouse.

Lake Huron lightvessel.—A fixed white light, visible 11¾ (13¼) miles, is shown 40 feet above the lake level from the fore masthead.

The vessel has two masts, is schooner rigged, and has no bowsprit. There is a circular black cage-work day mark at the fore masthead and a small black smokestack and fog signal between the masts. The hull is straw color, with "*Lake Huron*" in large black letters on each side and "*No. 61*" on each bow.

The vessel is moored 1½ (1¾) miles N. by E. ¾ E. (N. 20° E.) from Fort Gratiot lighthouse in 20 feet of water.

Fog signal.—A 6-inch steam whistle sounds a blast of two seconds' duration, followed by a silent interval of ten seconds. If the whistle is disabled, a bell will be rung by hand.

Dredged Cut buoy.—A red spar buoy marks the edge of the new cut near Lake Huron lightvessel No. 61, and is on the following bearing: Fort Gratiot lighthouse S. by W. ⅝ W. (S. 18° W.), distant 1¾ (1¼) miles.

Fort Gratiot light.—A fixed and flashing white light, flash every one minute, is exhibited 82 feet above the lake level from a conical white tower, with a red dwelling detached, on the western entrance point to St. Clair river. The light is visible 14¾ (17) miles in clear weather.

Fog signal.—An 8-inch steam whistle sounds a blast of three seconds' duration, followed by a silent interval of seventeen seconds. The fog-signal building is in front of the lightstation.

Fort Gratiot range lights.—Both lights are red, the front light 57 and the rear light 80 feet above the lake level. The front light is shown from a telegraph pole surmounted by a white triangle as a day mark, on the west bank of the river. The rear lighthouse, 300 feet SSW. ¾ W. (S. 31° W.) of the front light, is a white pyramidal open-framework tower, with day mark 8 feet long and 12 feet wide.

The description of, and directions for, St. Clair river are given in the next chapter.

CANADIAN SHORE OF LAKE HURON.

Detour passage and Port Collier are described in Chapter II.

Drummond island belongs to the United States; Cockburn and Grand Manitoulin islands to Canada. These islands form the eastern part of the northern shore of lake Huron. The southern shores of these islands have not been surveyed and no description can be given of them.

Vessels should give this whole coast a wide berth.

False Detour channel, nearly 17 (19½) miles east of Detour passage, is 6 (7) miles long NE. by N. and SW. by S., with an average width of 1¾ (2) miles. Apparently there are no dangers if a mid-channel course be kept.

Strait of Mississauga, the next passage east, is a little longer and broader than False Detour channel and takes a N. by E. ½ E. direction. This passage is also apparently clear in mid-channel.

At the western entrance to the strait off the southeastern side of Cockburn island are the Magnetic reefs. They extend 2 1/10 (2⅛) miles southeasterly from the south point of Cockburn island and 2 1/10 (3) miles into the strait.

Mississauga light.—At the southeastern entrance point to the strait is a fixed white light, visible 13 (15) miles in clear weather. It is exhibited 46 feet above the lake level from a white square tower on the SW. point of Grand Manitoulin island. It serves as a guide through the strait.

Fog signal.—A steam wildcat whistle sounds a blast of eight seconds' duration, followed by a silent interval of two minutes. The pitch of the whistle varies during the blast.

Shoals.—At the eastern entrance to the strait, S. by E. ½ E. (S. 20° E.), 3 (3½) miles from the light, is a detached rock and shoal.

Green island, a little farther eastward, is connected with Manitoulin island by shoals.

Duck islands, five in number, extend south off the coast of Manitoulin island 12 (13¾) miles. The Inner Duck island is surrounded by reefs, which extend northward almost to Manitoulin island. Reefs extend off the north shore of the Western Duck. Middle Duck is surrounded by reefs. Reefs extend off the eastern edge of Outer Duck,

and 1½ (1¾) miles southerly from its southern point. Reefs line the north and eastern shore of Great Duck, and extend a mile to the southward from its SE. end. There is a detached reef ½ mile off the north shore of Great Duck. The passage between the Duck islands and between the islands and the shore should not be attempted. The SW. end of the Great Duck is marked by a lighthouse.

Light.—A revolving red and white light, one red and two white flashes every two minutes, greatest brilliancy every forty seconds, and visible 15 (17¼) miles in clear weather, is exhibited 64 feet above the lake level from a square, white tower, with dwelling attached.

Fog signal.—A steam horn sounds a blast of eight seconds, followed by a silent interval of thirty-five seconds.

The fog-signal building is 150 feet SE. of the lighthouse.

Coast.—From abreast of Inner Duck island the south shore of Manitoulin trends 48 (55½) miles ESE. to Owen channel, and has only been partially surveyed. It is much indented, and there are several shoals a mile off shore. The principal bays are Portage, Providence, Michael, and Thomas. The two former are apparently filled with shoals. Michael point, the southern boundary of Michael bay, extends over a mile into the lake and is continued westward 2 (2⅛) miles as a narrow reef. The bight between Michael and Walker points is blocked by reefs. On the western end of Michael point is a lighthouse.

Michael Point light.—A fixed white light, visible 13 (15) miles in clear weather, is exhibited 40 feet above the lake level, from a square, white tower, on the south side of Grand Manitoulin island.

Fog signal.—A hand horn answers vessels' fog signals.

Between Hungerford point, the south point of Manitoulin island, and cape Hurd, 18 (20¾) miles to the southward, are Owen, Fitzwilliam, Yeo, Lucas, Main, MacGregor, Devil Island, and Cape Hurd channels, leading into Georgian bay. These channels are formed by the various islands in the entrance to the bay, and are described in SUPPLEMENT—NORTH CHANNEL AND GEORGIAN BAY.

Isle of Coves light.—A flashing white light, flash ten seconds, eclipsed fifteen seconds, visible 15 (17¼) miles in clear weather, is shown 90 feet above the lake level from a white circular tower on Gig point, the north point of Cove island.

Fog signal.—A steam horn sounds a blast of ten seconds, followed by a silent interval of one hundred and ten seconds.

The fog horn is westward of the lighthouse.

Coast.—Cape Hurd, the northwestern point of Saugeen peninsula, extends to the NW. from the mainland of Canada. The cape is low, flat, and covered with small timber. From cape Hurd the coast trends 20 (23) miles, SE. by S. to Greenough point. It is much indented, and is lined with reefs the whole distance. From a point 2 (2⅛) miles north of Greenough point a reef extends 2 (2⅛) miles southerly, having deep water inside it.

Stokes bay, east of Greenough point, is almost blocked by reefs,

and in its entrance is Lyal island, connected to the mainland, to the southward and eastward, by an extensive reef. North of Lyal island is the only clear water in Stokes bay. The NW. point of Lyal island is marked by a lighthouse.

Lyal light.—A revolving white light every fifteen seconds, visible 12 ($13\frac{4}{10}$) miles in clear weather, is exhibited 51 feet above the lake level, from a square, white lighthouse, with a dwelling attached.

The light is a coast light and a guide to Stokes bay and to a small boat harbor close by.

Coast.—Between Lyal island and Chiefs point, 15 ($17\frac{1}{4}$) miles south, the coast is lined with offlying reefs and islands, the principal of which are the Ghegheto islands. This part of the coast should be given a berth of at least $4\frac{1}{2}$ (5) miles.

Between Chiefs point and Chantry island the coast is freer from reefs. Chantry island is in the middle of an extensive reef which connects it with the shore and extends from it in all other directions for over $\frac{1}{2}$ mile.

The island is $\frac{1}{2}$ mile long, and $1\frac{3}{4}$ (2) miles WSW. from the mouth of the Saugeen river. On the north point of the island is a lighthouse.

Chantry Island light.—A fixed white light, visible 15 ($17\frac{1}{4}$) miles in clear weather, is exhibited 86 feet above the lake level, from a white, circular tower on the north point of Chantry island.

Fog signal.—A hand horn answers vessels' fog signals.

Southampton is at the mouth of the Saugeen river, east of Chantry island.

The harbor is formed by a breakwater 1,600 feet long extending easterly from the old breakwater at the northern end of the island and a breakwater 2,000 feet long curving from the mainland to within 400 feet of the end of the breakwater extending from Chantry island. A landing pier has been built in the inner harbor, where a quantity of stone has been removed from a shoal adjoining the anchorage ground. The breakwaters are continuous cribs, filled with stone. The depth of the channel is reported to be only 14 feet.

Saugeen light.—A fixed white light, visible 10 ($11\frac{1}{2}$) miles in clear weather, is exhibited 30 feet above the lake level from a mast with a brown shed at the base, standing on a crib on the breakwater, on the north side of the mouth of the Saugeen river.

It serves to guide fishing boats into Saugeen river.

Southampton Harbor range lights.—Front light.—Fixed red to the north, white in the harbor, visible 7 (8) miles in clear weather, is exhibited 29 feet above the lake level from a square white tower on the east end of the west breakwater, 933 yards NE. $\frac{3}{4}$ E. (N. 53° E.) from the light on Chantry island.

Rear light.—A fixed white light, visible 10 ($11\frac{1}{2}$) miles in clear weather, is exhibited 34 feet above the lake level from a white, square tower on the shore south of the landing pier, 2,100 yards S. by E. (S. 11° E.) from the front light.

Directions.—This range leads to the opening in the breakwater, at the north end of the harbor. The rear light must be opened east of the front light to clear the shoal running out from the north end of Chantry island.

Port Elgin is in the bight, 3½ (4) miles south of Chantry island. The reef extends northward from the point west of Port Elgin 1½ (1¾) miles.

Port Elgin light.—A fixed white light is exhibited from a pole on the corner of a shed on the outer end of the Government wharf.

Coast.—From west of Port Elgin the coast trends 8 (9¼) miles SW. to Douglas point, and should not be approached closer than 1½ (1¾) miles on account of the reefs which line it At 2 (2 1/10) miles south of Douglas point is Inverhuron, at the mouth of a small stream. It has one pier 450 feet in length, with 14 feet at the outer end. From here the coast trends 7 (8) miles SSW. to Kincardine, where there is a small stream.

Kincardine range lights.—Front light.—A fixed red light, visible 8 (9¼) miles in clear weather, is shown 37 feet above the lake level from a square, white tower on the north pier.

Main (rear) light, 1,185 feet ESE. (S. 68° E.) of front light, is an alternating red and white light every twenty seconds, visible 14 (16) miles in clear weather. It is exhibited 76 feet above the lake level from a fawn-colored octagonal tower, dwelling attached, on a high stone foundation on the hillside in the town of Kincardine.

The front light is visible in the direction of the range. The rear light is visible from all points seaward.

The range leads somewhat to the northward of the head of the north pier.

Point Clark is 7½ (8⅜) miles SW. from Kincardine light, the coast between being bordered by a reef which extends a mile off shore in places. There is a reef extending from the point 1½ (1¾) miles westerly, and south 3 (3½) miles of point Clark is a similar reef. On point Clark is a lighthouse.

Point Clark light.—A revolving white light, every thirty seconds, visible 15 (17¼) miles in clear weather, is exhibited 87 feet above the lake level from a white, circular tower.

Port Albert, at the mouth of Nine-mile river, is 8 (9¼) miles south of the last-mentioned reef, and Goderich, at the mouth of the Maitland river, is 8 (9¼) miles south of Port Albert. All this portion of the coast can be approached with safety to ½ mile.

Goderich, a harbor of refuge, is an inclosed basin, with a channel cut through the beach connecting it with deep water in lake Huron. The sides of the channel are protected by two piers extending west into the lake; the north pier has an extension to the NW. The width between the piers is 200 feet; depth about 16 feet. There is an artificial bank between the Maitland river and the harbor, the river discharging

into the lake through the north beach, and not into the harbor. There are clay banks from 60 to 120 feet high on each side of the harbor. Good anchorage off the piers; clay bottom.

The United States is represented by a consul.

Dues.—Tonnage dues range from 50 cents to $5.

Signal station.—There is a storm signal station in the harbor.

Goderich Main light.—A fixed white light, visible 18 (20¾) miles in clear weather, is exhibited 150 feet above the lake level from a square, white tower, dwelling attached, on the high bank south of the entrance to the harbor.

Fog signal.—An 8-inch steam whistle sounds a blast of ten seconds' duration, followed by a silent interval of fifty seconds.

The fog signal is on the town waterworks building on the beach, SE. by E. ¼ E. from the outer end of the north breakwater. It is 30 feet above the water, and maintained by a corporation.

Goderich range lights—Front light.—A fixed red light, visible 5 (5¾) miles in clear weather, is exhibited 45 feet above the lake level from a square, white, open-framework tower on the north pier about 117 feet from its outer extremity.

Rear light.—A fixed green light, visible 5 (5¾) miles in clear weather, is exhibited 34 feet above the lake level from a square, white tower on the north pier, 1,509 feet E. ¾ S. from the front light.

These lights in range E. ¾ S. (S. 82° E.) lead to the head of the breakwater.

Life-saving station is between the breakwaters.

Bayfield, at the mouth of Bayfield river, is 10 (11½) miles south of Goderich. There is a harbor composed of two piers and a basin. The north pier is 820 feet and the south 875 feet long, with a width of 200 feet between them. Depth of water at the entrance, 10 feet.

Lake View is 13 (15) miles south of Bayfield, and here the coast commences to bend to the westward to cape Ipperwash, the end of which is 15 (17¼) miles SW. by W. (S. 56° W.) from Lake View. The reef extends as the cape is approached, and surrounds the cape for a distance of 1½ (1¾) miles. It is a dangerous reef, having only 5 feet of water a mile from the cape and from 12 to 16 feet at its outer extremities. Between cape Ipperwash and Harris point there are bowlders and rocky points within a mile of the shore. The reef continues 2 (2½) miles south of Harris point. At Errol the coast changes direction to the westward, and becomes steep-to as far as the entrance to the St. Clair river, a distance of 9 (10⅓) miles.

Point Edward range lights (private lights).—Two fixed lights, white over red, are shown from high open-framework towers, which are conspicuous day marks. The range is S. ¾ E. (S. 8° E.), and leads 450 feet west of Northwest shoal, the most westerly of the shoal spots.

CHAPTER VIII.

ST. CLAIR AND DETROIT RIVERS, AND LAKE ST. CLAIR.

ST. CLAIR RIVER.

St. Clair river, the outlet of lake Huron, commences at the southern end of this lake, where the shores of the United States and Canada nearly meet. This river, in connection with lake St. Clair and the Detroit river, forms the link between lakes Huron and Erie. It is 39 (46) miles in length, counting from the 20-foot curve in lake Huron to the 20-foot curve in lake St. Clair. As the proposed improvements by dredging will form a continuous deep channel between these curves, it is but right to class them with the river proper, which extends from Fort Gratiot to the mouth of the South channel.

The proposed channel, from the 20-foot curve in lake Huron into the river and terminating just inside of Fort Gratiot lighthouse, is to have a depth of 21 feet, with a length of 2,400 feet at the Huron end, which will be continued to the deep water in the St. Clair river. January, 1896, the eastern half of the channel had been completed. Thence through the river the navigation is easy until leaving the South channel, when the flats are encountered.

NORTHERN APPROACH TO ST. CLAIR RIVER.

From Lakeport, in Michigan, the coast of lake Huron trends SSE. ½ E. to the mouth of the St. Clair river, and the coast can be approached within ⅛ mile until near Lake Huron lightvessel, when the ranges must be taken up for entering the river.

From Errol, on the Canadian side, the coast trends W. by S., and it is safe to approach within ½ mile until close to Fort Gratiot lighthouse.

In the approach to the river, if coming from the northward, vessels of light draft should pass close to the lightvessel, keeping it to port. Vessels of greater draft can find deeper water by keeping the lightvessel to starboard $1\frac{1}{10}$ ($1\frac{1}{4}$) miles away and continuing to approach the Canadian shore until Fort Gratiot light bears SW. by W. ¼ W. (S. 59° W.), distant 2 ($2\frac{1}{4}$) miles, whence a course WSW. ¼ W. (S. 70° W.) will lead through 4 fathoms until the Fort Gratiot range is made, on which range vessels should enter the river. When the channel is cut from the lake into the river all vessels can use it.

If coming from the eastward, vessels should bring Fort Gratiot light

to bear SW. by W. ¼ W. (S. 59° W.), distant 2 (2¼) miles, and then keep a course of WSW. ¼ W. (S. 70° W.), until on the Fort Gratiot range.

At the entrance of the river are Gratiot (United States) and Huron (Canadian), while just within the entrance is Port Huron, Mich., and Sarnia, Ontario.

The lights at the entrance to the river are given in the previous chapter.

Dry docks.—At port Huron are docks of 210 and 412 feet over all, with widths of gates 32 and 62 feet, and depths over sills of 13 and 18 feet.

DIRECTIONS FOR ST. CLAIR RIVER.

Fort Gratiot range.—On the west bank of this river and near the Grand Trunk Railway freight house and dock at Fort Gratiot is a fixed red light, shown from a telegraph pole surmounted by a white triangle for a day mark. The light is 57 feet above the lake level.

About 300 feet SSW. ¾ W. (S. 31° W.) is a second red light at a height of 80 feet above the lake level and shown from a white pyramidal framework tower with a day mark 14 feet long and 10 feet wide.

This range will carry deep water into the river and clear the 20-foot spot lying 300 yards SE. from Fort Gratiot lighthouse.

After passing this 20-foot spot a mid-channel course should be kept until near the mouth of Black river, when the deepest water will be found near the Canadian shore. A shoal makes out from the mouth of Black river 1,200 yards to the southward, with a greatest width of 500 yards. Twelve feet can be carried over this shoal, but a lookout must be kept for some spots of gravel and rock, on which there are but 10 feet.

Buoy.—A black spar buoy is moored in 15 feet of water to mark the easterly side of this shoal.

Caution as to Anchorage.—From Fort Gratiot light to below the rapids the holding ground is rocky and bad. Off Port Huron and Sarnia it is clay and good. Vessels should anchor as close to shore as safety will permit, so as to leave the mid-channel clear for passing vessels.

Black river.—If intending to enter this river it is well to know that a channel has been dredged from the St. Clair river to Washington avenue. The width varies from 150 feet at the mouth to 50 feet at the upper end. In January, 1896, the available depth at low water near the mouth was scant 15 feet, and near the upper limit of improvements about 9 feet.

Having cleared the shoal off Black river, a mid-channel course will carry deep water until approaching Stag island, which, with the shoals projecting from its north and south ends, divides the river and forms two narrow but deep channels, through either of which deep water can be carried, remembering that in the Michigan side channel there is a 15-foot spot a little below Stag island and nearer to the Michigan shore. The Canadian channel is clear.

Corunna range (Canadian).—The front light, a fixed white light, is shown from a white, skeleton-framed tower with an inclosed top, the side facing the water being slatted. It is 48 feet above high water and visible 4 ($4\frac{8}{10}$) miles.

The rear light, a fixed white light, 67 feet above high water, visible 4 ($4\frac{8}{10}$) miles, stands 568 feet S. by E. $\frac{1}{2}$ E. (S. 13° E.) from the front light. It is shown from a square white tower.

Both of these towers are in the village of Corunna, the front light being near the old wharf at the foot of Fane street, while the rear light is on the west side of Beresford street. The course S. 13° E. carries through the best water in the Canadian channel past the shoals at the head of Stag island, as also past the shoals off the mouth of Talfords creek.

Stag island is about $1\frac{8}{10}$ ($1\frac{1}{2}$) miles long, with shoals extending northward from its north end for nearly $\frac{3}{4}$ mile, and southward from the south end $\frac{3}{4}$ mile.

Buoys.—Near the north end of the northern shoals a red and black horizontally striped spar buoy is moored in 16 feet water. The shoal extends a short distance north from this buoy. A similar buoy is moored in 12 feet water on the south end of the southern shoal.

Caution.—A short distance to the southward from this buoy are two shoal spots of 17 feet water, and one of the same depth west from the buoy and nearly in mid-channel on the Michigan side.

Having passed the shoals near Stag island, deep water continues for $1\frac{1}{2}$ ($1\frac{3}{4}$) miles to a shoal nearly in mid-channel and extending from off Mooretown, Canada, to the mouth of the Pine river, Mich. The shoal water extends for a distance of nearly $1\frac{8}{10}$ ($1\frac{1}{2}$) miles, with a least depth, opposite St. Clair, of 4 feet. The shoal is marked by two buoys, and is known as St. Clair middle ground.

Buoys.—A spar buoy, painted in red and black horizontal stripes, is moored near the north end of this shoal in 16 feet of water, and is about 650 yards W. $\frac{1}{4}$ S. from the mouth of Baby creek, Canada.

A spar buoy, painted in red and black horizontal stripes, is moored near the south end of this shoal in 17 feet of water, and is about 450 yards ENE. from the north side of the mouth of Pine river.

Pine river.—This river empties into the St. Clair river at St. Clair. There is a dredged channel from its mouth to the shipyard, 10 feet deep and from 75 to 100 feet wide.

From the shoals off Pine river the channel is clear until Marine City is reached, a distance of $6\frac{3}{4}$ ($7\frac{3}{4}$) miles. Off Marine City, and just to the northward of Woodtick (Fawn) island, is a shoal nearly one mile long, with a least depth of 16 feet, and not buoyed. The main channel is on the Michigan side until Woodtick island is passed, and there is a narrow channel on the Canadian side.

Woodtick island.—This island, with its shoals, is $1\frac{8}{10}$ ($1\frac{1}{2}$) miles long by $\frac{3}{4}$ mile wide; the shoals are marked by buoys. There is a channel on

either side of the island, that of the United States being the straightest and widest and most frequently used.

Buoys.—A spar buoy, painted red and black in horizontal stripes, is moored in 16 feet of water on the shoal extending north from Woodtick island and about 900 yards from the northern end of that island; the shoal extends to the northward beyond the buoy.

A spar buoy, painted red and black in horizontal stripes, is moored in 13 feet of water on the end of the shoal extending to the southward from Woodtick island, and is about 700 yards from the south point of that island.

From the buoy off the south end of Woodtick island a mid-channel course can be kept until off Babys point.

Belle river.—This river, on the Michigan side, empties into the St. Clair river just above the northerly end of Woodtick island, and in the south end of Marine City. It has a dredged channel 50 feet wide and about 10 feet deep from the mouth to the first bridge, and thence to the Broadway bridge a vessel can carry 9 feet.

Chenal Ecarté (Canadian) is one of the seven months of the St. Clair river, and at Babys point takes its direction to the southeastward. It is very narrow, and navigable for vessels drawing 16 feet. About 5 ($5\frac{3}{4}$) miles from Babys point a second channel (Johnston) makes off to the southward.

About 3 ($3\frac{1}{2}$) miles farther on Bear creek empties into Chenal Ecarté. Neither of the channels lead into deep water.

South channel.—Before the construction of this canal the St. Clair river emptied into lake St. Clair through seven principal mouths or passes, the one most used being the South channel. Where the river runs into lake St. Clair there were formerly numerous shoals and flats; this has been remedied by the building of dikes and dredging, and a straight channel made carrying 20 feet.

St. Clair Flats canal.—The northern or river end of the channel has a bottom width of 650 feet, and from that narrows gradually until the canal is reached. Between the dikes a depth of 20 feet is to be maintained with a width of 300 feet for a distance of 7,221 feet. From the lake end of the dikes the width increases gradually until a bottom width of 800 feet is attained, and this width is continued to the 20-foot curve.

FROM BABYS POINT THROUGH SOUTH CHANNEL.

For the South Channel range lights, see latest United States List of Lights and Fog Signals on the Northern Lakes and Rivers.

Directions.—Keep a mid-channel course from Babys point until the upper range (No. 12–No. 11) is made, when bring this range a little on the starboard bow, giving the buoy (red and black horizontal stripes, in 16 feet water, 900 yards from No. 12 light) a clearance of at least $\frac{1}{4}$ mile. If the range is kept it will carry into 14 feet water. Continue as above until the Russel Island (No. 11) light is abeam, when the course

should be gradually changed to the southwestward until the lower range (No. 10–No. 11) on Russel island is made astern. This range should be made about ⅔ mile below the lower light, No. 10, and the range then carried to a little below Fish dock, when will be made the Herson Island lower range (No. 8–No. 7). Soon after heading on this range the Squirrel Shoal buoy (red spar, moored in 17 feet water to mark a shoal on which there is a depth of 13 feet) should be made.

Wreck.—A schooner lies sunk in 30 feet water about 150 feet from the west bank of the river and about 2,400 feet SW. from Squirrel Island buoy.

When abreast of this buoy the course should be changed gradually to the southward, keeping closer to the Michigan shore for the deeper water. When a little below the red light, No. 7, of the lower range, Squirrel Island buoy (red spar, moored in 11 feet water to mark the edge of the flat off Squirrel island) should be seen, and when it bears nearly South the upper range (No. 8–No. 9) should be brought on astern, and kept until off Bassett channel and Southeast Bend upper light, No. 6. This light shows white upstream, and when it changes to red the course should be gradually changed to the SW. for rounding the Southeast bend. A mid-channel course should be kept past the next two lights—Southeast Bend middle, No. 5, and Southeast Bend lower, No. 4. This light (No. 4) shows red upstream, changing to white at the time a vessel should change its course to take the range No. 3–No. 2. This range will carry nearly a mid-channel course through the upper part of the Lower reach, but do not go too close to the Canadian side. A vessel keeping to the northward of a line joining lights Nos. 4 and 1 will keep off the shoals. Do not go to the northward of a line joining lights Nos. 3 and 4, but on approaching that line, if on the range, the course can be gradually changed to the west, and a mid-channel course will carry past the lights until the lower range (No. 1–No. 2) is nearly made astern.

Vessels should not go westward of this range, but should keep close to it until nearing the Star Island hotel, when a course more in mid-channel should be kept.

When ⅔ mile to the southwestward of Star Island hotel, a course SW. ⅛ S. (S. 41° W.), with the lighthouse on the upper end of the west pier of the United States ship canal nearly ahead, will carry in deep water to the canal. At this entrance to the canal the width is 296 feet. There is a light on each end of the west pier.

St. Clair Flats Canal lights.—A fixed red light, visible 11¼ (13) miles, and 45 feet above the river level, is shown from an octagonal tower rising from the corner of a dwelling, both being built of red brick. It is on the NE. end of the west pier.

A fixed red light, visible 11¼ (13) miles, shown from the same description of tower and at the same height above the lake level, is on the SW. end of the west pier in lake St. Clair.

LAKE ST. CLAIR.

Lake St. Clair is of irregular shape, being 23 (26½) miles long from New Baltimore on the north to Belle river on the south, and 21 (24) wide miles across its southern part in an east and west direction.

Anchor bay, the northwestern section of the lake, is cut off by a bar, with a least depth of 8 feet over it at the center. This bar extends across from the mouth of the Clinton river to the mouth of the Chenal Aboutrond.

Anchor bay can be approached through the north channel, but it has a bar of 8 feet least water at its mouth.

New Baltimore and Fairhaven are on the north shore of the bay, the former having 8 feet and the latter 6 feet off the ends of the wharves.

At 7 (8) miles south of New Baltimore is Huron point, with shoal water off it. From here to Milk River point there is but 12 feet of water 1 (1½) mile from shore. From here to Windmill point vessels drawing 12 feet should not approach the shore nearer than ⅝ mile. On the south shore Belle River station is the only town of any size between the Detroit river and the Thames river. The 12-foot curve is from 1 to 1 $\frac{8}{10}$ (2⅛) miles off this coast.

The Thames at the SE. end of this lake is the only river of any importance on the Canadian side, and at its mouth are range lights.

Thames River lights.—A fixed white light, visible 12 (13 $\frac{8}{10}$) miles, is shown from a circular white tower. It is on the south shore of the mouth of the river.

A fixed white light, visible 6 (7) miles, is shown from a square red tower. It is 300 feet NW. ½ N. (N. 39° W.) from the main light. These two lights in one lead over the bar. This bar has a least depth of 7 feet.

From the Thames river the coast trends nearly north to Mitchel point and north and west of the point is Mitchel bay.

From the east shore the 12-foot curve averages the same distance as it does from the south shore.

The north shore from Mitchel point to the United States ship canal is low and marshy, with shoal water extending off over 1¾ (2) miles.

The course from the mouth of the ship canal to the bar of the Thames river is SE.

The middle of this lake has an average depth of 3½ fathoms, mud and clay.

Grosse Pointe flats extend into lake St. Clair from the head of the Detroit river.

On these flats at the ordinary stage of the lakes a depth of 16 feet can be carried, but during low water it is difficult to carry more than 15 feet.

A channel 800 feet wide and 20 feet deep has been cut through the flats from the 20-foot contour in lake St. Clair to the Detroit river.

Grosse Pointe lightvessel, No. 10, is moored about 1 $\frac{7}{10}$ (2) miles east of Grosse pointe.

The lightvessel is a scow with one mast, with a circular cage-work day mark at the masthead. The hull is painted red with the name in large black letters on each side, and *No. 10* on the stern. The day mark and topmast are painted black.

The light is fixed white, 25 feet above the lake level, and visible in clear weather $10\frac{1}{4}$ ($11\frac{3}{4}$) miles.

Fog signal.—During thick weather a bell is rung.

Windmill Point light.—A fixed white light varied by a red flash every fifteen seconds, visible $12\frac{3}{4}$ ($14\frac{3}{4}$) miles, is exhibited, 55 feet above the lake level, from a conical white tower connected with a red brick dwelling by a covered way. The tower is on Windmill point, the north side of the entrance to the Detroit river.

Lights.—The following lantern lights are shown from pile clusters to mark the 20-foot channel into the Detroit river. They are maintained by the Lake Carriers' Association.

Lower entrance beacon.—A fixed white light, $15\frac{3}{4}$ feet above lake level, on the pile cluster on the SE. side of the channel at the lower entrance, on the following bearing: Windmill Point lighthouse WSW. $\frac{1}{2}$ W. (S. 73° W.), distant about $1\frac{6}{10}$ ($1\frac{7}{8}$) miles.

Middle beacon.—A fixed white light, $15\frac{3}{4}$ feet above lake level, on the SE. side of the channel, on the following bearing: Windmill Point lighthouse SW. by W. $\frac{3}{4}$ W. (S. 65° W.), distant $2\frac{2}{10}$ ($2\frac{2}{5}$) miles.

Upper beacon.—A fixed white light, $15\frac{3}{4}$ feet above lake level, on the SE. side of the channel, on the following bearing: Outer end of Fishers dock W. $\frac{1}{4}$ S. (S. 87° W.), distant $1\frac{8}{8}$ ($1\frac{8}{10}$) miles.

DIRECTIONS ACROSS LAKE ST. CLAIR.

From the lighthouse on the SW. end of the west pier a course of SW. (S. 45° W.) for $10\frac{4}{10}$ (12) miles will carry to the Grosse Pointe lightvessel, which leaves to port. The pile beacons by day and lights at night mark the SE. side of the channel into the Detroit river.

DETROIT RIVER.

From the southern end of Grosse Pointe channel to the southern end of the ship canal below Amherstburg this river is $27\frac{3}{4}$ (32) miles long, with a navigable depth of water for large vessels of from $\frac{1}{4}$ to $\frac{1}{2}$ mile in width until the vicinity of Ballards Reef lightvessel is reached, whence the channel narrows decidedly and is filled with shoal spots having but 17 feet of water on them.

These spots are about the center of the main channel and extend from the lightvessel to Fort Malden. The channel from Fort Malden on is narrow, about $\frac{1}{4}$ mile, until $\frac{3}{4}$ mile below Bois Blanc lighthouse; thence to the cut which is to be dredged through the bar the channel widens. This cut is to be 800 feet wide and to carry a depth of 21 feet from the Detroit river into lake Erie. It has been completed for half its width.

Detroit.—The city of Detroit is near the head of the Detroit river, and has deep water alongside the numerous wharves.

Dry docks.—The Detroit Dry Dock Company has two timber docks, as also has the Clarke Dry Dock Company. The largest dock is 365 feet on blocks, 378 feet over all; width, gate 79 feet, top 90 feet, and depth on sill, 16 feet.

Weather signal station.—The United States Weather Bureau has a *special station* at Stanley B. Smith's coal dock, 5 miles below Detroit.

Amherstburg (Canadian) is on the Detroit river near lake Erie, the deep-water channel of the river passing in front of the city.

NOTE.—For the description of lights and ranges in the Detroit river see the latest United States List of Lights and Fog Signals for the Northern Lakes and Waters.

DIRECTIONS FOR THE DETROIT RIVER.

Isle aux Peches buoy.—A spar buoy, painted red, is moored in 16 feet of water on the edge of the shoal, extending from the west end of the Isle aux Peches.

Belle Isle (east end) buoy.—A spar buoy, painted red and black in horizontal stripes, is moored in 16 feet of water on the east point of the shoal off the head of Belle isle. It is also a mark for the division of the channel, which is divided into two parts by Belle isle.

MAIN CHANNEL.

A vessel having passed through Grosse Pointe, channel should steer to pass ¼ mile from Windmill Point light, and when this light is abeam a course SW. by W. ¾ W. (S. 65° W.) will carry between Windmill point and Isle aux Peches, which island is surrounded by shoal water, with a spit off the west end. Keep the course S. 65° W. until the Windmill Point range comes on, when bring it astern and stand SW. (S. 45° W.) between Isle aux Peches and Belle Isle buoys until Belle Isle light is abeam. From here a mid-channel course can be kept past Detroit until near Fighting island.

NORTHERN CHANNEL.

Scott Middle Ground buoys.—No. 6 is a spar buoy, painted red, moored in 18 feet of water on the north point of this middle ground.

A mid-channel course should be kept past buoys Nos. 4 and 2. No. 4 is a spar buoy, moored in 24 feet of water on the NW. point of the middle ground. No. 2 is a spar buoy, moored in 11 feet of water just above the Belle Isle bridge.

A vessel taking the northern channel should, when Windmill Point light is abeam, distant ¼ mile, steer a course W. ⅝ S. (S. 86° W.) until close to the Scott Middle Ground Upper End buoy. Pass this buoy, as also buoys No. 4 and No. 2, in mid-channel, leaving them to port, and then through the draw of Belle Isle bridge, after which a course close to Detroit will clear the spit extending west from Belle isle and marked at its extremity by a red and black horizontally striped buoy moored in 13 feet water. Leave this buoy to port, after passing which a mid-channel course can be taken until near Fighting island.

MAIN CHANNEL CONTINUED.

When nearing Fighting island keep a mid-channel course between Fighting island and Michigan until the Ecorse range comes on, when bring it astern and steer S. ¼ E. (S. 2° E.) between Grassy and Fighting islands, until Grassy Island light is abeam. This course passes west of Fighting Island Red Spar buoy in 11½ feet of water, marking the elbow of the flats at the upper end of Fighting island, and east of Grassy Island Black Spar buoy, marking the elbow of the Grassy Island shoal. When abeam of Grassy Island light the Mamajuda range should come on; bring it ahead, and steer on it S. ¾ W. (S. 8° W.), passing west of East Bank Red Spar buoy in 11½ feet water (marking the east side of the channel and the outer point of Fighting Island bank), when Grassy Island range should come on bearing north; then steer south, this range on astern, until the Grosse Isle North Channel range comes on, when steer on it S. by W. ¼ W. (S. 12° W.) until the Grosse Island South Channel range comes on, when bring it astern and steer S. by E. ¼ E. (S. 17° E.). This latter range should come on when just west of Fighting Island (lower) Red Spar buoy in 9½ feet of water, marking the east side of the channel and the outer edge of the bank at the southern end of Fighting island. The range passes about ¼ mile east of Ballards Reef lightvessel, showing a fixed red light, visible 5 (5¾) miles (fog signal, a bell), and marking the easterly end of Ballard reef. This course (S. 17° E.) will then carry over and between several 17 and 18 foot spots, west of the red can buoy marking Dougalls rock and to abeam and east of North Limekiln Crossing lightvessel, No. 65, showing a fixed white light (fog signal, a bell), and moored in 15 feet of water at west side of the north end of Limekiln Crossing dredged channel. A similar lightvessel is moored at the south end of the cut on west side of channel in 15 feet water. Between these lightvessels, steer on the Limekiln Crossing range S. 1° E. until abeam of South Limekiln Crossing lightvessel, No. 64; here the head of Bois Blanc Island range (Canadian) should come on, when steer on it S. by W. ¾ W. (S. 20° W.) until abeam of the front light of the Canadian Limekiln Crossing range. A near mid-channel course should now be kept until the Amherstburg range is made. It is preferable to keep on the Bois Blanc island side, to clear the New York bowlders marked by a red spar buoy. An obstruction has been reported as lying 775 yards SE. ¼ E. (S. 47° E.) of Bois Blanc Range rear light, and is almost in mid-channel. After passing west of the red spar buoy the Amherstburg range will come on, when bring it astern and stand down the river, heading S. by W. ¼ W. (S. 14° W.). Bois Blanc light, fixed white, on the south end of Bois Blanc island, visible 14 (16⅛) miles, will soon be passed, and below this light the various buoys should be passed, leaving them on their proper sides, the black buoys to the westward.

Pontiac shoal, with 17 feet over it, hard bottom, is on the Amherstburg range, and vessels should pass east of it, resuming the range after

passing, and continue on it until the red buoy off Bar point is abeam, when change course to S. $\frac{7}{8}$ W. (S. 10° W.), and stand down through the deep-water dredged cut to Detroit River (Bar Point) lighthouse; pass east of the lighthouse and into lake Erie. The east half only (400 feet) of the cut has been dredged to 21 feet. The east edge of this dredged cut is marked by seven red wooden spars.

Bar Point lightvessel is moored in 17 feet of water off Bar Point shoal. It is schooner rigged, two masts, no bowsprit. The light is fixed white, shown from three lanterns encircling the foremasthead. It is visible $11\frac{7}{10}$ ($13\frac{1}{4}$) miles. There is a circular, black cage-work day mark at the foremasthead and a small black smokestack and fog signal between the masts. The hull is black, with *No. 59, Bar Point Shoal* in white letters on each side.

Fog signal.—A 6-inch steam whistle sounds a blast of ten seconds every thirty seconds. If the whistle be disabled a bell will be rung by hand.

Detroit River (Bar Point) light.—The lighthouse is in the mouth of the river and is a conical tower, surmounted by a lantern. The tower and fog-signal house, both brown, on hexagonal pier. The light is fixed white for one minute, followed during the next minute by six consecutive white flashes at intervals of ten seconds. The light is 55 feet above the lake level and visible $12\frac{8}{10}$ ($14\frac{3}{4}$) miles.

Fog signal.—A 10-inch steam whistle gives blasts of five seconds, with silent intervals of twenty-five seconds.

CHAPTER IX.

LAKE ERIE.

Lake Erie is the most southern of the Great Lakes. The State of Michigan bounds its western shore, and Ohio, Pennsylvania, and New York its southern and southeastern shores. The Province of Ontario, Canada, bounds the northern shore.

The lake lies between 41° 20′ and 42° 55′ N., and between 78° 55′ and 83° 30′ W. It is nearly elliptical, the major axis, 217 (250) miles in length, lying east and west. Its greatest breadth north and south is 52 (60) miles, its circumference 573 (660) miles, and its area about 10,000 square miles. Its elevation above the sea level is 572.86 feet, and its surface is 326.25 feet above that of lake Ontario, this great descent being taken up by the Niagara river and falls, which connect the two lakes at the eastern end, its western end being connected with lake Huron by the Detroit river and St. Clair lake and river.

There are four important canal systems which connect with this lake: The Erie canal, extending from Buffalo, N. Y., to the Hudson river; the Miami and Erie canal, from Toledo to Cincinnati, on the Ohio river; the Ohio and Erie canal, from Cleveland to Portsmouth, on the Ohio river, and the Welland canal, connecting lakes Erie and Ontario, this latter being entirely within the Dominion of Canada.

Like lake Michigan, the coast of lake Erie is comparatively free from indentations, and, excepting the western end, it is clear of islands.

The shores, of clay and sand, are generally bold and elevated. The most fertile country is some distance from the banks, except at the western end, where the growth is more luxuriant along the beach, which here is of fine, white sand.

The peculiar features of lake Erie are its shallowness and its clayey shores, the depth, excepting East and SE. of Long point, rarely exceeding 100 feet.

The bed of the lake can be considered as in three divisions, increasing in depth from the Detroit river to the outlet. The western portion, as far as Pointe Pelée island, has a level bottom with an average depth of 30 feet. The middle portion, taking in the principal part of the lake to Long point, is also level and from 60 to 70 feet deep. Beyond Long point the depths vary from 210 feet near the point to 40 and 30 feet near the eastern shore.

The shallow waters of this lake are easily disturbed by the winds,

and, for this reason and the lack of good harbors, it is very dangerous navigation. Long-continued storms, with the wind setting along the lake in one direction, pile up the water to leeward with disastrous results. Buffalo has suffered much from this. The return of the waters after a storm is often so rapid, especially if the wind changes with it, as to produce powerful currents. On one occasion the waters burst a passage through Long point, making it an island.

The bottom is a light, clayey sediment, which rapidly accumulates from the wearing away of the shores.

Along the coast the disintegrating strata are frequently seen forming high cliffs, extending back into elevated plateaus, with rivers cutting channels through them and carrying the excavated matter into the lake. Underground water courses undermine the cliffs, and the waves aid in breaking them down. Landslides are of frequent occurrence and render the water turbid a long distance from shore. This may be seen on both sides of the lake. Near Cleveland the recession of the coast line has been particularly remarkable. From here the terrace cliffs (103 feet high at Cleveland) extend east to Fairport.

There is an immense commerce on the lake, the Welland canal being the outlet for it to lake Ontario.

HARBORS OF REFUGE.

Sandusky, for vessels of 17 feet draft;
Cleveland, for vessels of 19 feet draft;
Erie, for vessels of 17 feet draft;
Buffalo, for vessels of 23 feet draft;
Port Colborne, for small vessels;
Dunkirk, for small vessels;
Mouth of the Detroit river, and possibly
Rondeau harbor.

ANCHORAGES.

Good anchorage can be found under the lee of points Pelée, also under Long point; between Middle and South Bass islands, as well as under the lee of other islands.

NAVIGATION.

As a rule, navigation opens in the middle of April and closes the middle of December. See page 6.

DANGERS.

East of the meridian of points Pelée the lake is remarkably free from outlying dangers, Seneca and Waverly shoals at the extreme eastern end, and a reef westward of Port Maitland on the north shore, being the only ones well off shore. The northern shore of the lake has not been thoroughly surveyed, and there may exist some unknown offlying dangers, but the coast is generally steep-to.

West of the meridian of pointe Pelée the water is shallow, with many islands, between and around which are shoals. West of the islands are several shoals. From the western and southern shores of the lake in this locality shoal water extends out some distance. All of these dangers are described under the islands and shores of the lake.

Southeast shoal has recently developed $2\frac{8}{10}$ ($3\frac{1}{3}$) miles SE. $\frac{3}{8}$ S. (S. 41° E.) of the Dummy light. It has probably been formed by vessels grounding and dumping ballast overboard. This locality, especially to the westward of pointe Pelée, should be navigated with caution on account of shoal water and the various wrecks that have occurred.

ROUTES.

Detroit river to Welland canal and Buffalo.—From a point $\frac{1}{2}$ mile SE. of Detroit (Bar Point) light an ESE. $\frac{5}{8}$ E. (S. 75° E.) course for $11\frac{1}{2}$ ($13\frac{1}{4}$) miles will take a vessel a mile off Colchester Reef lighthouse with it abeam. From here an ESE. $\frac{3}{8}$ E. (S. 72° E.) course for $14\frac{1}{10}$ ($16\frac{1}{4}$) miles should take a vessel to a point with Pelée Island light bearing SW. and the Dummy light East. Here change course to SE. $\frac{3}{4}$ E. (S. 53° E.) for 7 (8) miles, when the Dummy should bear NNW. $\frac{1}{2}$ W. (N. 28° W.), distant $4\frac{3}{4}$ ($5\frac{1}{2}$) miles, the point of departure for all ports on the lake. Or, with the wind fresh from the southward, an ESE. (S. 68° E.) course from off Detroit River (Bar Point) light for $11\frac{1}{4}$ (13) miles will take a vessel a mile south of Colchester Reef light abeam. Here shape course ESE. $\frac{7}{8}$ E. (S. 77° E.) for $14\frac{1}{8}$ ($16\frac{1}{2}$) miles to the point designated above, NE. of Pelée Island light and west of the Dummy.

To Buffalo.—From off Pelée Spit lighthouse, an ENE. $\frac{1}{8}$ E. (N. 69° E.) course for $115\frac{1}{4}$ (133) miles will take a vessel $1\frac{3}{4}$ (2) miles south of Long Point lighthouse, when change course to ENE. (N. 68° E.) for 54 ($62\frac{1}{2}$) miles. This will take a vessel off Buffalo breakwater, passing northward of Waverly shoal and buoy. See special directions for entering.

To Port Colborne and the Welland canal.—From south of Long point, NE. by E. $\frac{1}{4}$ E. (N. 59° E.) for $40\frac{1}{8}$ ($46\frac{1}{2}$) miles will take a vessel off Port Colborne lights, at the entrance to Welland canal.

ISLANDS IN THE WESTERN PART OF LAKE ERIE.

The principal islands belonging to the United States are West Sister island, The Bass islands, Rattlesnake and Green islands, and Kelley island.

The principal islands belonging to Canada are Middle Sister, East Sister, The Chickens, Middle island, and Pointe Pelée island.

UNITED STATES ISLANDS.

West Sister island.—This, the most western island, lies (the lighthouse) $13\frac{7}{8}$ (16) miles east of Grassy point and $7\frac{1}{4}$ ($8\frac{1}{3}$) miles north of Locust point. It is $\frac{5}{8}$ mile long NE. and SW. and $\frac{1}{2}$ mile north and

south and steep-to, except on its SE. point, from which a rocky, narrow spit extends ⅛ mile SE. with 3 feet at its extremity.

Light.—On the SW. point of West Sister island, from a conical white tower, is shown, 57 feet above the lake level, a fixed white light visible 13 (15) miles. It is obscured on the NE. side of the island by trees through an arc of 1½ points.

A red light, shown at this station in place of the white light, is a signal of distress.

Niagara reef, with least depth of 7 feet, is ¾ mile long east and west and ½ mile north and south. It lies near the track of vessels from West Sister island to Green island, but it is marked by a buoy and can be easily avoided.

Buoy.—A black can buoy is moored in 14 feet water on the NE. side of the reef.

The Bass islands, three in number, with small outlying islands and shoals, occupy a space of 6 (7) miles north and south by 4⅛ (5) miles east and west. The various channels through these islands, although deep, should not be attempted by strangers, as there are many unmarked shoals, and no directions can be given for clearing them.

North Bass island is about a mile long north and south and nearly the same distance broad; its southern face, however, is 1½ (1⅝) miles broad, being widened by narrow peninsulas from the SW. and SE. points of the island. Shoals extend out 1 (1¼) mile along its western side, and ⅜ mile off at other points.

The channel between North and Middle Bass carries from 3¼ to 6 fathoms, but there is a detached 16-foot spot south of mid-channel and nearer to Middle Bass.

Middle Bass island lies a mile south of North Bass (the shores of these islands are nearly parallel east and west). The island is 1$\frac{3}{10}$ (1½). miles long north and south and somewhat narrower than North Bass. The NE. point extends eastward from the island as a narrow peninsula for 1 (1¼) mile. From the east point of this peninsula to the west point of Sugar island (which is nearly ½ mile east and west, and connected to Middle Bass by shoals) the south shore of the channel is 2⅛ (2¾) miles long. Shoals extend ½ mile eastward from the end of the peninsula. In the bight south of the peninsula the west shore of the island can be approached to a 4-fathom depth, and this bight affords excellent anchorage and protection from westerly and northerly winds. The island can generally be approached to ¼ mile excepting off the points, which should be given a wider berth.

The channel between Middle and South Bass islands runs east and west, and after passing the SE. point of Middle Bass bends to the NE. and around the north side of Ballast island. This channel carries 3½ to 6 feet water. There is no passage except for light-draft vessels between Ballast island and South Bass.

Ballast island, a small circular island, steep-to on its northern face

is connected to South Bass island by shoals, through which, and nearer Ballast island, is a narrow channel with 14 feet water.

Buoys.—A black spar buoy is moored in 15 feet of water, rocky bottom, at the south side of the eastern entrance to this channel. The south side of the channel extends 650 yards WNW. from this buoy.

A black spar buoy is moored in 16 feet of water at the inner end of the channel.

Rattlesnake island lies a mile west of the western point of Middle Bass. It is ¾ mile long NW. and SE. Shoals extend ¼ mile off its NW. point. A small detached rock lies nearly at the end of the shoal water. The rest of the island is steep-to.

South Bass island, the largest of the group, is south of Middle Bass. Its SE. shore is 3 (3½) miles long, while the NW. coast is but 1 (1¼) mile. On the north coast is Put in Bay. Its SW. face is steep-to and affords anchorage and protection from easterly and northeasterly winds. Shoals line the whole SE. coast and from the SE. point extend over ½ mile to Starve island, and some distance beyond. Beyond this shoal is a small detached spot, with 11 feet over it.

Put in Bay is ¾ mile wide and ⅝ mile deep. Gibraltar island lies in the western part of the bay. The whole western part of the bay and the eastern side for some distance is shoal, but snug anchorage can be obtained in 3½ to 5 fathoms, protected from all winds from the East, South, and SW. Port Orchard point is the west point of the bay.

Port Orchard Point buoy, red spar, is moored in 12 feet of water and marks the elbow of a rocky shoal extending 375 yards NE. from the point, and thence 170 yards toward Gibraltar island. The western edge of the shoal lies 140 yards outside the point.

Starve Island reef, 400 feet in diameter, least water 11 feet, lies one mile ENE. of Mouse Island reef. The track of vessels lies between these two shoals. This shoal lies exactly on the range of Green Island lighthouse and the SW. point of South Bass island. When Green Island lighthouse can be seen open south of South Bass island vessels are clear of the shoal to the southward. Two-thirds of the way from this reef to Starve island is a rocky patch, with 11 feet of water over it.

Buoy.—A red nun buoy is moored in 14 feet of water on the SW. end of Starve Island reef. Vessels must pass south of this buoy.

Mouse Island reef, least water 12 feet, lies 1 (1¼) mile north of Mouse island.

Buoy.—A black can buoy is moored in 16 feet of water on the NW. end of this reef. The shoalest water on the reef is 150 yards SW. by W. from the buoy. Vessels must pass north of this buoy.

Scott Point shoal, least water 12 feet, is a rocky shoal on the south of the channel. It is 400 yards wide and from its NW. end stretches toward and halfway to Mouse island, leaving a channel ½ mile wide between the shoal and the island. SE. of this shoal is an 18-foot patch ½ mile long east and west.

Buoy.—A black can buoy is moored in 16 feet of water on the NE. end of the shoal and lies very close to the track of vessels through the channel. This buoy should be left well to the southward in passing.

Shoal in South passage.—In the channel leading from eastward to Green island, South passage, is a sandy shoal. It extends 1,000 feet in an easterly and westerly direction and 700 feet north and south. Depth of water over this area is from 17 to 18 feet; it gradually deepens all around to 21 feet. The shoal is marked by a buoy, the bearings from which are as follows: Marblehead lighthouse SE. $\frac{3}{8}$ S. (S. 41° E.); Middle Island lighthouse NE. $\frac{3}{8}$ N. (N. 41° E.). The buoy is moored SE. $\frac{3}{4}$ E. from the SW. point of South Bass island and distant therefrom $3\frac{8}{10}$ ($3\frac{8}{10}$) miles.

There are four detached rocks and one shoal northeasterly of the above shoal within a distance of one mile.

Green island, $\frac{1}{4}$ mile long east and west, is 1 ($1\frac{1}{4}$) mile west of the extreme west point of South Bass island.

Light.—On the west end of Green island, from a square, gray tower, is shown, 60 feet above the lake level, a fixed white light varied by a red flash every minute, visible $13\frac{1}{2}$ ($15\frac{1}{2}$) miles. The light is obscured between the bearings SW. by W. (S. 56° W.) and NW. by W. (N. 56° W.) by the woods on the island.

The range of this with West Sister light NW. by W. $\frac{5}{8}$ W. (N. 63° W.) passes a mile to the northward of Niagara reef.

The light just open of the SW. point of South Bass island passes south of Starve Island reef. Open westward of the west end of Rattlesnake island, it passes west of the Chicken island and east of East Sister island.

Kelley island, the largest of the United States islands, is $2\frac{7}{8}$ ($3\frac{1}{4}$) miles north of Marblehead light. The island is $1\frac{1}{2}$ ($1\frac{3}{4}$) miles north and south and $2\frac{3}{8}$ (3) miles east and west. The NE. end of the island forms a narrow point a mile long. There are many small open bays on the North and SW. coasts of the island; the latter, in which is a wreck, affords anchorage in North and NE. winds. The north bay affords protection from all southerly winds. The East and SE. shores should not be approached to $\frac{5}{8}$ mile, as shoals extend off in places to nearly that distance. The other part of the island can be approached somewhat nearer.

Kelley Island reef is 1,500 yards NE. from the NE. point of Kelley island, with a clear channel between. The reef extends ENE. and WSW. for 1 ($1\frac{1}{4}$) mile and is 600 yards across its widest part, with least water 6 feet.

Buoy.—A black nun buoy is moored in 16 feet of water on the east end of this reef.

Gull Island shoal, north point, is 1 ($1\frac{1}{4}$) mile south of Middle Island lighthouse (Canadian), the international boundary line passing between. The shoal from its north end extends over a mile SW., and

from its southern end a spit extends westward ½ mile. There are rocks above water on the south end of this shoal.

Buoy.—A black can buoy is moored in 16 feet, rocky bottom, on the NE. end of the shoal. The water shoals gradually for 1,500 yards SW. of the buoy, where the rocks show above water.

CANADIAN ISLANDS.

Middle Sister, the western of the Canadian islands, lies on the eighty-third meridian, and is 9½ (11) miles south of the Canadian shore of the lake. It is a small rocky island, ⅛ mile NE. and SW. The island can be approached to ½ mile with safety.

Grecian shoal, with several small shoals, least water 12 feet, lies a mile south of the pier at Colchester on the north shore of the lake. There is deep water between the shoal and shore.

Colchester reef, a small patch, least water 8 feet, lies 3½ (4) miles SW. by S. of the pier at Colchester and 3 (3½) miles offshore. It lies just south of the track of vessels to pointe Pelée and is marked by a lighthouse.

Light.—Near the SE. end of the reef, from a red lantern on a white hexagonal building, standing on a circular stone pier, is shown, 72 feet above the lake level, a fixed white light visible 14 (16½) miles.

Fog signal.—A bell, rung by machinery, gives one stroke every fifteen seconds.

Wreck.—The wreck of the schooner *Adams* lies 4 3/10 (5) miles NW. by W. (N. 56° W.) from Colchester Reef light.

The wreck has but 2 feet of water over the bow and is marked by a float, with two white lights moored 200 feet due south of it.

North Harbor island lies 6½ (7½) miles ESE. ⅞ E. of Middle Sister island. The island is a rock in the middle of a shoal ⅛ mile in diameter.

Shoal.—At 1 (1¼) mile north of North Harbor island is the SE. end of a shoal which extends ⅜ mile NE., and is ¼ mile broad, with 2 feet least water.

East Sister island, ¾ mile south of North Harbor island, is ⅜ mile east and west. It lies on a shoal ½ mile wide, which extends east and west for over a mile.

Shoals.—Between ¼ and ¾ mile NE. of the east point of East Sister are detached shoals of 18 and 7 feet least water; the latter shoal is the farthest out and is ¼ mile long ENE. and WSW.

Hen island is 2⅞ (3¼) miles SE. by E. of the east end of East Sister. It is a small circular island on a shoal extending ½ mile east and west, and ¼ mile north and south.

Big Chicken island is 1 3/10 (1½) miles SW. of Hen island. It lies on the SW. end of a rocky reef extending ¾ mile NE. from the island. Its average breadth is also ¾ mile. North of the center of this reef are dry rocks.

Little Chicken island is 1⅛ (1⅓) miles east of Big Chicken island.

It lies toward the southern edge of a rocky reef, with least water 5 feet, near the northern point of the reef. The reef has a breadth of about ½ mile and extends ½ mile NW. and ⅛ mile east from the island. There are 3½ fathoms water between the Chicken reefs, but the passage should never be attempted.

Pointe Pelée island, the largest of all the islands in lake Erie, is (north point) 6⅛ (7¼) miles WSW. of Pelée Spit light (the Dummy). The island is rectangular in shape, with an average length of 4⅜ (5½) miles and a breadth of 3 (3½) miles. Sheridan point is the NW. point of the island, and between this and Lighthouse point is a bay, which affords anchorage and shelter from southerly and easterly winds. Vessels should not shoal under 4 fathoms. Mosquito point, the SW. point of the island, extends to the southward 1½ (1⅝) miles as a narrow spit. Mill point is the SE. end of the island, and off this point is a detached shoal extending east and west 1½ (1⅝) miles, with a breadth of ⅛ mile. There is a least depth of 13 feet on this shoal. Middle point is between Mill and Lighthouse points. Shoals extend a mile northward from Lighthouse point and also line the whole east coast of the island. One mile SE. of Middle point is a 17-foot spot. The northern half of the west coast of the island is bold. Shoals extend off the southern half for about ¼ mile, with two outlying 18-foot spots, the outer one ⅜ mile offshore. The southern point of the island has a shoal spit extending from it ½ mile south, and from the east side of this point shoals extend in places to the distance of a mile. Chickenolee reef, an extension of this shoal to the eastward for nearly 2 (2¼) miles, has only 4 feet of water in the center. Between Chickenolee reef and Mill Point reef and the shore of the island is a bay, which affords protection from westerly and northerly winds. There is, however, a 17-foot spot and an 18-foot spot in the middle of the entrance to the bay. Between the south spit point and Middle island are several detached shoals, least water 10 feet, and no vessel should attempt this passage.

Life-saving station is at the SE. end of the island near Mill point.

Light.—On Lighthouse point, from a white circular lighthouse, is shown, 45 feet above the lake level, a fixed white light, visible 9 (10¼) miles.

Middle island, 1¾ (2) miles south of the south point of Pointe Pelée island, is ⅜ mile east and west and ¼ mile broad. It lies north of Gull Island shoal and the international boundary line is south of it. The island is steep-to.

Light.—On the east point of Middle island, from a white square lighthouse, is shown, 70 feet above the lake level, a fixed red light, visible 12 (13¾) miles.

Fog signal.—A hand horn answers signals from vessels.

Middle ground.—Lying almost midway between Pointe Pelée island and Pelée Spit lights is a most dangerous unmarked shoal. It is just off the track of vessels bound to pointe Pelée from the West and SW.

It is a mile long north and south and ½ mile wide. Least water, 11 feet at lowest lake level. A WSW. and ENE. range of Pointe Pelée Island and Pelée Spit lighthouses passes over the center of the shoal. Midway between the Middle ground and Pointe Pelée island is a 16-foot patch.

Clearing marks.—By keeping Lighthouse Point light nothing west of SW. by W. (S. 56° W.) and Pelée Spit light nothing north of E. by N. (N. 79° E.) a vessel will pass to the northward of the shoal.

Grubb reef consists of several 12 and 16 foot rocky patches, lying 2 and 3 miles WNW. of Pelée Spit lighthouse. The reef has extended a mile to the eastward, with a least depth of 16 feet. This lighthouse bearing east leads clear to the southward of these shoals.

Pointe Pelée and shoals are described on pages 174 and 175.

UNITED STATES COAST OF LAKE ERIE.

MICHIGAN.

Coast.—The west coast of the lake from pointe Mouillée, the west entrance point of the Detroit river, to Grassy point, the west entrance point of the Maumee bay, has a general SW. direction. All this portion of the coast has flats extending off it for some distance. Several rivers and creeks empty into the lake, and the shore is generally low and marshy. The 3-fathom line is 1¾ (2) miles SE. of pointe Mouillée, but at Stony point it approaches the shore to ¼ mile. To the west of Stony point is a bight filled with flats, in which is the village of Brest.

At 3½ (4) miles SSW. of Brest is the Raisin river, at the mouth of which is Monroe harbor.

Monroe harbor is a part of the Raisin river about 2 2/10 (2½) miles above the dredged channel which forms the outlet into the lake. The mouth is protected by two piers. The channel is 4,000 feet long and 100 feet wide. At present the depth of water over the bar and throughout the greater part of the channel to the wharves is about 8 feet.

Reports state that it is impossible to charter a vessel drawing over 7 feet for Monroe.

Monroe light.—On a crib at the outer end of the north pier of the entrance to the channel leading into the Raisin river, from a square tower on a white dwelling, is shown a fixed red light, 46½ feet above the lake level, and visible 11¼ (13) miles.

Directions.—The best water is found by standing in, in line with the straight (inner) section of the north pier WNW. ⅛ W. (N. 69° W.).

Caution.—Southwest gales lower the water at the west end of the lake from 2 to 3 feet, and NE. gales raise it the same amount.

South of Monroe the flats extend farther from the shore, and almost fill that portion of the lake west of the meridian of Monroe light and Cedar point. Strangers should not enter this area except on the ranges and in the axis of the channels. The boundary line between Michigan

and Ohio is at the mouth of Ottawa river, western portion of Maumee bay.

OHIO.

Maumee bay, between Grassy and Cedar points, is filled with flats. Maumee river empties into it, and a short distance within the mouth of the river is the city of Toledo.

Depths in the channel.—January, 1896: Depth in the New Straight channel from the river to deep water of lake Erie, marked by buoys and range lights, 17 feet on axis and ranging from 16 to 20 feet on the sides of channel.

Dry dock.—There is a dry dock at Toledo, 425 feet in length over all, 60-foot gate, and with a depth on sill of 16 feet.

Buoys.—A black gas buoy, showing a fixed white light, marks the SE. side of the entrance to Straight channel, Maumee bay, and a red nun buoy marks the NW. side of the entrance. The channel in is marked by black spar buoys to port, and red spar buoys to starboard in entering. A red spar buoy is moored in 15 feet of water on the NW. bank of the channel, opposite the middle of the pile work, to show the extreme width of the channel.

LIGHTS.

A fixed red light is shown from a lantern suspended from the red spar buoy No. 30, marking the extreme inner end of the straight channel.

Turtle island. On Turtle island, at the entrance to the bay, from a square yellow tower, attached to a dwelling, a fixed white light, visible $12\frac{6}{10}$ ($14\frac{1}{2}$) miles, is exhibited 50 feet above the lake level. The light bearing S. by E. (S. 11° E.) is obscured by the chimney to the dwelling.

MAUMEE BAY RANGES.

Main beacon.—On the south bank, from a white dwelling on a crib, at the elbow of South and Long reaches, a fixed white light is exhibited $27\frac{1}{2}$ feet above the lake level.

East beacon.—At 1,000 feet northeastward of the Main beacon, from a brown shaft on a crib, is shown a fixed white light 42 feet above the lake level. This light shows up the dredged channel to the southwestward, and also in the direction of the outer end of the New Straight channel, over an arc of 50° between the bearings SSW. $\frac{7}{8}$ W. (S. 32° W.) and W. $\frac{1}{8}$ S. (S. 83° W.), the entrance to the channel lying about midway between, or on the bearing S. 58° W.

South beacon.—At 1,000 feet to the southward of the Main beacon, from a brown shaft on a crib, is shown a fixed white light 43 feet above the lake level.

These lights form the following ranges:

Main Beacon and South Beacon lights.—Range for the Old channel from Turtle island to the New Straight channel.

Main Beacon and East Beacon lights.—Range (back) for inner part of the Straight channel.

East Beacon and Main Beacon lights.—Range for the outer part of the New Straight channel from the lake.

MANHATTAN RANGE LIGHTS.

Front.—The front beacon stands on a platform 8 feet above the water on a substructure of red iron piles in 3 feet of water 4¼ (4⅙) miles SW. by W. ⅛ W. (S. 58° W.) from the front light of Maumee Bay ranges. The light is fixed red and 28 feet above the lake level.

Rear.—The rear beacon is a skeleton structure, except the section immediately below the lantern is inclosed, and is 3,470 feet SW. by W. ⅛ W. (S. 58° W.) from the front beacon. The light is fixed red and 53 feet above the lake level.

Each beacon is a square, white, pyramidal structure, with green window shutters, and is surmounted by an octagonal lantern with red roof. Each light is visible from ESE. ⅞ E. (S. 77° E.), through south, west, and north to N. by E. ⅛ E. (N. 13° E.), or 135° to the northward and 135° to the southward of the range.

Directions.—The entrance of the channel is 2⅒ (2½) miles E. ¼ N. (N. 87° E.) of Turtle Island light, and is marked by a black can and a red nun buoy. Keep in over 3 fathoms of water until the buoys are picked up or the beacons (East and Main) come in range S. 58° W. Stand in on the range until up to buoy No. 14, then haul a little to the westward to pass the cribs and pile work. When up to buoy No. 16 bring the Manhattan range on and steer between the buoys until past inner end of Channel Buoy No. 29. From this point steer for the draw of the Wheeling and Lake Erie Railroad bridge, and passing Middle Ground Buoy No. 34, steer for the draw of the Pennsylvania Railroad bridge and to the docks. Seventeen feet can be carried in on these directions.

Coast.—Locust point is 12⅛ (14) miles SE. by E. ½ E. of Cedar point, the shore between receding slightly from the line joining the points. All this part of the coast is bordered by flats, extending off about 1¾ (2) miles. At Locust point the flats widen and extend 5¼ (6) miles in the direction of Niagara reef, leaving a passage of one mile in width between the shoals and reef, but as there are several rocky, detached shoals to the westward of the reef, no vessel should attempt to pass inside of Niagara reef.

Niagara reef, with least depth of 7 feet water, is ¾ mile long east and west and ½ mile north and south. It lies near the track of vessels from West Sister island to Green island, but it is marked by a buoy and can be easily avoided.

Buoy.—A black can buoy is moored in 14 feet of water on the NE. side of the reef.

Coast.—Scott point is 12⅛ (14) miles E. by S. of Locust point, the shore between receding and forming a bight 4⅛ (5) miles deep. The flat extends 5¼ (6) miles to the eastward from Locust point, then turns sharply to the SSW. and approaches the shore to a mile, then extends to the eastward, filling the bight between Locust point and Moore point,

the west point of Catawba island. Between Moore and Scott points, Catawba island is bluff and steep-to. Just north of Scott point is Mouse island, connected to the point by a flat.

Port Clinton is at the head of the bight between Locust and Scott points.

Depths.—The channel has been dredged to a depth of 10 feet for a width of 100 feet between the piers; the harbor in front of the wharves has been dredged for a width of 200 feet and to a depth of about 10 feet; the bar has been dredged outside to a depth of 10 feet.

Light.—On the west pier, 20 feet from the outer end, is shown a fixed red light, 25 feet above the lake level and visible 8 miles.

The light is shown from an octagonal lantern surmounting a square pyramidal structure, with gallery at the top, on a platform of piles. The structure is yellow, with white trimmings and brown foundation.

Mouse Island reef, least water 12 feet, lies one mile north of Mouse island.

Buoy.—A black can buoy is moored in 16 feet of water on the NW. end of this reef. The shoalest water on the reef is 150 yards SW. by W. from the buoy. Vessels must pass north of this buoy.

Starve Island reef, 400 feet in diameter, least water 11 feet, lies one mile ENE. of Mouse Island reef. The track of vessels lies between these two shoals. This shoal lies exactly on the range of Green Island lighthouse and the SW. point of South Bass island. When Green Island lighthouse can be seen open south of South Bass island vessels are clear of the shoal to the southward. Two-thirds of the way from this reef to Starve island is a rocky patch, with 11 feet of water over it.

Buoy.—A red nun buoy is moored in 14 feet of water on the SW. end of Starve Island reef. Vessels must pass south of this buoy.

Scott Point shoal, least water 12 feet, is a rocky shoal on the south of the channel. It is 400 yards wide and from its NW. end stretches toward, and halfway to, Mouse island, leaving a channel ½ mile wide between the shoal and the island.

Buoy.—A black can buoy is moored in 16 feet of water on the NE. end of the shoal and lies very close to the track of vessels through the channel. This buoy should be left to the southward in passing.

Shoal in South passage.—Two shoal spots and four detached rocks lie easterly of Scott Point shoal. The most southerly one, a sandy shoal, lies W. ¾ S. (S. 82° W.) from Carpenter point, Kelley island, distant about $2\frac{1}{10}$ ($2\frac{4}{10}$) miles. It is marked by a buoy.

Coast.—Scott point (eastward) to Cedar point: This portion of the coast is much indented. Flats extend off the east side of Catawba island ⅝ mile. Off West harbor, which is filled with shoals, flats and rocky shoals extend in a spit nearly $1\frac{3}{10}$ ($1\frac{1}{2}$) miles, with 4 feet near its end; off East harbor, also filled with shoals, flats extend ⅝ mile. They then near the shore, and close to the United States life-saving station west of Marblehead lighthouse the shore is steep-to. Sand point is $1\frac{3}{4}$ (2)

miles south of Marblehead lighthouse. Between these two points flats extend across to Cedar point, filling the entrance to Sandusky bay.

North of this portion of the coast are numerous islands which reach almost to the north shore of lake Erie and among which are numerous shoals. These islands and shoals are described on pages 147–153.

Marblehead light.—On the northeastern end of the Marblehead peninsula is a fixed white light, shown 67½ feet above the lake level and visible 14 (16) miles. The lighthouse is a white conical tower; the dwelling, light buff, is westward of the tower.

Sandusky bay forms a natural harbor, separated from lake Erie on the north and NW. by Marblehead peninsula, and on the east by Cedar point, which is also a peninsula. This bay, which is from 8 to 12 feet deep, is protected from the effect of storms by a bar extending across the entrance, except for a short distance where the channel passes Cedar point. The depth on the bar is from 4 to 6 feet, excepting where dredged.

Currents.—The currents from the eastward set toward Marblehead point, being deflected at times so that they enter Sandusky bay between Marblehead and Cedar points, in the channel and across the flats; then, flowing eastward in the bay, they follow the east shore line and set southward until they reach the extreme south shore, when they are deflected to the westward.

Johnson island, a large island, lies just within Sand point in the northern part of the bay.

Sandusky river empties into the NW. part of the bay, 12½ (14½) miles by channel from lake Erie. Fremont, at the head of navigation, is 15⅜ (18) miles from the bay. Eight feet can be carried to Fremont.

Sandusky, at the southeastern end of the bay, has numerous wharves and railroad docks.

Channel.—The channel consists of an outer channel across the bar at the entrance to the bay; depth varies from 15 to 18 feet; a natural channel between Sand Point and Cedar Point shoals, and an inner dredged channel in one straight reach leading up to the Baltimore and Ohio Railroad docks in the city of Sandusky. The channel is 2 8/10 (3¼) miles long, and the bottom and banks are sandy until halfway through the straight cut, where both are soft. The dredged channel is 200 feet in width and dredged to 17 feet depth at mean lake level, but has shoaled some in places. The spar buoys on the banks of the dredged part of the channel stand within a few feet of the edge. There is a dredged channel 89 feet wide, with 17 feet depth at mean lake level, extending in front of the docks to the west end of the city.

BUOYS.

Outside buoy, No. 2, is a red can buoy in 13 feet of water.
Outer Bar buoy, No. 4, is a red spar buoy in 13 feet of water.
Inner Bar buoy, No. 6, is a red spar buoy in 13 feet of water.

North Shoal (outer) buoy, No. 8, is a red spar buoy in 14 feet of water.

South Shoal buoy, No. 1, is a black spar buoy in 13½ feet of water.

North Shoal (inner) buoy, No. 10, is a red spar buoy in 14 feet of water.

Sand Point buoy, No. 12, is a red spar buoy in 13 feet of water.

Cedar Point buoy, No. 3, is a black spar buoy in 12 feet of water.

Turning buoy, No. 14, is a red spar buoy in 14 feet of water, and marks the turning point into the New Straight channel.

Entrance to Straight Channel (outer) buoy, No. 5, is a black spar buoy in 14 feet of water on the east side of the entrance to the dredged channel.

Entrance to Straight Channel (outer) buoy, No. 16, is a red nun buoy in 15 feet of water on the west side of the entrance to the dredged channel and of the SE. bank of the deep hole.

Channel buoys.—The Straight channel is marked by four black spar and three red spar buoys, and the—

End of Channel (inner) buoy, No. 24, is a red spar buoy in 13 feet of water, marking the west side of the inner entrance to the Straight channel.

Dock Channel buoys.—Six buoys mark the channel extending along the city docks.

LIGHTS.

Cedar Point range (front).—On the crib at the outer edge of Cedar point, 600 feet NE. of the main (rear) light, is a fixed red light 28½ feet above lake level, and visible 7⅛ (8½) miles. The light is shown from a white building on a crib and is moved from time to time to correspond with the shifting of the line of best water at the outer bar. This light should not be approached nearer than ¼ mile on the range, nor passed, entering, nearer than 600 feet.

Rear (main).—On Cedar point is a fixed white light 48½ feet above the lake level and visible 12⅓ (14¼) miles. The light is shown from a low white tower on a dwelling.

Directions.—The Outside buoy, No. 2, may be approached from the eastward on any course between NW. and SE. by E. It is just to the northward of the Cedar Point range line. From it steer SW. ¾ W (S. 48° W.), on the range past North Shoal (outer) buoy, No. 8, to South Shoal buoy, No. 1, then haul to the westward and steer a course to carry between Cedar Point buoy, No. 3, and Turning buoy, No. 14. When abreast of No. 14 haul to port for the entrance to the straight channel between buoys Nos. 5 and 16, and steer S. by W. ½ W. (S. 17° W.) for the City Hall tower. There are buoys on each side of this channel.

STRAIGHT CHANNEL RANGE.

Front.—A fixed white light, 33½ feet above the lake level, is shown from a square tower attached to dwelling, yellow, standing on square

red crib. The crib is in 5½ feet of water, about ¼ mile NNW. ⅞ W. (N. 32° W.) from Cedar Point lighthouse on the northerly prolongation of the axis of the Straight channel.

Rear.—A fixed white light, 50 feet above the lake level, is shown from a square pyramidal yellow tower on a square red crib. The lighthouse is 1,500 feet N. by E. ½ E. (N. 17° E.) from the front light. The light is visible 12⅝ (14½) miles.

Each light illumnates an arc of 270° between SSE. ½ E. (S. 28° E.) and NE. by E. ½ E. (N. 62° E.) through east and south, or 45° to the westward of the range, the remainder of the illuminated arc being to the eastward of the range and showing into the lake.

Coast.—From Cedar point to Huron lighthouse the coast trends SE. for 8½ (9½) miles. SE. of Cedar point the shoal bank approaches the shore, and the 3-fathom line is less than ½ mile off shore.

Shoal.—A rocky shoal of 18 feet lies ¾ mile off shore and 1⅜ (1⅞) mile NW. of Huron lighthouse; it has 4 to 4½ fathoms around it.

Huron is at the mouth of the Huron river. Piers have been built and the bar dredged; width between the piers, 125 feet. The piers extend NE. ½ N.

Depth.—Channel dredged through bar at entrance to depth of 18 feet in August, 1895. Between piers 17 feet depth is maintained over nearly full width. Shifting sands cause depths to vary from time to time.

Light.—Twenty feet from the end of the west pier a fixed white light is shown from a brown skeleton tower 40½ feet above the lake level. It is visible 11¾ (13½) miles.

Directions.—Keep in 5 fathoms until the light is made out, when bring it to bear ahead SW. ½ S. (S. 39° W.) and stand in between the piers.

Coast.—Vermillion lighthouse is 8½ (9¾) miles E. by N. of Huron lighthouse, the shore between receding to the southward and forming a shallow bight. A short distance to the eastward of the head of the bight the flat leaves the shore again and extends in a spit for nearly a mile; it then follows the shore at the distance of nearly ¾ mile.

Vermillion is at the mouth of the Vermillion river. The bar has been improved from time to time by the building of piers and dredging. Width between the piers 130 feet. Direction of the piers, N. ¼ W. (N. 3° W.).

Bar.—The depth between the piers at Vermillion varies less than at most other places on the lake. The depth in the channel at mean-water level is from 12 to 14 feet. In November, 1895, 10⅔ feet, mean lake level, was found on a bar which had formed at the mouth of the piers.

Light.—On the west pier, 25 feet from the outer end, a fixed red light is shown 34½ feet above the lake level, and visible 8½ (9¾) miles, from a brown, octagonal structure.

Directions.—Keep in over 4 fathoms until the light is made out; bring it to bear ahead S. ¼ E. (S. 3° E.) and stand in between the piers.

Coast.—Black River lighthouse (rear) is 8⅔ (10) miles ENE. ½ E. of Vermillion lighthouse, the coast between trending East and then ENE. The flats to the eastward of Vermillion extend ½ mile off shore for a short distance; they then approach the shore to the distance of ¼ mile and the 3-fathom line is not more than this distance from the shore to Black River entrance.

Lorain.—Black River harbor is in the township and city of Lorain, where the Black river empties into the lake. In its natural condition there was only 3 feet of water over the bar at the mouth of the river, but this has been improved by the construction of piers and dredging. Width between the piers is 200 feet; direction of the piers NW. The Channel is 75 feet wide between piers dredged to a depth of 18 feet at mean lake level in May, 1895. Shifting sands cause these depths to vary from time to time.

RANGE LIGHTS.

Front.—On the west pier, 29½ feet from the outer end, 47 feet above the lake level and visible 12⅛ (14) miles, is a fixed white light, shown from a square pyramidal tower, brown below and white above.

Rear.—Near the shore end of the west pier, 1,061 feet from the front light, are three fixed lights—red, white, red—shown vertically. The lights are, respectively, 65½, 61½, 57½ feet above the lake level, and are shown from a square pyramidal skeleton tower, the foundation of which is red, the skeleton white, and the roof black.

These lights form a range for entering the harbor.

Directions.—Keep in 5 fathoms water until the range comes on, when stand in on the range and between the piers into the harbor.

From Black river to Avon point the coast trends ENE. for 8 (9½) miles and the 3-fathom line is nowhere at a greater distance than ½ mile from the shore. Avon point, broad and rounding, has shoals all around to the distance of ½ mile. At Avon point the coast bends around to the SE. and then takes a general easterly direction to Cleveland Pier lights, which are 13½ (15½) miles E. ½ S. from Avon point.

Caution.—A crib (intake of Cleveland waterworks) lies in 6 fathoms of water 1 (1½) mile nearly west of the light on the end of the west breakwater and 1 (1½) mile offshore. It is a serious menace to navigation, as the white light on it (an ordinary ship's lantern) is irregularly lighted and often not lighted at all.

Cleveland is at the mouth of the Cuyahoga river, which was originally obstructed by a long sand bar. The channel was crooked, and the depth of water over the bar was but 3 feet. The river has been straightened, piers have been built, and a breakwater constructed, forming an outer harbor and making it a safe harbor of refuge.

Breakwater.—The shore arm of the west breakwater starts from a point 700 feet west of the old bed of the Cuyahoga river and 5,950 feet

west of the west pier of the present channel. This arm runs into the lake nearly north a distance of 3,130 feet, where it is joined to the breakwater proper. The west breakwater is nearly parallel to the shore and is 4,030 feet long. At a point 200 feet from its eastern end a spur 100 feet long runs at right angles, breaking the force of the heavy seas and currents which run along the breakwater during northwesterly gales. These currents add greatly to the difficulty of taking vessels into the harbor.

The east breakwater commences on the prolongation of the west arm, leaving an opening of 500 feet. It is intended to build 3,500 feet on this line, and then to incline toward the shore for a farther distance of 2,000 feet.

A spur similar to the one on the west breakwater has been constructed. In 1895, 2,500 feet of this breakwater had been completed.

New entrance.—There is an opening 201 feet wide through the shore arm of the west breakwater. The outer end of this opening is 1,308 feet from the outside angle of the breakwater. This opening has been dredged to a depth of 16 feet.

Depths.—In September, 1896, there was from 17 to over 20 feet in midchannel from the breakwater to the L. S. & M. S. railroad bridge; from the bridge of the L. S. & M. S. railroad up stream to the crossing of the N. Y. P. & O. railroad there was a depth of 19 feet below the mean level of Lake Erie and a width of 130 feet; from the crossing of the N. Y. P. & O. railroad to the transfer lock, depth 16½ feet below the same level and width of 130 feet; above the transfer lock dredging was being done with the intention of attaining a depth of 16½ feet below the same level and a width of 100 feet for a distance of 2,000 feet. The anchorage in the harbor of refuge is accessible to vessels drawing 19 feet, and there is ample room, although there are several 18-foot spots. The deposit from the river and the lake causes the depths to vary from time to time.

Branch Hydrographic Office.—The United States Hydrographic Office has a branch office in the Arcade building at Cleveland.

The office is supplied with all the latest information pertaining to the lakes, also nautical books and instruments, all of which are open for free consultation or reference to the lake mariners or other interested parties.

Time ball.—The time ball is dropped by the branch office at noon every day (Sundays excepted) from the flagstaff on top of the Arcade building. The ball is hoisted five minutes before noon, central standard time, and is dropped exactly at noon. Should the ball be dropped before the exact instant at noon it will be hoisted immediately, and kept up until five minutes after noon (12h. 5m.) and then lowered slowly. Should the ball fail to drop exactly at noon it will be kept mastheaded until five minutes after noon (12h. 5m.) and then lowered slowly.

Life-saving station.—A life-saving station is at the west side of the entrance to Cleveland harbor.

Dry docks.—There are three dry docks. The longest, 465 feet over all, with 48-foot gate, has a depth of 16 feet on sill; the next in size, 360 feet over all, with 50-foot gate, has 20 feet over sill; the third is 325 feet over all, 45-foot gate, and 13½ feet over sill.

LIGHTS.

West breakwater (east end).—On a crib just inside of the end of the breakwater, from a brown, octagonal, pyramidal tower, 35½ feet above the lake level, is shown a light, flashing alternately red and white, the intervals between the flashes being ten seconds. The light is visible 11¼ (13) miles.

Fog signal.—From a brown house on the same crib a 10-inch steam whistle is sounded as follows: Blast three seconds, silent interval fifty-seven seconds.

East breakwater (west end).—Near the west end of the East breakwater, from a mast, is shown a fixed red light 25 feet above the lake level.

Caution.—The unfinished work on the east end of the east breakwater is not marked by a light or day mark.

West pier.—On the West pier, 53 feet from the outer end, from a square, brown, pyramidal tower, is shown, 47 feet above the lake level, a fixed white light, visible 11¼ (13) miles.

East pier.—On the East pier, 37 feet from the outer end, from a similar tower is shown, 37 feet above the lake level, a fixed red light, visible 7⅛ (8¼) miles.

Directions.—When off the breakwater, bring the east pier light (fixed red) to bear SE. by S. (S. 34° E.) and run in through the opening and between the piers.

Caution.—With westerly winds a strong set makes along the breakwater, and caution should be used in making the entrance.

Coast.—Cleveland to Fairport: The coast trends NE. for 24½ (28¼) miles and is generally safe to approach to the distance of ½ mile.

At 1¾ (2) miles west of Fairport the flats extend somewhat farther from the coast, and along here vessels should not approach within one mile.

Fairport is near the mouth of the Grand river. This river was originally closed by a hard sand bar, but it has been improved from time to time by the building of piers and dredging, so that there is now usually a 19-foot channel. Width between the piers is 180 feet. Direction of the piers, N. ⅜ W.

Bar.—A dangerous bar works across the mouth of the piers from the westward, with crest about 150 feet from end of the west pier; sometimes there is less than 13 feet on crest. An outside bar also forms. A channel was dredged through the bar in November, 1895, to 18 feet depth. Between the piers the depth is usuallly 17 feet.

Life-saving station.—The life-saving station is at the inner end of the west pier.

NOTE.—The life-saving station keeper reports as follows, November, 1895: The only danger to navigation at or near Fairport is the natural formation of sand bars which occurs each year, which, on account of the extremely low stage of the water, are dangerous in entering the harbor. The outside bar, 1,200 feet from the end of piers, has only 12 feet over it in places, but by keeping well to the eastward in entering, masters will avoid shoal spots. The inside bar is much worse, there being only 8 or 10 feet of water. The bar is about 90 feet from the end of the piers. There is a dredge at work cutting a channel from in range with the east pier, extending west about 75 feet, with a 17½-foot depth. In entering the harbor, unless perfectly familiar with the channel, it would be advisable to take a tug.

LIGHTS

Fairport.—On the bluff on the east side of the mouth of Grand river, from a conical gray tower, is shown, 102¼ feet above the lake level, a fixed white light, visible 16 (18½) miles.

Range (front).—Twenty-one feet from the outer end of the east pier, from a square pyramidal tower, brown below and white above, is shown, 37 feet above the lake level, a fixed white light, visible 11¼ (13) miles.

Range (rear).—Near the shore end of the east pier, 1,120 feet in the rear of the front light, from a brown, triangular, pyramidal skeleton tower are shown three lights, 4 feet apart and placed vertically. The lights are red, white, red. The middle light (white) is 52 feet above the lake level.

The lights form a range for entering the harbor.

Directions.—Keep in over 5 fathoms until the range comes on, when stand in on the range and between the piers into the harbor.

Coast.—Fairport to Ashtabula: The coast between these ports trends ENE. for 23¼ (26¾) miles. The 3-fathom line is less than ½ mile off shore, except just west of Ashtabula, where there is 17 feet at this distance

Ashtabula is at the mouth of the Ashtabula river. Originally the bar at the mouth of the river had but 2 feet of water over it, and the rock bottom was but 9 feet below the surface of the lake. The river has been improved from time to time by the building of piers and dredging. Width between piers, 213 feet; direction of piers, N. ⅛ E.

Depths.—The following depths of water have been reported over the bar at the entrance to Ashtabula, May 15, 1896:

On line of west pier, $15\frac{1}{10}$ to $17\frac{6}{10}$ feet.

On line of center of channel, $16\frac{3}{10}$ to $17\frac{9}{10}$ feet.

On line of east pier, $15\frac{6}{10}$ to $16\frac{3}{10}$ feet.

A channel 20 feet deep and 75 feet wide has been dredged along the west pier. Vessels will find the best water along the west pier.

Shifting sands cause these depths to vary from time to time.

Life-saving station is on the beach, west side of the entrance to the river.

RANGE LIGHTS.

Ashtabula (front).—On the west pier, 27½ feet from the outer end, from a square pyramidal tower, brown below and white above, is shown a fixed white light, 35½ feet above the lake level and visible 11¼ (13) miles.

Pierhead (rear).—Near the shore end of the west pier, 1,500 feet in the rear of the front light, from a brown, triangular, pyramidal skeleton tower are shown three lights—red, white, red—placed vertically and 4 feet apart. The middle light (white) is 52 feet above the lake level.

The lights form a range for entering the harbor.

Fog signal.—At Ashtabula light station the fog signal is a 6-inch steam whistle, which sounds as follows: Blast three seconds, alternate silent intervals of twelve and forty-two seconds.

Directions.—Keep in over 5 fathoms until the range comes on, when stand in on the range, between the piers into the harbor.

Coast.—Ashtabula to Conneaut: Between these ports the course continues ENE. for 11¾ (13½) miles, and the 3-fathom line is nowhere at a greater distance than ½ mile off shore.

Conneaut, at the mouth of the Conneaut river, is very near the boundary line between Ohio and Pennsylvania. The river had an original depth of 2 feet over the bar. The bar is being improved and will have a width of 200 feet between the piers. Direction of the west pier is N. by W. ¼ W.

The railroad company has repaired the old piers to some extent and dredged the entrance to 17 feet. Shifting sands cause the depths to vary from time to time.

LIGHTS.

Conneaut.—On the bluff, just west of the harbor, from a square pyramidal tower, brown below and white above, is shown a fixed white light, 69 feet above the lake level and visible 11¼ (13) miles.

Pierhead.—On the west pier, 25 feet from the outer end, from two white uprights, is shown, 20 feet above the lake level, a fixed white light.

Directions.—When in 5 fathoms bring the Pierhead light to bear S. by E. ¼ E. (S. 14° E.) and stand in on this bearing and between the piers.

PENNSYLVANIA.

Coast.—Just eastward of Conneaut is the boundary line between Ohio and Pennsylvania. From Conneaut to Presque Isle peninsula the coast trends ENE. for 19⅓ (22¼) miles. The shore can be approached anywhere in this stretch to ¾ mile. The depth at this distance is generally from 5 to 6 fathoms, except in the first 4½ (5) miles, where it is 4 fathoms. Nearly a mile NW. from the mouth of Crooked creek and ¾ mile offshore is a 3½-fathom spot.

Presque Isle peninsula trends NNE., gradually bending to the eastward, and, widening, protects Erie harbor from the north and west.

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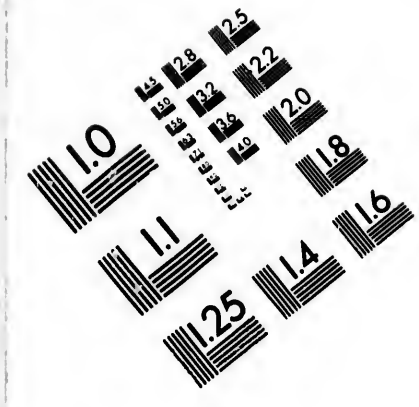

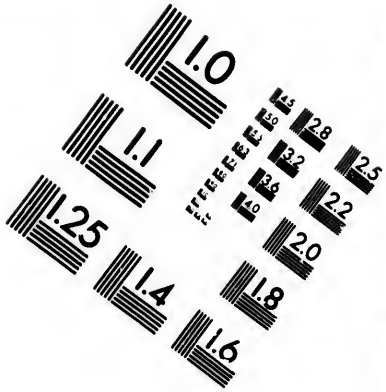

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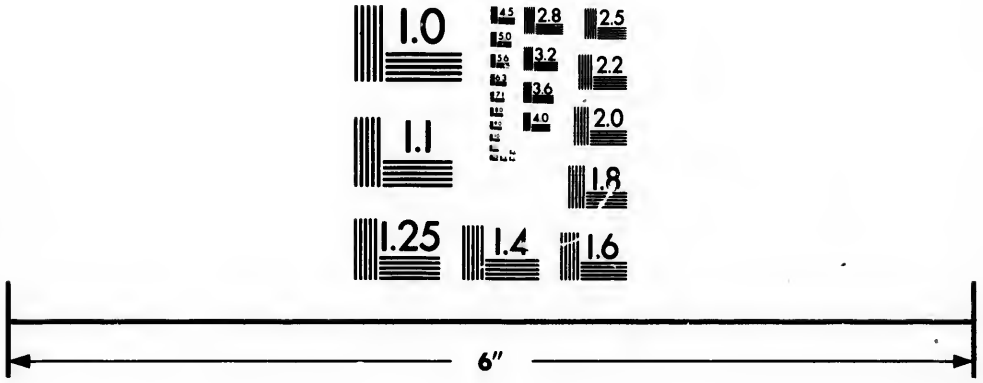

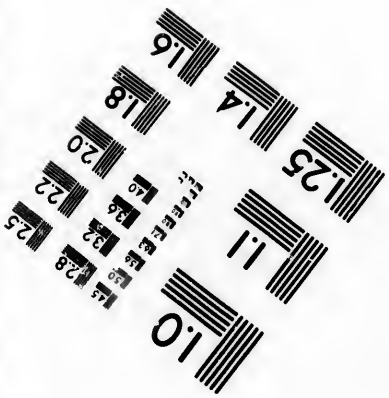

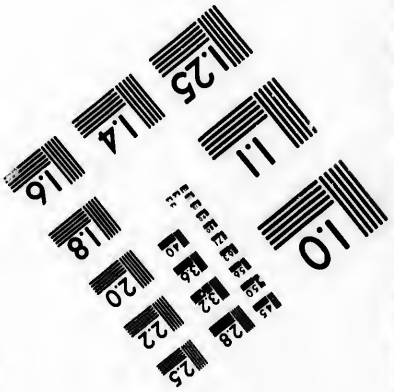

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The peninsula is much indented on its south shore, and in it are several small lakes. The west shore of the peninsula should not be approached within ⅛ mile. Misery bay, at its SE. end, is filled with flats.

Presque Isle light.—On the northern shore of Presque Isle peninsula, 400 feet from the lake, from a square, red tower, attached to a dwelling, is shown, 56 feet above the lake level, a light, flashing alternately red and white, the interval between the flashes being ten seconds. The light is visible 13 (15) miles. When the trees are in leaf this light is partially obscured in the bight at the entrance to Erie harbor.

Erie harbor (Presque Isle bay), protected by Presque Isle peninsula, has been artificially improved. Outside of the 3-fathom line it is over 1¾ (2) miles long by a mile broad, the width being somewhat contracted by a spit extending into the harbor from the middle of the south shore of Presque Isle peninsula. It is the finest natural harbor on the lake, and has accommodation for a large number of vessels.

Erie, on the south shore of the lake, is on a bluff, and has a large number of docks and wharves.

Improvements.—The present works consist of (1) the south breakwater, extending northerly from the main shore; (2) a pier on the south side of the entrance channel, extending easterly from the breakwater; (3) a pier on the north side of the entrance channel, parallel to the south pier and 350 feet distant, and (4) a catch-sand jetty, built about 3,000 feet north of the north pier. This jetty did not serve its purpose and has received no repairs since its construction.

Depth in the channel.—In January, 1896, the depth of water was not less than 18 feet at mean lake level, or not less than 16½ feet at low water for a channel width of not less than 250 feet.

Currents.—Southwest gales cause a strong incurrent through the channel and NE. gales a strong outcurrent.

Buoys.—A red can buoy is moored in 18½ feet of water on the prolongation of the inner face of the north pier and marks the northern side of the entrance to the channel. A black spar buoy is moored in 16 feet of water on the prolongation of the south pier and 250 yards outside of the end of the north pier. This buoy is 350 yards within the outer edge of the spit extending along the south side of the entrance channel. The outer edge of this spit is south of the north outer buoy. There are six other buoys (red to starboard and black to port) marking the channel in entering. The inner buoy, on the north bank, is a gas buoy, red, showing a fixed white light.

Life-saving station.—There is a life-saving station on the middle of the north pier, adjoining the light station.

LIGHTS.

Erie.—Eastward of Erie harbor, on a high bluff, from a conical tower, is shown, 128 feet above the lake level, a fixed white light, visible 17⅓ (20) miles.

The light is obscured by trees on Presque Isle peninsula through the greater part of the arc between the bearing SE. by E. ½ E. (S. 62° E.) and East.

Presque Isle (north) pierhead.—On the north pier, 30 feet from the outer end, from a square, white, pyramidal tower with brown trimmings, is shown, 40 feet above the lake level, a fixed red light, visible 11¼ (13) miles. With Erie Range No. 1 in line bearing SW. by W. ½ W. (S. 62° W.) it forms a range for approaching the piers.

Fog signal.—At this station a bell is struck by machinery every twenty seconds.

ERIE RANGE.

No. 1 (front).—On the north pier, 8 feet from the west end, from a white octagonal lantern on a square white tower, is shown, 21 feet above the lake level, a fixed white light, visible 9⅓ (10¾) miles.

NOTE.—After passing this light bring it in range astern with No. 2, rear, bearing NE. by E. (N. 56° E.). This range carries through the best water in the dredged channel into deep water of the harbor.

No. 2 (rear).—NE. by E. (N. 56° E.), 908 feet from No. 1 light, is a fixed white light, 46 feet above the lake level. The light is suspended from a white mast with a round black disk, 5½ feet in diameter, above the lantern.

Erie harbor.—Shoal.—North of the elevator 300 feet there is a 15-foot shoal.

Directions.—Coming from the westward, Erie Main light (fixed white) will probably be made out first, and then Presque Isle light (flashing red and white). This latter light can be approached to one mile and Presque Isle peninsula rounded at that distance. When Erie Main light (fixed white) bears S. ½ E. (S. 6° E.), steer for it on this bearing until the range, Presque Isle pierhead (fixed red) and Erie range No. 1 (fixed white) come in line bearing SW. by W. ½ W. (S. 62° W.); run in on this range, passing south of the red can buoy on the end of the shoal extending from the north pier, and remembering that the outer black spar buoy No. 1 is not on the outer end of the spit on the prolongation of the south pier, but halfway between the outer end of the spit and the outer end of the south pier.

After passing Erie Range light No. 1, bring [illegible]ight and Erie Range No. 2 (fixed white) in range astern, bearing [illegible]y E. (N. 56° E.); keep this range on astern and run in between the buoys into deep water of the harbor.

Approaching from the eastward, Erie Main light (fixed white) will be made out first. It should be approached on a SW. (nothing to the westward) bearing until the range SW. by W. ½ W. (S. 62° W.) comes on, when proceed in as directed above.

Coast.—From Erie to Dunkirk the coast trends NE. by E. for 38 (43¾) miles. The shore can be approached anywhere to ¾ mile, except one mile NE. of Van Buren point, where a spit extends from the shore

to the westward for a little over a mile. There are only 5 feet of water on this spit, ¾ mile from the shore. Several small creeks empty into the lake in this stretch and 24⅛ (28) miles NE. of Erie, on Chautauqua creek, is Barcelona. The boundary line between the States of Pennsylvania and New York is 8⅔ (10) miles SE. of this town, just east of Twenty-mile creek.

NEW YORK.

Dunkirk is on an artificial harbor, protected by a pier and a partially completed breakwater. In January, 1896, the channel entrance had a depth of 13 feet for a width of 100 feet, and 13 feet at the docks. A sand bar makes out from the beacon light in a NE. direction, on which there is only 12 feet.

Buoys.—A beacon buoy, black spar, is moored in 17 feet of water at the north side of the entrance to the channel. It may be rounded on the west side at 50 yards. A red spar buoy (Outer buoy) is moored in 14 feet of water in the channel close to the south side of the entrance, and marks the outer end of a ledge of rocks just covered, extending along the south bank of the channel nearly to the Inner buoy. A straight course may be steered between these (Outer and Inner) buoys. Inner buoy, red spar, is moored in 10½ feet of water on the south side of the excavated channel.

LIGHTS.

Dunkirk.—West of the harbor entrance, on a bluff point, from a square, reddish gray tower, is shown, 82 feet above the lake level, a fixed white light, varied by a white flash every 90 seconds, and visible 14¾ (17) miles.

Dunkirk pierhead.—On the easterly end of the west breakwater, about 25 feet from the channel face of the pier entrance to Dunkirk harbor, a fixed red lens lantern light is shown from a square, dark red, pyramidal, open framework structure, surmounted by a square lantern, with white roof, and having a balcony with black hand rail. The focal plane of the light is 41 feet above mean lake level.

Directions.—Making this harbor from the eastward, steer for the entrance between Dunkirk Pierhead lighthouse and the beacon buoy, and nothing inshore of a SW. by S. (S. 34° W.) course. From the westward keep in over 4 fathoms until the Pierhead lighthouse bears SW. by S. (S. 34° W.), when the channel entrance can be run for. The channel in is straight and marked on its south side by two red buoys.

During northerly gales a heavy swell sets into the harbor past the east end of the breakwater, rendering berths at the docks insecure.

Coast.—Dunkirk to Buffalo: From Dunkirk to Silver creek, 7 (8) miles NE. by E., the shore line is very irregular and projects into the lake in several small points, all of which have spits extending from them. Here it is best to keep at least 1 3/10 (1½) miles from the shore.

At Silver creek the coast line changes direction to the NNW. to Sturgeon point, which is $10\frac{1}{2}$ (12) miles distant. This part of the coast is also uneven, with several projecting spits for a distance of a mile. Off Big Sister creek, $2\frac{3}{8}$ (3) miles SW. $\frac{1}{2}$ S. of Sturgeon point, and 1 ($1\frac{1}{4}$) mile off shore, is a rocky shoal, with 6 feet least water. The shoal extends $\frac{1}{2}$ mile NE. and SW. and is $\frac{1}{4}$ mile broad. At Sturgeon point the coast line again changes direction to NE. by E., and continues for $10\frac{1}{4}$ ($11\frac{3}{4}$) miles to Hamburg, where it again changes direction to a little west of north, and so continues for 6 (7) miles to the entrance of Buffalo harbor. This stretch of coast is rather more even, but, on account of two rocky and extensive offlying shoals lying north of Hamburg, it should not be approached nearer than 1 ($1\frac{1}{4}$) mile.

Seneca shoal lies $3\frac{1}{2}$ ($3\frac{3}{4}$) miles off Hamburg, where the coast changes its direction to the northward. The shoal is nearly $\frac{1}{2}$ mile north and south by $\frac{3}{8}$ mile wide. It is rocky, with a least depth of 15 feet.

Buoy.—A black spar buoy is moored in 17 feet of water on the NW. side of the shoal. The 15-foot spot is 100 yards NE. from the buoy.

Waverly shoal.—The NE. end of this shoal lies 2 ($2\frac{3}{16}$) miles SW. by W. $\frac{5}{8}$ W. (S. 63° W.) from the light on Buffalo breakwater. The shoal is 100 feet wide, and extends 700 yards SW. and NE. Least water, 12 feet, is 400 feet SW. of the buoy. There is a small 16-foot detached spot a little eastward of the north end of the shoal.

Buoy.—A red and black horizontally striped can buoy is moored in 13 feet of water near the NE. end of the shoal.

Buffalo, on Buffalo creek, is at the NE. end of lake Erie, where it contracts to form the Niagara river. It extends along the river for some distance, and on the opposite shore is Fort Erie.

Improvements.—The object of the improvements is to protect the entrance to Buffalo harbor, the south shore of Buffalo creek, and to form an outer harbor of refuge.

The improvements are: North and south piers at the entrance to the creek (completed); masonry sea wall (completed); sand-catch or pile pier, and breakwater and shore arm.

The sand catch extends into the lake at a point 8,000 feet southward of the south pier. The breakwater, commencing about on a line of the south pier extended, lies parallel to and $\frac{1}{2}$ mile from the shore. This breakwater has its full length of 7,600 feet. The shore arm of the breakwater is intended to cover the opening between the south end of the main breakwater and the shore, leaving a passageway for vessels. Some 1,150 feet at the outer end of this shore arm had been completed, but in October, 1893, it was so badly wrecked by a storm that no attempt has been made to repair it.

Depths.—Twenty-three feet can be carried into the outer harbor. The Buffalo river and Blackwell canal are maintained by the city on the basis of an 18-foot depth at low water, as established by the city, which

would give about 19 feet at mean lake level. Actual depth allows about 16 feet draft.

Dry docks.—There are four docks, with lengths over all of 390, 295, 348, and 349 feet; widths of gates, 46, 40, 58¼, and 45 feet; depths of sills, 14, 11½, 9, and 14 feet. The 340-foot dock is to be lengthened to 400 feet, and will have a depth over sill of 17 feet.

BUOYS AT THE ENTRANCE TO THE NIAGARA RIVER.

Horseshoe reef.—A black spar buoy is moored in 17 feet of water and marks the south end of Horseshoe reef, lying between Middle reef and Buffalo.

It also marks the east side of the entrance to the Emerald channel.

Emerald channel.—A red can buoy is moored in 14 feet of water and marks the north end of the Middle reef and the south side of the northern entrance to Emerald channel.

Middle reef.—A black spar buoy is moored in 13 feet of water and marks the west point of Middle reef. Shoal water makes out from the Canadian shore opposite for more than one-third the way across, leaving a channel about ⅓ mile wide.

Bird Island reef.—A black spar buoy is moored in 14 feet of water and marks the western point of a reef making out from Black Rock Harbor pier, near its upper end. There is from 4 to 9 feet of water between the buoy and the pier; 17 feet in the channel between this and the buoy opposite.

Limekiln reef.—A red nun buoy is moored in 14 feet of water, 700 yards from the Canadian shore and nearly opposite Bird Island Reef buoy. It marks the eastern point of a reef with 8 to 10 feet of water on it. The range from this buoy to the west shore at the head of Narrows marks the west side of the channel.

Southeast shoal.—A black spar buoy is moored in 13 feet of water, about 100 yards SE. of the line of the Niagara River range lights, and shows the limit of the channel above the line.

Fort Erie point.—A red nun buoy is moored in 16 feet of water on the Canadian side of the river, and shows the width of the navigable channel west of the Buffalo Waterworks crib.

Buoy.—A red nun buoy (Fort Erie Point buoy) is moored in 19 feet of water, 1½ (1¾) miles N. by W. ½ W. of Buffalo Breakwater light.

LIGHTS.

Buffalo.—On the south pier, 342 feet from the outer end, from an octagonal gray tower, is shown, 74 feet above the lake level, a fixed white light visible 14⅓ (16½) miles.

Buffalo breakwater.—On a crib behind the north end of the break-

water, from a square white structure, is shown, 41½ feet above the lake level, a fixed red light visible 11¼ (13) miles.

Fog signal.—On the same crib is a brown fog-signal house alongside the lighthouse. The fog signal is a 10-inch steam whistle, which sounds as follows: Blast three seconds, silent interval fifty-seven seconds. If the whistle becomes disabled a bell is struck by machinery, a treble blow every thirty seconds.

Horseshoe reef.—In 6 feet of water on Horseshoe reef (south end of Middle reef), from a square white beacon on a masonry pier, is shown, 44½ feet above the lake level, a fixed white light varied by a white flash every ninety seconds. The light is visible 12⅛ (14) miles.

NOTE.—The Buffalo Waterworks Inlet pier, on the east side of the channel at the head of the "Narrows" of the Niagara river, is marked at night by a red light 22 feet above the water. One and a half miles below the Inlet pier the river is spanned by the International Railway bridge, the draw of which is marked at night by a stationary red light on each end of the drawpiers, low down on the free end of each protection pier, and on each side of the pivot pier, where it is crossed by the axis of the bridge. Three square lanterns, each 15 feet above the top of the drawspan, mark its ends and middle, and show red up and down stream when the draw is closed; but when the draw is open the lanterns show three green lights in line up and down stream, with the stationary low red lights making the width of the openings.

NIAGARA RIVER RANGE.

Front.—On the berm bank of the Erie canal, nearly abreast of the waterworks pier, from a square, white, pyramidal, open-framework structure, upper part inclosed, is shown, 54½ feet above the lake level, a fixed white light.

Rear.—At 1,200 feet NNE. § E. (N. 30° E.) from the front light, from a brown, triangular, skeleton pyramid, with a small house, 15 feet above the ground, surmounted by a circular gridiron day mark of slats, alternately black and white, is shown, 102 feet above the lake level, a fixed white light.

These lights in line lead through the shoals at the entrance of the river in the deepest water.

Caution.—Southwest gales raise the water in Buffalo harbor from 3 to 6 feet, and gales from the opposite direction lower it as much.

Life-saving station.—A life-saving station adjoins Buffalo lighthouse.

Current.—Inside the breakwater the current sets along the shore to the northward 2 miles per hour.

Directions.—Vessels should run in with the Buffalo Breakwater light bearing ENE. (N. 68° E.); the north end of the breakwater may be rounded close-to. Then head in for the piers of Buffalo creek,

allowing for the northerly current, or round-to in the outer harbor behind the breakwater.

Emerald channel lies between Middle reef on the west, Bird Island reef on the north, and Horseshoe reef on the east. The channel should only be attempted by light-draft vessels. The current sets strongly across it.

Niagara river is the natural outlet from lake Erie to lake Ontario. Its width north of the waterworks crib is 1,900 feet, and its greatest depth 48 feet. At this point the normal current is 5½ miles an hour, the extreme variation in the level of the river when uninfluenced by the wind being but 2 feet. During SW. gales the water rises as much as 4 feet in a few hours, and at such times the current attains a velocity of 12 miles an hour.

Two miles north of the International Railway bridge the river is divided into two arms, Tonawanda channel to the right and Chippewa channel to the left. Beyond Grand island the river descends to the Falls. Chippewa is just at the junction of the two arms on the Canadian side, a little beyond Navy island.

The Horseshoe reef channel has a depth of 18 feet for a width of 400 feet at mean lake level (January, 1896).

When passing this reef the ranges should be followed as far as the red can buoy *only*. From this point vessels should head to the west of the inlet pier or waterworks crib and pass that between 300 and 500 feet distant, keeping to the westward; if they are closer than that, they might strike a shoal, with 15½ feet on it, some hundred yards or so below the crib.

When opposite the ferry landing on the Canadian shore, but not before reaching this point, they should head for the upper buoy of the bridge channel.

In going down Strawberry channel, the best way will be found about 50 feet from the three black spar buoys. The last rock in the channel is now being removed, and it is being deepened.

Black Rock harbor is a canal 3 (3½) miles long and from 100 to 800 feet wide, formed along the river from Buffalo to Square island, and a pier extending from its lake end. The canal is used only by light-draft vessels to avoid the strong current of the Narrows. Seven feet can be carried through. There are no dangers.

Chippewa channel is 8⅔ (10) miles long, and from 650 to 1,150 yards broad, except at Navy island, where it is contracted to 450 yards. There is a good channel on either side of Navy island. Using the channel to the right, keep the Navy Island shore aboard to avoid the shoal extending from the NW. point of Grand island. Both shores of Chippewa channel are bold, and there are the following unmarked dangers:

A rock a few feet under water lies 250 feet from the Canadian shore

with the SE. point of Grand island bearing N. ¼ E. (N. 3° E.), distant 850 yards.

A shoal makes out one-fourth the way across the river from the point of the Canadian shore, just below Beaver island.

A reef, 3 feet under water and 400 yards long, lies 300 yards from the SW. shore of Grand island nearly opposite Black creek.

This channel is rarely used except by excursion steamers. The current is from 3 to 4 miles per hour.

Tonawanda channel lies on the east side of Grand, Strawberry, and Frog islands. Length, 7 (8) miles from the point of Strawberry island to Tonawanda island; its breadth is from 350 to 1,000 yards. It is not safe to attempt to carry more than 12 feet between Grand and Tonawanda islands. The best water is on the Grand island side. It is contemplated dredging a channel 18 feet deep from lake Erie to the north end of Tonawanda harbor. The current is from 3 to 5 miles per hour, depending on the width of the channel.

Buoys.—Red and black buoys mark parts of the channel, and there is a red and black horizontally striped spar buoy on Iron Works shoal off Tonawanda. Strangers should always employ a pilot.

Tonawanda to Niagara falls.—In the American channel from Tonawanda to Schlosser docks vessels of 12 feet draft can navigate with the aid of a pilot. The channel at the foot of Buckhorn island is marked by spar buoys Nos. 2 (red), 1 (black), and 3 (black). The buoys are placed in 13 feet of water. The harbor inside Connors island and opposite Schlosser docks is being improved; this harbor is 500 feet wide and nearly ½ mile long. The dredged channel leading to northward of Connors island is marked by spar buoys Nos. 5 (black), 4 (red), 7 (black), 6 (red), and 8 (red). No. 5 buoy is placed in 14½ feet of water; Nos. 4, 7, 6, and 8 were placed in 13 feet of water.

The current in the river abreast Connors Island harbor is 1⅝ miles per hour.

There are ten spar buoys (private) placed to mark bars and shoals near Niagara falls.

The captains of the tugs are the only pilots.

ERIE CANAL.

The Erie canal connects lake Erie with the Hudson river at Troy and Albany, and with lake Ontario at Oswego. Distance to Albany by canal is 351 statute miles, 7-foot depth, 72 locks, length of locks 110 feet.

A description of the Canadian shore of lake Erie will now be given (p. 173).

CANADIAN COAST OF LAKE ERIE.

ONTARIO.

Table of directions and distances between lightstations on the north and south shores of the lakes (the outer pier lights are taken).

Stations.	Directions.	Nautical miles.	Statute miles.
Pelée spit to Cedar point, Sandusky	S. 19° W.	24½	28 3/10
Black river	S. 30½° E	28	32½
Cleveland	S. 58° E	41	47½
Fairport	S. 83° E.	55	63½
Ashtabula	N. 89° E.	76	87½
Presque Isle, Erie	N. 81° E.	108	124½
Dunkirk	N. 75½° E.	145	167
Rondeau harbor to Cedar point, Sandusky	S. 36¾° W.	57	65¾
Black river	S. 14¼° W.	48½	55½
Cleveland	S. 11° E.	45¾	52¾
Fairport	S. 43¾° E.	41	47½
Ashtabula	S. 67½° E.	54	62 3/10
Presque Isle, Erie	S. 86° E.	80	92 1/10
Port Stanley to Cedar point, Sandusky	S. 42½° W.	95¾	110½
Black river	S. 31° W.	83	95 6/10
Cleveland	S. 17½° W.	72¾	83¾
Fairport	S. 2¾° W.	54	62 1/10
Ashtabula	S. 22½° E.	49½	56 6/10
Presque Isle, Erie	S. 59° E.	57½	66 1/10
Long point to Cedar point, Sandusky	S. 61½° W.	133	153 1/10
Black river	S. 55½° W.	114 4/10	131¾
Cleveland	S. 49½° W.	96 4/10	111
Fairport	S. 48½° W.	71⅞	82½
Ashtabula	S. 40½° W.	51	58¾
Presque Isle, Erie	S. 5½° W	23½	27
Dunkirk	S. 83½° E.	31½	36
Port Dover to Dunkirk	S. 64½° E.	41⅞	48
Port Maitland to Presque Isle, Erie	S. 29½° W.	47½	54⅜
Dunkirk	S. 24½° E.	23 8/10	27½
Port Colborne to Fairport	S. 53½° W.	111 6/10	128½
Ashtabula	S. 49½° W.	89½	102¾
Presque Isle, Erie	S. 41½° W.	56 9/10	65½
Dunkirk	S. 11° W.	23	26½

NORTH SHORE.

Coast.—From Bar point the coast trends about 8⅘ (10¼) miles SE. by E. to Little point, at Colchester, and forms the NE. entrance shore of the Detroit river. Leaving the river, shoal water is found some distance from the shore, the immediate entrance to the river being shoal, except in the channel. As Colchester is approached, the shoals close in on the shore and at Colchester extend only ⅛ mile off.

Grecian shoals.—Several shoals, least water 12 feet, lie about a mile off Colchester pier, with deep water between the shoals and shore.

Colchester reef and light. See page 151.

Coast.—At Little point the coast line changes direction to about ENE. for 9⅛ (10¾) miles to Kingsville. Shoals extend ⅛ mile from shore, widening out to over ½ mile before reaching Kingsville harbor.

Kingsville harbor is formed by two converging piers, extending about (east pier) SE. and (west pier) S. by E. into the lake. Width between outer ends of piers 150 feet; about 8 feet can be carried in, if the east pier is kept aboard.

KINGSVILLE RANGE LIGHTS.

Front.—On the outer end of the east breakwater pier, from a lantern on a pole, is shown, 27 feet above the lake level, a fixed red light, visible 5 (5¾) miles.

Rear.—On the top of a bank at the head of the east pier, 1,060 feet N. by W. (N. 11° W.) of the front light, from a white, square lighthouse, lantern red, is shown, 55 feet above the lake level, a fixed white light, visible 12 (13 8/10) miles.

These lights, in line N. by W. (N. 11° W.), lead to the entrance of Kingsville harbor. Leave the red light to starboard in entering.

Coast.—Leamington lighthouse is 6 (7) miles east of Kingsville lighthouse, with Ruthven dock about midway between. After leaving Kingsville, the shore can be approached to ½ mile.

Leamington light.—On the shore near the pier, from a white square tower, is shown, 48 feet above the lake level, a fixed white light, visible 12 (13 8/10) miles.

Shoal.—South of the light and on the east side of the pier is a shoal running out about 1,200 feet, with 4 feet over it.

Coast.—At Leamington the coast line changes direction to the southward, and so continues 8⅜ (10) miles to the south end of pointe Pelée. This whole stretch is steep-to, the 3-fathom line following the coast about 1,000 feet off.

Pointe Pelée, a narrow sharp point, extends southward into the lake for a distance of about 8⅜ (10) miles.

Excellent anchorage in 5 fathoms, mud, may be had behind the point, with shelter from easterly and northeasterly winds. The eastern side of the point also affords anchorage in 5 fathoms, with shelter from westerly and northwesterly winds. Shoals extend from this side of the point ⅓ mile.

Pointe Pelée spit extends south from the point 1⅞ (2⅛) miles. It curves to the eastward toward its southern part and then to the westward, thus forming a hook. The northern part of the spit is ½ mile broad, with but 2 feet water on it one mile from the point. Near the south end of the spit the Dummy has only one foot over it. Eastward of the Dummy about 1¾ (2) miles are several shoal spots, least water 15 feet, with a clear channel between, but this channel should not be attempted. Pelée Spit lighthouse, bearing NW. by W. (N. 56° W.), clears these shoals to the southward.

Wrecks.—The wreck of the *Wind and Wave* lies in 30 feet water nearly 1 3/10 (1½) miles NE. by E. ½ E. (N. 62° E.) from Pointe Pelée light.

The wreck of the *Walter H. Oades* lies in 17 feet water 1 (1¼) mile ESE. (S. 68° E.) from the same light.

The wreck of the *David Vance* lies in 40 feet water 1 9/16 (1½) miles SW. by W. (S. 56° W.) of the light. Soundings of 19 feet have been obtained over this wreck and, as it lies almost in the track of passing vessels, great caution should be observed when in this locality.

The wreck of the *Little Wissahickon* lies 25 (28⅝) miles S. ¼ W. (S. 3° W.) from Rondeau piers, and 30 (34½) miles E. ⅝ N. (N. 86° E.) from Pointe Pelée light. The schooner's spars project about 10 feet above water. The wreck lies a little southward of the regular course between Buffalo and Pointe Pelée.

Southeast shoal.—At 2 9/16 (3⅛) miles SE. ⅝ S. (S. 41° E.) from the Dummy light is the center of a large shoal, with a least depth of 13 feet (at lowest lake level). From this spot, as a center, shoal water extends in all directions for nearly ¾ mile. Between Southeast shoal and the Dummy are several 15 and 18 foot spots, and it is not safe for vessels to pass north of the shoal.

Grubb reef consists of several 12 and 16 foot rocky patches, lying from 1¾ (2) to 2 5/16 (3) miles WNW. of Pelée Spit lighthouse, with deep water between. The reef has extended to the eastward for a mile, with a least depth of 16 feet. This lighthouse, bearing east, leads well clear of the shoals to the southward.

Rocky shoal.—About midway between Grubb reef and the Middle ground is a rocky shoal ⅓ mile in diameter, within the 5-fathom line, with a least depth of 17 feet.

Pelée Spit (the Dummy) light.—On a caisson, about 1¾ (2) miles south from the extreme end of pointe Pelée, from a white, octagonal lighthouse on a steel-faced pier, is shown, 76 feet above the lake level, a white light, revolving every one and a half minutes, and visible 15 (17¼) miles.

Fog signal.—A steam horn sounds blasts of seven seconds' duration, with silent intervals of forty-five seconds.

Coast.—The east coast of pointe Pelée trends north 10 (11½) miles to Muddy creek and Two creeks. It then changes direction to the NE. by E. ½ E. for 26½ (30½) miles to Rondeau harbor.

Rondeau harbor is a small natural harbor suitable for very light-draft vessels. The entrance is protected by breakwaters and piers, but inside the harbor is quite shallow. The eastern side of the harbor is protected by Pointe aux Pins.

Current.—SE. gales raise the water considerably in this harbor. With SW. gales the waters run out in a very strong current, and at such times it is dangerous for vessels to be in the harbor.

RANGE LIGHTS.

Front.—On a crib-work block on the outer end of the east pier, from a white, square, open framework, is shown, 34 feet above the lake level, a fixed white light, visible 11 (12⅜) miles. This light is visible only over a small arc on each side of the alignment.

Rear.—At 780 yards N. by E. ⅜ E. (N. 15° E.) from the front light is shown, 70 feet above the lake level, a red and white light alternating every one and a half minutes. The light is visible 14 (16⅛) miles.

The alignment of these lights leads to the entrance, and the lights must be left to starboard on entering.

Coast.—The west point of Long Point island is ENE. ½ E. 66 (76) miles from Pointe aux Pins, the coast line between first trending NE. to Port Stanley, and then E. by S. forms an open bight with Port Stanley at its head. Many rivers and creeks empty into the lake along this stretch of the coast.

Port Stanley light.—On the west pierhead, from a white square lighthouse, 42 feet above the lake level, is shown a fixed white light, visible 11 (12⅜) miles.

Life-saving station in the harbor at Port Stanley.

Port Burwell.—A bar has formed across the mouth of the harbor, which has shoaled the water to 8 feet.

Port Bruce.—A fixed white light is shown on a pole at Port Bruce. This light is a private light, and not under the control of the marine department of Canada.

Port Burwell light.—Three hundred and thirty-three yards inshore, from an octagonal lighthouse, 96 feet above the lake level, is shown a fixed white light, visible 15 (17¼) miles.

Long Point island, formerly Long point, is a long narrow island projecting eastward nearly 17⅓ (20) miles from the main shore. It is over 1¾ (2) miles wide at Bluff point, the northeastern point of the island, and from Bluff point tapers to its eastern sharp extremity, Long point. At Pottohawk point, the NW. point, it is 2⅝ (3) miles wide and then tapers to the west end of the island, leaving a small bight partially filled with shoals between the NW. and NE. points. All the southern shore can be approached to ¾ mile, but from Long point west, on the north shore, the shoals gradually widen out until Bluff point is reached, where they extend northeasterly for 2⅝ (3) miles, leaving a little clear water between the outer end of the spit and the shoals which border the island. At Pottohawk point the shoals again approach the shore, and between this point and the mainland to the north is the eastern entrance to Inner bay, protected on the NW. by the mainland and on the SE. by Long Point island. The southern entrance to Inner bay is between the island and the mainland, but it is narrow, and is reported as having silted up. The bay is fit only for very small craft. Port Rowan is on its western shore. The deepest water in lake Erie is found south and east of Long point.

Life-saving station at Port Rowan in Inner bay.

LIGHTS.

West end of Long point.—On the east side of the new channel, from a square white tower, dwelling attached, is shown, 52 feet above the lake level, a red light, revolving every minute. The light is visible from all points seaward a distance of 12 (13⅞) miles.

When a lifeboat is required at this station the light is obscured toward Port Rowan.

Long point.—On the eastern extremity, from an octagonal lighthouse, 65 feet above the lake level, is shown a white light, revolving every minute, visible 13 (15) miles.

Fog signal.—The fog-signal building, white, is 200 yards south of the light. The signal, a steam horn, sounds blasts of seven seconds' duration, with silent intervals of thirty seconds.

Outer bay of Long point.—North of Long point, between the island and the main shore, Outer bay is 14¾ (17) miles wide and, from this line, 13 (15) miles deep to its western shore. The bay affords excellent anchorage, and is protected from all winds from south to north by way of west.

Port Dover is on the NW. shore of Outer bay. The harbor is at the mouth of the Lynn river, having two parallel piers, each about 1,000 feet long. Depth of water at end of pier 12 feet; inside the harbor 8 feet. There are no pilots.

Reefs.—A reef 1¾ (2) miles long, with 3 feet of water over it, lies about one mile off shore.

A reef lies one mile SE. of Port Dover lighthouse and is about ¾ mile from shore. Between the reef and the shore there are, in places, from 12 to 14 feet, but there is no safe passage for vessels on account of bowlders. Outside of the reef, 100 yards, the water is from 15 to 25 feet deep.

Port charges.—Vessels over 100 tons, 50 cents per day; under 100 tons, 25 cents per day.

Light.—On the west pier, from a white hexagonal lighthouse, 20 feet above the lake level, is shown a fixed white light, visible 8 (9¼) miles.

Nanticoke shoal, with 7 feet water, lies 4⅘ (5 9/10) miles S. 66° W. from Peacock point and 11¼ (13) miles N. 3° W. from the east end of Long point. The spot is a small rocky ledge and under a depth of 18 feet is ½ mile long NW. and SE. by ¼ mile wide, the shoalest spot being in the middle.

When in this vicinity, vessels should not shoal to less than 8 fathoms.

Coast.—Port Dover to Port Maitland: The coast trends easterly for 27¾ (32) miles, with several small projecting points.

Tecumseh shoal.—To the westward of Grand River bluff and (reported as lying) from 3 to 8 statute miles off shore is Tecumseh shoal, which extends westward and parallel with the shore for several miles. At low water rocks on the shoal uncover. This shoal is charted about 3 miles off shore and the same distance in extent east and west; it is probable that it is of larger size and farther off shore. When in this locality Port Maitland light should be kept well open of Hydes point, the first point west of Port Maitland, to clear the east end of Tecumseh shoal.

Port Maitland is on the Grand river, at the head of a small bight, to the eastward of Grand River bluff.

Light.—On the west pier at Grand River entrance, from a white open frame, 51 feet above the lake level, is shown a fixed white light, visible 10 (11½) miles.

Mohawk bay, a small dip in the coast line, is just eastward of Port Maitland, and between Barbed and Selkirk points. Barbed point is surrounded by a rocky reef which extends to the southward nearly ¼ mile.

Mohawk island, about 400 yards in diameter, lies in the center of the bay and outside the line joining the points. It is surrounded by rocks, shoals extending nearly a mile southeasterly, on which are many rocks. This shoal has a breadth of over ½ mile.

Anchorage.—There is deep water, clay bottom, midway between Mohawk island and Barbed point, which affords anchorage in winds from west to east by way of north.

Mohawk Island light.—On the island, from a white circular light-house, is shown, 64 feet above the lake level, a white revolving light, showing three flashes at intervals of thirty seconds, followed by an eclipse of seventy-five seconds. A complete revolution is made in two and one-fourth minutes. The light is visible 10 (11½) miles.

Coast.—Between Selkirk point and Morgan point, 6 (7) miles to the eastward, is Moulton bay, open to the southward. At 11 (12⅝) miles E. by S. from Morgan point is Abino point. The coast between, projecting in small points, has several bights open to the southward. From all these points shoals extend off some distance. Sugarloaf point, the west point of Gravel bay, on which is Port Colborne, is surrounded with shoals, and the east point of this bay has shoals extending off a mile, the bay being filled with shoals. Windmill point is 4⅛ (5) miles NE. of Abino point, with two bights filled with shoals between. From Windmill point to the mouth of the Niagara river shoals line the coast, and Windmill point should be given a berth of $1\frac{3}{10}$ (1½) miles. The coast may be approached somewhat nearer as the river entrance is neared.

Waverly shoal lies off this portion of the coast, the NE. end lying 2 ($2\frac{3}{10}$) miles SW. by W. ⅜ W. (S. 63° W.) from the light on the Buffalo breakwater. The shoal is 100 feet wide and extends 700 yards SW. and NE., least water 12 feet, 400 feet SW. of the buoy. There is a 16-foot spot a little eastward of the north end of the shoal, and an 18-foot spot in line with the buoy and breakwater light, and ¾ mile from the latter.

Buoy.—A red and black horizontally striped can buoy is moored in 13 feet of water near the NE. end of the shoal.

Port Colborne is at the entrance of the Welland canal. The entrance to the harbor has been improved by piers.

Beacon.—A vertically striped red and white beacon, surmounted by a globe, stands on the outermost crib of the east pier.

Main light.—On the head of the west pier from a white octagonal tower, on a brown cylindrical base, surmounted by a red lantern, is shown, 70 feet above the lake level, a fixed white light, visible 14 (16⅛) miles.

Crib light.—On a crib, east side of the entrance, 2,030 feet N. by E. ¼ E. (N. 12° E.) of the main light, is shown, 35 feet above the lake level, a fixed red light visible 8 (9¼) miles.

Fog signal.—At the main lightstation a fog horn sounds blasts of eleven seconds every one and a half minutes.

Shoal.—A bar runs across from the east to the west pier.

Sixteen feet may be carried to within 100 feet of the south end of the east unbroken pier, but inside scant 15 feet will be found.

There is a sand spit making out southwesterly from the south end of this pier (continuous part), and 100 feet distant there is but 13 feet at the edge of the track.

The deepest water track is very narrow, and a vessel only her own width out of it will, in all probability, find one foot less water.

In the above remarks it is assumed that there are 14 feet on the dock sill, with a liability of a change of one foot either way.

Directions.—The alignment of the lights N. by E. ¼ E. (N. 12° E.) gives the deepest water entering the canal, and clear of Sugarloaf reef. The main light must be left to port and the crib light to starboard in entering. The main light is visible from all points seaward; the crib light is visible in the line of range and into the harbor.

Welland canal.—The canal flanks the Niagara river, and is 26¾ statute miles in length from Port Colborne to Port Dalhousie. Its dimensions are as follows: Number of lift locks, 25 (270 by 45 feet); total rise of lockage, 326¾ feet; depth of water on the sills, 14 feet. Thirteen feet can be carried through at present. There are two pairs of guard gates and one guard lock.

CHAPTER X.

LAKE ONTARIO.

Lake Ontario is the eastern and smallest of the Great Lakes. The length of the lake between Sacketts Harbor and Burlington Bay lights is 165 (190) miles, and its greatest breadth $46\frac{8}{10}$ (54) miles; its maximum depth 738 feet, and its elevation above the sea 246.61 feet.

Its basin drains 29,760 square miles, including the lake surface of 7,240 square miles.

By reason of its greater depth the surface of lake Ontario is less disturbed by storms than lake Erie. It is much less obstructed by ice, the lake never freezing except near the shore, and navigation is rarely interrupted.

The chief tributaries are the Niagara, Genesee, and Oswego rivers on the south shore and the Trent on the north shore.

The south shore of the lake from the Niagara river east to the St. Lawrence is in the State of New York.

All of the north and west shores, and the south shore from the Niagara river west, is in the Province of Ontario, Canada.

NAVIGATION.

The two great evils to navigation are fog and snow.

There are no tides and but light currents for the master to contend with on the lake, and as these are the most uncertain of all elements for the navigator to calculate and allow for, it reduces very much the percentage of danger in lake navigation; hence the safe navigation of the lake is confined to a correct compass, with a knowledge and frequent use on the part of the master of the azimuth tables, the precaution to take cross-bearings of prominent points, and from them plotting the position frequently on the chart; also the familiar use of the chart in laying courses and correcting the same for variation and deviation.

DANGERS.

With the exception of the shoals among the islands at the NE. end, lake Ontario is remarkably free from outlying dangers. Off the mouth of the Niagara river are several offlying shoals, known as the Niagara bar. They are not only in the course of vessels entering and leaving Niagara river, but also are a menace to all vessels bound to or from the Welland canal and the lower lake ports. On the west coast of the lake, south of Port Credit, is an offlying shoal, the position of which is not well determined. Off Shoal bay and Prince Edward island, on the

north coast, are several offlying shoals. There are several shoals SE. of False Duck lighthouse. From Calf island a spit extends SW. for 1½ (1¾) miles, with only 10 feet on it; Charity shoal, with 5 feet over it, lies 2 9/10 (3) miles SE. of Pigeon island. Big Bar shoal, south of Amherst island, and an extensive shoal, with 4 feet over it, lying WSW. from Snake Island light, are the principal shoals in the NE. end of the lake.

ROUTES.

Welland canal to Cape Vincent.—From 3½ (4) miles north of Port Dalhousie outer light steer ENE. ¼ E. (N. 70°E) for 9½ (11) miles, when Fort Niagara light should bear South; change course to ENE. ⅜ E. (N. 72° E.) for 118 (136) miles, when Galloup Island lighthouse should bear abeam, distant 2 (2¼) miles; here change course to N. by E. ½ E. (N. 17° E.) for 11½ (13¼) miles, which should take a vessel ¾ mile west of Tibbets Point lighthouse; from here to the anchorage off Cape Vincent keep about ⅛ mile offshore.

Welland canal to Kingston.—From 3½ (4) miles north of Port Dalhousie outer light ENE. ¼ E. (N. 70° E.) for 112 (129) miles should take a vessel 3½ (4) miles south of False Duck light; continue this course for 5 (5¾) miles, when False Duck light should bear WNW. (N. 68° W.), and a vessel will clear to the eastward of Harris shoal; at this point change course to N. by E. ⅜ E. (N. 18° E.) for 17¾ (20½) miles, when Snake Island light should be abeam; this course passes within a mile of Nine-mile (Gage) Point lighthouse and between the two unmarked shoals north of it. Do not pass east of a line joining Nine-mile (Gage) Point and Pigeon Island lights until close up to Snake Island light. Continue N. by E. ⅜ E. (N. 18° E.) from abeam of Snake Island light for ⅞ mile, or until this light bears SSE. ⅜ E. (S. 30° E.) and Center Brother Island light bears W. ¼ N. (N. 87° W.), when change course to ENE. ¼ E. (N. 70° E.) and run along the shore, keeping not more than ¼ mile off to avoid the two 12-foot patches off Kingston, which should be kept to starboard if unmarked.

Vessels of 15 feet draft may pass between Simcoe and Snake islands. The channel is buoyed on the east side of Snake island, and by keeping the Snake Island buoy close aboard, or leaving two-thirds of the passage to the eastward, you can, by steering to the northward slowly as you pass Snake island, keep good water; but you can not, with a vessel drawing over 11 feet, steer straight for Kingston when abreast of Snake island.

Caution.—Unless a vessel is well satisfied of her position, the above directions should be used with caution, as the two unmarked shoals SW. of Snake island lie close to the track.

UNITED STATES COAST OF LAKE ONTARIO.

The United States coast of lake Ontario comprises all the shore of the lake from the Niagara river eastward to the town of Cape Vincent.

In the following description the Canadian shore, from the Welland

canal to the Niagara river, will also be considered; as also the coast of Wolfe, or Long island, from opposite Cape Vincent to Browns point.

Port Dalhousie, at the Ontario entrance to the Welland canal, has two piers 200 feet apart and 2,000 feet in length, extending about north into the lake. Fourteen feet can be carried between the piers and into the canal, but 13 feet only are allowed at present.

Front light.—About 26 feet from the outer end of the east pier a fixed white light is shown, 42 feet above the lake level, from a white square tower. It is visible 11 (12⅔) miles.

Main light.—On the same pier, 298 feet S. ¼ E. (S. 3° E.) from the outer light, is a white light, revolving every minute. It is shown from a white circular tower, 55 feet above the lake level, and is visible 12 (13¾) miles. This light shows from the east to west through south.

Fog signal.—At the Front light station is a fog bell which is rung by hand in answer to signals from passing vessels.

Shoal.—There is an 18-foot detached shoal ¼ mile NNE. ¾ E. of the outer pier light.

Coast.—Welland canal to the Niagara river: The coast trends 6¾ (7¾) miles NE. by E. ½ E., then changes direction to the eastward for 2$\frac{9}{10}$ (2½) miles to fort Massassauga, at the mouth of the Niagara river. Shoals border this coast and extend off shore in places ¾ mile. Off the mouth of the Niagara river are several offlying patches.

Shoals.—At 2$\frac{2}{10}$ (2½) miles W. by N. of Fort Niagara light is the south end of a detached shoal ⅝ mile off shore, with 16 feet least water, and extending north and south ¾ mile. At 2$\frac{6}{10}$ (3) miles NNW. from the light is the center of a shoal, 13 feet least water, which extends east and west ¾ mile. Between these two shoals are detached spots with 18, 11, 15 and 16 feet over them. These shoals are known as the Niagara bar, and are a menace to all vessels bound in or out the river, as well as to vessels bound to or from the Welland canal and lower lake ports. Not being properly located, they are the cause of many disasters.

Bell buoy.—A bell buoy is moored at the opening of navigation on these shoals, on the Canadian side of the channel, by the Niagara Navigation Company. Its position is not to be entirely relied upon.

Buoy.—On a rocky spit, extending a mile North and NW. from Fort Niagara, is a black spar buoy. It is moored in 14 feet, ⅔ mile from shore and ¼ mile inside the 3-fathom curve.

The water shoals gradually inside the buoy to a depth of 6 feet close to the shore. Abreast the outer face of Fort Niagara a spur of the reef projects a little beyond the range of the buoy and the outer corner of Fort Niagara wharf.

Niagara river.—This river is navigable for 6 (7) miles to Lewiston on the United States shore, and Queenstown on the Canadian shore. Its width is about 500 yards; depth from 4 to 12 fathoms, with muddy or rocky bottom. The banks are bold and high, and there are no dangers.

Youngstown and Niagara are just within the river mouth on the United States and Canadian shores, respectively.

Current.—At Lewiston the current is about 4 miles an hour, decreasing to 3 miles at the mouth of the river and to ¼ mile about 2 miles from shore The strength of the river current and the depth of water in the mouth of the river and at the west end of the lake are materially affected by winds blowing up or down the lake. The former wind decreases the current and raises the water, and the latter produces the opposite effect. The difference in level is sometimes as much as 3 feet.

Fort Niagara light.—On the high east bank of the river and ¼ mile within its mouth, from a gray, octagonal tower, 79½ feet above the lake level, is shown a fixed white light, visible 14½ (16¾) miles. It is obscured when bearing about SE., through an arc of a few degrees, by tall trees near the shore.

Life-saving station at Fort Niagara.

Directions.—Approach the shore with Fort Niagara light bearing south. When 3½ (4) miles north of the light bring Fort Massassauga ahead S. by W. (S. 11° W.) and stand in for it. When ¾ mile from the fort keep off a little to the westward to clear the edge of the spit extending from Fort Niagara, and when Fort Niagara light bears SE. ¾ E. (S. 53° E.) stand in for it, passing SW. of the black spar buoy, and shape a mid-channel course up the river.

Coast.—Niagara river to Wilson harbor: The coast trends ENE. ½ E. for 10 4/10 (12) miles. There is a detached 16-foot spot 1 (1¼) mile NE. by N. of Fort Niagara, and the water is shoal ½ mile from the shore between these places.

Wilson is at the mouth of Twelve-mile creek. Wilson harbor entrance has been improved by two piers. There is only a depth of 9 feet in the channel at mean lake level.

Coast.—Wilson to Olcott: The coast continues in the same direction for 5¼ (6) miles and has the same characteristics.

Rock.—A rock is reported as lying about 1¾ (2) miles west of Olcott lightstation. It extends east and west ½ mile and is the same distance off shore. There is only 4 or 5 feet water on the rock (November, 1895).

Olcott is on Eighteen-mile creek. Olcott harbor has been improved by the building of piers and dredging; width between the piers, 200 feet; direction of piers, N. ⅝ W.

Channel.—Between the piers the channel is 180 feet wide, the limiting lines being 10 feet from the piers, and from the shore end of the piers it decreases to 98 feet in width at the Main Street bridge. Depth in the channel, 13 feet, measured from mean lake level. A sand bar is reported as forming about 60 feet from the piers, with about 6 or 7 feet over it (November, 1895).

Light.—On the west pier, 30 feet from the outer end, is a square pyramidal tower, brown below and white above, exhibiting a fixed white light 30½ feet above the lake level, and visible 10⅞ (12¼) miles.

Coast.—Olcott to Thirty-mile point: The coast continues nearly ENE. for 10½ (12) miles, and the shoals are somewhat nearer the shore.

Thirty-mile point, just westward of Golden Hill creek, is rounding and only a slight projection from the coast line, and here the coast changes direction to the east.

Light.—On the point, from a square gray tower rising from the north point of a dwelling, 71½ feet above the lake level, is shown a white light, flashing every ninety seconds, visible 14⅛ (16¼) miles.

Thirty-mile point to Oak Orchard harbor.—Oak Orchard light is 12⅞ (14¾) miles east of Thirty-mile Point light; the coast between can be approached to a mile with safety.

Oak Orchard harbor, on Oak Orchard creek, has been improved by the construction of two piers, 200 feet apart, extending to the 12-foot curve, and a shore protection to the east pier, 91 feet long. The channel has a depth of 13 feet at mean lake level for its whole width between the piers, excepting 10 feet along each pier. Direction of the piers, N. ⅜ E.

Light.—On the west pier, 27 feet from the outer end, from a square, pyramidal tower, brown below and white above, 29¾ feet above the lake level, is shown a fixed white light, visible 10⅜ (12¼) miles.

Caution.—The shore eastward of Oak Orchard harbor should not be followed on account of a reef extending 1¾ (2) miles ENE. from the lighthouse.

Directions.—Approaching from the eastward, do not bring the light to bear south of SW. until a mile offshore, when stand in with the lighthouse bearing South.

Coast.—From Oak Orchard harbor the coast trends east 9⅓ (10¾) miles to the Devils Nose, a prominent bluff 77 feet high. A rocky spit extends 2 (2¼) miles ENE. from Oak Orchard harbor, its outer edge being nowhere over ¾ mile from shore; shoals then follow the shore line, at an average distance of about ⅓ mile, until the Devils Nose is reached, where they extend out over ½ mile. At the Devils Nose the coast changes direction a little to the southward for 9½ (11) miles, when it bends again to the southward and trends 2⅓ (2¾) miles SE. by S. to Braddock point. Shoals line all this portion of the coast and in places extend off ¾ mile. At Braddock point the shore changes its character, becoming lower, and between this point and Charlotte harbor, 6 (7) miles SE., there are several bays and ponds, fronted by shoals, extending off shore over ½ mile.

Braddock Point light station.—A fixed white light shown from a black lantern surmounting an octagonal, pyramidal, red-brick tower attached to the west side of a two-story red-brick dwelling with black slated roof. The parapet and gallery of the tower are brown. The tower and dwelling are on ground about 7 feet above mean lake level and stand about 100 feet back from the shore line. The focal plane of the light is 92½ feet above mean lake level and the light is visible 15⅞

(17⅛) miles. The light illuminates 180° of the horizon and is visible from all points of approach from the lake, excepting from the eastward to the southward of the bearing W. by N.

A small one-story red building and a red-brick barn are located near the tower to the southward, and a red-brick oil house stands between the tower and lake.

Charlotte is at the mouth of the Genesee river. Charlotte harbor is the port of Rochester, which is 1¾ (2) miles above the head of the navigable part of the river. The entrance to the harbor has been improved by the building of piers and dredging.

Channel.—Dredging in the fall of 1894 and spring of 1895 made a 16-foot depth in the channel at extreme low water for a width of about 112 feet at the inner end, narrowing to about 90 feet at the outer end, midway between the piers. The material is all sand and silt.

LIGHTS.

Genesee light.—On the west pier, 30 feet from the outer end, a fixed red light, visible 10⅞ (12½) miles, is shown, 31½ feet above the lake level. The tower, square, pyramidal, is painted brown below and white above.

Charlotte Harbor light.—At the shore end of the west pier, 1,923 feet from the outer end, three lights (fixed red, fixed white, and fixed red, arranged vertically, with the white light in the middle) are shown 60 feet above the lake level from a square, white, pyramidal, skeleton structure.

Fog signal.—The fog-signal house, brown, is near the outer end of the west pier, immediately south of the lighthouse. The fog signal, a 6-inch steam whistle, sounds a blast of three seconds, followed by a silent interval of fifty-seven seconds. If the whistle is disabled a bell is struck by machinery every thirty seconds.

Life-saving station at east side of entrance to harbor.

Directions.—When in not less than 6 fathoms, or about a mile from shore, bring Genesee and Charlotte Harbor lights in line SW. by S. (S. 34° W.) and stand in.

Coast.—The coast from Charlotte trends 3 (3½) miles ESE. to Irondiquot bay, the entrance of which is entirely closed by shoals. The country around this bay is more elevated, being from 120 to 180 feet high. From the bay the coast trends 4¾ (5½) miles ENE. to Lyons point. Shoals extend North and NE. from this point ½ mile. Smoky point is 5¼ (6) miles east of Lyons point, the coast between being shoal ¼ mile offshore. From Smoky point the coast continues easterly 5⅜ (6½) miles to Pultneyville. At 2 2/10 (2½) miles west of Pultneyville a shoal spit extends ½ mile from shore, with 14 feet at its outer end.

Pultneyville.—Pultneyville harbor, at the mouth of Salmon creek, has been improved by the building of piers and by dredging, but it is only available for small craft.

Coast.—Pultneyville to Big Sodus bay: Fairbanks point, 1¾ (2) miles east of Pultneyville, is a slight projection on the coast and has shoal water extending off it for ½ mile. The entrance to Big Sodus bay is 7¼ (8⅛) miles from Fairbanks point, the coast between trending a little south of east. Shoals extend off ¾ mile from the shore bordering the bay.

Big Sodus bay.—The entrance to Big Sodus bay is between Sodus and Charles points and has been improved by dredging and by building piers. The bay, 5 (5¾) miles long, 2 (2¼) to 3 (3½) miles wide, is deep and landlocked, and midway between Oswego and the Genesee river.

Channel.—The channel, 120 to 150 feet wide, runs diagonally across the space between the piers, from about 50 feet from the outer end of the west pier to about 50 feet from the inner end of the east pier, upon a course about S. ¾ E. (S. 8° E.). The best depths in the lake and in the bay lie upon the prolongations of this channel line, upon which all dredging has been done since 1892 to 16 feet depth below extreme low water (or 18 feet 5 inches below mean lake level). The cut is not completed outside the pier end. Its governing depth is about 12½ feet below extreme low water (or 15 feet below mean lake level). The material is sand and gravel, with a few cobblestones along the east side. Inside the bay there is good anchorage.

LIGHTS.

Big Sodus bay.—On Sodus point a fixed white light, varied by a flash every two minutes, is shown 70 feet above the lake level, from a square tower with a dwelling attached. The light is visible 13⅞ (16) miles.

Big Sodus (outer).—On a crib, 30 feet from the outer end of the west pier, a fixed white light, 32½ feet above the lake level, is shown from a square pyramidal tower, brown below and white above. The light is visible 10⅞ (12½) miles.

Big Sodus (inner).—On the west pier, 1,530 feet S. ⅝ W. (S. 4° W.) from the outer light, a fixed red light, 24 feet above the lake level, is shown from a white, square, pyramidal tower, surmounted by a lantern with copper roof. The light is visible 7⅛ (8½) miles.

Directions.—The outer light may be approached on any bearing from ESE. to SW., but not inshore of these bearings. When about 2 (2¼) miles offshore bring the lights in line S. ⅝ W. (S. 4° W.) and stand in. The mid-channel course from the inner light in, past Sand point, is SE. ⅛ S. (S. 44° E.).

Coast.—Big Sodus bay to Little Sodus bay: Between these bays the coast is fringed with shoals which extend off in places ¾ mile. These bays are 12⅛ (14) miles apart, and at Big Sodus bay the coast changes direction to the northeastward. In this stretch several creeks empty into the lake. East and Port bays, their entrances closed by shoals, also lie along this stretch.

Little Sodus bay, on which is Fair Haven, is 2 (2¼) miles long north

and south and ⅝ mile wide. It is deep and landlocked and midway between Oswego and Great Sodus.

The entrance to the bay has been improved by dredging and by building piers, the object being to contract the entrance to the bay to a width of 250 feet, and to maintain a channel 200 feet wide and 16 feet deep at extreme low water.

Channel.—The channel lies about midway between the piers and parallel with them, 136 feet wide, 50 feet from the west pier and 65 feet from the east one. During the fall of 1895 the entrance was greatly improved by dredging a channel 136 feet wide, 15 feet deep below extreme low water (17 feet 5 inches below mean lake level), through the 12-foot shoal of hardpan and bowlders which has hitherto obstructed the entrance. This excavation was extended 380 feet outside the west pierhead, and vessels should keep on the prolongation of the channel line until well out in the lake and in the bay to avoid shoals on the sides. The governing depth is now 12½ feet below extreme low water (or 15 feet at mean lake level), because of a deposit of silt between the piers where there has been no dredging for many years. This will be removed, giving a 15-foot entrance at extreme low water (or 17 feet 5 inches at mean lake level). Inside the bay there is good anchorage.

LIGHTS.

Fair Haven (outer).—Twenty-eight feet from the outer end of the west pier at the entrance to the bay, a fixed white light, 31¼ feet above the lake level, is shown from a square pyramidal tower, brown below and white above. The light is visible 10⅞ (12½) miles.

Fog signal.—A bell struck by machinery, a double blow every twenty seconds.

Fair Haven (inner).—Near the inner end of the west pier a fixed white light, 20½ feet above the lake level, is shown from a white mast.

Directions.—Fair Haven outer light may be approached bearing between SSW. ½ W. (S. 28° W.) and E. by S. (S. 79° E.), but nothing inshore of these bearings. When about 2 (2¼) miles off the light, bring the range lights in line S. ⅝ E. (S. 7° E.) and stand in between the piers. The lights in line from within the bay serve also as a range for making the channel between the piers when leaving.

Coast.—Little Sodus bay to Oswego: From the bay the coast trends NE. by N. for 5¼ (6) miles to Nine-mile point; here it changes its direction and trends NE. by E. the same distance to the breakwater at Oswego.

Shoal.—At 3½ (4) miles SW. of Oswego Breakwater light a rocky shoal spit extends off shore ¾ mile, and 6 only feet near its onter end. Although not a serious menace to navigation, yet disabled craft have been driven on the shoal.

Currents in the vicinity of the shoal are generally very light and eastward toward the St. Lawrence.

Oswego, at the mouth of Oswego river, is the principal United States port on lake Ontario.

Improvements.—An outer harbor is formed by the west breakwater which, 6,033 feet long, incloses 100 acres outside the 9-foot curve of what was formerly the lake front. It starts from the main shore nearly a mile westward of the mouth of the river and extends eastward on a line generally parallel to the lake front and 1,200 feet from it, to a point opposite the entrance to the inner harbor. The shore arm is 916⅔ feet long, extending from the shore into the lake to the 18-foot depth. There is a break 140 feet wide in the lake arm near the shore arm; this break will be permanent. It has served as a convenient entrance for vessels, and it also improves the sanitary condition of the harbor.

There are also two inner piers, with shore arms, which protect the immediate entrance to Oswego river, the west pier also partially protecting the outer harbor.

The entrance to the outer (west) basin is exposed to the force of NE. gales, and, in strong winds from this direction, it is almost impossible for a sailing vessel to enter.

Depths.—January, 1896: The outer harbor has an available depth of 18 feet at extreme low water, this depth, with sand bottom, being at the entrance. The inner harbor has a 15-foot depth at extreme low water up to the Northwestern Elevator and to the coal trestles slip. The deep water now extends for the full width of the river up to a line 316 feet south from the north side of the elevator.

Lights.—Oswego.—Near the inner end of the west pier, 75 feet above the lake level, is a fixed white light, shown from an octagonal, pyramidal, gray tower, with an oil room attached. The light is visible 14⅓ (16½) miles.

Oswego breakwater.—On a crib inside the east angle of the breakwater, and 1,250 feet NW. by N. (N. 34° W.) from Oswego light, is a fixed red light, 39 feet above the lake level and visible 11½ (13¼) miles. It is shown from a brown, octagonal, pyramidal tower.

Fog signal.—At this station the fog signal is a bell, struck by machinery every twelve seconds.

Life-saving station at east side of entrance to harbor.

Directions.—From the northeastward Oswego light should not be brought to bear inshore of the bearing SSW. (S. 23° W.). When a mile offshore bring the two lights in line SE. by S. (S. 34° E.) and stand in for the entrance to the river, leaving the lights to starboard.

EAST SHORE OF LAKE ONTARIO.

Caution.—Compass bearings can not be closely relied upon at the eastern end of lake Ontario. In the neighborhood of the Main Duck islands it has been frequently observed that there is a great deviation of the compass, sometimes as great as a point at a time. This renders navigating very uncertain in thick or foggy weather. This deviation is due, most probably, to numerous superficial deposits of iron ore. An examination of the magnetic observations that have been made in the

Province of Ontario, Canada, shows that there are numerous localities in the region immediately above lake Ontario where there are considerable local irregularities. The dips at Kingston and Belleville, at the foot of lake Ontario, and at Prescott, on the St. Lawrence river, are among the most irregular recorded on the Magnetic Survey of Canada, and it is certain that both the compass and the dipping needle will be subject to notable and irregular local influences in the eastern portion of the lake. At Brockville, about 12 miles west of Prescott, and at Cornwall, about 46 miles east of that place, the anomaly disappears.

Coast.—From Oswego the coast trends 5¼ (6) miles NE. to the west end of a wide bluff point, the east end of which is Nine-mile point. At this point the coast bends to the southeastward for 1¾ (2) miles to Pleasant point, where it again changes direction to the eastward for 3¼ (3¾) miles to the mouth of Little Salmon river, where there is a life-saving station.

Texas is about a mile up this river. From here the coast continues easterly for a short distance, when it changes direction to almost north, and so continues for 17⅛ (20) miles to Stony creek, forming the eastern shore of the lake. There are many creeks and several closed ponds or bays along this stretch, but all are useless for navigation purposes.

Port Ontario on the Salmon river is 3⅞ (4½) miles NE. of Texas life-saving station (destroyed). There is another life-saving station 8⅜ (10) miles north of the Salmon river. South of Stony creek and ⅝ mile off-shore is Drowned island, surrounded by shoals and connected to the shore by a shoal spit.

Between Stony creek and Stony point are two small rocky bays, partially filled with shoals. From Texas to Stony point the shore is comparatively steep-to, rocky, and without a harbor.

Stony point is the eastern point of the bay at the NE. end of lake Ontario, which is partially closed by a chain of islands stretching WNW. from Stony point to South Bay point on the Canadian side.

Stony Point light.—A fixed white light, varied by a white flash every two minutes, is shown, 38 feet above the lake level, from a square gray tower attached to a dwelling. The light is visible 11½ (13¼) miles.

Stony island lies nearly 2 (2¼) miles from the mainland, north of Stony point, the channel between being deep and free of dangers. The island is narrow and extends 3½ (4) miles NE. and SW. with a greatest width of 1 (1¼) mile at its southern end, tapering to a narrow point at its NE. end. The island is almost divided by a lake extending NE. and SW. On the NW. side of Stony island lies Dutch John bay; it is ¾ mile wide at its entrance and ⅛ mile deep, has ample water and affords a snug anchorage and protection from south and east winds. The NW. point of the island is shoal ¼ mile off, the southern face for ½ mile, and the SW. point is prolonged SW. for 2 (2¼) miles by Calf island and Calf Island spit. The latter, narrow and rocky, extends 1 (1¼) mile from Calf island, and has 10 feet near its extremity. The rest of the island is steep-to.

Buoy.—A black nun buoy is moored in 15 feet near the end of Calf Island spit.

Little Galloup island lies about midway between Stony island and Galloup island, $2\frac{2}{10}$ ($2\frac{1}{2}$) miles to the westward. The island is $\frac{1}{3}$ mile long and half as broad. Shoals extend nearly $\frac{1}{4}$ mile NE. from the NE. end of the island, and $\frac{1}{2}$ mile SW., South, and SE., from the SW. end. A small islet lies on the NE. shoal.

Galloup island is $4\frac{1}{2}$ ($5\frac{1}{4}$) miles long and has an average breadth of about a mile. Shoals extend nearly $\frac{1}{2}$ mile from the NE. end and $\frac{3}{4}$ mile from the SW. end of the island, the main shore of the island being steep-to. Behind a rocky reef on the NE. end of the island is Gills harbor, suitable only for very small craft. The NW. end has a slight indentation known as North pond; $\frac{1}{2}$ mile off this part of the island is a 14-foot shoal, narrow and extending $\frac{5}{8}$ mile NE. and SW. The channel between Galloup and Stony islands, with the exception of the shoals surrounding Little Galloup, is deep, but should not be attempted.

Galloup Island light.—On the SW. end of Galloup island is a fixed white light shown $58\frac{1}{4}$ feet above the lake level, from a conical gray tower connected by covered way with dwelling. The light is visible 13 (15) miles.

Galloup Island shoal lies $1\frac{2}{10}$ ($1\frac{1}{2}$) miles NW. from the SW. end of Galloup island. It is 620 yards long and 300 yards wide, with least water (6 feet) near its NE. end. There is deep water between Galloup island and shoal. This shoal is much dreaded and has been the cause of several wrecks.

Buoy.—A black nun buoy is moored in 18 feet on the west side, and 100 yards from the southern end of this rocky shoal. Pass to the westward of this buoy.

Henderson bay.—From Stony point the coast trends North and NE., forming a low peninsula and protecting Henderson bay on the SW. The bay is $4\frac{3}{4}$ ($5\frac{1}{2}$) miles wide between Snow Shoe point and Horse island, and about 2 ($2\frac{1}{4}$) miles long, with ample water and good bottom for anchorage. The eastern end of the bay has shoals extending a mile off shore. The SW. end is steep-to, and here are Whites bay and Henderson harbor; on the latter is Port Henderson. Shoals and islands lie across the mouth of the bay, leaving two narrow channels; the eastern one is between Gull and Snake Island shoals on the one side and Horse island on the other. Shoals extend westward $\frac{3}{4}$ mile from Horse island. This passage is deep and should be used in entering the bay. The shoal extending NE. from Six Town point is known as Lime Barrel shoal and has only $3\frac{1}{2}$ feet on its shallowest part. It is not safe to enter Henderson bay except by daylight, because of the shoals, lowland, and the absence of lights and other marks.

NOTE.—The island designated on the chart as Gull is Snake, and Snake is Gull.

Black River bay is over a mile wide at its entrance and extends

4¾ (5½) miles NE., the shores of the bay contracting slightly as its head is approached. This bay has deep water and the shores are steep-to, except at its head (where the Black river empties), which is filled with flats; here the bay opens out to the SE., forming Muskalonge bay, which is very shoal. The town of Dexter is a mile within the mouth of the Black river.

Sacketts harbor is on the southern shore of the bay, just within Horse island. This harbor is protected by a natural spur of loose rock and gravel, about 800 feet in length, extending easterly from the shore, forming a small sheltered bay. January 15, 1896: The entrance (380 feet wide) is defined (on the west) by Shiphouse point and the mooring crib, and on the east by the railroad wharf. The mooring crib runs about south into the harbor 190 feet from the end of Shiphouse point. It stands upon a 2-foot shoal which extends 40 feet around it. There is 10 feet depth at extreme low water (or 12 feet 5 inches at mean lake level) at 50 feet from mooring crib and elsewhere in the harbor except near the wharves. The best depth along wharf is at the north, 200 feet of the railroad wharf on east of entrance, where there is 9 feet at extreme low water (or 11 feet 5 inches at mean lake level).

Directions.—Entering the harbor, Shiphouse point may be rounded close-to, and the eastern wharves of the town steered for. A narrow sandbar extends two-thirds of the way from Shiphouse point to the southern wharves.

Sacketts Harbor light.—On Horse island a fixed white light, 47 feet above the lake level, is shown from a square red tower attached to a dwelling. The light is visible 12⅛ (14) miles.

Coast.—From Bull Rock point, the north entrance point to Black river, to Pillar point, 1½ (1¾) miles NW., the shore recedes, forming a small bay, almost filled with shoals, extending out from both points for nearly ½ mile. From Pillar point the coast trends to the NE. and East to the head of Guffin bay.

Guffin bay.—The shores of this bay are steep-to, except at its head, where Guffin creek empties. One mile up this creek is the town of Dexter. Vesuvius point and Cherry island form the north shore of this bay and separate it from Chaumont bay.

Chaumont bay to Cherry island has the same entrance as Guffin bay, the SE. face of Point peninsula forming the northern entrance shore. The bay has from 3½ to 4 fathoms, mud bottom in the center and western half, but the eastern half is filled with shoals, which extend out as a spit almost to the center of the bay. Catfish river empties into this bight, and on it is the town of Chaumont.

Three-mile bay, a small indentation on the north shore, has 3½ fathoms at its entrance, but its head is shoal. A town of the same name is on this bay.

Coast.—Point peninsula is 5¼ (6) miles long NE. and SW. Its SE. face is steep-to, except around the SW. point, which is shoal ½ mile off,

Several wrecks have occurred on this point, and it should be given a wide berth. Between the SW. point and Tibbetts point, 9½ (11) miles NNW., the coast is very irregular and broken. About midway between the points are Fox and Grenadier islands, connected with each other and with the shore by shoals, which line all this part of the coast. A shoal spit extends one mile west from the west end of Grenadier island, and vessels rounding this spit should not shoal to less than 10 fathoms.

Baird point is the southern point of a small shoal inlet known as Mud bay, into which Mud creek empties.

Stony point is the north point of Mud bay. Between Stony point and Grenadier island vessels with local knowledge will find good anchorage and protection from all but westerly winds.

A rocky spit extends a mile west from Stony point, and north of this point is Wilson bay.

Wilson point, the north point of Wilson bay, has a shoal spit extending ⅓ mile from it, and ¼ mile from the end of the spit is a detached 14-foot shoal.

Fuller bay lies between Wilson and Tibbetts points, the southeastern entrance point to the St. Lawrence river.

Tibbetts Point light.—On the point a fixed white light, 68¾ feet above the lake level, is shown from a round, gray tower with oil room at the base, the keeper's dwelling being to the northward. The light is visible 13 9/10 (16) miles, and marks the turning point for the south and best channel into the St. Lawrence river.

From Tibbetts point the coast trends 2 3/10 (2½) miles NE., to the town of Cape Vincent, and is steep-to, except around and near the point.

Cape Vincent is on the south shore of the St. Lawrence river, near the entrance to the South channel, and is the first United States port after entering the river.

CANADIAN SHORE.

Hinckley point, of Wolfe or Long island, is opposite Cape Vincent, and from here the coast of the island trends 4 6/10 (5¼) miles SW. to Bear point, ⅓ mile off which is a detached 14-foot shoal. The shore between the points is straight, with one shallow indentation, and is steep-to.

Bear point is a narrow peninsula ¾ mile long, and is almost connected to the 14-foot detached shoal by a spit, leaving a very narrow channel between, but this channel should not be attempted or the point rounded inside of ⅔ mile. All the SW. end of Wolfe island should be given a wide berth as it is a dangerous shore.

Shoal.—A small patch with less than 15 feet on it is reported as lying about 1 3/10 (1½) miles south of Bear point, locally known as "New Found shoal" (probably "Allen Otty shoal").

Long point is a similar but longer peninsula projecting from Wolfe island 1 3/10 (1½) miles, and is farther extended to the SW. for 1 (1¼) mile by a narrow spit with 16 feet at its SW. extremity and only 5 feet at ½ mile from the point. There have been many wrecks on this point.

Sand bay, 1¾ (2) miles wide between Bear and Long points, is open

to the SW., but affords shelter from northerly and easterly winds. A narrow spit, 17 feet at its outer end, projects nearly ½ mile from near the center of the head of the bay, otherwise the shores of the bay may be approached to ¼ mile.

Allen Otty or Keill shoal lies 1¾ (2) miles SSW. from Bear point and $2\frac{4}{10}$ (2¾) miles NE. ¼ E. of Charity shoal. It is a narrow shoal, 700 yards long, with from 15 to 18 feet over it; is unmarked and lies 400 yards north of the range between Charity Shoal buoy and Tibbetts Point lighthouse. It should be avoided in rough weather even by light-draft vessels.

Charity shoal lies $3\frac{7}{10}$ (4¼) miles SW. by S. from Bear point and 4¾ (5½) miles west from Grenadier island. This rocky shoal is ¾ mile long NE. and SW. and 350 yards wide. It has a least depth of 5 feet.

Buoy.—A red and black horizontally striped can buoy is moored in 18 feet, 300 yards from the southern end of Charity shoal. It is 6½ (7½) miles SW. by W. from Tibbetts Point lighthouse.

Shoal.—A dangerous shoal is reported as lying about $1\frac{3}{10}$ (1½) miles SE. of Charity shoal, and is locally known as "East Charity shoal."

Pigeon Island, $2\frac{6}{10}$ (3) miles NW. by W. from Charity shoal, is 3½ (4) miles SW. by W. from the end of Long point. The island is very small and lies in the center of a shoal which extends from it ¾ mile NE. and SW., the latter portion of the shoal being ⅛ mile wide. The lighthouse should be given a berth of at least one mile in rounding the island.

Pigeon Island light.—The lighthouse, painted white, is on the center of the island. From it is shown a white light, revolving every seventy seconds, 67 feet above the lake level. It is visible 12 (13¾) miles.

Fog signal.—A weak hand horn answers signals from vessels.

Reeds bay, between Long and Bells points, is 2 (2¼) miles wide. The head of the bay is filled with a rocky flat, and, although it offers protection from NE. winds, would hardly serve as a good anchorage on account of its rocky bottom.

Coast.—Bells point, a very narrow peninsula, has a reef just outside it, and the whole point is surrounded by shoals which extend off shore ¾ mile. Between Bells point and another narrow peninsula point 1½ (1¾) miles to the northward, the coast line bends to the eastward, and forms a small bight filled with reefs and shoals.

Horseshoe island, ¾ mile long and ¼ mile broad, lies ¼ mile off the northern peninsula point and is connected to it by shoals which surround the island and extend ½ mile SW.

Bateau channel, between Horseshoe and the Wolf islands on the south and Simcoe island on the north, is narrow and useless for any but small craft.

Simcoe island is 3¼ (3¾) miles long NE. and SW. and 1 (1¼) mile wide at its widest part. Its SE. face is steep-to, but elsewhere shoals

extend out for some distance, and its NW. point is almost connected to the shoals extending from Snake island, but the channel between the shoals is buoyed, barrel buoys on the Snake island side. Shoals extend from its NE. end to Garden island and Ferguson point of Wolf island and fill up all the intervening space between this line and Wolf island. Its SW. end has shoals extending from it ¼ mile, and on this end is a lighthouse.

Nine-mile (Gage) Point light.—The lighthouse is at the SW. extreme of the island and is a circular tower painted white. From it, 45 feet above the lake level, is shown a fixed white light, visible 12 (13¾) miles.

Fog signal.—A steam fog horn gives blasts of eight seconds, with silent intervals of twenty-two seconds.

Clearing mark.—This light and Pigeon Island light in line, bearing S. ¼ E. (S. 3° E.), passes close west of a small 15-foot shoal (unmarked) lying 1 (1¼) mile SW. of Snake Island light and well clear to the eastward of the large shoal, least water 4 feet (unmarked) lying in a parallel direction to Simcoe island and nearly 1¾ (2) miles from it.

Snake island is a small island lying near the NW. extreme of a circular shoal with 4 feet on its center. This shoal and the shoal extending from Simcoe island half close this entrance to the St. Lawrence river. Vessels drawing over 15 feet should not attempt to pass between Snake and Simcoe islands, but should keep west and north of Snake island.

Snake Island light.—The lighthouse is square, with dwelling attached, and is built on a crib on Snake Island shoal. From it, 35 feet above the river level, is shown a fixed red light, visible 6 (7) miles.

Directions.—Vessels of 15 feet draft may pass between Simcoe and Snake islands. The channel is buoyed on the east side of Snake island, and by keeping the Snake Island buoy close aboard, or leaving two-thirds of the passage to the eastward, you can, by steering to the northward slowly as you pass Snake island, keep good water, but you can not, with a vessel drawing over 11 feet, steer straight for Kingston when abreast of Snake island.

Wolfe or Long island.—All the north shore of this island is bordered by shoals. Garden island lies on the outer edge of these shoals just west of Ferguson point. Browns or Knapps point, a rocky peninsula 2 2/10 (2½) miles NE. of Ferguson point, has a small bay south of it, but it is shoal and only suitable for very small craft.

Browns or Knapps Point light.—The lighthouse on the north of this point is square and painted white. From it, 28 feet above the river level, is shown a fixed white light, visible 10 (11½) miles.

Shoal.—At 9/10 (1) mile WSW. ¾ W. from Browns Point lighthouse is an 11-foot detached shoal spot lying almost in mid-channel. It is usually marked by a beacon buoy, and vessels bound up or down the St. Lawrence river should keep the mainland aboard, which is here steep-to.

For Kingston, see page 205.

CANADIAN COAST OF LAKE ONTARIO.

Table of directions and distances between light stations on the north and south shores of the lake (the outer pier lights are taken).

Stations.	Directions.	Nautical miles.	Statute miles.
Gibraltar (Lighthouse) point to—			
Port Dalhousie	S. 13° E	24¾	28½
Fort Niagara	S. 34° E	25 4/10	29¼
Olcott	S. 60¾° E	33	38
Oak Orchard	S. 74¾° E	53¾	61 9/10
Big Sodus bay	S. 79° E	106	122
Fair Haven	S. 82° E	116½	134 1/10
Oswego	S. 86° E	124	142¾
Whitby harbor to—			
Port Dalhousie	S. 21½° W	40½	46⅝
Fort Niagara	S. 10° W	35	40 3/10
Olcott	S. 16° E	31	35⅝
Oak Orchard	S. 48¾° E	41¾	48 1/10
Big Sodus bay	S. 67¾° E	90	103⅝
Fair Haven	S. 72¾° E	100	115 1/10
Oswego	S. 77½° E	105¾	121¾
Coburg to—			
Port Dalhousie	S. 47½° W	64½	74¼
Fort Niagara	S. 44° W	56¼	64¾
Olcott	S. 34½° W	43 2/10	49¾
Oak Orchard	S. 2½° W	33¾	38¾
Charlotte harbor	S. 30½° E	46 9/10	54
Big Sodus bay	S. 52½° E	64 9/10	74¾
Fair Haven	S. 60½° E	71½	82½
Oswego	S. 68¼° E	76	87½
Presqu' Ile to—			
Port Dalhousie	S. 56° W	82½	95
Fort Niagara	S. 54½° W	73 8/10	85
Olcott	S. 50° W	59½	68½
Oak Orchard	S. 32° W	42½	49
Charlotte harbor	S. 3½° E	43½	50
Big Sodus bay	S. 35° E	52	59 9/10
Fair Haven	S. 47½° E	56¼	64¾
Oswego	S. 58½° E	58 6/10	67½

Niagara river.—For a description of this river and the offlying shoals, see page 182.

Niagara river to Welland canal.—The coast trends west for 2 2/10 (2½) miles, then changes its direction to SW. by W. ½ W. for 6¾ (7¾) miles to the entrance of the Welland canal. Shoals line this coast and extend off shore in places ¾ mile.

Port Dalhousie.—See page 182.

Shoal.—There is an 18-foot detached shoal ¼ mile NNE. ¾ E. of the outer pier light.

Coast.—Port Dalhousie to Burlington bay: The coast trends 21

(24 2/10) miles W. by N. to the south end of the narrow sand spit separating Burlington bay from lake Ontario. Except for about 5 (5 3/4) miles west of Port Dalhousie, it is everywhere steep-to and has no offlying dangers. There are several creeks in this stretch, which afford good shelter and boat landings.

Burlington bay is a large sheet of deep water, free from danger, the entrance to which is by a canal cut through the sand spit which separates it from lake Ontario. There is a shoal approaching the docks, but it is well buoyed and the navigation is safe.

Burlington canal is between two breakwater piers, built and maintained by the public works department of Canada. The canal is 2,300 feet long, and varies in width from 170 feet at the outer end to 106 feet near the inner end, and carries 14 feet of water. The south pier extends 420 feet farther into the lake than the north pier. The canal is crossed near the middle by a swing bridge of the Grand Trunk Railway.

Danger signal.—At night this bridge is marked in the center by a red danger signal.

RANGE LIGHTS.

Front light.—The lighthouse is near the outer end of south pier; it is 30 feet high, circular and painted white. From it, at 30 feet above the lake level, is shown a fixed white light, visible 4 (4 6/10) miles.

Main (rear) light.—The lighthouse is a gray, circular building, 79 feet high, built on the beach near the middle of the south pier, and 1,570 feet SW. by W. 1/8 W. (S. 58° W.) from the front light. From the lighthouse, at 75 feet above the lake level, is shown a fixed white light, visible 15 (17 1/4) miles.

Fog signal.—A hand horn answers signals from vessels.

Storm signals.—There is a signal mast on Burlington beach, in latitude 43° 16′ N. and longitude 79° 54′ W., from which the Canadian storm signals are shown.

Storms.—October and November are the months in which severe storms are most frequent. The wind, invariably commencing at SE., works around through South to West and NW., the time of the hardest blow being usually when the barometer begins to rise as the wind gets around to west.

Hamilton is the manufacturing center of the Dominion of Canada. Its population is about 50,000, and it has direct railway communication with all parts of the Province and the United States. There are ample wharves. There are no port charges or dues, and no pilotage. The United States is represented by a consul.

Directions.—Vessels making the canal from the lake should bring the two lights in range SW. by W. 1/8 W. (S. 58° W.) and keep them in one until close to the front light, which should be left to port and passed at a distance of about 100 feet. In a heavy sea from the NE., vessels drawing 11 or 12 feet are liable to strike. Vessel men who know the harbor will not attempt to risk coming in during a NE. storm, but

anchor under Toronto point till the sea goes down. After having passed through the canal the course is SW. to the wharves of the city.

Coast.—Hamilton to Toronto: From Burlington the coast trends about 23 (26½) miles NE. by N. to the Humber river, and has only a few slight indentations where creeks empty. It is steep-to, excepting off Clarkson, midway between Oakville and Port Credit. The chart shows a shoal, position doubtful, nearly a mile off shore.

Oakville is at the mouth of Sixteen-mile creek.

Oakville light.—On a cribwork block, near inner end of main pier, is the lighthouse level, 31 feet high, white, with a red lantern. The light, fixed white, is 39 feet above the lake, and visible 11 (12⅔) miles.

Port Credit is at the mouth of the Credit river.

Port Credit light.—The lighthouse, square and painted white, is on the outer end of the north breakwater pier. The light, fixed white, is 37 feet above the lake level and visible 11 (12⅔) miles.

Humber bay, into which the Humber river empties, is just west of Toronto harbor, the western part of the city being on the bay.

Toronto, the capital of the Province of Ontario, is between the rivers Humber and Don, and has a well-sheltered harbor suitable for light-draft vessels. The city is the seat of the provincial Government, with the official residence of the lieutenant-governor and the Government buildings.

The United States is represented by a consul and a vice and deputy consul.

Observatory.—The Magnetical and Meteorological Observatory, in the University grounds, stands 108 feet above the lake in latitude 43° 39′ 35.9″ N. and longitude 79° 23′ 39.75″ W.

Toronto harbor is formed by an island inclosing a harbor of nearly 3½ square miles. There are two entrances, both artificial, to the harbor. The western entrance is directly in front of Queens wharf, and separates the island from the main; the eastern entrance, now being constructed, is at the SE. end of the harbor. At present these entrances will not admit of vessels of heavy draft.

Gibraltar (Lighthouse) Point light.—On the SW. side of the point is a white hexagonal lighthouse with keeper's dwelling near. From this lighthouse, 66 feet above the lake level, is shown a white light, revolving every forty-five seconds. The light is visible 18 (20¾) miles.

Fog signal.—The fog-signal building of wood, white with brown roof, is 1,150 feet SSW. ⅜ W. from the lighthouse. The fog signal is a steam horn, which sounds blasts of seven seconds, with intervals of ninety seconds.

Queens Wharf light.—On the west end of the wharf, from a white hexagonal building, at 23 feet above the lake level, is shown a fixed white light, visible 9 (10½) miles.

Fog signal.—A fog bell, attached to the tower, is rung by hand.

Queens Wharf rear light.—On extension shoreward of wharf, 200 feet N. 23° E. from outer light, is a red octagonal lighthouse, from which

is shown, 37 feet above the lake level, a fixed red light visible 8 ($9\frac{2}{10}$) miles. The two lights in line lead clear of the point of bar, running south of and parallel to the wharf.

These lights are maintained by the Toronto harbor commissioners.

Life-saving station at inner side of Toronto island near the east end.

East Pier light.—A temporary light, established by the Government of Canada on the East pier at the East gap or Eastern entrance to Toronto harbor, has been put in operation.

The light is fixed red and 16 feet above the lake level. It should be visible 6 ($6\frac{2}{10}$) miles from all points of approach.

The light is shown from a column surmounting a hexagonal iron shed. The building is 11 feet high and is gray in color. It stands on the pier 100 feet from its outer end, but will be moved nearer the end of the pier and raised as soon as the construction work is finished. Another light to range with it will also be established later.

The light is intended to guide vessels approaching Toronto to the entrance through the East gap. Mariners will have to allow for the projection of the pier lakeward beyond the light.

Buoys.—A bell and five can buoys, all red, mark the bank to the South and SW. of Lighthouse point. The bell and can buoy to the east are in 5 fathoms. The can buoys to the west are in 8 fathoms, except No. 12, which is in 21 feet. It is not safe for vessels to go inside the buoys, as the bank rises very abruptly. An additional red spar buoy is placed on the NW. point of the island.

Directions.—West channel.—The red spar buoy on the starboard side of the channel is in 14 feet of water, with the lighthouse bearing N. 7° E., distant 620 feet.

One black buoy is on the north side of the channel at the entrance, with the White lighthouse bearing N. 57° E., distant 750 feet.

There are 11 feet of water in mid-channel. The best water is on the south side of the channel near the breakwater.

Directions.—East channel.—The buoys in this channel are placed as follows:

Three black spar buoys on the west or port side coming into the bay. There is 15 feet of water below zero in this channel. The channel is 400 feet between the buoys and cribs. Landmarks for entering are the cupola of St. Lawrence hall in line with a point midway between the tower of Metropolitan church and St. Michaels cathedral spire.

A black spar buoy is placed on the boiler shoal to the south of the gap. Vessels should not go to the NW. of it.

Harbor regulation.—The speed of any vessel entering, leaving, or within the harbor is limited to 4 knots per hour. Vessels offending are subject to a fine of $20.

Coast.—From Toronto (Gibraltar light) the coast trends $15\frac{6}{10}$ (18) miles NE. by E. to Port Union on the Rouge river. Just north of Port Union is Frenchman bay or Pickering harbor.

Frenchman Bay or Pickering light.—On the East pierhead is shown, 51 feet above lake level, a fixed green light, visible 10 (11½) miles.

At 7 (8) miles ENE. ¾ E. of this light is Whitby, and 5 (5¾) miles beyond, Oshawa harbor.

Whitby light.—On the West pier, 12 feet above the lake level, is shown a fixed white light, visible 5 (5¾) miles.

Oshawa light.—A fixed white light is shown from the pierhead.

Darlington light, just east of Raby head and 7 (8) miles E. by N. from Oshawa light, is shown on pierhead in Darlington harbor. It is fixed white and visible 3½ (4) miles.

NOTE.—These three last mentioned lights are not under the marine department of Canada.

Newcastle (Bond Head) light, on outer end of East Breakwater pier, is 29 feet above the lake level and visible 10 (11½) miles. The light is fixed white and maintained by the Newcastle Harbor Company.

Peach Stone reef is 3 (3½) miles east of Bond head, and 3 (3½) miles beyond this reef, off Port Granby, is another reef close to shore. ENE. of Port Granby 4½ (5$\frac{2}{10}$) miles is Port Britain, and 4 (4$\frac{8}{10}$) miles farther in the same direction is Port Hope, at the mouth of Jones creek. Peter rock lies close to shore, midway between Port Hope and Coburg.

Port Hope light, fixed white, is shown 40 feet above lake level, 110 feet from extremity of East breakwater. It is visible 4 (4$\frac{8}{10}$) miles, and is not under marine department of Canada.

Port Hope harbor.—The channel between piers is 200 feet wide at the entrance, with a depth of 17 feet. Eleven feet can be carried to the middle dock.

Storm signals are shown.

Life-saving station is in basin at Port Hope.

Peter Rock, or Gull Island, light is fixed white, 45 feet above lake level and visible 10 (11½) miles.

Coburg lights.—Corporation light is shown on East pier, 20 feet above lake level. It is a fixed white gas light and visible 8 (9¼) miles.

Life-saving station in basin at Coburg.

East Pierhead light, fixed white, is 409 feet S. 10° W. outside of Corporation light. It is shown 23 feet above the lake level and is visible 9 (10¼) miles.

West Pierhead light, fixed red, is shown on the West pier, at elbow, 190 feet from extremity. It is 26 feet above the lake level and visible 6 (7) miles.

Shoal bay, 17 (19½) miles east of Coburg, has several shoals in its entrance. Colborne harbor is between, and just west of Colborne, off Ogden point, is a reef.

Presqu' Ile harbor is separated from Shoal bay by an irregular-shaped peninsula, the south shore of which is lined with reefs. Off the entrance to the bay are several shoals lying almost in mid-channel.

Presqu' Ile light.—On the east point of the peninsula, from a white octagonal tower, is shown, 67 feet above the lake level, a fixed white light, visible 13 (15) miles.

Salt Point light is shown from a white square building on extremity of sand spit north of Presqu' Ile light. The light, fixed white, is 22 feet above the lake level and is visible 4 ($4\frac{9}{10}$) miles.

Brighton harbor has two piers, each about 100 yards long. There is about 13 feet depth; vessels keep in center of bay, and in passing out into the lake keep well to the east shore. There are no port charges or pilots.

Brighton ranges.—No. 3 light.—At 7,200 feet from end of canal piers and 3,020 feet from Brighton wharf, from a white square building on an octagonal pier is shown, 20 feet above lake level, a fixed white light, visible 3 ($3\frac{1}{2}$) miles.

No. 2 light.—At 5,360 feet S. 67° W. from No. 3 light, and 1,440 feet from Brighton wharf, is a fixed white light 45 feet above the lake level and visible 6 (7) miles. The lighthouse is a white square building on a square pier.

No. 1 light.—At 1,420 feet S. 65° E. from No. 2 light, and 1,100 feet from Brighton wharf, is a fixed white light 28 feet above the lake level and visible 6 (7) miles. The lighthouse is a white square building on a square pier.

Brighton.—Directions.—No. 3 light tower stands in 15 feet of water in the axis of the Murray canal and on the north side of the channel, which bears SW. by W. $\frac{1}{2}$ W. (S. 58° W.); in one with No. 2 light, it leads up from the canal through the center of the channel, and is to be left 100 feet on the starboard hand in passing up. After having passed it, if brought directly ahead, it will guide through the remainder of the dredged channel.

Prince Edward, a large island, is deeply indented on all sides by numerous bays. It is separated from the mainland by Quinte bay and the channels leading to it. Off the south shore of the island are numerous outlying shoals, and the prominent points have reefs extending from them for some distance.

Wellers bay is at the western end of Prince Edward island and directly opposite Presqu' Ile harbor. There are shoals in the approach to this bay.

Wellers Bay lights.—At the SW. end of Quinte Carrying Place is a white square lighthouse, from which is shown, 26 feet above the lake level, a fixed white light, visible 10 ($11\frac{1}{2}$) miles. At 508 feet N. 46° E. from the front light is a fixed red light 37 feet above the lake level and visible 7 (8) miles. The lighthouse is a white square building.

Directions.—The alignment of the lights leads clear of the extremity of spit off Bald head, and gives best water (10 feet) over Wellers bar, 3,300 feet outside the spit. Vessels entering keep the alignment N. 46° E., until the spit is passed at a distance of 150 feet.

Nicholson point, the SW. point of Prince Edward, has Nicholson

island lying off it. About a mile south of the west point of Nicholson island is Scotch Bonnet or Egg island.

Light.—On this little island is a fixed white light, 51 feet above the lake level and visible 12 ($13\frac{3}{10}$) miles. The white circular light tower has a dwelling attached.

Reef.—South $1\frac{1}{2}$ ($1\frac{3}{4}$) miles from Egg Island light is the north end of a reef which extends 2 ($2\frac{3}{10}$) miles in a SSW. direction; east of its south end is a small detached reef.

Sandy bay, between Nicholson and West points, is a deep bay, open to the southward. The town of Wellington is at its head, and here is a lifeboat station. Behind the shore of the bay is West lake, in which are several islands.

Little Sandy bay is between West and Wicked points and inshore of this bay is East lake. Both West and Wicked points have reefs extending from them, that from Wicked point being extensive and extending over 2 ($2\frac{3}{10}$) miles in a southwesterly direction and about the same distance alongshore to the eastward.

Wicked, or Salmon, Point light, fixed red, is shown on extremity of point from a white square lighthouse with dwelling attached. It is 40 feet above the lake level and visible 8 ($9\frac{2}{10}$) miles.

Soup harbor is between Wicked and Peter points. It has a small lake at its head.

Peter point, the most southerly point of Prince Edward island, has a reef extending from it to the southward. This reef is about $1\frac{3}{10}$ ($1\frac{1}{2}$) miles broad, surrounding Peter point, and extends directly south to a point, the southern extremity being $1\frac{3}{10}$ ($1\frac{1}{2}$) miles south of Peter point.

Peter Point light, revolving white every thirty-five seconds, is 62 feet above the lake level and is visible 13 (15) miles. The light building is a white, circular tower.

Fog signal.—Close in front of the tower, 16 feet above the water, is a steam fog horn, which in foggy weather gives blasts of nine seconds, with silent intervals of twenty-eight seconds. The building is white, with brown roof.

Gull point, next east of Peter point, has a reef extending from it for nearly a mile. The shore of Prince Edward between Gull and South Bay points is slightly indented and in places lined with rocky reefs.

South Bay point is the SE. extremity of Prince Edward island. Off it are Timber and False Duck islands, both of which are nearly connected to the point by shoals.

Shoal.—About $1\frac{3}{10}$ ($1\frac{1}{2}$) miles SSE. from South Bay Point light is a detached 12-foot shoal.

South Bay Point light.—On Traverse point, from a white square lighthouse, dwelling attached, is shown, 36 feet above the lake level, a fixed red light, visible 10 ($11\frac{1}{2}$) miles.

False Duck Island light, fixed white, is shown on the eastern point of the island, 68 feet above the lake level, and is visible 13 (15) miles.

Fog signal.—A hand horn answers signals from vessels.

William shoal, 12 feet water, and **Harris shoal**, 22 feet water, lie between False Duck and Main Duck islands, leaving a clear channel of 3½ (4) miles between Harris shoal and the Main Duck.

Main Duck island is a narrow island nearly 2 (2 $\frac{3}{10}$) miles east and west. The whole southern shore is lined with shoals and reefs, and this shore, as well as the western point of the island, should not be approached nearer than a mile.

Yorkshire island.—From the east point of Main Duck island a shoal extends over a mile in a northeasterly direction, and on this shoal is Yorkshire island.

Between Yorkshire and Galloup islands is a wide and deep passage, with no danger except Galloup shoal, lying a mile west of Galloup Island light. This shoal is buoyed, but has been the cause of many wrecks.

Prince Edward, or South, bay, a deep indentation in Prince Edward island, lies between South Bay and Pleasant (Indian) points.

Flats point is in the southwestern part of Prince Edward bay. There is a lifeboat station on the point next east of Flats. Waupoos island and Green island lie in Prince Edward bay on its northern shore. North of Green island is cape Vesey, and from this cape to Pleasant (Indian) point the shore of Prince Edward is steep-to and can be safely approached. Both the north and south shores of the bay are formed by long, narrow peninsulas extending NE. and easterly from Prince Edward island.

Pleasant (Indian) Point light, at entrance to Adolphus reach, Bay of Quinte, is fixed white, 52 feet above the lake level, and visible 10 (11½) miles. The light is shown from a white octagonal building with red lantern.

Big Bar shoal, detached and with 18 feet over it, lies 4½ (5⅛) miles ESE. ¾ E. from Pleasant Point light.

Murray canal is a straight cut, without locks, 5 $\frac{6}{10}$ (6½) miles long between extremities of piers, 80 feet wide on the bottom and 12 feet deep, below the ordinary low-water level of lake Ontario, joining Presqu'Ile harbor with the Bay of Quinte. Its axis is ENE. and WSW., and it is crossed by one railway and three highway bridges. At each end of the canal crib-work piers have been built on either side into the shallow water, and beyond them channels, dredged 200 feet wide, have been continued until water of the same depth as that in the canal was reached. The dredged cut at the east end extends 2,300 feet beyond the ends of the piers, and is for its whole length in the axis of the canal.

By day the center of the swings of the bridges, and by night the lights on the same (white if swings are open, red if closed), in range, will indicate, with sufficient accuracy, the middle of the dredged channel and of the canal. Each bridge is passed to the southward of the swing, which is somewhat to the northward of the axis of the canal.

MURRAY CANAL LIGHTS.

On the north pier, 30 feet from the outer end, west entrance to canal, is a fixed red light, 14 feet above the lake level and visible 4 ($4\frac{6}{10}$) miles.

Above the center of the swing pier of Lovatts bridge, 6,490 feet from west entrance to canal, is a fixed white and red light, 35 feet above lake level and visible 6 (7) miles.

Above the center pier of Smithfield bridge, 7,700 feet east from preceding, is a fixed white and red light, 35 feet above lake level and visible 6 (7) miles.

Above the center of the swing pier of the Central Ontario Railway bridge, 6,600 feet from the preceding, is a fixed white and red light, 20 feet above the lake level and visible 4 ($4\frac{6}{10}$) miles.

Above the center of the swing pier of the Carrying Place Highway bridge, 1,500 feet east of the preceding, is a fixed white and red light, 35 feet above the lake level and visible 6 (7) miles.

On the north pier, 30 feet from outer end, at east entrance to Murray canal, is a fixed red light, 19 feet above the lake level and visible 4 ($4\frac{6}{10}$) miles.

Bay of Quinte.—The name is applied to all the waters north of Prince Edward island which separate it from the mainland, although the bay proper, apparently, is the large indentation in the northern and central part of the island. The bay is connected with Presqu' Ile harbor and lake Ontario by the Murray canal on the west, and with lake Ontario and the St. Lawrence river by Adolphus reach and North channel on the east. On the north shore of the bay the Trent, Moira, Salmon, and Napanee rivers empty. East of the Napanee river is Casey point, and between it and Barker point is a narrow inlet known as Hay bay. The channel north of Pleasant point is Adolphus reach, which, with North channel, leads into the north branch of the St. Lawrence river. Adolphustown is at the west end of Adolphus reach, and Collins bay at the east end of the North channel. Trenton near the mouth of the Trent river, Belleville at the mouth of the Moira river, Shannonville near the mouth of the Salmon river, and Deseronto at the mouth of the Napanee river are the principal towns on the north shore of Quinte bay. On the south shore of the bay, west of Green point, are Big and other islands.

Trenton, at the mouth of the Trent river, has a good but not large harbor. The depth of water varies, but it usually averages 11 feet. There is a bar along the west bank of the river, and vessels approaching keep to the east and approach in a line about the center of the river. There are buoys after turning to the east going down the bay of Quinte toward Belleville. Between Trenton and Belleville a bar stretches along the middle of the bay, and vessels usually keep along the south shore. There is a current of about 2 miles an hour in the bay except during

heavy west winds. The prevailing winds in summer are SW. No port charges or pilotage.

Storm signals are shown at the outside lumber wharf on east side of river.

Hallowell bay, at the head of which is Picton, is east of Green point and opposite Barker point, on the main shore.

QUINTE BAY LIGHTS.

Nigger Island Shoal light is fixed white, 27 feet above the bay level, and visible 10 ($11\frac{1}{2}$) miles. The lighthouse is a square tower, surmounted by a square lantern, the whole painted white. It is 27 feet in height from the deck of the pier to the top of the lantern. It stands on a crib-work pier, sunk in 11 feet of water, on the north side of the steamboat channel and near the western extremity of the shoal running southwestwardly from Nigger island toward Potters island.

Directions.—Vessels upon leaving the swing of the Belleville bridge, bound up, can steer directly for the light on a course WSW. (S. 68° W.), and should pass the light, leaving it about 300 feet on the north side or starboard hand. Vessels leaving the Murray canal, bound down, after passing the red buoy off Onderdonk shoal can also steer directly for the light on a course NE. (N. 45° E.). When within 4,000 feet of it they should open it half a point on the starboard bow, so as to clear the north extreme of the shoal extending from Potters island. At 2,000 feet distant they should change their course so as to pass it, leaving it 300 feet to the northward, or on the port hand, and, after passing the most easterly black buoy on Potters Island shoal, can shape their course directly for the swing of Belleville bridge.

Bay of Quinte Bridge light, immediately west of Belleville, is fixed white south of southern opening; fixed white north of northern opening; red light at each end of drawspan when bridge is closed; two green lights at each end of drawspan when bridge is open. The light is 18 feet above the bay level and is visible 3 ($3\frac{1}{2}$) miles. The center pier of swing span is 195 feet from the south, or Prince Edward County, shore. A channel 100 feet wide lies both north and south of the swing pier. When draw is open two green lights, flanked by two white lights, will be seen, and vessels must pass between a green and a white light. The light is maintained by the bridge company.

Belleville light.—On the SE. edge of shoal, at entrance to the Belleville harbor, is a fixed white light, 38 feet above the bay level and visible 11 ($12\frac{3}{3}$) miles.

Telegraph Island light, between Trident point and Deseronto, is fixed white, 46 feet above the bay level and visible 12 ($13\frac{3}{16}$) miles.

Deseronto light, fixed white, is shown from square tower on roof of freight shed on the railway wharf. The light is 44 feet above the bay level, visible 11 ($12\frac{3}{3}$) miles, and serves as a guide to Deseronto from Belleville, Picton, and Napanee.

Amherst island, a large island on the south side of North channel,

is 9 (10⅓) miles NE. and SW., and about 3 (3½) miles north and south through its center. Pig point is the west point of the island and is steep-to, as is the whole north shore to the shoal extending north over 1$\frac{3}{16}$ (1½) miles from the NE. end of the island. This shoal is a mile broad, and on it are several islets; the outer ones are Brother and Center Brother islands; the bar is ¼ mile from the point. Amherst bay is an indentation on the south shore of Amherst island. The west point of this bay is surrounded by reefs, and a short distance off is Lagoon island. Emeric point, the east point of Amherst bay and the SE. point of the island, is also shoal, and off it is Nut island. The little bay inside of Nut island is shoal and rocky. The eastern shore of Amherst island is shoal, and in places there are outlying shoals about ¾ mile offshore.

Salmon island, 1½ (1¾) miles ESE. ½ E. from Brother island, is on the northern part of a large shoal, which is almost connected with the shoal from Amherst island. It extends South, SE., and SW. from Salmon island for about ¾ mile. Vessels should not attempt to pass south or west of Salmon island.

Center Brother Island light.—On the northernmost point of the island, from a white, square lighthouse with red lantern, is shown, 31 feet above the lake level, a fixed white light, visible 10 (11½) miles.

Outlying shoals.—Halfway between the NE. end of Amherst island and Simcoe island is the center of an extensive shoal, least water 4 feet. From its center the shoal extends ⅔ mile NE. and SW., and is the same distance broad. East of this shoal ⅔ mile is a small shoal, least water 15 feet, which lies 1 (1¼) miles SW. of Snake Island light, By keeping Nine-mile (Gage) Point and Pigeon Island lights in line, a vessel will clear both shoals, but passes close to the SW. edge of the smaller.

Shoal.—At 2 (2$\frac{3}{16}$) miles East from Center Brother Island light is a 15-foot shoal (unmarked), which lies ¼ mile off shore.

Kingston, at the mouth of the St. Lawrence, is on the Great Cataraqui river. It is of importance as a naval station, is fortified, and commands the entrance of the Rideau canal.

The United States is represented by a consul.

Dry dock.—There is a Government dock, 280 feet over all, width of gate 55 feet, and depth over sill 16 feet. It can be lengthened 313 feet by moving caisson.

Kingston harbor has depths of from 12 to 15 feet. There is good anchorage off the shipyard.

Directions.—The best approach from the west is west of Snake island and close alongshore inside of the two 12-foot shoals, marked by beacon buoys, lying off the city about ½ mile. In approaching from the eastward the main shore should be kept aboard to avoid the 11-foot shoal, marked by beacon buoy, a mile west of Browns Point light.

Leading marks.—Barryfield Range lights and targets in line carry clear of shoals to Kingston.

Storm signals are shown from staff on Folgers wharf.

Kingston light, a fixed white gas light, is shown from the City Hall clock. It is visible 9 ($10\frac{1}{3}$) miles.

Buoys.—Penitentiary shoal, Myles shoal, and Bolivia shoal, in Kingston harbor, are marked by wooden spar buoys surmounted by slat-work globes or spheres.

These buoys are painted in red and black bands and are moored as near the middle of the shoals as possible, in 12 to 14 feet of water.

Vessels should give the buoys a good berth, as the shoals extend some distance from them.

RANGE LIGHTS.

Front.—At 370 feet East from the end of Kingston bridge is a fixed white light, 48 feet above the river level, and visible 12 ($13\frac{8}{15}$) miles. It is shown from a red tripod, with white oval beacon at its top and brown shed at its base.

Rear.—Fifteen hundred feet NE. $\frac{1}{8}$ N. (N. 35° E.) from the front light is shown from a similar lighthouse, 75 feet above the river level, a fixed white light, visible 12 ($13\frac{8}{15}$) miles. The lights show over a small arc on each side of the alignment, which leads inside of Carruthers and Point Frederick shoals.

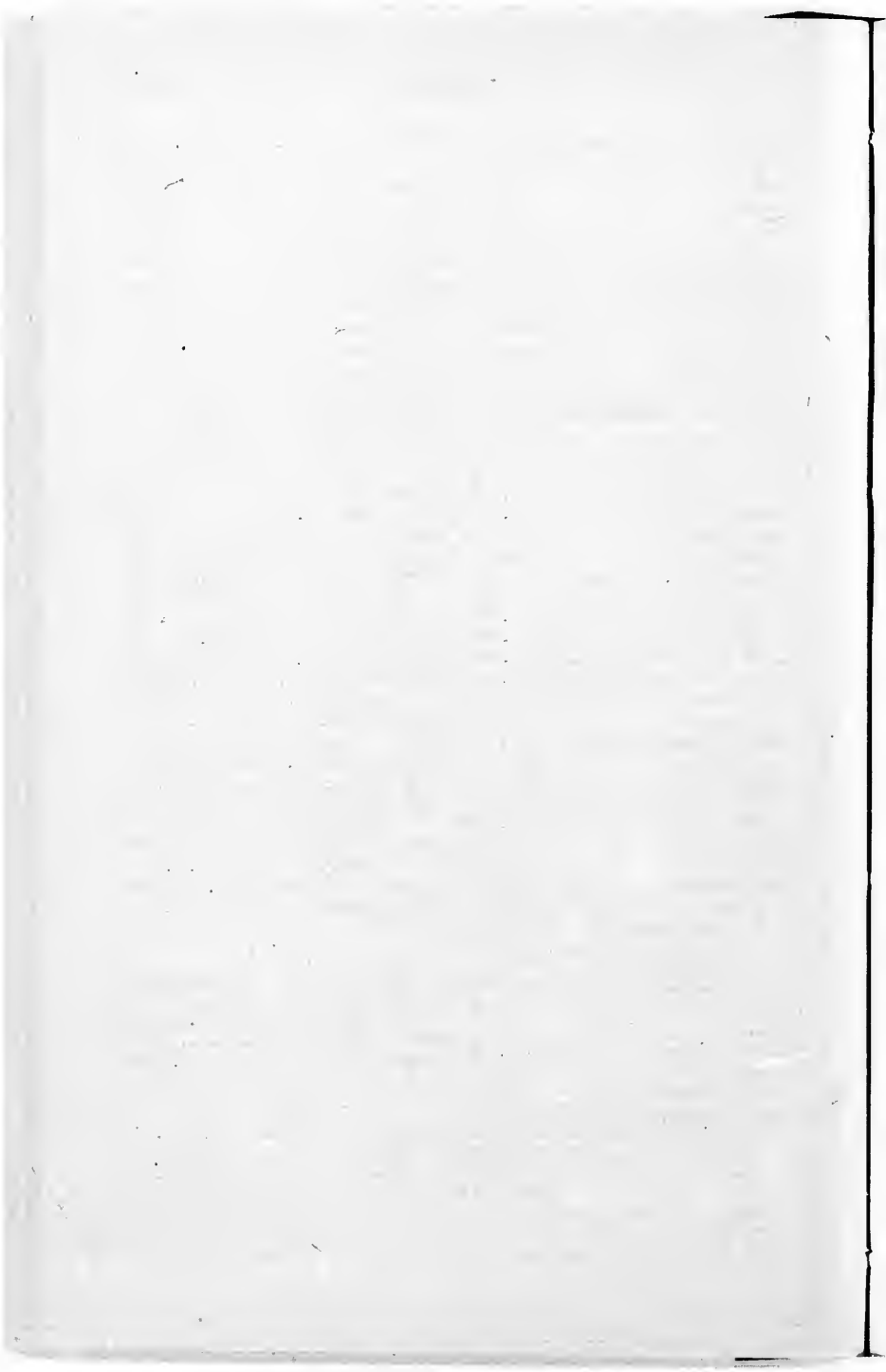
Point Frederick, fortified, separates Kingston harbor from Navy bay, which is shoal; and Point Henry, also fortified, separates Navy from Dead Man bay. Cedar island lies off Dead Man bay.

For the south shore and Browns (Knapps) Point light, see page 194.

INDEX.

E.

H.



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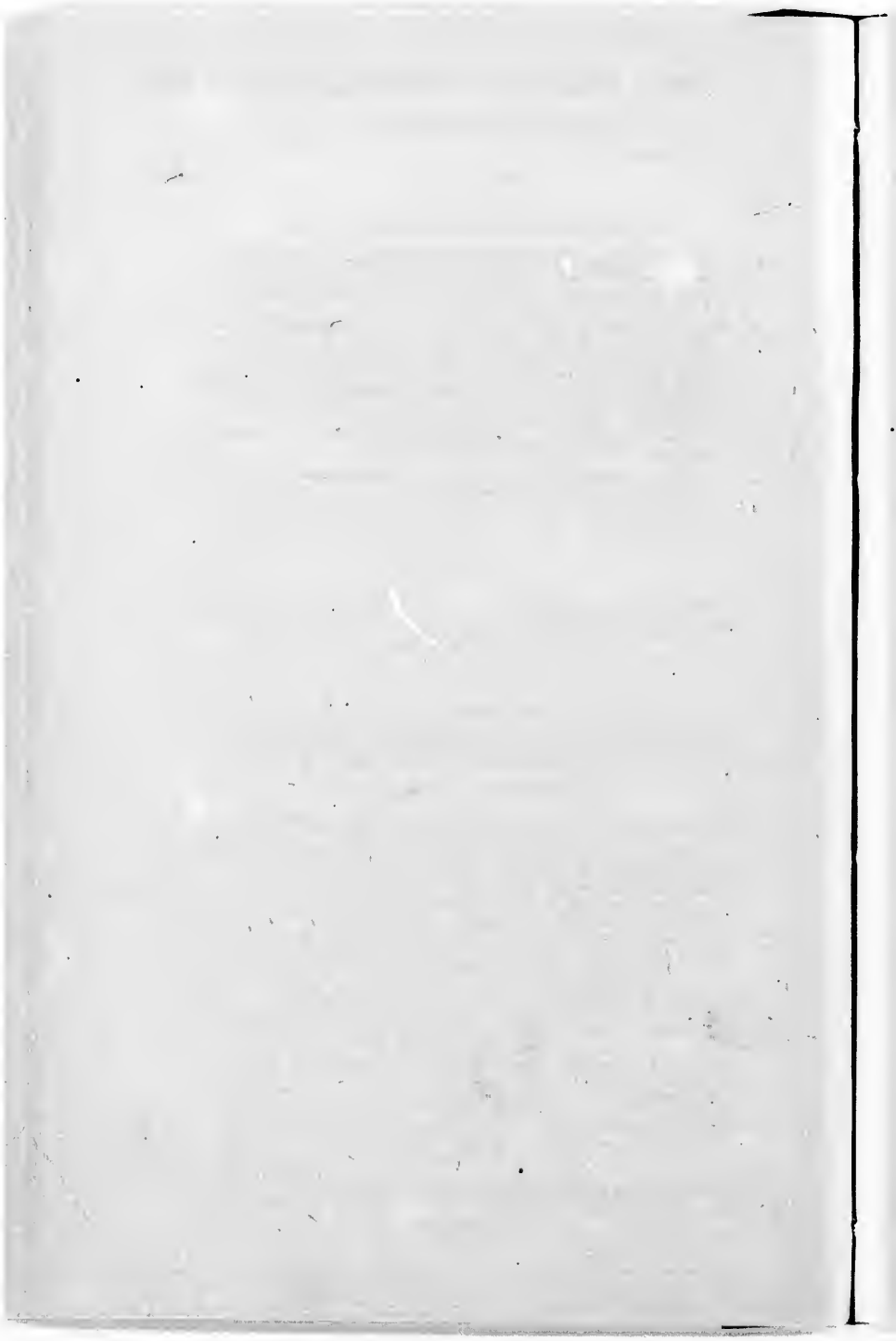

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