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UNITED STATES COMMISSION OF FISH AND FISHERIES
SPENCER F. BAIRD, COMMISSIONER

THE FISHERIES

AND

FISHERY INDUSTRIES

OF THE

UNITED STATES

PREPARED THROUGH THE CO-OPERATION OF THE COMMISSIONER OF FISHERIES AND THE SUPERINTENDENT OF THE TENTH CENSUS

BY

GEORGE BROWN GOODE
ASSISTANT SECRETARY OF THE SMITHSONIAN INSTITUTION
AND A STAFF OF ASSOCIATES

SECTION III
THE FISHING GROUNDS OF NORTH AMERICA
WITH FORTY-NINE CHARTS
EDITED BY RICHARD RATHBUN

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LETTER OF TRANSMITTAL.

UNITED STATES NATIONAL MUSEUM,
Washington, July 18, 1882.

SIR: I have the honor to transmit herewith, for approval and for publication, Section III of a general work upon THE FISHERIES AND FISHERY INDUSTRIES OF THE UNITED STATES, consisting of a description of the fishing grounds of North America, prepared by Capt. J. W. Collins, Mr. Richard Rathbun, Mr. Silas Stearns, Prof. D. S. Jordan, Dr. T. H. Bean, Mr. F. W. True, and Mr. Ludwig Kumlien. The work is edited by Mr. Richard Rathbun. It is the only report of the kind ever written. It describes the locations, the characteristics, and the productiveness of the numerous grounds resorted to by the fishermen of the United States, extending from Greenland to Mexico, from Lower California to Alaska, and including the fishing grounds of the Great Lakes. The accompanying charts illustrate the fishing grounds and the surface ocean temperatures of the eastern coast of North America.

I have the honor to be, very respectfully, your obedient servant,

G. BROWN GOODE.

Prof. SPENCER F. BAIRD,
United States Commissioner of Fish and Fisheries.

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INTRODUCTION.

By Richard Rathbun.

The term "fishing ground" is commonly applied to any area in which fishing is carried on, whether the fish are taken at the surface or at the bottom, whether near the coast or at a considerable distance from it. The regions traversed by the mackerel and menhaden, in their periodical migrations, during the spring, summer, and fall, are classed as the mackerel and menhaden grounds, and, in the popular mind, belong in the same category with those well-defined elevations and depressions of the sea bottom which are the constant resort of cod and halibut and other bottom-feeding species. We also speak of the fishing grounds for herring, lobsters, shrimps, oysters, and sponges, although those species are taken mostly near the shores, while the cod and halibut grounds are sometimes distant from them several hundred miles.

The main purpose in preparing this section of the Fisheries Report has been to describe that class of North American fishing grounds to which the term more properly belongs, or those areas of the sea bottom which are known to be the feeding or spawning grounds of one or more species of edible fishes, and which afford fisheries of greater or less extent. The most important grounds of this character are located off the eastern coast of North America, between Nantucket and Labrador, this region furnishing by far the most important cod and halibut fisheries of the world, and including the large and well-known offshore banks, extending from George's, at the southwest, to the Flemish Cap, off the eastern coast of Newfoundland. These banks form an almost continuous series of broad, submarine elevations, stretching a distance of 1,100 geographical miles, and with a varying width of 50 to 250 miles. They attracted the attention of early navigators, and in the period of the first-attempted settlements on the adjacent shores of North America, now included in the British coast Provinces, were regarded as one of the greatest sources of wealth then known to the world. The principal maritime nations of Europe soon became interested in developing the newly-discovered fisheries, France apparently taking the most active part, and every year large fleets of vessels were sent to fish upon the banks. Colonies were established in connection with the enterprise, and the influence of the Great Banks upon the early settlement of some portions of our northeastern coast has probably never been estimated at its true value by historians.

It is now nearly four hundred years since these grounds were first fished upon by Europeans, and their resources are still unfailing; but the fishing interests have been mainly transferred to the New World, France alone of European countries having continued to send fishing vessels across the Atlantic down to 1880. Since then, however, the Portuguese have begun to exhibit some activity in connection with the cod fishery of the Grand Bank, and in the spring and summer of 1885 bought several New England fishing schooners and fitted out others from home ports. Their voyages proving generally successful, they have added more vessels to their fishing fleet during the latter part of this year, and it is quite possible that, in the course of a few seasons, they will have firmly re-established themselves in the fisheries of the Western Atlantic. The

French fishermen visit principally the Grand Bank, Saint Pierre, Banquereau, and certain portions of the coast of Newfoundland, on which they have long possessed the right to fish by treaty with Great Britain. Much English capital is invested in the Provincial fisheries, and vessels of other nations than the French and Portuguese come to this country to load with fish for foreign markets, but few, if any, ever engage in fishing.

The great offshore banks are now chiefly resorted to by the fishermen of New England and the British maritime Provinces, the latter including Nova Scotia, New Brunswick, Prince Edward's Island, Lower Canada, and Newfoundland, but the Provincial fishermen seldom venture as far south as George's Bank, which is frequented mostly by Gloucester vessels, and a few halibut catchers from Southern New England.

The most distant grounds visited by the fishermen of the United States, at the time this report was prepared, are located in Davis Strait, in the vicinity of Holsteinborg, on the west coast of Greenland, about 67° north latitude. They consist mainly of rocky banks, with patches of sand and mud, the depths of water ranging from 20 to 50 fathoms, and abound in halibut, but cod are scarce, and are taken only in small quantities. In 1884, acting upon information furnished by the United States Fish Commission, three Gloucester vessels made excellent halibut trips to the fishing banks of Iceland, and in the summer of 1885 four vessels from the same port obtained full fares on the Iceland grounds. Fishing is reported to be more profitable than in Davis Strait, and this region will probably prove very attractive in the future. Very few United States vessels now go either to the coasts of Labrador or Newfoundland, or to the Gulf of Saint Lawrence. No fares of halibut have been taken in those regions since 1881, and during the six years preceding that date the amount obtained was very small. About 12 or 15 cod fishermen still resort to the Gulf of Saint Lawrence every summer, but the mackerel fishery has been mostly transferred to the open waters on our own coast. The mackerel fleet in the Gulf of Saint Lawrence from United States ports has, during the past 8 or 10 years, seldom numbered more than 40 or 50 vessels, and during the same period the catch in those waters has probably not exceeded 3 per cent. of the total catch of the United States fleet.

The fishing grounds indicated on the charts representing the Gulf of Maine, and the coast-lines of Maine, New Hampshire, and Massachusetts, are mostly small banks, ledges, and shoals, with rocky, stony, gravelly, and sandy bottoms, separated by tracts of mud and sand. Upon the elevations, cod, haddock, pollock, and cusk abound, while the muddy areas between constitute the best known localities for the capture of hake. Although individually of relatively small size, compared with the offshore banks, these grounds form in the aggregate a very extensive and valuable fishing region, of much importance to the smaller class of fishing vessels and the boat-fishermen. From Nantucket westward and southward, to the Gulf of Mexico, the fishing grounds of the same class are much less numerous than at the north, more widely separated, and often entirely wanting over long distances; they are also generally less defined, especially as regards differences in the depth of water, and bottom fishing is not carried on to nearly as great an extent.

At the southern extremity of Florida good bottom fishing is obtained on the edge of the Gulf Stream, and among the coral reefs, by the Key West market fleet. In the Gulf of Mexico there is a broad belt of fishing ground, following the general contour of the coast and extending from the Tortugas Keys nearly to the mouth of the Mississippi River. It has a greatly diversified bottom, consisting in some places of ledges, in others of sandy, shelly, muddy, and rocky bottoms, traversed by gullies, and living corals are said to be abundant on many portions. Fishing is conducted in depths of 5 to 40 fathoms, the principal species taken being the red and black groupers and the red snapper.

On the Pacific coast the sea fisheries have as yet been but little developed, and such as exist are mainly carried on along shore. No attempts are made to discover offshore grounds, probably because of the scarcity of markets for the sale of fish. The principal fisheries between the Straits of Fuca and Lower California are in the neighborhood of San Francisco, but the grounds resorted to do not extend seaward beyond the Farallone Islands. In Alaskan waters sea fishing is pursued mostly by the natives, but rich cod and halibut grounds exist in that region.

Of special sea fisheries, the mackerel, menhaden, and sponging grounds have been briefly treated, and accounts of the fishing grounds of the Great Lakes have also been admitted into this section. The mackerel and menhaden grounds furnish ocean fisheries of great magnitude, in the same general region in which are located many of the more important inshore fishing banks and ledges of the northeastern coast of the United States, and are frequented by large fleets of vessels built and equipped expressly for the purpose. The lake grounds are all situated comparatively near shore, but often extend into considerable depths of water; they are seldom characterized by any peculiarities in the nature of the bottom, but are generally favorable localities for the setting of nets, or passage-ways used by the fish in moving from place to place. The principal kinds of fish taken are the lake-trout and whitefish, the appliances used being chiefly pound-nets, gill-nets, and seines. In some places, as at the Sault de Ste. Marie, dip-nets are employed from canoes in the capture of whitefish, and some hook-and-line fishing is also done.

In locating and defining the various fishing grounds, the writers have resorted both to brief descriptive accounts and to sketch maps or charts, the latter being employed only where the grounds are sufficiently well known to permit of their being plotted with at least approximate accuracy. This has been possible for almost the entire eastern coast of North America, but that region alone has been thus graphically represented.

The information upon which the report is based was derived from many sources. The fishing grounds of Davis Strait were visited in 1879 by Mr. N. P. Scudder, then an assistant on the United States Fish Commission; and he has prepared a full account of his trip, from which we extract that portion bearing upon the cod and halibut banks, adding a few notes made by other observers. The map of the same region was also furnished by Mr. Scudder. As to the inshore grounds of the British coast Provinces and the grounds of the Gulf of Saint Lawrence, we have relied in part on Canadian fishery reports, in part on accounts received from United States fishermen, who have repeatedly visited that region.

The outlines and principal contours of the offshore banks, from the Flemish Cap to, and including, Brown's Bank, have been taken mainly from the British Admiralty charts, and those of George's Bank from the charts of the United States Coast Survey. The data respecting the characteristics of those banks, their productiveness and their history, were almost entirely brought together by Capt. Joseph W. Collins, whose personal experiences for many years in the fisheries of every part of that extensive region entitle his statements and opinions to our fullest confidence. The same author is also to be credited with obtaining most of the information concerning the fishing grounds of the Gulf of Maine and the New England coast north of Cape Cod, many of these grounds having likewise come within his personal observation. The account for Southern New England, New York, and New Jersey was prepared from information procured by Mr. R. Rathbun directly from reliable authorities, and that for the Southern Atlantic coast mainly from the observations of Mr. R. E. Earll. The report upon the fishing grounds of the Gulf of Mexico was furnished complete by Mr. Silas Stearns, of Pensacola, Fla., one of the best informed authorities on the sea fisheries of our southern coast. Prof. D. S. Jordan, who reports upon the western coast of the United States, and Messrs. Kumlien and True, who prepared the account for the Great Lakes,

based their descriptions on observations made while investigating the fisheries of those regions, on behalf of the fishery census of 1880. Dr. T. H. Bean's report upon Alaskan resources and fishing grounds is the result of studies made upon numerous collections of fishes received from that Territory, from time to time, during many years, supplemented by personal observations in the field during a trip to Alaska in 1880.

With respect to the fishing grounds of Eastern North America, a few additional words of explanation are necessary. The outlines of a fishing ground seldom conform to the contour lines used on hydrographic charts to define the limits of a bank, ledge, or other inequality of the sea bottom, as the fishes are not always influenced so much by differences in the depth of water (within certain limits) as by the abundance of food or other essential conditions, among which temperature probably enters as an important factor. A fishing ground may, on one side, have a less depth than 25 or 30 fathoms, and on the other descend to depths of 50, 60, or even, in some cases, several hundred fathoms, the same species of fish sometimes occurring at both extremes. Many of the data furnished by the ordinary class of hydrographic work are, therefore, entirely unsuited to fishery purposes, and it is of the greatest importance that special surveys be undertaken in the immediate interest of the fisheries, and with the object of ascertaining the full extent and character of all the larger grounds that may be profitably resorted to by our fishermen. Fishing grounds are constantly changing in productiveness, and any survey bearing upon them should be made continuous, in order that the changes may be noted and their causes explained, if possible.

Such a work as this belongs within the province of the now existing United States Commission of Fish and Fisheries, and so far as the means at its disposal have permitted, its researches in this particular have been carried on with thoroughness and precision. Until within a very few years, however, this Commission was provided only with small vessels, with which it was impossible to extend the explorations much beyond those areas commonly entitled the inshore grounds, or beyond the boundaries of the United States. In 1883, the Commission was, for the first time, supplied with a thoroughly reliable sea-going steamer, capable of visiting any part of the oceanic grounds, and it has already collected many important data bearing upon the great banks of the northeastern coast, the mackerel and menhaden grounds, and the fishing areas of the Gulf of Mexico. New fishing grounds of great value have already been discovered, and new species of edible fishes have been introduced to the markets; but this work, so far as the steamer Albatross is concerned, has only just begun, and in the near future may be expected to add greatly to our knowledge of the fishery resources of our country. The series of investigations by the Albatross being entirely subsequent to the preparation of this volume, no account of it will be found on the following pages.

The above remarks will serve to indicate how difficult it is to locate, and especially to plot with distinct outlines, many of the fishing grounds along our coast, particularly as very few of the inshore grounds are in any way indicated on the Coast Survey charts. For those that have been previously marked out, as in the case of defined banks and ledges, we have relied in part on published charts, in part on information furnished by fishermen, by means of which latter it has often been possible to greatly perfect the outlines. The work of plotting nearly all the inshore grounds has been first attempted in connection with this volume, the data having been mostly obtained directly from the fishermen who are constantly resorting to them, and some of whom have drawn the outlines themselves. Every precaution has been taken to procure such information only from reliable persons, and to verify the same by other means wherever possible; and although it is not expected that absolute accuracy has been reached in all cases, especially as regards distances, the fishermen having to rely mainly on their judgment in this matter, it is probable that the positions

and outlines assigned to the grounds are, in the main, correct. In resorting to offshore grounds, the fishermen make use of a patent log for determining distances, and also ascertain their positions by observations for latitude and longitude, and their statements respecting localities at a distance from shore are as reliable as could be obtained from any source.

The limited time available for the preparation of the account of the fishing grounds of Eastern North America prevented the incorporation of materials bearing upon their temperature, currents, and general natural history characteristics—subjects that cannot be ignored in the study of the fishery resources of any region. Many data of this character have been obtained by the United States Fish Commission, and, although some of them have been already published in brief reports, the greater portion are still in process of elaboration, and will be issued at a future date in such form as to conveniently supplement this report.

The text composing this section was finished and sent to the printer in 1882. Delays in printing and in the preparation and engraving of the charts have enabled the writers, in connection with the latter, to add much information obtained since 1880, especially respecting the cod and halibut fisheries of the large offshore banks. This new material is contributed by Captain Collins, and is the result of studies continued through many years, and based mainly upon his own observations and those of the Gloucester fishermen directly concerned in the facts recorded. It brings the history of the more important cod and halibut fisheries down to the spring of 1885, and notes the principal changes that have taken place in recent years in the character and richness of the different parts of the offshore banks.

The charts have been drawn by Mr. C. E. Gorham, assistant on the United States Fish Commission, and engraved by the Photo-Engraving Company of New York. All distances recorded with respect to the eastern coast of North America are in nautical miles.

WASHINGTON, *December* 30, 1885.

[NOTE.—Since this introduction was put in type it has been found possible to add to this report a brief discussion of the surface ocean temperatures along the Atlantic coast, with a series of thirty-two graphic charts, which are given at the end of this section.]

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LIST AND EXPLANATION OF THE CHARTS REPRESENTING THE SEA FISHING GROUNDS OF THE EASTERN COAST OF NORTH AMERICA.

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2. Explanations of Charts 3, 4, and 5.

The following notes are based on data mainly obtained previous to 1880, but, unfortunately, not available at that time for insertion in the body of the text, to which they now serve as an appendix. They have reference, for the most part, to the extensive halibut and cod fisheries of the important banks lying off the coasts of the British maritime Provinces, and are intended more especially to call attention to certain localities in which good fishing had been obtained down to the close of 1879, or the early part of 1880, the year in which the investigations respecting them were mostly made. A few facts of more recent date have also been added. The years in which good fares were obtained are generally mentioned, and these explanations, in connection with the charts to which they relate, furnish, therefore, important data of historical interest, as well as regarding the relative value of different parts of the several fishing grounds in past years.

Changes are constantly taking place in the abundance of fish on all the large fishing banks. In many instances these changes are of only a temporary nature, and if fish are scarce one year, they may be abundant again the next. The halibut apparently furnish an exception to this rule, and good grounds, once depleted, have seldom been known to regain their former status. A few instances are, however, on record, where old and seemingly worn-out grounds have again afforded a good halibut fishery, but such cases are said to be rare, and the facts are regarded as favoring

* Refer to the pages of the text where the grounds are described.

the presumption that schools of halibut which have been thinned out and scattered by incessant fishing require at least many years to recover their former size, or even to show a perceptible increase. The history of the halibut fishery of the Great Banks covers a comparatively short period, and future observations may correct some of the prevailing opinions respecting that fishery. These remarks do not apply to the regular migrations of the halibut, which have been elsewhere discussed.

Fewer references are made to the localities of cod than to those of halibut fishing, and the former relate mainly to certain areas on the Grand Bank which are deserving of special notice. They also furnish an idea of the principal localities where fishing is carried on in the different seasons, and the character of the bait used in different places.

Special localities are designated by Roman numerals to facilitate reference. All of the fishing schooners mentioned by name belonged to ports in the United States and most of them hailed from Gloucester, Mass.

CHART NO. 3.—THE BANKS OF NEWFOUNDLAND.

Bank of Saint Pierre.—Cod and halibut, although once abundant on this bank, were scarce during the few years immediately preceding 1880, and during that period not a single fare of halibut was taken in depths of less than 70 to 100 fathoms, and no good cod fishing was obtained there by American vessels. Since 1880, however, cod have apparently returned to Saint Pierre in as great abundance as ever, and we understand that several vessels from New England secured good fares there in a short time, during 1883 and 1884. Halibut were still scarce up to the last-mentioned date. From 1865 to 1872 this bank was much resorted to for halibut. The spots inclosed by the dotted lines marked I on this chart, and XIV on the chart of the Gulf of Saint Lawrence, were formerly good halibut grounds, but these are not the only localities where this species was taken on the bank.

I. The space inclosed by the dotted line is the so-called "Southern Shoal Water" of the Bank of Saint Pierre, and was formerly the most important halibut ground on the bank.

II. In this position, in a depth of 140 to 170 fathoms, halibut were abundant in 1878, and from May to September of that year the schooner Gwendolen took four or five good fares on a small area of hard bottom, surrounded by mud. Halibut have occasionally been taken since then, but are less common than when the place was first discovered.

Green Bank.—The gullies separating Green Bank from Saint Pierre and the Grand Bank, and the extensive deep plateau that extends from Saint Pierre to the Grand Bank, along the southern border of Green Bank, constitute together one of the most important halibut grounds that has been recently discovered. In their spring migrations, the halibut follow nearly along the course indicated by the dotted line running along the edge of the Grand Bank to the Bank of Saint Pierre. Since the deep-water halibut fishery was begun, in 1875, halibut have been abundant along the edge of the slope south of Green Bank, and have generally been most numerous from February to May. In some years they have been plentiful all summer and even in the fall. In the fall of 1882 one or more good fares of cod were obtained just south of this bank, in 65 fathoms of water.

III. The schooner Nathaniel Webster caught a fare of 80,000 pounds of halibut in this position, in March, 1879, and many other large fares have been taken in the same locality.

IV. Excellent fishing ground for halibut, in depths of 90 to 140 fathoms, from May to October, 1875. In April, 1876, halibut were again very abundant in 80 to 90 fathoms, and were noticed to be moving slowly westward along the edge of the ground. In the position marked, the schooner Howard took a fare of 95,000 pounds of halibut in a few days, and eight or ten other vessels obtained fares at the same time, ranging from 75,000 to 115,000 pounds each. Halibut were found here again, March 25, 1877, March 15, 1878, and February, 1879. In the years succeeding 1875, halibut, though abundant in the late winter and spring, were generally scarce in the summer and fall. In 1882, however, they were exceedingly plentiful during the entire summer and a part of the fall.

V. Halibut abundant in October, 1875.

VI. Large catches of halibut made in April, 1877.

The Grand Bank or Great Bank of Newfoundland.—VII. Good halibut fishing found by the schooner Ocean Belle at this place, in 52 fathoms, in April, 1877.

VIII. First fishing for fresh halibut on the Grand Banks in upwards of 100 fathoms at this place, in April, 1875. The fish were very abundant in depths of 100 to 160 fathoms.

IX. Very good halibut fishing, February, 1879.

X. The schooner G. G. Kidder found halibut abundant here in the spring of 1874 in 90 fathoms, and obtained the first fare of fresh halibut taken in deep water on the Grand Banks.

XI. The area inclosed by the dotted line afforded excellent halibut fishing during several years, the season lasting from February until May. Since 1877 the fish have been scarce here.

XII. In March, 1877, the schooner Howard caught 25,000 pounds of halibut at this place in one day, in 55 fathoms.

XIII. Good halibut fishing, January and February, 1879.

XIV. Halibut very abundant March, 1876, and many good fares obtained. In May, 1879, the schooner Mary F. Chisholm secured a fare of 40,000 pounds.

XV. In the inclosed area many large fares of halibut were caught in February and March, 1866 and 1867. At the spot marked with the cross the schooner Centennial obtained 100,000 pounds in one trip.

XVI. The crosses indicate the position of the halibut fleet in January, 1878, where good fares were obtained in depths of 160 to 200 fathoms. Halibut were scarce here in 1879.

XVII. Halibut were very abundant in the positions indicated by the crosses in the springs of 1876 and 1877, and fine fares were obtained in 150 to 300 fathoms. The edge of the Grand Bank on this side, from its southern end to 44° north latitude, has been one of the best halibut grounds in the Western Atlantic ever since the discovery of the deep-water fishery, and many large fares have been taken at all seasons. The halibut are, however, somewhat erratic in their movements, and are not equally abundant at all times. Those found to the southward of latitude 44° north appear to be moving off from the bank into water too deep for the fishermen to follow them, and all trace of them is lost. North of latitude 44° north they seem to be working along the edge of the bank, and often it is not difficult to trace their summer migrations in the early part of the season.

XVIII. In this position the schooner Stirling, on a "salt trip," made a large catch of halibut in 130 fathoms in April, 1873. This is the first recorded instance of deep-water halibut fishing on the Grand Banks.

XIX. The area inclosed by the dotted line was a favorite halibut ground in the winter and spring for several years previous to the beginning of the deep-water fishery. The schools of halibut were generally migrating towards the west and northwest. This area also furnishes excellent cod-fishing, and is much resorted to by fishermen from the United States, the British Provinces, and France. In the space inclosed at its southern end, and marked "Good Cod Grounds"—cod were very abundant in June, 1877. Good cod-fishing is still found here almost every summer, but halibut are no longer taken in any considerable numbers.

XX. In the position indicated by the cross many fine fares of halibut were caught prior to 1875. This locality is noted for the exceedingly large fare obtained by the schooner Mary Carlisle, in April, 1871, which paid the crew shares of $236 each, the largest ever realized from a fresh halibut trip.

XXI. Halibut abundant in January, 1876.

XXII. This ground, known as the "Eastern Shoal Water," was chiefly resorted to for halibut from 1864 to 1871. After 1869, however, but few halibut were caught here except in the fall. Good fall trips were made as late as 1874. The dotted cross in the western part of the inclosed area indicates where the schooner Mary G. Dennis took a large fare in the spring of 1868, and that in the southeastern part where the schooner N. H. Phillips, in October, 1871, obtained a fare that realized one of the largest stocks ever made on a fresh halibut trip up to that date. Up to within a few years of 1880, the Eastern Shoal Water was also a favorite place for cod in the fall, and sometimes at other seasons. Of late it has not been as much resorted to as formerly. It was on this ground that the "giant squid" were found in such large numbers in the fall of 1875.

XXIII. Halibut were abundant along this edge of the bank in 1881 and 1882, between 43° 30′ and 44° 15′ north latitude, and in depths of 125 to 300 fathoms. The prevalence of icebergs and the strength of the Arctic current render fishing here very difficult and dangerous.

XXIX. Halibut were abundant on and near the Virgin Rocks during the summers from 1868 to 1870, inclusive, and several large fares were obtained. Since 1871 no catches of importance have been made. The Virgin Rocks have been for many years a favorite locality for hand-line dory fishermen engaged in the cod fishery, and in the summer a fleet of vessels lies near the shoals, each one sending out from 10 to 25 dories. The cod average somewhat smaller than on other parts of the Grand Banks, being such as are called "mixed fish" in New England.

XXX. Good cod fishing obtained on trawls with salt clam bait and "shack," April, 1879.

XXXI. Good catches of cod made with capelin bait in June and July, 1877 and 1878.

XXXII. Cod fishing with shack bait good in June and July, 1874 and 1878.

XXXIII. This ground nearly always affords good cod fishing from May to July, with herring, capelin, and squid bait. The fish were very abundant in June, 1879.

XXXIV. Cod very abundant in June, 1875.

XXXV. Good cod fishing with herring bait, May, 1879.

XXXVI. Good catches of cod with squid bait were made in August, 1879.

XXXVII. Good cod fishing with squid bait, July, 1879.

XXXVIII, XXXIX. Good cod fishing with capelin bait, June, 1879.

XL. Good cod fishing with squid bait in August and September, 1879. The inclosed area north of this ground furnished an abundance of cod in July, 1878, when squid bait was used.

Barren ground.—Good fares of cod have been occasionally reported from this area, but we have not been able to obtain any reliable information respecting them.

CHART NO. 4.—THE FISHING BANKS OFF THE COAST OF NOVA SCOTIA.

Seal Island Ground.—This ground is now chiefly valued for the cod fishery which it affords from the first of May to October of each year. It is mostly resorted to by a large fleet of vessels hailing from ports in the vicinity of Cape Sable, Nova Scotia, and commonly called the "Cape Fishermen." These vessels spend most of the season fishing on this ground. A few United States vessels, fishing with hand-lines, frequently resort to it, and it was formerly a favorite locality for halibut, but is not at present.

I. Halibut were found in abundance at this place for a few days in June, 1878.

II. In this position, off the northwestern part of George's Bank, in depths of 110 to 160 fathoms, many good fares of halibut were obtained by hand-line fishermen in 1876 and 1877.

III. The schooner Alice G. Wonson made good fares of halibut in this vicinity, in depths of 160 to 200 fathoms, during several successive years preceding 1880. The prevalence of strong tides and the frequent parting and loss of trawl-lines by their becoming entangled in the large tree corals, *Paragorgia arborea* and *Primnoa reseda*, which are numerous on the bottom, have deterred others from fishing here, and no satisfactory results have been obtained by other vessels.

IV. In the fall of 1877, halibut were abundant along the region indicated by this dotted line, to the westward of Le Have Bank, but since then they have been scarce. The crosses at the eastern end of the line indicate positions where large fares of halibut were obtained from 1877 to 1879. At the easternmost position, the schooner Julia Wood caught 80,000 pounds of halibut in December, 1877. The depths fished in vary from 100 to 400 fathoms.

Sable Island Bank.—The Pot Ground, also called the "Tongue Ground," from its fancied resemblance to a tongue, is frequently an excellent locality for cod fishing in April and May. Since 1880, good fares of cod have been caught in depths of 60 to 90 fathoms on the edge of the bank, SE. by S. to ESE. from the eastern light of Sable Island. From 1852 to 1873 certain localities on Sable Island Bank, in depths of 30 to 60 fathoms, were much resorted to by the halibut fishermen, and since the discovery of the deep-water fisheries, in 1875–'76, many excellent fares have been obtained on the "fall off" of the bank along its southern and eastern edges.

V. This locality, on the eastern part of Sable Island Bank, was a favorite winter halibut ground from 1852 to 1873. It was fished on in the winter as late as 1877, but good fares have seldom, if ever, been taken since 1873.

VI. Several good fares of halibut taken between 1853 and 1868.

VII. Good halibut ground in 1852.

VIII. Good fares of halibut obtained between 1853 and 1873.

IX. Good halibut fishing at intervals from 1853 to 1870. The schooner William T. Merchant obtained a large fare here in February, 1868.

X. One fare of halibut has been taken on this steep incline, which slopes rapidly from 150 to 400 fathoms.

XI. The cross indicates a locality where many excellent fares of halibut were taken from 1877 to 1879, inclusive, in depths of 150 to 300 fathoms.

XII. One of the best deep-water halibut grounds on Sable Island Bank. Many good fares have been obtained; the bottom is covered with bush and tree corals.

XIII. The schooner Howard caught 45,000 pounds of halibut at this place in eight days, in August, 1877.

XIV. Good fares of halibut taken in 60 fathoms, in 1853.

XV. In this position, in July, 1877, the schooner William Thompson obtained a fare of 100,000 pounds of halibut, and the schooner Howard, fishing only six days, a fare of 82,000 pounds, in depths of 125 to 200 fathoms. Many other good fares have been taken in this vicinity at different seasons, and the edge of the bank, over a distance of more than 60 miles, was a favorite locality for halibut up to the close of 1879.

XVI. Position where the type specimen of the gold-banded bush coral, *Ceratoisis ornata*, was taken in 1878. This is one of the most rare and beautiful of the several species of corals obtained on the fishing grounds by the Gloucester fishing schooners.

XVII. Good fares of halibut obtained by the schooner Gertie E. Foster, in 1875–'76.

XVIII. Good fares of halibut taken in depths of 40 to 50 fathoms, from 1853 to 1855, inclusive.

XIX. The Gully is a celebrated halibut region. It extends from 58° 58′ to 59° 57′ west longitude, and from 44° 04′ to 44° 27′ north latitude. In its southern part, between 44° 04′ and 44° 10′ north latitude, there is located a small but important bank, described below. The crosses in the western part of the Gully, numbered XIX, indicate localities where halibut were found in abundance from 1874 to 1876, inclusive. The other crosses all refer to large catches of halibut made from 1877 to 1879, inclusive. In the three years last mentioned, enormous quantities of halibut were taken from this region, and to such an extent were its resources exhausted thereby that in the three or four years immediately following 1879 halibut were exceedingly scarce in the Gully, and during some seasons the fishing was quite unprofitable. In 1884–1885, however, a few good fares were obtained. The small bank in the southern part of the Gully, above mentioned, is separated from Banquereau and Sable Island Bank by narrow gullies, about 150 fathoms deep, the average depth of water upon the bank itself being about 100 fathoms, and the bottom consisting of coarse pebbles, gravel, and stones. Toward the northward the water deepens to 150 fathoms, and toward the south the bottom rapidly falls off to depths of 500 or 600 fathoms. Fishing was carried on in the Gully some years before the bank was discovered, and as it had never been surveyed or plotted on the charts, the fishermen supposed its position was occupied by deep water. It was probably first noticed about 1877, and during a few subsequent years exceedingly good halibut fishing was obtained along its southern edge; but the fish are much less abundant now than they were in the beginning.

Banquereau.—The cod obtained on this bank are, as a rule, small, and it is not as much resorted to now as formerly by fishermen from the United States. A limited number of hand-line dory fishermen and a few trawlers comprise the American fleet of cod fishermen. French vessels, using trawls, fish extensively on the bank north of 44° 30′ north latitude, but are seldom seen farther south. This bank is celebrated for its valuable halibut fisheries, which occur in the deeper water along the edges. The most noted of these are the "Southwest Prong" and the deep plateau off the eastern end.

XX. The first deep-water halibut caught on the Southwest Prong were taken in this position in 1876. The other crosses indicate where large catches were made from 1876 to 1879, inclusive.

XXI. Nearly 500,000 pounds of halibut were taken in this position, on a spot not more than one mile square, in the summer of 1879.

XXII. This locality, called the "Stone Fence" by the fishermen, is noted for the great abundance of corals growing on the bottom. On the Stone Fence and immediately to the north of it, many large fares of halibut have been caught in depths of 150 to 230 fathoms. This locality has shown less signs of becoming depleted than any other lying to the west of it.

XXIII. Halibut were abundant at this place in April, 1879, and several good fares were obtained.

Misaine Bank.—Scarcely anything has been known respecting the fisheries of this bank, and it has generally been regarded by the fishermen as comparatively barren ground. In the summer of 1885, the U. S. Fish Commission steamer Albatross, while engaged in explorations in this region, made a series of trials with hand-lines across the bank from its eastern to its western edge, and found cod fully as abundant as on any of the adjacent fishing grounds, and of as large size and good quality as are taken on Banquerean.

CHART NO. 5.—THE FISHING GROUNDS OF THE GULF OF SAINT LAWRENCE.

I. The first halibut taken on the coast of Anticosti Island were caught in this vicinity in 1869.

II. On this coast, between 61° and 62° west longitude, halibut were sometimes moderately abundant, close in shore, in the summer season prior to 1875. Since then no important catches have been made.

III. In the immediate vicinity of Red Island the fishing schooner Ocean Belle made a fare of 80,000 pounds of halibut in the summer of 1870. As explained in the text, however, this region is controlled by the French, and is not now resorted to by United States vessels.

IV. Moderately large fares of halibut were obtained at the Bay of Islands by American vessels in 1872 and 1874, but nothing of importance has been done since then.

V. The first catch of halibut at Green Point was made in June, 1871, by the schooner William T. Merchant, and in June and July of 1878 and 1879 several very large fares were obtained at the same place.

VI. A few small fares of halibut were obtained in the summer season about Bryon Island and on the shoal between the island and Bird Rocks. This region, however, has never been an important one for any of the Gulf fisheries.

VII. The area inclosed in the dotted line is the so-called "Flint Island Halibut Ground," on which fares of halibut were obtained from 1861 to 1875, especially during the months of May and June. Since the latter date, however, this ground has been practically abandoned by the halibut fishermen.

VIII. In 1861 the schooner Centre Point obtained a fare of 60,000 pounds of halibut in the narrow strait between Scatari Island and Cape Breton. This is supposed to be the first fare of halibut taken in this vicinity.

IX. In this locality the schooner Carl Schurz secured a fare of 90,000 pounds of halibut in April and May, 1879. Many other good fares have been taken in the same place, and also a short distance to the northwestward, in the winter and spring.

X. A fare of halibut was taken at this place by the schooner Centennial in May, 1878.

XI. A fare of 100,000 pounds of halibut by the schooner M. H. Perkins in May, 1879.

XII. Miquelon Beach halibut grounds. Halibut were very abundant here in the summer from 1868 to 1870, but have been scarce since then.

XIII. Pass Island halibut grounds. Fish were very abundant for two or three seasons, from 1870 to 1872, over an area not exceeding three miles across, and with a depth of about 160 fathoms. Many good fares were obtained, but the fish have been scarce since 1872.

XIV. Between 1865 and 1870 many halibut were caught on the northern part of Bank St. Pierre, within and near the dotted line.

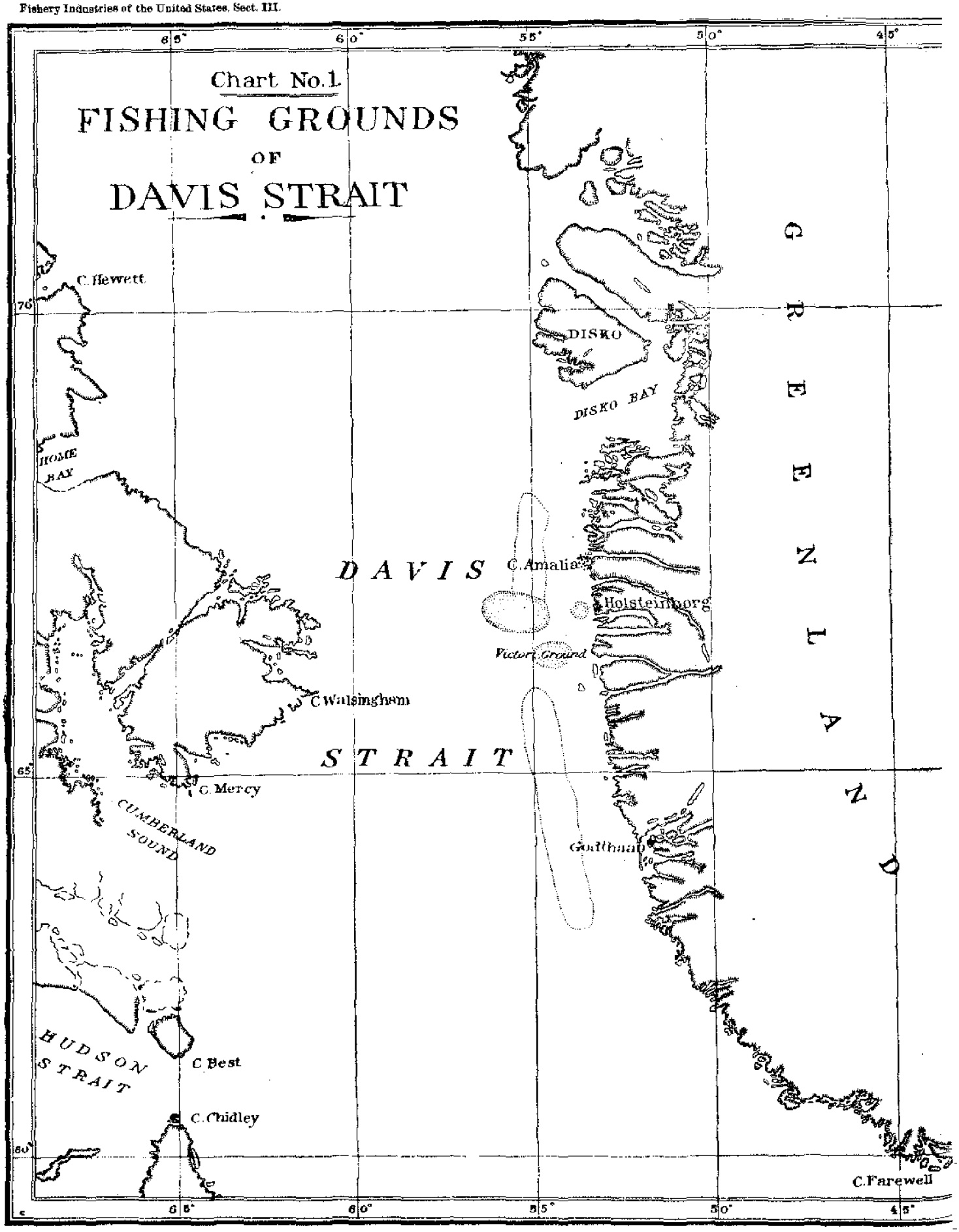


Chart No. 1.
FISHING GROUNDS
OF
DAVIS STRAIT
65°
60°
55°
50°
45°
70°
65°
60°
C. Hewett
HOME BAY
DISKO
DISKO BAY
GREENLAND
DAVIS
C. Amalia
Holsteinborg
Victor Ground
C. Walsingham
STRAIT
C. Mercy
CUMBERLAND SOUND
Godthaab
HUDSON STRAIT
C. Best
C. Chidley
C. Farewell

THE FISHERIES AND FISHING INDUSTRIES OF THE UNITED STATES.

FISHING-GROUNDS.

A.—THE SEA FISHING-GROUNDS OF THE EASTERN COAST OF NORTH AMERICA FROM GREENLAND TO MEXICO.

BY CAPTAIN JOSEPH W. COLLINS AND RICHARD RATHBUN.

1. THE FISHING-BANKS OF DAVIS STRAIT.

The most distant fishing-banks resorted to by the American fishermen on the Atlantic coast are those of Davis Strait, off the coast of Greenland, which abound in halibut and also furnish some cod. They are not much visited by fishermen, on account of the short duration of the fishing season, the possibility of being detained by ice in the passage out, the uncertainty of obtaining a full fare, and the great distance of the grounds from the fishing ports. Notwithstanding all this, however, quite a number of successful trips by Gloucester halibut vessels are on record, and were the localities better known and better mapped out, they might develop into very profitable fishing-grounds. During the summer of 1879, Mr. N. P. Scudder, assistant on the United States Fish Commission, made a trip to this region on the Gloucester schooner "Bunker Hill," and from his report of the cruise we extract the following account of the fishing-banks and their chief characteristics.

From the want of proper surveys it is impossible to mark out, with any degree of accuracy, the exact position and entire extent of these fishing-banks. The Danish charts indicate a line of soundings just off the coast of Greenland, extending from near Disco Bay in the north (about latitude 68° 15′ north) to near Lichtenfels in the south (latitude 63° 20′ north), and ranging in depth from fourteen to seventy-five fathoms and more. Over very extended areas, however, the depths are not greater than thirty fathoms. It is more than likely that these soundings continue farther along the coast toward Cape Farewell, for the reason that icebergs become stranded there, but there is no indication of them on the charts. The distance of the center of this line of soundings from the Greenland coast is about twenty miles, and the fishing-grounds have been stated to lie from twenty to forty miles from land. Immediately outside of the banks, and on the inner side also, there is much deeper water, the slopes being often very abrupt. Only a small area of these fishing-banks have been visited by American fishermen—that portion lying between Holsteinborg and Sukkertoppen, and off Cape Amalia.

That halibut are to be found throughout their entire extent is more than probable, for the species is identical with that taken on the Grand Banks, and we should naturally infer that these fish would be found in all favorable situations within the limits of their distribution. It is also reported that Capt. Rasmus Madison, who has made several trips to Greenland, set his trawls for halibut farther to the south (probably off Godthaab) and found them very abundant, but was unable to secure many on account of the numerous ground sharks, which destroyed his trawls.

The depth of water on the banks ranges from twenty to fifty fathoms, and this makes fishing easier than on the Grand Banks, where halibut can be found abundantly only along the outer slopes in much deeper water. The inner edges of the banks slope abruptly, so as to form between the banks and the main-land a long and narrow submarine valley, whose depth has not been determined. The surface is of a varied character, though generally rocky, with sandy and muddy spots scattered here and there.

The fauna of the banks, as determined at the locality to which the Gloucester fishermen resort, by specimens brought up on their hooks, varies considerably in different localities, and often abruptly. Halibut would take the hook readily in certain places, and very seldom in others close at hand. The former areas were generally found to be covered with immense quantities of an Ascidian, called sea lemon, and the latter with miniature forests of tree corals (Gorgonia). When the fishermen struck the latter kind of bottom they were generally certain not to obtain many fish. While this coincidence may hold good for this one region, it cannot be considered of any importance alone, and the differences probably depend on some other unexplained causes. On the more southern fishing-banks, the presence of Gorgonian corals in no way interferes with the abundance of fish. An examination of the stomachs of the halibut captured in some places disclosed mostly crustaceans and in others mostly small fish. Halibut were the only edible fish caught in sufficient numbers to prepare for market. Some cod were taken, but not enough to pay for salting, and they were eaten on board.

According to Dr. Henry Rink,[1] cod do not spawn on the coast of Greenland. At any rate spawners are very rarely taken, and during the winter cod are wholly absent from the coast. "Sometimes in spring a great many quite young ones arrive at the inlets between 60° and 61° north latitude, which would seem to suggest that their breeding places were not far off, but they generally make their appearance after June 20 on the fishing-grounds, which are situated between 64° and 68° north latitude, at a distance of sixteen miles from the shore, and in July and August resort to the inlets up to about 70° north latitude. With regard to numbers, the occurrence of codfish on Greenland shores is peculiarly variable. Some years, or certain periods of few years, may prove extremely favorable as regards the catch; whereas others turn out a total failure. The number annually caught by the natives may be estimated at somewhat about two hundred thousand fish on an average." According to the same author, "the larger halibut (*Hippoglossus vulgaris*) occurs on the banks, as well as in different places outside the islands, up to 70° north latitude, in depths of from thirty to fifty fathoms. Of late the capture of this fish has become an object of commercial speculation, and foreign ships, chiefly American, have been engaged in it, apparently with better success than that of the codfishing. A halibut of this species weighs from twenty to one hundred pounds, and its flesh is fat and much valued. Superior in taste as well as fatness is the smaller halibut or 'Kaleralik' (*H. pinguis*[2]), which is angled for in the ice fiords at depths of about two hundred fathoms." The other edible fish mentioned by Dr. Rink as inhabiting these fishing-banks are as follows: The lumpfish (*Cyclopterus lumpus*), perhaps the fattest of the Greenland species, which goes inshore in April and May for the purpose of spawning, and forms at this season,

[1] Danish Greenland, its people and its products. English version. London, 1877.

[2] *Platusomatichthys hippoglossoides.*

during a couple of weeks, the chief food in certain places. "The Norway haddock (*Sebastes Norvegicus*) is found only in certain though pretty numerous grounds south of 80° north latitude. The capelin (*Mallotus villosus*) has from times of old yielded the most profitable fishery to the Greenlanders, and may, in a dry state, in winter time, frequently be said to have constituted the daily bread of the natives. They are shoveled on shore by means of small nets, by women and children, and spread over the rocks to dry during four weeks of May and June, when they crowd to the shores of inlets south of 70° north latitude to spawn. This fishery has now considerably decreased, but may still be considered to yield one and a half million pounds weight or more of undried fish yearly."

The best harbors for the fishermen resorting to these banks, in the regions now visited by American vessels, are those of Holsteinborg and Sukkertoppen. Both are good places of shelter. Holsteinborg, the only one visited by Mr. Scudder, is surrounded by the high mainland on three sides, and is shut in on the outer side by several islands. It is thus completely protected from rough water, and the only wind that can enter must come from the side toward the strait, from which direction there are seldom any severe blows. The depth of water is ten to twenty-five fathoms. Holsteinborg and Sukkertoppen are ninety miles apart, and, as the best fishing was found midway between them, there was a good opportunity for running into shelter whichever way the wind might blow. On most of the trips that have been made it has been necessary to make a harbor three, or even more, times a month, on account of severe southwest and northeast winds, which, combined with the strong tides in such shallow water, soon produce a heavy sea.

The best season for fishing on these Greenland Banks is during July and August, although August is preferable to July. This is due to the character of the weather, temperature, etc., at that time, as well as to the greater abundance of fish then on the passage to and from the banks. Mr. Scudder found the temperature during July to vary from 36° F. to 49° F., and during August from 38° F. to 52° F. The mean and maximum temperatures of the surface waters during these months were 38¾° F. and 43¼° F. The climate at this season is, therefore, very favorable for work. The harbor of Holsteinborg is usually open by the middle of May, and fishing might begin by the first of June if vessels were stationed at this place; but the ice coming down the east coast of Greenland blocks up the more southern harbors, and interferes with the passage of vessels north until at least the middle of June. Then, again, winter begins to set in during the last part of August, putting a stop to all operations until the next year. The only icebergs seen by Mr. Scudder came from the south.

The tidal currents are not regular, and near the edges of the banks are very complex. In this locality the tide runs up the strait much longer and with greater velocity than in the other direction. In fact, some days there was no tidal current at all down the strait, but during the time when this current should have been running the water remained slack for seven or eight hours; also, instead of changing every six hours it would do so only twice a day. The greater velocity of the tide running north compared with that running south is probably due to the existence of a regular current on the east side of the strait running up the coast of Greenland. This strong northern flow renders fishing impossible for five or six hours at a time; but as the period of slack is usually equally long, there need not be any great loss of time, as the fishermen can arrange to sleep during the flow and fish during slack water. The nights are light enough in this latitude in July to permit of fishing being carried on at all hours during the twenty-four. The tides and currents are not, however, as simple as the above account would seem to imply; often in changing the position of the vessel only a few miles, an entirely different combination of currents would be met with. The tides running out of the many fiords along the coast of Greenland make

themselves felt a long distance from the shore. The fish seem to take the hook best about the close of the strong tide, and then it is that both hand-lines and trawls are most successfully used.

Temperature observations of the air and water, on the Greenland Fishing-Banks, by Mr. Scudder.

[Latitude about 66° north.]

Date.	Time of day.	Depth.	Temperature.
1879.			°F.
July 6	3 to 4 p. m.	Air	38
		Surface	38¾
		10 fathoms	37¾
		20 fathoms	36¾
		30 fathoms	35¾
		40 fathoms (bottom)	35½
July 7	3 to 4 p. m.	Air	40½
		Surface	36¾
		10 fathoms	37¾
		20 fathoms	36½
		30 fathoms	35¾
		40 fathoms (bottom)	35½
Aug. 2	7.30 to 8 p. m.	Air	44
		Surface	42½
		10 fathoms	39¾
		20 fathoms	38¾
		30 fathoms	38
		37 fathoms (bottom)	37¾
Aug. 5	7 to 7.30 a. m.	Air	46½
		Surface	41¾
		35 fathoms (bottom)	37
Aug. 8	6 p. m.	Air	45½
		Surface	43¾
		24 fathoms (bottom)	37¾
Aug. 20	8 to 8.30 p. m.	Air	44
		Surface	43
		25 fathoms (bottom)	38¾

The last set of observations was taken about forty miles west-southwest from Holsteinborg.

2. THE ATLANTIC COAST OF LABRADOR.

The existence has been known, for a great many years, of very extensive fishing-grounds along the northeastern coast of Labrador, between latitudes 53° and 56° north. As early as 1758, these grounds were visited by American fishermen, and from the collection of the Massachusetts Historical Society for 1792 we extract the following brief description of that region, as obtained from Captain Atkins, who visited it in the former year (1758):

"The coast is very full of islands, many of them very large, capable of great improvement as they have more or less fine harbors, abounding in fish and seal, water and land fowls, good land, covered with woods, in which are great numbers of fur beasts of the best kind. Along the coast are many excellent harbors, very safe from storms; in some are islands, with sufficient depths of water for the largest ships to ride between, full of codfish, and rivers with plenty of salmon, trout, and other fish. The entrance of Hancock's Inlet in 55° 50′ latitude; a very fair inlet; very little tide sets in or out; from fifteen to twenty fathoms of water going in; five hundred sail of ships may ride conveniently in this harbor secure from any storms. On the east side the harbor is a natural quay or wharf, composed of large square stones, some of prodigious bulk. . . . The harbor abounds in codfish, very large, that a considerable number of ships might load there without going outside, which may be cured on the shore and the quay, except in very high tides."

Not very much, however, was ever made known regarding the North Labrador fishing-grounds until 1876. Prof. H. Y. Hind, who had explored them in the interest of the Newfoundland

Government, published a report of considerable length on their extent and character. From this report we have extracted the following more important facts concerning the region:

"The fishing-grounds on the Atlantic coast of Labrador as far north as Sandwich Bay have been occupied to a greater or less extent for one hundred and twenty years. Those extending from Sandwich Bay to Cape Harrison (Webeck) have also been visited by fishing craft for a generation or more; but north of Aillik, about forty miles from Cape Harrison, the coast has only been frequented by Newfoundland codfishing craft during the last fifteen years. . . .

"The leading characteristics of the coast northwest of Aillik are as follows:

"1. The shore line is deeply serrated by a constant succession of profound and narrow fiords, stretching from thirty to fifty miles into the interior.

"2. It is fringed with a vast multitude of islands, forming a continuous archipelago from Cape Hillete to Cape Mugford, averaging twenty miles in depth from the mouths of the fiords seaward,

"3. Outside of the islands, and about fifteen miles seaward from shore, are numerous banks and shoals, which form the great autumnal, spring, and summer feeding grounds of the cod; while outside the shoals there appears to be a second range of banks, which are probably their winter feeding ground.

"4. The island-studded area forms an immense codfishing ground, which covers between Cape Harrison (Webeck) and Cape Mugford a boat fishing-ground (exclusive of the banks or shoals outside) nearly as large as the combined area of the English and French boat fishing-grounds on the chart of Newfoundland.

"For the sake of distinction, I have styled the area under review 'The Northern Labrador fishing-grounds,' beginning at Cape Harrison (Webeck), and, for the present at least, terminating at Cape Mugford."

The following table by Professor Hind shows approximately the area of the boat fishing-grounds about the island of Newfoundland, as compared with those of Northern Labrador. From this table it will be seen that the area of the Northern Labrador fishing-grounds alone, exclusive of the banks, is equal to about five-sixths the entire area of the British and French boat fishing-grounds on the coast of Newfoundland. The area of the inner range of banks cannot be even approximately stated.

Comparative table of the Northern Labrador and Newfoundland Fishing-Ground areas.

[In geographical square miles.]

Cape Harrison to Mugford, 260 miles, average 20 miles deep	5,200
NEWFOUNDLAND BOAT FISHERY.	
French shore, Cape Saint John via Cape Bauld to Cape Ray, 696 miles, by 3 miles deep, shore boat fishing	2,088
South shore of Newfoundland boat fishery, Cape Ray to Cape Race, 573 miles, by 3 miles deep, shore fishery	1,719
East shore of Newfoundland boat fishery, Cape Race to Cape Bonavista, 294 miles, 3 miles deep, shore fishery	882
Northeast shore of Newfoundland boat fishery, Cape Bonavista to Cape Saint John, 225 miles, 3 miles deep, shore fishery	675
Northeast shore of Newfoundland boat fishery, among islands in Bonavista Bay and Bay of Notre Dame, 120 miles, 7 miles deep	840
Area of British Newfoundland boat fishery	4,116
Area of French Newfoundland boat fishery	2,088
Total area of Newfoundland boat fishery	6,204
Area of Northern Labrador boat fishery, Cape Harrison to Mugford	5,200

Professor Hind attributes the formation of the inner banks to ancient glaciers, which once occupied the fiords along the coast. Regarding this subject he wrote as follows:

"But the glaciers of Labrador have probably left even more valuable records in the form of moraines of their early existence here than deep fiords or innumerable islands. These are the shoals or banks which lie some fifteen miles outside of the islands, and on which icebergs strand in long lines and in groups. I have styled them the inner range of banks, to distinguish them from a supposed outer range in deeper water, and where larger icebergs also sometimes take the ground. The inner banks, as far as they are known, are stated by fishermen to have twenty to forty fathoms of water on them.

"Commander Maxwell's soundings, between Cape Harrison and Gull Island, near Hopedale, and just outside of the island zone, rarely show depths greater than forty fathoms. In one instance only, in a distance of about one hundred and ten nautical miles, is a depth of fifty-nine fathoms recorded."

The character of the southernmost portion of the outer or Atlantic coast of Labrador is described as follows by Professor Hind:

"The admiralty chart portrays a very important conformation of the Labrador coast line from Saint Lewis Sound to Spotted Island. The trend between the Battle Islands south of Saint Lewis Sound and the Spotted Islands (Domino River), a distance of sixty-five miles, is due north, and, with very few exceptions, there are no islands throughout this distance off the coast; but as soon as the coast line begins to turn northwest islands are numerous, and continually increase in number as far as Cape Mugford, and even toward Cape Chudleigh. Between Capes Harrison and Mugford the island zone may be estimated as having a depth of twenty miles from the mouths of the fiords seaward. The causes of the general absence of islands south of Spotted Islands probably can be traced to the never-ceasing action of northern ice driven on the coast line, when it suddenly makes its southern bend by the influence of the rotation of the earth upon the Arctic current. This current sweeps past the Labrador with a velocity of from one and a half to two miles per hour, and a westerly pressure due to the earth's rotation estimated at about eleven inches; that is to say, the mean level of the sea, on the coast of Labrador, is about eleven inches above the level it would assume if uninfluenced by the earth's rotation. As soon as the ice-laden current reaches the Spotted Islands, it is in part relieved from this pressure by the trend of the coast from southeast to due south. Hence the current changes its course southerly and on to the land. But the effect of this sudden change in the direction of the current near the shore is to throw the icebergs on to the coast from Spotted Islands to Cape Saint Lewis, where they may be seen stranded each year in great numbers. The islands, which doubtless ever existed here, have been removed by constant attrition acting uninterruptedly for ages, and with the islands the moraines lying seaward. We may then trace the cause of the vast difference between the distribution of stranded icebergs south of Spotted Islands and northwest of them. In some cases they are stranded on and near the coast line, wearing it away and deepening the water near it, assisted by the undertow; in other cases they are stranded some fifteen miles away from the island fringe, and are continually adding to the banks the *débris* they may bring in the form of mud streaks from the glacier which gave them birth in the far north and northeast.

"It is more than probable that this distribution of icebergs has a very important bearing upon the food and feeding grounds of the cod, which justifies me for referring here in so much detail to the action of glacial ice."

The following additional accounts of the Northern Labrador fishing-grounds, their faunæ, etc., are also extracted from the report of Professor Hind:

RELATION OF THE CODFISH TO STRANDED ICEBERGS.—"Upon what forms of life do the codfish feed on the Northern Labrador coast, where the summers are so short, the capelin, the herring, the squid, and even lance comparatively scarce, and where icebergs continually abound? The answer may be expressed in one word—crustaceans. These are infinite in number, from the minute sea lice of the fishermen to a large crustacean resembling a prawn. Crabs, too, are very numerous, as well as mollusks. Although the capelin ceases to appear on the coast in large shoals above the latitude of Nain, the herring is not numerous beyond Wkkasiksalik, the squid is not found beyond Domino River, and the lance is the only known Southern Labrador fish which visits the northern coast in great numbers, yet crabs, prawns, and 'herring bait,' with medusæ, occur in vast numbers, and form, with mollusks, the chief food of the cod. The officer in charge of the Hudson's Bay Company's post of Wkkasiksalik informed me that at the more remote northern Hudson's Bay post, if seals were left in the fall of the year for a single night in the nets, the head was sure to be cleaned to the bone by the prawns. He also stated that in the northern water, opposite Hebron, Lampson, and Mactiwack, the cod feed on a small fish bearing a great resemblance to the ordinary tommy cod, but the crustaceans were their chief food. The connection existing between ice and the food of the cod is not apparent at the first glance, but when it is borne in mind that infusorial forms abound in sea water in the immediate vicinity of Arctic ice, and that on these minute creatures larger forms of life find sustenance, which again become the food of crustaceans and different species of fish upon which the cod are nourished, the chain is complete, and the relation of stranded icebergs to fish life on the Labrador coast becomes apparent. It has been shown by the labors of the United States Fishery Commission that the cod, which once existed to a large extent on the New England coast, has been starved out by the destruction of its food, and valuable fisheries ruined, but not beyond the power of restoration if the remedial measures suggested are faithfully carried out and sufficient time allowed. But on the Labrador, particularly the northern portion, through the unfailing advent of Arctic ice, a perennial supply of food is indirectly supplied to the cod, forbidding the idea of starvation on these coasts.

THE INNER RANGE OF BANKS.—"The foundations of the inner range of banks consist very probably, as stated, of glacial moraines. In their present state they may reasonably be assumed to be formed in great part of remodeled *débris*, brought down by the same glaciers which excavated the deep fiords. The absence of deposits of sand in the form of modern beaches on every part of the Labrador coast visited this season (except one) was very marked. The exceptional area observed lies between Sandwich Bay and Hamilton Inlet, Cape Porcupine being the center. It is protected from the northern swell of the ocean by the Indian Harbor Islands and promontory. Here larger deposits of sand are seen, covering many square miles in area. The reason why sandy beaches are not in general found on this coast, notwithstanding that enormous quantities of rock are annually ground up by the coast ice and ice pans driven on the shore, arises from the undertow carrying the sand seaward and depositing it on the shoals or banks outside of the islands. The undertow on this coast is remarkably strong, and it aids the formation and extension of the inner range of banks, and consequently of the feeding and spawning grounds of the cod to a very great degree.

"It may be advisable here to advert to a popular error, which assumes that the depth of water in which an iceberg grounds is indicated by the height of the berg above the level of the sea. It is commonly stated that while there is one-ninth above there will be eight-ninths below the sea

level. This is approximately true only with regard to the balance of a mass of the berg, not with regard to height and depth. A berg may show an elevation of one hundred feet above water and yet its depth below may not exceed double that amount; but its volume or mass will be about eight times the mass over the surface. Hence, while icebergs ground in thirty and forty fathoms of water they may expose a front of one hundred feet or three hundred and fifty feet, the broad massive base supporting a mass about one-ninth of its volume above the sea level."

As to the movements of cod, Professor Hind frames the following table:

Table showing the approximate mean date of arrival of cod, mean date of departure, and mean length of the fishing season for cod in Northeastern Newfoundland, Southern and Northern Labrador.

NEWFOUNDLAND.

[Over 4 degrees of latitude. Mean length of fishing season, 143 days.]

Latitude.	Locality.	Mean date of arrival.	Mean date of close of fishery.
° ′			
47 30	Conception Bay	June 1	Nov. 20
48 20	Bonavista Bay	June 10	Nov. 10
48 30	Notre Dame Bay	June 20	Nov. 10
50 00	Cape Saint John to Partridge Point	June 20	Nov. 1
49 30	White Bay	June 10	Nov. 1
51 00	Cape Rouge Harbor	June 10	Nov. 1
51 30	Cape Bauld to Cape Onion	June 20	Oct. 20

SOUTHERN LABRADOR (ATLANTIC COAST).

[Over 3 degrees of latitude. Mean length of fishing season, 87 days.]

52 00	Chateau Bay	June 20	Oct. 1
	Batteaux	July 12	Oct. 1
54 30	Indian Harbor	July 15	Oct. 1
54 54	Cape Harrison	July 18	Oct. 1

NORTHERN LABRADOR.

[Over 3½ degrees of latitude. Mean length of fishing season, 52 days.]

55 09	Aillik	July 20	Oct. 1
55 12	Kypokok	July 20	Oct. 1
55 27	Hopedale	July 20	Oct. 1
53 30	Double Island Harbor	July 22	Oct. 1
56 00	Wkkasiksalik	July 28	Oct. 1
56 30	Nain	July 28	Oct. 1
57 30	Okak	July 28	Oct. 1
58 30	Hebron	Aug. 15	Sept. 25
58 48	Lampson	Aug. 15	Sept. 25

From this table the following law is deduced:

"Over an area extending northerly from Conception Bay for seven hundred miles the cod approach the shore about one week later for every degree of latitude we advance to the north. These tables show also that for a period of about forty days the codfishing goes on simultaneously during August and September, throughout the length of a coast line extending from latitude 47° to latitude 58° 30′ in one continuous line, or more than seven hundred statute miles; hence it appears that the migrations of the shoals of this fish are merely from deep-water winter fishing-grounds to the nearest coast spawning-grounds, and from the coast to the nearest deep-

water feeding-grounds again. The coast migrations during the summer months appear to be of equally limited extent, and shoals of cod frequenting any particular coast may be said to be indigenous to it. On the Labrador, and especially in such known deep bays as Hamilton Inlet, the coast movements of the fish appear to be very regular, and determined to a large degree by the tidal currents. The capelin generally precede the cod by a few days, and these fish are known to approach the coast and enter the sandy coves for the purpose of spawning. The same law which guides the movement of the cod affects also the spawning of the capelin. I saw numerous shoals of this fish spawning in Trinity on the 27th of June. A month later they spawn in Kypokok Bay, and still later further to the north."

PRESENT STATUS OF THE NORTHERN LABRADOR FISHERY.—"About four hundred fishing craft, from eighteen to ninety tons burden, are supposed to have passed Cape Harrison this season (1876). Taking the average of the entire fleet, they carried each eight men, three fishing-boats and one shore boat. Out of the thirty-two hundred hands we may assume that twenty-four hundred were actually engaged in fishing. The estimated catch was sixty quintals per man, or *in the aggregate one hundred and forty-four thousand quintals. This work was accomplished in* an average aggregate of twenty-four fishing days, and to a large extent with the jigger, that is, without the use of bait. The average weight of the fish is about three pounds fresh. Allowing one hundred and thirty fish to the quintal, the number taken would be about eighteen millions; the number wounded and lost about four million five hundred thousand, although some fishermen consider that one fish out of three is wounded by the jigger and lost when the fish are very numerous."

We have quoted this report of the Labrador fishing-banks so much in detail mainly for its many valuable suggestions bearing upon several of the more southern fishing regions, which have not yet been so carefully studied. It is not probable, however, that American vessels will resort to these distant grounds for some time to come, or until forced to do so by the scarcity of cod in regions nearer home. The size of the Labrador cod is also below the standard recognized in United States markets.

Herring occur at various points along the coasts of Labrador, between the Straits of Belle Isle and Cape Harrison, and are principally taken in the vicinity of the bays and harbors resorted to by the vessels engaged in the cod fisheries of that region. This fishery is in season during the summer, but has at no time been very extensive.

3. THE EASTERN AND SOUTHERN COASTS OF NEWFOUNDLAND.

THE EASTERN COAST.

The eastern coast of Newfoundland furnishes a vast area of boat fishing-ground for cod, extending from Cape Race to the Straits of Belle Isle. Along the same side of the island, squid, capelin, and herring abound to a greater or less extent, and are taken for use as bait principally. There are no fishing-banks off this coast excepting at the southeast corner, just off which the Grand Banks are located. According to Prof. Henry Y. Hind, the extent of the shore codfishing-grounds on the eastern side of this island is as follows:

[In geographical square miles.]

Cape Race to Cape Bonavista, 294 miles, 3 miles deep	882
Cape Bonavista to Cape Saint John, 225 miles, 3 miles deep	675
Among the islands in Bonavista Bay and Bay of Notre Dame, 120 miles, 7 miles deep	840
Cape Saint John to Cape Bauld, French shore, 300 miles, 3 miles deep	900
Total	3,297

The first three estimates given in the above table are exactly as Professor Hind states them; but the fourth estimate has been extracted from his enumeration of the entire French shore, Cape Saint John to Cape Ray, via Cape Bauld, which lies at the outer entrance to the Straits of Belle Isle, on the Newfoundland side. The table given in his report on this region includes the entire French shore in a single item. According to the same authority, the length of the fishing season along the different portions of this coast and the mean date of arrival and departure of the cod for the same are as follows:

Table showing the approximate mean date of arrival of cod, mean date of departure, and mean length of the fishing season for cod on the eastern side of Newfoundland.

Latitude.	Locality.	Mean date of arrival.	Mean date of close of fishing.	Mean length of fishing season.
° ′				
47 30	Conception Bay	June 1	Nov. 20	143 days.
48 20	Bonavista Bay	June 10	Nov. 10	
48 30	Notre Dame Bay	June 20	Nov. 10	
50 00	Cape Saint John to Partridge Point	June 20	Nov. 1	
49 30	White Bay	June 10	Nov. 1	
51 00	Cape Rogue Harbor	June 10	Nov. 1	
51 30	Cape Bauld to Cape Onion	June 20	Oct. 20	

With reference to the construction of this table Professor Hind says: "In framing these tables I have been careful to eliminate extreme seasons, for the cod have been known to approach the shore during an exceptionally early season a fortnight or three weeks sooner than during the average of years. Although squid are abundant along the entire eastern coast, they are principally taken as bait to sell to the United States bank fishermen, toward the southeastern extremity of the island, in Conception, Trinity, and Bonavista Bays. Within the past few years this region has also been resorted to by a few American vessels, who obtain cargoes of squid, principally by purchase, to sell to the French fishermen at Saint Pierre. This traffic has also been participated in to some extent by the provincials, and small steamers have occasionally been employed to collect cargoes at Conception and Trinity Bays, and, perhaps, farther north. Capelin also abound between Saint Johns and Cape Race, and are taken by the natives for the same purpose as the squid. The principal localities furnishing this bait are Saint John's, Broyle Harbor, and Bay of Bulls. The United States fishermen visit this coast only to obtain bait."

Notwithstanding the privileges granted by the Washington treaty, and the award made by the Halifax Commission in payment for the right to fish in these, as well as in the other, provincial coast waters, United States fishermen have been frequently interfered with in the matter of fishing for bait along the southeastern shores of Newfoundland, and the natives have even gone so far as to refuse to sell bait to them, while at the same time they have threatened armed resistance to any persons who should attempt to fish for bait in waters adjacent to the shores. This direct violation of existing treaties has often resulted in the loss of much time to the fishermen, who have been obliged to go elsewhere in search of bait.

THE SOUTHERN COAST.

The fisheries carried on on the southern coast of Newfoundland are for cod, herring, capelin, and squid, and to some extent also for halibut. Herring are taken by the natives to supply the winter trade in frozen fish and to sell to the bank fishermen as bait, and for the latter purpose capelin are also taken in large numbers. The shore fishing-grounds for cod extend along the entire

southern coast of Newfoundland from Cape Race to Cape Ray. Fishing is mostly done from small, open boats, but also, to some extent, by vessels which go as far out as five to ten miles from shore, where the water is of a suitable depth. They seldom fish, however, in deeper water than from fifty to seventy-five fathoms. The fishing-grounds are so continuous that the natives can generally obtain fair fishing without going far from home. The fishing season for cod is from April to October. When in pursuit of capelin and squid, the cod approach so near the shore that they can often be taken in seines and in traps, which do not in many cases extend more than fifty fathoms from shore. The latter mode of fishing has been introduced since 1878, and has been more efficient than the former methods of using seines and lines. The boat fishermen depend principally on hand-lines and trawls, but in the spring, when bait cannot be obtained, they often use a jigger, which is also employed on other parts of the coast.

Off Pass Island, there is a small tract in about one hundred and sixty fathoms, not over five to eight square miles in extent, where halibut were found in considerable abundance for two or three years, from 1870 to 1873. During those years a considerable number of United States vessels resorted to this region, but the grounds soon became exhausted, and little or no fishing has been done since. More recently halibut have been taken off Burgeo Island. The best halibut fishing near this coast has been obtained about thirty miles from the main-land, longitude 58° west and latitude 47° 8′ to 47° 10′ north, over an area about ten or twelve miles square, in depths of one hundred and forty to two hundred and fifty fathoms. This region is now much resorted to for a short period in the spring and sometimes even in winter. Famous halibut grounds once existed off the beach between the larger and smaller Miquelon Islands, in four to eight fathoms, and also in the channel between Saint Pierre and Miquelon. The presence of the halibut there was due to their following the capelin to the shore. The capelin usually remain about a month, and the halibut seldom stay longer, if as long. Halibut are rarely taken now at Miquelon beach in large numbers. Fortune Bay has been the great resort for vessels engaged in the frozen-herring trade since 1865, but this trade is not so extensive now with Newfoundland as it has been in former years, having been largely transferred to New Brunswick. The many long and deep arms of the sea which indent the southern coast of Newfoundland are frequented by immense schools of herring during the winter and spring months. Cargoes can frequently be taken at numerous points along this shore, but, as above stated, Fortune Bay constitutes the principal fishing-ground. This bay is sixty-five miles long and thirty-five miles wide at the mouth, but it gradually narrows toward the center, where it varies in width from ten to twenty miles. The southern coast, although quite rugged and bold, is less so than the northern, and has several sloping shores with sand beaches. The northern coast is cut into by numerous deep and narrow bays or fiords, which are favorite spawning grounds of the herring. Long Bay, the principal fishing point, is usually covered with ice in the winter through much of its extent, but the lower portion remains open and permits of the seining and netting of fish. Among other harbors formerly and now resorted to are Saint Jacques, Bay the North, and Rencontre. The numerous deep coves and harbors on the north side of Fortune Bay, as well as the sandy shores of the south side, afford seining grounds for herring during the spring and early summer. Many herring from these places are sold in the spring to the United States bankers and to the French fishing fleet at Saint Pierre. The capelin are caught with seines on the beaches of Fortune and Placentia Bays, and taken in small vessels to Saint Pierre by the Newfoundlanders, who sell them there fresh to the French. They come in June and remain from four to six weeks. The fishing is done entirely by natives, as in the case of herring, and the catch is sold to the same fishing fleets. As a rule, the French salt

both their herring and capelin bait, but the Americans preserve theirs in ice. The herring remain on this coast more or less through the capelin season and generally all summer; but while the latter fish are on the herring fisheries of Fortune and Placentia Bays are more or less neglected, many of the fishermen of those regions limiting themselves chiefly to supplying the French fishermen with capelin.

The American vessels generally obtain their supplies of capelin north of Cape Race, where the method of capture and preservation is the same as at the south. Placentia Bay is resorted to by American vessels for both herring and capelin bait, but is visited for this purpose much less than Fortune Bay and other localities. Squid are taken for bait in Placentia Bay and other places along the south coast, but, as a rule, the American vessels obtain their squid bait from the bays and harbors on the east side of the island. A species of turbot was formerly taken in considerable numbers in Fortune Bay and vicinity during the winter season from 1855 to 1875. They were generally frozen and sold to the captains of American vessels, who in turn sold them at New York and Boston. Since the decline of the frozen-herring trade in this region, comparatively few American vessels visit it in the winter season, and the turbot industry has ceased, for a time at least, although the fish are probably as abundant now as at any previous time.

4. THE GULF OF SAINT LAWRENCE.

GENERAL ACCOUNT.—Fully one-half of the area of the Gulf of Saint Lawrence, including the bays and channels leading into it, has a depth of water less than sixty fathoms. This shallow portion, which borders the northern and eastern shores of the Gulf to a distance of from six to ten miles from land, but which comprises all the southwestern third at least, forms a more or less continuous fishing-ground of great value and importance. Of late years, as the fisheries of the outer banks and the Gulf of Maine have been more and more developed, United States vessels have resorted to the Gulf of Saint Lawrence much less than in times past, and we are now rapidly becoming independent of this once much coveted fishing-ground.

The western coast fishing-grounds of Newfoundland, from Cape Bauld to Cape Ray, according to Prof. H. Y. Hind, constitute a boat-fishing area for cod nearly four hundred miles long by about three miles deep. The rights of this fishery belong to the French by treaty, a privilege also enjoyed throughout most of its extent by citizens of the United States. A similar fishing-ground, though of less importance, borders the northern coast of the gulf and the island of Anticosti. Places worthy of note along this shore are the Natashquan cod-bank and the Mingan Islands. This group of very small islands lies between the western end of Anticosti and the north shore, and between the meridians of 63° and 64° west longitude. About sixteen islets, the largest not over five miles long, with a number of small rocky spots, are marked out on the admiralty chart as composing the Mingan Islands. Their distance from land varies from two to seven miles, the depth of water among and about them varying from four to forty-seven fathoms. They are scattered irregularly, the bottom between them consisting of sand, gravel, rocks, and shells.

The southwestern portion of the Gulf furnishes by far the most extensive and important fishing-grounds. The area within the limits of the sixty-fathom line reaches about one hundred and eighty miles eastward from the coast of New Brunswick and about one hundred and forty miles northward of Nova Scotia, and includes the well-known Magdalen Islands and Bradelle Bank.

There is great uniformity in the depth of water and the character of the bottom nearly everywhere, the bottom being generally rocky and diversified with areas of greater or less extent of sand, gravel, or mud.

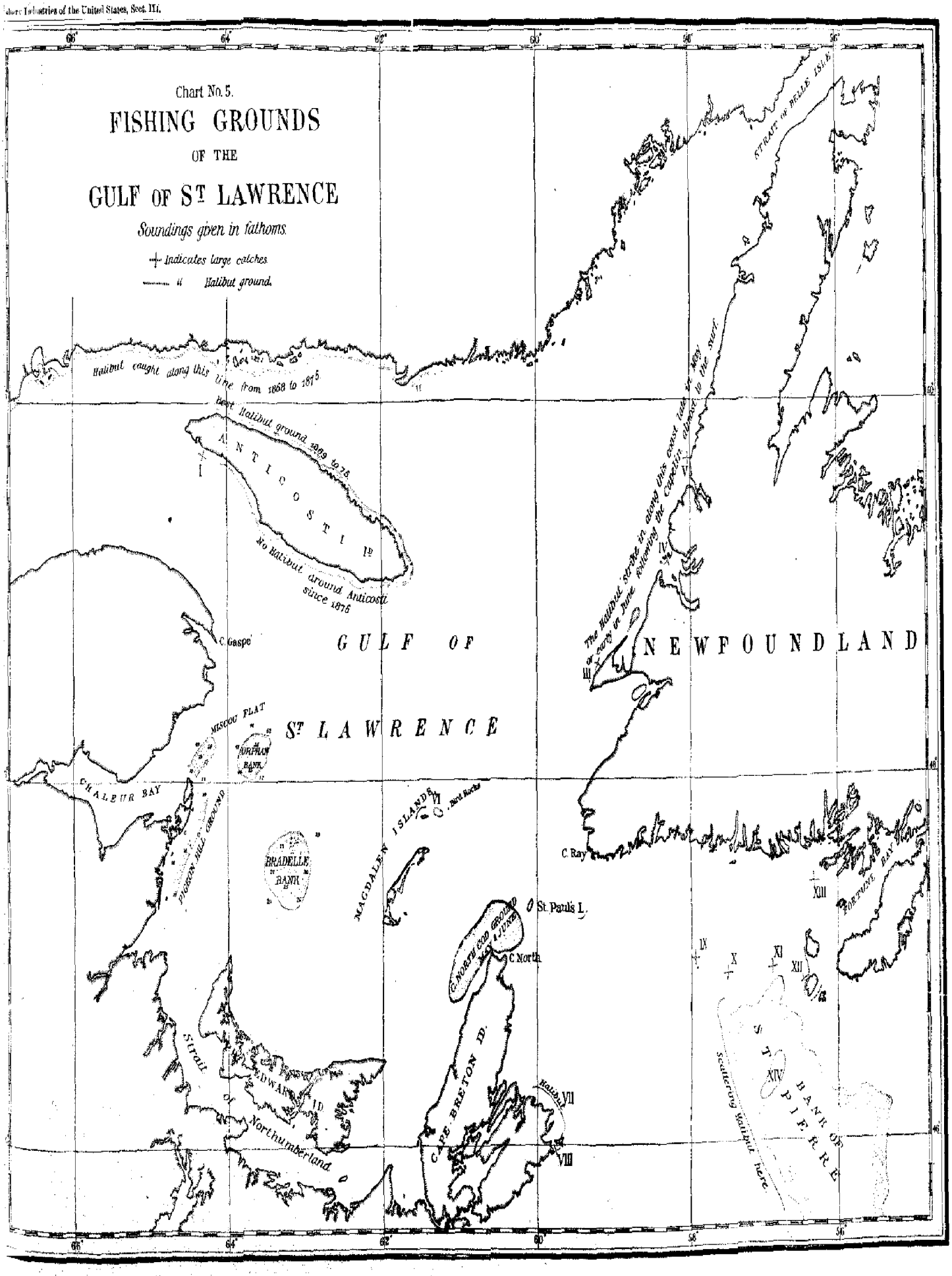


Chart No. 5.
FISHING GROUNDS
OF THE
GULF OF ST LAWRENCE
Soundings given in fathoms.
Indicates large catches.
" Halibut ground.
Halibut caught along this line from 1868 to 1875
Best Halibut ground 1869 to 75
ANTICOSTI ID
No Halibut around Anticosti since 1876
C. Gaspé
GULF OF
ST LAWRENCE
NEWFOUNDLAND
The Halibut strike in along this coast late in May or early in June following the capelin almost to the surf
STRAIT OF BELLE ISLE
MISCOU FLAT
ORPHAN BANK
CHALEUR BAY
PIGEON HILL GROUND
BRADELLE BANK
MAGDALEN ISLANDS
Bird Rocks
C. Ray
St. Paul's I.
C. North
C. NORTH COD GROUND MAY & JUNE
CAPE BRETON ID.
Halibut
Strait of Northumberland
EDWARD ID
FORTUNE BAY
BANK OF ST PIERRE
Scattering Halibut here
I
II
III
IV
V
VI
VII
VIII
IX
X
XI
XII
XIII
XIV
66°
64°
62°
60°
58°
56°
48°
46°

ORPHAN BANK, which lies thirty-five miles a little north of east of Miscou Island, at the mouth of Chaleur Bay, is of very limited extent. The shallowest sounding upon it, as indicated on the admiralty chart, is twenty-five fathoms, and this appears in only one spot, while about it and within a radius of eight miles are marked from thirty-five to fifty-three fathoms. The character of the bank and its fauna are thus described by Mr. J. G. F. Whiteaves:

"The Orphan Bank, which is situated off the entrance to the Bay des Chaleurs, is a stony patch, as are most of the inshore fishing-banks, many of which are not indicated or defined on the charts. The masses of rock are usually large pieces of reddish sandstone (often perforated by two species of boring bivalves, the *Saxicava rugosa* and *Zirphæa crispata*), with a small proportion of pieces of Laurentian gneiss, etc. Animal life is profusely abundant here, which is undoubtedly the reason why cod, mackerel, etc., frequent this and similar banks in such enormous numbers. Soft-bodied organisms of various kinds give a special facies to this particular one. These are incrusting sponges; tunicates of many genera and species, some of unusual size; an *Actinia* (*Metridium*); the common northern *Alcyonium* (*rubiforme*); *Alcyonidium gelatinosum*; Hydrozoa and Polyzoa, in great profusion, etc. Among the harder forms are an abundance of the commoner Echinoderms, with a few scarce species; large calcareous Polyzoa, and a large number of fine Crustacea. Shells are tolerably numerous, though not nearly so much so as on the Bradelle Bank, and Annelids were relatively scarce."

The character of the bottom on "Miscou Flat" and about the Magdalens is very similar to that of Orphan Bank, while it is probable that the Pigeon Hill Ground more nearly resembles Bradelle Bank.

BRADELLE BANK.—The Bradelle Bank is of much greater extent than the Orphan Bank. Its center lies about fifty miles west by north of Grindstone Island, Magdalen Islands, and, as laid down on the charts, it covers an area of about thirty miles long from north to south, by about twenty miles broad from east to west. The deepest sounding near the edge is about thirty fathoms and the shallowest twenty fathoms; the soundings mostly range from twenty-one to twenty-five fathoms. The distance from the center of Bradelle Bank to Orphan Bank is about forty miles, the greatest depth between being fifty fathoms. The greatest depth between Bradelle Bank and the Magdalen Islands is from thirty-six to forty-two fathoms. The bottom and faunal characters of Bradelle Bank are described by Mr. Whiteaves as follows:

"The Bradelle Bank is also a stony patch, but the pieces of rock are usually small, and there is a greater admixture of gravel, sand, and mud on this bank than upon the Orphan. Soft-bodied animals appear to be scarce upon the former, and shells occur in unusual abundance. The assemblage of Hydrozoa, Echinoderms, Polyzoa, and Crustacea is much the same on both banks, though a few peculiar species were found on each. The rarer forms found at these two places will be catalogued in the second part of this report. While the animal life of the shores of Cape Breton (except in deep water), of those of the Magdalen group and of Prince Edward's Island, as well as that of the whole of Northumberland Strait up to the southern entrance to the Baie des Chaleurs, is of an Acadian or Southern type, the fauna of the Orphan and Bradelle Banks has a decidedly Arctic or Northern character. The Bradelle Bank, in particular, presents the phenomenon of a small patch tenanted by an assemblage of marine animals which usually inhabit very cold water, and almost entirely surrounded by another series, which are for the most part prevalent where the bottom is warmer and more affected by surface conditions of temperature."

MISCOU FLAT is a stretch of rocky shoal ground that makes out from Point Miscou in an east-southeast direction a distance of nearly twenty miles. There is depths of water upon it of ten to twenty-two fathoms, the bottom gradually falling off to the outer part.

PIGEON-HILL COD GROUND consists of the shore soundings (four to seventeen fathoms) that lie from ten to twenty miles southeasterly from Shippegan Island, New Brunswick, and extends southward along the coast about eighteen to twenty miles.

Codfishing is pursued on all of these grounds—Bradelle Bank, Orphan Bank, Miscou Flat, and Pigeon-Hill Ground—only during the warm seasons of the year (May to October).

The abundance of cod, especially of large fish, varies somewhat with the different seasons, their presence in greater or less numbers being governed to a large extent by the amount of food (herring, mackerel, etc.) on the ground. Miscou Flat and Orphan Bank are noted for large codfish. There are sometimes what appear to be two schools of codfish at the same time on these banks, one of which is caught in the day-time and the other only at night. The first is of small size, but the second is extraordinarily large, being larger than are found at any other locality.

The fishing is mostly carried on by residents of the vicinity in small boats, although some Nova Scotia vessels and a limited number from the United States sometimes engage in it.

MAGDALEN ISLANDS.—The Magdalen Islands, which lie about fifty to sixty miles northwest of Cape Saint Lawrence, Cape Breton Island, form an elongate chain trending in a northeast and southwest direction. The total length of the chain with its outlying rocks is in the neighborhood of fifty to fifty-five miles.

The main group consists of five or six small islands, separated by narrow channels varying in width from a few rods to half a mile. Its greatest length is thirty-six miles and its greatest breadth about five or six miles. The shores of these islands are quite irregular, being very bold and rocky in some portions and in others formed of stretches of sand.

The entire group lies toward the eastern edge of the sixty-fathom limit, but is wholly included within it. The surrounding area, within a distance of five or seven miles of the islands, ranges in depth from four to eighteen fathoms, and contains many small scattered rocky spots or reefs reaching to near the surface of the water. The bottom, as indicated on the charts, is made up of sand, shells, stones, and rocks. A reddish sandstone predominates in the shoal water about the islands. Between the shallower soundings of the islands and Cape Breton Island the depth ranges from twenty-four to seventy-five fathoms, the deepest water extending close along the Cape Breton Island coast. Formerly, when hand-lines alone were used, codfishing was carried on to a considerable extent around the entire group of islands; but since the introduction of trawls United States fishermen have found it more profitable to resort elsewhere. The so-called "sharp bottom" of the region, due to the many rocks and stones scattered about, unsuits it for trawl fishing. Now the codfishing is almost wholly carried on in the open boats of the resident fishermen and by the small vessels belonging to the British Provinces and the French Islands of Saint Pierre and Miquelon. A few catches of halibut have been taken on the shoals about Byron Island, but the appearance of these fish in that locality is so uncertain that the halibut catchers rarely go there.

CAPE NORTH FISHING-GROUND.—Around the northern end of Cape Breton Island is located a codfishing-ground which is of considerable importance for a few weeks in the spring and early summer. It lies between Cape North and Saint Paul's Island, at a distance of four to fifteen miles from land; thence it extends westerly about fifteen miles, and southwesterly, along the coast of Cape Breton Island, as far as Limbo Cove. The shore here is high and steep, so that, notwithstanding the close proximity of the fishing-ground, the depth of water upon the latter is from sixty-five to one hundred fathoms. The bottom is mostly tough clay, but ten to fifteen miles from land some rocky ridges exist. The current sets out from the Gulf of Saint Lawrence toward the southeast, over a portion of the ground, although the direction changes more or less with the trend of the shore.

Strong westerly winds increase the strength of the current, which after a long continuation of them sometimes runs at the rate of two to three miles an hour. As a rule, however, the tides run slowly. Fishing is often hindered by floating field ice, which sometimes prevents the vessels from reaching the grounds until late in the season. About 1860 and 1861, cod and halibut were found abundantly on these grounds; but later the halibut almost wholly disappeared, and for several years they have been taken only occasionally. Cod are still quite plentiful in May and June, at which time they are moving slowly in by the head-land, on their way to the shoaler grounds of the Bay of Saint Lawrence.

This fishing-ground is resorted to by both provincial and United States vessels, but, owing to the difficulties alluded to above, the fleet is usually small.

COD AND HALIBUT GROUNDS.—Vessels from the United States used to frequent the Gulf of Saint Lawrence both for cod and halibut, but mainly for the former species, until the trips became unprofitable from the scarcity and small size of the fish obtained, and until the introduction of trawls, with which better results could be obtained on the outer fishing-banks. Vessels on their way to Northern Labrador would sometimes harbor along the shores of the Straits of Belle Isle, and fish from small boats to make up a portion of their catch. Several attempts were also made for cod by Gloucester vessels on the Natashquan cod-banks, Southern Labrador, but the trips never paid, and the grounds have since been neglected.

From 1868 to about 1875, Gloucester vessels resorted to the southern coast of Labrador, between the parallels of 60° and 66° west longitude, and the coast of Anticosti in search of halibut. These fish approach quite close to the shores in pursuit of capelin or other small fish, and were caught in considerable numbers within two or three miles of the coast, in five to twelve fathoms of water. As a rule, the halibut were of medium size and fine quality, but they were not nearly so plentiful as in the more recently worked "deep water" of the outer banks. The principal disadvantage of carrying on this fishery was that the bait (herring) had to be obtained in the southern part of the Gulf, and would often become old and unfit for use before a school of halibut could be found, as it sometimes happened that a long stretch of shore would have to be skirted in search of the fish; the distance from market was great, and head winds were usually encountered on the passage, at least as far as Canso, and, finally, the fish decreased so much in numbers that the trips would no longer pay. Vessels have visited this region within three years, but none of them have secured good catches. The halibut grounds of Anticosti were mainly on the northern side of the island, with the same depths of water as on the Labrador coast.

The western coast of Newfoundland likewise furnished cod and halibut grounds in former years for United States vessels, but they have also been nearly deserted for the outer banks. The principal localities where halibut were taken were Saint George's Bay, Red Island, Port au Port Bay, Bay of Islands, and Green Point; but no important catches have been made in any of these places excepting Green Point for a number of years. Green Point was given up at the same time as the others, but fishing began there again in 1878, and more or less fish have been taken nearly every year since. At Red Island, a French fishing station, foreign vessels are not permitted to fish, but in a few instances the Gloucester vessels were allowed to carry away all the halibut they could secure by giving over to the French fishermen whatever cod were taken on their hooks. This practice has since been abandoned, however, and United States vessels have never resorted extensively to this region for cod. Several trials for cod were made in the winter of 1861 and 1862, but such small fares were obtained as to discourage the fishermen. Similar attempts have been occasionally made since then, but always with the same results, due perhaps more to the severity of the weather than to the scarcity of fish. It should be remembered, however, that all these attempts were made in

winter, while the provincials and French fish here for cod only in the summer. Much better cod grounds, however, lie nearer the coasts of the States.

MACKEREL GROUNDS.—No positive rules can be laid down as to the appearance of mackerel on the several grounds of the Gulf of Saint Lawrence. Formerly, when these grounds were largely resorted to by vessels from New England, the fishing was principally carried on in the early part of the season (June and July) north of Prince Edward's Island and between there and Cape Gaspé. This section embraced the "West Shore" from Escuminac to Point Miscou, the Bay of Chaleur, Bradelle Bank, Orphan Bank, and the adjacent waters. Later in the season, August and September, the vessels generally visited the waters along the north side of Prince Edward's Island and about the Magdalen Islands. During some years, however, the fishing was continued on the first-mentioned ground throughout the entire summer. As the season advanced, mackerel were generally found in the greatest abundance in the extreme southern parts of the Gulf, especially about the eastern point of Prince Edward's Island, the north side of Cape Breton Island, in Saint George's Bay, and also about the Magdalen Islands. The principal points where good catches were usually obtained on the coast of Cape Breton were in the vicinity of Sea Wolf Island and Cheticamp Island. These places were generally the last visited in the fall. As a rule, when the mackerel were found here at all they occurred in great abundance; but when the schools left this region they were rarely seen again the same season. Mackerel have also been taken in great numbers along the east coast of Cape Breton Island, between the entrance to Great Bras d'Or Lake and Flint Island, and good catches have been obtained there from July until late in October. Their appearance in this region has not always been regular, however, and a season of great abundance is often followed by one of extreme scarcity.

Although the movements of mackerel in the Gulf of Saint Lawrence during the summer and fall months are about as has been described above, they are subject to certain variations at different periods, and it occasionally happens that good fares are obtained about the north shore of Prince Edward's Island early in the season. Again, this locality may furnish the best fishing during August and September one year, and the next year mackerel may be scarce there though very abundant in other portions of the Gulf. The appearance of large bodies of mackerel in the different localities is doubtless much influenced by the abundance of food, the direction and strength of the prevailing winds, and by other causes not so well understood.

In exceptional instances, fares of mackerel have been obtained at the Seven Islands, and Mingan Islands, on the southern coast of Labrador, and also at the mouth of the Saint Lawrence River, from Cape Chatte to Cape Gaspé. On one occasion, at least, a fare was also obtained at Port au Port, on the west coast of Newfoundland. These catches, with the exception of the last named, were obtained chiefly by the crews in boats, either with hooks and lines or with seines, while the vessels lay at anchor in the harbors.

The vessels visiting the northern fishing-grounds were usually provided with a number of dories, and, after the schooners were securely moored, the men would start out at daylight in the boats, trying for mackerel in the coves and along the shores where the vessels could not be taken. As the mackerel were secured they were carried on board the schooners, dressed and salted.

The fishing grounds of the Gulf of Saint Lawrence, though a favorite resort for mackerel catchers when this fishery was carried on exclusively with hook and line, are not well adapted to the use of purse-seines, which are the principal apparatus now employed in the capture of mackerel. The localities to which they usually resort are too shallow for purse-seines, and, again, the mackerel appear less frequently at the surface in the Gulf of Saint Lawrence than off the coast of the United States, and though they may occur at the former place in large numbers,

their presence is not generally as readily detected. Another hinderance to seining in the Gulf is the greater prevalence there of stormy weather, after the month of July, than on the coast of the United States.

HERRING GROUNDS.—The principal fishing-ground for herring in the Gulf of Saint Lawrence is Pleasant Bay, situated at the southern end of the Magdalen Islands, and opening broadly toward the east. The shores of the bay are bold and rocky in some places towards the north, but are low and sandy elsewhere. Its depth varies from three to eight fathoms, the bottom being composed of white sand. The herring arrive about the last of April and continue in great numbers throughout the spawning season, entirely disappearing about the first of August.

Herring also resort to various portions of the coast of the island of Anticosti, situated in the northern portion of the Gulf, about ninety miles from the Magdalens; but the principal herring grounds are about the North Cape, the eastern extremity of the island. Fishing is at its height here during the month of June, and cod vessels failing to load at the Magdalens can reach the island in time to secure a fare. Until the past few years vessels have rarely, if ever, visited this region, as there has been an abundance of fish in more easily accessible places.

Herring visit many localities on the coast of Newfoundland, and are taken to a greater or less extent in all the bays and harbors. The principal fishing-grounds are in Fortune Bay, on the southern side, and in Bonne Bay and Bay of Islands, on the western side of the island. Bonne Bay, which is situated about midway between the Straits of Belle Isle and Cape Ray, is a small, deep-water bay, with two arms, of which the southern one is more frequented by herring, which enter in large numbers. Bay of Islands, about twenty-five miles farther south, is of larger size than the above, and constitutes a more important fishing-ground. Of its several deep-water arms, extending from fifteen to twenty miles inland, the most southern one, locally known as the "Sou'west arm," furnishes the principal fishing-ground. The fish are found in this region during the greater part of the year. They visit it in the early spring to spawn, and remain through the season to feed upon the small crustaceans, which are very abundant in these waters. These fish are mostly captured by the natives, who sell them to the provincial and United States vessels.

The herring when they arrive in the spring are quite poor, but fatten rapidly, and those caught in the fall are considered equal, if not superior, to any others taken on the American coast.

Vessels occasionally visit Bonne Bay and Bay of Islands in the spring, when they have failed to secure a catch at the Magdalens. The principal season, however, is during the fall, the vessels generally arriving in October and leaving before the last of December. They frequently leave earlier than this to prevent being frozen in by the ice, but a number of vessels have been detained by this cause nearly all winter.

A school of herring enters Saint George's Bay, between Nova Scotia and Cape Breton Island, in June, and remains there one or two weeks, during which time the fish are usually very abundant. At this season, the locality is visited by the United States bank fishermen in search of bait. The principal points where herring are taken on the gulf side of Cape Breton Island and Nova Scotia to sell as bait to the bank fishermen are Port Hood, the Judique shore, and Havre Bouche or Knight Inlet.

TIDAL CURRENTS.—Prof. H. Y. Hind, in his account[1] of "the relation of the movements of mackerel in the Gulf of Saint Lawrence to tidal currents," describes those currents as follows:

"There is, perhaps, no part of the world where the tidal waves and resulting currents are distributed in such a remarkable manner as in the Gulf and estuary of the Saint Lawrence.

[1] The Effect of Fishery Clauses of the Treaty of Washington, etc. Halifax. 1877.

"The meeting and overlapping of tidal waves of different ages, that is to say, the tide of to-day meeting the tide of twelve hours ago, and producing a double overlapping tide, is of rare occurrence, and is due to the configuration of the sea bottom conjointly with the relative position of islands and neighboring coast lines.

"Northumberland Straits and the north shore of Prince Edward's Island afford the most remarkable instances on the American continent of the meeting of tides of different ages, and it can scarcely be doubted that the long and continuous line of inshore eddies, produced in a large measure by this singular confluence, conjointly with the low temperature resulting from the mixing of cold underlying with warm surface sea-strata, is the chief cause why mackerel fishing-grounds should be there so close inshore with such undeviating constancy.

"*a. The Prince Edward's Island double tide.*—The tidal wave, entering the Gulf of Saint Lawrence between Cape Breton and Newfoundland, rushes with great rapidity along the edge of the bank forming the boundary of the sixty-fathom line of soundings. It sends off lateral waves toward the Straits of Belle Isle and toward Prince Edward's Island, while the main wave, following the deep water at the edge of the sixty-fathom line of soundings, pursues a rapid course toward and up the Lawrence estuary, and reaches Cape Chatte and Point de Monts precisely at noon on the days of full and change of the moon.

"Regarding for the present the lateral wave which strikes off toward the southwestern portion of the Gulf, we find it split into two portions by the Magdalen Islands; one-half, namely, the eastern part, sweeps past the shores of Cape Breton and reaches the east point of Prince Edward's Island at eight hours thirty minutes, Cape Bear at nine hours, and the middle of the straits opposite Hillsborough Bay at ten hours. Here it meets a flood tidal wave coming down Northumberland Strait from the northwest, but this wave is not the other half of the wave which was split by the Magdalen Islands two hours before; it is the tidal wave twelve hours old, which has been delayed in its detour round the north part of the Magdalens and over the shallows of the Bradelle and Orphan Banks. A line drawn through the Magdalen Islands, Roche's Point, and the mouth of Hillsborough River, in Prince Edward's Island, and Wallace Harbor, in Nova Scotia, will pass through the places where the overlapping of the confluent tidal waves takes place, at the full and change of the moon, near the shores of Prince Edward's Island. . . .

"Admiral Bayfield is of opinion that these waves of different ages, one being twelve hours younger than the other, meet on the north side of the great bight of Prince Edward's Island, between Tracadie Harbor and Savage Harbor. On the Admiralty charts this locality is designated by the words "Tides Meet." The current is inshore toward this point, both from North Point and East Point, and the effect of the indraft is to determine toward the coast line the floating or free-swimming food of the herring and the mackerel. The great bight formed by the concave northern coast line of Prince Edward's Island is the result of ages of action on the part of these confluent tidal waves dragging along the sloping beaches, and washing away the resulting *débris* from the sandstone rocks, of which a large part of this coast line is composed. The ceaseless operation of these forces is thus manifested in the wearing away of the shores most subject to their influences.

"*b. The eddy flood tide in the estuary of the Saint Lawrence.*—According to Admiral Bayfield, the flood tide in the estuary of the Saint Lawrence, beginning at Anticosti and proceeding some miles above Bic, rushes up the broad midchannel as far as Red Islet and Green Island, where part of it, being obstructed by the islands, turns round and, as an eddy flood tide, sweeps along

and down the southern coast as far as Gaspé Basin, only a thin and narrow band of flood tide running upward between the eddy flood and the coast line.

"On the days of full and change of the moon it is high water at noon both at Point de Monts and Cape Chatte, and high water later and later down the coast, so that at Cape Rozier it is one hour thirty minutes before it is high tide there.

"In other words, the flood tide rushing up the deep midchannel between Cape Rozier and Anticosti Island passed up more than an hour and a half before the eddy flood tide returned coastwise to Cape Rozier.

"Bayfield states that there is a very narrow flood tide close inshore running westerly along the Gaspé coast inside of the eddy flood. These currents moving so constantly in opposite directions, and close inshore, tend to produce the continuous line of eddies which cause the free-swimming food of the mackerel to be found near to the land, and make that portion of the estuary a mackerel ground.

"On the north shore of the estuary, between Mingan and Point de Monts, the periods of high water at full change of the moon are altogether different. The tidal wave reaches Mingan Island at 1.30, Seven Islands at 1.40, Cawee Island at 1.50, English Point at 2, and a few miles farther on it meets the ebb tide two hours old sweeping past Point de Monts.

"The flood tide on the north shore is only about three leagues broad. The strength of the stream is greatest inshore, and beyond three leagues from the coast it becomes insensible.[1]

"The eddies produced in the bays between Moisie and Point de Monts by this inshore flood tide throw in and keep the food near the coast line.

"Hence it is that the flood tide on the north shore flowing westerly and the eddy flood on the south shore flowing easterly, with a thin belt of westerly flowing flood between it and the land, produce inshore eddies, which concentrate the free-swimming food of the mackerel, hereafter described, on these coasts.

"The strength of the current in deep water off shore, on the south coast of the estuary of the Saint Lawrence, is stated to be sufficient to prevent fishing operations there, thus offering a practical difficulty, which is repeated on some parts of the northern shore during high tides.

"In the Bay of Chaleurs, where the tides are regular, the mackerel ground of the day depends upon the wind. A southerly wind converts the south side of the bay into a lee shore, and the fish are found chiefly on that side, especially toward Nepissignit Bay. When the wind is northerly the Gaspé becomes a lee shore, and the fish are chiefly found between Bonaventure Island and Paspebiac, and on toward Cascapedia Bay. It has already been observed that mackerel and surface feeders generally swim with open mouths against the wind and tide. The cause which brings the mackerel from the south shore to the north shore arises from the fact that in the natural pursuit of their surface food against the wind they are brought up by the land, and finding food in the tidal eddies there, they pursue their course inshore against the tidal currents, until a change in the wind induces them to cross again to the opposite shore, where similar conditions prevail. On the gulf coast of Cape Breton the set of the currents is oftentimes inshore."

5. THE OUTER COASTS OF CAPE BRETON ISLAND AND NOVA SCOTIA, INCLUDING THE BAY OF FUNDY.

OUTER COAST OF CAPE BRETON ISLAND AND NOVA SCOTIA.—Shore fishing-grounds for cod exist along the entire outer coast of this region. They are located on the so-called shore soundings, which range in depth from about ten to fifty fathoms, the average width of this coast belt being

[1] Sailing Directions for the Saint Lawrence.

about eighteen miles. Fishing is mostly carried on beyond three miles from shore, though some boats fish much farther in, and begins about the first of May and lasts until October; it is mainly in the hands of the provincials, although a few vessels from the United States resort to the region occasionally. Saint Ann's Bank is a cod-fishing ground on the shore soundings off the east end of Cape Breton Island, which is mainly fished upon by the people living on the adjacent shores.

For a number of years several American vessels were in the habit of visiting the halibut grounds in the vicinity of Flint Island and Scatari Island, Cape Breton, and a number of good fares of halibut were obtained there. The grounds were of small extent, however, and soon became exhausted. No important trips have been made to that region since 1875. Halibut have rarely been taken in large quantities on the coast of Nova Scotia.

Herring are abundant at numerous points along this coast, and are mainly taken to supply the United States and provincial vessels with bait. The Peninsula of Halifax, especially about Prospect, is a great baiting station, and other similar stations occur all along shore between Cape Sable and Canso. Mackerel make their appearance about the western part of Nova Scotia in May, and follow eastward along the coast until they arrive at Cape Canso, where they turn northward, entering Chedabucto Bay and passing through the Strait of Canso into the Gulf of Saint Lawrence. They come from the south and southwest, and appear to strike the entire coast at very nearly the same time, arriving at the eastern end, however, a little later than at the western, the schools gradually working eastwardly. At the same time large quantities of mackerel pass around the east end of Cape Breton Island and thus reach the Gulf of Saint Lawrence. In the fall they return by the same route, and continue to pass up the coast until about the last of November; but some seasons they remain later and others they are earlier in their migrations toward the south. As a rule, no mackerel of any account are on this coast from the 1st of July to the 15th or 20th of September; some schools of small fish remain the entire summer. They are captured in gill-nets, seines, pounds, and traps; but during their fall migrations it is not always safe to set the nets far from land on account of the severity of the weather. The mackerel fishery of the coast of Nova Scotia and Southern Cape Breton is of slight importance compared with that of the Gulf of Saint Lawrence, as the fish remain in the first-mentioned localities for a much shorter time, and are taken only by the natives along the coast.

BAY OF FUNDY.—The only important fishery at present in the Bay of Fundy is that for herring. Mackerel occasionally enter Saint Mary's Bay and other places at the mouth of the Bay of Fundy, and from 1835 to 1850 this region was considered a famous mackerel ground. During the last thirty years, however, it has been but rarely visited by United States vessels. Fair catches of halibut were formerly obtained at the mouth of the bay, in from thirty to sixty fathoms, and even farther in than Bryer's Island, but for the past fifteen years this fishing, like that for mackerel, has not been profitable. Codfishing is carried on near the mouth of the bay, but not to any great extent, mainly because of the strong tides, which are not favorable to it. The Grand Manan Ripps were formerly the most celebrated herring-grounds on the northern coast, and were much resorted to by American vessels. The fishery has, however, been gradually transferred to the coast of the main-land about the mouth of the Bay of Fundy, especially on the north side, although herring are also taken in considerable quantities in and about Saint Mary's Bay, on the southern coast. The herring approach Grand Manan in July, and remain there until the middle of September Toward the last of October other schools arrive upon the shores of the main-land about Campobello Island, and later, during midwinter, the waters between Eastport, Maine, and Point Le Preau, New Brunswick, become crowded with them. They enter Saint Andrew's Bay and remain until late in the spring. The fishery begins to the westward, commencing first about Grand Manan and

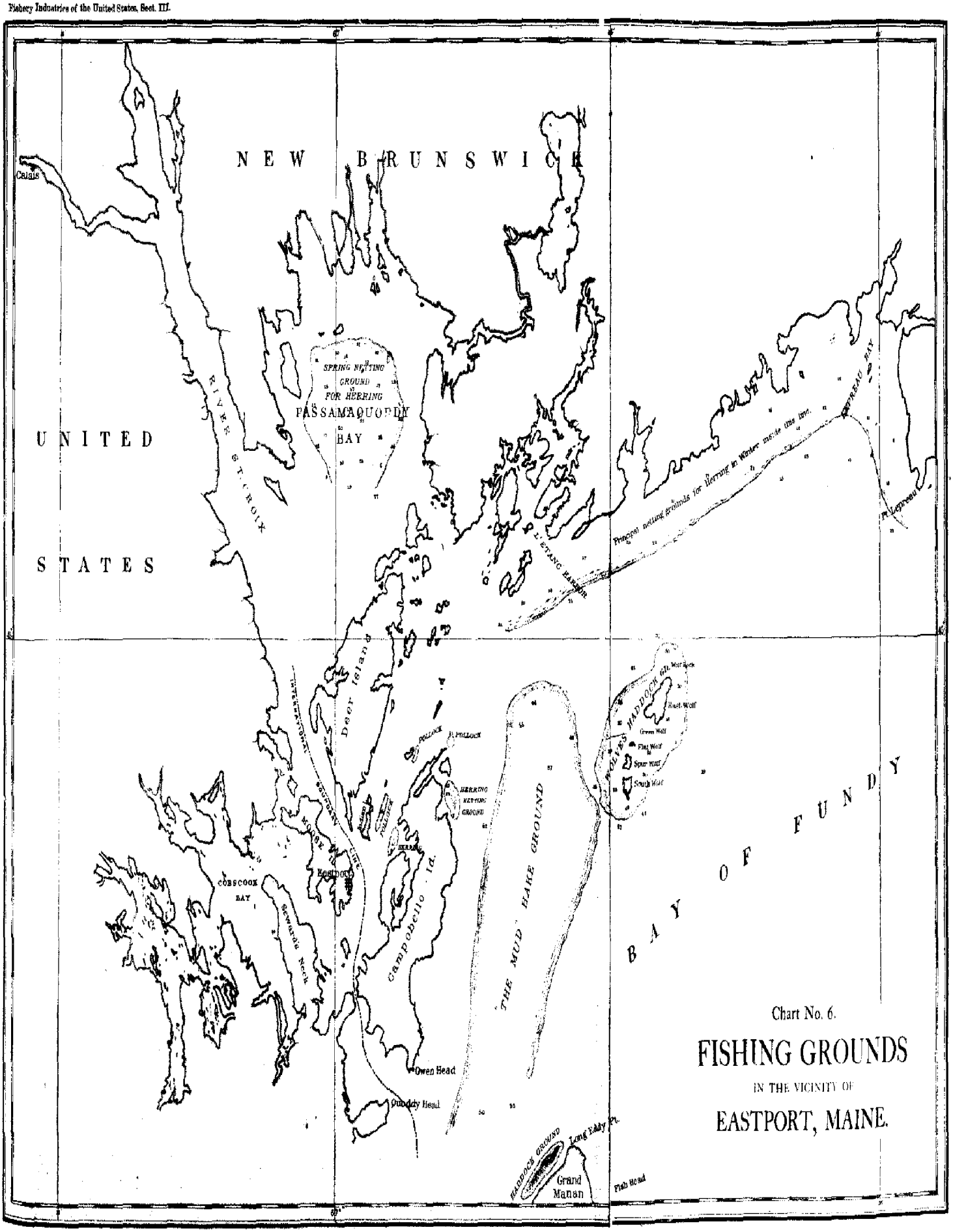


Chart No. 6.

FISHING GROUNDS

IN THE VICINITY OF

EASTPORT, MAINE.

Campobello, and continues later about Point Le Preau and in Saint Andrew's Bay. These fish are taken to supply the frozen-herring and sardine trade, and to sell to the bank fishermen as bait.

There are a few distinct grounds for hook and line fishing at the mouth of the Bay of Fundy, located and characterized as follows:

THE WOLVES HADDOCK GROUNDS.—Around the group of islands called the Wolves, which lie off the southwest coast of New Brunswick, the bottom is composed of rocks and gravel for a distance averaging about three-quarters of a mile from the shore. This narrow strip is a favorite haddock-ground, and is much resorted to by the small boat fishermen of the vicinity, and also by others from Eastport and Lubec, Maine. The depths vary from eighteen to thirty-four fathoms, and the bottom is somewhat broken and irregular.

Small haddock-grounds also exist close inshore to the westward of the northern end of Grand Manan. The outer edge lies about half a mile off shore, the length of the ground being about two miles and the depth of water from fifteen to forty fathoms.

THE MUD is a broad area of muddy bottom, forming the channel to the eastward of Campobello Island, beginning in the north to the westward of the Wolves and extending southward to between West Quoddy Head and Grand Manan. The western edge of this ground lies about two miles off Campobello, and its width averages about three and a half miles. The depths vary from thirty-nine to sixty fathoms, the bottom consisting of soft mud. This is the best ground for hake in this vicinity, and is resorted to by small vessels and open boats from Western New Brunswick and Eastern Maine.

POLLOCK GROUNDS.—Two pollock grounds occur in this vicinity, both lying to the westward of the northern part of Campobello Island. One lies just to the eastward of, and very near to, Indian Island, and is formed of strong tidal eddies. Another lies at the mouth of the channel between Campobello and Casco Bay Island, being close to the eastern shore of the latter island, and likewise is an area of strong tidal eddies. Both of these grounds are of limited extent and of less importance now than formerly, but they are still much resorted to by the small boats of the vicinity.

TEMPERATURES IN THE BAY OF FUNDY.—The following observations, made during August, 1872, by the United States Fish Commission, will serve to indicate the summer temperatures of the surface and bottom waters at the mouth of the Bay of Fundy. They are too few in number, however, and extend over too short a period, to be of much value in making comparisons with the temperatures of other regions which have been more fully worked up.

The surface temperature to the east of Grand Manan, at distances varying from two and a half to ten miles from the island, during August 23 and 24, 1872, ranged from 48° F. to 53° F.

Within the same area the bottom temperatures, taken at the same time, were as follows: Two miles from the island, depth twenty-nine fathoms, 44° F.; two and one-half miles from the island, depth twenty-eight to fifty-two fathoms, 39¼° F.; eight to ten miles from the island, depth from ninety to one hundred and five fathoms, 37¾° F. to 38° F.

To the westward of Grand Manan, at distances of three to six miles from land, the surface temperatures on August 28, 1872, ranged from 47° F. to 48° F. The bottom temperatures of the same area, at depths of forty to fifty-five fathoms, varied from 40° F. to 45° F.

Just east of Campobello Island, on the fishing-ground called the "Mud," the surface temperatures from August 2 to 16, 1872, varied from 48½° F. to 57½° F. The bottom temperature at twenty-five fathoms was 47° F.; at sixty fathoms 43° F.; at eighty fathoms 39¾° F.

In Passamaquoddy Bay, between Deer Island and the coast of Maine, in depths of water ranging from thirty to seventy fathoms, the surface temperature was 48° F., and the bottom temperatures from 45° F. to 46° F.

6. THE COAST OF MAINE.

GENERAL ACCOUNT.—Within the limits of the sixty-fathom line, which lies at an average distance of twelve to fifteen miles from the coast, there occur a very large number of rocky or gravelly patches, which are the favorite resorts for cod, haddock, and pollock, while on the muddy bottoms between hake are generally found in greater or less abundance during the summer. In addition to these grounds, of which special descriptions are given on the following pages, there are many other banks, mostly of small size, situated in the bays and among the numerous islands dotting the coast line, on which the different species of the cod family can be taken. These banks, with the intervening valleys, form a more or less continuous and rich fishing-ground, bordering the entire coast of Maine. During a part of the summer, when the dogfish have driven away nearly all of the fish from the outer grounds lying off the coast, good fishing can generally be obtained near land. Herring and mackerel are also very abundant in their season along the entire coast. The former species is caught in large numbers in weirs and gill-nets, placed for their capture around the outer islands and in the numerous bays and harbors which indent the coast. From June to November immense quantities of mackerel visit the coast of Maine; they are often so abundant as to enter the bays, large schools being met with some distance inside of the coast line, as far inland, in fact, as the saltness of the water will permit. The deeper water off this coast is, however, better suited to their capture, as described elsewhere.

Lobsters are more abundant on the coast of Maine than elsewhere within the territory of the United States. In some localities they are captured throughout the year, and doubtless the season might be as continuous nearly everywhere were the demands sufficient to warrant their being taken at all times. In the summer they enter all the bays and estuaries, and some generally ascend as far as the water is sufficiently salt for them.

The soft clam (*Mya arenaria*) also abounds on the shores of the Maine coast. It is extensively used as food and as bait for cod and other fish. Large quantities are salted annually to sell as bait to the bank fleet.

On the following pages, brief descriptions are given of the principal inshore fishing-banks, the majority of which lie within the sixty-fathom line. Some of those lying just without this limit, in part or wholly, are, however, also included here, as belonging to the same series of grounds, and as being visited by the same class of fishing boats. This list, although it cannot be considered as complete, probably contains nearly all the fishing-grounds of any size that can be distinctively marked off from the general fishing area of the coast.

GROUNDS OFF MOOS-A-BEC LIGHT.

LUKE'S ROCK bears south by east from Moos-a-bec light; distance, three miles. It is nearly circular in outline, about one mile in diameter, with depths of twenty-five to thirty-five fathoms, and a bottom of rocks, gravel, and mud. Hake, cod, and pollock, together with a few haddock, are taken on this rock by the small-boat fishermen.

NEWFOUND GROUND.—This is a small rocky spot, not more than one-fourth of a mile in diameter, having in the center an automatic buoy, placed there by the Government as a guide to vessels bound to or from the Bay of Fundy. It bears south by west from Moos-a-bec light-house, from which the buoy is distant about three miles. The depth is eighteen fathoms. This ground is resorted to by a few small-boat fishermen, using hand-lines.

HENRY'S ROCK lies five miles southwest by south from Moos-a-bec light-house. It is one-fourth of a mile in diameter, with a depth of thirty fathoms, the bottom being quite level. It is resorted to by small boats, hand-lines only being used.

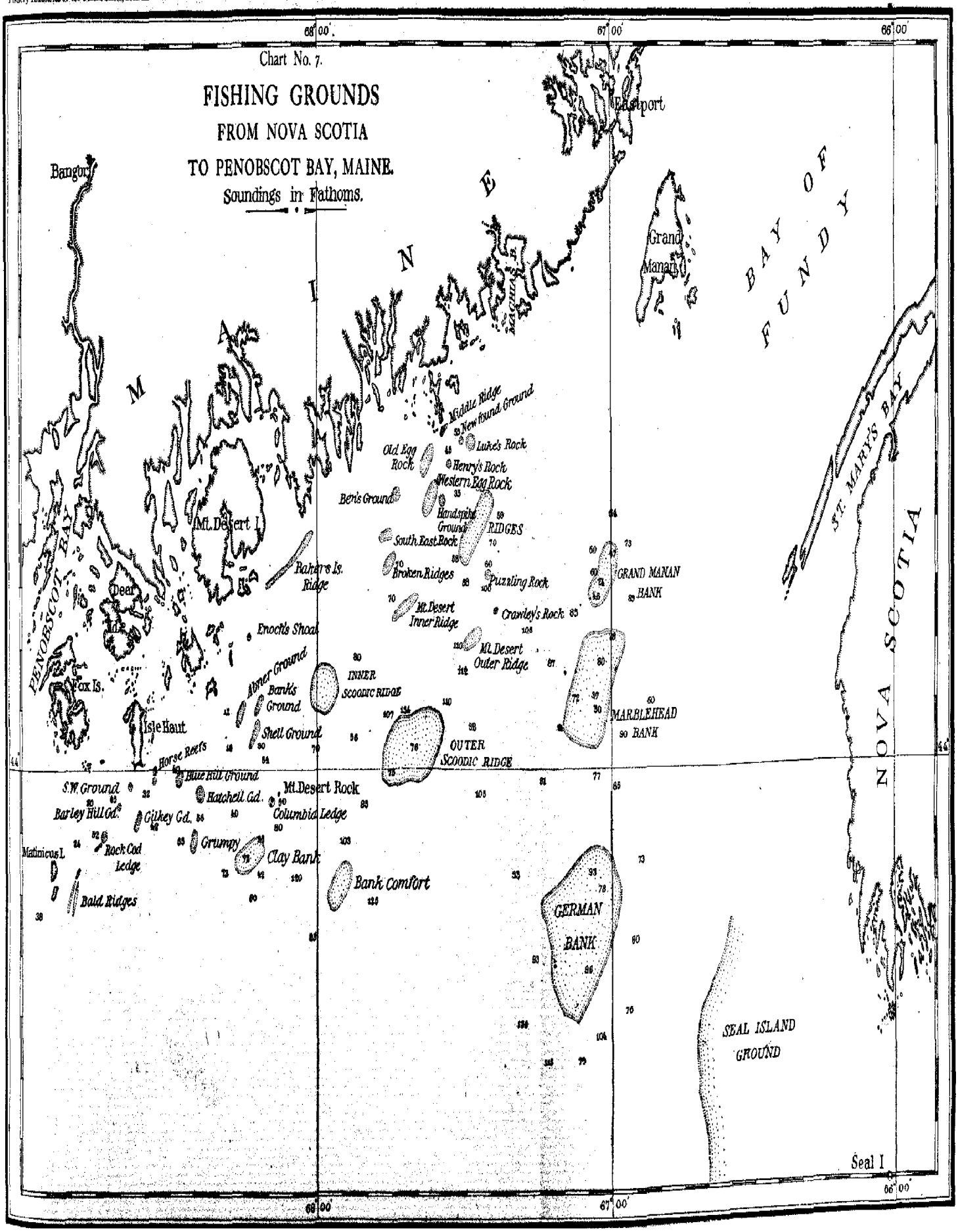


Chart No. 7.
FISHING GROUNDS
FROM NOVA SCOTIA
TO PENOBSCOT BAY, MAINE.
Soundings in Fathoms.
68°00'
67°00'
66°00'
Eastport
Bangor
Grand Manan
BAY OF FUNDY
MAINE
ST. MARY'S BAY
NOVA SCOTIA
PENOBSCOT BAY
Mt. Desert I.
Deer Isle
Fox Is.
Isle Haut
Middle Ridge
New found Ground
Luke's Rock
Old Egg Rock
Henry's Rock
Western Egg Rock
Ben's Ground
Handspike Ground
RIDGES
South East Rock
Broken Ridges
Puzzling Rock
Bahar's Is. Ridge
GRAND MANAN BANK
Mt. Desert Inner Ridge
Crawley's Rock
Enoch's Shoal
Mt. Desert Outer Ridge
Abner Ground
Banks Ground
INNER SCOODIC RIDGE
Shell Ground
MARBLEHEAD BANK
OUTER SCOODIC RIDGE
Horse Reefs
Blue Hill Ground
S.W. Ground
Hatchell Gd.
Mt. Desert Rock
Barley Hill Gd.
Gilkey Gd.
Columbia Ledge
Grumpy
Matinicus I.
Rock Cod Ledge
Clay Bank
Bank Comfort
Bald Ridges
GERMAN BANK
SEAL ISLAND GROUND
Seal I.
44°

HANDSPIKE GROUND.—This is a small rocky shoal, lying eight miles southwest by south from Moos-a-bec light-house. It is nearly circular in outline, about half a mile in diameter, and with depths of thirty-five to forty fathoms.

WESTERN EGG ROCK lies eight miles southwest from Moos-a-bec light-house. Its length, in a northeast and southwest direction, is three miles and its breadth one mile. The depths range from twenty to thirty-five fathoms, and the bottom is irregular, sharp, and rocky, being too rough for trawls; hand-lines are, therefore, almost wholly used by the boat-fishermen, who resort to it in summer for cod and pollock.

OLD EGG ROCK bears west southwest from Moos-a-bec light-house; distance, six miles. It extends three miles in a southwest and northeast direction, and is one mile wide. The bottom is rocky, with depths ranging from twenty-five to thirty-five fathoms. It is principally resorted to by small boats in pursuit of cod and pollock, which are mainly taken with hand-lines, though trawls are occasionally used.

MIDDLE RIDGE lies three miles west by south from Moos-a-bec light-house, and extends one mile northeast and southwest, the width being one-half mile. The depth varies from eighteen to twenty-five fathoms, the bottom being rocky and rough. It is occasionally resorted to by small-boat fishermen, using hand-lines only, but only a few fish are taken.

BROKEN GROUND is a large piece of broken bottom, the eastern end of which bears south by east fifteen miles from Moos a-bec light, whence the ground extends west-southwest to within four miles of Mount Desert Rock; its average width is about one mile. The depths vary from fifteen to one hundred fathoms, the shoaler portions being sharp and rocky, and the deep places consisting of clay and gravel. Some of the spots are half a mile long, and others from one to three miles in diameter, with an average depth of seventy fathoms. Cod are taken on the outside of the grounds, pollock and small cod on the shoals, and hake on the inside. By some this is considered the best fishing-ground on the coast. Several of the spots have special names, as "Crawley's Rock," "Puzzling Rock," "Lenke's Rock," and "The Ridges." Fishing continues four months—from June 1 to September 30. Herring are abundant here in their season and are used in large quantities for bait.

The *Ridges*, which form a part of the "Broken Ground," bear south from Moos-a-bec: distance to the center, nine miles. They are seven miles long, southwest and northeast; two miles wide, and have a depth of from thirty to thirty-five fathoms. The bottom consists of rocks and gravel, on which cod and pollock are abundant.

Crawley's Rock bears south seventeen miles from Moos-a-bec light, and has a shoal of about fifteen acres in extent, with a depth of fifteen fathoms and a bottom of sharp rocks.

Puzzling Rock bears south fourteen miles from Moos-a-bec light, and has a shoal about half a mile in diameter, on which the depth of water is fifteen fathoms, and the bottom sharp and rocky.

GROUNDS OFF PETIT MANAN.

TIBBETT'S LEDGE bears about east from Petit Manan; distance, four to five miles. (Marks: Schoodic Island, over the green island of Petit Manan, and the Ladle, over Nash's Island.) This ledge consists of two rocky shoals, with a depth of three to three and a half fathoms. The shoals are only about one acre in extent and a quarter of a mile apart, bearing northwest and southeast from each other. To the westward of these shoals the ground is broken nearly to Petit Manan, and this section is a favorite resort for small boats. To the eastward, however, the ledge drops off suddenly into mud. In May, large cod are caught over the muddy bottom, just to the eastward

of the ledge, in a depth of twenty-seven to thirty-four fathoms. In the spring of 1880, three men, with hand-lines, caught three hundred cod here in a single day.

BEN'S GROUND bears east-southeast from Petit Manan; distance, four to five miles. (Marks: Petit Manan light, to the northward of the high or middle hill of Mount Desert, and Humpback Mountain, on the west side of Trafton's Island, or Pond Island light-house, to the eastward of Jordan's Delight.) This ground is circular in shape, with a diameter of about three-fourths of a mile, and has a very irregular bottom of rocks and mud. The depths range from fourteen to thirty fathoms. This ground is at present of but little importance, but is occasionally visited by the boat-fishermen in summer for cod and haddock; on muddy bottom, in the immediate vicinity, hake grounds occur.

SOUTHEAST ROCK.—This is a ledge which becomes nearly uncovered at low water on its shoalest part. It bears south-southeast from Petit Manan; distance, four and one-half miles. From the shoaler portion of the ledge the bottom slopes off towards the northeast a distance of four miles, with an irregular bottom, the depth increasing from seventeen to thirty fathoms. The shoal portions are rocky, while the deeper places between are generally muddy. Cod and haddock are taken on this ground by the boat fishermen in May and June, but from July to September hake are the most common fish.

BROKEN RIDGES, "JOE RAY GROUND."—This ground bears south-southeast from Petit Manan, from which the center is seven miles distant. It is two miles long in a southwest and northeast direction, and one mile wide, the depths ranging from twenty-seven to thirty-three fathoms. The bottom is very uneven, and consists of rocks and mud. The shoalest part of the ground is near the center. The depths vary so greatly over short distances that a boat at anchor, swinging with the tide, may find a difference in depth of from five to six fathoms. This ground is considered very good for cod and haddock. It is resorted to by small vessels in the spring and by open boats during the summer.

BLACK LEDGES GROUND.—This is an excellent fishing-ground for haddock, situated between *"Jordan's Delight"* and the "Halibut" or "Black Ledges." *The fish strike in very plentifully* in summer, probably in pursuit of herring. One day, in the first part of July, 1879, three persons in one boat, with a trawl of seven hundred hooks, took eleven hundred haddock by under-running *on this ground, and more than five thousand haddock were probably taken there that day by* all of the small boats fishing there. The haddock do not usually remain long.

GROUNDS OFF MOUNT DESERT ISLAND.

BAKER'S ISLAND RIDGE.—This is a narrow ridge making out from Baker's Island in an east by north direction. The eastern part bears south by east from Schoodic Island, from which it is *distant three-fourths of a mile. The ridge is much broken, with an average width of one-half* mile, and depths varying from twenty to twenty-five fathoms. The bottom is rocky in some places and gravelly in others. As a rule, but little fishing is done on the shoaler portions of the ridge, but where the bottom slopes off to depths of thirty to thirty-five fathoms, with a bottom of mud, hake are generally quite abundant from July to October inclusive. During that season the ground is resorted to by small vessels and open boats.

MARTIN'S GROUND.—The center of this ground bears west-southwest from Schoodic Point, from which it is distant about three miles. It is a rocky patch, with depths of fifteen to twenty-five fathoms. Its extent does not exceed four or five acres. This is not an important *fishing-ground, but is sometimes resorted to by the boat-fishermen in the fall, when a limited* amount of cod are taken with hand-lines.

EGG ROCK BROKEN GROUND.—This is a rocky ridge which makes out in a south by west direction from Egg Rock ledges a distance of about two miles, and has a width of about half a mile. The bottom is irregular, and the depth of water ranges from nine to fifteen fathoms. This ridge, together with Martin's and Seavey's Grounds, divide the western or Baker's Island mud channel from the Schoodic mud channel, both of which are good hake grounds, with depths varying from thirty to forty fathoms. The bottom consists of mud. Mr. Nathan Hammond, of Winter Harbor, Gouldsborough, Maine, states that from 1830 to 1840 thirty to forty vessels were frequently seen at anchor in Baker's Island Channel at one time, all of them being engaged in catching hake. These fish are much less abundant now upon these grounds than formerly, but nevertheless they are more or less resorted to at present by open boats and vessels during the summer, and large catches are still taken by the local fishermen.

INNER SCHOODIC RIDGE bears southeast by south from Baker's Island, from which the center of the ground is twelve miles distant. It is nearly circular in shape, with a diameter of about four miles, the depths ranging from eighteen to sixty fathoms. The bottom is composed of rocks, gravel, and mud; the shoaler portions are sharp and rocky.

OUTER SCHOODIC RIDGE.—The northwest part of this ridge bears southeast from Baker's Island, from which it is distant twenty-two miles. It is about eight miles long in a southwest and northeast direction, being nearly parallel with the neighboring coast. In the widest part its breadth is about six miles. The bottom, which is composed of rocks and gravel in the shoaler parts and of mud in the deeper portions, is quite broken and irregular, the depths of water varying from twenty-two to eighty fathoms. This ridge lies seven miles outside of the Inner Schoodic Ridge, and is considered one of the best shore fishing-grounds on the coast of Maine.

MOUNT DESERT INNER RIDGE.—The center of this ground bears southeast one-quarter east from Schoodic Island, about fifteen miles distant. It extends four miles in a west by south and east by north direction, and has a width of half a mile, the depths ranging from thirty to forty-five fathoms. On the shoaler parts the bottom is rocky, but elsewhere it consists of sand and gravel. It is considered a good fishing-ground for several species of the cod family during April, at which time both trawls and hand-lines are used.

MOUNT DESERT OUTER RIDGE bears southeast by east from the big hill of Mount Desert Island. The distance from Schoodic Island to the center of this ground is twenty-five miles. It is two miles long, east by north and west by south, and about three-fourths of a mile wide. The depths vary from forty-five to sixty fathoms. On the shoal part the bottom is rocky, but toward the sides sand and clay predominate. Although of small size, this is considered a good fishing-ground for cod, etc., from April to July. Fishing is done principally with trawls.

ENOCH'S SHOAL bears east-northeast from Great Duck Island; distance, three miles. This is a small hummock on the outer part of a ridge that extends out to it from Big Duck Island. It has a sharp, rocky bottom, and an average depth of eighteen fathoms.

BANK'S GROUND.—The center bears southeast by south from Great Duck Island, from which it is distant five miles. This is a small patch of ground, about one and one-half miles long, in a southwest and northeast direction, by one-fourth of a mile wide, and has depths varying from thirty-five to fifty fathoms; the bottom is muddy. It is principally resorted to by the small-boat hake fishermen.

SHELL GROUND bears southeast from Long Island Head, from which the center of the ground is distant about six miles. It extends two miles in a southwest and northeast direction, and is about half a mile wide. It has a shoal of twenty-five fathoms in the middle portion, the bottom of which is composed of sharp rocks. On all sides of this shoal the bottom is quite

irregular, consisting of pebbles and mud. The greatest depth near the edge of the bank is about fifty fathoms. This ground is especially good for haddock in July and August, during which months it is resorted to by the small boats of the region, the fishing being carried on principally by means of trawls.

ABNER GROUND bears south-southeast from Gott's Island; distance, eight miles. It extends one and one-half miles in a northeast and southwest direction, and is one-fourth of a mile wide. The bottom, which is composed of rocks and mud, is broken, the depth of water ranging from twenty-five to fifty fathoms. This is a good haddock ground in July and August, and is visited by the same class of fishermen that resort to "Shell Ground" and other similar places in that vicinity.

GROUNDS OFF ISLE AU HAUTE.

GRUMPY.—The Grumpy bears southeast from the western head of Isle au Haute; distance, ten miles. This ground is two and one-half miles long, northeast and southwest, by three-fourths of a mile wide, and has a small shoal of fifteen fathoms on the northeast part. The general depth varies from thirty-five to forty fathoms, the bottom being gravelly. It is considered one of the best inshore grounds for cod the entire year, for haddock in the winter, and hake, just off the edge, in the summer. Both trawls and hand-lines are used.

HATCHELL GROUND bears southeast by east three-quarters east, about nine and one-half miles, from the western head of Isle au Haute, the marks being as follows: Eastern Mount Desert Hill in the middle saddle of Long Island, and Little Spoon Island in the great or center saddle of Isle au Haute. This ground is but little more than a mile in diameter, and is said to have a shoal of fifteen fathoms, which is so small, however, as to be difficult to find. The general depth varies from twenty-five to forty fathoms, the shoalest part being in the middle of the ground, where the bottom slopes off gradually on all sides. The character of the bottom is sharp and rocky on the shoal, but gravelly and pebbly toward the sides; at the edge of the ground the bottom consists of soft mud. Various low forms of animal life, the most of which serve as food for fishes, are constantly brought up on the hooks of the trawlers. This ground, next to the "Grumpy," is considered the best one inside of Mount Desert Rock; cod and a few pollock are caught here in the spring; hake are taken on the mud near the edge of the ground in summer, and haddock are abundant in winter. Both hand-lines and trawls are used.

BLUE HILL GROUND bears east by south three-quarters south (approximate) from the western head of Isle au Haute; distance, about seven miles. The marks for determining the locality of this ground are as follows: Brimstone Island, out by the western head of Isle au Haute, and Blue Hill, on the west side of Marshall's Island. These marks lead to a depth of twenty-five fathoms on the northeast part of the ground, from which the bottom drops off gradually to the southwest, in which direction a depth of forty fathoms is reached a mile from the shoaler portion, which is about half a mile wide. The bottom consists of gravel and pebbles. This is a good locality for cod during the spring and fall, but is best for haddock during the entire winter. Both trawls and hand-lines are used.

INNER HOUSE REEF bears southeast three-quarters east, one and a half miles, from the eastern ear of Isle au Haute. It contains a shoal of twenty-five fathoms, about one-eighth of a mile in diameter. From this shoal the water gradually deepens toward the northeast for a distance of a half mile, when it drops off into mud. The depth of the northeast portion is about thirty-five fathoms. The bottom consists of pebbles and gravel. This is a good ground for cod in the spring and fall, and for hake, close to the edge, in the summer. Trawls and hand-lines are used.

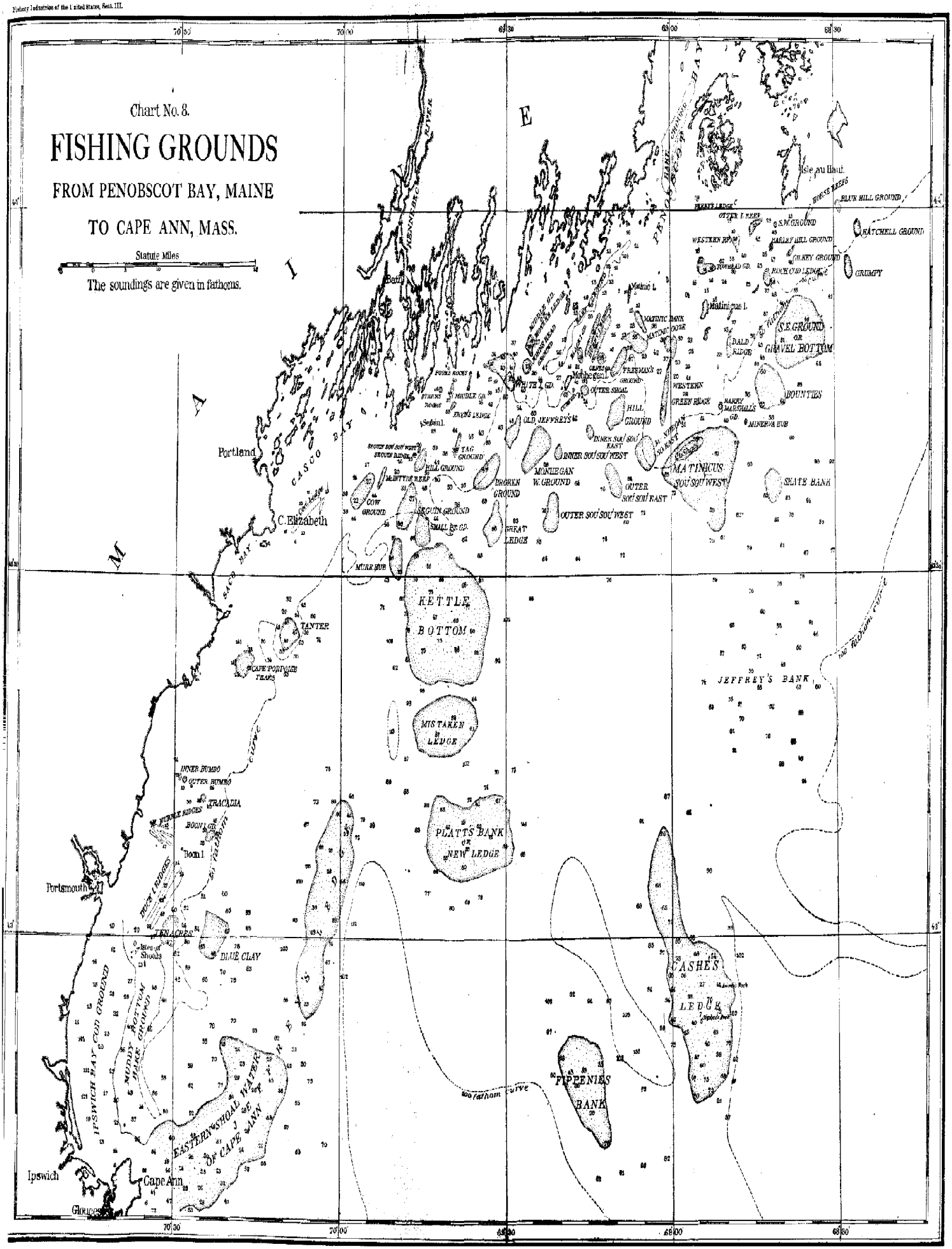


Chart No. 8.
FISHING GROUNDS
FROM PENOBSCOT BAY, MAINE
TO CAPE ANN, MASS.
Statute Miles
The soundings are given in fathoms.
Portland
C. Elizabeth
Portsmouth
Ipswich
Cape Ann
Gloucester
Isle au Haut
Matinicus I.
Monhegan I.
Seguin I.
Boon I.
KETTLE BOTTOM
MISTAKEN LEDGE
PLATTS BANK OR NEW LEDGE
JEFFREY'S BANK
CASHES LEDGE
FIPPENIES BANK
S.E. GROUND OR GRAVEL BOTTOM
BOUNTIES
MATINICUS SOU' SOU' WEST
SKATE BANK
OUTER SOU' SOU' WEST
OUTER SOU' SOU' EAST
INNER SOU' SOU' WEST
MONHEGAN W. GROUND
BROKEN GROUND
GREAT LEDGE
OLD JEFFREYS
HILL GROUND
WESTERN GREEN RIDGE
FREEMAN'S GROUND
OUTER SHOAL
TAG GROUND
COW GROUND
SEGUIN GROUND
SMALL FIR GD.
MURR HUB
TANTER
CAPE PORPOISE TEARS
INNER BUMBO
OUTER BUMBO
TRACALIA
BOON GD.
ROCK LEDGE
TENACES
BLUE CLAY
IPSWICH BAY COD GROUND
MUDDY BOTTOM DARK GROUND
EASTERN SHOAL WATER OF CAPE ANN
100 fathom curve
CASCO BAY
PENOBSCOT BAY
MAINE
S.W. GROUND
HARLEY HILL GROUND
CHUKEY GROUND
ROCK OUD LEDGE
GRUMPY
RATCHELL GROUND
BLUE HILL GROUND
HORSE REEFS
OTTER I. REEF
WESTERN REEF
TOWHEAD GD.
MATINICUS BANK
MATINICUS OOZE
DALD RIDGE
MARRY MARSHALL'S GD.
MINERVA HUB
PEEKS LEDGE
POOKS ROCKS
MIDDLE GD.
WHITE GD.
INNER SOU' SOU' EAST
OUTER SOU' SOU' EAST
SOUTH RIDGE
MIDDLE RIDGES
BOON RIDGE
Shoals

OUTER HORSE REEF lies but a short distance to the southwest of the Inner Horse Reef, there being only a narrow gully between the two. The shoal, which is small, and falls off rapidly on all sides, has a depth of thirty fathoms. Over a space a quarter of a mile in diameter the bottom is gravelly. This ground is resorted to for the same fish, and at the same seasons, as the inner ridge.

SOUTHWEST GROUND lies two miles southwest from the western head of Isle au Haute; is circular in shape, one-half mile in diameter, and has a gravelly bottom, with depths of from thirty-five to forty fathoms. This is a good locality for large cod from April to June and from September to November. A few haddock and pollock are taken with the cod. Hand-lines are principally used, with clam and herring bait.

BARLEY HILL GROUND bears north-northeast from Seal Island and south-southwest from the western head of Isle au Haute, being directly in a line between the two, and very nearly equidistant from each, the distance being three and one-half miles. This is a small ground, not over half a mile in diameter, circular in shape, with depths of from twenty-eight to thirty fathoms, and with a mixed bottom of rocks and mud. It is a good fishing-ground for cod in the fall and spring, and a few halibut are also occasionally taken upon it. Both trawls and hand-lines are used.

GILKEY GROUND bears south from the western head of Isle au Haute; distance, four miles. It extends in an east-northeast and west-southwest direction, and is about one and one-half miles long by one-third of a mile wide. It has a rocky bottom on the shoaler portion, where the depth is twenty-three fathoms, but it slopes off gradually to a depth of thirty-five fathoms on the southwest part, where the bottom is gravelly. The bottom is comparatively smooth, and both trawls and hand-lines are used upon it. This is a good ground for cod during the spring and fall, for haddock during the winter, and for hake, near the edge, in the summer.

ROCK-COD LEDGE.—This ledge lies about one mile northeast of Seal Island (off Isle au Haute), and has a depth of only three and one-half fathoms on the shoalest part. On all sides it slopes off gradually for quite a distance. The bottom consists of sharp rocks, and is broken in places. This is a very fair ground for rock-cod during the spring and fall, and has always been considered an excellent locality for hooking mackerel when these fish are in this vicinity.

SOUTHEAST GROUND AND GRAVEL BOTTOM.—This is an extensive piece of flat ground lying to the southward of Seal Island, the western part bearing a little east of south, and the eastern part about east-southeast from the island. It is five or six miles in diameter, and although forming a single stretch of ground, the eastern portion has received the name of Southeast Ground, while the western part is called the Gravel Bottom. The latter name is derived from the character of the bottom, which is pebbly and gravelly on the western part, and muddy, with patches of gravel, on the eastern part. The western portion has depths of from thirty-five to forty-five fathoms, while the eastern part varies in depth from forty to sixty fathoms. This is a good ground for cod in the spring, for hake in the summer, and for haddock in the winter. Fishing is done mostly with trawls.

LAISDELL'S GROUND.—This is a small rocky spot outside of the Brandy Ledges, and is not more than a fourth of an acre in extent. It has a depth of twenty fathoms, with a sharp, rocky bottom. It is considered the best fishing-ground for cod and haddock in Isle au Haute Bay.

SADDLE-BACK REEF bears about south from Saddle-Back Ledge, from which the inner part is distant three-fourths of a mile. It is two-thirds of a mile long, north and south, and quite narrow, being not more than one-fourth of a mile in width. The depths vary from fifteen

to thirty-five fathoms, and the bottom is broken and rocky. Cod are caught during May and June with hand-lines.

OTTER ISLAND REEF, SNIPPER SHIN, and WESTERN REEF.—These names are applied to different sections of an irregular, broken piece of rocky ground, that lies about half way between Vinal Haven and Seal Island. Otter Island Reef, by which name the eastern section is known, lies about four miles west by south one-quarter south from the western head of Isle au Haute, and has depths of from ten to twenty-five fathoms, with a rocky and broken bottom, on which trawls can seldom be used. It is a favorite ground for cod and haddock during all the seasons when these fish are in shoal water, but is best for cod in the spring and for haddock in the fall. Snipper Shin is only a westerly continuation of the Otter Island Reef, and lies between it and the Western Reef. The general direction of this ground is about northwest until it joins the Western Reef, which trends more to the southwest. It contains a shoal of seven fathoms, about which the water is twenty-five fathoms deep in places. The general characteristics of the ground are similar to those of Otter Island Reef, but small halibut are occasionally taken in addition to cod and haddock. The Western Reef has the same depth and character of bottom as the other two pieces of ground.

GROUNDS OFF AND ABOUT MATINICUS ISLAND.

BALD RIDGES.—These ridges begin just outside of Wooden Ball Island, and run off in a nearly direct line for Matinicus Rock. They are almost parallel with one another, and quite close together, the distance between them not being over half a mile. They are from a fourth of a mile to half a mile in width each, and have depths of from fifteen to thirty fathoms, with a broken, rocky bottom. The shoalest part is distant about a mile from Wooden Ball Island, and from there the depth increases toward the southern end. This is a good ground for cod at all seasons when they are on the coast, the shoal being a favorite resort of the rock-cod.

HARRY MARSHALL'S GROUND bears south by west from Matinicus Rock, distance, about three miles, and has an area of not more than two acres. The shoaler portion has a depth of thirty-five fathoms, with gravelly bottom; on the edge the depth is forty-five fathoms, and the bottom consists of rocks and mud. A good ground for cod in spring and for hake in summer.

THE BOUNTIES bears southeast by south half-south, distant six miles, from Wooden Ball Island. It is about four miles in diameter, and nearly circular in shape, with depths of forty to sixty fathoms. The bottom consists of gravel and rocks, and is somewhat broken. It is a good ground for cod and cusk in the spring and fall and for haddock in the winter.

MINERVA HUB.—This is a small gravelly spot, not more than a fourth of a mile in diameter, with a depth of thirty-five fathoms, and abounds in cod during the spring and fall. It bears south-southeast from Matinicus Rock; distance, nearly six miles.

SKATE BANK bears south-southeast, distant twelve miles, from Matinicus Rock; is about two miles in diameter, and nearly circular in shape, with depths of thirty-five to sixty fathoms. The bottom is gravelly, but quite uneven. The best season for fishing on this ground for cod and cusk is from April to July.

MATINICUS SOU'-SOU'WEST GROUND.—This ground bears south-southwest from Matinicus Rock, from which the inner edge is distant about six miles. It extends about nine miles north and south, and has about the same width, being nearly triangular in shape, and broadest at the northern end. On the northern part there is a shoal of about thirty fathoms, two miles long east and west, and one mile wide. Sharp rocks cover the shoal, but the ground is not broken and drops off gradually to depths of fifty and fifty-five fathoms, and even to sixty fathoms on the

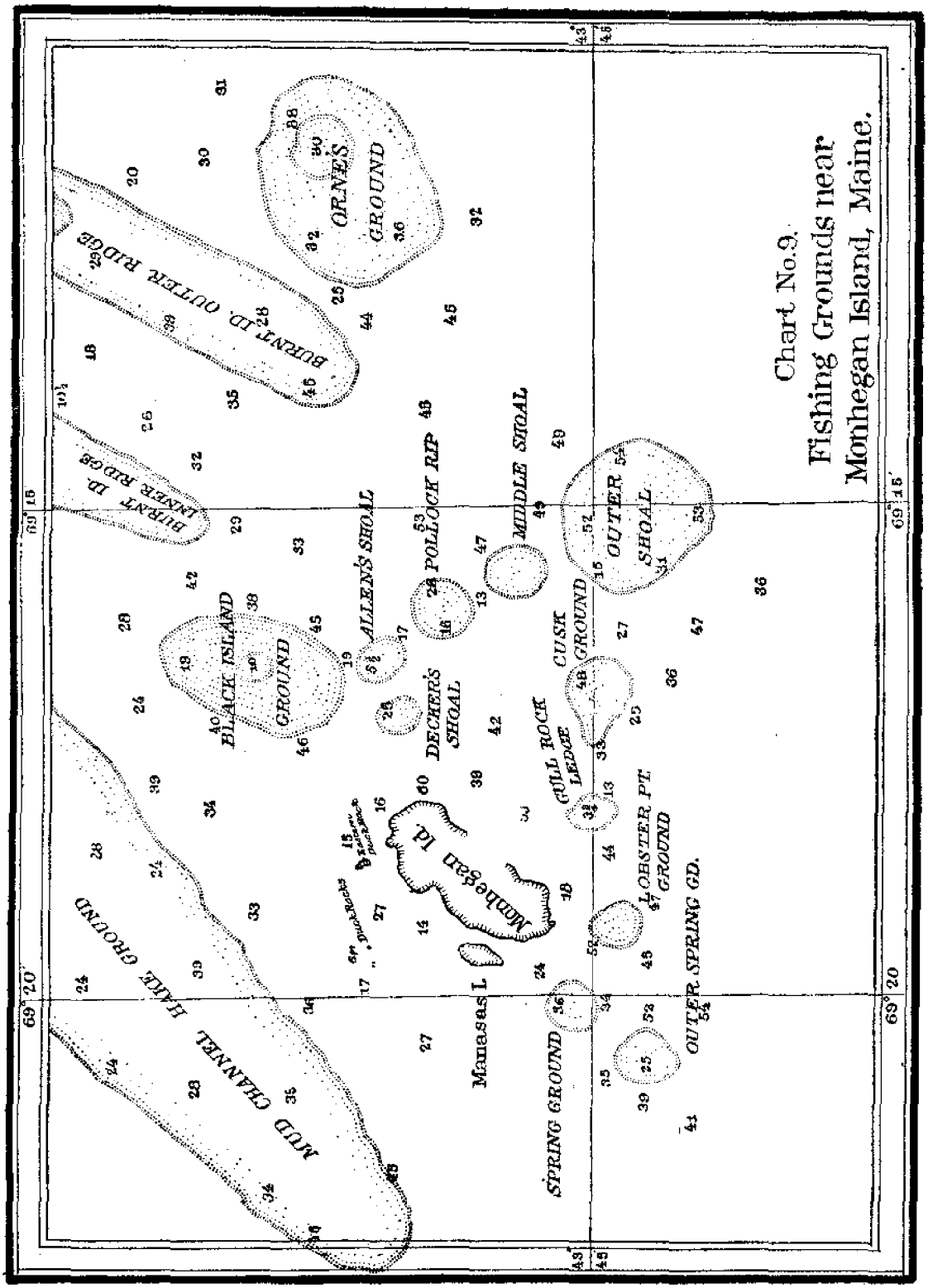


Chart No. 9.
Fishing Grounds near
Monhegan Island, Maine.
ORNE'S GROUND
BURNT I. OUTER RIDGE
BURNT I. INNER RIDGE
ALLEN'S SHOAL
POLLOCK RIP
MIDDLE SHOAL
OUTER SHOAL
BLACK ISLAND GROUND
DECHER'S SHOAL
CUSK GROUND
GULL ROCK LEDGE
LOBSTER PT. GROUND
OUTER SPRING GD.
SPRING GROUND
Manasas L.
Monhegan Id.
MUD CHANNEL
HAKE GROUND
69° 20'
69° 15'
43° 45'

southern part. Outside of the shoal the bottom is pebbly and gravelly. This is one of the best fishing-grounds for cod and haddock in this vicinity. Both trawls and hand-lines are used.

INNER BREAKER lies two miles west of the southwest point of Matinicus Island, and is a rocky shoal about an acre in extent, with seven fathoms of water. From the shoal the ground slopes gradually to depths of twenty-five and thirty fathoms, and this slope offers good fishing for cod in May and June. The bottom is rocky and much broken, being too sharp for trawls.

TOW-HEAD GROUND bears north by east one-half east from Matinicus Island, from which it is distant two and one-half miles. It has a depth of from twelve to thirty fathoms; is somewhat irregular in shape, with a very rocky and broken bottom. The ground designated by this name is from two and one-half to three miles long, and from one-half to one and one-half miles wide. It extends in an east by south and west by north direction, and is considered one of the best inside shoal grounds for cod and haddock in the bay. Hand-lines only are used.

The entire bay, between Vinal Haven and Matinicus and the Green Islands, is full of broken, rocky patches of fishing-ground, certain portions of which have received local names from the fishermen of the vicinity.

WESTERN or GREEN ISLAND RIDGE.—The northern portion of this ridge lies six and one-half miles northwest by west from Matinicus Rock, from which place it extends about seven miles in a south-southwest direction. Its greatest width is not over one mile; the depths vary from fifteen to thirty fathoms, the bottom being broken and rocky. This is a good ground for cod in the spring and fall.

GROUNDS OFF MATINIC ISLAND.

MATINIC BANK is an extension of the shore soundings which make out to the southward and eastward of Matinic, a distance of two or three miles, with depths, outside of one and a half miles, of twenty-three to thirty fathoms. The bottom is quite level, consisting of rocks, pebbles, and gravel, and abounds in cod from March until June. Just off the edge the bottom is soft and muddy, with depths of forty to fifty fathoms.

MATINIC OOZE.—This is a flat bottom composed of ooze and shells that makes off to the eastward of the Haddock Ledge and Shoal, and bears about south from Matinic. Haddock Shoal and the Ooze are really parts of one ground, though known to the fishermen under different names. The Haddock Shoal is now considered poor ground and is little resorted to. The Ooze falls off gradually, reaching a depth of fifty fathoms on the outer part. It is considered fair fishing-ground for cod and haddock in the spring, and for cod and hake in the summer and fall.

FREEMAN'S GROUND lies about six and one-half miles east from Monhegan Island, between Orne's Ground and Matinicus Western Ground. It is about three miles long, in a northeast and southwest direction, and one mile wide. It includes a shoal of twenty fathoms on the southwest part, having a sharp, rocky bottom, the rest of the ground being from twenty-five to forty fathoms deep, with a bottom of rocks, gravel, and broken shells, quite uneven in some places and smooth in others. This is a good ground for cod in the spring and for hake, cod, and pollock in the summer and fall.

GROUNDS IN THE IMMEDIATE VICINITY OF MONHEGAN ISLAND.

MIDDLE SHOAL, POLLOCK RIP, ALLEN'S SHOAL, and DECKER'S SHOAL are small rocky patches lying to the eastward of Monhegan and northerly from the Outer Shoal. They have depths varying from six to thirty fathoms, and generally a sharp, rocky, and broken bottom. They are fished on with hand-lines for cod and pollock.

Another lot of small patches lie westerly from the Outer Shoal and close to Monhegan Island. These are, the Cusk Ground, with depths of from twenty to thirty-five fathoms; Gull Rock Ledge, a shoal of three and three-fourths fathoms; Lobster Point Ground, with depths of fifteen to thirty fathoms; Inner Spring Ground, fifteen to thirty fathoms; and Outer Spring Ground, twenty-five to thirty-five fathoms. All of these are fished on for cod, haddock, and pollock by small boats, principally in the early spring and late fall. Not much distinction can be made between these grounds, as a boat may fish on several of them in the course of a single day. The Spring Grounds, however, are so near the harbor that they are generally the first visited in the spring; hence the name.

GROUNDS NORTH, NORTHEAST, AND EAST OF MONHEGAN ISLAND.

HAKE GROUND OF MUD CHANNEL.—This is a soft, muddy channel, extending from just outside of White Head to abreast of Monhegan Island, on the northern side. The depth varies from twenty to forty-five fathoms, and it was formerly one of the best hake grounds along the shore. It is now of less importance.

BLACK ISLAND GROUND bears east-northeast from Monhegan Island, from which the inner edge is distant about one mile. It is about one mile in diameter, and has a small shoal of ten fathoms, with a sharp, rocky bottom in the center. From this shoal the depth increases gradually to the edge of the ground, where it reaches forty fathoms. Beyond the depth of twenty-eight to thirty fathoms the bottom is gravelly and smoother. Monhegan Island boats fish on this ground all the season, from spring until fall, cod being caught in the spring, pollock on the shoal in the summer, and cod and hake on the edge in summer and fall.

BURNT ISLAND INNER RIDGE bears northeast by east from Monhegan Island, from which the inner edge is distant about three miles. This is a broken piece of ground, with depths varying from fifteen to twenty fathoms, the bottom being generally rocky and gravelly, with occasional mud holes. It extends in a northeast direction about four miles, reaching nearly to the Roaring Bull Ledge, and is about half a mile wide. Cod are taken here in the spring, from April to June, and cod and hake in the fall, from September to November.

BURNT ISLAND OUTER RIDGE.—This runs parallel with the Inner Ridge, at a distance from it of about three-fourths of a mile. It has depths varying from five to twenty-five fathoms, the bottom being somewhat less broken than on the Inner Ridge. This ground is fished on for the same species as are taken on the Inner Ridge.

ORNE'S GROUND bears east, distant four and one-half miles, from Monhegan light to the center. It is about a mile and a half long, east and west, and about a mile wide, with depths varying from thirty to forty-five fathoms. On the shoal part the bottom consists of sharp rocks and is broken, but on other portions of the ground it is gravelly and pebbly and quite level. The shoal lies toward the eastern part of the ground. This is a good locality for cod.

GROUNDS SOUTHEAST OF MONHEGAN ISLAND.

OUTER SHOAL lies about three miles southeast from Monhegan light-house. It is circular in shape, one and one-half miles in diameter, and has depths ranging from ten to thirty-eight fathoms. A small rocky shoal of ten fathoms is located near the center of the ground, the remainder having a gravelly bottom. Cod occur here from spring until fall, and the shoal is also a good locality for pollock.

MONHEGAN INNER SOU'-SOUTHEAST GROUND.—This shoal bears south-southeast from Monhegan light-house, from which the center is distant about five miles. It is nearly circular in

shape, and about a mile and a quarter in diameter. It has depths of thirty to fifty fathoms and is shoalest on the eastern part. This shoal is broken and rocky, but on the other parts of the ground the bottom is gravelly, with spots of mud. Cod and cusk are the principal fish taken here, although a few haddock, pollock, and hake are also caught. June is considered the best month on this ground for small boats, which usually fish until they are driven away by dogfish.

MONHEGAN OUTER SOU'-SOUTHEAST GROUND is about three miles outside of the Inner Sou'-Southeast, on the same bearing, and is similar in size and shape to the Outer Sou'-Sou'-west Ground. The bottom is rocky and muddy, or composed of hard clay, and the depths range from thirty-five to fifty-five fathoms. This ground is resorted to by the same kinds of fish that are caught on the inner shoal.

MONHEGAN SOUTHEAST GROUND bears southeast from Monhegan Island, from which the center is distant twelve miles. It is nearly three miles in diameter, and circular in shape, but the bottom is so broken, the depths within very short distances varying from thirty-five to seventy-five fathoms, that it is somewhat difficult to find. The bottom consists of rocks, gravel, and mud. This is considered a good locality for cod from April to July; both trawls and hand-lines are used.

HILL GROUND bears nearly south-southwest nine miles from Matinic, and is between three and four miles long, southwest and northeast, and about two miles wide. The shoalest portion has a depth of thirty-five fathoms, with rocky bottom; but from here it slopes off gradually to a depth of fifty fathoms, with a mixed bottom of gravel, rocks, and mud. The best fishing it offers is for hake. Both trawls and hand-lines are used.

GROUNDS SOUTHWEST OF MONHEGAN ISLAND.

MONHEGAN INNER SOU'-SOU'WEST GROUND.—This piece of ground derives its name from its bearings, lying as it does to the south-southwest of Monhegan light-house, at a distance of about five miles; its length in a south-southwest and north-northeast direction is about one and one-half miles, and its width one and one-fourth miles. It has a sharp, broken, rocky bottom, and includes a very small shoal of twenty fathoms and several other hummocks with somewhat greater depths. The deepest water is fifty fathoms. This ground is fished on mostly by the Monhegan boats in the spring, from May until July, for cod and pollock.

MONHEGAN OUTER SOU'SOU'WEST GROUND.—This ground bears the same as the last, the center being nine miles distant from Monhegan light-house. It is four miles long, south-southwest and north-northeast, and about two miles wide. The depths range from sixty to eighty fathoms, the bottom being generally pebbly and quite level. This is considered a good ground for cod in the spring and fall, and is resorted to by the small boats from Monhegan and by small fishing-vessels, ranging in size from fifteen to twenty tons, and owned between Portland and Isle au Haute, which visit these shoal spots during the spring and summer.

GROUNDS WEST OF MONHEGAN ISLAND.

OLD JEFFREY'S.—This is an exceedingly good ground for fish, and it is said that better fishing may be obtained here than on any other ground of its size in the vicinity. In the spring, cod are most abundant, while hake, together with cod and pollock, are taken in the late summer and fall. This ground bears southeast from Pumpkin Rock from which the center is distant about six miles. It is about three miles long, southwest and northeast, and about a mile wide. The depth varies from twenty-five to fifty fathoms, the bottom being broken and consisting of rocks, gravel, and mud.

MONHEGAN WESTERN GROUND.—This ground, which is of considerable extent, lies about four and one half miles west-southwest from Monhegan Island. It has depths of twenty-two to forty-five fathoms, the bottom being rocky and gravelly, and considerably broken in places. It is considered a good feeding-ground for fish, cod being abundant in the spring and hake in the summer, when dogfish are not too plentiful. The length of the ground is about four or five miles, and it is nearly two miles wide on the eastern or widest portion, gradually narrowing toward the western end, where the breadth does not exceed one mile.

BROKEN GROUND.—The center of this ground bears nearly south from Pumpkin Island (entrance to Boothbay Harbor); distance, seven miles. It extends four miles in an east-northeast and west-southwest direction, and has an average width of one and three-fourths miles. The depths range from thirty-five to fifty fathoms, the bottom being composed of rocks and mud. Cod occur here the year round, and hake are taken from June to September.

GREAT LEDGE bears south by east, distant twelve miles, from Cape Newagen; it is about four miles long, south-southwest and north-northeast, and from one to two miles wide. It is said to have a shoal of fourteen fathoms on the northern edge, and another of twenty-two fathoms near the center. These shoals are broken and rocky, but the main portion of the ground, having depths of thirty to forty-five fathoms, is mostly composed of sand, and is quite level, sloping gradually toward the edge. This is a good ground for haddock and cod in the winter and for cod in the spring; a few pollock are also taken at times.

GROUNDS BETWEEN MONHEGAN ISLAND AND PEMAQUID.

MIDDLE GROUND.—This piece of shoal ground lies about in midchannel between Monhegan Island and Pemaquid, and has a shoal of three fathoms on the eastern part, where the water breaks in heavy weather. This shoal is called Moser's Ledge, and is broken and rocky, but the ground slopes off gradually to the southwest, reaching a depth of forty-eight fathoms, with a bottom of gravel and mud on the deepest part. The ground is about two miles long, southwest and northeast, and about a mile wide. Boats fish here for cod and haddock in the spring.

JOHN'S HEAD GROUND lies about four miles south-southeast from Pemaquid Point. It has depths of twenty-five to thirty-five fathoms, with a sandy bottom, and is a good locality for cod during April and May, when it is much resorted to by small boats from Bristol. This ground is circular in shape and about one mile in diameter.

WHITE ISLAND GROUND bears east-southeast from the White Islands, from which the inner edge is distant about half a mile and the outer edge about four miles. In outline this ground is triangular and somewhat resembles a harrow, being widest at the outer end. It is very broken and uneven, the depths ranging from six to thirty fathoms. In some places the bottom is gravelly, but on the shoals it consists of sharp, broken rocks. These small, rocky spots are known by other names, for instance, Brown's Head Ground, on which the fishermen catch a few rock-cod, and a number of others which are resorted to by small boats.

GROUNDS OFF SEGUIN ISLAND.

HILL GROUND bears south-southwest from Seguin Island, distance about three miles. It is three miles long, southwest and northeast, and about three-fourths of a mile wide. The depths range from twelve to twenty-three fathoms, and the bottom is uneven. The northeast part is very rough, with several shoal spots, having depths of twelve to fourteen fathoms, while between them the depths vary from twenty to twenty-three fathoms. The southern part, though rocky, is

more even than the northern. Cod, hake, and pollock are the principal fish found here. Both trawls and hand-lines are used.

SEGUIN SOU'SOU'WEST GROUND bears south-southwest from the western part of Seguin Island, from which the center is distant four miles. It is a rocky shoal, about one-half mile long by two hundred yards in width, with a shoaler portion in the center about one-half acre in extent. The marks are Elwell's Rock, touching the west side of Seguin, and Fuller's Rock, touching the southern part of Bald Head. The depths range from seven to fourteen fathoms. This ground is resorted to by boat fishermen in September for rock-cod, fishing wholly with hand-lines. It is evidently a south-southwest continuation of the Hill Ground.

SEGUIN RIDGE bears about southwest by south from Seguin Island; distance, a little more than three miles. It is about one mile long in an east-southeast and west-northwest direction, and one-fourth of a mile broad. It consists of a number of small, rocky hummocks, with depths of nine to fourteen fathoms, on which cod are taken by the small-boat fishermen in the fall.

SEGUIN GROUND bears southwest by south from Seguin Island, from which the center is distant about seven miles. It is about four miles long, southwest and northeast, and a little more than two miles broad in the widest part. There is a small hummock, called Bumper's Island Ground, on the northern end, with a depth of thirteen fathoms. The northern part is mostly rocky, but toward the south the bottom is gravelly and sloping, so that on the middle and southern portions there are depths of thirty-five to forty-five fathoms. Cod, hake, haddock, and pollock are taken on these grounds, which are considered to furnish the best fishing in the vicinity of Seguin Island. Both trawls and hand-lines are used.

MCINTIRE REEF bears south-southwest from Bald Head (Cape Small Point); distance to the center, four and one-half miles. It is two miles long, northeast and southwest, by one-half mile wide. This reef is very broken and hummocky, with a rocky bottom, and depths of water ranging from fourteen to twenty fathoms. It is resorted to by the small-boat fishermen of Casco Bay, who fish for cod with hand-lines. Just to the eastward of this is a piece of bottom composed of hard mud and shells, where hake are usually quite abundant in the summer.

COW GROUND bears nearly southwest from Bald Head, from which the center is distant six and one half miles. This ground is nearly four miles long, in a northeast and southwest direction, and about one and one-half miles wide. The northeast portion is rocky and rough, with depths varying from sixteen to eighteen fathoms, while on the southwest part gravel and pebbles predominate, and the bottom slopes to depths of twenty to thirty fathoms. Cod and pollock are the principal fish occurring here.

MURR HUB bears south by west one-quarter west from Small Point, from which the center is distant ten and three-fourths miles. This ground is three miles long, north and south, and has an average width of one and one-half miles. The depths vary from thirty-four to forty-five fathoms. The inner part of the Hub is shoalest, and there the bottom consists of sharp, broken rocks. From this shoal the ground slopes gradually to the south, where it is composed of sand and gravel. Large quantities of marine invertebrates, affording food for the fishes, are brought up on the fishermen's hooks here as elsewhere. Cod occur from spring until October, hake from June to October, and haddock during the winter. Trawls only are used.

TAG GROUND lies between the Broken Ground and Seguin Island, bearing east-southeast from the latter; distance, five miles. This is a narrow, rocky ridge, about two miles long in a north northeast and south-southwest direction, with an uneven bottom and with depths varying from fourteen to thirty fathoms. It is principally frequented by small fishing boats.

KETTLE BOTTOM.—The center bears south from Seguin Island, from which the inner edge of the ground is distant ten miles. Its length is twelve miles in a north and south direction, and its width about ten miles, the shape of the ground being nearly circular. This is an uneven piece of bottom, consisting of rocks, gravel, and mud, the depths ranging from twenty-five to seventy-five fathoms. This is considered one of the best, if not the best, fishing-ground on this part of the coast. Cod are the most abundant fish and are taken the year round. Haddock abound in the winter. More fish are taken from this bottom than from any other single ground in the vicinity of Seguin. Harpswell and Portland boats fish here.

GROUNDS OFF CASCO BAY.

WEST COD LEDGE consists of a succession of rocky patches, extending about four and one-half miles in an east-northeast and west-southwest direction, with a width of about half a mile, the southwestern end of which bears southeast three-quarters south from Portland Head light; distance, four and three-fourths miles. The northeastern extremity lies from six to seven miles east-southeast from Portland Head light. The shoalest portion of this ledge has a depth of fourteen to eighteen feet; on other parts the depths vary from five to twenty-two fathoms. The bottom is irregular and composed of rocks and gravel. This is a favorite ground for small-boat market fishermen from Portland, cod and haddock being the fish principally taken.

GROUNDS OFF CAPE PORPOISE.

Lying off Cape Porpoise, between the bearings of southeast and south-southwest, and at distances varying from six to eight miles, are a number of small, rocky or pebbly patches of ground, having depths ranging from eighteen to twenty-five fathoms. During certain seasons they abound in cod and haddock and are visited by the fishermen of the vicinity.

TANTER bears south from Cape Elizabeth, from which the center is distant eight miles. It is from two to three miles in diameter, with a depth of about forty fathoms, and a bottom of rocks and gravel. An excellent fishing-ground for cod in the spring.

OUTER AND INNER BUMBO.—These are two small, rocky patches (large enough for only a single vessel to lie upon) bearing northwest from the Tracadia Ground, from which they are distant two and one-half and three miles, respectively, the Outer Bumbo being the nearest.

NUBBLE RIDGES consist of four or five narrow, rocky ridges, bearing southeast from the Nubble, and extending in the direction of Boone Island; they begin near the main shore and extend nearly to the island. The depths of water upon them vary from eleven to twenty fathoms. These ridges are much resorted to by small vessels and open boats, and good catches of cod and haddock are made in the spring and fall, but especially in the latter season, when both trawls and hand-lines are used.

CAPE PORPOISE PEAKS are a number of small, rocky patches, bearing about southeast from Cape Porpoise, from which they are distant four to five miles. These spots are in depths of twenty to forty fathoms, are considered good grounds for cod, haddock, and cusk, and are much resorted to by the boats and small vessels of the vicinity.

TRACADIA bears northeast from Boone Island, from which it is distant five miles. It is one-half mile in diameter; has a depth of fifty fathoms, and a bottom of rocks and gravel. A good haddock ground the entire year.

BLUE CLAY bears south-southeast from Boone Island, from which it is distant eight miles. This ground is nearly square, and four to five miles across, with depths ranging from forty-eight

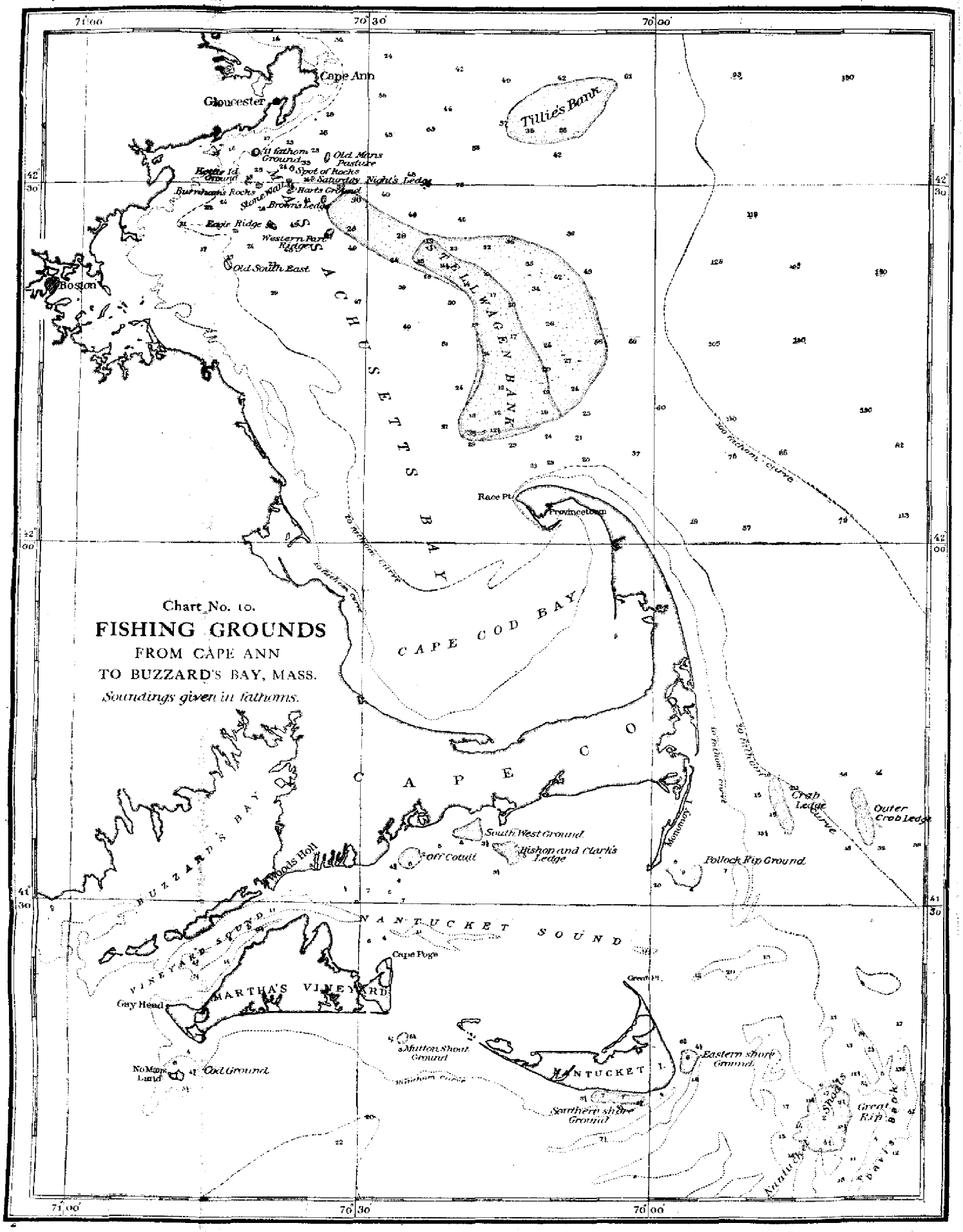


Chart No. 10.
FISHING GROUNDS
FROM CAPE ANN
TO BUZZARD'S BAY, MASS.
Soundings given in fathoms.
Cape Ann
Gloucester
Boston
Tillie's Bank
Old Mans Pasture
Spot of Rocks
Saturday Night's Ledge
Harts Ground
Brown's Ledge
Eagle Ridge
Western Part Ridge
Old South East
MASSACHUSETTS BAY
STELLWAGEN BANK
Race Pt.
Provincetown
CAPE COD BAY
CAPE COD
BUZZARD'S BAY
Woods Holl
South West Ground
Off Cotuit
Bishop and Clark's Ledge
Monomoy I.
Pollock Rip Ground
Crab Ledge
Outer Crab Ledge
NANTUCKET SOUND
VINEYARD SOUND
Cape Poge
MARTHA'S VINEYARD
Gay Head
No Mans Land
Cod Ground
Mutton Shoal Ground
NANTUCKET I.
Eastern shore Ground
Southern shore Ground
Great Rip
Nantucket Shoals
Davis Bank
Great Pt.
71° 00'
70° 30'
70° 00'
42° 30'
42° 00'
41° 30'

to sixty fathoms, and a bottom of tough blue clay. This is the best winter haddock ground in the vicinity, and is much resorted to at that season by the haddock trawlers.

DUCK ISLAND RIDGES.—These are two narrow, rocky ridges running out from Duck Island (one of the Isles of Shoals) in the direction of Boone Island, reaching to within a mile of the latter. The depths range from twenty-five to thirty fathoms. A good ground for haddock and cusk in the winter and spring, and resorted to by open boats, and also by many large vessels.

BOONE ISLAND ROCK GROUND begins one-half mile to the eastward of Boone Island Ledge, and runs in an east-southeast direction for a distance of two to three miles from the ledge, having a bottom of sharp rocks and clay, and depths ranging from forty to sixty fathoms. It is considered an excellent fishing-ground for cod, haddock, and cusk, and one of the best winter haddock grounds in the vicinity, at which season it is resorted to by the trawlers.

TEN ACRES bears south from Boone Island and east from the Isles of Shoals, these cross bearings meeting near the center of the ground, which is about five miles in diameter, with a small, rocky shoal (one-fourth mile wide) in the middle; on this shoal there is a depth of eighteen to twenty fathoms. The bottom around the shoal consists of clay and mud, and slopes gradually to depths of fifty to sixty fathoms near the edge. This is a good fishing-ground for cod, haddock, cusk, and pollock, while on the muddy bottom surrounding it large quantities of hake are taken.

In addition to the above-described grounds, there are in Well's Bay several small, rocky patches of less importance which are chiefly resorted to by small-boat fishermen.

7. THE COASTS OF NEW HAMPSHIRE AND MASSACHUSETTS TO NANTUCKET.

IPSWICH BAY.—Ipswich Bay, from the north side of Cape Ann to about Portsmouth, is resorted to during the winter season by large schools of cod, which visit this region to spawn. The shore soundings of the bay gradually deepen outwards from the land, reaching depths of thirty-five to forty fathoms at a distance of six to seven miles from shore. Within this limit, the bottom is mainly composed of sand, although there are numerous rocky patches between Newburyport and Cape Ann. Beyond a depth of forty fathoms, however, the bottom consists mostly of mud. The principal codfishing-grounds of Ipswich Bay lie off the northern shore, from Newburyport to the entrance of Portsmouth Harbor, at a distance of one and a half to five miles from the land, where the water is from twelve to twenty-five fathoms deep. Cod are also taken abundantly on the ledges at the south. A large fleet of vessels engage in this fishery in winter. Prior to 1880, trawls and hand-lines were universally used by the shore fleet, but in that year gill-nets were introduced with good results.

The area of muddy bottom outside is generally a favorite fishing-ground for hake in the late summer and fall. This fishery is participated in by the open-boat fishermen of eastern Cape Ann and the Isles of Shoals, and by small vessels coming from more distant places.

MASSACHUSETTS BAY.—The larger part of this bay, inside of Stellwagen's Bank, has a muddy bottom, on which large quantities of fish are rarely taken. Farther in, however, on the shore soundings, especially between the entrance to Boston Harbor and Plymouth, exist numerous rocky ledges, which are favorite feeding-grounds for cod in the fall and winter. This region is frequented by the Swampscott fleet and by other vessels supplying the Boston market. Near the center of Cape Cod Bay there is a rocky elevation, on which cod are taken, and numerous other ledges of larger and smaller size lie off the south side of Cape Ann.

Herring make their appearance about Cape Ann in the month of September. They come in large numbers, and remain about two weeks, the best fishing, however, continuing only about

one week. The school then moves slowly inward toward the head of the bay, the last fish being taken usually in the vicinity of Minot's Ledge, off Boston.

The mackerel, in the course of their autumn migrations after leaving the coast of Maine, pass in by Cape Ann and enter Massachusetts Bay, where they are generally taken in large quantities during October and November, by vessels of the regular mackerel fleet, using purse-seines.

GROUNDS IN THE VICINITY OF EASTERN POINT, CAPE ANN.—*Old Man's Pasture* bears southeast, distant five miles, from Eastern Point light. It is about three-fourths of a mile long, north-northeast and south-southwest, by one-third of a mile wide, the average depth of water being twenty-four fathoms; the bottom is rough and rocky. Cod occur here the entire year.

Western Part Ridge bears south by east half east from Eastern Point light; distance, about nine and one-fourth miles. The length, northeast and southwest, is one and one-half miles, and the average width three-fourths of a mile. The average depth is twenty-nine fathoms, the bottom being broken and rocky. Small vessels and open boats visit this ridge for cod and haddock in the summer.

Hart's Ground bears south half east from Eastern Point light; distance, five and one-half miles. Its length, in an east-northeast and west-southwest direction, is three-fourths of a mile, and its width one-fourth of a mile. This is a rocky patch with a depth of water of about thirty fathoms, and is visited by boat fishermen for haddock in the summer.

Eagle Ridge lies seven and two-thirds miles south by west from Eastern Point light, and is one mile long, southeast and northwest, by one-third of a mile wide. It has an average depth of twenty-five fathoms and an uneven rocky bottom, and is a favorite winter ground for cod.

Inside of the above-described grounds, at an average distance of two and one-half miles from Eastern Point light, and between the bearings of south half east and southwest, are a number of small rocky patches, with depths ranging from ten to twenty-five fathoms, designated as follows: *Brown's Ledge, Spot of Rocks, Stonewall, Saturday Night's Ledge, and Burnham's Rocks.* Still farther in are two other shoal spots, bearing nearly west from Eastern Point, one of which is distant about three-fourths of a mile, the other a little more than two miles. Each of these has a depth of about eleven fathoms, the former being called *Eleven-fathom Ground*, and the latter, which lies only half a mile southeast of Kettle Island, *Kettle Island Ledge.* Both of these patches are fished on by the boat and dory fishermen, using hand-lines, for cod in winter and for haddock in summer.

Numerous other rocky hummocks, of very limited extent, are located easterly of the grounds already described and within a few miles of them. They bear local names, and are less frequented than the larger areas, and the fishermen only reach them by means of cross-bearings from objects on land. The chief winter-grounds for cod in the vicinity of Eastern Point are Old Man's Pasture, Eagle Ledge, and Brown's Ledge.

STELLWAGEN'S BANK or MIDDLE BANK separates Massachusetts Bay from the Gulf of Maine, and extends from near Cape Ann to near Cape Cod. The center of the bank bears about south by east half east from Thatcher's Island, and north by west half west from Highland light, Cape Cod. The southern point of the bank is distant about five and one-half miles from Race Point, Cape Cod, and the northwest prong reaches to within about twelve to fifteen miles of Eastern Point, Cape Ann. The shoaler portion, with depths of from nine and one-half to nineteen fathoms, is seventeen and one-half miles long, in a north by west and south by east direction, and has an average width of four miles. This part of the bank is sandy, but on the eastern slope, in depths of twenty-five to fifty-five fathoms, it consists of coarse sand, gravel, and pebbles. On this

gravelly slope, for a number of years, haddock and cod were taken in abundance, the former in winter, the latter in fall and spring. The fishery was continued on a large scale until as late as 1875, and is even now carried on to a greater or less extent by the smaller vessels composing the coast fleet. The grounds off the southern end of the bank, and between it and Race Point, abound in cod in the fall and winter.

EAST SIDE OF CAPE COD.—The sea bottom off the east side of Cape Cod is sandy, and slopes off gradually from the beach, reaching depths of thirty to forty fathoms at distances of five to seven miles from land; below Chatham the slope is even more gradual. Within these limits good catches of cod are occasionally obtained, and the same is true of haddock, though to a less extent. Farther from shore, in depths of forty to eighty fathoms, and from a point eight to ten miles off the highlands of Cape Cod to another point lying twenty miles or more east-southeast of the Chatham lights, there is one continuous stretch of excellent winter haddock grounds, which were first generally fished upon about 1870. From that time until about four or five years ago, these grounds were much resorted to during the most of the winter months, and they still afford abundant catches to the vessels of the shore fleet.

MORRIS LEDGE, lying to the eastward of Chatham, is a favorite locality for certain codfishermen during the spring and early summer.

Two very excellent fishing-grounds for cod lie off the southeastern part of Cape Cod; one of these is situated close inshore; the other is an off-shore ledge. They are described as follows:

OUTER CRAB LEDGE.—The center of this ledge lies about fourteen miles east-southeast of Chatham lights; it extends about five or six miles in a north and south direction, and is about one mile broad. The depth of water ranges from nineteen to twenty-three fathoms; the bottom is rocky. Cod are more or less plentiful on this ledge during the entire year, but are fished for during the fall, winter, and spring, the same fishermen engaging mainly in bluefishing during the summer. The boats used are large cat-rigs, of twenty to thirty-five feet in length, and belong mostly to Chatham; a few also hail from Harwich. From seventy to eighty boats of this character may often be seen about this ledge at the same time. In former years, this ledge was frequented by large well smacks, of thirty to fifty tons burden, belonging to the south shore of Cape Cod. It is now occasionally resorted to by large Gloucester schooners.

POLLOCK RIP GROUNDS lie between Pollock Rip light-ship and Shovelful light-ship, and extend northward to Pollock Rip Shoal. The extent of these grounds is about three miles east and west and two miles north and south, the depths of water ranging from four to twelve fathoms. They are fished upon during the spring and fall by cat-rigged boats from Monomoy. In stormy weather Chatham boats also frequently resort to them, instead of going to Crab Ledge. Late in the spring and early in the fall, the cod move in nearer shore, and may be caught between Brush's shoal and Monomoy light. In the winter, however, the cod entirely leave Pollock Rip Grounds, and move into deeper water.

NANTUCKET SHOALS.—There are three principal codfishing-grounds included in these shoals. They are as follows:

Great Rip lies about thirteen miles east by south one-half south from Sankaty Head, Nantucket, and is about five miles long north and south, and three miles broad. Over this area the depths are only nine to eighteen feet, but fishing is mainly carried on around the edge of the shoal, in depths of six to twelve fathoms, where the bottom consists of gravel and shells, covered with sponges, kelp, etc. This region is visited mostly by well smacks from the ports of Long Island Sound, which fish more or less during the entire year, and carry their catch alive to New York. More fishing is done here during the winter and spring than at other seasons.

Fishing Rip is an elongate bank, situated about twenty-nine miles southeast from Sankaty Head light. It extends about ten miles in a northeast and southwest direction, and is about one and one-half miles broad; the depths of water upon it vary from four and three-quarters fathoms to eight and three-quarters fathoms. The character of the bottom is the same as upon Great Rip, and it is visited by the same fleet of fishing-vessels, and also occasionally by smacks from Nantucket.

Phelps' Bank lies about thirty-eight miles southeast one-half south of Sankaty Head light, and agrees more or less in size, shape, trend, and character of bottom with Fishing Rip. The depths of water range from ten to seventeen fathoms. It is resorted to occasionally by the same fleet of smacks that visit the two preceding banks.

Strong tidal currents flow over these three banks, the flood tide running northeast and the ebb southwest.

8. THE GULF OF MAINE.

The Gulf of Maine constitutes one of the most important fishing areas of the eastern coast of North America, both from the abundance of fish which resort to it and its close proximity to numerous large and enterprising fishing ports. It is nearly rectangular in shape, being bordered on the north and west by Maine, New Hampshire, and Massachusetts; on the south by George's Bank; and on the east by Nova Scotia, Brown's Bank, etc. Its greatest length is from Cape Cod to Cape Sable, the distance between these two points being about two hundred and fifteen miles. The average breadth at right angles to this line is about eighty miles. The area of the Gulf is, therefore, more than seventeen thousand square miles, all of which is more or less available for fishing of one kind or another. From the sixty-fathom line, which lies from twelve to twenty-five miles off the coast, the bottom descends rapidly in some parts, in others more gradually, to depths of one hundred to one hundred and sixty fathoms, nearly all the deeper tracts having a bottom of mud, on portions of which hake are sometimes abundant. To the north of the center of the Gulf, along a line running more or less directly from Cape Ann to the mouth of the Bay of Fundy, are distributed a number of elevated, gravelly, rocky patches of greater or less size, which are described below, and on which cod and haddock feed in immense numbers. These grounds are mainly visited by vessels of from fifteen to fifty tons, belonging to the New England fishing fleet. The mackerel fisheries of the Gulf of Maine are now the most important in the world. From the first of June to November, this species of fish is more abundant here than elsewhere along the coast, and the schools are distributed over the whole extent of the Gulf from the shores outward, irrespective of the depth of water. The shallow-water fishery is described elsewhere, but it is in the deeper waters, where the immense purse-seines can be freely used, that the large catches are made. Formerly, the Gulf of Saint Lawrence was most resorted to by the mackerel catchers of our ports, but since the introduction of purse-seines for the capture of this fish, the shallow waters of the Saint Lawrence have been largely deserted by the vessels of our fleet, which have been able to obtain much more profitable fares nearer home.

Herring also abound in the Gulf of Maine, where they used to be taken in gill-nets for use as bait by the fishermen at anchor on the cod grounds. This was at one time the principal method resorted to by the fishermen of the Gulf of Maine for securing bait, but now almost all the herring so used are obtained from the harbors and islands along the shore.

GRAND MANAN BANK.—Grand Manan Bank lies at the entrance to the Bay of Fundy, and bears southwest one-half south from the southwest head of Grand Manan Island, from which the northern part of the bank is fifteen miles distant. It is ten miles long and five miles wide, and

extends in a southwest and northeast direction. The bottom is mostly composed of stones and gravel, and the depths of water vary from twenty-four to forty-five fathoms. The tides are quite strong over this bank, but not sufficiently so to prevent trawling. Cod and pollock are the principal fish occurring here, cusk, hake, haddock, and halibut being less plentiful. The fishing season is from April to October, during which time the fish come on the bank to feed. In the spring, the fish are usually most abundant on the southwest portion, but later in the season the best fishing is generally obtained on the other end of the ground. This bank is a favorite fishing-ground for that class of small vessels known as the shore fishermen.

GERMAN BANK.—Although this bank is not usually laid down on the charts, it is one of the most important in the Bay of Fundy. It bears southeast from Baker's Island light, Mount Desert, from which the northwest part is about fifty-two miles distant. The length is about fifteen miles and the width nine to ten miles. It lies between 43° 38′ and 43° 53′ north latitude, and 66° 58′ and 67° 15′ west longitude. There are from sixty-five to one hundred fathoms of water. The bottom is mostly a tough red clay, but with spots of mud, sand, gravel, and pebbles on some parts. The tides set out and in over the bank, to and from the Bay of Fundy, the ebb running about southwest and the flood northeast, but the currents are not so strong as might be expected. Cod, hake, cusk, and haddock are the fish chiefly taken, but a few halibut and pollock are occasionally caught. The fishing season is from April to October, although fish are usually most abundant in the spring. This bank is mainly resorted to by vessels from the coast of Maine, but is sometimes visited by the Massachusetts fishermen.

MARBLEHEAD BANK.—This fishing-ground, which is quite an important one for the shore codfishermen, is not laid down on the published charts, and the fishermen who visit it are, therefore, probably the only persons familiar with its location and extent. The ground, which they call Marblehead Bank, is situated between Grand Manan and German Banks, the shoal water bearing south-southeast from Moos-a-Bec light, and being distant thirty-two miles. It is about twelve to fifteen miles long and seven or eight miles wide, and lies between 44° 00′ and 44° 10′ north latitude, and 66° 58′ and 67° 13′ west longitude. There are from thirty-five to seventy fathoms of water over it, and the bottom is mostly clay and gravel. The fish which occur in the greatest numbers are cod, pollock, and haddock, but with these are also found more or less hake and cusk. The best fishing is generally in the spring and early summer. The same class of vessels, the shore fishermen, which frequent Grand Manan and German Banks also resort to this bank, but occasionally those of a larger size make one or more trips to it during the summer season.

JONES' GROUND.—This is quite an important fishing-ground for cod, and, though of comparatively small size, is much resorted to by many of the same vessels that also visit the other banks in the Gulf of Maine. The western part bears southeast from Baker's Island, from which it is distant thirty-two miles. The entire ground is about ten to twelve miles long, northeast and southwest, and five miles wide. The depths range from fifty to one hundred fathoms, and the bottom, which is quite broken, consists of rocks, gravel, and mud. On the northeast part of the ground, where the depths vary from fifty to seventy fathoms, the bottom is rocky and rough. This part bears southeast by east, one-half east, from Baker's Island light, from which it is distant about thirty-five miles. The entire ground furnishes good trawl fishing from the first of May to the last of September. The principal fish taken are cod of large size; a smaller amount of hake, cusk, pollock, and haddock are also secured.

CLAY BANK bears southwest by west from Mount Desert Rock, from which the center is distant seven miles. It is four miles long, west-southwest and east-northeast, by two miles broad.

The depths are fifty to eighty fathoms, and the bottom consists of hard clay. The principal fish taken here are cod.

BANK COMFORT, which is a comparatively little known fishing-ground, bears southeast by south from Mount Desert Rock; distant thirteen miles. It is said to be about five miles long, southwest and northeast, by three miles wide; has a hard gravelly bottom, and depths ranging from seventy-five to eighty fathoms. It is considered an excellent fishing-ground for cod in the spring and summer, but is less frequented than some other localities, since its small size renders it difficult for the fishermen to find it, except under the most favorable circumstances.

JEFFREY'S BANK.—This bank, which lies east of Cashe's Ledge, is of comparatively little importance as a fishing-ground. It is about twenty miles long, southwest and northeast, and ten miles wide, the northern and southern limits being 43° 30′ and 43° 15′ north latitude. The eastern edge is in 68° 25′ and the western in 68° 45′ west longitude. The bottom, which is somewhat broken, is composed of mud, sand, gravel, and pebbles, the depths of water ranging from thirty-five to seventy fathoms. Cod, haddock, hake, and cusk are the most abundant fish; some pollock are caught, but halibut are rarely taken. The best season is late in the spring and early in the summer, before the schools of dogfish strike in, after which but few fish can be obtained. This bank is resorted to by the smaller-sized vessels, from fifteen to fifty tons.

NEWFOUND AND MONHEGAN FALL GROUNDS are evidently parts of Jeffrey's Bank, according to the statements of intelligent fishermen who have visited them. Newfound Ground is on the eastern part of the bank, and has a very irregular and broken bottom. Monhegan Fall Ground lies westerly from Newfound. Both of these grounds used to furnish excellent fishing, but are not now resorted to as much as formerly.

CASHE'S LEDGE.—This is not now a very important fishing-ground except for a brief period in the spring, although it is resorted to somewhat by the shore fishermen in summer and fall, when good trips are usually obtained. It bears east from Cape Ann, from which the shoaler portions are seventy-six miles distant. The bank is about twenty-two miles long, from 42° 49′ to 43° 11′ north latitude, and about seventeen miles wide, from 68° 40′ to 69° 03′ west longitude. There are three small shoals on the western part of the bank, the southern one with a depth of seven fathoms of water, the middle one with four fathoms, and the northern one with eleven fathoms. The position of the middle shoal is 42° 56′ north latitude and 68° 52′ west longitude. From this the south shoal bears south by east, and the north shoal north-northeast, each being three and one-half miles distant from it. The water breaks on these in rough weather, and though of small extent they are dangerous to passing vessels, especially as they lie almost directly in the track of vessels bound from Cape Sable to ports in Massachusetts Bay. With the exception of the shoals the depth of water ranges from fifteen to sixty fathoms. The ground is more or less broken, with a bottom of sand, pebbles, and rocks. The greater part of the fish caught here are cod, hake, and cusk. Halibut are rarely seen, and haddock and pollock are less plentiful than the other kinds. Good fares are often secured on the edge of the ground in May and June, but the dogfish, which appear about the last of June or in July, usually drive everything before them, and, for a time, stop the fishing. The vessels fishing on Cashe's Ledge range from fifteen to forty-five tons, and are classed as shore-trawlers.

FIPPENIES BANK bears east one-quarter south from Thatcher's Island; distance, sixty-one miles. It is nearly ten miles long north and south, and has an average width of four and one-half miles. The bottom consists of gravel, pebbles, and clay, the depths ranging from thirty-six to sixty fathoms. Resorted to by the shore fleet in the spring and early summer.

PLATT'S BANK, OR NEW LEDGE, bears east by north one-half north from Thatcher's Island, from which the shoal portion of the ledge is distant fifty-three miles. This bank is twelve miles long, southwest and northeast, and eight miles wide. The shoal, which is rocky and of small extent, is situated near the center, and has a depth of twenty-nine fathoms. Over a large extent of the bank the depths range from thirty to thirty-five fathoms, with a bottom of rocks and gravel. From the edge of this area the bottom slopes gradually to a depth of fifty to sixty fathoms; beyond which it drops suddenly to eighty or ninety fathoms with a muddy bottom. This is considered one of the very best fishing-grounds for cod and haddock in the Gulf of Maine, and hake are generally abundant during the summer on the muddy bottom near its edge. Trawl-lines are used. Resorted to by the shore fishing-vessels from all along the coast, from Cape Cod to Maine.

MISTAKEN LEDGE bears north from the center of New Ledge, from which it is distant about ten miles. This ground is about eight miles long in an east and west direction, and five miles wide. The depths range from thirty-five to sixty fathoms, and the bottom consists of rocks and gravel. In proportion to its size this ground is nearly as important as New Ledge, being resorted to by the same species of fish and visited by the same class of fishing vessels.

JEFFREY'S LEDGE.—This may be considered one of the best shore fishing-grounds in the Gulf of Maine, although it is of comparatively small size. It appears to be an extension of the shoal ground that makes off in a northeasterly direction from Cape Ann; it is about twenty miles long, northeast and southwest, and from two to four miles wide. Its southern limit is 42° 54′ and its northern 43° 11′ north latitude, and the eastern and western boundaries may be placed at 69° 58′ and 70° 18′ west longitude. The bottom is rocky on the shoalest parts, with gravel and pebbles along the edges. The depths of water range from twenty-seven to thirty-five fathoms on the bank, and fall off to forty and fifty fathoms at the edges. There is usually little or no tide, although an occasional current sets toward the southwest. Cod, cusk, and haddock are taken in the fall, winter, spring, and early summer, with a greater or less quantity of hake or pollock. For a number of years Jeffrey's Ledge was a favorite winter fishing-ground for haddock, which were very abundant there, and even at the present time many vessels resort to it in pursuit of that species; but since the haddock fishermen have extended their cruises to the outer banks, a less number now visit Jeffrey's Ledge. Besides the haddock catchers, other vessels engaged in the shore fisheries come to this ground in the spring and fall.

EASTERN SHOAL WATER OF CAPE ANN.—This ground extends off in an east-northeast direction from Cape Ann, a distance of fifteen to eighteen miles. It is, in reality, a southwest continuation of Jeffrey's Ledge, the two forming a nearly continuous ridge, running northeast from Cape Ann, a distance of about forty-two miles. The depths of water on the so-called "Eastern Shoal Water" vary from twenty to forty-five fathoms, the bottom consisting of rocks, pebbles, and coarse gravel over the most of its extent. On the edges sand and mud occur. The eastern part of this ground is resorted to by the haddock fleet during the fall and early winter, and the other parts are visited more or less the entire year, for cod, haddock, and pollock, by the vessels composing the shore fleet, and by the boat fishermen of Cape Ann.

TILLIE'S BANK bears east by south one-half south from Thatcher's Island, Cape Ann, from which the shoal (located near the center of the ground) is distant eighteen miles. A small, rocky shoal, with a depth of twenty-eight fathoms (some fishermen claim a less depth), is situated near the center, outside of which the water deepens to forty fathoms, this depth occupying quite an extended area. The length of the entire ground is ten miles, in an east and west direction, and

the width about five miles. At the edge it falls off rapidly to depths of fifty to sixty fathoms, before reaching the mud at a still greater depth. The bottom is rough and rocky over the greater part. Tillie's was formerly regarded as one of the best fishing-grounds off Cape Ann, and is still resorted to for cod and in the fall for haddock. Trawls are the principal kinds of fishing gear in use.

9. THE SOUTHERN COAST OF NEW ENGLAND.

THE SHORE GROUNDS OF NANTUCKET.

There are two principal shore grounds for cod on the coast of Nantucket; one lies off the eastern side of the island, the other off the southern. The eastern ground extends from off Siasconsett (north of Old Man's Shoal) northward to off Sankaty Head light, a distance of two miles, and off shore from three-fourths of a mile to two miles, with depths of four and one-half to eleven fathoms. The bottom is gravelly, with mussels and kelp. These grounds are fished on by about seventy dories during the spring and fall. The southern grounds extend westward from Tom Never's Head to Weedweeder Shoal, a distance of four miles, and off shore a distance of about one mile. Fishing is carried on in depths of eight to ten fathoms, on sandy and shelly bottoms, by about thirty dories belonging to Nantucket town, but quartering at the South Shore Life-Saving Station. Both cod and haddock are taken in the spring and fall. In the summer this is a good bluefishing-ground, and the fishery is carried on by means of gill-nets and hooks and lines.

NANTUCKET SOUND.

BISHOP AND CLARK'S LEDGE, near Hyannis, is a very rough bottom, with some exposed rocks, and is about one and three-fourths miles long and five-eighths of a mile wide. Fishing for tautog is carried on here, in depths of three to six fathoms, during the entire summer, or from June to October or November. This ledge is visited by large cat-rigged boats from Hyannis, which fish with hook and line. It is also a good ground for lobsters.

SOUTHWEST GROUND, HYANNIS, extends from the breakwater, off Hyannis, out to Bell Buoy, a distance of about two miles, and westward to Collier's Ledge, a distance of two and one-half miles, with depths of ten feet to four fathoms; the bottom consists of sand, gravel, and rocks, covered with algæ and eel-grass. During June this is considered the best sea-bass ground on the Massachusetts coast. Tautog, scup, and bluefish are also taken from June to October. This ground is frequented by cat-rigged boats from Hyannis, Centreville, and Cotuit.

OFF COTUIT, over an area about two miles square, and with an average depth of three fathoms, gill-net fishing for bluefish is extensively carried on during June and July. As many as three hundred or four hundred gill-nets are often set there at a time.

MUTTON SHOAL GROUND lies in the outer or southwestern part of Muskeget Channel, and extends about one mile south from Mutton Shoal, with a width of about the same. The depths range from three and three-fourths to four fathoms. Cod and haddock are taken in the spring and fall, and bluefish in the summer, the latter being fished for mainly in the rips at the side of the channel, with hooks and lines. This region is frequented by the so-called "Vineyard-fishing boats" hailing from Edgartown, Martha's Vineyard.

VINEYARD SOUND.

Vineyard Sound, from Hedge Fence Shoal, off East Chop, Martha's Vineyard, to east of Gay Head, constitutes one of the most extensive sea-bass grounds of the New England coast. Fishing is carried on everywhere throughout this region in depths of six to twelve fathoms, where the

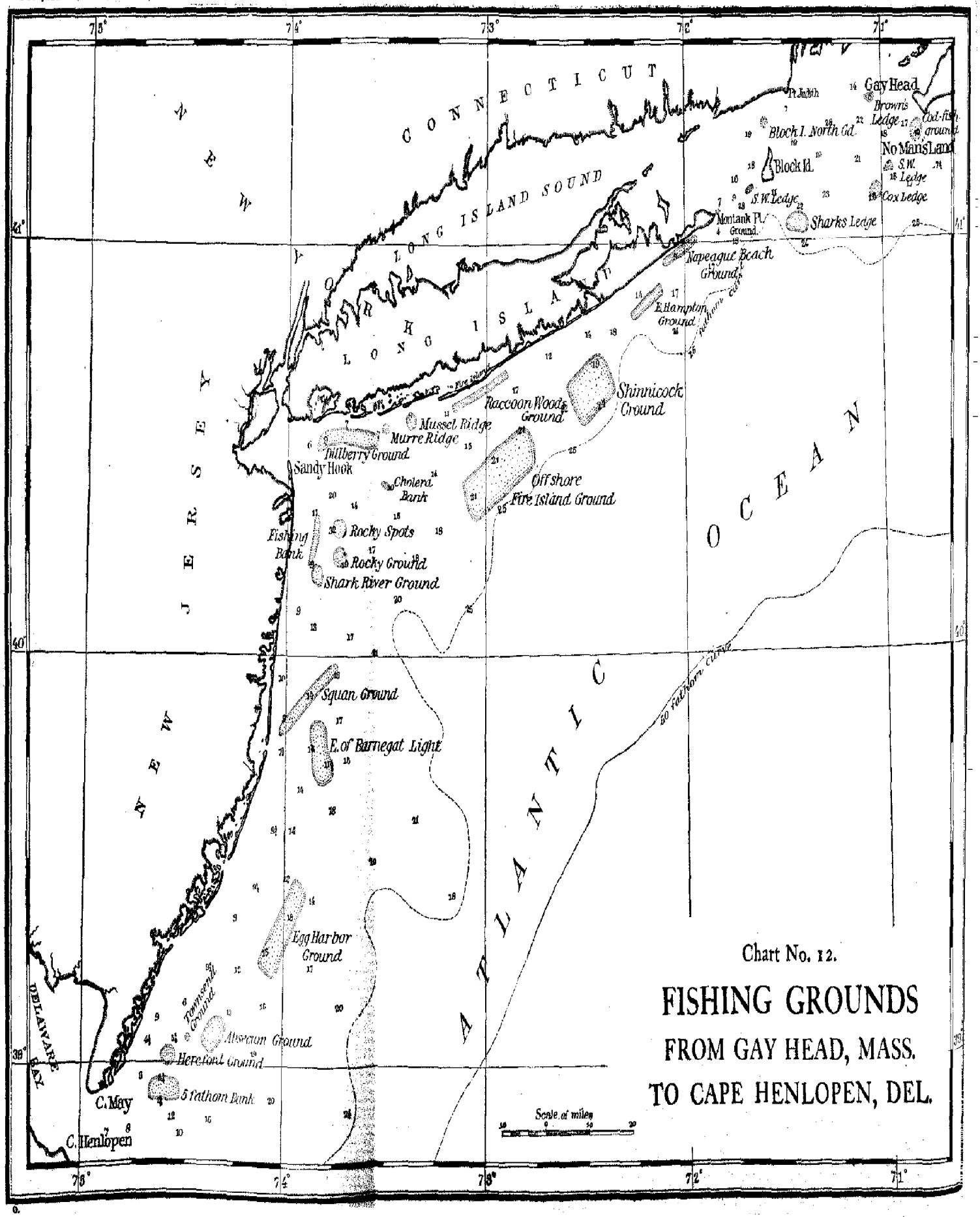


Chart No. 12.
FISHING GROUNDS
FROM GAY HEAD, MASS.
TO CAPE HENLOPEN, DEL.
CONNECTICUT
LONG ISLAND SOUND
LONG ISLAND
NEW JERSEY
ATLANTIC OCEAN
DELAWARE BAY
Gay Head
Pt. Judith
Brown's Ledge
Cod-fish ground
No Man's Land
S.W. Ledge
Cox Ledge
Block I. North Gd.
Block Id.
S.W. Ledge
Montauk Pt. Ground
Sharks Ledge
Napeague Beach Ground
E. Hampton Ground
Shinnicock Ground
Raccoon Woods Ground
Mussel Ridge
Murre Ridge
Tillberry Ground
Sandy Hook
Cholera Bank
Off shore Fire Island Ground
Fishing Bank
Rocky Spots
Rocky Ground
Shark River Ground
Squan Ground
E. of Barnegat Light
Egg Harbor Ground
Townsend Ground
Museum Ground
Hereford Ground
5 Fathom Bank
C. May
C. Henlopen
20 fathom curve
Scale of miles

bottom is rocky, gravelly, or shelly. The fishing fleet consists of cat-rigged boats from Martha's Vineyard, Wood's Holl, and Falmouth, and well-smacks from New London and Noank, Connecticut, there being about fifty of the former class and thirty of the latter class regularly employed in this fishery. The season extends from the middle of June to the first of October; the boats shifting from place to place as the supply of fish becomes exhausted in each locality, and returning to the same ground at a later period. The well-smacks carry their catch directly to New York, but the fish taken by the smaller boats are shipped in barrels with ice.

Tautog are caught in small quantities along the western shore from Wood's Holl to Job's Neck, Naushon, a distance of about two miles, by the shore fishermen. They are also taken about Cuttyhunk through September and October, and likewise in November if the weather is moderate. The latter locality is considered to furnish the best tautog fishing of this region.

Lobster pots are set along both sides of the sound, from West Chop and Wood's Holl to Gay Head and Cuttyhunk, in depths of eight to fifteen fathoms. This was, in former times, a very valuable lobster region, and still remains so in its outer portions; but lobsters have become more and more scarce every year in the upper part of the sound, while they have apparently increased in abundance about Gay Head, Cuttyhunk, and No Man's Land. This fishery has, therefore, been mostly transferred to the outer grounds. The number of pots set in the sound during the past few years has varied from about 700 to 2,000 annually. Around Cuttyhunk about 900 pots are now in use. Very many pots are set just to the west and north of Gay Head, by parties residing temporarily at Menemsha Bight. Lobstering in the sound is confined to rocky and gravelly bottoms.

BUZZARD'S BAY.

The principal fishery of Buzzard's Bay is for tautog during the summer. Tautog appear at the head of the bay about May, and work into the shallow water farther out about a month later. The fishery is conducted on both sides of the bay, on rocky bottoms, in average depths of three fathoms, by a fleet of about twenty smacks from New Bedford and Westport, Massachusetts. Sea bass and scup are also taken during the summer months, but are not as abundant here as in Vineyard Sound.

OFF VINEYARD SOUND.

No Man's Land.—Cod are taken on all the rocky bottoms about this island during the fall and spring, and lobsters on all kinds of bottom during the spring and summer. The fall cod-fishery begins about the first of October, and continues until very stormy weather prevents the men from venturing out in their boats. About the first of April they begin to fish again for cod, and stop about the middle of May. The lobster season extends from the middle of May until about the twentieth of September. The bottom to the east and south of the island is sandy and gravelly; while to the west and north it is more or less the same, with numerous rocky patches. Codfishing is carried on from one-half to one and one-half miles from shore, in depths of four to ten fathoms, by about thirty boats using hand-lines only. The lobster pots are set from one-half to two miles from shore, in depths of ten to thirteen fathoms. There are from fifteen to twenty lobstermen fishing from here during the summer, using about one thousand pots. The catch for 1882 amounted to about one hundred thousand marketable lobsters. The fishermen of No Man's Land belong entirely to Martha's Vineyard, and live on the former island only during the fishing season; they use the "Vineyard fishing-boats." In addition to these, there are several well-smacks from New London and Noank, Connecticut, which visit this region more or less constantly during both the cod and lobster seasons, carrying their catch to New York.

SOUTHWEST LEDGE lies about thirteen miles southwest by south from Gay Head, Martha's Vineyard. It is oval in outline, extending about two miles east and west and one and one-fourth miles north and south. The depth of water is about fourteen or fifteen fathoms, and the bottom is rocky and gravelly. This is a very good cod ground, and is resorted to by New York smacks in the summer, and by schooners from New England in the spring, the former using hand-lines and the latter trawls.

COX'S LEDGE is a cod ground, the center of which lies about twenty-three miles southwest one-half west from Gay Head, Martha's Vineyard. It is elongate in shape, being four or five miles long, east and west, and about two miles wide. The depths of water range from fifteen to twenty-two fathoms. The bottom consists of rocks and gravel. Cod are found the entire year, and some haddock are also taken. This ground is frequented by eight or ten smacks from New Bedford and New London, and three large schooners from Fair Haven, Massachusetts, the former using hand-lines, the latter trawls. The smacks fish principally through the summer and the schooners through the early spring.

Several interesting small areas or "spots" about Cox's Ledge are known to the fishermen. They are of very limited extent, but are noted as furnishing excellent fishing. They are described as follows:

"Southwest Spot" lies about two miles southwest of the ledge. It has a hard bottom, and a depth of twenty fathoms. "West Spot" is about one-half mile west of the ledge, with the same character of bottom, and a depth of twenty-two fathoms. "Southeast Spot," situated about seven miles southeast of the ledge, has also the same bottom and a depth of eighteen fathoms. Other smaller and less defined spots occur in the same vicinity.

BROWN'S LEDGE lies six miles southwest by west from Sow and Pigs (Vineyard Sound) light-ship. It is about two miles square, and has a rocky bottom, with depths of seven to ten fathoms. Cod are taken here in the spring and fall, and tautog in the fall. This ground furnishes the last tautog of the season for this part of the coast. Fishing is carried on by smacks from New Bedford and Westport, Massachusetts. Some lobsters are caught on this ledge by Noank, Connecticut, smacks.

THE COAST OF RHODE ISLAND.

SHARK'S LEDGE bears southeast by south from Block Island light, nine miles to the center. Its length, east and west, is about five miles. This is a rocky ground, with about twenty fathoms of water, and is fished upon for cod and haddock during the winter, or from November to May or June, by New York smacks and Block Island boats using hand-lines. Fish are generally abundant.

There are numerous small, rocky patches, without names, but furnishing good cod and haddock fishing, situated to the south and southeast of Block Island, and between that island and Shark's Ledge. The season is the same as for the ledge. Fishing is carried on mainly by Block Island boats.

SOUTHWEST LEDGE OF BLOCK ISLAND.—The center of this ledge lies about three miles southwest by west one-half west from the southwest head of Block Island. It is about two miles long in a northeast and southwest direction, the inner edge being about two miles off the southwest head. The width of the ledge is about one-half mile; depth of water, five to nine fathoms; character of bottom, rocky. This is a good ground for cod and haddock from November to June. It is visited by New York smacks and Block Island boats.

NORTH GROUND OF BLOCK ISLAND lies about one and one-half miles north-northwest of the nun buoy, off the northern end of Block Island, and extends about one mile north and south, and one-half mile east and west. The bottom is rocky and broken. This is a good ground for cod in the spring, and is visited by the same class of boats that resort to Southwest Ledge.

O. NEW YORK TO SOUTHERN FLORIDA.

LONG ISLAND SOUND.

Good sea-bass grounds occur at numerous intervals along the northern side of Long Island, close inshore. Off the eastern side of Gardiner's Island there are many small, rocky spots, which abound in sea bass, and which the fishermen find by means of ranges on shore. Again, from off Brown's Hill, near Orient, to Horton's Point light, in Southold, there are a series of rocky spots, situated at irregular intervals close to the shore, where good sea-bass fishing is found. These spots are mostly eddies on either side of points or small headlands, and have depths of nine to twelve feet. They are of slight extent, seldom more than ten rods in diameter, and are resorted to by small boats from the neighboring shores, principally for pleasure, though to some extent as a regular business. The fishermen go one in a boat. Fleets of ten to fifteen of these boats often collect together on one of these grounds at a time. The most western sea-bass grounds of Long Island Sound are situated off Eaton's Point, near Huntington Bay, in twelve feet of water, with rocky bottom. Blackfish are also found here. Fishing is carried on in the same manner as to the east. The sea-bass season in Long Island Sound is from the middle of June to the last of September.

SCUP and small bluefish, called "snappers," are caught in most of the bays and harbors of Long Island Sound. The latter fish are most abundant in tide-ways. Both species are taken mainly in depths of one to three fathoms, on sandy bottoms, by pleasure parties, but are seldom sought after by professional fishermen.

THE OUTER SIDE OF LONG ISLAND.

MONTAUK POINT GROUND lies between Montauk Point, Long Island, and Great Eastern Rock, with depths of four to seven fathoms and a rocky bottom. This is a cod ground from April 1 to June 1, and is resorted to in the summer for sea bass. Fishing is done with hand-lines only.

NAPEAGUE BEACH GROUND is an inshore cod ground, extending from south of Montauk Point along Napeague Beach, a distance of about ten miles. Fishing is carried on from one-half to one and one-half miles off the beach, on sandy bottoms, in depths of three to eight fathoms, by New York smacks using trawls. The season lasts from the middle of April until the first of June.

EAST HAMPTON GROUND begins off East Hampton, at a distance of three to five miles from shore, and extends westward, parallel with the shore, a distance of eight miles. The bottom consists of sand; the depths range from fourteen to seventeen fathoms. The season and fishing boats are the same as for the last ground.

SHINNICOCK BAY GROUND begins off Shinnicock light, at distances of seven to fifteen miles from shore, and extends parallel with the shore, a distance of about ten miles, to off Moriche's Bay. The bottom is sandy and broken, with depths of sixteen to twenty-four fathoms. This is a winter cod ground, the season lasting from the first of January to May. Fishing is carried on by New York and New England smacks using trawls.

RACCOON WOODS GROUND lies close off Fire Island Beach, about one-fourth of a mile from land, and extends from off Raccoon Woods to Fire Island light, a distance of about seventeen miles. The bottom is sandy; depths, two to five fathoms. This is a spring and fall cod ground, and is visited by New York market smacks using trawls.

FIRE ISLAND OFF-SHORE GROUND.—The center of this ground bears about southeast from Fire Island light; distance, fifteen to eighteen miles. It is about five miles wide and from fifteen to eighteen miles long, extending nearly parallel with the neighboring Long Island shore. The depths range from sixteen to twenty-three fathoms; the bottom consists of sand and gravel, with sea weeds and sea clams. This is a winter cod ground for New York market smacks using trawls.

CHOLERA BANK lies about twelve miles south of Jones Inlet, and is about one mile long, east and west, and one-half mile wide. The bottom is rocky; depth, twelve fathoms. Fall ground for cod; visited by New York market smacks.

MUSSEL RIDGE is situated southeast of Jones Inlet, about one and one-half miles off the beach, and has depths of eight to ten fathoms, with a bottom of sand, mussels, and clams. This is a cod ground in the fall and spring; visited by New York market smacks and small sloops from Jones Inlet.

DILLBERRY GROUND extends westward, parallel with the shore, from three to five miles off Jones Inlet, to off Rockaway Inlet, a distance of fourteen to fifteen miles. The depths of water range from four to ten fathoms; the bottom is sandy, with some rocks. This is a boat fishing-ground for cod in the spring and fall, and some fishing is also done in the winter.

THE COAST OF NEW JERSEY.

ROCKY GROUND lies from twelve to fifteen miles southeast of Highland light, New Jersey, and is about three miles long, southeast and northwest, and one mile wide. Cod are occasionally taken here in the winter, but the principal fishery is for bluefish in the summer. This region is visited by the New York market smacks.

ROCKY SPOTS IN THE CHANNEL are located about eight miles south-southeast from Sandy Hook light-ship, in depths of twenty fathoms. This area is about three miles square, and is mainly valued as a bluefish ground.

FISHING BANK begins southeast of Highland light, about three miles from land, and extends south a distance of about eight miles. Depths, eight to twelve fathoms; bottom, sandy and rocky. This is a good ground for bluefish and sea bass in the summer.

SHARK RIVER GROUND.—The center of this ground bears southeast from Long Branch; distance, six miles. It is about three miles square, with depths of twelve to sixteen fathoms. Cod are found here in the winter and bluefish in the summer.

SQUAN GROUND begins about fifteen miles southeast of Squan, and runs to within five miles northeast of Barnegat light. It is located on the so-called twelve-fathom ridge, where the bottom consists mainly of sand, stones, and mussels. This is a winter ground for cod.

EAST OF BARNEGAT LIGHT.—The center of this ground lies from twelve to fifteen miles east of Barnegat light. It extends about seven or eight miles north and south, and is about three miles broad. The depths of water range from twelve to sixteen fathoms. The bottom is sandy and gravelly, with sea clams. A winter cod ground; visited by New York market smacks.

EGG HARBOR GROUND.—The center of this ground lies fifteen miles southeast of Egg Harbor light. The ground is about fifteen miles long and three miles broad, and extends parallel with the neighboring coast. Depths, twelve to fifteen fathoms; bottom, sandy, with algæ, sea clams, and mussels. A winter cod ground; resorted to by New York market smacks.

ABSECUM GROUND bears south of Absecum light fifteen to eighteen miles to the center of the ground. It extends about seven miles parallel with the coast, and is about four miles broad.

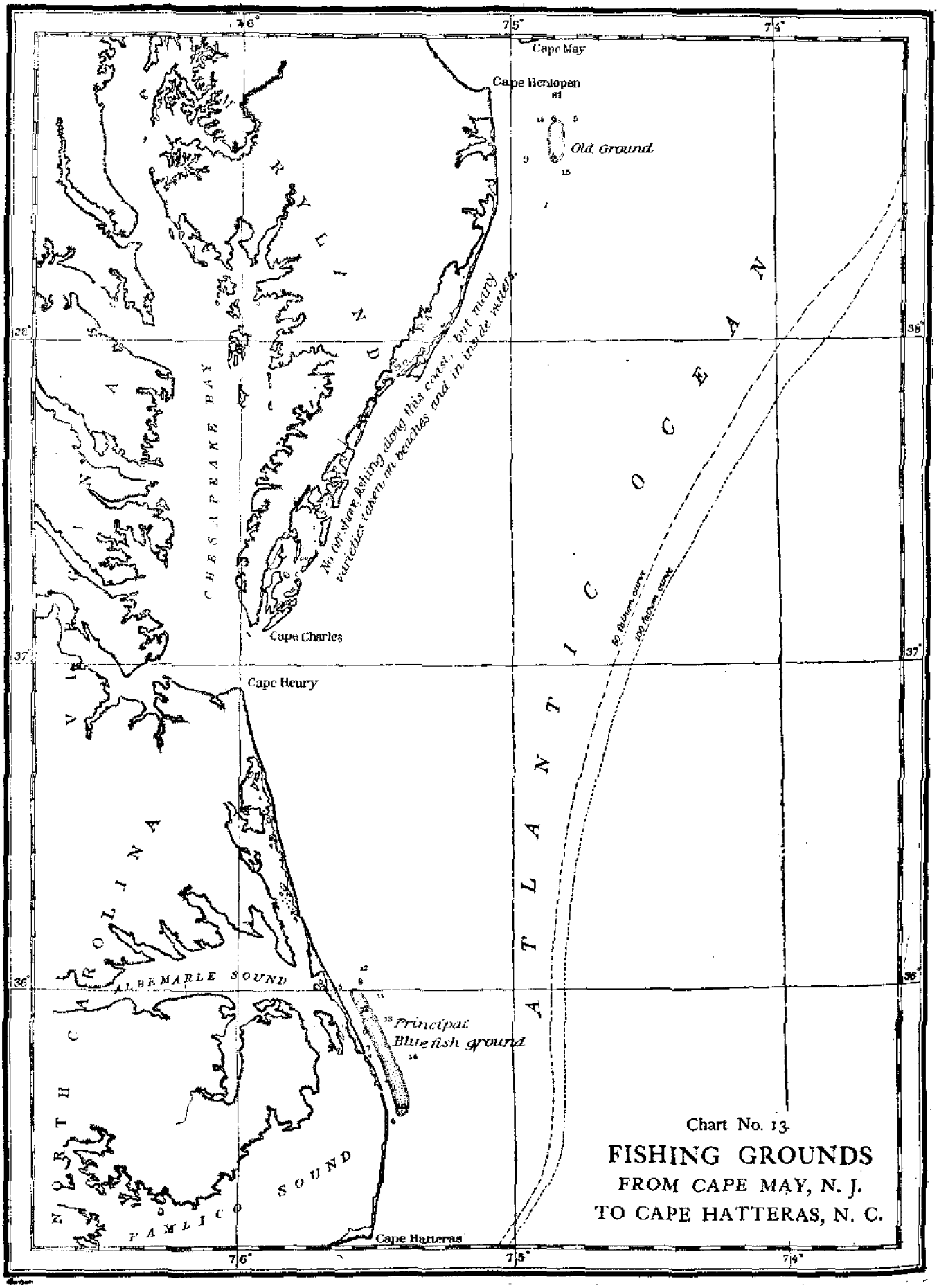


Chart No. 13.

FISHING GROUNDS
FROM CAPE MAY, N. J.
TO CAPE HATTERAS, N. C.

Depths, seven to fifteen fathoms; bottom, sandy and gravelly, with clams. A cod ground; visited by New York market smacks and sloops from Atlantic City using trawls.

TOWNSEND GROUND is a very small clay bank, situated about ten miles east-southeast of Townsend Inlet. It is about ten rods square, with a depth of ten fathoms. This is a good sea-bass ground in the summer; visited by New York market smacks.

HEREFORD GROUND lies about nine miles east of Hereford light. It is about four miles square, with sandy and rocky bottom, and depths of nine to ten fathoms. Sea-bass ground, of the same character as the last.

FIVE-FATHOM BANK lies mostly to the north and east of the buoy, located north of the Five-Fathom Bank light-ship. It extends five or six miles east of the buoy, and one or two miles west of it, and has a width of about three miles. This bank is a series of gullies, the depths ranging from three to ten fathoms, and the bottom consisting of sand, with many mussels. It is a winter cod ground; visited by the New York market smacks.

THE COAST OF DELAWARE.

OLD GROUND.—The cross-bearings to the center of this ground are given as follows: Cape Henlopen, bearing northwest, distant fifteen miles; Indian River, bearing west, distant ten miles. This ground is about eight miles long, north and south, and three miles broad; depths of water, nine to fourteen fathoms; bottom, rocky. It is one of the largest and oldest known grounds of this part of the coast, and the most extensive rocky bottom south of Montauk Point. Cod are taken here in the winter and sea bass in the summer by New York market smacks, and sea bass in the summer by Philadelphia pungies.

SAND-DITCH BAR bears northeast from Kit's Hammock Beach, from which the center is four miles distant, and is two miles long in an east and west direction by one-half mile wide. This is really an oyster-bed, having a depth of eight feet only at low tide, and is visited by local fishermen in summer, for weakfish and other species which frequent these waters.

SOUTHEAST BANK, which is similar to the last in character and in the varieties of fish taken, bears south-southeast from Kit's Hammock Beach; distance, five miles. It is eight miles long in a direction corresponding with the trend of the bay, and half a mile wide. The depth of water at low tide is twelve feet, and the bottom consists of blue clay.

THE COAST OF MARYLAND FROM ISLE OF WIGHT TO CHINCOTEAGUE INLET.

Along this stretch of coast no outside fishing-grounds, properly speaking, occur at any distance from the land; but menhaden, bluefish, and sea mullet are taken on the outer beaches with seines, and drumfish are caught in the same localities with hooks and lines. In the inner waters of Assateague, Sinepuxent, and Isle of Wight Bays quite an extensive seine and gill-net fishery is carried on for striped bass, perch, and various other species of fish.

THE EASTERN COAST OF VIRGINIA FROM CHINCOTEAGUE INLET TO HOG ISLAND.

This coast is low and sandy, with a very gradual slope out under the water, an average depth of seven to eight fathoms only being reached at a distance of five miles from the land. Over this section, however, within seven or eight miles of the land, there are quite a number of shoals, with depths of three and one-half to six fathoms, on which cod are said to occur in the winter. Hook and line fishing, in a small way for home supplies, is carried on in the creeks and inlets of this coast, where fish are plentiful enough to supply a much larger demand. This region also furnishes a good ground for seining menhaden in their season.

THE COAST FROM CAPE CHARLES, VIRGINIA, TO SOUTHERN FLORIDA.

The shores of this coast consist almost entirely of long, sandy beaches and a great number of low, marshy islands, separated by diffusely branching tide channels. These channels sometimes have a considerable width at high tide, but at low water are usually narrow, leaving broad flats exposed. Good fishing-grounds exist along almost the entire coast, but fish are now mostly taken on the sandy shores near the deeper holes and in the various inlets only in the vicinity of the larger towns and cities, as in such localities only can a market be found for the catch. Fish are more abundant in the inlets than on the outer shores. Mullet[1] are taken along the outer and inner shores of both North and South Carolina by fishing crews, who build temporary camps to last only during the fishing season. Bluefish are found along the entire coast, from Cape Cod to Southern Florida, and constitute one of the most important species south of Chesapeake Bay. There are two principal localities where bluefish are taken in gill-nets in the late fall and winter. One of these is situated off Cape May, in the vicinity of Five Fathom Bank. The other is on the coast of North Carolina, beginning a few miles below Cape Henry and extending to Cape Hatteras Inlet.

VICINITY OF CAPE LOOKOUT.—On the south side of Cape Lookout, and within a short distance of the beach, mullet, Spanish mackerel, drum, and sheep's-head abound, and toward the end of the cape large quantities of menhaden are seined. In this vicinity, a fishery for porpoises and whales is also carried on, usually at a short distance from the shore, by means of small boats. In the sound, inside of the outer beach, mullet and several other species of small fish are common in their season.

BEAUFORT HARBOR, NORTH CAROLINA.—At and off the entrance to this harbor there are good bluefishing-grounds in summer. To the eastward of the entrance, along the beach of Shackleford Banks, "sea trout" are seined for in the spring and fall, and drum and mackerel are caught in the fall. Inside of these banks sea trout, sheep's-head, hogfish, and spots are also taken in the fall. West of the entrance, along the outer shore of Bogue's Banks, for a distance of

[1] The scientific names of the several species of fish referred to on pages 52 to 55 are as follows:

Bass	*Sciænops ocellatus.*
Bastard Snapper	*Rhomboplites aurorubens.*
Black Grunt	*Hæmulon formosum.*
Blackfish or Sea Bass	*Centropristis atrarius.*
Bluefish	*Pomatomus saltatrix.*
Butter-fish	*Stromateus alepidotus.*
Cobia	*Elacate atlantica.*
Drum	*Pogonias chromis.*
Grunts	*Hæmulon* (various species).
Hogfish	*Pomodasys fulvornaculatus.*
Jack	*Caranx hippos*, and other carangoids; the name is also applied to the Pompano.
Menhaden	*Brevoortia tyrannus.*
Mullet	*Mugil brasiliensis* and *M. albula.*
Porgees	*Stenotomus aculeatus, &c.*
Red Snapper	*Lutjanus Blackfordii.*
Sailor's-Choice	*Lagodon rhomboides.*
Sea-trout	*Cynoscion maculatum.*
Sheep's-head	*Archosargus probatocephalus.*
Spanish Mackerel	*Scomberomorus maculatus.*
Spot	*Liostomus obliquus.*
Spotted Bass. (*See* Bass.)	
Squirrel-fish	*Diplectrum fasciculare.*
Tautog	*Tautoga onitis.*
Tom-cod or Kingfish	*Menticirrus nebulosus.*

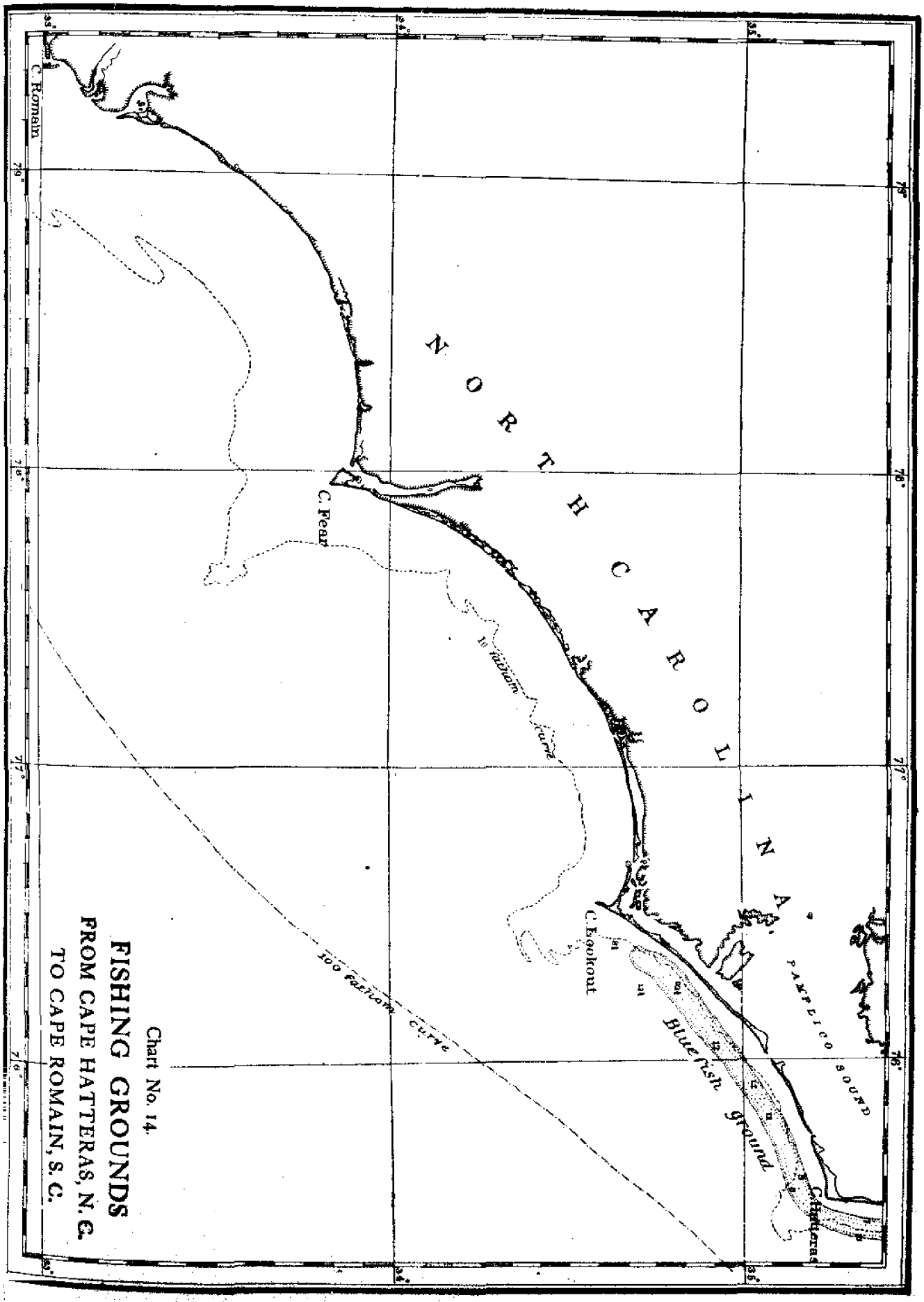


Chart No. 14.

FISHING GROUNDS

FROM CAPE HATTERAS, N. C.

TO CAPE ROMAIN, S. C.

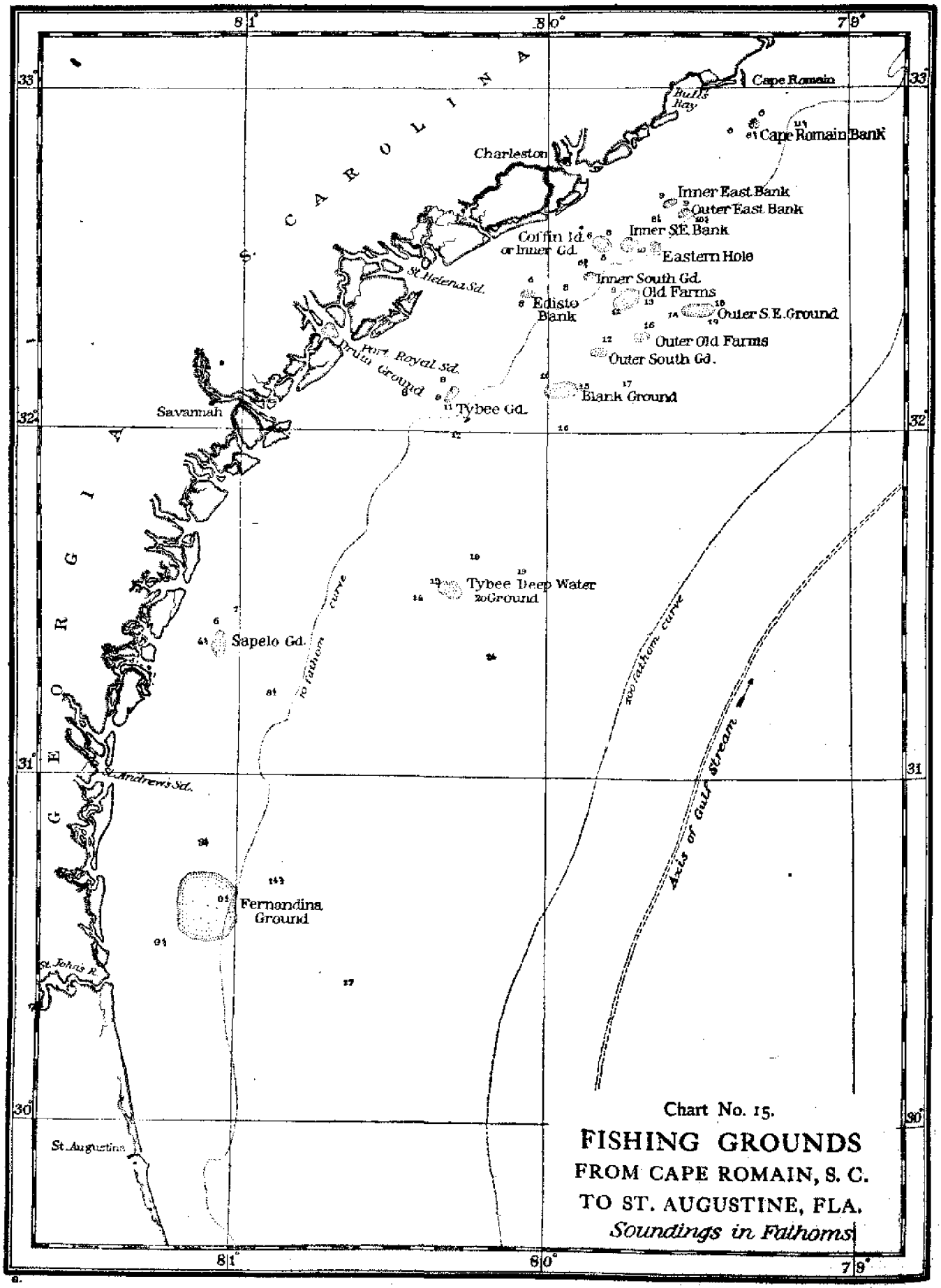


Chart No. 15.

FISHING GROUNDS
FROM CAPE ROMAIN, S. C.
TO ST. AUGUSTINE, FLA.
Soundings in Fathoms

two miles or more from Fort Macon, sea trout are taken in seines in the spring and summer. Inside of Fort Macon they are taken in the fall. Farther west, off the beach, whale-fishing is carried on by small boats from the shore.

VICINITY OF CAPE FEAR, NORTH CAROLINA.—At the entrance to Wilmington River, near Fort Caswell, and along the beach south of the fort, a distance of twelve to fifteen miles, mullet are taken in the fall in haul-seines. North of Cape Fear, along the outer beach and in the waters inside, mullet, sea trout, and several other species of fish abound in their season and are fished for with gill-nets and seines.

VICINITY OF CHARLESTON, SOUTH CAROLINA.—All along the shore, a distance of ten to fifteen miles on both sides of the entrance to Charleston Harbor, mullet seining is extensively carried on in the fall.

THE OFF-SHORE FISHING-GROUNDS OF SOUTH CAROLINA AND GEORGIA.[1]

CAPE ROMAIN BANK.—This is a small, rocky patch, about half a mile square, situated eight miles south-southeast from Cape Romain light, and four miles south by west from the outer shoal buoy. It has a depth of eight fathoms, the bottom consisting of lime rock and gravel with willow corals (Gorgonians) growing upon it. Fish are caught on this ground from June to October, the following varieties being taken, namely: Sea bass, porgees, grunts, bluefish, sharks, a few sailor's-choice, and in October spotted bass which often weigh from thirty to forty pounds each.

INNER EAST BANK bears southeast by east from Charleston light-ship; distance, eight miles. It extends one mile east and west and one-half mile north and south, and has a depth of seven and one-half fathoms. It is frequented by smacks and small boats, the smacks going there from June to December, and the small boats only from June to September. The fishing is done with hooks and lines, and the following kinds of fish are caught: blackfish, porgees, jacks (abundant), and flounders.

OUTER EAST BANK bears southeast by east from Charleston light-ship; distance, eleven miles. It extends one mile east and west and one-half mile north and south, and has eight and one-half to ten fathoms of water upon it, the bottom consisting of coral rock, and yellow sand. The same smacks and boats fish on this bank that visit the Inner East Bank, the season being the same and also the species of fish taken.

EASTERN HOLE bears southeast by east fifteen miles from Charleston light. It is about a mile in diameter, with a depth of twelve fathoms, and a bottom of lime rock, sand, and willow corals. It is fished on by smacks only, from October to April. Sea bass are the fish chiefly caught in the day-time, but at night tom-cod, butterfish, tautog, and a few flounders are also taken.

OUTER SOUTHEAST GROUND bears southeast twenty-seven and one-half miles from Charleston light, and extends five miles east and west and two miles north and south. The bottom is mostly coral rock, with many purple willow corals (Gorgonians). The south side of the ground is covered with large red shells, the east side with bright white sand and white sand mixed with black specks, the west side with shells and sand. The smacks fish here from November to April and May, the catch consisting of sea bass, bastard snappers, red snappers, and jacks.

INNER SOUTHEAST BANK bears southeast ten miles from Charleston light, and extends two and one-half miles east and west and one and one half miles north and south. It has about ten

[1] Frequented by the smack and boat fishermen running to the Charleston markets and elsewhere on that coast.

fathoms of water and a coral bottom. This is a summer fishing-ground, and small boats and smacks visit it from May until August. Porgees, blackfish, red-mouth grunts, black grunts, tautog, sailor's-choice, and cobias are taken. Porgees school here abundantly in August, and about three hundred is considered a fair day's catch; these weigh from three-fourths of a pound to one pound each, and are tied in bunches of five each for sale. The average daily catch of blackfish is two hundred and fifty; of grunts three hundred; but only a few tautog, black grunts, and sailor's-choice are taken. Cobias come in May and remain until July; they drive all other fish away from these grounds. The average daily catch of this species to a man is three.

COFFIN LAND GROUND or INNER GROUND bears south-southeast eight miles from Charleston light, and is three miles long east and west by two and one-half miles wide north and south. The bottom is of coral rock and the depth seven to nine fathoms. Smacks and boats fish on this ground with hooks and lines (the only method pursued on these grounds) principally from April to December. Jacks are caught from April to August, porgees from July to October, and blackfish and sea bass from the first of October to the first of December. The average daily catch to a man of all kinds is about four hundred fish.

OLD FARMS GROUND bears south-southeast eighteen miles from Charleston light, is five miles long east and west by three miles wide north and south, and has a depth of twelve to seventeen fathoms, with a bottom of coral and broken shells. This is a winter fishing-ground and only smacks resort to it. Sea bass, red snappers, and bastard snappers are the principal fish taken from October to April, but, besides these, a few tautog, black grunts, and red-mouthed grunts are caught. The bait used on this and other grounds in the vicinity is blackfish, shark, and squid. The former is the best. The daily catch of fish to a man is about three hundred.

OUTER OLD FARMS GROUND bears south-southeast twenty-five miles from Charleston light, and is three miles long east and west by one and one-half miles wide north and south. The bottom is of coral rock with "willows," and the depth seventeen fathoms. This is also a winter ground for the same kinds of fish that are caught on the Old Farms, and fishing is carried on from October to April.

INNER SOUTH GROUND bears south one-half east from Charleston light; distance, fifteen miles. Its length is one and one-half miles east and west, and its width one-half mile north and south. It has twelve fathoms of water, and an uneven bottom of coral rock and yellow "willows." This is a winter ground, resorted to by smacks only, from December until April. Blackfish, bastard snappers, red snappers, black grunts, porgees, and occasionally sharks, nursefish, and squirrel fish are taken. Bastard snappers are the most plentiful, while the other kinds are generally scarce.

OUTER SOUTH GROUND bears south one-half east, twenty-seven and one-half miles, from Charleston light, and extends two miles east and west and three-fourths of a mile north and south. The depth of water is fourteen and one-half fathoms, and the bottom consists of coral rocks, yellow "willows," and sponges. It is a winter ground, fished on from December to April. The same kinds of fish occur upon it as upon the Inner South Ground.

EDISTO BANK bears southeast by south eleven miles from Edisto Harbor. It is one mile long east and west by one-fourth of a mile wide, and has a depth of eight to ten fathoms. The bottom consists of rocks and shells and on the north side of red sand. Smacks fish here from April to October. The fish taken are sea bass, porgees, red-mouthed grunts, a few jacks, and occasionally a cobia. Sharks (puppy sharks) are so plentiful in June as to stop fishing.

BLANK GROUND bears southwest one-half south eight or nine miles from Outer South Ground, and extends four or five miles east and west and two miles north and south. It has

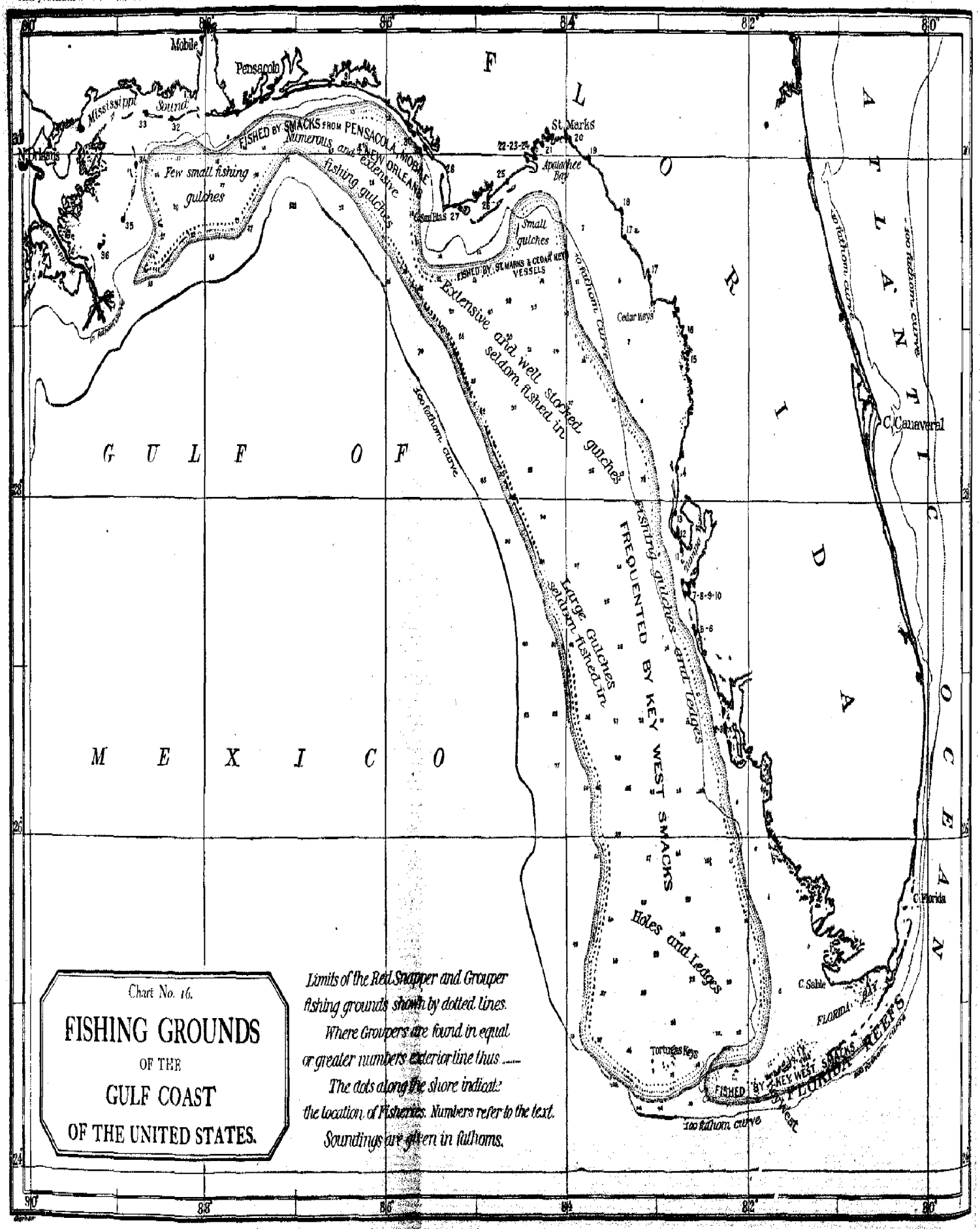


Chart No. 16.

FISHING GROUNDS
OF THE
GULF COAST
OF THE UNITED STATES.

Limits of the Red Snapper and Grouper fishing grounds shown by dotted lines. Where Groupers are found in equal or greater numbers exterior line thus ..... The dots along the shore indicate the location of Fisheries. Numbers refer to the text. Soundings are given in fathoms.

fourteen fathoms of water; and the bottom consists mostly of "willows," with some other corals. Fishing is best in January.

TYBEE GROUND bears east one-half north twelve to fourteen miles from Martin's Industry light-ship. It is one and one-half miles long southeast and northwest, and one-half mile wide. The bottom consists of shells and corals, the depth being nine to nine and one-half fathoms. This ground is resorted to by the smacks, from August to January, for blackfish and trout, which are taken to the Charleston market, fifty miles distant.

TYBEE DEEP WATER GROUND bears southeast forty miles from Tybee light-house, and is three miles long northwest and southeast by two miles wide. The bottom consists of corals, "willows," fine sand, and shells, and the depths range from fifteen to eighteen fathoms. Smacks fish here from January to March for blackfish and snappers.

SAPELO GROUND bears east by north from Wolf Island, from which it is ten miles distant. It is four miles long north and south and one mile wide. The bottom consists of corals and shells, and the depth is nine to ten fathoms. Smacks fish here for blackfish and snappers for the Charleston and Savannah markets, from June to January.

FERNANDINA GROUND bears from east-southeast to east by north from Fernandina light-house; distance, fifteen miles. This is a nearly circular ground from seven to ten miles in diameter. The bottom is of corals and is generally broken, the average depth being seventeen fathoms. It is fished on in the winter season for blackfish and other species.

11. THE GULF OF MEXICO.

THE FISHING-GROUNDS OF THE GULF OF MEXICO BELONGING TO THE UNITED STATES.

BY SILAS STEARNS.

The southern and easternmost of the fishing-grounds of the Gulf coast are those of the Florida Reefs, which are mainly visited by the Key West market fleet.

These reefs, as a natural consequence of their coral formation and the protection afforded by their uneven surfaces, are exceedingly well populated with all the forms of invertebrate animals common to this latitude, and, therefore, we find about them an abundance of fishes, attracted by the vast stores of food. On the Gulf Stream side of the keys all forms of animal life exist in greater abundance than on the opposite side, owing probably to the greater depth, clearness, and warmth of the water. In the narrow channels through the reefs, and about solitary rocks and clusters of rocks the best fishing-grounds usually exist, but the kind of fish sought for has much to do with this, for some kinds swim in open water in search of prey, and others along the bottoms of channels, while others again obtain their food from the sides of high-standing rocks and in shoal water.

During warm weather fish abound both outside and inside of the Reef to the south shore of the keys, but during cold "northers," when much of the cold water from Florida Bay is driven through between, and to the south of, the keys, the majority of the fish retreat to the outer side of the Reef, where they can be in the warm water of the Gulf Stream. This movement is particularly noticeable with the kingfish (*Scomberomorus regalis*), and it is during such cold spells that the largest catches of this species are made, for they are then congregated within narrow limits. The kinds of fish commonly taken on these grounds are as follows:

Carangus hippos. Jackfish.
Paratractus pisquetus. Horse-eye Jack.
Decapterus punctatus.
Enneacentrus punctatus. Coney.
Sarothrodus bimaculatus. White Angel-fish.
Holacanthus ciliaris. Yellow Angel-fish.

Seriola punctatus. Amber-fish.
Hæmulon punctatus. White Grunt, Yellow Grunt, Black Grunt.
Lutjanus caxis. Gray Snapper.
Lutjanus Blackfordii. Red Snapper.
Lutjanus Stearnsii. Mangrove Snapper.
Mesoprion uninotatus (?). Schoolmaster Snapper.
Ocyurus chrysurus. Yellow-tail Snapper.
Trisotropis brunneus. Black Grouper.
Trisotropis falcatus. Grouper.
Trisotropis undulosus. Rockfish.
Epinephelus morio. Red Grouper.
Epinephelus striatus. Nassau Grouper.
Epinephelus nigritus. Jew-fish.
Epinephelus Drummond-Hayi. Deer Grouper, Hind.
Holacanthus tricolor. Black Angel-fish.
Sparus pagrus. Porgee, Margate fish, Goat's-head Porgee, Sheep's-head Porgee.
Scomberomorus regalis. Kingfish or Cero.
Scomberomorus maculatus. Spanish Mackerel.
Scomberomorus caballa. Kingfish or Cero.
Sphyræna picuda (?). Barracuda.
Lagodon rhomboides. Sailor's-Choice.
Lachnolæmus falcatus. Hogfish.
Sciænops ocellatus. Channel Bass.
Centropristis atrarius. Sea Bass.
Balistes capriscus. Turbot.
Pomatomus saltatrix. Bluefish.
Menticirrus alburnus. Whiting.
Cyphosus Boscii. Brim.

Proceeding northward in the Gulf from the Florida Reefs fishing-grounds, we find innumerable places for sea-fishing, which follow one another so continuously from the Tortugas Keys to the mouth of the Mississippi River, that the entire region can be best described as an extensive fishing-ground in the form of a broad belt following the general contour of the coast.

The character of the southern portion of these grounds, from about the latitude of Anclote Keys southward, is different from that of the northern portion in some respects. The bottom at the south seems to consist of a more recent formation than at the north; there is less sand and mud, and fish occur near to and among the ledges which stand up from the deposit of sand and shells.

Along the coast from Anclote Keys to Charlotte Harbor there exist extensive and continuous lines of ledges, upon which, as well as in the gullies between, fish abound. The same kind of bottom is again found just north of the Florida Reefs, but between the two regions there is an almost barren waste of sand.

The fishing-grounds on the off-shore limit of this section are, so far as known, in the gullies between the rocks where there are living corals, or else in gullies in sandy and shelly bottoms also containing living corals and a soft rock formation.

The grounds of the northern portion, embracing the region between Anclote Keys and the mouth of the Mississippi River, are wholly in gullies. The bottom off to a depth of about twenty fathoms generally consists of sand with an admixture of broken shells, but in the gullies, which vary from one hundred to one thousand yards in width and from one-fourth of a mile to several miles in length, the bottom is covered with living and dead corals or hard rock. Outside of about twenty fathoms, rocky and coral bottom predominates, and the soundings show it to be very uneven. At some places in this northern portion the small gullies or gulches are found quite near to the coast, as, for instance, off Appalachee Bay, Dog Island, and Crooked Island, off the coast between Saint Andrew's and Choctawhatchee Bays, and off Pensacola, where they occur in from five to ten fathoms of water.

The deepest waters in which fishing is carried on in the Gulf of Mexico are off Pensacola, in a southeast direction and in a depth of nearly fifty fathoms.

Just east of the Mississippi River and off Mississippi Sound there are a few small gulches inshore, which were formerly resorted to, but are not fished on now.

The general character of the bottom in this section is muddy, and it is possible that the

sediment from the Mississippi River is filling up the fishing-holes near by. West of the Mississippi, off the coasts of Louisiana and Texas, the bottom is also muddy. Several fishing schooners from Pensacola have carefully explored this region and have found but two or three small patches of hard bottom. These yielded a few fares of red snappers and were left for the time as almost barren. Since they are in shoal water (10 to 20 fathoms) it is probable that they are inhabited only in summer when the water is warm, and even then only to a slight extent.

On the grounds of the southern portion or district, as I have classed it, the majority of the edible fish taken are groupers, chiefly the red and black groupers (*Epinephelus morio* and *Trisotropis brunneus*) while the red snappers are much less abundant. On the northern grounds it is just the opposite, red snappers being more numerous and groupers much less common. Other kinds of fish are often caught, many of which are not salable. The most common of these are as follows, those marked with an asterisk not being eaten:

Balistes capriscus. Leather Jacket or Turbot.*
Epinephelus Drummond-Hayi. Hind.
Epinephelus nigritus. Jew-fish, Warsaw.
Echeneis naucrateoides. Suckerfish.*
Lutjanus Stearnsii. Mangrove Snapper.
Sparus pagrus. Porgee.
Centropristis atrarius. Sea Bass.
Rhomboplites aurorubens. Bastard Snapper.
Lagocephalus lævigatus. Bottle-fish.*
Sciænops ocellatus. Channel Bass, Redfish.
Batrachus taupardus. Sea Robin.*
Seriola bonariensis. Rock Salmon.
Seriola Stearnsii. Amber-fish.
Trisotropis falcatus. Scamp.
Several species of sharks.*

The off-shore fishing-grounds, off Cedar Keys, where red-snappers, groupers, and such fishes can be caught, lie over thirty miles in a westerly direction from Cedar Keys. From there, by following the deepest water on a southeast or a northwest course, fish are found in abundance, until shoal water is reached, either off Tampa Bay or off Cape Saint George. On these banks groupers, especially the red grouper, are found in greater abundance than to the westward, any where between Cape Saint George and the Mississippi River; and, on an average, two-thirds of the catch will be groupers and one-third snappers. On the bottom there is a greater deposit of lime rocks, and probably more living corals, etc., than in the Pensacola Bight, which explains the causes of their abundance.

Along the entire coast there is a tendency among these fishes to move from the shoaler water to off-shore grounds at the approach of cold weather. During mild winters they remain inshore, but during severe seasons they are not to be found there.

The fishermen prefer to take fish from shoal water, as it is less laborious than deep-water fishing, and the fish taken there are much hardier and better able to bear transportation alive in vessels' wells than those from very deep water. The consequence is that the grounds of the deep-water regions are not much explored, and it is probable that the most important store of food-fishes of the Gulf has not yet been drawn upon.

The seining flats are smooth sand-bars lying in the thoroughfares of schooling fishes, and conveniently located for drawing the seines ashore. Such places are not common along the coasts of

southwestern Florida, and of Louisiana and Texas, where the shores are mainly uneven and marshy, but where they do occur fishing establishments are formed each season. In the regions most convenient to markets nearly all the favorable seining flats have been secured by fishermen or fishing firms, who build permanent houses and wharves for the prosecution of their business.

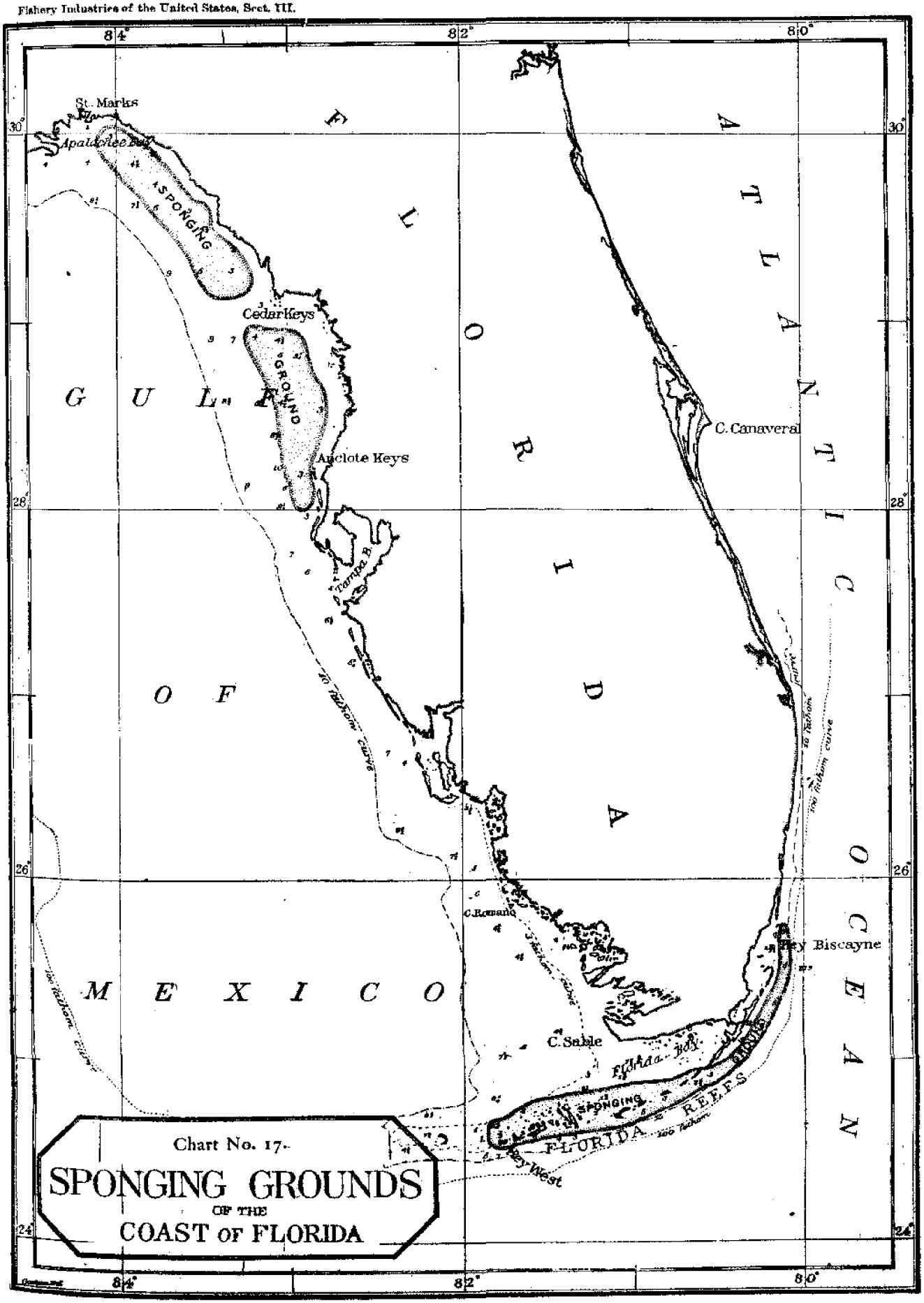
At other and more remote points, temporary shanties, generally constructed from palmetto leaves, are built, which are occupied one year by one crew and the next year by another, according to whichever reaches the locality first. Those nearest the markets are the most used and have the most elaborate and complete outfits. Probably in the course of a few years all suitable sites will have been secured. Usually they occur near the entrances to bays or rivers, or on islands or projecting points of land—places where schools of fishes coming from, or going to the sea, must approach near the shore.

The region from Appalachee Bay to the mouth of the Mississippi River has an almost unbroken shore that is suitable for seining. As a result, there are few permanent stations, and the fishing is carried on from small vessels and boats that accommodate the crew and their catch while on short trips from the nearest markets.

THE FLORIDA SPONGE GROUNDS.

The Florida sponging-grounds form three separate and elongate stretches along the southern and western coasts of the State. The first includes nearly all the Florida Reefs; the second extends from Anclote Keys to Cedar Keys, and the third from just north of Cedar Keys to Saint Mark's, in Appalachee Bay. The Florida Reef grounds have a linear extent of about one hundred and twenty miles, beginning near Key Biscayne, in the northeast, and ending in the south, at Northwest Channel, just west of Key West. The northeastern half of the grounds are very narrow, having an average width of only about five miles, and being limited to the outer side of the reefs. At about the Matacumbe Keys the grounds broaden out so as to cover the entire width of the reefs, which are much broader here than at the north. The entire southern half of the grounds have more or less the same breadth, which is about thirteen or fourteen miles. The second sponge-ground begins just south of Anclote Keys, with a breadth of seven or eight miles, but rapidly broadens out toward the north to a width of fifteen miles, which it maintains from a point about opposite Bay Port to Sea Horse Reef, just south of Cedar Keys. The total length of this sponging-ground is about sixty geographical miles. Its distance from the shore varies somewhat; at the south the inner edge approaches within four or five miles of the mainland, and comes close upon Anclote Keys; but throughout the remainder of its extent it is distant from six to eight miles from the shore, until it touches the shallow bottom and reefs of Cedar Keys. The depth of water on these grounds, as indicated on the Coast Survey charts, ranges from three to six fathoms, but many portions are undoubtedly shallower than this. The northern sponging-ground, which maintains a nearly uniform width throughout, is about seventy miles long by about fifteen miles broad. It approaches to within about five miles of the shore, and terminates just off the mouth of Saint Mark's River. The depth of the water upon these grounds is the same as upon the next one to the south—from three to five fathoms.

The total area of the Florida sponging-grounds, which are now being worked upon, including also those which were formerly fished but have since been more or less abandoned, may be roughly stated at about three thousand square geographical miles. This does not, however, probably indicate the entire extent of the sponging-grounds of the Florida waters, for the fact that new grounds are being constantly discovered would indicate that there might still be more to find, and it is certain that no very strenuous efforts have yet been made to extend the already known grounds, the discovery of new sections generally having been made by accident.


84°
82°
80°
30°
28°
26°
24°
St. Marks
Apalachee Bay
SPONGING
Cedar Keys
GROUND
Anclote Keys
Tampa B.
C. Canaveral
C. Romano
Key Biscayne
C. Sable
Florida Bay
SPONGING
REEFS
FLORIDA
Key West
GULF
OF
MEXICO
FLORIDA
ATLANTIC
OCEAN
10 fathom curve
100 fathom curve
Chart No. 17.
SPONGING GROUNDS
OF THE
COAST OF FLORIDA

LIST OF THE FISHING-STATIONS ON THE GULF COAST OF THE UNITED STATES.

BY SILAS STEARNS.

[The numbers refer to the chart prepared by Mr. Silas Stearns to show the fishing-grounds of the Gulf coast of the United States.]

No. 1. CAPTIVA FISHERY.—Situated upon the north end of Captiva Island, mouth of Charlotte Harbor. Consists of temporary palmetto shanties, occupied only through the fall for the purpose of salting mullet for the Cuban markets.

No. 2. SPANISH FISHERY.—Situated at Lacosta Island, near the main entrance to Charlotte Harbor. Includes several buildings, mostly permanent, occupied in the fall for the mullet fishery. Spaniards from Key West carry on this fishery.

No. 3. SPANISH FISHERY.—Situated near No. 2 and similar to it.

No. 4. GASPARILLA FISHERY.—Situated upon Gasparilla Island, mouth of Charlotte Harbor. Several permanent shanties, owned by the Messrs. Peacons, of Key West, who salt mullet for the Cuban trade in the fall.

No. 5. SARASOTA FISHERY.—At the north end of Little Sarasota Island and on the Big Sarasota Pass. Mullet are salted for Cuban markets at this station in the fall. Temporary shanties.

No. 6. SARASOTA FISHERY.—Near the last. Occupied in 1879 for salting mullet for the Florida trade. Temporary shanties.

No. 7. HUNTER'S POINT FISHERY.—Situated upon Hunter's Point, the dividing line between Sarasota and Palmasola Bays. Mullet salted for Cuban markets. Buildings permanent and the best arranged on the coast. Owned by Sweetzer & Thomson.

No. 8. PALMASOLA SMALL FISHERY.—Situated on the back side of Palmasola Bay. Small permanent shanty, occupied each fall by gill-net and cast-net fishermen, who salt mullet for home trade.

No. 9. PALMASOLA FISHERY.—Near the last. Occupied by seining-crews every year for the purpose of salting mullet for home trade. A permanent palmetto shanty.

No. 10. PALM KEY FISHERY.—On the north end of Palm Key. Occupied sometimes by Key West fishermen and in 1879 by Appalachicola fishermen. This is a good station for mullet in the fall. Contains temporary shanties.

No. 11. PASS À GRILLE FISHERY.—On Long Key, in Boca Ceiga Bay. A station for catching and salting mullet during the fall months. Not occupied every year. The catch is usually sent to Cuba. The shanties are temporary ones.

No. 12. TURTLE-CRAWL POINT FISHERY.—At Turtle-Crawl Point, Boca Ceiga Bay. A mullet fishery, where fish are salted for the Florida trade. Small temporary shanties, not regularly occupied.

No. 13. KILGORE'S FISHERY.—On the passage from Boca Ceiga Bay to Clear Water Harbor. Mr. Kilgore salts fish during the fall for the country trade, and has permanent buildings near his house for the work.

No. 14. ANCLOTE RIVER FISHERY.—Situated at the mouth of the Anclote River. Parties are stationed here in the fall to catch mullet, which are sold in Florida. Appalachicola crews occupied it in 1879. Permanent shanty.

No. 15. CRYSTAL RIVER FISHERY.—At the mouth of Crystal River. A station occupied each fall by parties from the neighboring country or from Cedar Keys, engaged in the mullet fishery. Temporary shanties.

No. 16. CHAMBERS MILL FISHERY.—On the coast, a few miles north of the mouth of the

Crystal River. Mullet are caught here in the fall for Cedar Keys and the country trade. The buildings used are those of an abandoned saw-mill.

No. 17. SUWANNEE RIVER FISHERY.—At the mouth of the Suwannee River. Seining crews fish here for mullet in the fall to supply the country trade and sometimes for that of Cedar Keys. Temporary shanties.

No. 17*a*. PINEY POINT FISHERY.—On Piney Point, between Suwannee and Steinhatchee Rivers. Similar to the last. One permanent building.

No. 18. STEINHATCHEE RIVER FISHERY.—At the mouth of the Steinhatchee River. A mullet fishery for country trade. No buildings.

No. 19. FENHOLLOWAY RIVER FISHERY.—At the mouth of the Fenholloway River. Mullet fishing for country trade. Temporary shanties.

No. 20. OCILLA RIVER FISHERY.—At the mouth of the Ocilla River. Carried on for mullet in the fall. Catch sold in the country. Temporary shanties.

No. 21. SHELL POINT FISHERY.—A few miles west of the Saint Mark's River. Occupied in the fall by crews who salt mullet for country trade. Permanent shanties.

No. 22. OYSTER BAY FISHERY.—Carried on for mullet, which are sold to country customers. Seines and gill-nets are used. Buildings permanent.

No. 23. DICKERSON BAY FISHERY.—Same as the last. Buildings permanent.

No. 24. OCKLOKONY BAY FISHERY.—At the mouth of Ocklokony Bay. Same as Nos. 22 and 23. Permanent buildings.

No. 25. CROOKED RIVER or PICKETT'S FISHERY.—Occupied in the fall for mullet fishing. Catch sold, salted, at Appalachicola. Permanent shanties.

No. 26. CAT POINT FISHERY.—A station sometimes occupied by Appalachicola parties. Temporary shanties.

No. 27. INDIAN PASS FISHERY.—A gill-net station, occupied in the fall by Appalachicola crews. Permanent palmetto shanties.

No. 28. SAINT JOSEPH'S POINT FISHERY.—Occupied in the fall by Saint Andrew's Bay and Appalachicola crews, while salting mullet and other fishes, and in the spring to catch pompano, which are salted or sent to Pensacola fresh. They have several permanent palmetto shanties.

No. 29. CROOKED ISLAND FISHERY.—A station on the north end of Crooked Island, where Saint Andrew's Bay crews fish in the fall and spring, to catch pompano, mullet, sheep's-head, redfish, etc. Temporary shanties or tents.

No. 30. SAINT ANDREW'S POINT FISHERY.—On the west point at the entrance to the bay, a station used by people of Saint Andrew's Bay for the same purpose as the last. Temporary shanties, and one permanent one.

No. 31. CAPT. LEN. DESTIN'S FISHERY.—At the Choctawhatchee or Santa Rosa Bay Inlet, Captain Destin has fish-house, ice-house, and very complete arrangements. He fishes nearly all the year, chiefly for pompano, and sends the catch to Pensacola in ice, also salts a few barrels annually for country trade. This is the most important pompano fishery in the Gulf.

No. 32. PETIT BOIS FISHERY.—On the island of that name, outside of Mississippi Sound, a station occupied nearly all the year by Mobile and New Orleans seine and gill-net fishermen. Fish sold fresh.

No. 33. HORN ISLAND FISHERY.—On Horn Island, outside of Mississippi Sound. A station similar to No. 32. Fish sold fresh. Permanent buildings for habitation.

No. 34. CHANDELEUR ISLANDS, No. 35. GRAND GOSIER ISLAND, and No. 36. ISLE BRETON, are all prominent stations for seine and gill-net crews from New Orleans, who resort to them at intervals through the year. No fish are salted at these places.

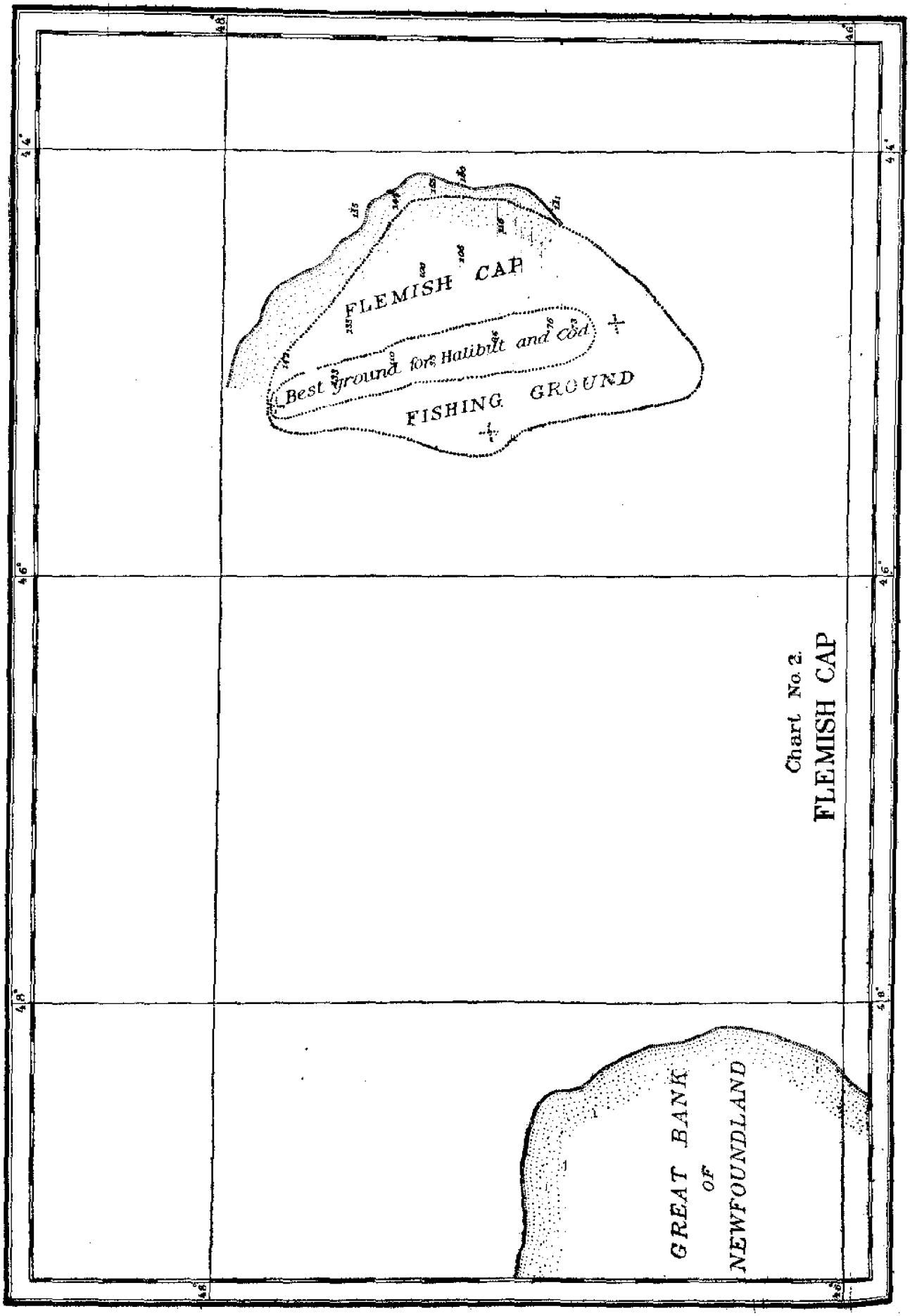


Chart No. 2.
FLEMISH CAP

12. THE OFF-SHORE BANKS, INCLUDING THE GRAND BANKS.

THE FLEMISH CAP.

The Flemish Cap is the outermost of the Great Newfoundland Fishing Banks, as it is also the least perfectly known. The Admiralty chart locates its eastern end by three lines of soundings extending about northeast and southwest, but of its western limit absolutely nothing is known. The center of the series of soundings given on the chart lies about one hundred and fifty miles east-northeast of the northeastern part of the Grand Bank. Less than one-half of the intervening area between these two banks has yet been sounded, so far as indicated on the published charts, and the soundings off the northeastern end of the Grand Bank show depths of sixty to one hundred and forty-five fathoms only. There is, therefore, a possibility that the Flemish Cap extends much nearer to the Grand Bank, and has a much greater area than is indicated on the charts of the region, and it is even probable that this outlying shoal is a direct continuation northeastward of this same large bank. Combining the soundings of the Admiralty chart with information gathered from the Gloucester fishermen, who have visited this region, it would appear that the known area of the Flemish Cap was irregularly elongate in outline, the longer axis extending about north and south.

This area lies between the parallels of 46° 50′ and 48° north latitude, and the meridians of 44° 06′ and 45° 25′ west longitude, the greatest length being, therefore, seventy geographical miles, and the greatest width fifty-six miles. Its extent is about two thousand seven hundred and fifty square geographical miles. The soundings range from seventy-three to one hundred and fifty-five fathoms, the least depth being located near the center and the southern parts of the bank, and the deepest water occurring on the eastern edge. Beyond this, to the eastward, no depths were reached by the vessels making the survey of this region, but the sounding line they used appears to have had a total length of only about one hundred and sixty fathoms.

The bottom is composed of mud, sand, gravel, pebbles, and rocks, distributed in patches of variable extent and character. In the localities resorted to by vessels from the United States the prevailing bottom is often a slaty rock, apparently *in situ*, and forming a smooth surface, on which the anchor often fails to take a firm hold.

Cod and halibut are the only fish that have been sought for on the Flemish Cap. Nothing is known about their abundance in the winter, as the bank can only be visited in the spring and summer (April to August at the most). But often during the spring the weather is so rough that fishing can be carried on only a small part of the time, and after June the region is so much infested with ground-sharks that the trawls are rapidly destroyed. Another danger frequently arises from the presence of icebergs, which are often abundant. All of these causes combined have deterred fishermen from frequenting this bank, which, so far as known, has only been visited for cod and halibut by a few vessels from Gloucester during the past few years.

The region thus far resorted to for cod lies mainly within a distance of ten to fifteen miles of 47° north latitude and 45° west longitude. In one or two instances, however, large catches of cod as well as halibut have been obtained from eighteen to twenty miles west of the forty-fifth meridian in 47° north latitude. According to the statements of the fishermen most familiar with these grounds, no trouble is ever experienced in obtaining large quantities of medium-sized cod, which are, however, below the standard recognized in the United States markets. Larger fish are less common, although taken in considerable numbers, and very successful fares have occasionally been made. The general opinion is that while fish are sufficiently abundant, no

great dependence can be placed on securing a profitable trip, on account of the several hindrances alluded to.

The best known halibut grounds of the Flemish Cap are said to be located near the meridian of 45° west longitude, between the parallels of 47° 30′ and 47° 50′ north, where the bottom consists of rocks, pebbles, and coarse gravel. The only vessels that have visited the Flemish Cap have been those engaged in the salt halibut and cod fishery.

THE GRAND BANK.

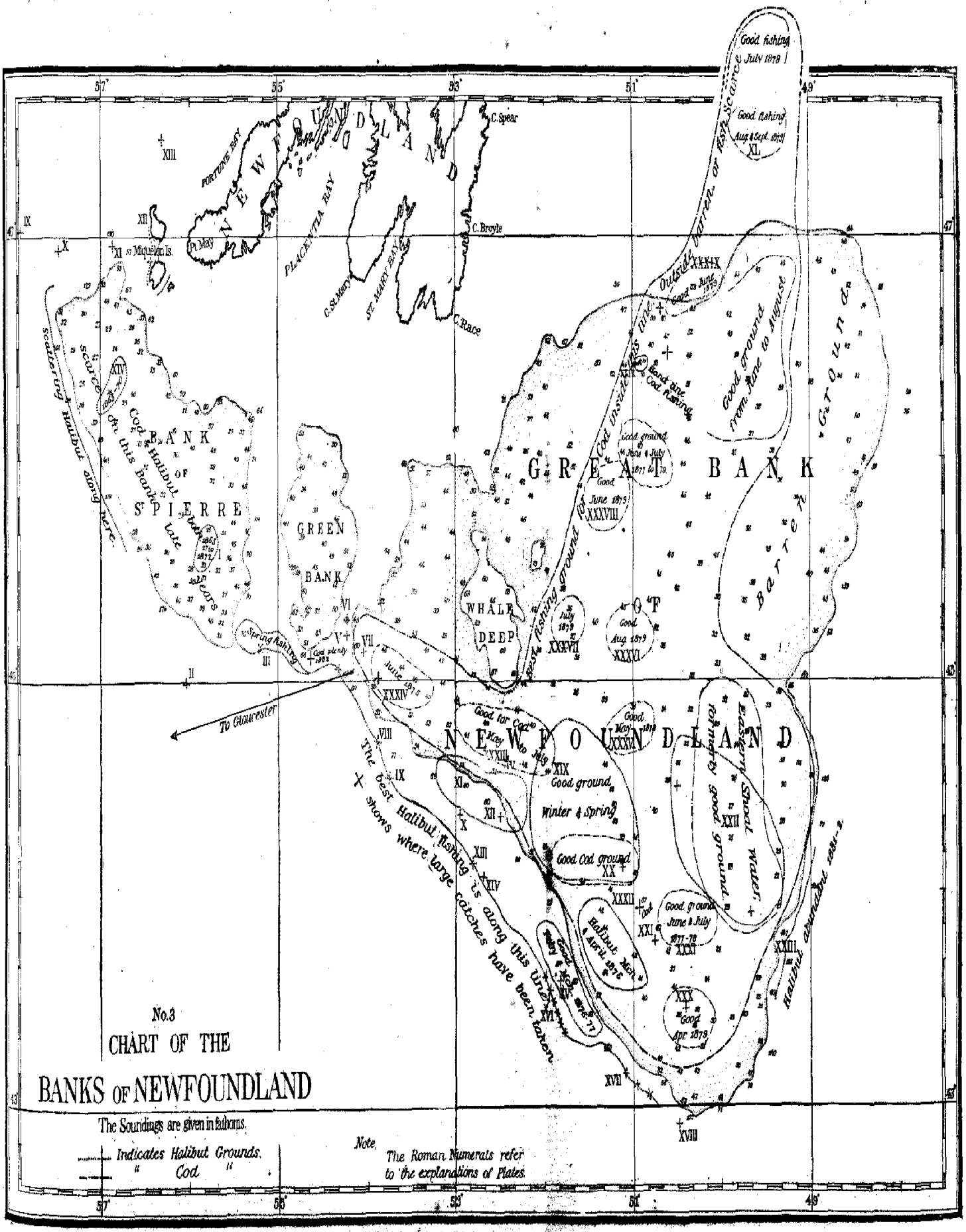
This immense fishing-ground, which lies southeasterly from Newfoundland, is of about the same size as that British province, and equals in extent all of the other off-shore fishing-banks of the eastern coast combined. Its area, within the sixty-fathom limit, is about thirty-seven thousand square geographical miles. It extends over more than four degrees of latitude from 42° 57′ to 47° 04′ north, and over nearly six degrees of longitude, from 48° 06′ to 54° 11′ west, and has an irregularly triangular outline, one side facing north-northwest, another southwest, and the third about east by south. The northwestern and eastern sides are each about two hundred and sixty-four miles long in a straight line, and the southern side about two hundred and twenty-five miles long.

The most remarkable shoals are the Virgin Rocks and Eastern Shoal Water, located near the center of the northern part of the banks. The channel separating the bank from Cape Race has a width of about thirty-six miles. Considered both as to its area and the extent of its fisheries, the Grand Bank is undoubtedly the most important fishing-ground of the world.

In order to describe its somewhat varied characteristics in sufficient detail, we have, for the sake of convenience, divided the area of the bank into several arbitrary sections suggested by their importance as fishing grounds.

South of 44° north latitude the depths range from twenty-five to fifty-three fathoms, and the bottom consists almost entirely of fine sand, varying somewhat in color. Over the east and west portions of this section there are, however, a few scattered patches of coarse sand and gravel with an admixture of small pebbles, and occasionally of rocks of larger size. The eastern edge drops off rapidly at a distance of a mile or more from the sixty-fathom limit, but halibut have been found there abundantly in depths of one to three hundred fathoms. On the western side of the slope the descent is apparently more gradual, especially north of the parallel of 44° north latitude, where a depth of one hundred and fifty fathoms is found at a distance of twenty-five miles or more from the edge of the bank. Over the greater part of this area there occur large numbers of bank quahogs (*Cyprina islandica*), bank clams (*Siliqua costata*), periwinkles (*Buccinum*), and small crustacea, and wherever the bottom is pebbly, sea anemones, sea pumpkins or holothurians, and sea lemons (*Boltenia*) abound, and crabs are generally plentiful. Owing to the strong currents that sweep by the eastern edge, and the frequent occurrence there of large icebergs, fishing in that locality is attended with many difficulties and some danger.

Another section may be laid out between the parallels of 44° and 45° 20′ north latitude, and extending the entire width of the bank. The eastern part of this section, in the vicinity of and to the eastward of the meridian of 50° west, is generally known as the "Eastern Shoal Water." It has depths of twenty-two to thirty-five fathoms, and the bottom is mainly composed of fine sand, with an admixture of gravel, pebbles and large stones over certain areas. The eastern edge descends rapidly into comparatively deep water. The fauna of this section resembles that of the southern section already described. Between 50° and 51° west longitude lies what is known among fishermen as the "pumpkin bottom," from the immense quantities of a large


No.3
CHART OF THE
BANKS OF NEWFOUNDLAND
The Soundings are given in fathoms.
Indicates Halibut Grounds.
" Cod "
Note.
The Roman Numerals refer to the explanations of Plates.
NEWFOUNDLAND
FORTUNE BAY
PLACENTIA BAY
ST. MARY BAY
C. Spear
C. Broyle
C. Race
Pt. May
Miquelon Is.
BANK OF SPIERRE
GREEN BANK
WHALE DEEP
GREAT BANK OF NEWFOUNDLAND
Barren Ground
Eastern Shoal Water, formerly good ground
Good fishing July 1878
Good fishing Aug. & Sept. 1879
Good ground from June to August
Good ground June & July 1877 to 79
Good June 1879
Good Aug. 1879
Good for Cod May to July
Good ground Winter & Spring
Good Cod ground
Good ground June & July 1877-78
Good Apr. 1879
Halibut abundant 1881-2
Scattering Halibut along here.
Cod Halibut both 1865-70 1872
Cod plenty 1882
Spring fishing
To Gloucester
The best Halibut fishing is along this line. shows where large catches have been taken.
Best fishing ground for Cod inside this line. Outside barren, or fish scarce
Good June 1879
Hand line Cod fishing
Good ground June & July 1877 to 79
Good May 1879
Halibut Mch. April 1876
Good May & Mch. 1876-77
57°
55°
53°
51°
49°
47°
45°
43°

holothurian found there. The depths vary from thirty to thirty-eight fathoms, with a bottom of sand, gravel, pebbles, and smooth, round rocks. In addition to the holothurians, large numbers of star-fishes, periwinkles, crustaceans, bank quahogs, and bank clams also occur. West of 51° west longitude and north of 44° 20′ north latitude, in this section, the depths range from thirty-six to fifty-five fathoms, the latter soundings occurring only along the edge of the bank. The bottom is mostly rocky, the rocks being much perforated with a species of boring mollusk. The fishermen's hooks frequently catch in these holes and large fragments of the rock are in this manner often brought to the surface.

Besides many of the lower forms of animal life common to other sections of the Grand Bank, this area especially abounds in crabs and shrimps, and many specimens of octopus have been taken from the stomachs of fish captured here. To the westward of the sixty-fathom line, the bottom slopes more or less gradually to a depth of two hundred fathoms, which it reaches at a distance of ten to fifteen miles from that line. Within the area of this slope the bottom is generally composed of sand or mud; but along the edge outside of one hundred and fifty fathoms, there occur numerous rocky patches of considerable size. This section, between 44° and 45° 20′ north latitude, in depths generally less than 55 fathoms, is more commonly resorted to by the cod fishermen than any other part of the Grand Bank.

That portion of the bank lying between 45° 20′ and 46° north latitude can be considered as a third section, concerning which but very little is yet known. In consequence, the greater part of this region is generally regarded as barren by the fishermen, although, by trial, it is possible that portions of it might furnish good fishing. It has so far been but very little resorted to. This section has depths of thirty-two to fifty-seven fathoms, and embraces a great variety of bottom in its different parts—fine and coarse sand, pebbles, rocks, and broken shells, variously combined. Good catches of cod have been obtained between 50° and 51° west longitude. The "whale deep" occurs on the western part of the section. It is an irregular, shallow depression in the bank, extending nearly north and south, with a length of about forty-five miles and a width of about twenty-three miles. Its southern end lies in about 44° 58′, and its northern in 45° 41′ north latitude. The extreme eastern part is in about 52° 14′ west longitude. It has depths of fifty-seven to sixty-seven fathoms, the bottom consisting of mud. We are not informed as to the origin of the name by which this area is known, but it does not seem very appropriate, for one of its chief characteristics appears to be the absence of whales as well as of fish; while its shallowness, as compared with the depths at a short distance off the western edge of the bank, is quite marked.

The fourth or northern section of the Grand Bank comprises all that portion lying north of the parallel of 46° north latitude. It has an elongate triangular shape, being one hundred and eighty miles long on the parallel of 46°, and is about sixty-four miles wide on the eastern part, where it extends to 47° 04′ north latitude. Its width near the middle is about forty-five miles. This section includes the Virgin Rocks, which lie in 46° 27′ north latitude and 50° 54′ west longitude. The area westward of the Virgin Rocks has depths of thirty-seven to fifty-three fathoms, and a diversified bottom of sand, gravel, pebbles, broken shells, and large rocks. It is comparatively little resorted to by the fishing-fleet, and for this reason is less known than most of the other parts of the bank.

The group of small, rocky shoals, known as the Virgin Rocks, lies between 46° 23′ and 46° 28′ north latitude, and 50° 50′ and 50° 58′ west longitude. It consists of a large number of submerged elevations, the principal ones being named and characterized as follows: Main Ledge, lying in 46° 27′ north and 50° 47′ west, depths, three to nineteen fathoms; Brier Shoal, just

east of Main Ledge, thirteen to twenty fathoms; Southwest Rock, southwest of Main Ledge, fourteen fathoms; part of Main Ledge, twenty-nine fathoms; Bucksport Shoal, one and one-fourth miles nearly south of Main Ledge, four and three-fourths to eleven fathoms. A short distance from the latter shoal, on the south and east sides, are three other smaller shoals, called Sea Patch, Lone Star or Harper Shoal, and Bryant Shoal, with depths varying, from eleven to nineteen fathoms. South of these again, within a distance of one and three-fourths miles, are three more shoals, known as the Bull Dog, Old South Shoal, and Cabinet Shoal, with depths of seventeen to twenty fathoms. About one mile due north from Main Ledge begins a line of eight small shoals, which extends a distance of about three miles, with depths of nine to twenty-three fathoms. The nearest ones are called Northwest Shoals, and the remainder, in the order of their position, are Maloney Ledge, Prairie Shoal, The Hummocks, and Deep-Water Bank.

Fifteen miles eastward of the Virgin Rocks, between 46° 27′ and 46° 29′ north latitude, there is a group of similar shoals, known collectively as the Eastern Shoals. They extend about four miles north and south, and have an average width of a little more than two miles. Each shoal is of slight extent, but few of them exceeding one-fourth of a mile in diameter. There are twenty-five of these shoals in all, on which the depths of water range from seven to twenty-seven fathoms; between the shoals the depths vary from twenty-eight to thirty-nine fathoms, and the bottom is broken and rocky.

Between the Virgin Rocks and Eastern Shoal and about them the depths range from thirty-three to forty-eight fathoms, and the bottom consists of sand, coarse gravel, rocks, and broken shells. Bank clams (*Siliqua costata*), abound here, and squid and capelin are plentiful in their season, attracting large numbers of cod and making this region a very profitable one for the fishermen. Halibut also formerly occurred here in large numbers. The cod which frequent these shoals are generally of somewhat smaller size than those taken on other parts of the Grand Banks; they are caught with hand-lines on the shoaler areas, where the fishermen go in dories, one man to each boat, while the vessels lie at anchor near by.

The eastern part of the northern section of the Grand Bank, lying eastward of the Eastern Shoal and westward of 49° west longitude, has depths of thirty-seven to forty-five fathoms. The bottom consists of sand, coarse gravel, pebbles, rocks, and broken shells, much of this area being covered with rocks and supporting a rich assemblage of animal life. This rocky bottom is composed essentially of smooth round bowlders, distributed over sand, many of them being perforated by boring mollusks. Immense numbers of crustaceans, especially crabs, abound here, together with bank clams and other shell-fish, small star-fish, Holothurians, Ascidians, etc. This is one of the most favorable grounds for cod, principally from July to September.

That portion of the northern section lying east of the forty-ninth meridian is much less resorted to than the last above described, and is, therefore, less known. The depths of water range from thirty-four to fifty-four fathoms, and the bottom consists of sand, pebbles, and rocks.

North of the northeastern portion of the Grand Bank, the bottom slopes off gradually a distance of forty to forty-five miles from the edge of the bank, the depths nowhere exceeding seventy-five fathoms, excepting in a few small areas. The bottom is composed of sand, mud, and pebbles, the shoaler portions, with depths of fifty-five to sixty-five fathoms, being generally composed of coarse sand and rocks. Within the past five years good catches of cod have been made in this region by Gloucester fishing-vessels.

THE FISHERIES OF THE GRAND BANK.—The most important fishery of the Grand Bank is that for cod, which is engaged in by vessels from France, the United States, and the British

provinces. During the fishing season, which lasts from April first to October, large fleets of vessels from these three countries visit the different parts of this bank. In the early part of the season, April and May, the southern portion of the bank is principally resorted to, and good catches are frequently made south of 44° north latitude. As a rule, however, the larger part of the fleet remain between 44° and 45° north latitude. At this season, sand lant are especially abundant on this part of the bank, and large numbers are often found in the stomachs of the cod. In June, capelin make their appearance on the bank, at which time the cod seem to greatly increase in numbers. This body of cod, found in connection with the capelin, or in the capelin season, has received from the fishermen the name of "capelin school." It is distributed over all parts of the bank visited by the fishing-fleet. After the beginning of June, many of the vessels move to the northern part of the bank, fishing in the vicinity of, and to the eastward of, the Virgin Rocks. Very few vessels now remain south of 44° north latitude, for the best fishing is found between 44° and 45° 20′ north latitude, and to the northward of 46° north latitude.

As a rule, squid make their appearance on the Grand Bank in July, after which time but few fish can be caught with capelin or herring bait. The body of cod now occurring on the bank is termed the "squid school" by the fishermen. It is probable that these schools of cod, though known by different names, are composed mainly of the same fish that come on the bank in the spring, though with the addition of many others, which appear to be attracted to the region during the summer by the schools of capelin and squid. They occupy the same ground, and the fishing continues through September. Formerly, cod were abundant till December, but, at present, these fish leave the bank at a comparatively early period in the fall.

The cod fishery of the Grand Bank dates from the earliest settlement of North America and it probably had much to do with the opening up of our country in those early times.

The halibut fishery began on the Grand Bank about 1865, and has been vigorously prosecuted there ever since. At first the vessels resorted to Eastern Shoal-water, between 43° 45′ and 45° north latitude, where halibut were then found in immense numbers. Though so abundant at first their numbers soon became greatly reduced, and consequently other grounds were sought for. For a series of years that section of the bank lying west of 51° west longitude, and between 43° 40′ and 45° north latitude, was the favorite halibut ground, and several large fares of halibut were also taken in the immediate vicinity of the Virgin Rocks for two successive years (1869 and 1870), during the months of July and August. Notwithstanding the great abundance of halibut on the shoaler parts of the bank (from twenty-two to fifty fathoms), during the earlier years of the fishery, their capture was followed up so closely that they rapidly became much less numerous, and the fishermen were forced to seek new fields in the deeper waters (one to three hundred fathoms) along the southern and western edges of the bank. When first discovered in these deeper places, they were found in incredible numbers all along the western part of the bank in the winter and spring, and during the entire summer in other localities off the Northwest Prong. Although even in these places halibut are much less abundant now than formerly, the Grand Bank is still the great resort for vessels engaged in this fishery, and this region yet remains the most important halibut fishing-ground of the Western Atlantic.

When the halibut fishery first began on the Grand Bank, large catches could be made in the shoal waters during the entire year. After two or three years' continuous fishing, however, they could be found abundantly on the shoal grounds only in the winter and spring. While they were crossing the bank on their way to more northern localities or to deeper water, to which they were not known at that time to resort by the fishermen, it was supposed that they came on the bank from the eastern and southern edges, as they were distinctly seen to move towards the northwest.

More recently, since the beginning of the deeper-water fishing, it has been discovered that they more commonly migrate toward the northwest, along the edge of the bank on the west side, and in some cases their course has been traced even beyond the limits of the Grand Bank.

Since the foregoing was written (1880), halibut have been found in abundance in the deep water off the eastern side of the bank, but owing to the presence of icebergs during the greater part of the year, and the strength of the polar current in that region, but few vessels have ventured there.

GREEN BANK.

Green Bank is for its size one of the least important of the fishing-banks of the Western Atlantic, but one of the best halibut grounds lies in the deep water near its southern part, and as this is also called Green Bank by the fishermen, it may not be out of place to consider it in this connection. This bank has an irregular, elongate pear-shaped outline, the longer axis extending due north and south. It is situated between Grand and Saint Pierre Banks, being seven miles distant from the former and fifteen miles from the latter. Its extreme length within the sixty-fathom line, is sixty-two miles, north and south, from 45° 09′ to 46° 11′ north latitude, and its width is thirty-six miles, between the meridians of 54° 08′ and 54° 58′ west longitude. The area of the bank is about fourteen hundred and fifty square geographical miles. The depths range from forty to sixty fathoms, and the bottom is composed of sand, shells, pebbles, and rocks. The general direction of the polar current, which sets over this bank, is usually from the north to the southwest, its course, as well as its force, being more or less influenced by the wind. But little is known of the abundance of cod here, as the fishermen prefer to resort to grounds with which they are better acquainted and have seldom fished on this one. Within the past two or three years, however, some good fares of cod have been taken on Green Bank, in the late summer and the fall, by New England vessels.

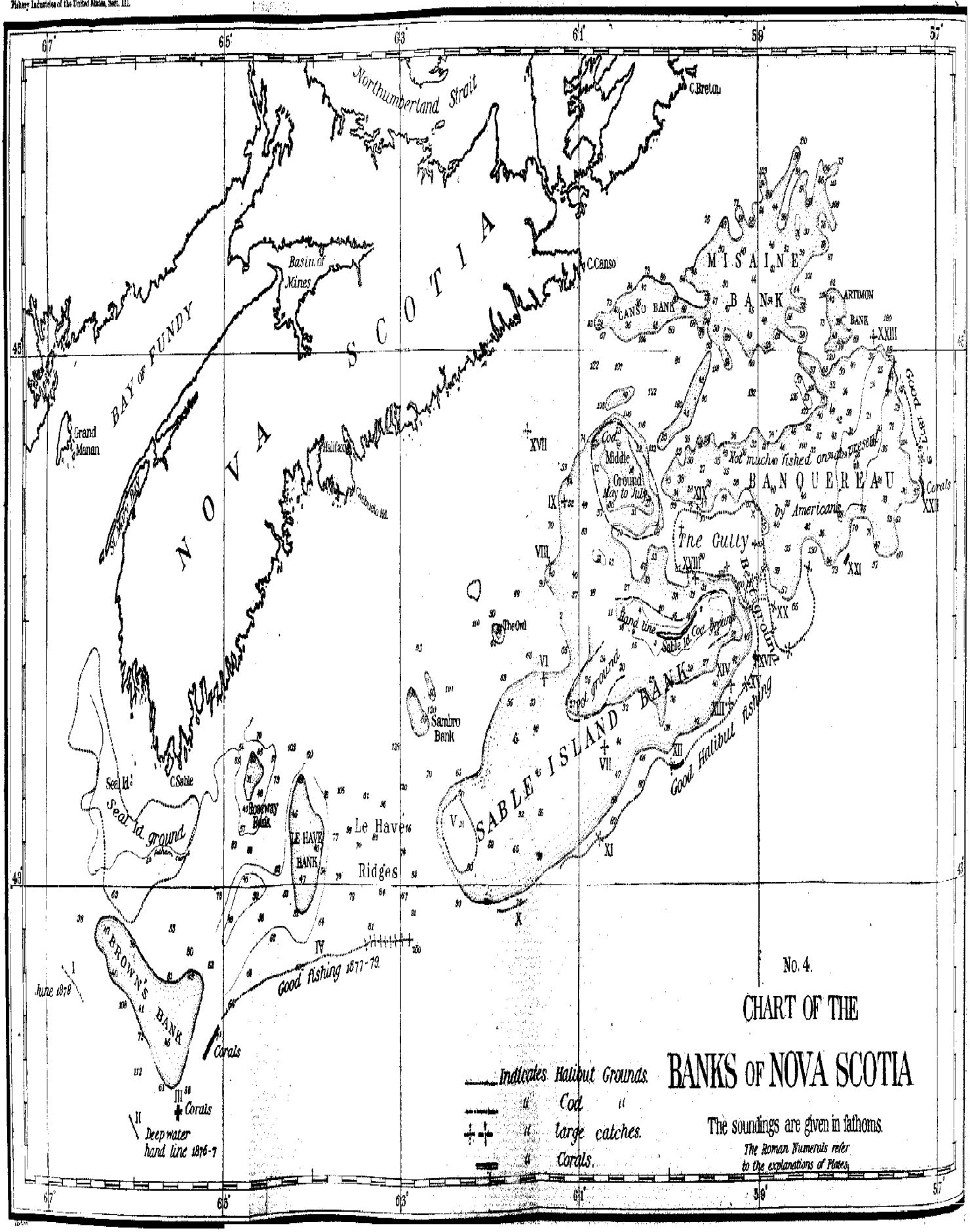
Since 1875, halibut have generally been found very abundantly in the winter and spring, and sometimes even during the summer, in from seventy-five to three hundred fathoms, off the southern edge of the bank, between the Grand Bank and Saint Pierre Bank.

This locality appears to be a feeding-ground in the winter, and during the spring lies in the direct course taken by the halibut in their migrations from the Grand Bank to other places farther north. At this season it is not uncommon for immense schools to make their appearance in this region and move leisurely along the edge of the bank. The only vessels fishing for halibut at this place are from Gloucester, Massachusetts.

BANK OF SAINT PIERRE.

The Bank of Saint Pierre is situated off the center of the southern coast of Newfoundland, between the parallels of 45° 10′ and 46° 54′ north latitude, and the meridians 55° 16′ and 57° 30′ west longitude. It is irregularly oblong in shape, about twice as long as broad, and extends in a northwest and southeast direction. At the northwestern extremity it is about half as wide as at the southeastern, where it rapidly broadens out, and ends abruptly along a nearly straight line bearing north and south. The longest side of the bank, which measures about one hundred and twenty-five miles, presents a slight outward curve and faces the southwest. The width of the northwestern end is about thirty-five miles, and that of the southern end sixty-five miles.

The northeastern edge of the bank is distant about twenty-seven miles from the nearest point on the Newfoundland coast, and from nine to ten miles from the islands of Saint Pierre and Miquelon. The gully separating Saint Pierre Bank from Green Bank runs directly


No. 4.
CHART OF THE
BANKS OF NOVA SCOTIA
The soundings are given in fathoms.
The Roman Numerals refer to the explanations of Plates.
Indicates Halibut Grounds.
" Cod "
" large catches.
" Corals.
Northumberland Strait
C. Breton
C. Canso
Basin of Mines
BAY OF FUNDY
NOVA SCOTIA
Grand Manan
Halifax
Chebucto Hd.
MISAINE BANK
CANSO BANK
ARTIMON BANK
Cod Middle Ground May to July
Not much fished on at present
BANQUEREAU
by Americans
The Gully
Best Ground
Hand line
Sable Id. Cod ground
Pot ground
The Owl
Sambro Bank
SABLE ISLAND BANK
Good Halibut fishing
Seal Id.
C. Sable
Seal Id. ground
Roseway Bank
LE HAVE BANK
Le Have Ridges
BROWN'S BANK
Good fishing 1877-79.
Corals
June 1878
Deep water hand line 1876-7
Corals
Corals
Corals
Good Ground
67°
65°
63°
61°
59°
57°
45°
43°

north and south, has a minimum width of fifteen miles, and depths ranging from sixty-five to one hundred fathoms. The total area of Saint Pierre Bank is about forty-six hundred square geographical miles. The depths range from twenty-two to fifty fathoms, the bottom being mostly composed of rocks and pebbles, although in some parts there are considerable areas of sand and gravel. Ordinarily, there is not much current over this bank, although at times, when driven by strong winds, the polar current, which sweeps around the south coast of Newfoundland, becomes quite strong.

Cod and halibut are the only food-fishes found in any considerable numbers on the bank of Saint Pierre, though a few cusk and haddock are sometimes taken. The general season for both cod and halibut begins usually about the first of April and continues until November. Cod are most abundant from the first of June to October, during which period they come in pursuit of capelin and squid. Halibut were formerly abundant on various parts of this ground during the spring and summer, but now they are rarely numerous except in the deeper water along the edges, or on rocky spots fifteen to twenty miles distant from the bank, in localities where no soundings are indicated on the published charts. Some of the schools of halibut breed on these rocky patches, but the greater number merely pass along the edge during their migrations toward the north. But few fishing-vessels, beyond the fresh halibut catchers and those owned by the French, resort at present to the bank of Saint Pierre, as some of the other neighboring banks offer much greater inducements. Saint Pierre has, therefore, lost a great deal of its former prestige as a fishing-ground, and assumes but a second rank among our great ocean banks.

The invertebrate fauna of this bank is moderately rich, but much less so than that of many parts of the Grand Bank, the fauna of the two regions including, however, about the same variety of forms.

BANQUEREAU.

Banquereau may be regarded as one of the most important fishing-banks lying between the fortieth and forty-eighth parallels of north latitude. Its entire outline is very irregular, but the main portion of the bank has a somewhat rectangular shape, with an elongate and nearly regular prolongation extending to the west. The length of the bank in an east and west direction is a little more than one hundred and twenty miles, and its greatest width about forty-seven miles; its total area is about two thousand eight hundred square miles. The main portion of the bank lies between 44° 04′ and 45° 01′ north latitude, and 57° 10′ and 59° west longitude, and the western prolongation between 44° 24′ and 44° 42′ north latitude, and 59° and 60° 05′ west longitude. North of Banquereau lie Artimon and Misaine Banks, the former being distant only about three miles and the latter from two to fifteen miles, the intervening depths ranging from sixty-one to one hundred and fifty-five fathoms. South of the western part of the bank is the eastern part of Sable Island Bank, from which it is separated by the "Gully" to be described further on.

On the eastern part of Banquereau there is an area of shoal ground, called the "Rocky Bottom," having a depth of about sixteen fathoms; elsewhere the depths range from eighteen to fifty fathoms, and the bottom is rocky as a rule, but on some parts of the bank there are patches of sand and gravel.

A current issuing from the Gulf of Saint Lawrence here meets the polar current, but although this produces some disturbance of the surface waters, the latter current is usually the stronger, and the tendency of the flow is, therefore, chiefly towards the west. The force as well as the direction of the current is much influenced by the wind, so that while quite strong tides may prevail for several days at a time, intervals may follow when there is but little if any current.

Cod and halibut are about the only fish taken in abundance on Banquereau, but hake, haddock, and cusk are sometimes found in small numbers. The Rocky Bottom is principally resorted to for cod, by the hand-line dory fishermen during the summer, and at times several hundred dories can be seen fishing there close together. As a rule, cod are most plentiful on the eastern part of the bank, although good catches are sometimes made toward the west. The best season for them is from May to November, when the schools gather upon the bank to feed on the lant, squid, crustaceans, and shell-fish, which are then very abundant.

Halibut are found throughout the entire year off the edges of the bank, where, at depths of one hundred to four hundred fathoms, large numbers are often taken. These localities are apparently both feeding and breeding grounds for halibut, and it is not unusual for a school of these fish to remain several weeks or even months in one locality, although it is very probable that some of the schools observed on the eastern side of the bank in the spring are migrating toward the north.

The principal places for halibut are along the southern and eastern borders of the bank; the Southwest Prong (in about 44° north latitude, and between 58° 30′ and 58° 55′ west longitude); the Middle Prong (44° 14′ north latitude and 58° west longitude); and the Eastern Slope (from 44° 28′ to 45° north latitude), in depths of one hundred and fifty to four hundred fathoms. These deep-water areas are rocky, and support a very rich growth of Gorgonian corals, sea anemones, etc.

ARTIMON BANK.

Artimon Bank lies north of the eastern part of Banquereau, from which it is separated by a narrow gully. It is of such limited extent (about one hundred and twenty square miles) that, compared with the latter, it is of but slight importance as a fishing-ground. The fishermen generally prefer to fish on the larger bank, and therefore know but little concerning the abundance of fish here, although it is certain that cod occur in greater or less numbers. This bank is fourteen miles long and ten miles wide, with depths of thirty-eight to fifty fathoms, and a bottom of coarse gravel and rocks.

MISAINE BANK.

This bank lies north of the western two-thirds of Banquereau, from which it is mainly separated by a channel about twenty miles wide. The eastern prolongations of these banks, however, approach one another quite closely. Misaine Bank has a very irregular outline, its general trend being about northeast by east and southwest by west. It lies between the parallels of 44° 55′ and 45° 45′ north, and the meridians of 58° 06′ and 59° 50′ west. Its greatest length is, therefore, about eighty miles and its greatest width about forty miles, its superficial area amounting to about seventeen hundred square geographical miles. The depths of water range from forty to sixty fathoms, and the bottom is generally broken and rocky.

But little is known concerning the abundance of fish on this bank, as it has been very rarely visited by vessels. It is probable, however, that occasional visits have demonstrated that cod are less abundant here than elsewhere in this region, and that this bank does not afford as profitable fishing as some others not far distant from it. This seems remarkable when we consider its large size and close proximity to Banquereau, which is an exceedingly valuable ground for both cod and halibut.

CANSO BANK.

Canso Bank is situated to the southeast of Cape Canso, Nova Scotia, from which it derives its name. The distance of its western end from the cape is about twelve miles. It is really a

western extension of Misaine Bank, with which it is connected by a narrow neck. It is very elongate, extending in an east and west direction, and lies between about 59° 50′ and 60° 50′ west longitude and 45° 01′ and 45° 16′ north latitude. Its length is about forty-five miles, its greatest width about thirteen miles, and its area not far from four-hundred and twenty-five miles. The depths of water on this bank range from thirty to fifty-six fathoms and the general character of the bottom is sandy, with spots of gravels and pebbles. It is unimportant as a vessel fishing-ground, and is too far distant from the land to be much resorted to by small boats.

THE GULLY.

The so-called Gully of the bank fishermen is the deep passage-way lying between Banquereau and Sable Island. It extends in a west-northwest and east-southeast direction north of Sable Island, but turns abruptly toward the south at its eastern end, and continues down between the eastern end of the Western Bank and the southwest prong of Banquereau. It constitutes an important halibut ground. Its entire length is about sixty miles, and its greatest width twenty miles. The depths range from sixty-six to one hundred and forty-five fathoms, and the bottom consists of rocks, gravel, sand, and mud. The rocky and gravelly portions form several ridges, separated generally by areas of the finer materials, excepting in the eastern section, where the intervening bottom is mostly composed of pebbles and sharp rocks. The ocean currents generally set over this area in a westerly direction, but vary much in strength, an easterly wind often increasing their force, while at other times there may be no perceptible current at all. Halibut have not been found, at least not in sufficient numbers to warrant fishing for them, over the entire extent of the Gully; but the halibut grounds proper are limited to the rocky and gravelly ridges and slopes of that portion of the Gully included between the meridians of 59° and 60° west longitude. When this fishery began it was carried on chiefly during the spring, in the northern and western part of the Gully; but in 1877 the fishermen made successful trials farther out, taking good fares even as late as June and July; since then good catches have been obtained in the winter, and it would appear that the halibut come here merely to feed, as they generally move to other localities just previous to the spawning season. With a few exceptions, Gloucester halibut vessels are the only ones that have fished on this ground. Instances are on record of the appearance of cod in the Gully in sixty-five to ninety fathoms of water, but they are not found regularly in the same places each year. The rocky bottoms of the Gully are very rich in animal life, affording abundant food for the halibut, and lant and herring are also frequently plentiful in their season.

SABLE ISLAND BANK OR WESTERN BANK.

Western Bank is one of the most important fishing-grounds of the Western Atlantic, considered either as to size or the abundance of fish. It lies south of Cape Breton Island and the eastern part of Nova Scotia, between the parallels of 42° 55′ and 44° 46′ north latitude and the meridians of 59° 04′ and 62° 35′ west longitude, and has a length of one hundred and fifty-six miles and a width, including the Middle Ground, of seventy-six miles. The general contour of the bank within the sixty-five-fathom line, as laid down on the Admiralty chart, approaches somewhat a very elongated ellipse, with the longer axis running about northeast by east and southwest by west; but over a broad area to the eastward of the center of the bank soundings of less than sixty fathoms connect it directly with Middle Ground, which we have here included in the same bank. The total extent of the bank thus defined is about seven thousand square geographical miles. Off its eastern end lies Banquereau, with the Gully between, and a short distance off the western end are the Le Have Ridges.

The depths off the southern side of the bank rapidly increase from sixty to seven hundred, twelve hundred, and fourteen hundred fathoms.

At the eastern end of Western Bank is Sable Island, a long and narrow crescent-shaped elevation, entirely formed of sand, which has been blown into innumerable hummocks or dunes. Off both ends of the island are long and dangerous sand-bars. The length of the island is about twenty miles, and its greatest width one and one-half miles. It extends in a nearly east and west direction. The depth of water on the bars, for a distance of from seven to ten miles, does not exceed two fathoms, and even ten miles farther out, both to the east and west, the depths are not greater than ten or eleven fathoms.

As a general rule, the bank slopes gradually from the island toward the south and west, the depths ranging from eighteen to sixty fathoms. The bottom is mostly sandy, with patches of gravel and pebbles. On the Middle Ground there are several shoal spots, with depths of ten to nineteen fathoms. The currents are occasionally quite strong in the vicinity of Sable Island and generally very irregular, being much influenced by winds. On the remainder of the bank there is usually but little current, whatever there is usually tending in a westerly direction.

Cod and halibut are the principal food-fish taken, other species of bottom swimmers occurring in less numbers. Cod are generally most abundant in the spring, from the first of March to June, although good fares are obtained throughout almost the entire year. For more than twenty-five years the Western Bank has been a favorite resort of the halibut fishermen. At first, these fish were found very plentiful on different parts of the bank in from forty-five to sixty fathoms, and since 1876 have been caught in great numbers along the edges on the south and east sides, in one hundred to three hundred fathoms. Like the cod, they are found during the entire year, the period of greatest abundance, however, being from the first of January to the first of October. The Western Bank may be considered both as a feeding and spawning ground for the cod and halibut. It abounds in shell-fish (quahogs, mussels, clams, and periwinkles), and crustaceans (crabs, shrimps, etc.), as well as in several species of small fish (lant and herring), upon which the cod and halibut prey. Although the cod do not gather in such great schools in winter as they do on George's Bank, it is nevertheless quite evident that they assemble at that season for the purpose of reproduction. Usually they are found most abundant on the western part of the bank in winter, but as spring advances they move into shoaler water in the vicinity of Sable Island, the "bend" of the island and the region about the bars being favorite grounds during the late spring and early summer. The fish taken near the island are, as a rule, somewhat smaller than those caught farther west. Vessels from all along the New England coast and from the British provinces resort to this bank to pursue the cod fishery, but fishing for halibut is almost exclusively carried on by the Gloucester fleet. The two bars at the eastern and western ends of Sable Island, as well as the shoal water off the northern side of the island, are favorite localities for dory hand-line fishing for cod.

THE OWL AND DOUBTFUL BANKS.

The Owl is a very small bank, lying in 43° 57′ north latitude, and 61° 55′ west longitude. It is somewhat triangular in outline, being about five miles long by three miles wide at the broadest end, and having an area of about ten square miles, as laid down on the Admiralty chart. The only depth of water given is fifty-four fathoms, with sixty to ninety fathoms off the edge.

Doubtful Bank lies about fifteen miles northwest of the Owl, and is of less extent than the latter, having an area of about six or seven miles only. The depth of water is thirty-two fathoms, eighty-two fathoms occurring in the immediate vicinity. Both of these small grounds

have in times past furnished a few good trips of halibut, but they are not now considered of any importance to that fishery. They are, however, more or less resorted to for cod by American vessels.

SAMBRO BANK.

Sambro Bank lies between the parallels of 43° 36′ and 43° 47′ north, and the meridians of 62° 40′ and 62° 55′ west, the greatest length, northeast by north and southwest by south, being twelve miles and the greatest width seven miles. The area of the bank is about seventy square miles. It has a depth of fifty-four to sixty fathoms, with depths of one hundred and ten to one hundred and thirty-three fathoms a short distance off its northeastern edge. The bottom consists mostly of sand, gravel, and pebbles. Sambro Bank, from its small size, is seldom visited by fishing-vessels, and has, therefore, never attained any importance as a fishing-ground.

LE HAVE BANK.

Le Have Bank is situated to the eastward of Brown's Bank, and south and east of Roseway Bank. It extends from 42° 34′ to 43° 26′ north latitude, a distance of fifty-two miles, and from 63° 50′ to 65° 07′ west longitude, a distance of about fifty-four miles. The bank is nearly divided into two portions, of which the eastern portion (Le Have Bank proper) extends north and south thirty-nine miles, and the western portion nearly east and west about thirty-five miles. The total area of the bank is about twelve hundred and forty square miles. The bottom is largely composed of coarse gravel, pebbles, and rocks, with smaller areas of sand distributed here and there. The depths of water range from forty to fifty fathoms. The general set of the current is to the westward, but this, however, is influenced very much by the direction and force of the wind, generally running quite strong during easterly winds. The principal fish taken on this bank are cod and haddock, although other species of bottom feeders are more or less plentiful. Cod are found at all seasons of the year, but are, perhaps, more abundant during the early winter than at any other period, and good trips are frequently obtained by the Gloucester vessels, which are the only ones that go there at that season. The Gloucester winter haddock-catchers, which carry their catch fresh to the Boston market, have extended their trips from George's and Brown's Banks to Le Have, and during the present winter (1880–'81) have made some remarkably good fares, several of them being the largest on record. Most of the lower forms of animal life found on the Western Bank and Le Have Ridges also occur on Le Have Bank. Le Have was at one time (1855 to 1865) quite a favorite fishing-ground for halibut, and considerable quantities are occasionally taken now by the hand-line cod fishermen in winter, though they do not occur in sufficient numbers to warrant trawlers going there.

LE HAVE RIDGES.

The fishing-ground known as Le Have Ridges is simply a continuation of Le Have Bank to the eastward, in the direction of the Western Bank, a distance of about forty-five miles. This places the eastern limit in 62° 50′ west longitude, while the northern and southern boundaries are about the same as those of Le Have Bank. The extent of the ridges is about fifteen hundred and seventy-five square miles. The bottom is a succession of ridges of gravel and pebbles, with occasional patches of rocks, the depths varying from fifty-five to eighty-five fathoms. The current, though occasionally strong, is weaker here than farther west on the bank, and, excepting during easterly winds, is but little noticed. The general set is westerly. The Ridges were for a number of years one of the favorite places of resort for the halibut catchers in the winter, and many good trips of cod have also been taken there at that season. At present, but few halibut

are caught except in the deep water along the southern edge of the ground, where they have sometimes been found quite plentiful during nearly the entire year. Hake are also found in large numbers in the deep water about the edges of the ground, and even on the ridges. As a general thing, few vessels besides those from Gloucester have made a practice of fishing on Le Have Ridges, though cod-fishermen from other places stop there now and then during the summer. In the deep water bordering the southern side of Le Have Ridges, Gorgonian corals (*Primnoa*, *Paragorgia*, *etc.*) occur on the rocky bottoms, while on the ridges themselves sea anemones, star-fishes, mollusks, crabs, and other crustaceans abound.

ROSEWAY BANK.

Roseway Bank lies north of the western part of Le Have Bank and southeast of Shelburne light, Nova Scotia. It is oblong in shape, and of slight extent (about two hundred and seventy square geographical miles), its greatest length being about twenty-one miles, and its greatest breadth about fifteen miles. It extends from 43° 12′ to 43° 33′ north latitude, and from 64° 25′ to 64° 52′ west longitude, and at the northwest corner is connected with the shore limit of sixty fathoms by a narrow neck. The depths on this bank vary from thirty-three to forty-eight fathoms, and the bottom consists of sand, gravel, and rocks.

The currents in this region are not nearly so strong as in the vicinity of Cape Sable and Brown's Bank. The general direction of the flow is about west-southwest and east-northeast, the westerly current being usually much the stronger, although the force and direction of both are more or less influenced by the winds. The principal fish taken on this bank are cod, haddock, and cusk, but hake, pollock, and halibut also occur there. The best fishing season is generally from May to October, during which time the bank is mainly resorted to by small sized vessels from the western part of Nova Scotia, although a few New England vessels also occasionally fish there.

BROWN'S BANK.

Brown's Bank lies in a northeasterly direction from George's Bank, and is separated from it by a gully fifteen miles wide, in which the depths of water range from one hundred to four hundred and fifty fathoms. This bank is imperfectly laid down on the published charts now in use by the fishermen, and no comprehensive idea of its extent and consequent importance as a fishing-ground is, therefore, conveyed by them.

The charts published by the United States Coast Survey define the boundaries of the bank much more accurately and afford a better idea of the area visited by the fishing-vessels than the Admiralty and Eldridge charts. The depths of water range from twenty to seventy-five fathoms over this area, which embraces within its limits about twenty two hundred and seventy-five square miles. The greatest length of the bank, from southeast to northwest, is sixty-three miles, and the extreme breadth forty-three miles. It is situated between 64° 52′ and 66° 29′ west longitude, and 41° 50′ and 43° 02′ north latitude. There is a small rocky shoal on the northern part (the exact location of which seems not to have been definitely determined), on which, it is said, there is not more than nine to fifteen fathoms of water. The bank slopes away from the shoal on the south and east, to depths of fifty-five to seventy-five fathoms; but at a distance of twelve to fifteen miles off it again rises to depths of thirty to fifty fathoms. This area of shoal water, within the fifty-fathom limit, is fifty miles long with an average width of fifteen miles. North of the shoal the bottom drops off suddenly to depths of seventy to eighty fathoms. The bottom is largely composed of coarse sand, gravel, pebbles, and rocks, and is rich in animal life.

The tides are quite as strong here as on the eastern side of George's Bank, the ebb having an average strength of one and one-third miles an hour, while the flood runs somewhat stronger. The greatest strength of the flood-tide sets nearly northwest, while the ebb flows in nearly an opposite direction.

Cod, halibut, and haddock are the principal food-fish occurring on this bank, but pollock and hake are also found in less numbers. Cod are quite plentiful in the winter, and some good fares are obtained, although comparatively few vessels fish here at that season, most of them going to George's. At other seasons, however, the cod fishery on Brown's Bank compares favorably with that of any of the other banks in that vicinity. Quite a number of the so-called Georgesmen fish here, and a few resort principally to this bank during the entire year. Halibut were formerly found in abundance, but at present this fishery is limited to an occasional trip to the deep water off the southern or western edge. A small quantity of this fish is also caught by the hand-line fishermen. The haddock fishermen frequently visit this bank during the winter, and often make good catches.

SEAL-ISLAND GROUND.

Off the western part of Nova Scotia there is an important fishing locality, to which no name is given on the charts, but which is called by the fishermen Seal-Island Ground. It is a direct continuation of the shore soundings, which slope gradually from the land toward the south and west, and continue in a northerly direction beyond what might be properly regarded as the limit of the ground. To the south it extends nearly to Brown's Bank, from which it is separated by a narrow gully; to the west it reaches thirty-eight miles beyond Seal Island, and to the northwest about thirty-five miles from the same island. The southern limit of the ground is in 43° and the northern in 43° 45′ north latitude, while the western boundary may be placed at 66° 40′ west longitude. The entire ground covers an area, outside of the three-mile line, of twelve hundred and fifty square miles.

There is a small shoal called Pollock Rip, with a depth of seven fathoms, bearing southwest from Seal Island, from which it is distant nine and one-half miles, but otherwise the ground slopes quite gradually, the depths ranging from fifteen to seventy fathoms.

The bottom is mainly composed of coarse gravel and pebbles, with occasional rocky spots of greater or less extent. The tides sweep out from and in toward the Bay of Fundy with considerable force, the course varying with the direction of the land, so that while they run nearly north and south on the northern part of the ground, they swing round to the southward of Seal Island and there run northwest and southeast. The flood is stronger than the ebb, and the fishermen estimate that one flood tide will carry a vessel nearly as far in a northerly direction as two ebb tides will carry it in the opposite way, although this is doubtless an exaggeration.

The principal fish caught on this ground are cod, haddock, and pollock; but halibut, cusk, and hake are taken to a limited extent, and occasionally herring and mackerel are netted for bait.

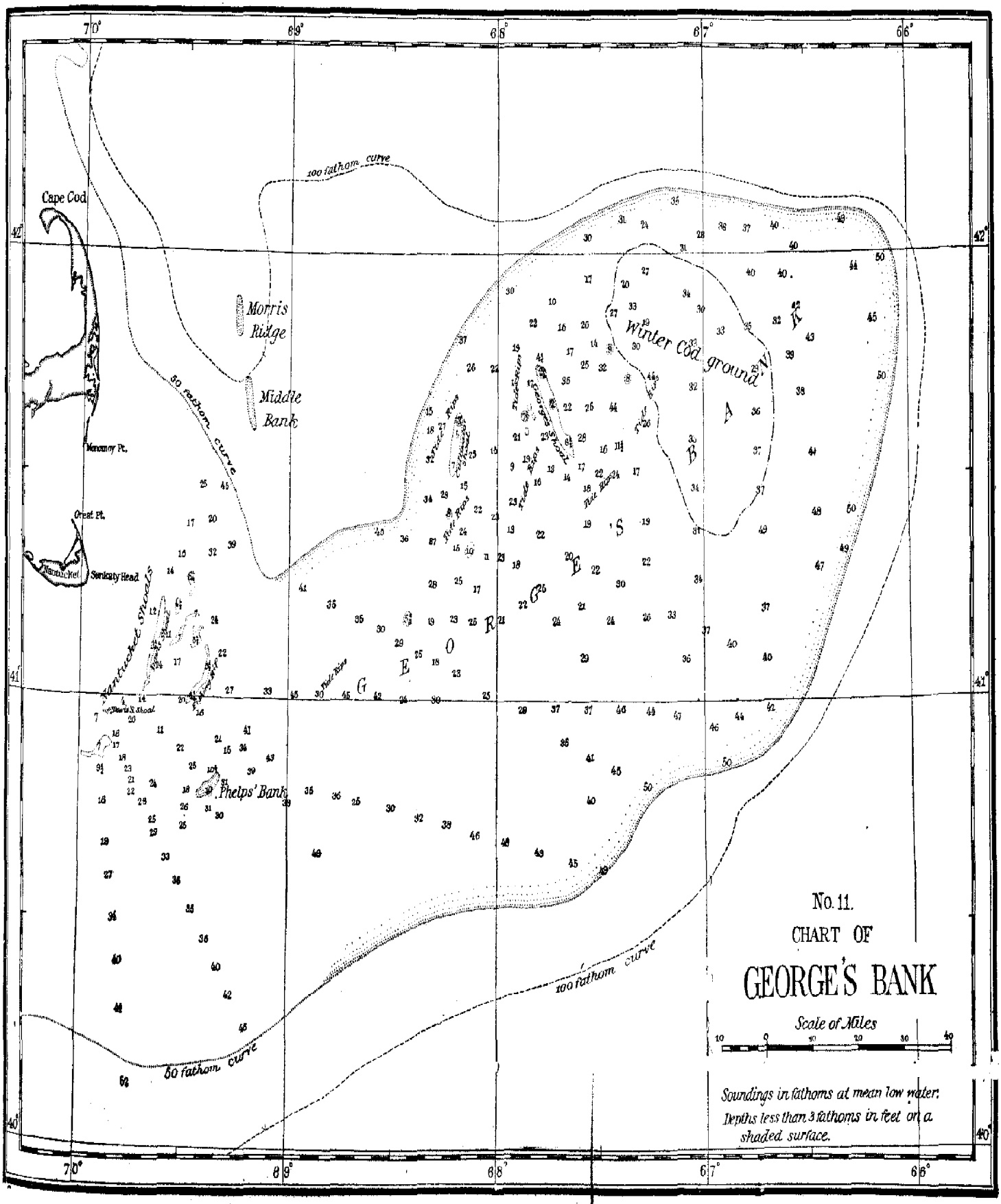
Cod are generally more abundant from spring until fall than during the winter, but haddock and halibut occur throughout the year. Fishing usually begins in April or May, and continues until October. Halibut were formerly very plentiful in this region, but are now comparatively scarce.

This ground may be considered as essentially a feeding-ground for cod, which appear to come here after the spawning season is over, to fatten upon the crabs and mollusks living on the bottom and the herring and other species of small fish that swim back and forth in the tide rips. All parts of the ground are fished on at the same time. This was formerly a favorite fishing

locality for vessels from the coast of Maine, but since the almost universal adoption of trawl-fishing, only a few American vessels beyond Georgesmen (hand-liners) go there. The New London halibut schooners occasionally visit it in summer. The fleet resorting there now is principally composed of vessels belonging to the western part of Nova Scotia, which generally "fish at a drift," moving back and forth over the ground with the wind and currents.

GEORGE'S BANK.

George's Bank is by far the largest and most important fishing-ground near the coast of the United States, and is second to none in the Western Atlantic except the Grand Bank of Newfoundland. It lies to the eastward of Cape Cod and Nantucket Shoals, and is apparently an extension of the latter, since the water is no deeper between the southern part of the shoals and the western part of the bank than in many places upon it. As laid down on the charts, the southern limit is in 40° 40′ north latitude, although the fifty-fathom line extends seven miles farther south; the southern boundary may, therefore, be regarded as in about 40° 30′ and the northern as 42° 08′ north latitude. The eastern part is in about 66° and the western in 69° west longitude. The greatest length from the northeastern to the southwestern extremity is about one hundred and fifty miles, and the greatest width north and south ninety-eight miles, according to the charts of the United States Coast Survey. The depths range from two to fifty fathoms. On the western part, between the parallels of 41° 10′ and 41° 53′ north latitude and the meridians of 67° 20′ and 68° 37′ west longitude, are a number of shoals, known as the East Shoal, the North Shoal, the Southwest Shoal, Cultivator Shoal, etc. The Southwest Shoal is the largest, being fifteen miles in length south-southwest and north-northeast, with an average width of two and one-half miles. The position of the center of this shoal is 41° 39′ north latitude and 67° 48′ west longitude. There are from two to fifteen fathoms of water on the shoals, and between them from twelve to thirty fathoms. The tides sweep over these with great force, causing strong rips, and, during rough weather, the sea breaks heavily on them, rendering approach to their vicinity extremely hazardous. The bottom is chiefly sand, although patches of rough ground—gravel, pebbles, and rocks—of greater or less extent, are found in some localities. Its position between the Bay of Fundy and the Gulf Stream causes the tides to run swifter than on the other banks, and to swirl around instead of passing directly back and forth. They sweep around the compass, from left to right, attaining the greatest velocity when flowing southeast and northwest and the least velocity when moving southwest and northeast. The first attempt at fishing on this bank, of which there is any record, was made in 1821 by three Gloucester vessels. The George's cod and halibut fishery of later date did not become fully established as a permanent industry until about 1835, although vessels went there for halibut in 1830. At first the catches consisted mostly of halibut, but since 1850 they have been chiefly of codfish, although more or less halibut are taken with them. During the months of February, March, and April large schools of cod make their appearance on the bank. They are generally found on the "winter fishing-ground," a part of the bank lying to the eastward of the shoals, between 41° 30′ and 42° north latitude and 66° 38′ and 67° 30′ west longitude. This is essentially a spawning-ground for the cod, which appear to come on the bank from the southeast, as they almost invariably, after reaching the ground, move slowly to the north and west as spring approaches. This is in the direction of the shoals, and, as the pursuit of the fish brings the vessels near the latter, great loss of life and property sometimes occurs during heavy easterly gales. As soon as the spawning season is over the schools of cod break up, but more or less fish are caught on different parts of the bank during the entire year, though rarely, if ever, are they found so plentiful as when the winter school is on the ground.


No. 11.
CHART OF
GEORGE'S BANK
Scale of Miles
10 0 10 20 30 40
Soundings in fathoms at mean low water.
Depths less than 3 fathoms in feet on a shaded surface.
Cape Cod
Morris Ridge
Middle Bank
Winter Cod ground
Monomoy Pt.
Great Pt.
Nantucket
Sankaty Head
Nantucket Shoals
Phelps' Bank
100 fathom curve
50 fathom curve
70°
69°
68°
67°
66°
42°
41°
40°

The codfish fleet, which numbers about one hundred vessels, is wholly from Gloucester, Massachusetts. Besides these, there are twenty-five to thirty vessels from the same port that fish on George's for haddock in the winter, and a few others, from ports in Long Island Sound, engage in the halibut and cod fishery to a limited extent in the spring and summer.

The area of the "winter fishing-ground" is about eleven hundred square miles, while that of the whole bank is eighty-four hundred and ninety-eight square miles. All of this area, with the exception of the shoals, is available for fishing purposes in the summer season for cod, halibut, haddock, and mackerel.

Various kinds of shell-fish, such as pectens, mussels, and periwinkles, and crabs, and other crustaceans abound over most parts of the bank, and herring and lant are quite plentiful during most of the year.

13. THE MACKEREL AND MENHADEN FISHING-GROUNDS OF THE EASTERN COAST OF THE UNITED STATES.

THE MACKEREL GROUNDS.

The most extensive and valuable mackerel fishing-grounds of the world are located off the eastern coast of the United States, between the parallels of 36° and 45° north latitude, and the meridians of 66° and 75° 30′ west longitude. They extend from a point a short distance north of Cape Hatteras (about fifty to seventy miles directly off the mouth of Chesapeake Bay) to the eastern and northern limit of the Gulf of Maine, comprising the entire extent of the latter region. The length of these grounds, in round numbers, is about seven hundred miles, and the average width may be regarded as at least eighty miles, making a total area of about 56,000 square geographical miles, all of which is resorted to by the mackerel catchers of the United States. Over this region the mackerel swarm at certain seasons in incredible numbers, although the entire region is not generally filled with schools of these fish at the same time.

In their spring migrations the mackerel approach the coast north of Cape Hatteras, and the first captures are usually made in the latter part of March or the beginning of April, between the parallels of 36° and 38° north latitude, at distances of twenty-five to seventy miles from the land. The following statements of early catches of mackerel, from 1878 to 1881, will give a comprehensive idea of the localities and dates at which the first schools make their appearance.

EARLY CATCHES OF MACKEREL IN 1878.

March 30.—Off Chincoteague, Virginia; schooner Lilian, of Noank, Connecticut.

April 16.—Latitude 36° 10′ north, longitude 74° 45′ west; schooner Sarah M. Jacobs, of Gloucester.

April 18.—Twenty-five miles southeast of Cape May; schooner Alice, of Swan Island, Maine.

April 25.—Fifty miles southeast of Cape May; schooner John Somes, of Swan Island, Maine.

EARLY CATCHES OF MACKEREL IN 1879.

April 12.—Latitude 36° 35′ north, longitude 74° 50′ west; schooner Sarah M. Jacobs, of Gloucester.

April 13.—Latitude 37° 57′ north, longitude 74° 23′ west; schooner Augusta E. Herrick, of Swan Island, Maine.

April 13.—Seventy-five miles south-southeast of Cape Henlopen; schooner S. G. Wonson, of Gloucester.

April 14.—Latitude 38° 08′ north, longitude 73° 57′ west; schooner Charles Haskell, of Gloucester.

April 19.—Latitude 37° 50′ north, longitude 74° 03′ west; schooner Alice, of Swan Island, Maine.

EARLY CATCHES OF MACKEREL IN 1880.

April 1.—Latitude 35° 30′ north, longitude 74° 15′ west; schooner Edward E. Webster, of Gloucester.

EARLY CATCHES OF MACKEREL IN 1881.

March 20.—Latitude 37° 10′ north, longitude 74° 05′ west; schooner Edward E. Webster, of Gloucester.

April 18.—Latitude 38° 38′ north, longitude 74° west; same schooner.

May 16.—Off Block Island; schooner Alice, of Swan Island, Maine.

As the season advances the mackerel move northward, the vessels following their migrations so far as possible. After a short period, however, the schools appear to strike the coast in a succession of waves, if that term may be allowed, and it generally results that, within a few weeks at most after the first captures have been made in the spring, numerous schools are to be met with along a considerable extent of coast, and, not unfrequently, from near the land to a distance of sixty to seventy miles off. It is often difficult for the fishermen to determine positively whether the mackerel that suddenly appear off Sandy Hook or Long Island belong to schools met with south of the Delaware a day or two previously, or whether they have just approached the coast for the first time, having come in directly from the Gulf Stream. However that may be, it frequently happens that they are taken at the same time at numerous places all along the coast from near Montauk Point, Long Island (and possibly near Block Island), to the mouth of the Delaware River, and even farther southward. It is also not unusual for catches to be made on the same day both at Cape Cod and off New York, with reports of fish in greater or less abundance at intervening localities, as off Montauk Point, Block Island, No Man's Land, and the south shoal of Nantucket, and in the south channel between George's Bank and Nantucket Shoals.

During the early part of the season, while the spring or southern mackerel fishery is in progress (usually from March 20 to June 1), a large percentage of the catch is marketed fresh, chiefly in New York. The vessels frequently meet in port, and the fishermen are thus afforded an opportunity of comparing notes, which, in consequence of the broad areas traversed in the passage to and from market, enables them at this season to correctly estimate the area covered by the mackerel as well as their abundance.

After the beginning of June, the Gulf of Maine becomes the great mackerel ground. As the schools of fish pass in the South Channel they appear to separate, a portion moving up by Cape Cod, usually not far from the land, while other schools take a more easterly course, sweeping off toward Cashe's Ledge, or even across toward Cape Sable. These various schools, which seldom have precisely the same movements two years in succession, are followed by different sections of the mackerel fleet, and at this season the vessels are scattered from Block Island and No Man's Land to Cashe's Ledge and Cape Sable. The vicinity of Block Island has frequently remained a favorite fishing-ground throughout the summer, mackerel of extraordinary size and superior quality having been taken there during this entire period. George's Bank has also been a more or less favorite locality at the same season, and, like Block Island, has been quite celebrated for the excellent quality of its fish. Owing, however, to the prevalence of exceedingly strong tides on this bank, and to the fact that stormy weather is usually of frequent occurrence in the fall, mackerel fishing is not generally carried on there after the middle of September. As the loss of seine boats,

and possibly of seines, may result from the vessels being caught out in a severe gale, the fishermen are more cautious at the present time about remaining on George's in the fall than they were formerly, when hooks and lines were the chief appliances of capture.

Mackerel are occasionally found in abundance on Brown's Bank, situated northeast of George's Bank, and on the Seal-Island Ground, but their occurrence in great numbers in these localities may be regarded as exceptional rather than as the rule. Although the movements and abundance of mackerel are subject to yearly variations of greater or less magnitude, it can be safely stated that during the months of June, July, and August, the following localities furnish the most important mackerel grounds on our coast: Cashe's Ledge and vicinity, covering an area about sixty or seventy miles across, and having Cashe's Shoal as a center; the vicinity of Monhegan Island, from near Cape Elizabeth to Matinicus Rock, and from close in shore to a distance of forty miles off shore; and the vicinity of Mount Desert Rock, from the rock to near the main land, and outward from it in all directions for distances of twenty to twenty-five miles.

In the fall, after the mackerel have begun their migrations toward the south and west, the principal localities resorted to by the fishermen are successively as follows: Off Cape Elizabeth, and about Boon Island, Maine; off Cape Ann, Massachusetts Bay, Barnstable Bay, and off the outer side of Cape Cod. Fortunately, at this season, the mackerel usually follow the trend of the shore, and strike into the larger bays which indent the coast line. This permits of the fishery being carried on with little risk, at a period when severe gales are of frequent occurrence on the New England coast, as the vessels are generally within easy reach of safe harbors.

Efforts have been made from time to time to trace the movements of the schools of mackerel after they have passed Chatham, Cape Cod, the last locality where they are generally caught in the fall, but always without success. The failure of these attempts is chiefly due to two causes, namely: first, the almost steady prevalence at that season of unfavorable weather for fishing operations; and, second, the disinclination of the fishermen, at the close of the season, to push with their accustomed vigor an enterprise which appears to promise but slight money returns at the most, and exposes them to great personal risk.

THE MENHADEN GROUNDS.

The menhaden fishing-grounds of the eastern coast of the United States extend at the present time (1883) from Chesapeake Bay to and including Long Island Sound, and, in some seasons, also include a portion of Vineyard Sound, on the southern coast of Massachusetts. They are of limited width, the fishery being rarely carried on at greater distances from land than ten to fifteen miles. Their total area may be reckoned, in round numbers, at about 5,350 square geographical miles, which can be itemized as follows: Long Island Sound and the vicinity of Block Island, 1,200 square miles; off the south side of Long Island, from Montauk Point to Sandy Hook, with an average width of fifteen miles, 1,575 square miles; off the New Jersey coast, from Sandy Hook to Cape May, 1,575 square miles; Delaware Bay, 150 square miles; Cape Henlopen to Cape Charles, with an average width of about two miles, 250 square miles;[1] Chesapeake Bay, from the capes to Tangier Sound, 600 square miles.

Formerly the menhaden fishery was carried on along a much greater range of coast, extending from North Carolina to Mount Desert, Maine. Prior to 1879 menhaden occurred in great abundance in the Gulf of Maine, and the bays and estuaries connected with it, from May to October, and the waters of that region often seemed literally alive with the numerous large schools, many of

[1] Along this stretch of coast fishing for menhaden is carried on only to a limited extent, chiefly by means of seines set from the beaches, and the area of the grounds is, therefore, very small considering their great length.

which ascended the rivers to the limit of salt water. Before the introduction of purse seines they were extensively captured in gill-nets, for use as bait by the cod and mackerel fishermen, and a large proportion of the fish taken to supply the factories of menhaden oil and fertilizers, during the early period of that industry, were obtained in the same manner. In the summer of 1879, from some unexplained cause, but presumably from the prevalence of lower average temperatures in the surface waters, the menhaden failed to make their appearance north of Cape Cod, and since then they have never returned to their former grounds in the Gulf of Maine.

Mr. R. Edward Earll, who investigated the coast fisheries of the southern Atlantic States in 1880, states that for several years previous to 1878 menhaden fishing was carried on to a limited extent in Core Sound and about Ocracoke Inlet, on the coast of North Carolina. At Oregon Inlet some menhaden fishing was also done for two or three years, steamers having been employed for the purpose during one season. A purse seine was set once from Charleston, South Carolina, but it was so badly cut by the sharks that it was never tried again.

Previous to 1878 the above mentioned stations on the coast of North Carolina marked the southern limit of the menhaden fishing-grounds, but as the catches there proved unremunerative, the fishery was discontinued, and since that time Chesapeake Bay has been the most southern region where fishing is conducted. In this locality, according to Mr. Earll, fishing begins in May and continues until October; but the fishery is neither so important nor profitable as it is farther north, both because of the less abundance of fish and their poorer quality as compared with those taken about Long Island and off the New Jersey coast.

As to the times of arrival and departure of the schools of menhaden in the several fishing-grounds, Mr. G. Brown Goode says: "The first schools appear in Chesapeake Bay in March and April, on the coast of New Jersey in April and early May, and on the south coast of New England in late April and May; off Cape Ann about the middle of May, and in the Gulf of Maine about the latter part of May and the first of June. Returning, they leave Maine in late September and October, Massachusetts in October, November, and December, Long Island Sound and vicinity in November and December, and Cape Hatteras in January.[1]

Off the coast of New Jersey and the southern side of Long Island, fishing usually begins in April, and by the last of that month or early in May it is carried on along the entire coast of Long Island, although it sometimes happens that no fish are taken in this region until after the first of May. The schools generally "play" in near the coast, where the fishing steamers lie in wait for them usually at no great distance from the shores; and whenever the schools rise to the surface they are quickly surrounded by the purse seines. During May the fish move around Montauk Point and into Long Island Sound, which, during the remainder of the season, becomes the most important fishing-ground for this species on the coast. There are periods of greater or less duration, however, during which the menhaden show little or no inclination to come to the surface. At such times the steamers often cruise on other grounds, going to the New Jersey coast, or even as far as Delaware Bay. When the schools are moving south in the fall, the steamers frequently follow them as far as the Delaware, but as the factories are mostly located on Long Island Sound, these long cruises are only made when the scarcity of fish nearer home renders them absolutely necessary in order to obtain supplies. Large catches of menhaden have seldom been made at a greater distance from the land than ten miles, and, as a rule, the best fishing has been obtained within two to five miles of the land.

[1] This statement of the arrival and departure of menhaden, extracted from "A History of the Menhaden," by G. Brown Goode, 1877, p. 39, applies to the condition of the fishery prior to 1878, since which time, as above described, these fish have not visited the coast of Maine.

B.—THE SEA FISHING-GROUNDS OF THE PACIFIC COAST OF THE UNITED STATES, FROM THE STRAITS OF FUCA TO LOWER CALIFORNIA.

By David S. Jordan.

14. THE PACIFIC COAST FROM THE STRAITS OF FUCA TO LOWER CALIFORNIA.

Except the salmon fisheries of the Sacramento and the Columbia, and the ocean fisheries in the immediate neighborhood of San Francisco, the fisheries of the Pacific coast exist only as possibilities. For the most part only shore-fishing on the smallest scale is done, and no attempt is made to discover off-shore banks, or to develop them when discovered. The present report can, therefore, only discuss the places where fishing is now actually carried on.

South of Monterey the entire coast is made up of alternations of rocky headlands (rincones), usually of sandstone, with long curves of sandy beaches, and is broken by occasional large and small bays (esteros and lagunas). The immediate neighborhood of the shore has almost always a sandy bottom, and is not very rich in either animal or vegetable life. Farther out, at varying distances, is a belt of rocky bottom, thickly covered with the great kelp (*Macrocystis pyrifera*), and beyond this there are occasional rocky reefs, usually continuous with the rincones on the shore and with the rocky islands, which have the same origin.

About these headlands and on the reefs some still-fishing is done, mainly for species of rockfish (*Sebastichthys*), and occasionally a gill-net is put down. The best known of these reefs are about the islands of Santa Catalina and Anacapa, but they doubtless exist around all of the islands in this region, which are mostly situated at a distance of about twenty miles from the shore. The middle parts of the channels between are, in summer, the resorts of the large migratory fish, which are caught in considerable numbers by trolling. Along the sandy beaches seining is practiced, and gill-nets of little depth are set to catch the common shore-fishes (largely surf-fish, roncadors, and flounders). In the bays of sufficient size seining is largely pursued, especially by the Chinese. In some of the smaller bays the oil-shark (Galeorhinus) breeds, and is taken by hook and line. Certain fishes (redfish, whitefish) are also taken in large numbers by still-fishing along the line of the kelp.

From Monterey to the mouth of the Columbia the coast is quite similar, but it is in general more rocky, with less sand, and presents an additional feature in the existence of rivers of considerable volume and more deeply indented bays. In all of these rivers there is a greater or less run of salmon in the fall, and in those fed by snow water, in the spring also; and in many these fish are taken for market purposes, in nearly every case by the use of gill-nets. The number of rocky reefs seems to increase to the northward, and the number of species inhabiting them is greater, so that both in Monterey Bay and about the Farallone Islands baited trawl-lines

are largely used for taking rockfish. In the bays seines are extensively used. Trolling and still-fishing in the kelp are little practiced, because the fishes caught in this way are mostly southern in their range. Between the rocky headland of Point Reyes and the entrance to the Golden Gate is a long stretch of smooth sandy bottom at a considerable depth. The bottom here swarms with flounders, and a mode of fishing is pursued analogous to the trawl-net fishing of the Atlantic—the fishing of the Paranzella. This mode of fishing is doubtless possible outside the kelp at many places along the coast, but the markets elsewhere are too small to make it profitable, excepting on a few small reefs in the neighborhood of the Farallones where rock-cod abound, and at the mouth of Monterey Bay; and, beyond this stretch of deep water now fished by the Paranzella, we can hardly say that any definite off-shore fishing-grounds exist south of the Straits of Juan de Fuca. Off the mouth of the Straits of Fuca, about eight miles northwest of Cape Flattery, there is an extensive halibut bank, where the Indians take halibut in large numbers, and which may some time become of importance to the white people.

The channels among the islands in Puget Sound and to the northward are resorted to by dogfish (*Squalus*), and the bays at certain seasons swarm with herring. In Alaska many banks frequented by halibut and cod doubtless exist, but thus far the only ones developed to any considerable extent are about the Shumagin Islands.

C.—THE FISHERY RESOURCES AND FISHING-GROUNDS OF ALASKA.

By Tarleton H. Bean.[1]

15. THE FISHERY RESOURCES OF ALASKA.

The Territory of Alaska has seventy-five species of food-fishes, seven-eighths of which are strictly adapted to the use of man, the balance being more suitable for bait. More than one-half of this number are widely distributed. More than two-thirds of the whole number exist in great abundance where they occur.

The flat-fishes and flounders (*Pleuronectidæ*) have representatives on all parts of the coast; the number of species is, however, smaller north of Unalashka than is found around the shores of the Gulf of Alaska and its groups of islands.

The codfishes (*Gadidæ*) are equally divided between Southern and Northern Alaska, the southern species excelling the northern in size; of these the pollock is one of the best baits known for cod.

There are thirteen species of sculpins (*Cottidæ*), nearly all of which are important as food, the scaly sculpins (*Hemilepidotus*) being especially good.

Although the number of species of *Sebastichthys* is much smaller than on the Californian coast, the five that do occur in the waters of Southern Alaska are all excellent, and two of these are known from as far north as Kodiak.

The so-called "rock-cod" (species of *Hexagrammus*) rank with the preceding in good qualities, and they are extremely abundant, some species reaching as far north as Port Clarence; *Hexagrammus asper* of Steller is found all along the coast from Sitka westward to Attu. These fishes are generally known to the Russians and largely to the Aleuts as the "tor-poog"; one species (*H. ordinatus*, Cope) is the "green-fish," so called on account of the green color of its flesh, which is nevertheless quite palatable; the green color disappears in the process of cooking; the "green-fish" is remarkable for another peculiarity in its smoky brown ova. One of the most important members of this family of *Chiridæ* is the "striped fish," "yellow-fish," or "Atka mackerel," *Pleurogrammus monopterygius* (Pallas) Gill, which, besides its own intrinsic value as an edible fish, possesses rare worth as a bait for cod.

The family of *Trachinidæ* is represented by one species called "cusk" at the Shumagins, a fish which was too rare in museums for us to try its table qualities, although it forms an element in the bait-supply for cod.

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[1] The report of Dr. Bean might, with almost equal propriety, be included in the section devoted to the methods of the fisheries, but since it is in the main a discussion of undeveloped resources it is deemed more fitting to include it in the section devoted to the fishing-grounds.—G. Brown Goode.

There is one species of sand launce or "lant" (*Ammodytes personatus*) which is extremely abundant in most parts of Alaska, and extends north to Point Belcher, as we certainly know; this launce is largely useful in the cod fishery and in general hook-fishing in Southern Alaska as well; its abundance is wonderful.

The pike (*Esox lucius*, L.) we have from Slave Lake; it is "common in all the lakes and ponds of . . . Northern Alaska, but absent from the rivers. It is caught with seines in summer and early winter. It is principally used for dog-feed, being of little value for the table."[1]

The family *Microstomatidæ* as distributed in Alaska includes the smelts (two species), the capelin, the surf-smelts (two species), and the eulachon. The smelt, which is most abundant and important, resembles the common species of the Atlantic seaboard very closely; it may be, too, that the second form, which is remarkably slender posteriorly, is merely the spent female of the first. The distribution of these fish is probably northerly, as the National Museum has no examples from any point south of Saint Michael's; Steindachner, the describer of *Osmerus dentex*, had it from De Castrie's Bay. We obtained, September 6, 1880, from Eskimo, in Eschscholtz Bay, dried smelt which they had prepared for food. The capelin (*Mallotus villosus*) is universally and abundantly present throughout the Territory; it plays a very important part in the salmon and cod fishery, forming as it does the principal food of these fishes during a part of the summer. Young capelin are extremely abundant north of the Arctic circle, but we have not seen them in Southern Alaska; the number annually consumed by cod and salmon must be enormous. I have taken forty from the stomach of a single cod on Portlock Bank; salmon may be seen in pursuit of capelin even in the brackish waters where small streams fall into the bays and coves. The species of *Hypomesus*, though of small size, form a considerable portion of the food-supply; one of them is known in southern waters (*H. pretiosus*); the other, instead of spawning in the surf like its southern congener, runs into fresh-water ponds to perform this function, and seems to be confined to Northern Alaska and Northeastern Siberia. A well-known representative of the family of *Microstomatidæ* is the eulachon or candle-fish (*Thaleichthys pacificus*), an inhabitant of the shores of the whole Gulf of Alaska. The uses and the mode of capture by Indians of surf-smelts and eulachon are so well explained by Mr. Swan in the "Proceedings of the National Museum,"[2] that it is unnecessary to add anything to that portion of the subject. Eulachon have been salted at Katmai on the peninsula of Aliaska and brought to Saint Paul, Kodiak. Mr. B. G. McIntyre, who gave me information concerning this industry, and furnished some examples of the product, speaks highly of the table qualities of salted eulachon. Unfortunately there is no harbor at Katmai, else it might become the seat of an important trade in this article.

The whitefishes (*Coregonidæ*) form one of the great staples of food in Northern Alaska (from the Yukon northward), replacing the salmon almost entirely in the extreme north. There are five species of *Coregonus*, the largest of which, as represented in the collections of the National Museum, was once considered identical with the common *clupeiformis*[3] of the Great Lakes; it is the fish for which Milner proposed the name *Kennicotti*, and is quite distinct from the *clupeiformis*; this is the "Broad Whitefish" of Mr. Dall, which he says: "Is the next in size of the Alaska

[1] DALL, in Report of the Commissioner of Agriculture, 1871 (for 1870), 387.

[2] Vol. III, pp. 43 and 257.

[3] *Stenodus Mackenzii* is the species referred to by Mr. Dall in the "Report of the Commissioner of Agriculture for 1870," page 386, as the "Great Whitefish," concerning which he says: "This enormous whitefish is the finest of its tribe, both in size and flavor. It is found in the rivers most of the year, but is most plentifully obtained and is in its best condition about the months of June and July. We have seen them four feet long and weighing about fifty pounds. It is distinguished by its long nose and slender form, and is of a silvery white, somewhat darker above. It is full of spawn from September to January, when it disappears."

whitefish, and reaches a weight of thirty pounds. It is distinguished by its broad body, short head, and large scales. It is usually very fat and excellent eating. It abounds in both winter and summer, spawning in September in the small rivers falling into the Yukon."[1] The "Round-fish" of Mr. Dall's paper is *Coregonus quadrilateralis*, Rich. "A long, slender, subcylindrical fish, not very abundant, but of excellent quality. They are caught occasionally throughout the winter on the Yukon, and are distinguished by their attenuated muzzle and peculiar form." The "Humpback" of Mr. Dall is related to *clupeiformis*, from which it is separated by its arched and compressed back. The "whitefish" (Russian *Morskoi ciga*) is *C. Laurettæ*, Bean. Mr. Dall says of the *Morskoi ciga*: "This is the most abundant and best flavored species of *Coregonus* in most localities. It is distinguished by its small scales, fins, tail, and head, and is of symmetrical proportions and moderate size. It rarely exceeds three pounds in weight, and is the staple article of food in winter on the Yukon."[1] *Coregonus Laurettæ* is the prevailing species of the far north; the writer obtained it in Port Clarence while in company with the United States Coast and Geodetic Survey Expedition to Alaska, in 1880, and Capt. C. L. Hooper, commanding the Revenue-Marine steamer Corwin, thus records it from Point Barrow in his report to the Treasury Department of November 1, 1880:

"The temperature of the water was 40° F. We bought from the natives some eider ducks, which were found to have a strong fishy taste, and some fish resembling shad, but smaller and very fat; they differ also from the shad in having two double [misprint for dorsal] fins. We saw the same species in Kotzebue Sound and at other places within the Arctic circle. They are called by the natives 'tupook.' I preserved some specimens for the Smithsonian Institution."

The "Nulato whitefish" (Russian "*Nulatoski ciga*") is evidently what I have called in my list of Alaskan food-fishes *Coregonus Merkii*, Günther, variety. This is a small, thin, bony species, common near Nulato, on the Yukon, and is rarely more than half a pound in weight. It is of little use as food, and is principally abundant in summer. Captain Hooper forwarded to the Smithsonian Institution many specimens of this whitefish, which he obtained doubtless in Kotzebue Sound and elsewhere in the Arctic regions. The grayling or blanket-fish concludes the list of *Coregonidæ*. Of this Mr. Dall has written as follows:

"Abundant in the small rapid rivers of Alaska. It is the only fish in the Yukon territory which will take the hook. It is of moderate value only for table use, and is especially abundant in spring when the whitefish begin to be scarce."

The greatest fish wealth of Alaska lies in its abundance of fine salmon, so far at least as shore-fishing is concerned. There are five species of *Oncorhynchus*: *chouicha*, *keta*, *nerka*, *kisutch*, and *gorbuscha*—all readily distinguished one from the other by well-marked characters, except the first two. Three of them may be at once recognized by a single character even; *gorbuscha*, for example, has much smaller scales than any other species; *kisutch* has a much smaller number of pyloric cæca than all the rest; *nerka* has much the largest number of gill-rakers; *chouicha* is the giant of the group, and may well be called the "king salmon." This is the largest and finest of the Alaska salmon, reaching a weight of sixty to ninety pounds. Those weighing eighty pounds are not uncommon, and others weighing a hundred-weight have occasionally been taken. This fish, or a fish called by the same name, ranges from Sitka to Bering Strait, and is found in all water-courses from the tide-ways of the Alexander Archipelago to the broad current of the Yukon. It ascends the latter river for at least twelve hundred miles and perhaps farther. It is a short and broad fish, with a large head, but comparatively small mouth and fins. It reaches

[1] DALL, *loc. cit.*

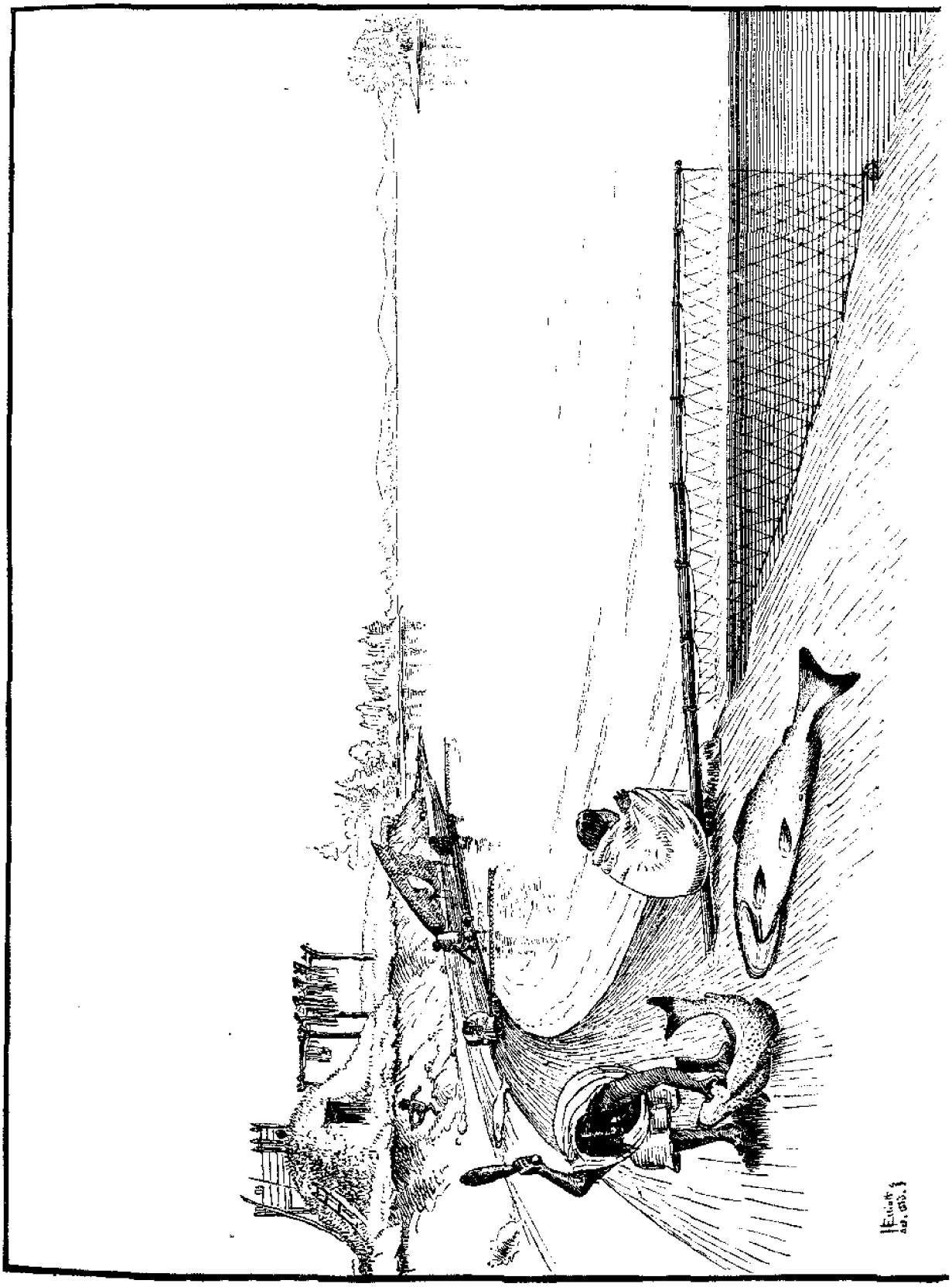
the mouth of the Yukon about the middle of June, and runs for six weeks. It ascends the river slowly, reaching Fort Derabin (about three hundred and sixty miles above the mouth of the river) about the first week in July, and Fort Yukon (about one thousand miles above the mouth) about the middle of July. It is dried for winter use by the natives. All dry fish is called *ukali* by the Russians. The chowichee ukali are made by cutting the fish in three slices after removing the head, leaving the backbone in the middle slice, and all three connected by the tail. Two or three dry chowichee ukali will weigh at least fifty pounds. One of them is accounted sufficient for a day's food for six men or dogs. They cost, from the natives upon the Yukon, one leaf of tobacco each, or, when dry, five to eight musket-balls per ukali. The more northern the ground where the fish are taken, the finer their flavor, and the chowichee of the Yukon were held in such esteem that several hogsheads were annually salted for the emperor's table by the Russians.[1]

It is now believed that the famed "chowichee" and the "quinnat" salmon known to fish-culturists and anglers are one and the same species. The maximum size of this "king salmon" is so great as to be almost incredible, and yet there is no doubt that individuals weighing one hundred pounds have sometimes been taken. Mr. E. G. McIntyre, at Saint Paul, Kodiak, had one that was smoked by Capt. James Wilson at Fort Kenai in 1879, which weighed sixty-six pounds in its cured state; this must have weighed fully ninety pounds in the fresh condition. Capt. H. R. Bowen states that he brought one down from Kassilov that weighed eighty-four pounds after smoking, with head, fins, entrails, and half of the backbone removed. Mr. Thomas Devine told me that a silver salmon five feet long was brought to Pirate Cove, Shumagins, in 1877; this must have been *O. chouicha*. Rufus Bordukofsky claims that he has seen a chowichee salmon seven feet long at Iliuliuk, Unalashka. This seems a little too long, but I mention it as an additional confirmation of the enormous proportions reached by the species. I have been informed by Capt. E. P. Herendeen and Capt. H. R. Bowen, both of whom have caught the "king salmon," that they do not run in schools, but two or three together, keeping very close to the banks, perhaps to escape from the beluga. Of *kisutch* and *keta* (hoikoh) Mr. Dall says:

"These two species have the same range as the king salmon, and are dried for food in the same way. They are, however, much more common, much smaller, and are held in less esteem. They form the bulk of the better class of salmon in all the rivers of Alaska. They arrive later than the king salmon, remain longer, and travel more rapidly. They reach Fort Derabin upon the Yukon about the tenth of July, and Fort Yukon early in August. They weigh from ten to thirty pounds, and dry, after cleaning and removing the backbone, to about two or three pounds. They are more slender than the king salmon, and the males are furnished in the breeding season with a formidable array of recurved teeth, so that the natives are accustomed to knock them on the head with a club before attempting to remove them from the nets."

I noticed that the Aleuts almost invariably broke the skull of salmon, which they carried in bidarkas, near its junction with the vertebræ; this was done to kill them quickly and prevent their struggling after being stowed away. The "redfish" (*O. nerka*) and the "dog fish" (*O. gorbuscha*), Mr. Dall observes, "are principally valued for use as dog-feed. They are placed in the order of their quality as articles of food. . . . They are . . . exceedingly common, of small size, and appear later than the previously mentioned varieties. The redfish, as its name denotes, is partly of the most brilliant scarlet, but its flesh is not so red as that of the king salmon or the hoikoh (*O. keta*). They arrive in July and disappear late in August." This estimate of the redfish agrees perfectly with the opinion of Captain Bowen, who thinks it is the

[1] DALL, in Report of Commissioner of Agriculture for 1870, pp. 382 and 383.



Eskimo squaws gill-net fishing for salmon. Yukon and Kaskokvim Rivers.

Drawing by H. W. Elliott.

poorest salmon salted, though it sells best on account of its red color. For my own part I think the fresh *gorbuscha* equal to any other salmon, but I prefer the chowichee bellies among the salt fish. There is nothing on the west coast which exactly corresponds with the Maine salmon. *Salmo Gairdnerii* is most like it in general appearance, and sometimes approaches it in size, but its habits are different, since it is found filled with ripe ova in June. We have this species from Sitka and Kodiak. It is very difficult to distinguish Gairdner's trout from the "rainbow trout" (*S. irideus*), so well known in the McCloud River, the characters which are supposed to separate them being unimportant. I found at Sitka one young trout which may be called *irideus* or *Gairdnerii* indifferently, and it will puzzle any one to tell which it really is. Clark's trout (*Salmo purpuratus*) is very abundant in Southern Alaska, and must be rare to the northward. Dall says that it is not found north of Aliaska Peninsula. Captain Hooper had it from Northern Alaska, but the exact locality is not stated. This beautiful species is not known to reach the great size in Alaska that is claimed for occasional individuals in the Columbia River, but it is very abundant and an excellent food-fish. We found it feeding on sticklebacks (*Gasterosteus microcephalus*, Girard) in Piseco Lake at Sitka. The species known in California as the "Dolly Varden" trout is everywhere present in Alaska, reaching as much as fifteen pounds in weight, and literally swarming in the streams and adjacent tidal waters. The young of this trout were found as far north as Cape Lisburne, and the species is very abundant in Northeastern Siberia. While it remains in the streams it is generally dark colored, but after a sojourn in the sea upon re-entering the brooks and rivers it quickly shows its beautiful red spots. We found that individuals taken from the salt water showed no trace of red spots, but immediately assumed them upon being immersed in spring water. This difference of color, varying with the place of residence, has led to the supposition that they represent two species, the large silvery ones in the coves and bays being called salmon trout while the smaller inland form is known as brook trout. There is good evidence of the occurrence of one species of *Oncorhynchus* (*O. gorbuscha*), the little humpback salmon, in Colville River. Captain Hooper reports that "the salmon is the only variety of fish in the Arctic that is of any value. Although smaller than the salmon caught farther south, they are of fine flavor. They are quite plentiful, and the coast natives cure large quantities of them by smoking and drying for winter use."[1] Capt. E. E. Smith, who was the Corwin's ice pilot on her cruise of 1880, in 1875 put up in salt two barrels of little *gorbuscha* which he bought at the mouth of Colville River.

The sole representative of the herring family of much importance as a source of food is the *Clupea mirabilis* of Girard, the common sea-herring of the Pacific coast. Widely distributed and extremely abundant, invaluable as bait and delicious on account of its fatness, it deserves a high rank among the staples of Alaskan waters. There are no finer herring anywhere than may be seined at Iliuliuk and sometimes near Saint Paul. They are as plentiful as menhaden once were in Peconic Bay, so plentiful that a lazy Indian with a stick armed with pointed nails can soon impale a canoe load; vessels have sailed for hours through shoals of them which seemed unending; acres of grass are sometimes covered with their eggs when a high tide takes them far ashore and the receding waters suddenly leave them aground. Natives are very prompt to profit by such accidents. When we came into Chugachik Bay, in Cook's Inlet, we found a sand spit strewn with recently stranded herring and their wasted eggs, while here and there were groups of poles selected from driftwood on which the fish had been hung up to dry after being split and having the head of one passed through the gills and mouth of another. The spawn clinging to blades of grass after a little sun-drying had a rather pleasant, slightly salt taste.

[1] Report of cruise of Corwin, November 1, 1880 (1881), p. 68.

The sucker family (*Catostomidæ*) has but a single species so far as known, and that is apparently identical with the long-nosed sucker of the Great Lakes and the Upper Mississippi. This fish is abundant in the Yukon and other large rivers in Northern Alaska. It is of moderately large size, reaching five pounds in weight. It is generally of a reddish color. The body is so full of bones that it is unfit for food, but the heads, when boiled with the roe, make a very palatable soup. These fish are filled with spawn in April, a period when other fish appear to be out of season.[1]

There is one lamprey known to us from Alaska, the *Ammocœtes aureus* of Bean. This one is extremely abundant in the Yukon, according to Mr. L. M. Turner, and is used for food. Mr. Turner's specimen was taken at Anvik (latitude 63 north, longitude 160 west from Greenwich).

16. A REVIEW OF THE ALASKAN FISHING-GROUNDS BY DISTRICTS.

I have been thus explicit in naming the food-fishes of the Territory and tracing their distribution, in order that their importance as a means of subsistence for the inhabitants may be fully appreciated. All parts of the coast of Alaska are abundantly supplied with fish, and every male native of suitable age is to be considered a fisherman—one who employs the best expedients within his reach for the capture of fish, because his very life depends in great measure on that supply. Even the women and children help to increase the store for winter, tugging away bravely at great strings of salmon or other species caught in the seines by the men. Whenever there is any pulling of this kind to do, you may see them skirting along the shore, half floating the burden near the water's edge. The total number of fishermen estimated for Alaska in Census Bulletin No. 176 is fifty-six hundred and fifty, which is certainly not too high. According to Petroff's preliminary report on the population of that Territory, there are about thirty thousand inhabitants, distributed as will be seen in the following table:

POPULATION OF ALASKA.

[From Petroff.]

Southeastern Alaska	5,517
Estimate of Prince William Sound	500
Kenai Mission or Cook's Inlet district	984
Interior division	2,226
Kadiak Parish	2,606
Belkofsky Parish	669
Unalashka Parish	1,392
Bristol Bay division	4,340
Pribylov Islands	390
Saint Lawrence Island (estimated)	400
Nunivak Island (estimated)	500
Kuskoquim division	3,654
Yukon delta	2,006
Uphoon mouth to Anvik	1,345
Coast of Norton Sound from Saint Michael's upward and as far as Sledge Island	633
King's Island to Point Barrow	2,990
	30,152

[1] DALL, in Report of Commissioner of Agriculture for 1870, p. 388.

Leaving out the interior division, and supposing that one-fifth of the whole population are adult male fishermen, we shall have about the number estimated in the Census Bulletin. Bearing in mind the great abundance of fish everywhere, and the wasteful habits of a people who neither profit by the hint of prosperity nor take warning from the kick of adversity, we may form some idea of the millions upon millions of fish annually taken in Alaska. There are not fewer than twenty-eight thousand people in the Territory who live largely upon fish, fresh during half of the year or less, and in the form of *ukali* during the balance of the year. In the absence of records to show the amounts actually put up for winter use, we must depend upon estimates. Mr. William J. Fisher, of Saint Paul, Kodiak, has very carefully inquired into the matter, taking counsel with parties who are in the business of preparing *ukali* for consumption, and observing the quantities put up by natives for their own use. Mr. Fisher has given us the following result of his investigation:

"The annual supply of dried salmon (*ukali*) put up by a native family, consisting of two adults and two children, is estimated at fifteen hundred fish, averaging about five pounds each before being dried, and, when cured, averaging about one-half pound each. The Creoles (native whites), in addition to the above, put up about six barrels of salt fish for winter consumption. These stores are not touched until the beginning of November, when, owing to inclemency of the weather, the catching of fresh fish has to be suspended. By the first of May, when the weather permits fishing again, these stores are generally exhausted. The dried fish or *ukali* is used to a great extent in lieu of bread. In addition to the above supplies, each family adds about one-half barrel of salmon spawn, more or less, to their winter stores."

I take this estimate of the quantity of fish consumed on the island of Kodiak as the basis of a calculation for the whole Territory, because the supply, as shown on previous pages of this account, is ample on all portions of the coast; Mr. Fisher's statement, moreover, agrees with all the information we have concerning the region. On the above basis each one of the population will consume at least seven hundred and fifty fish annually, the supply of *ukali* lasting only six months and being replaced by fresh fish during the rest of the year. At the low average weight of five pounds we have the equivalent of thirty-seven hundred and fifty pounds of fresh fish per year for each person, and twenty-eight thousand people at the same rate will eat one hundred and five million pounds of fish. The first cost of fish is about one-half cent per pound, so that the yearly supply of the Territory represents five hundred and twenty-five thousand dollars.

We will now consider the different divisions adopted by Mr. Petroff, giving an account of *the number of fishermen, the kinds of fish, and the modes of capture and preservation.*

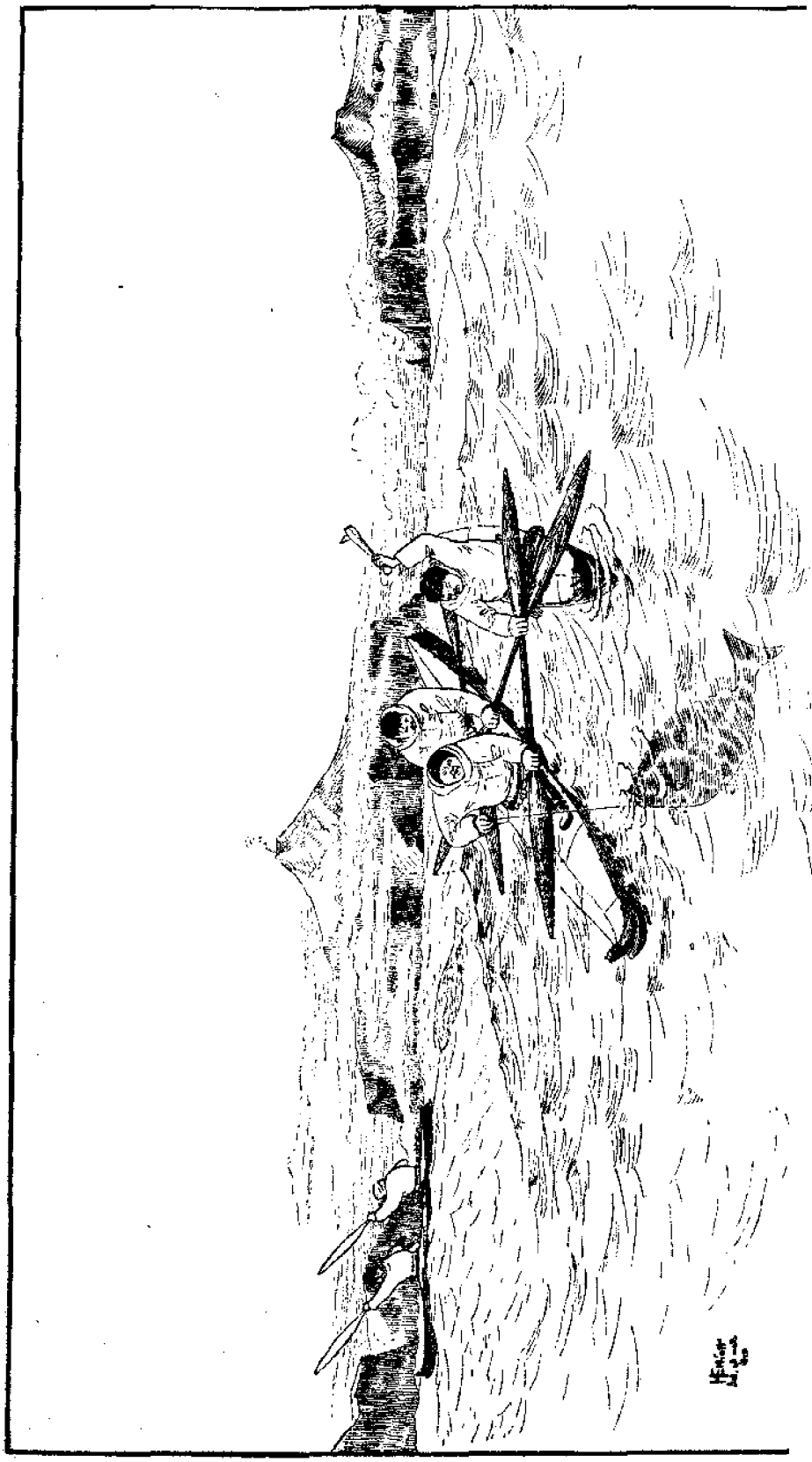
SOUTHEASTERN ALASKA.

There are at least as many as eleven hundred adult Indian fishermen in this division, who devote themselves wholly or in large part to the business of fishing for a livelihood while the season lasts. Our own observations began at Sitka, continuing there from May 28 to June 16, 1880. During this time the fishes most frequently seen in canoes and offered for sale were the halibut, several species of rock-fish, sea trout or bass, cultus cod, common cod, Gairdner's trout, red-spotted trout, Clark's trout, "hoikoh" salmon, and "keezich" salmon. In hook-fishing, which is the common method, sand launce and herring are generally used for bait. At Sitka abalones are abundant and are eaten raw by Indians. Some Chinamen, belonging to the "Jamestown," were drying large quantities of them for export to China. Delicious clams (a species of *Saxidomus*) are extremely plentiful, and form an important part of the Indian diet. The Indian village at Sitka for our purposes may be taken as the type of such villages throughout the region under

discussion. The solid log-houses here are built convenient to the water's edge. Between the houses and the water may be seen the dug-out canoes and the fish-drying frames; here and there are hung the bark fishing-lines for halibut furnished with their clumsy but effective hooks. Some very good illustrations of the Sitka halibut hooks, furnished by Commander Beardslee, U. S. N., appear in Forest and Stream, of 1879. The hook consists essentially of two pieces of wood fastened together at one end with strips of spruce roots so as to form an acute angle with each other, the longer arm of the angle being armed with a bent, pointed piece of iron; the wood is generally carved so as to represent some animal whose co-operation thus secured will insure successful fishing. The bait (usually herring) is tied on so as to cover not only the hook but also the wooden shaft in which the hook is fastened; halibut will gulp down the bait as long as it lasts, opening their jaws wider and wider; the short arm of the hook, being so fixed as to leave only a narrow space between it and the iron point, will admit of the motion necessary to fasten the fish, but prevents its escape. A halibut thus held with its mouth wide open will soon be drowned, and can easily be taken into a canoe. This Indian style of halibut hook is much more effective than the common halibut hook of civilization. A very common method of fishing for halibut at Sitka is by the use of set-lines, each provided with one hook, a stone sinker, an inflated stomach of seal for a buoy, with a small flag or signal attached to it so as to show when a fish is hooked. It is usual to see these lines set in ten to twenty fathoms of water off the numerous inlets of Sitka Bay. Salmon are caught by trolling with herring bait, by seining, and by spearing. Edgecumbe trout (Ah-shut of the Sitkas), *Salmo Gairdnerii* Rich., were taken by the spear on their way out (?) from Lake Edgecumbe to the sea in June. Herring are caught in great quantities by impaling them on pointed nails fastened into a long, thin strip of wood. The process of collecting herring eggs, by receiving them on spruce boughs, is too well known to need description here. The prevailing fish on the drying-frames at Sitka was halibut. This was cut in strips and dried partly in the open air and partly by smoking in the dwelling-houses. The fire is made in the center of the space inclosed by the walls, there being no floor covering this portion, and the smoke escapes through a wide opening in the roof. A frame of poles supports the strips of fish to be smoked. Very little fire and a great deal of smoke are the requirements. Besides fish, it is common to see viscera and other portions of porpoises hanging on the poles. The price of fresh fish at Sitka is usually about one-half cent per pound. Halibut ranged from twenty to seventy-five pounds in weight during our stay; we were told, however, by Mr. Whitford, that he has seen two caught in the harbor, one weighing two hundred and fifty-six and the other two hundred and sixty pounds.

I am indebted to Mr. George Hamilton, of Chacon, for the following information about halibut at Klawack:

Their average size is about fifty pounds; they are not brought in plentifully from November to March, but they are abundant during the rest of the year; Indians do not fish for them much in the winter; they are caught with the Sitka style of hook with kelp or bark lines, or sometimes eastern cod and halibut lines. Squid bait (*Octopus*) is preferred. The fishing is done in from ten to twenty fathoms of water. For the cannery, Indians go off in the afternoon and bring in the fish on the following morning. They will average eight or ten halibut to a canoe, having in it two persons who use not more than three or four hooks. The price at Klawack in 1878 was one-half cent per pound, which, unnecessarily and through mistake, was increased in 1879 to one and one-half cents. The amount canned in 1878 was two hundred or three hundred cases in two-pound cans, there being two dozen cans in a case. These were shipped to Sisson, Wallace & Co., San Francisco. Mr. Hamilton has seen more halibut in the vicinity of Warren Island than



Aleuts catching halibut at the mouth of Akootan Pass, Bering Sea, Alaska.

Drawing by H. W. Elliott.

anywhere else. He saw fifteen Indians fishing there, and between one hundred and one hundred and fifty halibut of small size lying on the beach. The women were splitting them to dry.

In this region of Southeastern Alaska are two salmon-canning establishments—one at Klawack, and the other at Old Sitka or Turner's Point. In 1879 the Klawack cannery was said to have employed one hundred and sixty Indians and twenty whites. Of the Indians, thirty were women, five or six boys of eight to twelve years, and the rest men. In 1878 the wages for Indian men were one dollar, and for woman fifty cents per day. In 1879 the men received one dollar and twenty-five cents and the women seventy-five cents per day, although it is claimed there was no need of increasing the pay. The wages of the white men ranged from twenty dollars to fifty dollars per month. The season lasts about two months here. I suppose the capacity of the cannery is about the same as of the Old Sitka one, but there are no returns to refer to. The Old Sitka establishment is situated near the mouth of Sitka River; it was not in operation in 1880, but in 1879 it shipped seven thousand cases, of four dozen one-pound cans each, to the Cutting Packing Company of San Francisco. The boxes in which these cans are shipped are sent in shooks from Portland. The cans are made on the spot in a separate building. The high price for tin and solder was given as a reason for the inactivity of 1880. The salmon are seined by Indians, the seines being purchased by them from the cannery owners. The processes employed at Klawack and Turner's Point are essentially the same as in the Columbia River canneries. The Old Sitka establishment, either in 1878 or 1879, put up two hundred cases of halibut, each containing four dozen one-pound cans.

The eulachon, which we have from the Stickene River, Wrangell, Sitka, and Chilkat River, is caught in the same way and used for the same purposes, as described by Mr. Swan in his paper, in the Proceedings of the United States National Museum, vol. 3. The once famous Deep Lake salmon fishery at the Redoubt on Baranoff Island, which in 1868 secured two thousand barrels, is now reaping the results of overfishing. A description of the fishery by Mr. Dall is given in the Report of the Commissioner of Agriculture for 1870, page 385.

This account may be closed with the following list of the principal food-fishes of Southeastern Alaska:

1. Pleuronectes stellatus.
2. Lepidopsetta bilineata.
3. Limanda aspera.
4. Hippoglossoides elassodon.
5. Hippoglossus vulgaris.
6. Pollachius chalcogrammus.
7. Gadus morrhua.
8. Microgadus proximus.
9. Hemilepidotus trachurus.
10. Hemilepidotus Jordanii.
11. Sebastichthys maliger.
12. " caurinus.
13. " ruber.
14. " melanops. ("Black bass," Sitka.)
15. Hexagrammus asper.
16. " superciliosus.
17. " decagrammus.
18. Ophiodon elongatus.
19. Anoplopoma fimbria.
20. Bathymaster signatus.
21. Ammodytes personatus.
22. " alascanus.
23. Mallotus villosus.
24. Hypomesus pretiosus.
25. Thaleichthys pacificus.
26. Salvelinus malma.
27. Salmo purpuratus.
28. " Gairdnerii.
29. " irideus (probably).
30. Oncorhynchus chouicha.
31. " keta.
32. " nerka.
33. " kisutch.
34. " gorbuscha.
35. Clupea mirabilis.

PRINCE WILLIAM SOUND DIVISION.

According to Mr. Petroff's estimate, there are five hundred Indians in this division, and among them, if we continue our usual proportion, there are about one hundred adult male fishermen. We have no information about the fishes or the methods of fishing, but it is safe to say that the region closely resembles the preceding one just described. They certainly have flat-fishes, flounders, halibut, cod, tom-cod, sculpins, launce, herring, and all the species of salmon, and doubtless many more; hair seal, too, are sure to be found just as they are in the inlet.

KENAI OR COOK'S INLET DISTRICT.

The number of adult male fishermen in this division is near two hundred in a total population of nine hundred and eighty-four. The most important fishes, as will be seen from the accompanying list, are halibut, cod, scaled sculpins, launce, capelin, eulachon, trout, salmon, and herring. The native methods of capture are essentially like those of Southeastern Alaska. This region is the field of two salmon fisheries operated by Capt. James Wilson, for the Alaska Commercial Company, and by Capt. H. R. Bowen, for the Western Fur and Trading Company. Mr. William J. Fisher, United States Coast Survey tidal observer at Saint Paul, Kodiak, has kindly obtained from these gentlemen most of the information we possess about those fisheries. Writing of the "king salmon," Mr. Fisher says:

"The Indians living near these two rivers catch only very small numbers of the fish, partly owing to their very imperfect implements used for the purpose. The fish being too large they cannot use their spears effectually. Their usual and most efficient mode of capture is as follows: A stage is erected in the river which an Indian mounts, holding a large wicker basket with an aperture of about five feet square, in the river, patiently waiting, sometimes for weary hours, before a salmon is so foolish as to enter the basket, while many hundred will go past, over, or under the basket, ignoring the invitation to enter. The natives smoke and dry their catch, and when they do sell any they charge at the rate of ten cents per fish."

Mr. Fisher gives the following notes on the "chowichee" or "king salmon" (*O. chouicha*):

"They are found in the inlet from May 20 to August 20, being more abundant during small tides; they are only one-fifth as plentiful as the silver salmon (*O. kisutch*), and one-third as abundant as red salmon (*O. nerka*); they reach a maximum length of six feet and a weight of forty pounds; they appear regularly on the 20th of May, running in pairs and not in schools, following the shore closely to avoid the beluga; they refuse to take the hook at all times; they prey upon eulachon and sticklebacks, not consuming very much; they are caught by the whites in weirs and nets; the nets are (of) eight and one-half inch mesh, twelve feet deep, and one hundred and twenty feet long, and are used during the entire season; the average daily catch is about one hundred fish; they are caught more plentifully from (the) first (of the ebb) to half-ebb tide; the natives dry them for winter use, while the whites salt them for shipment to San Francisco; small quantities are smoked; about three hundred barrels were salted in the season of 1880; one vessel, employing from five to eight men, is engaged in the fishery."

"The run of salmon in 1880 at Kenai was very light until July 20. Prior to that date the fish were running largely at Tyonik, about seventy miles up Cook's Inlet from Kenai, and also up the Sutchitna (Sushetno) River at the head of the inlet. These fish have seldom been known to go up the latter river during past years, and then only in very small numbers. The Sutchitna (Sushetno) River Indians, who, owing to scarcity of fish heretofore in their river, always bought their winter supply of smoked and dried fish from the natives of Tyonik, caught such an abundant supply in 1880 as to enable them to sell to their former purveyors."

On the 4th of July, 1880, we saw two species of salmon—"redfish" or "krasnoi riba (*O. nerka*) and "hoikoh" (*O. keta*)—hanging on the drying-frames at Alexandrovsk in great numbers. A lagoon near the village, which receives a small but rapid stream, is well supplied with fish. In addition to the ordinary frame of poles on which the split and gashed salmon are hung, the natives frequently fasten small trees in the ground, cut off the limbs to a suitable length, and cover them with the blood-red fruits of their labors, making them a kind of Christmas tree of substantials. The little houses in which dried fish are stored for winter are set on logs placed endwise to insure protection from dogs. Cod and halibut are reported to be present here the year round. The halibut-line of these people is made of the stem of bull kelp, which grows here to an immense size. One of the plants measured aboard the "Yukon" had a stem sixty-seven and one-half feet long, with eighty-six fronds, two of which measured twenty-five and thirty-five feet, respectively. On this kelp line two hooks are fastened at the ends of a short bar on short snoods. The stone sinker is fastened to the middle of the bar by a snood longer than those holding the hooks. The bidarkas are made of the skins of hair seal. At the time of our visit seven skins of sea-otter recently killed were stretched on drying frames. The sea-otter are said to feed largely on chitons and clams. The abundance of fine clams near Alexandrovsk makes it a good otter-ground. From Alexandrovsk due northward is a settlement called Seldovia, consisting of sixty-eight Kodiak natives and creoles, who are devoted to sea-otter hunting. On the opposite side of Chugachik Gulf, near Anchor Point, is the village of Laida, containing seventy-eight Kenai people, who are also sea-otter hunters with indifferent success. Mr. Petroff gives a graphic account of the Kenai people, from which I extract the following remarks relating to the fishing:

"These people build birch-bark canoes with which to navigate the numerous swift and brawling rivers in their Territory, and they go down to the seaboard, buy skin canoes of the Kodiak pattern, and navigate to some extent on salt water, in quest of fish, in this manner. In this connection we wish to call attention to the fact that these people do not make, in any form whatever, wooden canoes; for that matter the explorer will find no wooden canoes north of Mount Saint Elias in this whole region. They are expert fishermen, and they certainly enjoy an abundance of piscatorial food, salmon of fine size and quality running up their rivers, trout in the thousand and one lakes of their country, finding them there all through the winter, fishing through the ice; and with a certain degree of contempt for the salt water, which is the treasure-trove and life-trust of the Kodiaker and the Aleutian, they spend no time there unless the steamboat-puffing of an approaching school of white whales attracts their cupidity and supplies them with a rare feast. These animals (the 'beluga') are found here running up some of their rivers quite a distance."[1]

THE KASSILOV SALMON FISHERY.

The Kassilov fishery, owned by the Western Fur and Trading Company of San Francisco, and operated by Capt. H. R. Bowen, is located at the mouth of Kassilov River, Cook's Inlet. It was established in 1879. The gill-nets are twenty-four fathoms long, two fathoms deep, with a mesh of eight and one half inches, and cost ten dollars each. They are made of Barber's shoe-thread. Gill-nets are used for salmon also. Two buildings, valued at two hundred and fifty dollars, are in use. There are three sixteen-foot dories. Four natives of Alaska are employed. The fishery is active from May 20 to September 1. Tide water makes up the river about seven miles; there are no obstructions except rapids. Two weirs are constructed here; the leaders are

[1] Preliminary Report on Census of Alaska, 1881, p. 36.

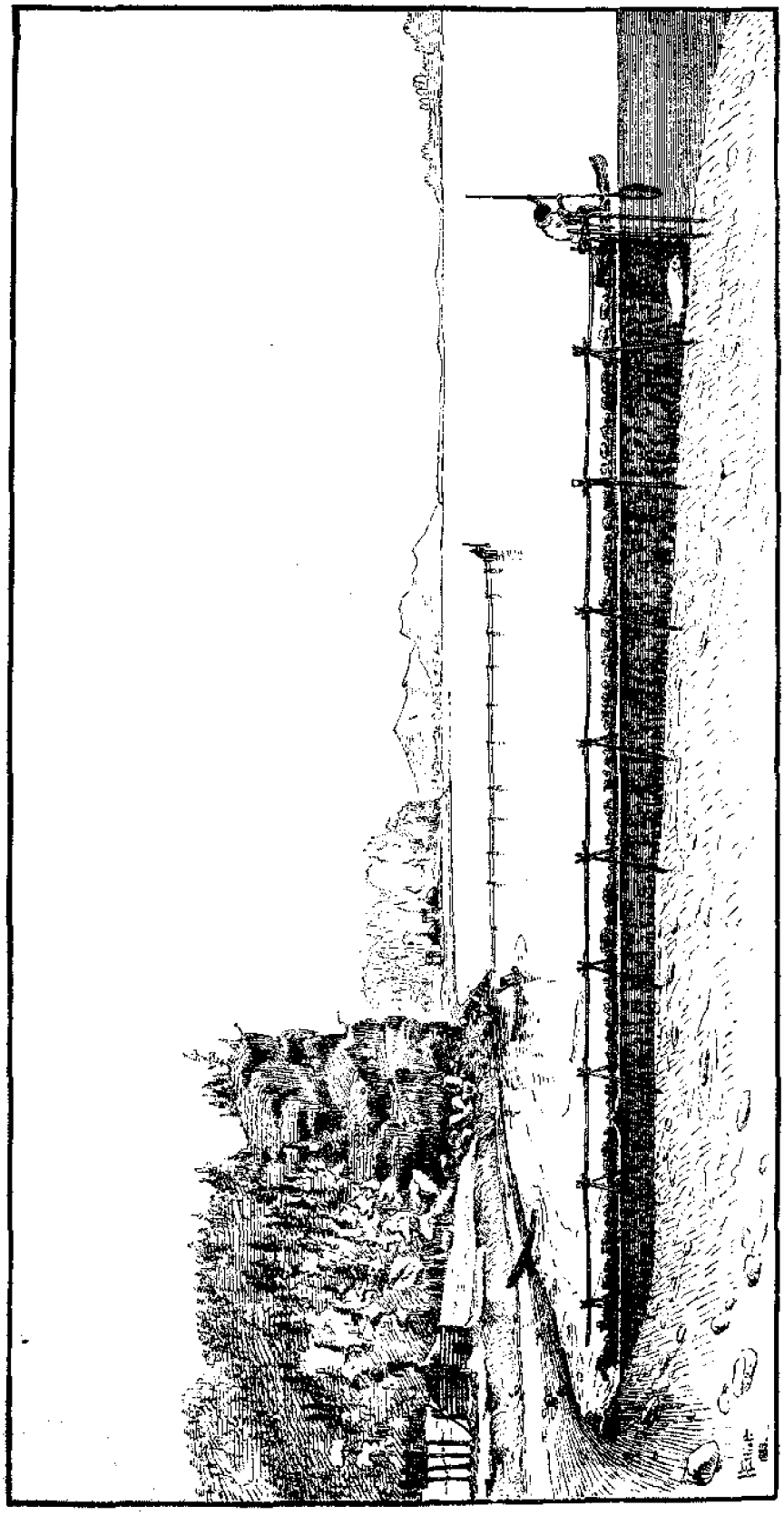
seventy-five feet long; the weirs or hearts are fifteen feet square, and are made of stakes and brush; they are kept down four months, beginning in June; "king" (*O. chouicha*), "silver" (*O. kisutch*), and "red salmon" (*O. nerka*) are taken in them. Captain Bowen says he is putting up the "king salmon" in full barrels with Liverpool salt. The first lot sent down brought ten dollars per barrel; the second lot, seven dollars. The flesh is very red when they first come; after they have been some time in the river the skin becomes red and the flesh light-colored. The "redfish" or "red salmon" sell for seven dollars in two half barrels or six dollars in full barrels. The "silver salmon" accompanies the red, is larger and every way superior, but is not nearly so plentiful. Captain Bowen put up fifty barrels of them last fall (1879) and says he could easily salt eight hundred barrels. These fish are sent to San Francisco by two schooners in August and October. Captain Bowen salts salmon bellies, also, in small packages. Bellies are worth twelve dollars by the barrel. Barrels, half-barrels, quarters, and kits are sent in shooks from San Francisco. They are made of Portland spruce. The half-barrel complete costs one dollar and seven cents, the barrel one dollar and thirty nine cents for the stock alone. Barrel hoops cost twenty-four dollars per thousand.

Products of the Kassilov Salmon fishery, 1880.

Months.	Kind of salmon.	Barrels.	Number of fish.	Weight in pounds.
July	Chowichoe bellies	160	8,000	320,000
August	Silver salmon	185	18,500	185,000

KENAI SALMON FISHERY.

The Alaska Commercial Company has established on Kenai River a fishery, which is managed by Capt. James Wilson, one of the company's traders. For the information concerning this fishery I am indebted to Mr. B. G. McIntyre, an agent of the Alaska Commercial Company. Salmon were first salted by this company in 1878, and bellies were first salted by them in 1879. The "Saint George," a trading schooner of one hundred and twenty tons, takes the barrels of salmon only incidentally, her regular business being that of a trader. Salmon in Cook's Inlet are very uncertain—some years the natives cannot get enough for their own use, and other years they are very abundant; this does not seem to depend on the severity of the winters. "King salmon" are taken in gill-nets, dip-nets, and weirs. Two weirs, similar to those in use at Kassilov, are in operation here. "Red salmon" are taken successfully only in seines. The natives here receive ten cents apiece for salmon. Only the bellies are salted; they are generally worth twelve dollars per barrel, sometimes fourteen dollars. At Kenai sixty pounds of salt are used to a barrel of fish. The fish are washed in pure spring water after they have been dressed, and then they are "struck" in the barrels in brine made of the same water. When the barrels are filled up after heading the brine added is made of spring water, but it must be brought to the boiling point and then put in after cooling. The brine does not seem to get strong enough unless it is boiled. The usual plan is to strike the fish and then repack, which takes eighty to one hundred pounds of salt. To put up a barrel of salt "king salmon" costs about three dollars and fifty cents at Kenai; one dollar for the fish, one dollar and seventy-five cents for the barrel and cooperage, forty cents for the salt, and thirty-five cents for the labor. The "red salmon" will not cost much less. Captain Wilson told Mr. McIntyre that in eleven years he has not seen a "king salmon" that weighed over one hundred pounds. The Alaska Commercial Company sells its salmon wherever a market offers. The amount salted in 1880



Stake and rider salmon weir. Constructed in the tide flats of Cook's Inlet by old Indians, and used exclusively by them. The young and able-bodied savages use gill-nets and traps.

Drawing by H. W. Elliott.

was one hundred and fifty barrels of bellies. Estimating fifty fish to the barrel we shall have seventy-five hundred fish, weighing about three hundred thousand pounds; of course, only a small portion of each fish goes to form the finished product.

For the sake of completeness I mention some of the principal food-fishes of Cook's Inlet:

Pleuronectes stellatus, Pallas.
Lepidopsetta bilineata, (Ayres) Gill.
Hippoglossus vulgaris, Fleming.
Pollachius chalcogrammus, (Walb.) Jor. & Gilb.
Gadus morrhua, Linnæus.
Tilesia gracilis, (Tiles.) Swainson.
Hemilepidotus trachurus, (Pallas) Günther.
" Jordanii, Bean.
Hexagrammus asper, Steller.
Ammodytes personatus, Girard.
Mallotus villosus, (Muller) Cuv.
Thaleichthys pacificus, (Rich.) Girard.
Salvelinus malma, (Walb.) Jor. & Gilb.
Salmo purpuratus, Pallas.
Oncorhynchus chouicha, (Walb.) Jor. & Gilb.
" keta, (Walb.) Gill & Jor.
" nerka, (Walb.) Gill & Jor.
" kisutch, (Walb.) Jor. & Gilb.
" gorbuscha, (Walb.) Gill & Jor.
Clupea mirabilis, Girard.

KODIAK PARISH.

The total population of this division is stated to be about twenty-six hundred. Taking our usual percentage of this we shall have two hundred and twenty fishermen, most of whom are Kodiak Innuits and Creoles. The methods and results of the fishing, particularly on the island of Kodiak, have been greatly modified by civilization. The people have a wonderful wealth of fish in the waters around them, and they have learned how to capture and preserve them to the best advantage. Boats and small vessels of ten to thirty tons replace to a great extent the bidarka. While we were at Saint Paul a small vessel was being built for Captain Caton. The settlement on Wood Island has a small shipyard, where vessels of twenty-five or thirty tons are built for fishing and trade, according to Petroff.[1] The village of Afognak engages also in boat-building, at which the men are expert; they have many orders, chiefly for row-boats for the fishermen. Every settlement in this parish is engaged in sea-otter hunting, many of them almost exclusively. From Mitrofania at the southern extreme to Douglas in the north, in the waters bathing the eastern shore of the peninsula of Aliaska and the islands of the Kodiak group natives pursue this valuable quarry, securing, according to Mr. Petroff's returns, nine hundred skins in 1879. This number includes the catch to the eastward to Mount Saint Elias, but falls to the share of Kodiak Parish mainly. The small settlement of Ayakhtalik, on Goose Island, gets quite a number of sea-lion skins around Sitkhinak Island. The people of Kaguiak obtain a few sea lion skins, and the Orlovsk men secure a great many annually.

This parish is profusely supplied with cod, halibut, salmon, herring, capelin, eulachon, clams, and mussels. There are many other fishes which are abundant, but those named are the great staples. On the islands of Kodiak and Afognak alone Mr. Fisher records the following quantities prepared for home consumption:

	Salted salmon.	Salmon spawn.	Ukali.
	Barrels.	*Barrels.*	*Pounds.*
One hundred and sixty-five families of Creoles put up	990	82	126,750
Three hundred and thirty-four families of Aleuts put up	.....	167	250,500
Total	990	249	377,250

[1] Preliminary Report on Census of Alaska, 1881, p. 29.

It must be kept in mind that one pound of ukali represents ten pounds of fresh fish. Mr. Fisher's estimates of the supplies of the settlements on Cook's Inlet and part of Aliaska Peninsula is as follows:

	Salted salmon.	Salmon spawn.	Ukali.
	Barrels.	*Barrels.*	*Pounds.*
Thirty-four Creole families put up	170	17	25,500
Three hundred and ten Indian families put up	.....	155	230,000
Total	170	172	255,500

The average retail price of fresh fish at Saint Paul is one-half cent per pound, while the average price of fresh beef is ten cents per pound, and of salt pork fifteen cents. Cooked oysters are brought up from San Francisco and sell at forty cents per can. Canned lobsters from the same city are retailed at the same price. Clams from the vicinity sell for twenty cents a pail, fresh. Small quantities of salmon are smoked by the natives. Mr. Fisher names the following shell-fish as of common occurrence: *Cardium corbis*, *Cardium LaPerousii*, *Modiola*, *Tapes staminea*, *Saxidomus Nuttallii*.

THE KARLUK RIVER SALMON FISHERIES.

Karluk River, on the west side of Kodiak Island, furnishes more salt salmon than any other Alaskan stream, about sixteen hundred barrels having been secured there during the season of 1880 by two firms. One of these fisheries is owned by the Western Fur and Trading Company of San Francisco, and is operated by Capt. H. R. Bowen, of Saint Paul, Kodiak. Mr. Fisher has obtained from Captain Bowen the following account of that fishery: It was established in 1880, at the mouth of the river, and was active during June, July, August, September, and part of October. Fish run up the river into a lake—the source of the river—about seventeen miles. Tide-water extends up the stream about four miles. The only obstructions are rapids. All the species of *Oncorhynchus* now recognized run into the river; they are known by the Russian names "krasnoi riba," "keezitch," "chowichee," "gorbuscha," and "hoikoh." The trout or "sumgah" (*Salvelinus malma*) also occurs here abundantly.

Salmon are caught at this fishery by seines, in the handling of which dories are used. The natives use their spears as well as seines; instead of dories they use bidarkas. There are about three hundred natives at the Karluk settlement, nearly all of whom are Kodiak Innuit. It is stated by Captain Bowen that these three hundred caught and dried at least one hundred thousand salmon (averaging one-half pound each in the dried state) during the summer.

The seines here are twenty-five fathoms long, three fathoms deep, with a mesh of three and one-fourth inches; they cost thirty-dollars each. Four dories, sixteen feet long, are in use. The fishery employs twenty men, five of whom are Norwegians and fifteen natives of Alaska. The product of the fishery is as follows:

	Number of fish.	Estimated weight, pounds.	Barrels.
O. nerka.			
June 16	750	7,500	15
June 17	3,000	30,000	60
June 18	2,000	20,000	40
June 19	3,000	30,000	60
June 20	3,000	30,000	60
June 21	1,500	15,000	30
Month of July	12,000	120,000	240
Month of August	7,500	75,000	150
O. keta and gorbuscha.[1]			
August 12	18,500	185,000	.....
September 16	21,000	210,000	.....

[1] Made into *ukali*.

The *ukali* were made for the use of native hunting parties. As before stated, the average weight of a cured fish is one-half pound; hence the fish converted to this use resulted in nineteen thousand seven hundred and fifty pounds of *ukali*.

The schooner "O. S. Fowler" of thirty-five and forty-five one-hundredths tons, is engaged in this fishery and the Kassilov fishery for the Western Fur and Trading Company. Captain Bowen informed me that her present value is five thousand dollars, and that her outlay for the season of 1880 was five thousand dollars, which includes the cost of the buildings at Saint Paul, Kodiak, used in preparing the fish for market. The "O. S. Fowler" has three Norwegians, one Russian Creole, and one American (the captain) as its force. She brought to Saint Paul one thousand barrels of salted salmon and nineteen thousand seven hundred and fifty pounds of *ukali* from Karluk and Kassilov, during the season of 1880.

Smith & Hirsch own a fishery which is also at the mouth of Karluk River. Charles Hirsch is the superintendent. According to Mr. B. G. McIntyre, this fishery was established in 1879, during which year they put up six hundred barrels of salt salmon which brought about six dollars per barrel. This firm has in its service the twenty-nine ton schooner "Calistoga", of which Oliver Smith is master. Her present value is said to be twenty-five hundred dollars. Besides the master she carries four men, one of whom is a Swede and the other three are Russian Creoles. The average share of the crew is twenty to thirty dollars per month. Mr. McIntyre, to whom I am indebted for information about the vessel, thinks the "Calistoga" had about five thousand dollars invested in the business in 1880. Smith & Hirsch are represented as having salted nine hundred and thirty-nine barrels of salmon and dried seventeen thousand five hundred pounds of *ukali*.

Two seines are used by Smith & Hirsch, and their dimensions are: Length, fifteen and twenty-five fathoms; depth, one and one-half and two fathoms; mesh, three and one-half and four and one-half inches. The smaller one cost twenty-five dollars and the larger thirty-five dollars. A building used here for fish-salting purposes cost five hundred dollars. Six eighteen-foot dories are in use. Twenty-five men are employed—one Swede, one Irishman, and twenty-three natives.

The results of the season of 1880 were as follows:

	Number of fish.	Estimated weight in pounds.	Barrels.
O. nerka.			
June	37,500	375,000	125
August	19,950	199,500	399
September	20,750	207,500	415

The average weight of these red salmon is estimated at ten pounds. Of the thirty-seven thousand five hundred fish caught in June only the bellies were salted, making one hundred and twenty-five barrels.

In the beginning of July red salmon became scarce, and after the run of humpbacks (*O. gorbuscha*) set in (July 12), the red salmon (*O. nerka*) disappeared altogether. Smith & Hirsch stopped fishing until August 14, when the red salmon again made their appearance.

During July, August, and September, Smith & Hirsch made into *ukali* thirty-five thousand red and humpback salmon, whose estimated weight fresh was three hundred thousand pounds; the *ukali* made from them weighed about seventeen thousand five hundred pounds.

The fish put up by this firm are consigned to the Alaska Commercial Company, and sold by Lynde & Hough, of San Francisco.

Captain Bowen says that a seine adapted for use at Karluk River should be thirty fathoms long, three fathoms deep, of three-inch mesh, with five-foot poles on the wings. He has caught and

cured at Karluk one hundred and seventy-five barrels of red salmon in less than four days with ten natives at work. The natives do everything but salt the fish; this Captain Bowen does himself. Ten men could average fifty barrels a day easily if a vessel could lie there every day, but Karluk is open to the sea. With proper buildings ashore ten thousand barrels might be put up in a season. At Karluk the salmon are thicker on the flood tide, becoming thicker as the tide rises, but going off at high water. Looking down into the water, it would seem that a lead-pencil could not be passed down between the densely crowded fish; a bidarka cannot be paddled over them when the salmon are thick.

Red salmon are abundant every year at Karluk. There is perhaps no better place in Alaska for the establishment of a great salmon fishery.

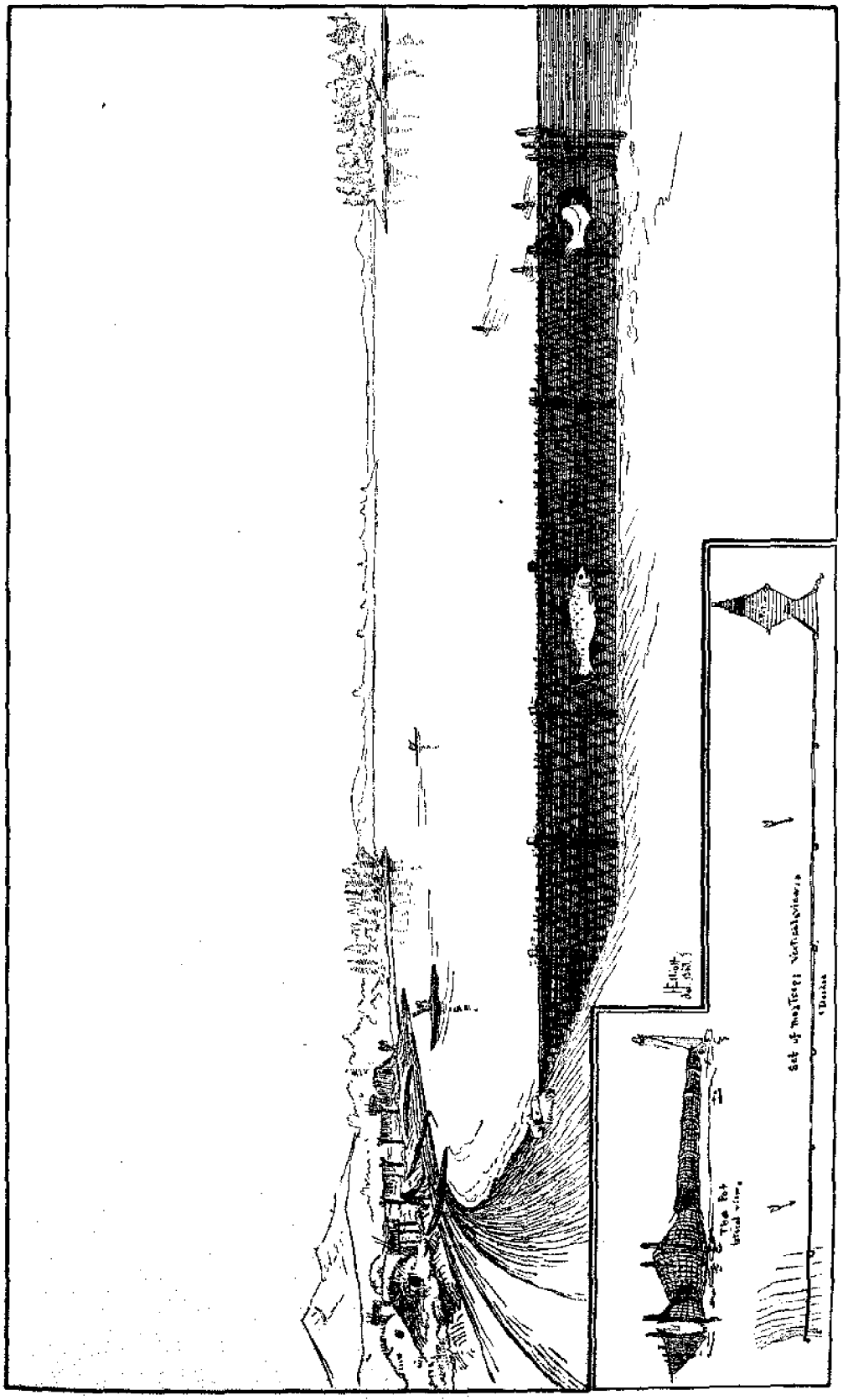
The following are the principal food and bait fishes of Kodiak Parish:

Pleuronectes stellatus, Pallas.
" quadrituberculatus, Pallas.
Lepidopsetta bilineata, (Ayres) Gilb.
Limanda aspera, (Pall.) Bean.
Hippoglossoides classodon, Jor. & Gilb.
Hippoglossus vulgaris, Flem.
Atheresthes stomias, Jor. & Gilb.
Pollachius chalcogrammus, (Pall.) Jor. & Gilb.
Gadus morrhua, Linn.
Tilesia gracilis, (Tiles.) Swainson.
Cottus polyacanthocephalus, Pallas.
Hemilepidotus trachurus, (Pall.) Günther.
" Jordanii, Bean.
Sebastichthys melanops, (Grd.) Jor. & Gilb.
" ciliatus, (Tiles.)
Hexagrammus asper, Steller.
Hexagrammus ordinatus, Cope.
" superciliosus, (Pall.) Jor. & Gilb.
" decagrammus, (Pall.) Jor. & Gilb.
Pleurogrammus monopterygius, (Pall.) Gill.
Ammodytes personatus, Girard.
Mallotus villosus, (Müller) Cuv.
Thaleichthys pacificus, (Rich.) Girard.
Salvelinus malma, (Walb.) Jor. & Gilb.
Salmo purpuratus, Pallas.
" Gairdnerii, Rich.
Oncorhynchus chouicha, (Walb.) Jor. & Gilb.
" keta, (Walb.) Gill & Jor.
" nerka, (Walb.) Gill & Jor.
" kisutch, (Walb.) Jor. & Gilb.
" gorbuscha, (Walb.) Gill & Jor.
Clupea mirabilis, Girard.

The following are the names of fishes given to us on the voyage from Alexandrovsk to Saint Paul, Kodiak, by a native of the island of Kodiak. The species were all shown to him except the *krasnoi riba*:

Gadus morrhua	Ah-mo-doc.
Tilesia gracilis	Sah-ke-lakh.
Muraenoides ornatus	Poo-lakh.
Ammodytes personatus	Ah-zhing ah-ryeerk.
Hemilepidotus	Kah-log.
Cottus polyacanthocephalus	Ki-oo-loong-chook.
Gasterosteus cataphractus	E-lach-en-akh.
Mallotus villosus	She-gakh.
Salvelinus malma	Ahn-chuck.
Oncorhynchus gorbuscha	Ah-mah-kee-akh.
keta	Ah-lay-makh.
nerka	Nee-klee-uk.
Names of other objects:	
Littorina	E-book.
Diomedea brachyura	Kay-may-ryeerk.

EXPLANATION.—A is sounded as in father, except in the second syllable of Ah-lay-makh, and in the first two syllables of Kay-may-ryeerk. The names express as nearly as possible the sounds used by the native in conveying his identification of the objects to me.



Salmon trap in common use by the natives on the great rivers of Alaska, especially on the Yukon and Kuskokwim.

Drawing by H. W. Elliott.

Settlements on Kodiak and Afognak Islands.

	Creoles.				Aleuts.[1]			
	Adults.		Children.		Adults.		Children.	
	Male.	Female.	Male.	Female.	Male.	Female.	Male.	Female.
Saint Paul	77	82	55	53	5	6	1	3
Lesnoi	19	20	6	12	42	32	12	13
Afognak	68	66	36	25	40	44	36	24
Ilobia	26	31	14	7				
Orlova (Eagle Harbor)	6	6	4	1	84	83	39	55
Old Harbor	8	7	5	3	81	65	28	22
Kaguyak					97	60	35	41
Iachiok					36	32	20	16
Karluk	8	7	4	5	90	99	49	30
Total	212	219	124	106	475	421	230	213

[1] Actual count taken from church registers.

NOTE.—The totals of Creoles are equal to one hundred and sixty-five families of four persons each; the totals of Aleuts, to three hundred and thirty-four families of four persons each.

SALMON PREPARED BY NATIVES FOR HOME USE.

	Salmon salted.	Salmon spawn.	Ukali.
	Barrels.	*Barrels.*	*Pounds.*
One hundred and sixty-five families of Creoles put up	990	82	126,750
Three hundred and thirty-four families of Aleuts put up		167	250,500
Total	990	249	377,250

Settlements on Cook's Inlet and Alaska Peninsula.

[Actual count taken from the church registers.]

	Creoles.				Indians.			
	Adults.		Children.		Adults.		Children.	
	Male.	Female.	Male.	Female.	Male.	Female.	Male.	Female.
Katmai	11	13	8	5	64	58	30	29
Kamishak					14	11	11	10
Nuchek					40	38	25	23
Illiamna					15	12	11	7
Alexandrovski					20	18	10	12
Seldowa					12	10	8	8
N. Nilchik	15	12	7	8				
					Families.			
Kassilov					4			
Kenai	19	16	12	6	30			
Knik					30			
Tyonak					30			
Sutchitna					30	Approximate.		
N. Kishki					10			
Kusketan					10			
Kugak					10			
Douglas					20			
Total	34 families.				310 families.			

SALMON PREPARED BY NATIVES FOR HOME USE.

	Salmon salted.	Salmon spawn.	Ukali.
	Barrels.	*Barrels.*	*Pounds.*
Thirty-four families of Creoles put up for winter stores	170	17	25,500
Three hundred and ten families of Indians		155	220,000
Total	170	172	255,500

Recapitulation of catch of fish for home consumption and export in 1880.

	Herring, smoked.	Codfish.		Salmon.			Ukali.
		Salted.	Boneless.	Smoked.	Salted.	Spawn.	
	Boxes.[1]	*Barrels.*	*Barrels.*	*Pounds.*	*Barrels.*	*Barrels.*	*Pounds.*
Alaska Commercial Company					150		
Smith & Hirsch					939		17,500
Western Fur and Trading Company:							
Kassilov fishery					345		
Karluk fishery					655		19,750
Saint Paul fishery	500		250	4,000			
Creoles, Kodiak Island					990	82	126,750
Aleuts, Kodiak Island						167	250,500
Creoles, settlements, Alaska Peninsula					170	17	25,500
Indians, settlements, Alaska Peninsula						155	230,000
Total	500		250	4,000	3,249	421	670,000

[1] Boxes of thirty pounds each.

In addition to the above the Western Fur and Trading Company have put up experimentally:

Smoked halibut, pounds	500
Codfish tongues, in kits of twenty-five pounds each	10
Halibut fins and napes, salted, in kits of twenty-five pounds each	10
Frostfish, salted, in quarter barrels	10
Salmon-trout, salted, in quarter barrels	30
Codfish, dried, in one hundred pound boxes	30
Herring, salted, in quarter barrels	25
Herring, salted, in kits of twenty-five pounds each	100

BELKOFFSKY PARISH.

Since the fishes of this division are practically the same as those of the Shumagins, it is unnecessary to furnish a separate list of them. Mr. Petroff gives the population as six hundred and sixty-nine. The division, in fact, includes the settlements on the Shumagin group, and this group has essentially the same species as Kodiak Parish with the addition of *Trichodon stelleri* and *Bathymaster signatus*, the latter being important mainly for bait. *Bathymaster* is called "cusk" at Pirate Cove, Shumagins.

Belkoffsky Parish contains the settlements of Belkoffsky, Nikolaievsky, Protassov, Vosnessensky, Unga, and Korovinsky. The wealthiest of all is Belkoffsky, which has an abundance of fish, and takes nineteen hundred to two thousand sea-otter annually. Protassov takes five hundred sea-otter and some walrus. Unga takes about six hundred sea-otter. Vosnessensky and Korovinsky also take a few sea-otter. The natives of Korovinsky are occasionally employed at the cod-fishing stations of the Shumagins. At Belkoffsky, a fine salmon river falls into the bay. Natives take the salmon in small seines, and the women and children string them on twigs

U. S. Fishery Laboratory
Beaufort, N. C.

U. S. FISH COMMISSION
BEAUFORT, N. C.

and pieces of cord and drag them along just at the edge of the water around the beach to their village. The fish are piled in heaps and then begins the process of cutting, splitting, and gashing, preparatory to hanging them on the drying-frames. Great heaps of heads and entrails lie all around, very attractive to flies and beetles, but rather repulsive to visitors. At the time of our visit (July 23, 1880), *O. gorbuscha* was the species taken. Mr. Frost told me that the *gorbuscha* comes first, and that it appeared in quantities two weeks prior to our arrival; the "*hoikoh*" (*O. keta*) was there and the "*krasnoi riba*" (*O. nerka*), but neither of these was plentiful; they come later. Cod are caught in the harbor. A few cod were hanging up to dry, but salmon were abundant everywhere. The natives nearly all have comfortable-looking houses, a few of which are painted blue, with red roofs.

Mr. Devine says that natives from Korovinsky come over to a cove on Popoff Island, near Pirate Cove, to fish for salmon; they generally get good silver salmon (*O. kisutch*?) there. A silver salmon five feet long was brought to Pirate Cove in 1877; from the size, I would suppose this to have been *O. chouicha*. Clams are very abundant and excellent about the Shumagins.

One of the finest known baits for cod is common in deep water about the Shumagins; it is the "yellow-fish" or striped fish" (*Pleurogrammus monopterygius*), a species which is found in great schools and may be taken in the purse-seine like mackerel, which it resembles in size, and, after salting, in taste. Cod are passionately fond of this fish, and also of the "whiting" or "silver hake" of the region (*Pollachius chalcogrammus*). The Shumagin cod fishery, having already been treated at length, need not be entered upon here.

UNALASHKA PARISH.

This division, with a total population of nearly fourteen hundred, would have a fishing population of about two hundred and eighty. It includes the islands of Attu, Atka, Umnak, Unalashka, Spirkin, Akutan, Akun, and Avatanok. In this district will be observed a difference from the single paddle of the eastern shore of the Gulf of Alaska and the Kodiak group, the bidarkas here being propelled by double paddles and with quite a change of motion. The effect of the double paddle, which is grasped in the middle, is pretty, but the movement is not so steady as that resulting from the use of the single paddle. The bidarka is the universal form of boat for coasting and even for sea-going in weather that will allow its use.

Aleut names of parts of a bidarka, obtained through Mr. King.

English.	Russian.	Aleut.
Gunwale	Shistee	Un-mah-ghigh.
Keel	Keel	Ah-tah-kay.
Ribs	Riobra	Keel-ghagh.
Beams	Beamsi	Ah-gah-dach.
Stringer (between hatches)		Koo-lich.
Hatch	Luke	Oo-looch.
Stern	Korma	Tah-sach.
Lashings	Zaviaski	Eck-thoo-sahk.
Luvtak	Luvtak	Lach-tach-ach. Chang-iak.
Nose of prow (in three pieces)	Nosok	Kut-koo-mah. Koo-goo-show.

A good three-holed bidarka is worth from thirty dollars to fifty dollars. The luvtaks, or skin coverings of the wooden frame-work, are made of sea-lion here.

The fishes of this division are nearly the same as those of Kodiak Parish, with the exception of the species of *Sebastichthys*, none of which in the National Museum are from Unalashka Parish.

All the Alaskan species of *Hexagrammus*, however, are present, the commonest one at Iliuliuk, known to the whites as "green-fish" and to the Russians as *turpuk*, being *H. ordinatus* of Cope. These fish remind me very much of our cunner and tautog, but they are much better than either, being more solid and less bony. Flat-fishes and flounders are very abundant, and are taken in large quantities by the spear in the evening, when they come into the shoal water close to the shore, and may be readily seen on the sandy bottom. Halibut and cod abound. The "striped fish", "yellow-fish", or "Atka mackerel" exists here in immense numbers, and deserves to become a very important element in the Alaskan salt-fish trade. It extends around the whole of the Aleutian chain and the Shumagins, congregating in great schools. At Attu it is known as the "kelp-fish," at the Shumagins as the "yellow-fish" or "striped fish," and from Unalashka to Atka as the "Atka mackerel." The last name is derived from the fact that when salted just as mackerel are salted it has the same taste. I have been told that this fish can be taken by the purse-seine, its movements being similar to those of the common mackerel. There is no doubt that if the "striped fish" was properly introduced into the market it would find a ready sale, for it is certainly an excellent fish, either salted or fresh. The fish was originally described by Pallas as *Labrax monopterygius*, and is at present known as *Pleurogrammus monopterygius*, (Pallas) Gill. Last year it visited Chernoffsky and Iliuliuk, on Unalashka Island, reappearing at the latter place after an absence of a few years. Petroff states that "full barrels of it [have] commanded the unwonted price of twenty-four dollars each in San Francisco." Mr. Robert King, agent of the Western Fur and Trading Company for the Unalashka district, writes me as follows concerning the species: "Our agent at Atka says they are there in considerable numbers, and wishes me to make preparations for taking three hundred barrels, which he thinks may be obtained in one season of say two or three months. I believe these fish are more generally distributed than has been heretofore known, as we saw young ones of the same kind at Chernoffsky on this Island, and during the last few days there have been thousands of them moving through between the cribs of our wharf." Mr. King's letter was dated at Iliuliuk, August 3, 1880.

With regard to the price offered for the salted "striped fish," there seems to be some difference of experience. Mr. Hague, general agent of the Western Fur and Trading Company, has kindly written me the following concerning them: "The best offer we have had for these striped fish is for a quantity to arrive not to exceed forty to fifty barrels at ten dollars per barrel."

Trout and salmon are among the most important fishes of the region. The red-spotted trout and all the species of *Oncorhynchus* are taken in their season. Herring are not always abundant, but that they are of unusually good quality our own experience has proven.

Sea-lions are captured at Attu, and in rather large numbers, by the Akun people, who go to Oogamak for them and for the numerous hair-seals found there. The skins of the hair-seal and sea-lion are used in making bidarkas, which are used by the sea-otter hunters who visit Sanakh.

Quite a number of young fur-seals are caught by natives off Umnak, as they travel southward from Bering Sea. The people of Makushin, too, secure between one thousand and thirteen hundred of these animals yearly on their way through Umnak Straits in the fall. The inhabitants of Borka capture from twelve hundred to fourteen hundred young fur-seals in favorable seasons as they go through Oonalga Pass.

Sea-otter are taken in small numbers by the people of Akutan around the small islands near them and on the south end of Unimak. The village of Borka secures a few sea-otter in its vicinity, and some of its people also unite with the Unalashka hunters who visit Sanakh. The Chernoffsky natives take sea-otter in Umnak Straits and send representatives to Sanakh with the

Iliuliuk parties. Koshigin gets a few of these animals yearly in the same places as those visited by Chernoffsky natives. The people of Makushin and Iliuliuk join forces in quest of sea-otter at Sanakh, where they are taken, and whence they are brought back annually by vessels engaged in the trade. The people on the southwest coast of Umnak Island secure about one hundred and fifty sea-otter yearly. Atka is largely engaged also in this chase and successfully. Trading vessels carry its hunters to the haunts of the otter, where they remain during the season, and at the end of their work they are returned to their homes. Mr. Petroff, from whom I have copied my information about the otter, fur-seal, and sea-lion, gives the catch of sea-otter in Unalashka district, from the Shumagin Islands to Attu, as forty-eight hundred and fifty for the season of 1879.

In "Notes on the Islands of the Unalashka Region" (translation from the Russian title), by Ivan Veniaminoff, Vol. II, pages 402 to 408, will be found an account of the fishes which Mr. Marcus Baker, of the United States Coast and Geodetic Survey, has had the kindness to translate for me. What the bishop says about the methods of fishing is here quoted: "The method of taking the migratory fish by the Aleuts was formerly exceedingly crude and unprofitable. They built dams in the rivers, piling large stones on a kind of float where the circumstances admitted of it, which served as a barrier to the fish going up the rivers. Standing upon this they fished with small spears pointed with iron (and formerly with bone) and barbed, thrown into the water more by chance than by choice, and when by good luck a fish was struck it was dragged ashore by a line attached to the spear. They now (1840) make use of small nets; but at the principal settlements the company has large seines, with which more fish are taken at the time when they first begin to approach the shores or enter the bays."

At the present time short seines and the ordinary fishing gear of the United States are generally employed in the fisheries. *Ukali* forms a very important part of the trader's stock at Iliulink.

BRISTOL BAY DIVISION.

In this division there is a total population of forty-three hundred and forty. This may be called the great lake region of Alaska, the lakes emptying through rivers into Bristol Bay. Iliamna, the largest lake, is upwards of ninety miles long, and varies between fifteen and thirty miles in width. Nushegak, the largest river, wide and deep, with rapid current and turbid waters, rushes down from Nushegak Lake to the bay, and asserts its presence far out over bars and flats. Besides the Nushegak there are seven other rivers in the division.

At Nushegak, Mr. Petroff says, the Unalashka style of bidarka is left behind, and is replaced by the one-holed "kyak," a skin canoe similar to the bidarka and similarly propelled. The spear is much used in fishing and in the capture of seal. The lance is in great demand for sealing, too.

The coast population have opportunities to take walrus, seals, beluga, and an occasional stranded whale. The settlement of Igagik, according to Petroff, devotes its time principally to the walrus hunt. At Kulluk, again, is a small population, devoted largely to the chase of walrus and seal; here the banded seal (*Histriophoca fasciata*) is found along with others. It is claimed that a fresh-water seal inhabits Iliamna Lake, but the statement needs to be confirmed by the possession of a specimen.

The principal fish of the region are flat-fish, flounders, halibut, cod, pollock, "wachna," sculpins, two or more species of "green-fish" (*Hexagrammus*), launce, capelin, trout, whitefish, salmon, and herring. In order to form some idea of the abundance of salmon one should read Petroff's description of the Igushek River and of the Togiak as well.[1] The whole region is

[1] Preliminary Report on Census of Alaska, 1881, p. 48.

abundantly supplied with choice fish, while the sea-coast is inhabited by the larger marine animals already mentioned. I have been told that Iliamna Lake is well stocked with the best of fish.

The following are some of the food-fishes of Bristol Bay division:

Pleuronectes stellatus.	Ammodytes personatus.
Lepidopsetta bilineata.	Mallotus villosus.
Limanda aspera.	Salvelinus malma.
Hippoglossus vulgaris.	Salmo purpuratus.
Pollachius chalcogrammus.	Oncorhynchus chouicha.
Gadus morrhua.	" keta.
Tilesia gracilis.	" nerka.
Cottus polyacanthocephalus.	" kisutch.
Gymnacanthus galeatus.	" gorbuscha.
Hexagrammus asper.	Clupea mirabilis.
" *ordinatus.*	

Besides these there are some species of *Coregonus* which have not come into the United States National Museum and have not been recorded by any writer, so far as I know.

PRIBILOFF ISLANDS.

This group is so thoroughly absorbed in the important business of taking fur-seal that the trifling occupation of fishing is, for the most part, left to the small boys, and their principal catch is the skulking, rock-loving sculpin, known to the Aleuts as kah-log. They have smooth-skinned sculpins and scaled sculpins, representing the genera *Cottus* and *Melletes*, but all are kah-log. Large halibut, too large to be devoured by the roaring "lion" and the bellowing "bear," which exterminate all the unwary small fry, are the only important fish that can be readily taken near the shores. The *bidarra* is the fishing-boat, and the fishing implements are all from the United States.

Sea-lion are taken in large numbers, and are very important for the covering of *bidarras*.

SAINT MATHEW AND SAINT LAWRENCE ISLANDS.

Saint Mathew is a great resort for walrus, and it was once supposed that fur-seal might be taken there in large numbers.

Saint Lawrence Island derives a precarious subsistence from the walrus and seal that visit its shores, and, according to Captain Hooper, are present all the year. Whales also supply a large part of the food of its people. The walrus and the seal furnish them not only with food, but also with houses, fuel, boats, and clothing. Their catch of whalebone and walrus ivory is disposed of to traders for rum, rifles, and ammunition. This island marks nearly the northern limit of the codfish, which is occasionally taken there.

KUSKOQUIM DIVISION.

We have here a population of thirty-six hundred and fifty-four, which is augmented during the salmon fishing to six or seven thousand, according to Mr. Petroff, from whose report I take the bulk of the information concerning the fishes of the Kuskoquim River. In the absence of collections, we know nothing definite about the species of fish, but it is reasonable to suppose that they do not differ greatly from those of the Yukon, from which we have many species, as will be seen from the list accompanying the account of that division. Salmon, trout, and whitefish are

the principal and prevailing forms, and the fact that the people of the region not only consume vast quantities themselves, but also divide their supplies with about two thousand natives from the lower delta of the Yukon, is a sufficient voucher for the wonderful abundance of fish.

The run of salmon up this stream is very great, and is long continued, the season opening in June and not closing until the end of August. The density of the population, as so remarkably portrayed in our list of the settlements at the mouth and in the immediate country adjoining, is such that in their active and energetic fishing for their own consumption they seem to absorb the greater part of this salmon run; at least the natives at the source of the river complain very often of the scarcity of salmon. Not only the people of the Kuskoquim proper fish here, but even those of the lower delta of the Great Yukon. Two thousand of them come over here to fish, making a sum total of six or seven thousand fish-eaters, consuming and wasting a quantity of salmon that should feed at least six or eight times their number were the fish canned or salted, instead of being used in their wasteful processes.[1]

YUKON DIVISION.

I shall combine here the two sections of Mr. Petroff, put down as Yukon delta and Uphoon mouth to Anvik, with a population of thirty-three hundred and fifty-one.

According to Petroff, hair-seals (two species) ascend the Yukon as far as three hundred to four hundred miles. White whales or beluga are abundant in the mouths of the river, where they pursue the salmon.

The number of species of marine fishes is comparatively small, while there are a goodly number of river fishes, particularly salmon and whitefish. There is generally no trouble in getting all the salmon required by the natives for bounteous subsistence, but Mr. Petroff mentions a contingency that arose last summer by which a fish famine was caused at the mouth of the Yukon. At the breaking up of the ice in the spring, it came down in such masses that it grounded in the delta in the month of July and prevented the ascent of the salmon. Natives had to seek food northward along the shore of Norton Sound and down on the Kuskoquim. To the people of the Lower Yukon the absence of fish means starvation, unless a supply can be obtained from other sources. The run of salmon in the Yukon is short, not much exceeding two months in all. Mr. Dall has published a memorandum of the trap-fishing at Nulato, on the Yukon, based upon his observations extending over several seasons, and this will give a good idea of the species taken and their relative abundance at different seasons.

NOVEMBER.—The fish-traps are set for winter. A week or two usually elapses before the trap takes any fish. The natives say that it is necessary for the resin to be washed out of the wood of which the basket and funnel are made before the fish will approach the trap. The first fish taken are the losh (*Lota maculosa*), which usually come in great numbers.

DECEMBER.—Suckers and losh predominate. A few whitefish and a straggling salmon are occasionally taken.

JANUARY.—Much the same; but the whitefish begin to be more plentiful.

FEBRUARY.—Losh scarce. The traps are filled with the different species of whitefish.

MARCH.—Much the same; but suckers begin to enter the traps.

APRIL.—Graylings and suckers very plenty; whitefish more scarce; a few losh taken.

MAY.—A few poor whitefish and small losh are taken, but the bulk of the catch is composed of graylings. Ice carries away the traps. As soon as the river is clear new traps and gill-nets are set.

[1] Petroff, Preliminary Report on Census of Alaska, 1881, p. 52.

JUNE.—King salmon appear toward the middle of the month.

JULY.—"*Hoikoh*" (*O. keta*), "redfish" (*O. nerka*), "dogfish" (*O. gorbuscha*), and a few whitefish.

AUGUST.—*Keezich* and straggling salmon of the other species. Whitefish, especially the *Luciotrutta* and *muksun*, are more abundant.

SEPTEMBER.—Salmon trout and whitefish are in their best condition and most abundant.

OCTOBER.—Much the same; but toward the twentieth of the month ice begins to form and puts a stop to fishing until it is firm enough to allow of the setting of the winter traps, which does not usually occur until early in the following month.[1]

The method of making and setting the Yukon fish-traps is so well explained by Mr. Dall in the paper already quoted, that I shall simply state that the trap is essentially a double fyke-net with the fence placed at right angles with the bank of the river, catching fish either ascending or descending the stream. Gill nets and seines are used in summer. The Tinneh tribes formerly made their seines out of the inner bark of willow and alder. The Innuit made theirs of fine seal-skin strips. In localities where the river is small and narrow, the natives make what corresponds in effect with the V-shaped fish-trap of the Susquehanna and other Eastern rivers—huge bundles of willow brush are tied together and placed side by side so as to block the passage of fish completely, except at the little opening where the basket is placed. Birch canoes are used in river fishing on the Yukon.

We have little information about the running of the Yukon salmon beyond that obtained by Mr. Dall from the natives at Fort Derabin, Nulato, which follows:

"*King salmon:* Arrive at Nulato 'when the trees have got into full leaf,' about the 20th of June, and continue to run about three weeks. The last that come up are poor and lean. *Hoikoh:* The first arrive about the 10th of July, just as the king salmon are about gone, and they last about three weeks. Stragglers are occasionally caught as late as January. *Redfish:* This arrives about a week or ten days after the first hoikoh, and continues with the latter until about the end of August. A few straggling dogfish are occasionally caught with it, but the majority of this species do not ascend the river as high as Nulato. *Keezich:* This is the last of the salmon to ascend the river, and is obtained until the cold weather sets in and puts a stop to the summer fishing."

The same habit of running in twos or threes instead of in schools is reported of the "king salmon" in the Yukon, as well as in the rivers of Cook's Inlet. Capt. E. P. Herendeen told me that he has always noticed it, and he thinks the salmon follow the shore to escape the *beluga*.

The superiority of the king salmon of the Yukon has long been well known; persons who are able to secure a supply of the salted bellies from that source consider themselves very fortunate. The species seems to improve in flavor regularly to the northern limit of its distribution, although it is highly prized even on the Columbia.

The following is a list of the principal fishes of the Yukon division:

Flat-fish	Pleuronectes stellatus.	(Marine.)
	" glacialis.	(Marine.)
	Limanda aspera.	(Marine.)
Halibut	Hippoglossus vulgaris.	(Marine.)
Polar cod	Boreogadus saida.	(Marine.)
Waehna	Tilesia gracilis.	(Marine.)

[1] Report of Commissioner of Agriculture for 1870 (1871), p. 392.

Burbot or losh	Lota maculosa. (Fresh water.)
	Lycodes Turnerii. (Marine.)
Sculpin	Cottus polyacanthocephalus. (Marine.)
	" tæniopterus. (Marine.)
	" humilis. (Marine.)
	Hexagrammus asper. (Marine.)
Launce	Ammodytes americanus. (Marine.)
Pike	Esox lucius. (Fresh water.)
Smelt	Osmerus dentex. (Marine.)
Capelin	Mallotus villosus. (Marine.)
Smelt	Hypomesus olidus. (Fresh water.)
Whitefish	Coregonus Artedi. (Fresh water.)
	" Laurettæ. (Fresh water.)
	" Merkii, subsp. (Fresh water.)
	" clupeiformis. (Fresh water.)
	" Kennicottii. (Fresh water.)
	" quadrilateralis. (Fresh water.)
Grayling	Thymallus signifer. (Fresh water.)
Trout	Salvelinus malma. (Fresh water.)
Salmon	Oncorhynchus chouicha. (Fresh water.)
	" keta. (Fresh water.)
	" nerka. (Fresh water.)
	" kisutch. (Fresh water.)
	" gorbuscha. (Fresh water.)
Herring	Clupea mirabilis. (Marine.)
Sucker	Catostomus longirostris. (Fresh water.)
Lamprey	Ammocœtes aureus. (Fresh water.)

According to Mr. L. M. Turner, the lamprey is very abundant at Anvik and is used for food.

Although the Ingaliks, or the people of the great interior, are omitted here, they have an abundance of salmon and whitefish in the Upper Yukon and the Tananah.

NORTON SOUND DIVISION.

In the region embracing the coast of the Sound from Saint Michael's upward and as far as Sledge Island, Mr. Petroff reports six hundred and thirty-three inhabitants. The fishes, of course, are about the same as those mentioned in the Yukon division and need not be repeated. There is one very important fishery, the tom-cod or *wachna* fishery, which is characteristic of the region, and should be described in detail. This has already been done by Mr. Dall in the following terms:

"This fish much resembles the common tom-cod of the Eastern States, . . . but, while the latter is of most insignificant importance from its scarcity and poor quality, the former species occupies a very important place in the domestic economy of both natives and Russians on both shores of Bering Sea. It is apparently a permanent inhabitant of these coasts, but is most abundant in the fall of the year, when the ice begins to form in the rivers and along the shores. The Waúkhni fishery commences about the middle of October. At first it is caught from boats anchored close inshore, but later the natives cut holes in the new ice, set up two or three stakes, with a mat hung upon them to keep off the wind, and sit there all day, hauling them in as fast as

the line is dropped into the water. The hook is made of white walrus ivory, furnished with a sharp pin set in obliquely, but without a barb. The whiteness of the ivory, which is kept constantly in motion, attracts the fish, but no bait whatever is used. In November, when the ice becomes very thick, and the cold increases, the fish retire to deeper water, and the fishing is over until the following spring. In the summer the natives are occupied with the salmon fishery and pay no attention to these small fish. They are preserved by removing the intestines, and drying in large bunches strung on seal-line, or by throwing them as they are into long cylindrical baskets made of twisted grass, and keeping them entire in a frozen state. . . . They are among the most palatable of the many fish found in these seas, and the number preserved is so great as to be almost incalculable. They serve the natives for food either boiled or in the frozen state. They also form an important article of dog-feed in the northern portions of Alaska, near the coast. They are well suited, from their abundance and firm flesh, to be used as bait in the cod-fishery."[1]

The *wachna* extends southward into Cook's Inlet, where I have seen individuals a foot in length; their average length so far as observed by me is about ten inches and their weight a half pound or less. The form is much like that of the tom-cod, but by pressing on the sides of the body a little behind the breast fins a series of small knobs will be felt on the ends of the lateral processes of the backbone; these are caused by white, spoon-shaped, flexible caps that fit on the processes and help to form a sort of roof over the abdominal cavity; the presence of these appendages makes it necessary to use another name than *Gadus* for the genus, and as Swainson has proposed to call it *Tilesia*, though on trivial grounds, his name may be used. It is usual to see traveling parties of Innuits in summer supplied with strings of *wachna* with the intestines partly removed and a very gamy flavor substituted. The hook of walrus ivory is still used, and farther north it is attached to a line of whalebone splints.

The herring run in Norton Sound is of very short duration, the fishery lasting only a fortnight, but the schools are enormously large. Seines are used in taking them. The fish are kept until they become half putrid, and are then considered at their best.

Parties traveling in summer by sea in this region are usually well supplied with a small flat-fish (*Pleuronectes glacialis*), which has a close resemblance to the "fool-fish" or "Christmas fish" of Massachusetts Bay and the Maine coast, together with *wachnæ* and smelt.

The sea boat in common use is the *bidarra* or *baidar* (*oomiak* of the Innuit), a flat-bottomed, walrus-skin covering stretched over a wooden frame-work and securely lashed with whalebone and seal-skin strips or sinew. Occasionally an oar is used, the wooden rowlock being lashed to a rib with thongs, but short paddles are more general. A small square sail is always used when the wind is favorable, and when not forced to embark against wind and tide the native emulates his civilized brother, and waits. The *bidarra* serves not only as a mode of conveyance by day, but also as a shelter for the night. As this boat is so largely used throughout Northern Alaska it will be of interest to quote portions of Captain Hooper's remarks on the subject:

"An ordinary oomiak contains, in addition to the stock-in-trade of oil, skins, etc., a tent of drilling or deer-skin, guns, traps, spears, bows and arrows, a *kyack*, a seal-skin poke filled with water, a quantity of dried meat, a sled, several pairs of snow-shoes, a fish-net, and several smaller nets for catching birds, a large drum on a pole for the use of the 'shaman,' and several seal-skin bags containing skin clothing. The *personnel* consists of three or four men, about as many women, and two or three children. Add to these two or three dogs, each with a litter of puppies, and some idea may be formed of what a traveling oomiak contains. The working dogs are often

[1] Report of Commissioner of Agriculture for 1870 (1871), p. 380.

left on the beach to follow on foot, which they do, keeping up a continued and most dismal howl. If the wind comes in ahead, and the natives desire, for any reason, to continue their journey, they paddle in near the shore, harness their dogs, and attach them to the oomiak, after the manner of a canal-boat and horses, settle themselves in the boat, and saying 'nakouruck' (good!), go on their way at the rate of four or five miles an hour with no other effort than steering with the paddle."[1]

Fish hooks and lines also form an important part of the oomiak outfit, since fish, especially in summer, are so largely depended upon for food.

Seal, walrus, and whale, as well as *beluga*, are important objects of the chase in this division, but as the methods pursued are the same as we find farther north we will refer to this subject again.

KING'S ISLAND TO POINT BARROW.

For this extent of territory Mr. Petroff gives a total population of twenty-nine hundred and ninety. For convenience of treatment I shall subdivide the region into several smaller parts, taking up Port Clarence, Kotzebue Sound, and Arctic Alaska north of Kotzebue Sound, separately.

1. PORT CLARENCE AND VICINITY.—We must include here King's Island, one of the most remarkable human habitations in any country, with a reputed population of one hundred souls on its inhospitable cliffs. The shores are all bold, and the contour is jagged and broken. Here, in summer-houses of walrus skins, and winter burrows in the face of the cliffs, live a class of seal and walrus hunters who are said to be the bravest sailors in Alaska. I have heard it stated that men are sometimes lifted up in their kyacks by their comrades and thrown from the cliffs clear of the surf, which must roll almost incessantly around those ragged rocks. Clad in a water-proof kamlayka, or shirt made of the intestines of walrus, the hardy islander is thrown out to battle with the waves that would surely ingulf a less skillful sailor. Captain Hooper says that the kyack of these people is covered with walrus hide. The bidarras have the same kind of covering, and while at sea, transporting trading goods, etc., a cover protects the cargo from breaking waves. The flesh of seal and walrus forms the principal food of these natives, but in summer a part of them may be found at Port Clarence and on the east side of the bay of which this harbor forms a portion, engaged in trading and fishing.

The skins of walrus and hair-seal are converted by these men into "luvtak" which form boat-covers; these are carried off to the mainland for trade. The throat of the seal is made up by the King's Island natives into water-proof boots, which are in great demand for the use of whalers, and their seal-skin boots are largely disposed of to the same parties. The Cape Prince of Wales men are fishermen and whalers.

In the shallow, fresh-water lagoons, so plentiful on the spit protecting the western side of Port Clarence, there are great quantities of sticklebacks. The King's Island people, who were here at the time of our visit, brought to us whitefish (*Coregonus Laurettæ*), smelt (*Osmerus dentex*), herring (*Clupea mirabilis*), and "wachna" (*Tilesia gracilis*). They were well provided with oil in seal-skin bags, fishing-lines, hooks, and sinkers. The sinkers were made of soft stone resembling slate, often of two colors, one light and the other dark, abruptly divided. A hole was drilled at each end and a shallow groove was made to receive the line. The holes were drilled by means of a piece of steel or iron rotated by an ivory or bone drill-bow supplied with a string of sinew. The commonest form of line was made of narrow strips of whalebone neatly fastened together. The hook is often an ivory or bone imitation of a fish, and sometimes two, sometimes four, are

[1] Report of Cruise of Corwin, November 1, 1880 (1881), p. 28.

fastened to one shank. Occasionally pieces of white and bluish stones are made the basis of support for the hooks, and great taste is shown in their arrangement. As an additional lure, we saw what was supposed to be the corneous appendage of the angle of the mouth of mormons, which, when dry, resembles in shape and color an imperfect salmon egg. The rod was not over two and one-half feet long, and the line of about ten or twelve feet was neatly folded around the ends of the rod, which were crotched to receive it. Over the jig-like hook was pulled a sheath of seal-skin as a protection against accidents.

From the settlement at Port Clarence we obtained some dressed skins of the red-spotted trout (*Salvelinus malma*), which are used for making quite ornamental water-proof vests. Small seines are used.

The following are some of the edible fishes of Port Clarence:

Pleuronectes stellatus.	Mallotus villosus.
" glacialis.	Hypomesus olidus.
Limanda aspera.	Coregonus Laurettæ.
Hippoglossus vulgaris.	" Merkii.
Boreogadus saida.	Salvelinus malma.
Tilesia gracilis.	Oncorhynchus chouicha.
Cottus polyacanthocephalus.	" keta.
" tæniopterus.	" nerka.
" humilis.	" kisutch.
Hexagrammus asper.	" gorbuscha.
Ammodytes personatus.	Clupea mirabilis.
Osmerus dentex.	

2. KOTZEBUE SOUND.—In this body of water, especially in Eschscholtz Bay, the *beluga* or white whale is extensively taken. In the vicinity of Elephant Point we found numerous skulls of this animal lying on the beach, not far from the mouth of Buckland River.

"There are no natives living on Eschscholtz Bay, but a number are located on the Buckland River, and come down to the bay during the summer months to kill white whales (*Beluga catodon*), catch salmon, and gather berries, which they 'cache' until the snow comes, when they are taken to the settlement on sledges. Like all Indians, these are very superstitious. While hunting the white whale they are not allowed to chop wood, dig in the earth, sew, tan skins, and many other things, for fear the spirit that controls the movements of the white whales will take offense and not permit them to return the next season. When the whaling is completed they collect the bones and burn them; those who can afford it burn the clothes worn while whaling, the poorer natives paying tribute to the 'god of the white whale,' by cutting off and burning a small piece of some garment."

"The 'kyack' used by the natives on Kotzebue Sound, and, in fact, along the entire coast to Point Barrow, is a marvel of speed and beauty. It is very narrow and light, and great skill is required in its management. In these fleet boats the natives easily drive the white whale, a very timid animal, into shallow water, where it is dispatched with strong, flint-headed spears."[1]

The spear-point used here for the capture of *beluga* is usually made of a brown or black stone which is very hard; this is fastened to a wooden handle, about four feet in length, by strips of whalebone. The *beluga* are hunted in kyacks; a dozen or more natives take up a position near the entrance of some bay, where they can see them as they come in with the tide. As soon as they have passed, the natives paddle out behind them, and, by shouting and beating the water,

[1] HOOPER, Report of Cruise of Corwin, 1881, pp. 24-25.

drive them into shoal water, where they are easily dispatched with flint spears. According to their tradition, to kill the *beluga* with any other weapon would entail endless misfortune upon the guilty party.[1] We might suppose that the *beluga* spear would be held in high esteem by the Innuit, but, on the contrary, it is freely bartered for a trifle of tobacco or a few percussion-caps.

In this portion of Alaska the capture of hair-seals is one of the most important native occupations. The seal is patiently watched for until it appears at its breathing-hole, when it is shot with a rifle. A very ingenious decoy used by these natives is a short piece of wood on which are fastened seal-claws, which are intended to make a scratching sound like that of the seal. Captain Hooper thus describes the movements of the seal hunter:

"The hunter approaches cautiously, by crawling over the ice, his body nearly prostrate, raised slightly on one elbow. He has a piece of bear-skin, about two feet long and a foot wide, which he attaches to his leg on the side upon which he rests; this enables him to slide more easily over the ice. The elbow rests upon a ring of grass."

As already mentioned, seal oil is carried in seal-skin pouches or bags, and the natives sometimes partly fill the bag with water and partly with oil when making preparations for trading.

The gill-nets used by the Arctic Alaskan natives for the capture of seal did not come under my observation, but those used in Plover Bay, which are similar to the Alaskan, are made of strong seal-skin line. They are about thirty to forty feet long and six deep; the bottom is furnished with stone sinkers at short intervals, and the top has a series of floats made of stuffed seal flippers; they are set off from the beach and sunk to the bottom, standing up for the seal to run into as they swim along shore in search of food. Seal-skin lines are attached to the net and held by heavy stones on the beach; with these the net is hauled in when a seal has been secured. A small stone placed on the slack of some of the hauling lines and readily displaced by the struggle of a captive shows when to take up the net. Captain Hooper says the Alaskan gill-net is set from the shore by means of a pole sixty to eighty feet long, made by joining a number of short poles together; with this the net is pushed out to its desired position and then the pole is withdrawn. The seal-skin lines are cut from a skin by passing round and round continuously. The line is then stretched between whalebone posts or large rocks, and the whole net after it is finished is folded into a narrow, long bundle, and carefully stretched between similar supports.

A glance at the map will show this region to be supplied with a few rivers, the Selawik and Finland being the largest. Selawik River communicates, through a lake of the same name, with Hotham Inlet, near the mouth of which the Finland empties also. Buckland River, a small but important salmon stream, flows into Eschscholtz Bay. These streams are well supplied with salmon and whitefish. Petroff says that "the streams or small rivers which empty into Kotzebue Sound mark the extreme northern limit of the run of salmon in America,"[2] but in this he was, perhaps, misled by Seemann. We took the young of the red-spotted trout at Cape Lisburne in the summer of 1880, and at least one species of *Oncorhynchus* is known from as far north as Colville River.

The species of fish observed by us in the possession of natives in Kotzebue Sound were fresh flat-fish (*Pleuronectes glacialis*) and smelt (*Osmerus dentex*) and a species of dried salmon. Dried smelt were obtained also. Most of the species recorded from the region were taken in our seine.

While in Eschscholtz Bay, natives from Cape Espenberg were there for the purpose of fishing and trading. They were well supplied with small objects made of walrus ivory, and many of

[1] HOOPER: Op. cit., p. 59.
[2] Preliminary Report on Census of Alaska, 1881, p. 59.

these were curiously carved to represent seal, walrus, bear, whale, and even the singular large isopod crustacean so common on all the Arctic beaches. The articles were usually intended for belt-toggles, powder-charges, swivels, lance-heads, and other useful implements, but some were representations of the human figure or other merely ornamental subject. Quantities of seal-skin line were freely traded for a mere trifle. The lance-heads usually consisted of a base of ivory or bone and an iron point.

Seemann says that herring and whiting are very abundant in Hotham Inlet. The whiting of Seemann is supposed to be *Pollachius chalcogrammus*, but there is some doubt about the occurrence of this species so far north, since none of the collectors at Saint Michael's have sent it down from their still more southern latitude. The mullet of Seemann must be a large species of whitefish (*Coregonus*). The mode of fishing in these waters is thus described by Captain Hooper:

"Salmon and other small fish are taken in nets, either by a seine in the ordinary way, or by means of a gill-net, which is set from the shore in a very ingenious manner. This net of seal thongs is from thirty to forty feet in length and about five feet wide; floats of light wood are attached to one side, with pieces of stone for sinkers on the other side, and to the outer end is secured a stone somewhat larger than the rest, serving as an anchor; a number of short poles, about three inches in diameter, are lashed together to a length of sixty or eighty feet, and the end secured to the stone anchor by means of a loop, which allows the whole pole to be withdrawn after the net is set. This pole is used for pushing the net from shore into the desired depth of water; when let go the net naturally assumes a perpendicular position. The outer end is held in place by the stone anchor, while the inner end is fastened to a line of seal-thong leading to the shore, with which the net is drawn in."[1]

The following are some of the food-fishes of Kotzebue Sound:

Pleuronectes stellatus.
" glacialis.
Limanda aspera.
Pollachius chalcogrammus (doubtfully).
Boreogadus saida.
Tilesia gracilis.
Cottus polyacanthocephalus.
" tæniopterus
" humilis.
Ammodytes personatus.
Osmerus dextex.
" spirinchus.
Mallotus villosus.
Coregonus Laurettæ.
" Merkii.
" Kennicottii.
Salvelinus malma.
Oncorhynchus chouicha.
" keta.
" nerka.
" kisutch.
" gorbuscha.
Clupea mirabilis.

3. Arctic Alaska north of Kotzebue Sound.—From Kotzebue Sound northward the Eskimo are engaged principally in the capture of seal, walrus, and whale. Many of them go with whaling vessels, and all who are able to do so unite with a will in taking whales during the absence of the fleet as well. In the spring of 1880, the Point Hope men sold the bone from five whales which they killed after the vessels left in 1879. Natives all along the coast from Kotzebue Sound up are supplied with whaling gear such as the whites use, and in their trustworthy oomiaks they show great skill and courage in this chase. Whalebone is brought out to every vessel that comes in sight anywhere in the Arctic. The season of 1880 was a remarkable one for all concerned in the fishery; the Eskimo were fairly gorged with blackskin and blubber, while every sail carried away a heavy cargo of oil, bone, and ivory. On the 20th of August, 1880, the settlement of Point

[1] Report of Cruise of Corwin, 1881, p. 59.

Hope showed no signs of life, the natives being off fishing, hunting, and perhaps trading. There were plenty of drying-frames, and at various points along the low shore were large conical piles of drift-wood.

The spear-points observed at Cape Lisburne were made of copper or iron in a bone socket. Sometimes chert or some other hard stone replaces the metal. At Icy Cape a great number of chert flakes were found at an old Eskimo encampment, where the spear-maker had been at work. The pole to which the head is attached is usually nearly six feet long, the shank forming a socket fitting on a pivot on the pole and firmly lashed on. To the pole is fastened, by seal-skin thongs, an inflated seal-stomach. The natives throw these lances into a whale and the buoys prevent his sinking very far; each time when he comes up to breathe more and more lances are thrust into him, until finally the death stroke is given. The flesh and blubber are common property; the whalebone belongs to the captors of the animal. The jaw-bone is used for various purposes; cut into strips of suitable thickness, it is employed for shoeing sled-runners; the ribs and parts of the jaws are frequently planted in the ground in a circle for the frame-work of winter dwellings; blubber-holes are secured by a covering of similar bones; ribs also are sunk upright into the ground to serve as posts for stretching lines and for supports of various kinds. It is hard to tell whether the Eskimo prefer whale meat fresh or tainted; they eat it very freely and with apparent relish when it becomes simply revolting to our taste. The crisp, hard cracklings left by the whalers after trying out the oil are eagerly sought for by traveling parties.

The walrus and the seal are of more importance to the Eskimo than the whale, both of them being more readily obtained and supplying a greater number of wants. The flesh of the whale of course serves as food, the oil as food and fuel, the bone for house-frames and certain utensils, the baleen as an article of trade; but whales are hard to capture and are not to be depended upon, while walrus and seal, judging from the numerous remains of these animals found wherever we landed on the Arctic shores, and from the numberless appliances for which they serve, are the great essentials, not only to the comfort, but to the very existence of the natives. To use the language of Captain Hooper: "The seal may be called the mainstay of the Innuit of Arctic Alaska. The flesh and oil form his chief articles of subsistence; the skin furnishes him clothing, tents, and boats; cut into thongs, it is used to make nets for catching fish and birds. The oil is also burned in lamps (*nannue*), which light and warm the *tupecks* during the long, dark winter nights."[1]

In the vicinity of Icy Cape we saw great quantities of broken skulls of walrus and seal and of polar bear. Heaps of burned bones were quite frequent; the natives burn the bones to appease the spirit dwelling in the animal, fearing a failure in their future hunting if this mark of respect be withheld.

Walrus ivory has many uses besides that of a basis of trade; whole tusks of the proper shape are formed into handsome and very effective ice-picks; snow-knives, resembling somewhat in shape the throw-sticks of some Indians, are made of this ivory; numberless implements of small size but great usefulness are manufactured from the same material.

The number of species of edible Arctic fishes is small, and there is no question that fish-food is much less important to those Innuit than the flesh of seals and walrus, but it is consumed in considerable quantities and forms a very agreeable variation from the ordinary diet. Two species of flat-fish are known to be abundant, and the small polar cod is superlatively so. Two sculpins named in the appended list (species of *Cottus*) reach a large size and they are very common. All

[1] Report of Cruise of Corwin, 1881, pp. 58, 59.

the lagoons observed by me were well filled with sticklebacks and young sculpins. Lant and capelin abound. Smelt and grayling are reported as far around as Colville River by Capt. E. E. Smith, ice-pilot of the Corwin in 1880. A species of whitefish (*Coregonus Laurettæ*) was obtained in abundance by Captain Hooper from natives at Point Barrow. We took the red-spotted trout in our seine, and Captain Smith reports it from Colville River, where he also secured herring and humpback-salmon (*Oncorhynchus gorbuscha*). Seemann has declared that salmon are not found in Alaska north of Kotzebue Sound. This is an error; we found remains of a species of *Oncorhynchus*, which I believe to be *gorbuscha*, at Icy Cape, and Captain Smith, referred to above, salted in 1875 two barrels of humpback salmon which he bought at the mouth of Colville River. Concerning the whitefish of Point Barrow, Captain Hooper in his report, already referred to, says: "We bought from the natives . . . some fish resembling shad, but smaller and very fat; they differ also from the shad in having two (dorsal) fins. We saw the same species in Kotzebue Sound and at other places within the Arctic circle. They are called by the natives *tupook*."

Farther on he writes thus: "The salmon is the only variety of fish in the Arctic that is of any value. Although smaller than the salmon caught farther south, they are of fine flavor. They are quite plentiful, and the coast natives cure large quantities of them by smoking and drying for winter use."

The list of fishes given includes only such food-fishes as are known to occur; there are no doubt others which will be discovered by collectors in the future. The methods of capture do not differ from those already described, seines, gill-nets, hooks, and spears being employed just as they are farther south.

The following is a partial list of Arctic-Alaskan fishes:

Pleuronectes stellatus.
" glacialis.
Boreogadus saida.
Lycodes coccineus.
Cottus polyacanthocephalus.
" tæniopterus.
" humilis.
Gymnacanthus pistilliger.
Ammodytes personatus.
Osmerus dentex.
Mallotus villosus.
Coregonus Merkii.
" Laurettæ.
? Thymallus. (*Fide* Smith.)
Salvelinus malma.
Oncorhynchus gorbuscha.
Clupea mirabilis.

17. STATISTICS OF THE ALASKAN FISHERIES IN 1880.

Salmon exported from Alaska, 1880.

	Month.	Barrels.	Number.	Pounds.
Karluk River Fishery, Smith & Hirsch	June	125[1]	37,500	375,000
Do	August	399	19,950	199,500
Do	September	415	20,750	207,500
Karluk River Fishery, Western Fur and Trading Company	June	265	20,000	200,000
Do	July	240	12,000	120,000
Do	August	150	7,500	75,000
Kassilov Fishery, Western Fur and Trading Company	July	160[2]	8,000	320,000
Do	August	185[3]	18,500	185,000
Kenai River Fishery, Alaska Commercial Company		150[2]	7,500	300,000
Total		2,089	151,700	1,922,000

[1] Barrels of bellies. [2] Chowichee bellies. [3] Silver or keesitch.

Fish exported from Alaska, 1880.

Name of company.	Herring.		Halibut.		Cod.			Frost-fish.	Salmon trout.	Salmon.	
	Smoked.	Salted.	Smoked.	Fins and napes.	Dried.	Boneless.	Tongues.			Smoked.	Salted.
	Boxes.		*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Barrels.*	*Barrels.*	*Pounds.*	*Barrels.*
Alaska Commercial Company.											150
Smith & Hirsch											939
Western Fur and Trading Company.	500	pounds, 2,500 ¾-barrels, 6 barrels, 18	500	250	3,000	10,500	250	2½	7½	4,000	1,000
											2,089*
Value		$180	$50	$25	$60	$505	$25	$17	$75	$200	$19,820

* 2,089 barrels equal 151,700 fish, equal 1,962,900 pounds.

18. TABLE SHOWING THE GEOGRAPHICAL RANGE OF FOOD-FISHES IN ALASKA.

Names.	Stickeene River.	Wrangell.	Sitka.	Port Althorp.	Yakutat Bay.	Cook's Inlet.	Katmai.	Kodiak.	Belkoffsky.	Shumagins.	Unalaska.	Atka.	Kyska.	Amchitka.
Pleuronectes stellatus			×		×	×		×			×			
" glacialis														
" quadrituberculatus								×						
Lepidopsetta bilineata			×		×	×		×		×	×			
Limanda aspera			×					×		×				
Hippoglossoides elassodon								×		×	×			
Hippoglossus vulgaris			×	×		×		×		×	×			
Atheresthes stomias								×		×				
Pollachius chalcogrammus						×		×		×	×			
Boreogadus saida														
Gadus morrhua			×		×	×		×	×	×	×			
Microgadus proximus					×									
Tilesia gracilis						×		×						
Lota maculosa														
Lycodes Turneri														
" coccineus														
Cottus polyacanthocephalus			×		×	×		×		×	×			×
" tæniopterus														
" niger										×				
" humilis														
Gymnacanthus pistilliger											×1			
" galeatus											×			
Hemilepidotus trachurus			×	×		×					×		×	
" Jordanii				×		×		×		×	×			
Melletes papilio														
Sebastichthys maliger			×											
" caurinus			×											
" brevispinis				×										
" melanops			×					×						
" ciliatus								×						
Hexagrammus asper			×		×	×					×	×		
" ordinatus			×							×	×			
" superciliosus			×		×			×			×			
" scaber											×			×
" decagrammus			×	×							×			
Pleurogrammus monopterygius								×		×	×	×		

Table showing the geographical range of food-fishes in Alaska—Continued.

Names.	Stickeene River.	Wrangell.	Sitka.	Port Althorp.	Yakutat Bay.	Cook's Inlet.	Katmai.	Kodiak.	Belkoffsky.	Shumagins.	Unalaska.	Atka.	Kyska.	Amchitka.
Ophiodon elongatus			×											
Anoplopoma fimbria			×											
Bathymaster signatus			×							×	×			
Ammodytes personatus			×			×		×		×	×			
" alascanus			×											
Esox lucius														
Osmerus dentex														
" spirinchus														
Mallotus villosus			×			×		×						
Hypomesus olidus														
" pretiosus					×									
Thaleichthys pacificus	×	×	×	×			×							
Stenodus Mackenzii														
Coregonus Lauretta														
" Merkii														
" Nelsonii														
" Kennicottii														
" quadrilateralis														
Thymallus signifer														
Salvelinus malma			×	×		×		×		×	×		×	
Salmo purpuratus			×					×						
" Gairdnerii			×					×						
" irideus			×											
Oncorhynchus chouicha						×		×		×	×			
" keta			×			×		×	×					
" nerka									×		×			
" kisutch			×		×						×			
" gorbuscha						×		×	×					
Clupea mirabilis			×	×	×	×		×			×			
Catostomus longirostris														
Ammocœtes aureus														
Total			28	8	10	17	1	25	4	16	24	2	2	2

Names.	Attu.	Saint Paul Island.	Saint Lawrence Island.	Saint Michael's.	Yukon River.	Port Clarence.	Kotzebue Sound.	Diomedes.	North Alaska.	Cape Lisburne.	Point Belcher.	Point Barrow.	Colville River.	Coppermine River.
Pleuronectes stellatus				×					×				× ¶	×
" glacialis							×		×					
" quadrituberculatus														
Lepidopsetta bilineata														
Limanda aspera						×								
Hippoglossoides elassodon														
Hippoglossus vulgaris		×		×										
Atherestbes stomias														
Pollachius chalcogrammus														
Boreogadus saida				×			×			×				
Gadus morrhua			×											
Microgadus proximus														
Tilesia gracilis				×		×								
Lota maculosa					×									

Table showing the geographical range of food-fishes in Alaska—Continued.

Names.	Attu.	Saint Paul Island.	Saint Lawrence Island.	Saint Michaels.	Yukon River.	Port Clarence.	Kotzebue Sound.	Diomedes.	North Alaska.	Cape Lisburne.	Point Belcher.	Point Barrow.	Colville River.	Coppermine River.
Lycodes Turnerii				×										
" coccineus								×						
Cottus polyacanthocephalus				×							×			
" tæniopterus				×							×			
" niger		×												
" humilis				×			×				×			
Gymnacanthus pistilliger														
" galeatus														
Hemilepidotus trachurus														
" Jordanii														
Melletes papilio		×												
Sebastichthys maliger														
" caurinus														
" brevispinis														
" melanops														
" ciliatus														
Hexagrammus asper				×		×								
" ordinatus														
" superciliosus	×													
" scaber														
" decagrammus														
Pleurogrammus monopterygius	×													
Ophiodon elongatus														
Anoplopoma fimbria														
Bathymaster signatus														
Ammodytes personatus						×					×			
" alascanus														
Esox lucius					×									
Osmerus dentex				×		×								
" spirinchus							×							
Mallotus villosus				×						×	×			
Hypomesus olidus				×										
" pretiosus														
Thaleichthys pacificus														
Stenodus Mackenzii					×									
Coregonus Laurettæ					×	×						×		
" Merkii				×					×					
" Nelsonii					×							×		
" Kennicottii					×							×		
" quadrilateralis					×									
Thymallus signifer					×								× ?	
Salvelinus malma					×	×			×	×			× ?	
Salmo purpuratus														
" Gairdnerii														
" irideus														
Oncorhynchus chouicha					×									
" keta				×					×					
" nerka														
" kisutch														
" gorbuscha													× ?	
Clupea mirabilis				×		×							× ?	
Catostomus longirostris					×									
Ammocœtes aureus					×									
Total	2	3	1	15	12	8	4	1	5	3	5	3	5	1

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D.—THE FISHING-GROUNDS OF THE GREAT LAKES.

By Ludwig Kumlien and Frederick W. True.

19. LAKE SUPERIOR.

On account of the peculiar nature of the fisheries of the Great Lakes, the fishing-grounds are all located comparatively near shore. In considering them, we shall begin at the western end of Lake Superior, and proceed eastward and southward toward the eastern end of Lake Ontario.

Isle Royale to Keweenaw Point.—Gill-net grounds of considerable importance extend almost without a break along the northwestern and southern shores of Lake Superior, from Isle Royale to within a few miles of Keweenaw Point, a distance of more than three hundred miles. The bottom is everywhere clayey, except about the Apostle Islands, where it is sandy and rocky. On the northwest shore of the lake, the depth of water at the outer limit of the grounds varies from eighty to one hundred and forty fathoms, but on the south shore it is much less, being not greater than eighty fathoms at any point.

The grounds on the northwest shore are visited by Duluth fishermen in the fall. They fish commonly about forty-five miles from the village, but frequently go forty or fifty miles further north. In the spring and summer they set their nets at different points along the south shore, between Duluth and the Apostle Islands, but in the earlier part of the season they fish mostly at a station about twenty miles east of the village.

A portion of the grounds, extending eastward from the Apostle Islands one hundred and twenty-five miles, is visited by the fishermen of Bayfield and Ashland. The most favorable localities are off Iron River and Little Girl's Point, and in the vicinity of the Porcupine Mountains and Sleeping River. Different stations from Bark River to beyond Ontonagon are occupied at different times, according to the season and the movements of the fish. In the fall the nets are removed from the south shore and carried across the lake to Isle Royale.

The pound-net grounds of this district are located among the Apostle Islands and in the immediate vicinity. Other portions of the coast are too much exposed to the violence of storms, and in other respects are unsuitable for pound fishing. We may except, however, the sandy bar near the entrance to Superior City, where, in 1879, two pounds were located. During the same year one pound was set in Bark Bay, three in Siskowit Bay, sixteen among the Apostle Islands, mainly inshore, and from the islands nearest the mainland, and seven on the south side of the long sandy bar at the entrance of Chaquamegon Bay.

The most westerly seining-grounds of the lakes are at Superior City and Fond du Lac. In the former locality a very little seining for whitefish is prosecuted late in the fall. At Fond du Lac, at the head of Saint Louis Bay, the seining is more extensive, but the catch consists entirely of pike. There are many seining-reaches farther to the eastward, between Bark River and Bayfield, particularly in the smaller bays and among the islands, but the grounds are changed so often that it is quite impossible to locate them accurately. Bark Point, however, may be mentioned as one of the most favorable localities.

In winter small quantities of pike are taken in different parts of Saint Louis Bay with hook and line, and in the deeper passages among the islands near Bayfield considerable numbers of trout are caught.

ISLE ROYALE.—The fishing-grounds at Isle Royale are mostly off the south shore. The bottom is rocky for more than a mile from the island, but becomes clayey beyond. The fishermen set their gill-nets on the inshore rocky reefs early in the fall, but later in the season follow the fish into deeper water. They frequently set their nets in one hundred fathoms of water. The catch consists principally of trout. The Isle Royale grounds are frequented by the fishermen of Bayfield and of other localities on the south shore of Lake Superior.

KEWEENAW POINT TO GRAND ISLAND.—Gill-net grounds extend along this entire stretch of coast, except between Big Bay Point and Sauk's Head, a distance of about fifteen miles. The land is high at many points, and the water deep at a short distance from shore. The inshore bottom is rocky, but between Keweenaw Point and Big Bay Point it changes to clay and mud farther out, while from Sauk's Head to Grand Island sand and gravel largely predominate. The outer limit of the grounds is uniformly about seven miles from shore, where the water is forty or forty-five fathoms deep, except opposite Marquette and Train Bay, where the fishermen frequently fish ten miles from shore, in water from fifty to seventy fathoms deep.

The fishermen of L'Anse and the neighboring villages commonly set gill-nets in the fall on the west side of Keweenaw Point, opposite the entrance to the Portage Lake canal. In winter they keep near shore, generally fishing in L'Anse Bay, but in warmer weather they venture into deeper water, visiting various reefs and shoals, the position and extent of many of which is known only to themselves. A large share of the fishing is also carried on in the vicinity of the stations where pound-nets are set.

All fishing prosecuted between Sauk's Head and Grand Island is carried on by fishermen from Marquette. In the fall the grounds off Shot and Granite Points are visited, while in the spring the larger proportion of the gill-netting is prosecuted off Big Presqu' Isle and in the vicinity of Grand Island.

The principal pound-net stations of this section of the shore are at Bete Grise Bay, Portage Entry, Keweenaw and Huron Bays, the shallow bay east of Marquette, and the channel between Grand Island and the mainland. Between Keweenaw Point and Sauk's Head the nets are set in seventeen to forty-five feet of water, while further to the eastward the extremes are twenty and twenty-eight feet. During the year 1879 the pounds were distributed as follows: In Bete Grise Bay, one; at Portage Entry, two; in Keweenaw and L'Anse Bays, seven; in Huron Bay, two; between Granite Point and Presqu' Isle, one; between Marquette and Shot Point, three; and in the channel between Grand Island and the mainland, four. In 1878, and again in 1880, there were two more pounds at Grand Island. Some of the more intelligent fishermen of Marquette are now seeking some reef or shoal within convenient distance of that village, where they may catch larger quantities of fish. All the shoals now known are so far distant that they are unable, with their sail-boats, to reach them and return in one day. Many of the best pound-net grounds cannot be utilized on account of their exposed position. Even in the more sheltered localities, in stormy seasons, serious losses of netting are frequently sustained.

Small and unimportant seining-grounds exist at L'Anse and Portage Entry. Eastward the seining is prosecuted entirely in and about Marquette Harbor, and even these grounds are productive of very little except herring.

Stannard's Rock, a dangerous reef lying about forty-five miles due north of Marquette, is one of the most important trout-grounds of the Great Lakes. Marvelous stories are told

regarding the quantities of trout taken there. The grounds extend ten or twelve miles from the rock in every direction, and the water at the outer limit is more than one hundred fathoms deep in many places; the bottom is rocky and clayey. It is a very favorable place for hook-fishing, and is visited from time to time by the fishermen of Marquette.

GRAND ISLAND TO SAULT DE STE. MARIE AND DETOUR.—There are but few fishing-grounds along the south shore of Lake Superior east of Grand Island, except at Whitefish Point. Gill-net grounds extend a few miles on either side of the point, and five or six miles from land. The water is comparatively shallow and the bottom everywhere sandy. A tug visits the western grounds at certain seasons. The fishermen state that the water has receded considerably at this point within the past five years, and that fisheries of all kinds, except gill-netting, have been less successful than formerly.

The exposed condition of the coast about Whitefish Point renders the successful establishment of pound-nets quite impossible. During 1879, however, one net was set a short distance west of the point, and another to the south of it, in Whitefish Bay.

Large quantities of whitefish are caught with dip-nets in the rapids at Sault de Ste. Marie by the Indians. Not infrequently several hundred pounds are taken by a single canoe in one day. Grounds of limited extent exist in Whisky Bay, on which small quantities of fish are taken with trap-nets.

20. LAKE MICHIGAN AND THE STRAITS OF MACKINAC.

POINT DETOUR TO SEUL CHOIX POINT.—The fishing-grounds in the Straits of Mackinac and vicinity are widely scattered and difficult of location, and it is quite possible that some of them have escaped observation.

The first important gill-net ground west of Detour Passage extends from Strong's Island, about sixteen miles in a southeasterly direction, to and about Spectacle Reef. The water is very deep in the southern part of this ground, in some places approaching three hundred fathoms, but about Spectacle Reef and near shore it is of course comparatively shallow, although in some spots, in very close proximity to the former, from forty to sixty fathoms may be found. The nature of the bottom differs very much in different parts of the ground, but mud, sand, and rock predominate. This ground has the reputation of being exhausted at the present time, and very little fishing is prosecuted on it.

Some little gill-net fishing is carried on between Mackinac and Round Islands and to the westward of the latter, and also for a short distance along the shore north of Point Saint Ignace. These grounds are frequented, however, only by fishermen using but ten or twenty nets, who sell their fish to the steamers and hotels.

The whole northern shore of Lake Michigan, from the straits to Seul Choix Point, is one vast gill net ground. It is considered one of the best on the lake. Fishing is carried on at a distance of ten, fifteen, or even twenty miles from land. The favorite grounds are southeast of Point Patterson, between Simmons's Reef and Point Epoufette, westward of Saint Helena Shoal, and southwest of Point aux Chenes. On the first-mentioned ground the bottom is chiefly sandy, but on the others the sand is largely mingled with rock and clay. The depth of water does not exceed sixteen or eighteen fathoms at any point, the average depth being considerably less.

The boats fishing on these shoals belong at different points along the north shore and at Mackinac. Many Beaver Island boats also fish here, especially on the southern borders of the grounds.

Between Detour Passage and the Straits of Mackinac there are but two permanent pound fisheries. One is located at Strong's Island, the most easterly of the Les Cheneaux group. Seven pounds were employed here in 1879. It is a very important and productive fishery. The second is situated at the head of Saint Martin's Bay, where, in 1879, six shoal-water pounds were established.

On the north shore of Lake Michigan, west of the Straits of Mackinac, we find the most extensive and profitable fishing-grounds of the lake, as regards both pound-net and gill-net fishing. The first pound-nets to the eastward are those established at Gros Cap Point, eight and one-half miles west of Point Saint Ignace. The "Six-mile sand-beach," further to the west, at Point aux Chenes, is a noted and productive ground. From this point westward we find pound-nets scattered along the shore at Point Epoufette, Biddle Point, Mille Coquins Point, Point Patterson, and Scott's Point. Between Point Saint Ignace and Scott's Point, a distance of less than fifty miles, there were located in 1879 more than sixty pound-nets, and about seventy-five gill-net boats also fished there.

Along this coast the pound-nets are all set quite close inshore, and generally each man's nets in a line. Prominent exceptions, however, are furnished in the case of two firms, each of which sets two nets on a shoal about seven miles south of Mille Coquins Point. Another firm has nets set in deep water about nine miles south-southwest of Point Epoufette, and two more are set a short distance west of Simmons's Reef, and about the same distance directly south of Point Epoufette. The latter two are among the most profitable pound-nets on this shore.

THE BEAVER ISLANDS.—The shores of the Beaver Islands present very favorable conditions for the establishment of pound-nets, and they have therefore become the center of an extensive fishery. The bottom consists chiefly of sand, although in some parts, especially on the west shore of the main island, rocky grounds are very abundant.

In 1879 thirty-two pound nets were in use at the islands, sixteen of which were located on the east side of the large island which gives its name to the group, and constituted the Sand Bay fishery. Of the remaining nets, two were located at the north shore of Hog Island, two at High Island, and the others at the north, east, and south shores of Beaver Island.

At Beaver Harbor, near Saint James post-office, in the northeastern portion of Beaver Island, there is an extensive seining-reach, where, in 1879, two seines were employed.

Off Gull Island, the most westerly of the Beaver group, is a noted gill-net ground. The island is owned by three persons, each of whom employs two boats in the fishery.

SEUL CHOIX POINT TO POINT DETOUR, GREEN BAY.—The only fishery between Seul Choix Point and Point Detour is located at Point aux Barques, where, in 1879, sixty gill-nets were employed. The ground extends about four or five miles from the point, the outer limit being in about twenty fathoms of water. The bottom is generally hard and sandy.

GREEN BAY.—The fisheries of Green Bay are very extensive, and quite varied in character. The bay is a body of water of no mean proportions, being about two hundred miles in length and twenty miles in breadth at the widest part, or somewhat more than twice the size of Lake Champlain. There are many large and flourishing towns on the west shore, while the east shore is comparatively unoccupied.

In considering the fishing-grounds we shall begin at Point Detour, at the entrance of the bay, and having spoken of the grounds in Big and Little Bays de Noquette, pass southward along the west shore to Green Bay City, and thence northward along the east shore to Porte des Morts.

At the entrance of Green Bay, extending around Summer Island, within a radius of about six miles, we find an important gill-net ground, known as the Sag Bay ground. West of and adjoining the Sag Bay ground is another, six or eight miles in diameter, called the Summer Island ground. As many as three hundred and fifty gill-nets are annually employed there. Extending in a southwesterly direction from the grounds already mentioned, and directly north of Washington Island, is still another and much larger ground styled the Washington Island ground. Every summer about six hundred gill-nets are in use here, and in the fall the number swells to one thousand. The bottom, as might be expected on account of the great extent of the ground, varies considerably in character, but is generally hard and sandy. The water is comparatively shallow, the maximum depth not exceeding twenty-three or twenty-four fathoms.

There are no extensive gill-net grounds in either Big or Little Bay de Noquette, although in the latter some nets are used in winter under the ice. A few miles south of the entrance to Little Bay de Noquette, and east of Indian Town, we find a ground which supports about one hundred and thirty-five nets. The character of bottom and depth of water are about the same as those of the Washington Island ground, which, in fact, it touches at its western limit.

Between this ground and the next to the southward, a space of about five miles intervenes. The latter ground extends from near shore, in a southeasterly direction from the mouth of Bark River, about nine miles. The depth of water at the outer limit is about seventeen fathoms, and the character of the bottom is similar to that of those previously mentioned.

Farther south there are no more important "open-water" gill-net grounds, or such as are visited during the warmer weather, either on the west or east side of the bay, except at Green Bay City. The grounds extend for about two miles along the low and marshy shores at the mouth of Fox River. The nets are set in the numerous sloughs running into the marsh, and are visited every two days. Nothing is taken in them but rough fish. The only large ground still unmentioned is the Saint Martin's ground, which extends from the island of the same name into Lake Michigan eastward, northeastward, and southeastward, about eight miles.

As we have stated already, "open water" gill-net fishing has died out almost entirely south of the Bark River ground except at Green Bay City. One fisherman set a few gill-nets in 1879 directly north of the bar at the mouth of the Peshtigo River. Summer gill-net fishing is also carried on to a limited extent on the east shore, between Bay Settlement and Chambers Island, especially at the entrance of Little Sturgeon Bay, where formerly it was extensively pursued.

In winter, as soon as the ice is sufficiently firm to be walked upon with safety, the fishermen begin setting their nets. The grounds are located almost anywhere outside the ten-fathom line, often in the middle of the bay, and the nets are moved from time to time. Very few are in use north of Menomonee, many of the more important pound-owners not possessing any. Southward as far as Peshtigo they increase in number. A few are set off Suamico and between Bay Settlement and Chamber Island, on the east shore. They are set across the bay, in gangs of from five to thirty, and anchored.

The pound-net fisheries of Green Bay are very extensive and important. The larger proportion of the nets are set on the west shore, between Cedar River and Green Bay City, but many are also scattered over other parts of the bay.

On the north shore of Saint Martin's Island, at the entrance of the bay, we find the largest and deepest pound-net on the Great Lakes. The pot stands in ninety-seven feet of water, and is inclosed by stakes one hundred and twenty-five feet long, spliced three times. The net cuts off a deep channel by which the fish appear to enter the bay, and the catch is very large.

On the west shore of Big Bay de Noquette, between Saint Vital Point and Chippewa Point, seven pounds were in operation in 1879. The shores of the bay are unsettled, and the region is too far away from any shipping point to enable men to carry on the fisheries successfully. It is believed, however, that the bay abounds in fish.

At the mouth of Big Bay de Noquette, about midway between Peninsula Point and Summer Island, and nearly seven and one-half miles from any land, there is a small pound-net ground, where, in 1879, five pounds were located. The bottom is hard, and the depth of water varies from six to eight fathoms. The ground is very productive.

On the eastern shore of Little Bay de Noquette, directly opposite Escanaba, there were, in 1879, three pounds; at Masonville, at the head of the bay, one; and on the west shore of the entrance of the bay, about five miles south of Escanaba, three. The latter are so near the mouth of the bay that whitefish are caught in them in considerable quantities.

Directly opposite Indian Town, on the west shore, and about six miles from land, we find two more pound-nets. They are set in about thirty feet of water, and are very productive. They are about the only pounds that take considerable quantities of trout. A few miles farther south, but close inshore, there are two more pounds.

Between Cedar River and Little Tail Point, ten or twelve miles north of Green Bay City, we find a remarkably large number of pound-nets. In 1879 there were no less than one hundred and twenty nets situated along this section of coast. In the vicinity of Cedar River the water is very deep near shore, many of the pounds being in seventy-five feet of water, but southward the shore slopes more and more gently, forming sandy reaches, over which the water is but twenty or thirty feet deep. Between Menomonee and Suamico the nets are set on these shoals.

About four miles above the mouth of Little Suamico River, and three and one-half miles from shore, a rocky reef, nearly three miles in length, extends north and south. One net is usually set inside the reef and three placed in line east of it, the one farthest eastward being about five miles from shore.

The catch in all the pounds on this section of coast consists principally of herring.

The pound-net grounds of Green Bay City are located near the mouth of Fox River, in about fifteen feet of water. Four large pound-nets and seventeen "baby-pounds" owned in the city, together with a number of others, were employed here in 1879.

At the present time the pound-net grounds of the east shore of Green Bay are located between Shoemaker's Point and Little Sturgeon Bay. The whole extent of coast occupied is not more than six miles. Two nets are also set off Chambers Island. The latter grounds were formerly of great importance, but they are now almost abandoned.

At the head of Big Bay de Noquette, in Ogontz Bay, there is a single seining-reach, and another at the head of Little Bay de Noquette. The catch in these nets consists chiefly of rough fish and sturgeon, whitefish and trout not being found so far up in the bays.

There are but four seining-reaches on the west shore of Green Bay which are now visited by the fishermen. Two are located a short distance south of the mouth of the Menomonee River. There is also one at the mouth of the Suamico River, and one at the mouth of the Oconto River. Both, however, are insignificant, no large hauls having been made within seven years. Formerly seining was a leading industry in this section, but many of the old grounds are now occupied by pound-nets. From 1858 to 1865, seines were used on all suitable shores in this vicinity, and large quantities of fish were taken.

At Green Bay City five large seines were in use in 1879. The yield of this fishery is very large.

On the shoals south of Green Island, which is situated in the middle of the bay, southeast of Menomonee, hook-fishing is prosecuted to a considerable extent. Prior to 1867, this fishery was quite extensive and important.

At Green Bay City about one hundred and fifty fyke-nets are set in Fox River, near the mouth, and various species are taken.

Hook-fishing is carried on on the east shore of Green Bay, in Door county, to a very limited extent.

De Pere being situated at the head of Fox River, and not directly on Green Bay, its fisheries may be more properly considered separately, although they are of little importance. The catch consists principally of dory, pickerel, catfish, and sturgeon, but some whitefish are also taken. A number of small gill-nets are used and two seines, together with about one hundred dip-nets. In the latter many kinds of fish are taken, such as moon-eyes, which are only used for manure or as bait for catfish.

PORTE DES MORTS TO PORT WASHINGTON.—The first gill-net grounds on the west shore of Lake Michigan, south of Porte des Morts, are near Jacksonport, around the Cana Islands. Gill-net fishing was formerly prosecuted here to a considerable extent, but pound-nets have gradually taken their place so that only about a hundred gill-nets remain between Porte des Morts and Clay Banks, a distance of about thirty miles.

The next gill-net ground is at Clay Banks. It extends about two miles north of the village and the same distance south of it. At the outer limit the water is from ten to fourteen fathoms in depth and the bottom is everywhere rocky. The principal species of fish caught here is the trout.

About four miles south of Clay Banks we find another small gill-net ground. In 1879 there were two small gangs of fishermen here who employed gill-nets in taking trout. As a rule they fish in not more than ten fathoms of water.

Between Stony Creek and Two Creeks on the south, a distance of about twenty-five miles, there are no fishing-grounds of any sort. At Two Creeks, however, we reach the upper end of the great gill-net grounds, frequented by the fishermen of Two Rivers. These grounds extend from nearly opposite Two Creeks on the north to Manitowoc on the south, a distance of about fourteen miles. The inner limit of the grounds is uniformly about two miles from shore, where the water is from ten to fourteen fathoms in depth. At the outer limit of the grounds, about ten miles from shore, we find eighty or ninety fathoms of water. This outer region, however, is visited only by the tugs, the smaller Mackinac boats fishing closer inshore. The catch consists chiefly of trout, blackfins, and lawyers.

Passing southward we find the next gill-net ground opposite Sheboygan. This ground extends from two and one-half to eighteen miles from shore, the water varying from twelve to sixty or seventy fathoms in depth. This ground was abandoned in 1866 on account of the scarcity of fish, but a few years later, fishing being resumed, the yield was as large as, or larger than, ever before known.

The most northerly pound-net ground on this section of coast is located at Jacksonport. The grounds are situated a little to the southward of the village, and the nets are usually set about a mile from shore. At Whitefish Bay, about seven miles south, is one of the oldest and best known whitefish grounds on the lake. The bottom here is ridgy, clay and gravel alternating in furrows. This kind of bottom is believed to be that most frequently visited by whitefish.

The next pound-net ground to the southward is located between Two Creeks and Manitowoc, and between the shore and the outer limit of the great Two Rivers gill-net ground. The bottom

is generally sandy and the maximum depth of water not more than six or seven fathoms. In 1879 thirty-three pounds were situated here.

Another pound-net ground is located about thirteen miles north of Port Washington, opposite the small village called Amsterdam. The ground extends about four miles north and south. The bottom is everywhere sandy. The pounds are usually set in from twenty-five to sixty feet of water. Pound fishing was first introduced here in 1862.

At Oostburg there is a pound-net ground extending along six or seven miles of shore. The outside nets are located about a mile from shore.

At Port Washington the nets are usually set in from thirty to fifty-five feet of water, the majority being in about forty-five feet.

There are no shoals or reefs in the immediate vicinity of Jacksonport, but at a distance of twenty-five miles there is an extensive shoal which was formerly a very famous trout ground. It is now seldom visited.

PORT WASHINGTON TO SOUTH CHICAGO.—The most important gill net grounds within these limits are in the vicinity of Milwaukee. The fishermen set their nets in a southerly and southeasterly direction from Milwaukee from ten to forty miles, northward to northeastward forty to ninety miles, and eastward from fifteen to fifty miles. The principal outside ground is the Big Reef, which is situated directly opposite Milwaukee, at a distance of about forty miles, but runs in a southeasterly and northwesterly direction, so that its most northerly limit is only about fifteen miles off shore opposite Port Washington. Inside of this reef and only about six miles from shore there is another productive ground.

During summer the fishermen go to the outside reef, but in the fall, when the fish are spawning, they visit the inner one. Mr. Schultz, of Milwaukee, states that there are apparently less fish on the outer reef than there were twenty-five or twenty-six years ago, but that there has been no perceptible diminution on the other portions of the grounds.

The gill-net grounds at Racine extend from Wind Point, a short distance north of the city, to about four miles south of the city. The nets are usually set at distances of from three to twenty miles from shore, the water varying in depth from ten to seventy-five fathoms. The greater portion of the fishing, however, is done in water about twenty fathoms deep and from six to ten miles from shore. The catch consists principally of whitefish, trout, and lawyers, and rarely a few other kinds of no commercial importance.

We find the next gill-net ground about three miles south of Kenosha. The southern portion of this ground is about fifteen miles distant from shore. The boat fishermen fish from twelve to sixteen miles from shore, but the tugs sometimes go as far as twenty miles. At the outer limit of the ground the water is about seventy-five fathoms deep.

In the vicinity of Milwaukee the only pound-net station is in Whitefish Bay, a short distance north of the city. Only two nets were in use there in 1879.

In the vicinity of Waukegan pounds are set along the sandy beach for a distance of about twelve miles, the northern limit of the ground being about nine miles north of the city. The bottom slopes gently from the shore, and the character of the ground is such that there is no difficulty in driving the stakes firmly. The quantity of fish taken here is about one-fourth less than it was twenty years ago. In 1879 twenty-nine nets were located on different parts of this ground.

At Chicago a few nets are set directly off the mouth of the river in comparatively shallow water, and at South Chicago also the pounds are located very near shore.

SOUTH CHICAGO TO SAUGATUCK.—There are no fishing-grounds at the head of Lake Michigan, between South Chicago and Michigan City. Between Michigan City and Saint Joseph the gill-net grounds are situated a long distance from shore. In summer the fishermen commonly go seven to fifteen miles from shore, and in winter much farther. The water, however, on these grounds is comparatively shallow, at a distance of twenty miles being not more than twenty-eight fathoms. The bottom is principally sandy, but clay and gravel predominate in some places. From New Buffalo northward the grounds curve gradually outward, the outer limit opposite Saint Joseph being from eight to twelve miles in summer, and in winter from fourteen to twenty miles. Beyond Saint Joseph the outer boundary curves inward again, until at South Haven it is quite near shore. Although the distance to which the boats go is very great, the water is not deep at the outer limit, being scarcely more than sixty fathoms. A few miles south of Saugatuck and comparatively near shore there is a whitefish spawning-ground, which for a long time has been very productive. In 1879 the fishing at this point proved almost a failure. With the exception of this ledge, the bottom is generally sandy or clayey, and the fishermen set their nets almost anywhere in certain depths with equally good success. One fisherman stated that he had fished with his boat to a distance of twenty-five miles due west from Saint Joseph, but it is certainly dangerous for the fishermen to go such distances in small boats, although the steam-tugs, of course, can safely go much farther.

Hook-fishing is carried on on the same grounds opposite Saint Joseph.

In former years seining was carried on to a considerable extent on this coast, but at the present time the fish do not come inshore. It is supposed that the foulness of the rivers has driven them into deeper water.

The pound-net grounds of this section extend from a few miles south of Michigan City to New Buffalo. All the nets are set close inshore, in water from twenty-five to fifty-two feet deep. The bottom consists of hard sand, and is very suitable for the driving of stakes.

SAUGATUCK TO MANISTEE.—From Saugatuck northward the grounds gradually extend outward, and at Grand Haven it is not an unusual occurrence for a boat to go out thirty miles. North of Grand Haven the outer boundary again bends inward, and at Whitehall boats usually fish not further than from two to four miles from shore. The most productive parts of this ground are said to be at Whitehall and Muskegon, but as there are no good shipping facilities at these points, very little fishing is done. No particular kind of bottom is sought for by the gill-netters, the depth of water appearing to be a more important consideration. It is supposed that in cold weather the fish pass out into deeper water, as it is found necessary in winter to go a much longer distance from shore than in summer in order to find profitable grounds.

At Pentwater most of the gill-net fishing is prosecuted in about forty fathoms of water, though the fishermen occasionally go as far as fifteen miles from shore, where the water is seventy or seventy-five fathoms in depth. These grounds are considered to be less productive and to have been greatly damaged by mill refuse. At Ludington most of the fish are taken at a distance of about ten miles from shore, but northward the outer limit of the ground gradually comes nearer and nearer shore. The most productive portion of this ground is at Big Point Sable, although even here fish are much less abundant than formerly. In 1875 the firm of Wilson & Brothers had a line of gill-nets in use here, which was about eight miles in length.

But little gill-net fishing is carried on at Manistee. A few boats fish here in from nine to forty fathoms of water, the outer limit of the ground being about eight miles from the shore.

There are but few pound-net stations along this whole section of coast. A short distance on either side of Big Point Sable six pounds were established in 1879, set close inshore, in from thirty to forty feet of water. A short distance from Ludington one pound is in use.

MANISTEE TO CROSS VILLAGE, INCLUDING LITTLE AND GRAND TRAVERSE BAYS AND FOX ISLANDS.—The most southerly gill-net grounds of this section, of any importance, are situated on the west shore of Grand Traverse Bay between Cat-Head Point and Sutton's Point. Of these the most noted are at the entrance of Grand Traverse Bay, where vast numbers of blackfins are taken. One of the greatest spawning-grounds in the lake is situated off Light-house Point to the eastward and northeastward, but from its position it is so exposed to the winds, and the bottom is also so rocky, that no fishing can be done. South of New Mission Point there are no fisheries in Grand Traverse Bay, on the west shore, except in Sutton's Bay, where large quantities of herring are taken. On the east shore there is but one fishery, which is situated a little to the north of Torchlight Lake.

The most southerly pound-net station of this section is at Good Harbor Bay, where, in 1879, two nets were located. In Grand Traverse Bay there are several important stations, the one most worthy of notice being in Northport Bay. Six nets were in use here in 1879. Just north of Northport Point we find three more nets. At Hog Island, near the head of the west arm of Grand Traverse Bay, there is one pound-net station where one net is located. North of Grand Traverse, between Petoskey and Cross Village, there are three pound-net stations. Two are located on the north shore of Little Traverse Bay, and one farther northward near its mouth. Five nets in all were employed at these stations in 1879.

Important gill-net grounds extend from Charlevoix to Cross Village. The outer limit of the ground is about 4 miles from shore. Fishing is carried on at all seasons. The maximum depth of water is about 45 fathoms. The bottom is rocky and clayey.

Off the east shore of North Manitou Island there is a small gill-net ground, which is visited by three fishermen. The water varies from thirty to sixty fathoms in depth. The bottom is clay.

Due east of South Manitou Island, a distance of about three miles, there is one pound-net station.

Gill-net grounds extend about South Fox Island to the outer limit of the great sandy shoal which exists there. The fishermen fish on the north and east shores of Fox Island in summer, but in winter usually fish most extensively on the west shore. Between the two islands two pound-nets are located.

CROSS VILLAGE TO LAKE HURON.—Between Cross Village and Point Wangoshance there are a few pound-net stations, but in 1879 the fishery proved almost a failure. The shore is too rocky and exposed for successful fisheries of this sort. Two pound nets are set to the northward of Wangoshance, a few miles east of old Fort Mackinac.

21. LAKE HURON.

STRAITS OF MACKINAC TO ALCONA.—Very little fishing is done on the section of coast between Point Wangoshance and Thunder Bay Point. In Hammond's Bay, near the eastern entrance of the Straits of Mackinac, there are eleven pound nets.

The Alpena gill-net grounds are located east and north of North Point as far as, and beyond, Middle Island, the outer limit being about fifteen miles from shore. There is no gill-net fishing in Thunder Bay proper. It is estimated that the abundance of fish here is only one-third what it was ten years ago.

The pound-net stations in Thunder Bay are situated on the north shore, between North Point and Whitefish Point. Fifteen nets were located here in 1879. On the shore at the north of Sulphur Island, in four or five fathoms of water, there are four nets. The bottom on this ground is very hard and stony.

ALCONA TO POINT AUX BARQUES, INCLUDING SAGINAW BAY AND THE CHARITY ISLANDS.—Gill-net fishing is not prosecuted to any considerable extent on this shore. The pound-net fishing of Saginaw Bay is very important. The shores of the bay are very sandy, and great shoals extend from the shore, upon which pounds can be established very firmly. The most westerly station is at Ottawa Point, near the mouth of the bay, where two nets are located. Three other stations on the west shore of the bay are located at Gravelly Point, Point aux Grès, and south of the shoal at the mouth of Rifle River. At the head of the bay the stations are very numerous. They are set at approximately regular intervals along the whole shore between Nayaliquing Point and Fish Point. Not less than one hundred nets were in use within these limits during the year of the canvass.

The sandy shoal, on which the nets at the head of the bay are placed, extends out a great distance from the west shore, and in this part of the bay four lines of nets, comprising in all about fourteen, are located at distances of from six to eight miles from land. Three other stations are located respectively at North Island, the main shore about four miles north of Sebewaing, and at about two miles east of North Mineshas Island, at the edge of the inner shoal. The most easterly shoal occupied by pounds is that making off north of Sandy Point. Four lines of nets were in use here in 1879. Three lines of nets are also located on the shoals which extend from the Charity Islands, situated in the middle of Saginaw Bay near the mouth.

The Charity Islands fisheries are considered to be the most profitable on the whole chain of lakes. On the north and northeast portion of these grounds, however, the nets are greatly exposed to storms, and heavy losses frequently occur.

Seine fisheries are still carried on quite extensively in this district. At the head of the bay, on the west shore, there are several important seining reaches. The principal ones are situated, (1) near the mouth of the Saginaw River on the west side of the mouth of the Ogahkaning River, (2) midway between the Opinkawning and Saginin Rivers, (3) midway between the Rifle and Pine Rivers, and (4) on either side of Gravelly Point. The last three fisheries are carried on by the Indians. The one between Rifle and Pine Rivers is the oldest and best known seine-fishery in Saginaw Bay.

There are no gill-net fisheries in Saginaw Bay proper, but to the northward of Point aux Barques and Point au Sable there are several important grounds. Some gill-netting is still carried on in winter, but this branch of the fisheries has declined very much within the last ten years. The same may also be said of the seine-fisheries, but on the other hand the number of pound-nets has considerably increased within that time.

The winter fishing in Saginaw Bay is very important, and gives employment to a large number of men. Not only gill-nets and pound-nets, but hooks and spears are used, the last being by far the most convenient and effective device for the capture of fish. The location of the spearing grounds varies according to the season and the thickness of the ice. The fishery is usually carried on, however, outside of a line drawn from Point aux Grès to the west shore of Sebewaing. During a profitable season quite a village springs up on the ice, and a variety of supplies are brought out by the buyers of the fish. It is stated, however, that the fishery is becoming less and less profitable every year. A few years ago the spearing was so profitable that a supply of fish could always be

depended upon, but the experience of the last few years seems to show that the decrease has been so great that dealers will no longer depend upon obtaining a supply from the spearmen.

Besides the bay fisheries, there are quite a number of pound-nets located in Saginaw River, extending from its mouth about twenty miles inland. They are set in from ten to twenty-four feet of water, and large quantities of fish, especially pike, perch, and suckers, are taken. The river fishery differs somewhat from the bay fishery, inasmuch as it is only prosecuted in winter.

At the mouth of the Ogahkaning River, a pond about two acres in extent has been constructed for the purpose of keeping fish when caught in great abundance, so that when the amount of fish taken is small the fishermen may still be able to supply the demand of the dealers. The pond is now only six feet in depth, but the owners propose dredging it and also extending its area.

POINT AUX BARQUES TO PORT HURON.—Gill-net fishing is prosecuted all along the shore of Lake Huron from Point aux Barques to Port Huron, the principal stations being at Port Austin, Grindstone City, Huron City, Port Hope, Sand Beach, White Lake, Forestville, Port Sanilac, and Lexington. Fishing is carried on more or less extensively at all these points, but the most important are Sand Beach and Port Hope. The grounds extend from five to twenty-five miles from shore. The catch consists mainly of whitefish and trout.

There are no pound-nets in use between Point aux Barques and Port Huron, the shore being much exposed to the violence of storms. There are many seining reaches all along this section of coast, but the fishing is not carried on so extensively as formerly.

PORT HURON TO DETROIT, INCLUDING SAINT CLAIR RIVER AND LAKE SAINT CLAIR.—All fishing in Saint Clair River is carried on by means of seines. The grounds extend along twenty miles of the river, and there are in all five fisheries on the American side. Seines are also employed along the shore of the lake, but not so extensively as formerly. The season opens about the middle of May and lasts until August.

FISHING-GROUNDS ON THE DETROIT RIVER.—The fisheries in Detroit River, with the exception of those carried on by means of a few fykes and "baby" pounds, is prosecuted by the aid of seines about sixty fathoms in length. There are thirty fisheries on the river between Windmill Point at its head and Bar Point at its mouth. They are located both on the American and Canadian shores, and on the islands which occupy the central portion of the river. The most northerly are situated at Isle a la Pèche, at the head of the river. South of this, on the American side, there are two more reaches. On the east shore of Belle Isle there are three fisheries, and on the west shore one. South of Belle Isle there are no more until we have passed the city of Detroit. Off Fort Wayne, on the American side, there are four fisheries, and a little to the northward, opposite the town of Sandwich, on the Canadian side, one. The next five are on the Canadian side, the most northerly being about a mile north of Sandwich. On the west shore of Fighting Island there are five fisheries, and on the east shore of Grassy Island two. On the northeastern shore of Grosse Isle we find three fisheries; at Stony Island, further to the south, one, and at Sugar Island still another. The latter is the most southerly ground on the river. Many of these reaches are located on the mud banks that make off from the shore, but in some places the bottom is sandy and stony. The catch consists of whitefish and pike. A few days before the whitefish appear there is usually a run of herring, and a smaller mesh in the pockets of some of the seines is used for the purpose of taking them.

22. LAKE ERIE.

MOUTH OF THE DETROIT RIVER TO PORT CLINTON.—Along this section of shore fishing is prosecuted almost entirely with pound-nets. Stations extend without interruption from Bar Point, at the mouth of the Detroit River, to Port Clinton. Between these two points, in 1879,

there were not less than 425 pound-nets. Each company's nets are set in a line, the outer net being often four or five miles from shore. The fisheries of Toledo extend from Teal Ground to Locust Point.

Off Toussaint, about ten miles west of Port Clinton and three miles from shore, there is a gill-net ground of considerable importance. The bottom here varies greatly, in some portions being rocky and in others muddy or sandy. The water at the outer limit of the ground is about twenty-eight fathoms in depth.

Some seining is prosecuted in and about the mouths of the various rivers along this stretch of shore. At Portage River it is carried on only in winter. A few fyke-nets are set in Portage and Four Rivers as well as in some of the bayous, but the fishery is not important, although considerable quantities of inferior varieties of fish are taken.

PORT CLINTON TO VERMILLION.—The pound-net grounds continue without interruption along this section of shore. The fishing-grounds of Sandusky and vicinity may be divided into four great districts, each partaking of some peculiarity not shared by the others. They are generally spoken of as the Cedar Point fisheries, the bay fisheries, the island fisheries, and the main shore fisheries. The Cedar Point fisheries are the oldest and most important. They begin at Cedar Point, at the entrance of Sandusky Bay, and extend about six miles towards Huron. There are sixty-six nets in this district. Many of the outside nets are five and one-half miles from shore, the nearest being about one-half mile. They are set in from twenty to thirty feet of water, the average depth being perhaps about twenty-eight feet. The shore as well as the bottom of the fishing-ground is sandy. The catch here consists largely of herring, but great quantities of whitefish are also taken.

The bay fisheries are prosecuted not only with pounds but also with fykes and seines, the stations and reaches being scattered along both shores. The water in both the upper and lower bays being shallow, nets having a depth of five to twelve feet only are used.

The main shore fisheries extend from Sugar Bluff to the entrance of Sandusky Bay, the pound-net stations being scattered regularly along the shore. They are set in from twelve to thirty-five feet of water. The bottom is generally clayey. This fishery is noted for the large catch of herring, the next fish in importance being the catfish.

What are known as the island fisheries are situated about North, Middle, and South Bass Islands and Kelley's Island. On the North Bass Island there are but seven nets, though northwestward from the island there is an extensive whitefish spawning-ground. On the north of the island it is impossible to drive stakes on account of the rocky bottom. At Middle Bass Island there are twelve nets, many of them being set in thirty-five feet of water. The fisheries at South Bass Island are the most important of the group. On the shoals and reefs about the islands there are extensive and important whitefish spawning-grounds. The most productive of them, however, are those north of North Bass Island, in Canadian waters. At Kelley's Island there are twenty-three pounds, and the fishery would be very profitable were it not that vessels run through and destroy the nets. The principal fish taken on these grounds are herring, whitefish, and black bass. The seine-fishing in this locality is quite extensive and important. The principal grounds are located about Willow Point. In Sandusky Bay seine fishing is carried on all winter. The principal grounds are near the mouth of the Sandusky River.

North and northeast of Kelley's Island there are two reefs, which are frequented by sturgeon, and about two hundred gill-nets are set here annually.

The pound-net grounds of Huron extend about five miles east and the same distance west of the mouth of the Huron River. In 1879 seventy-four pounds were located in this district. Five

miles east of Huron there is a small whitefish spawning-ground, but the bottom is very rocky and only one net is located there. The pounds are set in from twenty-two to forty-two feet of water, most of them being from seventy-five rods to three and one-half miles from shore. The "driving bottom" in most portions of the Huron grounds is excellent, the outer portions being better in this respect than the inside grounds. The clay bottom of the lake is covered by layers of sand forming the best kind of "holding ground." The catch at Huron consists chiefly of herring; in fact, these grounds are considered the most favorable for herring fisheries of any on the lake. The general fishery is also very profitable, there never having been a failure since it was begun. The migratory varieties, such as whitefish, are taken only while passing, but herring and blue pike are always present in abundance. Such fish as go towards the head of the lake to spawn sometimes fail to reach that locality, and consequently there is liable to be a failure there, but small quantities, at least, are always caught on the Huron grounds. Very extensive herring spawning-grounds are situated here, and this fact possibly accounts for the extraordinary numbers of this fish which are taken here in autumn.

The Vermillion fishing-grounds occupy but a very small extent of shore, the nets being set at but one station and close together about four miles west of the mouth of Vermillion River. Nets are set in from thirty to forty feet of water, and from two and one-half to three and one-half miles from shore. The bottom is all clay, and very favorable both for driving the stakes and holding them firmly.

VERMILLION TO CONNEAUT.—The most westerly pound-net grounds of this section of shore extend from Vermillion to the mouth of Black River, a distance of about eleven miles. The next station to the eastward, known as the Dover Bay fishery, is about six miles east of Black River. Only twelve pounds are set here in water from twenty to forty feet deep, the inner pounds being about seventy rods from shore, the outer about one and one-fourth miles. The bottom is sandy and the "holding ground" very good. Passing easterly we find the next stations between Chagrin River, near Willoughby, and Grand River, near Painesville. Thirteen nets were used here in 1879. The only other station in this section is situated about three miles east of the mouth of Grand River, where there are four nets. The bottom, as at other points along this shore, is sandy and gravelly.

Between Ashtabula and Conneaut we find important gill-net grounds extending twenty-five miles from shore. In spring the fishermen do not go farther than twelve miles from shore, but in summer they go to the outer limit of the ground, about twenty-five miles distant. Large quantities of whitefish and blue pike are taken on these grounds. The fishermen are well acquainted with the migrations of the different species and follow them from shoal into deep water and *vice versa*.

There are two seining reaches at the mouth of Conneaut Harbor, which are visited for a short time in the spring and in some years a few days in autumn.

CONNEAUT TO BUFFALO.—The fishing-grounds of Erie extend from about eight miles west of the "Head" to the western part of the peninsula encircling Erie Bay and pass in a northeasterly direction, the distance from shore varying from four to fifteen miles according to the season. The greater portion of the fishing is prosecuted in from twelve to eighteen fathoms of water. In the spring the fish come from the westward and the grounds earliest visited are west of the "Head," but the best fishing is always north-northeast of the mouth of the harbor and about ten miles out. No considerable quantity of whitefish is taken within four miles of shore. The abundance of fish on the Erie grounds is thought to be increasing. The largest quantities of whitefish are taken in June and July and in the fall about the middle of October. Later than this, quantities of pike are

taken in small-mesh nets, set three or four miles from shore. Pound-nets are not allowed nearer shore than three miles, so that all fishing is done with gill-nets and hooks.

Many years ago Barcelona was the most important fishing town on Lake Erie, but at present the grounds are almost entirely depleted. The grounds at Dunkirk were also famous for a long time, but very little fishing is prosecuted in that locality at present.

23. LAKE ONTARIO.

There are no important fishing-grounds on the south shore of Lake Ontario between the Niagara River and Port Ontario, and very little fishing is carried on along this shore. The only important grounds are located at the east end of the lake and on the north shore within Canadian limits. There are small and unimportant gill-net grounds at Poultneyville, Fairhaven, Oak Orchard, Wilson, Braddock's Bay, Charlotte, and Cole's Landing, near Oswego, where a limited amount of fishing is carried on, the products of which are principally for local consumption. A few small seines are also employed along this stretch of coast for the same purpose.

At Port Ontario the seining-grounds begin a mile and a half north of Salmon River and extend along the shore towards Sturgeon Point, a distance of about six miles. Outside are located the gill-net grounds, the nets being in from sixty to two hundred feet of water, and from one and a quarter to seven miles from land.

Near Cape Vincent one pound is located, set in about twenty feet of water, and at Bear Point there are two in eighteen feet.

Along the entire shore from Port Ontario to Amherst Island, there are numerous gill-net grounds, famous localities being about the Duck Islands and Torch Islands, Long and Bear Points.

This whole stretch of shore also furnishes suitable grounds for traps and fykes, some localities being particularly suited for bull-head fishing. Southwest of Point Peninsula there is a famous white-fish ground. Traps and fykes are set along the Saint Lawrence River, on the American side, for a considerable distance.

Sacket's Harbor grounds are situated about Black River Bay, Chaumont Bay, and in the lake off Grenadier and Fox Islands, Stony Point, etc. The principal fishery, however, is located at Duck Island, in Canadian waters. These grounds are considered the most profitable on the entire lake.

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E.—THE GEOGRAPHICAL DISTRIBUTION OF FRESH-WATER FOOD-FISHES IN THE SEVERAL HYDROGRAPHIC BASINS OF THE UNITED STATES.

By David S. Jordan.

The following collection of partial faunal lists has been prepared for the purpose of indicating the number of species of fishes suitable for food occurring in the several hydrographic basins of the United States.

GEOGRAPHICAL LISTS OF THE INLAND FOOD-FISHES OF THE UNITED STATES.

24. THE GREAT LAKES.

Lota maculosa. Lawyer.
Haploidonotus grunniens. Sheep's-head.
Percina caprodes.
Perca americana. Yellow Perch. Perch.
Stizostedion canadense. Wall-eyed Pike.
Stizostedion vitreum. Sauger.
Roccus chrysops. White Bass.
Micropterus salmoides. Black Bass.
Micropterus dolomiei. Small-mouth Black Bass.
Pomoxys sparoides. Bar-fish.
Ambloplites rupestris. Rock Bass.
Chænobryttus antistius.
Lepomis cyanellus.
Lepomis pallidus.
Lepomis megalotis.
Lepomis gibbosus. Common Sunfish.
Esox nobilior. Muskellunge.
Esox lucius. Pike.
Esox vermiculatus.
Percopsis guttatus.
Coregonus quadrilateralis. Menomonee Whitefish.
Coregonus labradoricus.
Coregonus clupeiformis. Whitefish.
Coregonus Artedi. Lake Herring. Cisco.
Coregonus Hoyi. Cisco.
Coregonus nigripinnis. Blue-fin.
Coregonus tullibee.
Thymallus tricolor. Grayling.
Salvelinus namaycush. Lake Trout. Mackinaw Trout.
Salvelinus siscowet. Siscowet.
Salvelinus fontinalis. Brook Trout.
Hyodon tergisus. Moon-eye.
Clupea vernalis. Saw Belly.
Semotilus corporalis.
Nocomis biguttatus.
Notemigonus chrysoleucus.
Notropis megalops. Shiner.
Moxostoma carpio.
Moxostoma macrolepidotum. Red Horse.
Moxostoma aureolum. Mullet Sucker.
Moxostoma anisura.
Moxostoma velatum.
Minytrema melanops.
Erimyzon sucetta. Creek-fish.
Catostomus teres. Common Sucker.
Catostomus catostomus. Long-snouted Sucker.
Carpiodes cyprinus. Carp Sucker.
Ictalurus punctatus. Channel Cat.
Amiurus nigricans. Great Lake Catfish.

Amiurus natalis.
Amiurus vulgaris.
Amiurus nebulosus. Bull-head Catfish.
Amiurus melas. Bull-head.
Noturus flavus.
Anguilla rostrata. Eel.
Amia calva. Dogfish.
Lepidosteus platystomus. Gar Pike.
Lepidosteus osseus. Billfish. Gar Pike.
Acipenser rubicundus. Sturgeon.

25. THE LAKES OF MAINE.

Lota maculosa. Eel-pout.
Perca americana. Perch.
Lepomis auritus.
Lepomis gibbosus.
Coregonus labradoricus.
Salvelinus namaycush. Togue. Lunge.
Salvelinus oquassa. Blue-back Trout.
Notropis megalops.
Erimyzon sucetta.
Catostomus teres.
Amiurus nebulosus.

26. THE CONNECTICUT RIVER BASIN

Lota maculosa. Eel-pout.
Perca americana. Perch.
Lepomis auritus. Sunfish.
Lepomis gibbosus. Sunfish. Roach.
Esox reticulatus. Pickerel.
Esox americanus. Pickerel.
Salvelinus fontinalis. Trout.
Semotilus bullaris. Chub.
Notemigonus chrysoleucus. Shiner.
Notropis megalops. Dace.
Erimyzon sucetta. Sucker.
Catostomus teres. Sucker.
Amiurus catus. Bull-head.
Anguilla rostrata. Eel.

27. THE HUDSON RIVER BASIN.

Perca americana. Perch.
Lepomis auritus. Sunfish.
Lepomis gibbosus. Pumpkin Seed. Sunfish. Roach.
Esox reticulatus. Pickerel.
Esox americanus. Brook Pickerel.
Salvelinus fontinalis. Trout.
Exoglossum maxillingua.
Semotilus corporalis. Dace. Horned Dace.
Semotilus bullaris. Dace. Horned Dace.
Notemigonus chrysoleucus. Shiner.
Notropis megalops. Horned Dace.
Erimyzon sucetta. Sucker.
Catostomus teres. Sucker.
Amiurus catus. Bull-head.
Anguilla rostrata. Eel.
Acipenser oxyrhynchus. Sturgeon.

28. THE DELAWARE RIVER BASIN.

Perca americana. Perch.
Roccus lineatus. Rockfish.
Roccus americanus. White Perch.
Mesagonistius chætodon. Banded Sunfish.
Enneacanthus obesus. Spotted Sunfish.
Enneacanthus simulans.
Pomoxys sparoides. Goggle-eyed Perch.
Acantharchus pomotis. Mud Sunfish.
Lepomis auritus. River Sunfish. Ruddy Rudder. Black-eared Sunfish.
Lepomis pallidus. Blue Sunfish.
Lepomis gibbosus. Sunfish.
Micropterus Dolomiei. Black Bass.
Esox reticulatus. Pike.
Esox americanus. Ditch Pike.
Salvelinus fontinalis. Trout.
Semotilus corporalis. Chub.
Semotilus bullaris. Chub.
Notemigonus chrysoleucus. Roach.
Notropis megalops. Redfin.
Erimyzon sucetta. Mullet.
Catostomus teres. Sucker.
Amiurus albidus.
Amiurus nebulosus. Catfish.
Anguilla rostrata. Eel.
Lepidosteus osseus. Gar Pike.

29. THE SUSQUEHANNA RIVER BASIN.

Percina caprodes.
Perca americana. Perch.
Lepomis auritus. Pumpkin Seed.
Lepomis gibbosus. Pumpkin Seed.
Esox reticulatus. Pike.
Esox americanus. Pickerel.
Salvelinus fontinalis. Trout.
Semotilus corporalis. Chub.
Semotilus bullaris. Fall fish.
Nocomis biguttatus. Horned Dace.
Notemigonus chrysoleucus. Shiner.
Notropis megalops.
Exoglossum maxillingua. Cut-lips.
Erimyzon sucetta. Sucker.
Catostomus nigricans.
Catostomus teres.
Carpiodes cyprinus.
Amiurus albidus. Catfish.
Amiurus lophius. Catfish.
Amiurus nebulosus. Catfish.
Anguilla rostrata. Eel.
Lepidosteus osseus. Gar.

30. THE POTOMAC RIVER BASIN.

Percina caprodes.
Perca americana. Perch.
Pomoxys sparoides.
Lepomis auritus. Bream.
Lepomis gibbosus.
Esox reticulatus. Pike.
Esox americanus. Pickerel.
Salvelinus fontinalis. Trout.
Dorosoma Cepedianum. Mud Shad.
Carassius auratus. Gold-fish.
Semotilus corporalis.
Semotilus bullaris.
Nocomis biguttatus.
Notemigonus chrysoleucus. Shiner.
Notropis megalops.
Moxostoma macrolepidotum. Mullet Sucker.
Erimyzon sucetta.
Catostomus nigricans.
Catostomus teres.
Amiurus albidus. Catfish.
Amiurus catus. Catfish.
Amiurus lophius. Catfish.
Anguilla rostrata. Eel.
Lepidosteus osseus. Gar Pike.

31. THE NEUSE RIVER BASIN.

Perca americana.
Micropterus salmoides. Chub.
Centrarchus macropterus.
Pomoxys sparoides.
Pomoxys annularis.
Ambloplites rupestris.
Chænobryttus gulosus.
Acantharchus pomotis.
Lepomis auritus.
Lepomis gibbosus.
Esox reticulatus.
Esox americanus.
Salvelinus fontinalis. Trout.
Dorosoma Cepedianum.
Semotilus corporalis.
Nocomis biguttatus.
Notemigonus americanus.
Notropis megalops.
Moxostoma macrolepidotum.
Moxostoma crassilabre.
Moxostoma cervinum. Jump Rocks.
Moxostoma album.
Moxostoma velatum.
Moxostoma papillosum.
Erimyzon sucetta.
Catostomus teres.
Amiurus niveiventris.
Amiurus natalis.
Amiurus nebulosus.
Amiurus platycephalus.
Anguilla rostrata. Eel.
Amia calva. Grindle.

32. THE SANTEE RIVER BASIN.

Micropterus salmoides.
Centrarchus macropterus.
Pomoxys sparoides.
Chænobryttus gulosus.
Lepomis auritus.
Lepomis pallidus.
Lepomis gibbosus.
Esox reticulatus.
Esox americanus.
Salvelinus fontinalis.
Dorosoma Cepedianum.
Semotilus corporalis.
Nocomis biguttatus.
Notemigonus americanus.
Moxostoma cervinum.
Moxostoma album.
Moxostoma velatum.
Moxostoma coregonus.
Moxostoma papillosum.
Minytrema melanops.
Erimyzon sucetta.
Catostomus teres.
Amiurus platycephalus.
Amiurus brunneus.
Anguilla rostrata.
Amia calva.
Lepidosteus osseus.

33. THE SAVANNAH RIVER BASIN.

Micropterus salmoides.
Micropterus Dolomiei.
Centrarchus macropterus.
Pomoxys sparoides.
Chænobryttus gulosus.
Lepomis auritus.
Lepomis pallidus.
Lepomis megalotis.
Lepomis gibbosus.
Esox reticulatus.
Dorosoma Cepedianum.
Semotilus corporalis.
Notemigonus americanus.
Moxostoma cervinum.
Moxostoma papillosum.
Catostomus nigricans.
Catostomus teres.
Ictalurus punctatus.
Amiurus brunneus.
Anguilla rostrata.
Amia calva.
Lepidosteus osseus.

34. THE SAINT JOHN'S RIVER BASIN.

Micropterus salmoides. Trout.
Centrarchus macropterus.
Pomoxys sparoides. Speckled Perch.
Chænobryttus gulosus. Warmouth Perch.
Lepomis punctatus. Chinquapin Perch.
Lepomis auritus. Red-bellied Perch.
Lepomis pallidus. Copperhead Bream.
Lepomis Holbrooki.
Lepomis gibbosus. Bream.
Esox reticulatus. Jack.
Lepidosteus osseus. Gar Pike.
Dorosoma Cepedianum. Stink Shad.
Notemigonus americanus. Silver-fish.
Erimyzon Goodei. Sucker (Goode's Sucker).
Ictalurus punctatus. Channel Cat. Small-mouth Cat.
Amiurus nigricans.
Amiurus niveiventris.
Amiurus marmoratus.
Amiurus erebennus. Speckled Cat (Goode's Cat).
Anguilla rostrata. Eel.
Amia calva. Mudfish.

Many sea fish run up the river far above brackish water.

35. THE CHATTAHOOCHEE RIVER BASIN.

Micropterus salmoides.
Micropterus Dolomiei.
Centrarchus macropterus.
Pomoxys sparoides.
Ambloplites rupestris.
Chænobryttus gulosus.
Lepomis pallidus.
Lepomis megalotis.
Esox reticulatus.
Salvelinus fontinalis.
Hyodon selenops.
Clupea chrysochloris.
Dorosoma Cepedianum.
Nocomis biguttatus.
Moxostoma macrolepidotum.
Moxostoma cervinum.
Ictalurus punctatus.
Amiurus brunneus.
Anguilla rostrata.
Amia calva.
Lepidosteus osseus.

36. THE ALABAMA RIVER BASIN.

Haploidonotus grunniens. Drum.
Percina caprodes.
Stizostedion vitreum.
Micropterus salmoides. "Trout."
Micropterus Dolomiei.
Centrarchus macropterus.
Pomoxys sparoides.
Pomoxys annularis.
Ambloplites rupestris.
Chænobryttus gulosus.
Lepomis auritus.
Lepomis pallidus.
Lepomis megalotis.
Lepomis notatus.
Esox reticulatus.
Clupea chrysochloris.
Dorosoma Cepedianum.
Hyodon selenops.
Nocomis biguttatus.
Notemigonus chrysoleucus.
Notropis megalops.
Moxostoma macrolepidotum.
Moxostoma pœcilura.
Minytrema melanops.
Erimyzon sucetta.
Catostomus nigricans.
Catostomus teres.
Cycleptus elongatus.
Ictiobus cyprinella.
Ictiobus urus.
Ictiobus bubalus.
Ictalurus punctatus.
Amiurus natalis.
Anguilla rostrata.
Amia calva.
Lepidosteus platystomus.
Lepidosteus osseus.

37. THE MISSISSIPPI RIVER BASIN.

a. THE LOWER MISSISSIPPI.

Haploidonotus grunniens. Gaspergou.
Percina caprodes.
Stizostedion vitreum. "Salmon."
Roccus chrysops. White Bass.
Roccus interruptus. Yellow Bass.
Micropterus salmoides.
Micropterus Dolomiei.
Centrarchus macropterus.
Pomoxys sparoides.
Pomoxys annularis. Crappy. Sac-a-lai.
Ambloplites rupestris.
Chænobryttus gulosus. Warmouth.
Lepomis cyanellus.
Lepomis symmetricus.
Lepomis auritus.
Lepomis pallidus.
Lepomis megalotis.
Lepomis notatus.
Lepomis miniatus.
Esox vermiculatus.

Hyodon tergisus.
Hyodon selenops.
Clupea chrysochloris.
Dorosoma Cepedianum.
Semotilus corporalis.
Nocomis biguttatus.
Notemigonus chrysoleucus.
Notropis megalops.
Moxostoma macrolepidotum.
Moxostoma pœcilura.
Moxostoma velatum.
Minytrema melanops.
Erimyzon sucetta.
Catostomus nigricans.
Catostomus teres.
Cycleptus elongatus.
Ictiobus cyprinella.
Ictiobus urus.
Ictiobus bubalus.
Carpiodes carpio.
Carpiodes cyprinus.
Ictalurus furcatus.
Ictalurus punctatus.
Ictalurus ponderosus.
Amiurus nigricans.
Amiurus natalis.
Amiurus nebulosus.
Amiurus marmoratus.
Amiurus vulgaris.
Amiurus melas.
Leptops olivaris.
Noturus flavus.
Anguilla rostrata.
Amia calva. Johnny-grindle.
Lepidosteus spatula. Alligator Gar.
Lepidosteus platystomus. Duck-bill Gar.
Lepidosteus osseus. Long-nosed Gar.
Polyodon spathula. Paddle-fish.
Scaphirhynchops platyrhynchus. Shovel-nose Sturgeon.
Acipenser rubicundus. Sturgeon.

b. THE UPPER MISSISSIPPI.

Lota maculosa. Ling.
Haploidonotus grunniens. Sheep's-head. White Perch. Black Perch. Drum.
Percina caprodes.
Perca americana. Yellow Perch. Ringed Perch.
Stizostedion canadense.
Stizostedion vitreum. Salmon. Wall-eye Pike.
Roccus chrysops. White Bass.
Roccus interruptus. Yellow Bass.
Micropterus salmoides. Black Bass.
Micropterus Dolomiei. Black Bass.
Pomoxys sparoides. Calico Bass. Tin-mouth.
Pomoxys annularis. Crappy.
Ambloplites rupestris. Goggle Eye.
Chænobryttus antistius. Bigmouth Sunfish.
Lepomis cyanellus.
Lepomis pallidus. Common Sunfish.
Lepomis megalotis. Long-ear Sunfish.
Lepomis gibbosus. Yellow Sunfish. Spotted Sunfish.
Esox nobilior. Muskellunge.
Esox lucius. Pike. Pickerel.
Esox vermiculatus.
Umbra limi. Bastard Dogfish.
Percopsis guttatus.
Coregonus Artedi. Cisco.
Salvelinus fontinalis. Trout.
Hyodon alosoides.
Hyodon tergisus. Moon Eye. Toothed Herring.
Clupea chrysochloris. Skipjack.
Clupea sapidissima. Shad.
Dorosoma Cepedianum. Hickory Shad. Gizzard Shad.
Semotilus corporalis. Chub.
Nocomis biguttatus. Horny-head.
Notemigonus chrysoleucus.
Notropis megalops. Shiner.
Quassilabia lacera. Hare-lip Sucker.
Placopharanx carinatus.
Moxostoma macrolepidotum. Red Horse.
Moxostoma aureolum.
Moxostoma velatum.
Minytrema melanops. Spotted Sucker.
Erimyzon sucetta. Sweet Sucker.
Catostomus nigricans. Hog Sucker.
Catostomus teres. White Sucker.
Catostomus catostomus.
Cycleptus elongatus. Missouri Sucker. Blue-fish.

Carpiodes cyprinus. Spear Back. Quill Back.
Carpiodes carpio. White Carp. Carp Sucker.
Ictiobus bubalus. Stub Nose. Sucker Mouth. River Buffalo. Black Carp. Slough Buffalo. Buffalo fish.
Ictiobus urus. Stub Nose. Sucker Mouth. River Buffalo. Black Carp. Slough Buffalo. Mongrel Buffalo.
Ictiobus cyprinella. Stub Nose. Sucker Mouth. River Buffalo. Black Carp. Slough Buffalo. Red-mouth Buffalo.
Ictalurus furcatus. Chuckle-head Cat.
Ictalurus punctatus. Channel Cat.
Amiurus ponderosus. Big Cat.
Amiurus natalis.
Amiurus vulgaris.
Amiurus nebulosus. Cat-fish. Eastern Bull-pout. Bullpout.
Amiurus nigricans. Mississippi Cat. Blue-Cat. Fulton Cat.
Amiurus melas.
Leptopsolivaris. Yellow Cat. Goujon. Bashaw.
Noturus flavus. Stone Cat.
Anguilla rostrata. Eel.
Amia calva. Dogfish.
Lepidosteus spatula. Alligator Gar. Duck Bill.
Lepidosteus platystomus. Short-nose Gar.
Lepidosteus osseus. Long-nose Gar. Billy Gar.
Polyodon spatula. Spoon Bill. Paddle-fish. Duck-bill Cat.
Scaphirhynchops platyrhynchus. White Sturgeon. Shovel-nose Sturgeon.
Acipenser rubicundus. Black Sturgeon. Stone Sturgeon.

c. THE OHIO RIVER.

Haploidonotus grunniens.
Percina caprodes.
Stizostedion canadense.
Stizostedion vitreum. Black Salmon. White Salmon.
Roccus chrysops. White Bass. Bachelor Perch.
Micropterus salmoides. Black Bass. Green Bass.
Micropeterus Dolomiei. Black Bass.
Pomoxys sparoides.
Pomoxys annularis.
Ambloplites rupestris. Rock Bass. Goggle Eye. Red eye.
Lepomis cyanellus. Sunfish.
Lepomis pallidus. Sunfish.
Lepomis megalotis. Sunfish.
Esox vermiculatus.
Salvelinus fontinalis.
Hyodon alosoides.
Hyodon tergisus. Tooth Herring.
Clupea sapidissima. Sea Shad. Potomac Shad.
Clupea chrysochloris. Skipjack. Ohio Herring.
Dorosoma Cepedianum. Hickory Shad.
Semotilus corporalis. Chub. Silversides.
Nocomis biguttatus. Horned Chub.
Notemigonus chrysoleucus.
Notropis megalops.
Quassilabia lacera.
Placopharanx carinatus.
Moxostoma carpio. Red Horse.
Moxostoma macrolepidotum. Red Horse.
Moxostoma aureolum. Mullet.
Moxostoma anisura.
Moxostoma velatum.
Minytrema melanops.
Erimyzon sucetta. Sucker.
Catostomus nigricans. Sucker.
Catostomus teres. Sucker.
Cycleptus elongatus. Missouri Sucker. Gourd-seed Sucker.
Carpiodes cyprinus. Carp Sucker. Quill-back.
Carpiodes carpio. Carp Sucker.
Ictiobus cyprinella. Red-mouth Buffalo.
Ictiobus urus. Mongrel Buffalo.
Ictiobus bubalus. Buffalo.
Ictalurus furcatus.
Ictalurus punctatus. Blue or Channel Cat.
Amiurus nigricans. Mississippi Cat.
Amiurus natalis. Yellow Cat.
Amiurus nebulosus. Bull-head Cat.

Amiurus xanthocephalus.
Amiurus melas.
Leptops olivaris. Mud Cat.
Noturus flavus.
Anguilla rostrata. Black Eel. Yellow Eel.
Amia calva.
Lepidosteus platystomus. Short-nose Gar-fish.
Lepidosteus osseus. Gar Pike.
Polyodon spatula. Spoon-bill Cat.
Scaphirhynchops platyrhynchus. Shovel-nose Sturgeon.
Acipenser rubicundus. Red Sturgeon.

d. THE MISSOURI RIVER.

Lota maculosa.
Haploidonotus grunniens.
Percina caprodes.
Stizostedion canadense.
Stizostedion vitreum.
Roccus chrysops.
Micropterus salmoides.
Micropterus Dolomiei.
Pomoxys sparoides.
Pomoxys annularis.
Ambloplites rupestris.
Lepomis cyanellus.
Lepomis pallidus.
Lepomis megalotis.
Esox lucius.
Percopsis guttatus.
Thymallus tricolor.
Salmo purpuratus.
Hyodon alosoides.
Hyodon tergisus.
Dorosoma Cepedianum.
Semotilus corporalis.
Platygobio gracilis.
Nocomis biguttatus.
Notemigonus chrysoleucus.
Notropis megalops.
Moxostoma macrolepidotum.
Moxostoma aureolum.
Minytrema melanops.
Erimyzon sucetta.
Catostomus nigricans.
Catostomus teres.
Catostomus retropinnis.
Catostomus catostomus.
Cycleptus elongatus.
Carpiodes cyprinus.
Ictiobus cyprinella.
Ictiobus urus.
Ictiobus bubalus.
Ictalurus punctatus.
Amiurus nigricans.
Amiurus natalis.
Amiurus melas.
Leptops olivaris.
Noturus flavus.
Anguilla rostrata.
Amia calva.
Lepidosteus platystomus.
Lepidosteus osseus.
Polyodon spatula.
Scaphirhynchops platyrhynchus.
Acipenser rubicundus.

38. THE RIO GRANDE BASIN.

Haploidonotus grunniens.
Percina caprodes.
Micropterus salmoides.
Lepomis cyanellus.
Lepomis pallidus.
Lepomis megalotis.
Salmo spilurus.
Dorosoma Cepedianum.
Notemigonus chrysoleucus.
Squalius atrarius.
Squalius pandora.
Moxostoma albidum.
Minytrema melanops.
Erimyzon sucetta.
Pantosteus generosus.
Carpiodes cyprinus.
Ictalurus furcatus.
Ictalurus punctatus.
Amiurus lupus.
Amiurus natalis.
Anguilla rostrata.
Lepidosteus osseus.
Scaphirhynchops platyrhynchus.

39. THE COLORADO RIVER BASIN.

Salmo purpuratus.
Salmo spilurus.
Platygobio gracilis.
Squalius atrarius.
Squalius niger.
Gila robusta.
Gila Grahami.
Gila elegans.
Ptychochilus lucius.
Moxostoma macrolepidotum.
Catostomus Clarki.
Catostomus insignis.
Catostomus cypho.
Catostomus latipinnis.
Catostomus discobolus.
Pantosteus generosus.

40. THE SACRAMENTO RIVER BASIN.

Archoplites interruptus.
Hysterocarpus Traski.
Salmo irideus.
Salmo Gairdneri.
Salvelinus malma.
Mylopharodon conocephalus.
Mylochilus caurinus.
Pogonichthys macrolepidotus.
Squalius gibbosus.
Ptychochilus oregonensis.
Ptychochilus Harfordi.
Lavinia exilicauda.
Orthodon microlepidotus.
Catostomus occidentalis.

41. THE COLUMBIA RIVER BASIN.

Coregonus Williamsoni.
Salmo Gairdneri.
Salmo purpuratus.
Salvelinus malma.
Mylochilus caurinus.
Richardsonius balteatus.
Ptychochilus oregonensis.
Acrochilus alutaceus.
Catostomus macrochilus.
Catostomus discobolus.

42. THE SALT LAKE BASIN.

Coregonus Williamsoni.
Salmo purpuratus.
Salmo spilurus.
Platygobio gracilis.
Squalius atrarius.
Squalius rhomaleus.
Chasmistes liorus.
Catostomus fecundus.
Catostomus ardens.
Pantosteus generosus.

43. TABLE SHOWING THE GEOGRAPHICAL DISTRIBUTION OF THE RIVER FOOD-FISHES.

	The Great Lakes.	The lakes of Maine.	Connecticut.	Hudson.	Delaware.	Susquehanna.	Potomac.	Neuse.	Santee.	Savannah.	Saint John's	Chattahoochee.	Alabama.	Lower Mississippi.	Rio Grande.	Ohio.	Upper Mississippi.	Missouri.	Salt Lake Basin.	Colorado.	Sacramento.	Columbia.
Lota maculosa	×		×													×	×	×				
Haploidonotus grunniens	×												×	×	×	×	×	×				
Percina caprodes	×					×	×						×	×	×	×	×	×				
Perca americana	×	×	×	×	×	×	×	×									×					
Stizostedion canadense	×															×	×	×				
" vitreum	×												×	×		×	×	×				
Roccus chrysops	×													×		×	×	×				
" interruptus														×			×					

Table showing the geographical distribution of the river food-fishes—Continued.

	The Great Lakes.	The lakes of Maine.	Connecticut.	Hudson.	Delaware.	Susquehanna.	Potomac.	Neuse.	Santee.	Savannah.	Saint John's.	Chattahoochee.	Alabama.	Lower Mississippi.	Rio Grande.	Ohio.	Upper Mississippi.	Missouri.	Salt Lake Basin.	Colorado.	Sacramento.	Columbia.
Micropterus salmoides	×							×	×	×	×	×	×	×	×	×	×	×				
" Dolomici	×									×		×	×	×		×	×	×				
Centrarchus macropterus								×	×	×	×	×	×	×								
Pomoxys sparoides	×				×		×	×	×	×	×	×	×	×		×	×	×				
" annularis								×					×			×	×	×				
Archoplites interruptus																					×	
Ambloplites rupestris	×							×				×	×	×		×	×	×				
Chænobryttus gulosus								×	×	×	×	×	×	×								
" antistius	×																×					
Acantharchus pomotis					×			×														
Lepomis cyanellus	×													×	×	×	×	×				
" *punctatus*											×			×								
" miniatus														×								
" auritus		×	×	×	×	×	×	×	×	×	×	×	×	×								
" pallidus	×				×				×	×	×	×	×	×	×	×	×	×				
" megalotis	×									×		×	×	×	×	×	×	×				
" Holbrooki											×											
" notatus													×	×								
" gibbosus	×	×	×	×	×	×	×	×	×	×	×						×					
Hysterocarpus Traski																					×	
Esox nobilior	×																×					
" lucius	×																×	×				
" reticulatus			×	×	×	×	×	×	×	×	×	×	×									
" vermiculatus	×													×		×	×	×				
" americanus			×	×	×	×	×	×	×													
Percopsis guttatus	×																×	×				
Coregonus quadrilateralis	×	×																				
" labradericus	×	×																				
" clupeiformis	×																					
" Williamsoni																			×			×
" Artedi	×																×					
" Hoyi	×																					
" nigripinnis	×																					
" tullibee	×																					
Thymallus tricolor	×																	×				
Salmo irideus																					×	×
" Gairdneri																					×	×
" purpuratus																		×	×	×		×
" spilurus															×				×	×		
Salvelinus namaycush	×	×																				
" siscowet	×																					
" malma																					×	×
" *fontinalis*	×	×	×	×	×	×	×	×	×			×				×	×					
" oquassa		×																				
Hyodon alosoides																×	×	×				
" tergisus	×													×		×	×	×				
" selenops												×		×								
Clupea chrysochloris													×	×		×	×					
Dorosoma Cepedianum	×						×	×	×	×	×	×	×	×	×	×	×	×				
Mylopharodon conocephalus																					×	
Mylochilus caurinus																					×	×
Pogonichthys macrolepidotus																					×	
Semotilus corporalis	×			×	×	×	×	×	×	×			×	×		×	×	×				
" bullaris			×	×	×	×	×															
Platygobio gracilis																			×	×		
Nocomis biguttatus	×					×	×	×	×			×	×	×		×	×	×				
Richardsonius balteatus																						×
Notemigonus chrysoleucus	×		×	×	×	×	×						×	×	×	×	×	×				

Table showing the geographical distribution of the river food-fishes—Continued.

	The Great Lakes.	The lakes of Maine.	Connecticut.	Hudson.	Delaware.	Susquehanna.	Potomac.	Nense.	Santee.	Savannah.	Saint John's.	Chattahoochee.	Alabama.	Lower Mississippi.	Rio Grande.	Ohio.	Upper Mississippi.	Missouri.	Salt Lake Basin.	Colorado.	Sacramento.	Columbia.
Notemigonus americanus								×	×	×	×											
Squalius gibbosus																					×	
" atrarius																			×			
" thomaleus																			×			
" niger																				×		
" pandora															×							
Gila robusta																				×		
" Grahami																				×		
" elegans																				×		
Ptychochilus oregonensis																					×	×
" Harfordi																					×	
" lucius																				×		
Notropis megalops	×	×	×	×	×	×	×	×					×	×		×	×	×				
Notropis Storerianus	×																					
Exoglossum maxillingua				×			×															
Laviuia exilicauda																					×	
Orthodon microlepidotus																					×	
Acrochilus alutaceus																×	×					×
Quassilabia lacera																×	×					
Placopharanx carinatus																×	×					
Moroctoma carpio	×															×	×					
" macrolepidotum	×						×	×				×	×	×		×	×	×		×		
" aureolum	×															×	×					
" crassilabre								×						×	×							
" anisura																×						
" pœcilura													×	×								
" albidum															×							
" cervinum								×	×	×												
" album								×	×													
" velatum	×							×	×					×		×	×					
" coregonus									×													
" papillosum								×	×	×									×			
Minytrema melanops	×								×				×	×		×	×					
Erimyzon sucetta	×	×	×	×	×	×	×	×	×	×			×	×	×	×	×	×				
" Goodei									×						×							
Chasmistes liorus																			×			
Catostomus nigricans						×	×			×			×			×	×	×				
" Clarki																				×		
" insignis																				×		
" cypho																				×		
" fecundus																			×			
" teres	×	×	×	×	×	×	×	×	×	×			×	×		×	×	×				
" ardens																			×			
" macrochilus																						×
" occidentalis																					×	
" catostomus	×																×	×				
" retropinnis																		×				
" latipinnis																				×		
" discobolus																				×		×
Pantosteus generosus															×				×	×		
Cycleptus elongatus													×	×	×	×	×	×				
Carpiodes cyprinus	×					×									×	×	×	×				
" carpio																×	×					
Ictiobus bubalus													×	×		×	×	×				
" urus													×	×		×	×	×				
" cyprinella													×	×		×	×	×				
Ictalurus furcatus														×	×	×	×					
" punctatus	×									×	×	×	×	×	×	×	×	×				

Table showing the geographical distribution of the river food-fishes—Continued.

	The Great Lakes.	The lakes of Maine.	Connecticut.	Hudson.	Delaware.	Susquehanna.	Potomac.	Neuse.	Santee.	Savannah.	Saint John's.	Chattahoochee.	Alabama.	Lower Mississippi.	Rio Grande.	Ohio.	Upper Mississippi.	Missouri.	Salt Lake Basin.	Colorado.	Sacramento.	Columbia.
Amiurus lupus															×							
niveiventris								×			×											
albidus					×	×	×															
lophius						×	×															
ponderosus														×			×					
nigricans	×										×			×		×	×	×				
erebennus											×											
natalis	×							×					×	×	×	×	×	×				
vulgaris	×													×			×					
nebulosis	×	×	×	×	×	×	×	×								×	×					
xanthocephalus																×						
melas	×													×		×	×	×				
platycephalus								×	×													
brunneus									×	×		×										
Leptops olivaris														×		×	×	×				
Noturus flavus	×													×		×	×	×				
Anguilla rostrata	×		×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×				
Amia calva	×							×	×	×	×	×	×	×		×	×	×				
Lepidosteus spatula														×								
platystomus	×												×	×		×	×	×				
osseus	×				×	×	×		×	×	×	×	×	×	×	×	×	×				
Polyedon spathula														×		×	×	×				
Scaphirhynchops platyrhynchus														×	×	×	×	×				
Acipenser rubicundus	×													×		×	×	×				

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OCEAN TEMPERATURES

OF THE

EASTERN COAST OF THE UNITED STATES,

WITH

THIRTY-TWO CHARTS.

By RICHARD RATHBUN.

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OCEAN TEMPERATURES OF THE EASTERN COAST OF THE UNITED STATES, FROM OBSERVATIONS MADE AT TWENTY-FOUR LIGHT-HOUSES AND LIGHT-SHIPS.

[With thirty-two charts.]

By RICHARD RATHBUN.

INTRODUCTION.

Temperature has long been recognized as having an important influence upon the general movements of fishes, and especially of those species that migrate periodically from one region to another. The salmon, shad, and alewives ascend the rivers in the spring, and at about the same time large schools of mackerel and menhaden approach the coast from the direction of the Gulf Stream, and, to some extent at least, work northward as the season advances. Cod are abundant near shore only during the colder months, while lobsters retreat into deeper water at the beginning of winter, and return again in the spring. Whatever may be the impelling power that incites these and other species to change their grounds at stated periods, whether the necessity of seeking new sources of food or more congenial waters for the purposes of breeding, it has generally been observed that their migrations coincide more or less closely with certain changes in temperature, and the latter, therefore, appears to exert a controlling or restraining influence upon their movements. Until recently, however, very little has been published respecting the precise relations of temperature to fish migrations, and the subject is but little understood.

In a history of the menhaden, published in 1879,* Mr. G. Brown Goode discusses the water temperatures taken at several stations along the Atlantic coast of the United States for a period of three years, in connection with such information as was then obtainable respecting the movements of menhaden during their spring migrations. In prefacing this subject, Mr. Goode remarks that "the date of the earliest appearance of the schools of menhaden at any given point upon the coast corresponds very closely with that of the arrival of scup, shad, bluefish, and other of the non-resident species. It depends primarily upon the temperature of the water, [and the departure of the schools] is regulated by the same causes. At the approach of settled warm weather the schools make their appearance in the coast waters. They remain in the bays and near the shores until they are warned away by the breath of coming winter. The date of their appearance is earlier in the more southern waters, and the length of their sojourn longer. It is manifestly impracticable [from the data he then possessed] to give anything but approximate dates to indicate the time of their movements. In fact, the comparison of two localities, distant apart 100 or 200 miles, would indicate very little. When wider ranges are compared there becomes perceptible a proportion in the relations of the general averages. There is always a balance in favor of earlier arrivals at the more southern localities. Thus it becomes apparent

* The Natural and Economical History of the American Menhaden, by G. Brown Goode. U. S. Commission of Fish and Fisheries. Report of the Commissioner for 1877, Appendix A, 529 pp., 31 plates. Washington, 1879.

that the first schools appear in Chesapeake Bay in March and April, on the coast of New Jersey in April and early May, and on the south coast of New England in late April and May, off Cape Ann about the middle of May, and in the Gulf of Maine about the latter part of May and the first of June. Returning, they leave Maine in late September and October; Massachusetts in October, November, and December; Long Island Sound and vicinity in November and December; Chesapeake Bay in December, and Cape Hatteras in January. Farther to the south they appear to remain more or less constantly throughout the year."

In his concluding remarks the same writer states that "these facts [which he sets forth in considerable detail] appear to indicate that under ordinary circumstances the menhaden prefers a temperature of 60° to 70° Fahrenheit. When the rising temperature of spring has passed the limit of 50° to 51°, the fish are certain to appear, and when the falling temperature of autumn reaches that point, their departure is equally sure, though a few individuals may linger in waters not congenial to them. The opposite limit seems to be marked by the line of 80° or perhaps 75°. An easterly or northerly wind, lowering temporarily the surface temperature, causes the schools to sink below the surface. The chill of night also drives them down. These conclusions are not to be regarded as final. The movements of the fish about Cape Hatteras are very puzzling, and need to be interpreted by a series of careful temperature observations."

More recently similar comparisons of water temperatures have been made by Col. Marshall McDonald with respect to the shad and river herrings or alewives,* the observations he makes use of being relatively more extensive than was the case in Mr. Goode's studies of the menhaden. His observations are restricted to the Chesapeake Bay region, with special reference to the Potomac River, and are accompanied by instructive diagrams, on which the relations of temperature to the abundance of the two species of herring and the shad are graphically represented.

His final conclusions are as follows: "The diagram showing fluctuations of water temperature in the Chesapeake Bay region furnishes very interesting and suggestive data for discussion. During the winter months the water temperatures on the ocean plateau, outside of the capes, is higher than that of Chesapeake Bay or the Potomac River. The latter part of February or early in March the temperature of the bay waters rises above that of the ocean waters outside. Coincident with this the shad make their appearance in the Chesapeake and are taken in the pounds which are set in salt-water along the shores of the bay. About the first of April the temperature of the water in the Potomac River rises above the temperature of the water in the bay. Coincident with this is the beginning of the shad season in the river. The lesson taught by the diagram is that shad do not enter our rivers to spawn until the temperature of the river waters is higher than that of the salt-water from which they come. Should the waters of either the Potomac or Susquehanna continue during the season at a lower temperature than those of the bay, we would have no run either of shad or glut herring during the season."

Our object in prefacing this introduction with the above extracts from two of the most important contributions on the subject of water temperatures in their relation to the migration of fishes, has been to give a practical illustration of the great value of such studies, which have been strangely neglected by investigators. With respect to the oceanic species, there are, of necessity, many difficulties, some of them insurmountable, in the way of obtaining observations, as permanent stations for that purpose must be located mostly on or very near the coast, while the larger schools of fishes often remain some distance from the land. River stations for observ-

* The Shad—*Clupea sapidissima*, by Marshall McDonald. The Fisheries and Fishery Industries of the United States, by George Brown Goode and a staff of associates. Section I: Natural History of Aquatic Animals, pp. 594-607, plates 214, 215. Washington, 1884. Also in Report United States Commissioner of Fish and Fisheries for 1883 (1885), p. 1034, pl. 1.

ing water temperatures conjointly with the migrations of fishes can be readily established, and excellent opportunities for good work in this direction are afforded by all the larger rivers of our country.

The practical value as well as scientific importance of investigations of this character, in their bearing upon many of our most extensive sea and inland fisheries, has been fully recognized by the U. S. Fish Commissioner, and in all the explorations carried on under his direction the observation of water temperatures has been made a conspicuous feature. Unfortunately, the field work of the Fish Commission is, necessarily, limited to a comparatively short season in each year, during which operations have, for the most part, been confined within narrow areas, changing more or less from year to year, or have been extended irregularly from place to place, dependent upon the movements of the steamers. The temperature observations made by the Commission do not, therefore, form continuous series sufficiently complete in themselves for detailed comparison with the movements of fishes during an entire season of their migrations. In order to supplement and extend this class of investigations with reference to the surface waters and surface schooling fishes, the co-operation of the U. S. Light-House Board and U. S. Signal Service was obtained, and for a number of years past continuous series of observations have been taken at some sixty stations belonging to these two services, distributed along the entire Atlantic and Gulf coasts of the United States from Eastern Maine to Southern Texas.

In this report we have given the temperature results of the light-house stations only, reserving those of the Fish Commission and Signal Service for a future one. Most of the light-house stations form a series which can well be considered apart from the others, all of the stations here included being located on exposed portions of the coast, while those of the Signal Service are mostly situated in inclosed bays or harbors. A few of the light stations are, however, in similar situations to those of the Signal Service and will be considered with them. Before describing the positions and relations of the stations, it may be best to note briefly the character of observations required for application to the problem of fish migrations.

While general temperature results are of much interest, it is evident that they are totally inadequate to explain the varying movements of fishes. The changes in temperature from day to day and from season to season must be studied in great detail in order to ascertain their precise influence in regulating the arrival, progress, and departure of the schools. If mackerel appear at an earlier date in one year than in another, is that earlier appearance accompanied by a more rapid rise in temperature? If more abundant or more widely distributed during one season than another, is it due to warmer temperatures covering a wider area than usual, or to other causes? Answers to these questions are to be sought in a better understanding of the conditions of temperature along our coast, although it cannot be denied that other subjects, such as the distribution and abundance of food, and the influence of the winds and currents, need to be considered in the same connection. In order to make this precise study of the temperatures it is necessary to establish numerous stations at successive points along the course followed by the fishes in their migrations. These stations should be located at a sufficient distance from the coast to be beyond the influence of local conditions, and at such an ideal series of observing posts the determination of the relations of temperature to fish migrations would be simply a question of time, but unfortunately it is impossible to locate many such stations, and inferior ones have to be selected to complete the series. Observations should be made continuously throughout each season of migrations for several successive years, and by this means many parallel series of records would be obtained suitable for the work of comparison.

In this report we have to do only with the surface temperature of the waters immediately

bordering the coast, considered also in their relations to the temperature of the air. The outside light stations selected for taking the observations are twenty-four in number, and represent the entire eastern coast of the United States from Southern Florida to Eastern Maine. As enumerated and described below, it will be noticed that some are light-ships anchored off the land, while others are light-houses, situated on islands or on the main coast. Those of the first class are infinitely better located for temperature purposes than either of the others. At most of the stations observations were begun as early as 1878, but prior to 1881 so many breaks occurred in the records that it has been found inexpedient to make use of any of the data relating to the first three years. This report, therefore, covers a period of only five years, from 1881 to 1885, inclusive. Although the depths at the different stations vary greatly, ranging from a few feet to 18 fathoms, it was thought advisable to have the observations cover the bottom as well as the surface waters, but the former having been entirely neglected at nearly every station, no reference is made to bottom temperatures on the following pages.

The record blanks supplied to the light-house stations call for the following observations: Depth of water where the observations are taken, at mean low tide; time of observations, which are to be made twice each day at the first high water and first low water after 7 a. m.; temperature of the water at the surface and at the bottom, and by exposing the thermometer in the open air; direction and force of the wind, and state of the sky at the time of taking the temperature observations; occurrence and duration of rain or snow; occurrence and movements of any kinds of fish, singly or in schools, especially menhaden, herring, cod, mackerel, swordfish, horse-mackerel, bluefish, &c., and also of seals or whales.

As the observations are taken at the first high water and first low water after 7 a. m., they are not made at the same time every day, but generally fall within the twelve hours following 7 a. m., or between 7 a. m. and 7 p. m. Should the time for taking the first observation come immediately after 7 a. m., the second observation would be made soon after noon. As, in some places, there is considerable difference between the temperature of the water at high tide and low tide, this method of regulating the hours of observation appeared to afford the most satisfactory means of equalizing results. As elsewhere explained, the temperature observations were limited at most stations to the surface water and the air. Observations respecting the direction and force of the wind, the state of the sky and the occurrence of rain were generally well kept, but the opportunities for observing the movements of fishes were not equally good at all stations, nor was it to be expected that a constant outlook would be maintained by volunteer observers already burdened with other and more important duties. Nevertheless many interesting and valuable records were made in that line, although nothing of importance was learned respecting the regular migratory movements.

The thermometers employed were of two kinds, both of which were especially designed for taking water temperatures not only at the surface, but also in slight depths. During the first few years the stations were supplied with the excellent pattern made for the Signal Service, and kindly lent for the purpose. These thermometers are inclosed in a stout bronze case, with suitable openings for the entrance of water, and every instrument was carefully compared with a standard before being sent out. From time to time the Signal Service thermometers have been replaced by a new and equally reliable pattern, made by Charles Wilder, of Peterboro', N. H., for this special kind of work, and at present all the light-house observations are taken with these instruments. The tube is protected in a cylindrical copper case, somewhat similar in construction to that of the Signal Service, but of larger size. All instruments are compared and none having a large error are made use of. Occasionally, at some of the stations, when the regulation ther-

mometer has accidentally been broken, the observations have been continued by means of a lighthouse thermometer, or of one purchased at a neighboring town, pending the receipt of a new instrument, but such instances have been of rare occurrence and not likely to make any appreciable difference in the character of the records for the short periods involved.

While the light keepers have not been specially trained in the methods of taking temperature observations, their monthly returns testify to their high grade of intelligence and to their great zeal in fulfilling these additional duties without extra compensation. We are led to believe that their records contain comparatively few serious errors for which they are directly responsible, excepting in those cases which will be explained hereafter; and that, in the main, their observations have been conscientiously made and are deserving of consideration. It is also worthy of comment that so extensive an undertaking as this should have been carried on successfully at so little expense and with so little friction.

As above explained, detailed temperature observations rather than general results are essential for comparison in studying the migrations of the fishes. For that reason the reductions plotted on the accompanying charts have been made for comparatively short intervals, the entire year being divided into periods of ten days, each of which is equivalent to about one-third of a calendar month. As two observations are made daily, the mean of each ten days is derived from twenty observations, and small errors are thereby practically eliminated. Each station is represented by a chart on which the ten-day means of surface-water temperatures are given for each of the five years from 1881 to 1885, inclusive, and the air temperatures from 1881 to 1883, inclusive. The method of representing the temperatures is by curves connecting the ten-day periods, as explained on the charts. At the stations north of Cape Hatteras there were frequent indications of careless observation during exceedingly cold weather in the months of January and February, the thermometer, at times, not being read quickly enough after it had been withdrawn from the water. As such readings would manifestly afford a lower mean temperature than the actual, it has been deemed best to omit the records for those two months at the northern stations. At some of the shore stations the observations also show the effects of local influences which render them inapplicable to the open waters of the coast; but special explanation of those stations is made further on.

In addition to the charts of ten-day means, there are also seven isothermal charts on which the temperature observations at all the stations are combined, in order to afford more convenient means of comparison. Five of these charts represent the separate years from 1881 to 1885, inclusive, a sixth, the means of the same five years, and the final one, the relations of the air isotherms to the surface isotherms. The isotherms are plotted for every 5° of temperature, Fahrenheit, from 40° to 80°, inclusive. The isotherm of 35° F. occurs only at the northern stations, and there mainly in the months of January and February, the records for which have not been used. The writer has refrained from drawing any conclusions from the temperature results presented in this report, and his remarks on the following pages are mostly confined to describing the stations and indicating some of the main features with respect to the temperature curves and the isotherms. The Fahrenheit scale of temperatures has been exclusively used both in making the observations and in the construction of the charts.

The work of reducing the many observations to ten-day means and of making the original plottings of the same has been done by Miss M. J. Rathbun, while the writer is responsible for the computations for, and the plottings of, the isotherms. The charts were prepared for engraving by Mr. C. E. Gorham.

ENUMERATION AND BRIEF DESCRIPTIONS OF THE STATIONS.

The light-houses and light-ships selected as temperature stations numbered thirty-six in all, distributed at intervals along the eastern coast of the United States, from Petit Manan Island in Eastern Maine, to the Tortugas Reefs in Southern Florida. As explained before, twenty-six of these stations were located off shore, or on exposed portions of the coast, and the remainder in more or less inclosed bays, sounds, and harbors. The outside stations are alone considered in this report, and of this class the two following have been omitted, reducing the number to twenty-four. The observations were continued for so short a period at Minot's Ledge light-house, in Massachusetts Bay, that it was deemed inexpedient to make use of them; and the records for Race Point light-house, at the northern extremity of Cape Cod, show such extreme variations within short periods, due probably in part to the very gradually sloping shore in front of the light, as to render their value questionable until further examination can be made.

The outside stations differ widely in the character of their surroundings, and therefore do not afford the means of obtaining observations of equal value respecting the open waters along the coast. Ten are light-ships, anchored off shore, in depths of 5 to 18 fathoms, and consequently possessing unusual advantages for the taking of ocean temperatures; nine are located on small islands or reefs, more or less widely separated from the mainland; and five are situated on the shore of the mainland or on large islands, the last, as a rule, forming the least desirable stations of the series. Some of those stations situated on small islands or reefs also show considerable variations of temperature due to local influences, as described further on.

The arrangement of stations followed in this report is generally from south to north, this order affording the most natural sequence for comparing the different ranges of temperature in successive latitudes. The locations and general characteristics of the stations are as follows: *

THE FLORIDA REEFS.

Dry Tortugas light-house.—Located on the western island of the Tortugas, at the southwestern extremity of the Florida Reefs. The light-house is situated on the eastern side of Loggerhead Key (or island), which is bordered by a channel having depths of 10 to 12 fathoms and occupied by strong tidal currents. The surface temperature observations were taken where the water is only 5 feet deep, and show indications of local influences, which render them more or less unsatisfactory with respect to the open waters surrounding the reefs.

Carysfort Reef light-house.—Located near the northeastern end of the Florida Reefs, about 158 miles from the Dry Tortugas light-house, and on the outer side of Carysfort Reef. Depths of 50 fathoms occur within 2 miles of the light. Observations were taken in a depth of only 3 feet, but evidently in a more exposed position than at the Tortugas station, as the effects of local influences are less apparent in the surface temperature records.

Fowey Rocks light-house.—Located on the outer edge of Fowey Rocks, at the northeastern extremity of the Florida Reefs, and 23 miles from Carysfort Reef. The 100-fathom curve is distant about 2¼ miles. The depth of water at the place of observation is 5 feet, and the water temperature records compare favorably with those of Carysfort Reef, indicating a similar exposure.

SOUTH CAROLINA.

Martin's Industry light-ship.—Anchored in 9 fathoms of water, about 8¼ miles from land, off the entrance to Port Royal Sound; distant about 390 miles from Fowey Rocks light-house.

Rattlesnake Shoal light-ship.—Anchored in 5 fathoms of water, about 5 miles off land, just north of the entrance to Charleston Harbor, and about 56 miles from Martin's Industry light-ship.

NORTH CAROLINA.

Frying Pan Shoals light-ship.—Anchored in 10 fathoms of water, about 17 miles southeast of Cape Fear, and about 108 miles from Rattlesnake Shoal light-ship.

Cape Lookout light-house.—Located on the outer shore, about 3 miles north of the extremity of Cape Lookout, and 90 miles from Frying Pan Shoals light-ship. The observations were taken at the lower edge of the beach in a depth of 1 foot of water. The bottom slopes gradually, and attains a depth of 10 fathoms about 5 miles from shore. Although the maximum and minimum surface temperatures at this station correspond closely with the same at Frying Pan Shoals, the surface curves are much less regular, and show direct atmospheric influence.

* For more complete descriptions, reference should be made to the explanations of the charts.

Body's Island light-house.—Located near the southern end of Body's Island, about 35 miles north of Cape Hatteras, and 86 miles from Cape Lookout. The shore is similar in character to that at Cape Lookout, but the surface observations were taken where the depths are from 7 to 9 feet. The temperature curves for the surface and air are almost precisely alike, and the observations cannot be regarded as of any value with respect to the open waters off shore.

VIRGINIA.

Winter Quarter Shoal light-ship.—Anchored in 10½ fathoms of water, 8½ miles off Assateague Island, and about midway between the entrances to Chesapeake Bay and Delaware Bay; distant about 128 miles from Body's Island.

NEW JERSEY.

Five-Fathom Bank light-ship.—Anchored in 12 fathoms of water, about 14 miles off the coast, just east of Cape May, and off the entrance to Delaware Bay; distant about 56 miles from Winter Quarter Shoal light-ship.

Absecon light-house.—Located on the beach in front of Atlantic City, and just south of the entrance to Absecon Inlet; 34⅝ miles distant from Five Fathom Bank light-ship. The shore is faced with shoals, but the surface observations were taken in the channel leading to the inlet, in depths of 9 to 15 feet of water. The surface records are much more satisfactory than at either of the previous shore stations (Cape Lookout and Body's Island), and the surface curves are nearly as regular as at Five Fathom Bank light-ship.

NEW YORK.

Sandy Hook light-ship.—Anchored in 14 fathoms of water off the entrance to New York Bay; 6 miles east of Sandy Hook, N. J., the nearest land; and about 70 miles from Absecon light.

Fire Island light-house.—Located on the east side of Fire Island Inlet, south side of Long Island, 31 miles from Sandy Hook light-ship. The surface observations were taken in the entrance to Great South Bay, between Fire Island and Oak Island, in 3 feet of water. A strong current flows through the channel, which is somewhat similar in character to the entrance to Absecon Inlet.

RHODE ISLAND.

Block Island southeast light-house.—Located at the southeastern corner of Block Island, 82 miles from Fire Island light. The observations were taken at the lower edge of the beach, which faces the open sea to the south. The surface temperature curves are comparatively regular and show less variation from local influences than would be expected at a shore station of its character.

Brenton's Reef light-ship.—Anchored in 14½ fathoms of water, off the entrance to Narragansett Bay, and about 1⅞ miles from land; 17¾ miles distant from Block Island southeast light.

MASSACHUSETTS.

Vineyard Sound light-ship.—Anchored in 15 fathoms of water, on the western side of the southern entrance to Vineyard Sound, 2½ miles from Cuttyhunk Island, the nearest land, and 17½ miles from Brenton's Reef light-ship.

Nantucket New South Shoal light-ship.—Anchored in 16 to 18 fathoms, at the southern edge of Nantucket shoals, and 21 miles southeast of Nantucket Island, the nearest land; distant about 58 miles from Vineyard Sound light-ship. This station occupies a very important position with reference to the off-shore fisheries.

Pollock Rip light-ship.—Anchored in 5 to 7 fathoms of water, in the eastern entrance to Nantucket Sound, and 3½ miles SE. by E. ½ E. from Monomoy Point light-house, Cape Cod; distant about 36 miles from Nantucket New South Shoal light-ship. This light-ship is mostly surrounded by numerous shoals which are separated by channels occupied by strong tidal currents.

Thatcher's Island lights.—Located on Thatcher's Island, off the eastern extremity of Cape Ann, about 73 miles from Pollock Rip light-ship. Depths of 60 fathoms occur within a distance of 6½ miles to the eastward. The surface temperature observations were taken where the water is 7 feet deep, and show variations from local influences. Observations were first made at this station by one of the light-house keepers, but after April, 1881, by an observer of the U. S. Signal Service.

MAINE.

Boon Island light-house.—Boon Island is a small rocky island lying off York Harbor, and 5¾ miles from the nearest land. It is distant about 35 miles from Thatcher's Island, and is surrounded by depths of 5½ to 25 fathoms within a radius of 1 mile. The depth of water where the surface observations were taken is 9 feet. Many gaps occur in the records of this station, and the reductions plotted on the chart are therefore probably not reliable.

Seguin Island light-house.—Seguin Island is small and rocky, and is situated about 2½ miles off the nearest point of the mainland, on the eastern side of the entrance to Kennebec River, and about 47 miles from Boon Island. The light-house is on the western side of the island, where the water is from 6 to 8 fathoms deep close inshore at the place of observation.

Matinicus Rock light-house.—Matinicus Rock is a rocky islet about 14 miles south of Vinal Haven, at the mouth of Penobscot Bay, and about 80 miles from Seguin Island. Depths of 4 to 45 fathoms occur within a radius of 1 mile, the depth where the surface observations where taken ranging from 6 to 12 fathoms.

Mount Desert Rock light-house.—Mount Desert Rock is similar in character to Matinicus Rock, and is situated about 18 miles off Mount Desert Island and 34 miles from Matinicus Rock. Within a radius of 5 miles the depths

range from 50 to 95 fathoms; the depths of water where the observations were taken were 2 to 10 fathoms; the records are about as imperfect at this station as at Boon Island.

Petit Manan light-house.—Petit Manan Island consists of a group of low, rocky islets, situated about 2 miles from land, off the western entrance to Pigeon Hill Bay, and 27 miles from Mount Desert Rock. They are surrounded by deep water, the observations having been taken where the depths range from 8 to 15 fathoms.

RELATIVE POSITIONS OF THE STATIONS.

The three most southern of the temperature stations, those at the Tortugas, Carysfort Reef, and Fowey Rocks, are located on the northern and western edge of a deep and comparatively narrow channel, called the Straits of Florida, which extends first easterly from the Gulf of Mexico and then northerly into the Atlantic Ocean. This channel, which is occupied for its entire width and length by the Gulf Stream, is bounded on the north and west by Florida, on the south by Cuba, and on the east by the Bahama banks and islands. Its length is about 350 miles, but the temperature stations are limited to its central and western portions, all being situated on the Florida Reefs. In front of the Tortugas, the 100-fathom curve is distant about 15 miles from the southern edge of the reefs, which are located at the southern end of the submerged continental slope bordering the west coast of Florida for a width of 110 to 145 miles. At Carysfort Reef, the *100-fathom curve is distant only about 7 miles from shore, and at Fowey Rocks only 2½ miles.* The deepest water in the straits occurs at the western entrance, opposite the Tortugas, and in places exceeds 1,000 fathoms, the southern and eastern sides of the straits being generally deeper than the northern and western. The influence of the great body of warm water composing the Gulf Stream is felt directly upon the Florida Reefs, although these reefs are known to be bathed by a narrow counter current flowing to the westward. The axis or warmest band of the Gulf Stream passes nearer the southern and eastern than the Florida side of the channel.

The Tortugas Reefs are situated at the western end of the Straits of Florida, on the northern side, where the distance across from land to land is about 90 miles. The Tortugas station, however, is in a somewhat protected position, and local influences are perceptible in the temperature records. At Fowey Rocks, the width of the channel is reduced to about 40 miles, this width being the least of any in the straits. The stations at Carysfort Reef and Fowey Rocks both occupy more exposed positions than the one at the Tortugas, and are therefore better located for ascertaining the temperature of the open waters bordering the reefs.

Between the Florida Reefs and the first station to the north (Martin's Industry light-ship, South Carolina), a distance of about 6½ degrees of latitude intervenes. Within this distance the 100-fathom curve and the inner edge of the Gulf Stream gradually recede from the coast line as far as Georgia, whence to near Cape Lookout, North Carolina, they retain a nearly uniform distance from the shore. Along this section of the coast the submerged continental plateau has an *average width of about 55 miles to the 100-fathom curve, which lies just within the inner edge* of the Gulf Stream or "Cold Wall." The bottom slopes gradually from the shore into depths of about 50 fathoms, beyond which the descent is very rapid. Just south of Cape Lookout the 100-fathom curve bends in somewhat toward the shore, and in front of Cape Hatteras the submerged continental border is only about one-third as wide as it is farther south, the Gulf Stream also approaching nearer to the land. North of Cape Hatteras the 100-fathom curve again recedes from the shore and the Gulf Stream is deflected toward the east.

Between Georgia and Cape Hatteras there are four stations, of which three are light-ships, located several miles off shore, in depths of 5 to 11 fathoms. Martin's Industry light-ship is off the entrance to Port Royal Sound, South Carolina, in front of Martin's Industry Shoal, which separates the south and southeast channels; Rattlesnake Shoal light-ship is just north of the

entrance to Charleston Harbor, and Frying Pan Shoals light-ship is 17 miles off Cape Fear, North Carolina. It is possible that the fresh waters emptying into the sea in the neighborhood of the two former stations may influence the surface temperatures to a greater or less degree, but the distance of these light-ships from shore makes this supposition improbable. Cape Lookout light-house is a shore station affording results of local value only, and Body's Island light-house, about 35 miles north of Cape Hatteras, is of the same character.

At Winter Quarter Shoal light-ship, Virginia, the next station north of Body's Island, the 100-fathom curve is distant about 55 miles from shore, the submerged continental plateau having about the same width here as to the south of Cape Lookout. At Five-Fathom Bank the width increases to over 65 miles; opposite New York Bay entrance it is about 100 miles wide, and in front of Nantucket Island about 80 miles wide. The slope of the bottom along this part of the coast is also very gradual until a depth of about 50 fathoms is reached, the distance between the 50 and 100 fathom curves being only 5 to 15 miles. The inner edge of the Gulf Stream is distant from the shore at Winter Quarter Shoal about 100 miles; at Five-Fathom Bank about 140 miles; at Nantucket Island about 200 miles, and, therefore, bears no relation to the submerged continental border, north of Cape Hatteras, as determined by the 100-fathom curve.

Winter Quarter Shoal and Five Fathom Bank light-ships are the two most southern stations on this part of the plateau, and both are favorably situated, the former 8½ miles off shore in a depth of 10 fathoms; the latter 14 miles off shore in a depth of 12 fathoms. The next light-ship to the north is that off Sandy Hook, New Jersey, which is anchored in 14 fathoms of water. Being located directly off the mouth of New York Bay, the surface waters at this station may possibly be influenced to some extent by the outflow from the Hudson River, especially in the early spring after the ice has broken up, but there is no special evidence to that effect. Between Delaware Bay and Rhode Island there are three shore stations, two (Absecon and Fire Island) situated upon tidal inlets, and one (Block Island) upon an ocean beach. The two former have furnished better observations than would ordinarily be considered possible in such places.

East of Block Island there are four temperature stations off the southern coast of New England, all of which are well located. The Brenton's Reef and Vineyard Sound light-ships belong to the area included between Block Island and Martha's Vineyard. Pollock Rip light-ship is at the eastern entrance to Nantucket or Vineyard Sound, and, although surrounded by shoals, is in the midst of strong tidal currents, which are probably not influenced by the neighboring land. Nantucket New South Shoal light-ship occupies one of the most exposed positions on the coast, and is distant over 20 miles from the nearest land. A series of stations like this one, distributed along the entire coast, could be made to furnish most important data respecting the fisheries.

The Gulf of Maine, in which the remaining stations are located, is a moderately deep basin, surrounded on the west, north, and northeast by land, on the south by George's Bank, and on the east by Brown's Bank, in part, and the shoal water off Cape Sable, Nova Scotia. The Bay of Fundy opens into it from the northeast. This area contains many banks and ledges, and the bottom contour lines are very irregular. The 50-fathom curve is nowhere distant from the land, and along the northern coast, where most of the stations are situated, approaches close to it. The 100-fathom curve is also not very far distant from the Massachusetts coast, and approaches the coast of Maine between Mount Desert and Machias. The most southern station is on Thatcher's Island, off Cape Ann, an important location, though, unfortunately, the observations were taken in too shallow water to make them of value with respect to the open waters of the gulf. Boon Island is in the western part of the gulf, midway between Cape Ann and Portland. Seguin Island, Matinicus Rock, and Mount Desert Rock are in nearly the same latitude, the first mentioned being near

the mainland, the two latter close to the 50-fathom curve. Petit Manan Island, like Seguin, lies but a short distance off the mainland, and is the most northern and eastern station of the series.

COMPARISON OF THE STATIONS WITH RESPECT TO TEMPERATURE.

As explained elsewhere, the stations do not all afford temperature observations of equal value on account of differences in the nature of their surroundings. Many of the stations included in this report do not, therefore, furnish correct data with respect to the open waters of the coast, but the character of the surface observations may be more or less accurately determined by a study of their relations to the air temperatures. The light-ships, being all located off shore in depths exceeding 5 fathoms, are naturally best adapted for the taking of ocean temperatures, while next in order of excellence, as a rule, are the light-houses situated on small islands and reefs, more or less distant from the mainland. The records for January and February at nearly all the stations north of Cape Hatteras have not been used, on account of the manifest errors of observation sometimes made during extremely cold weather, by not reading the thermometer quickly enough after it has been withdrawn from the water. These errors do not appear to extend much into either December or March, although at some stations the records for those months may show too low a range of temperature by a very small amount. However, the winter surface temperatures are not of much importance in connection with any fishery problem north of Cape Hatteras.

At the extreme south we recognize a group of stations which differ from all the others in the conditions of temperature. It includes only the three light-houses of the Florida Reefs, bordering the Gulf Stream. At Carysfort Reef and Fowey Rocks the curves of surface temperature are more regular than at the Tortugas and correspond less closely with the air curves, indicating fewer local influences or more open exposures at the places of observation. The three succeeding light-ships, Martin's Industry, Rattlesnake Shoal, and Frying Pan Shoals, afford more or less uniform results, the plottings forming much more pronounced curves than at the Florida Reefs; the surface curves are most regular at the first mentioned light-ship. Cape Lookout is a shore station at which the irregularities in the air curves are almost exactly repeated in the surface curves, although the maximum surface temperature is no higher than at Frying Pan Shoals light-ship. At Body's Island, another station on the mainland, both the air and surface curves indicate extreme fluctuations in temperature, which are almost precisely alike for both the air and surface. The surface lines at Winter Quarter Shoal and Five-Fathom Bank light-ships correspond closely in their general curvature, and also in many of their details. At Absecon Inlet, the third shore station, the water curves are more regular than at either Cape Lookout or Body's Island, but the maximum temperature is the same for both the air and water. The surface curves differ considerably from those of the air at Sandy Hook light-ship, and at Fire Island and Block Island the results are much more satisfactory than at any of the other shore stations, in both cases the maximum surface temperatures being about 8°.5 lower than the maximum air temperatures. At the three succeeding light-ships, Brenton's Reef, Vineyard Sound, and Nantucket New South Shoal, the surface curves are all comparatively regular; but at Pollock Rip light-ship, they present many irregularities which do not, in all cases, correspond with those of the air. The fluctuations of temperature are still greater at Thatcher's Island, where the observations were taken in a sheltered position in shallow water. Of the islands in the northern part of the Gulf of Maine, the most regular and uniform series of surface curves are presented by Matinicus Rock, Seguin Island affording the next best series in that respect. At the three other stations the surface curves are less regular, especially from 1881 to 1883, inclusive, but the irregularities do not appear to be due, in most cases, to atmospheric influence.

THE FLORIDA REEFS.—Excluding the observations for the Tortugas, the extreme range of surface temperature at the Florida Reefs is 16°.5, with a maximum of 86°.5. The maximum at the Tortugas is about the same, but the minimum is 5° lower. The air temperature presents a range of 18° to 21°.5, the air maximum being about the same as the surface maximum at Fowey Rocks, 2°.5 higher at the Tortugas, and 2°.5 lower at Carysfort Reef. At none of the other stations along the coast do we find nearly so short a range either of surface or air temperature, and these are the only stations that are situated directly within the influence of the Gulf Stream.

SOUTH CAROLINA TO VIRGINIA.—At the light-ships of Martin's Industry Shoal and Rattlesnake Shoal, the range of air temperature is 41°, the surface range 38°, the maximum for the air being 86°.5, the maximum for the water 85°, or about 1°.5 lower than at the Florida Reefs. The greater range of temperature at these two light-ships, and at the stations immediately following them toward the north is due to the much lower temperatures of winter, amounting to over 20°, the differences in the maximums being slight. At Frying Pan Shoals light-ship, the maximums of both air and surface temperatures are slightly lower, the air range being the same as at Rattlesnake Shoal, the surface range only 33°, with a maximum of 82°.5. The records for Cape Lookout and Body's Island, show approximately the same range for both air and surface temperature at each, amounting to about 42° at the former station, and 64° at the latter.

VIRGINIA TO NEW YORK.—North of Chesapeake Bay the maximums of surface temperature are much lower than to the south, reaching 76°.5 at Winter Quarter Shoal light-ship, and about the same at Five-Fathom Bank light-ship. This is 6° lower than at Frying Pan Shoals, the first light-ship south of Cape Hatteras, and about 9° lower than at Rattlesnake Shoal and Martin's Industry light-ships. At the northern stations, beginning with Winter Quarter Shoal light-ship, the temperature plottings for January and February have been omitted in most cases, and the ranges of temperature, where given, are, unless otherwise stated, for only ten months. At Absecon Inlet, on the mainland, the surface maximum is about 3° higher (79°.5) than at the two preceding light-ships, and agrees with the air maximum; at Sandy Hook light-ship the surface maximum is 1½° to 2° lower than at Five-Fathom Bank and Winter Quarter Shoal, and 7° lower than the air maximum at the same place; at Fire Island the surface maximum is 8° lower than the air maximum, and about the same as the surface maximum at Sandy Hook, showing more satisfactory observations than at any of the previous shore stations.

BLOCK ISLAND TO CAPE COD.—The surface maximum at Block Island is 8°.5 lower than the air maximum, and only 1°.5 higher (70°.5) than at the nearest light-ship, which is about 18 miles distant. Brenton's Reef and Vineyard Sound light-ships afford closely corresponding results, the maximum of both air and surface temperature being slightly lower at the latter station. The surface maximum at Brenton's Reef is 69°, being 5°.5 lower than at Sandy Hook, 7°.5 lower than at Winter Quarter Shoal, 16° lower than at Martin's Industry, and 17°.5 lower than at the Florida Reefs, the maximum for Brenton's Reef being a little lower than the minimum for the Florida Reefs. At Nantucket New South Shoal, and Pollock Rip light-ships, the maximums of surface temperature are approximately the same, about 62°, and the range of temperature is but slightly less at the former station; the air maximum is 3° higher at Nantucket than at Pollock Rip. The surface maximum is the same at these two light-ships as at Boon Island, in the Gulf of Maine, which has also approximately the same range, 29° for 10 months. This range is much shorter than at Vineyard Sound light-ship and preceding stations, while the air range remains about the same. The surface curves at Nantucket New South Shoal and Pollock Rip are, therefore, straighter in comparison with the air curves than at the more western stations, and this same feature will also be found characteristic of the stations in the Gulf of Maine.

GULF OF MAINE.—Considerable differences occur in the maximums of both air and surface temperatures at the several stations in the Gulf of Maine. Aside from Thatcher's Island, the highest air maximum is 75°.5, at Mount Desert Rock, the lowest 65°, at Matinicus Rock; the highest water maximum is 62°, at Boon Island, the lowest 54°, at Matinicus Rock. As to the surface curves, *Boon Island agrees most closely with Pollock Rip and Nantucket New South Shoal, while* Matinicus Rock and Mount Desert Rock afford the lowest surface maximums of any of the stations on the entire coast.

Table showing the minimum and maximum temperatures of the air and surface water, and the ranges of air and surface temperature at the light-house stations, for the five years from 1881 to 1885, inclusive.

Stations.*	Period.	Air temperature.			Surface temperature.		
		Minimum.	Maximum.	Range.	Minimum.	Maximum.	Range.
		° F.	° F.	° F.	° F.	° F.	° F.
Petit Manan Island, Me	March 1 to January 1.	20	70	50	31	58.5	27.5
Mount Desert Rock, Me	do	25.5	75.5	50	33	54.5	21.5
Matinicus Rock, Me	do	23	65	42	32.5	54	21.5
Seguin Island, Me	do	24	70.5	46.5	33	58	25
Boon Island, Me	do	22.5	73.5	51	33	62	29
Thatcher's Island, Mass	Entire year	30	78.5	48.5	35	67	32
Pollock Rip, Mass	March 1 to January 1.	27	66	39	32	62.5	30.5
Nantucket N. S. Shoal, Mass	Entire year	26	69	43	33.5	62	28.5
Vineyard Sound, Mass	March 1 to January 1.	28.5	71.5	43	31	68	37
Brenton's Reef, R. I	do	29	74.5	45.5	34	69	35
Block Island, R. I	do	22	79	57	29.5	70.5	41
Fire Island, N. Y	do	35	83.5	48.5	35	75	40
Sandy Hook, N. Y	do	31.5	81.5	50	33	74.5	41.5
Absecon Inlet, N. J	do	33	79.5	46.5	34.5	79.5	45
Five-Fathom Bank, N. J	do	36.5	83.5	47	37	76	39
Winter Quarter Shoal, Va	do	33	81	48	35.5	76.5	41
Body's Island, N. C	Entire year	27	91	64	28	91	63
Cape Lookout, N. C	do	43	84	41	42	84	42
Frying Pan Shoals, N. C	do	44	85	41	49.5	82.5	33
Rattlesnake Shoal, S. C	do	45.5	86.5	41	47	85	38
Martin's Industry, S. C	do	45	86.5	41.5	47	85	38
Fowey Rocks, Fla	do	68	86	18	70	86.5	16.5
Carysfort Reef, Fla	do	65.5	84	18.5	71.5	86.5	15
Tortugas, Fla	do	67	88.5	21.5	65.5	86	20.5

* The names of light-ships are printed in italics.

RELATIONS OF THE TEMPERATURE CURVES.

A comparison of the temperature curves for corresponding years at successive stations shows great uniformity in their relative positions and also in those irregularities which are indicative of more or less rapid changes of temperature. This uniformity often extends to stations that are widely separated or differently situated. Between January 20 and April 10, 1881, there were three separate periods during which the temperature fell below the average for that time of year at the southern stations. These several periods of low temperature are well brought out for both the air and surface by marked deflections in the curves beginning at the Tortugas and extending as far as Body's Island, the most northern station at which the temperature observations have been plotted for January and February. North of Body's Island, the last of these three periods, occurring between March 21 and April 10, can be traced as far as the Gulf of Maine, although at the northern stations the temperature at that time was not always lower than in other years. Again, between November 16 and December 16, 1882, another unusually cold spell is indicated on all the charts from the Tortugas to the Gulf of Maine. Many other indications of conformity between the

temperature curves at different stations will be observed on even a very superficial comparison of the charts. It will also be noticed that, while at the southern stations the temperature curves are generally most regular during the summer months, the reverse is true of the extreme northern ones.

THE SURFACE ISOTHERMS.

The purpose in view in preparing the charts of surface isotherms (Nos. 26 to 31), has been to present the temperature observations on which this report is based, in what appears to be the most convenient form for use in connection with such fishery problems as are suggested by the migrations of surface schooling fishes. If such species as the mackerel are controlled in their movements toward the north by conditions of temperature that are constant for all latitudes, a line drawn upon a chart to indicate their progress with reference to time must agree more or less closely with some line of equal temperature projected from point to point along the same coast. This supposition expresses in a general way the belief of many persons who have studied the migrations of mackerel and other economic fishes, but up to the present time sufficient data have not been collated to render possible the practical application of the principle to those species that live solely in salt water.

The isothermal charts are seven in number; one for each of the five years from 1881 to 1885, inclusive, one representing the means of the same five years, and the final one illustrating the relations of the air and surface isotherms. The annual charts are of most importance for fishery purposes, as, in showing the changes of position of the isothermal lines from year to year, they may possibly serve to explain the causes of the irregularity in the appearance of certain species upon different parts of the eastern coast in different years. A few words of explanation are necessary respecting the construction and contents of these charts.

Although, as elsewhere explained, the temperature results are not of equal value at all the stations, the latter have all been included in the charts, for the reason that it was impossible to determine satisfactorily, excepting in a few cases, which should be excluded. The observations at Cape Lookout, Body's Island and Absecon Inlet evidently do not apply to the open waters of the coast, and the same is probably true to some extent with respect to a few of the other mainland and island stations. The three stations specially referred to have not generally been considered in discussing the isothermal charts. The data for the construction of the charts has been taken from the original temperature records, and not from the reductions to ten-day means, although the latter have been considered in deciding every date used in constructing the isotherms. In determining the dates for each isotherm no observations were considered unless the means of twenty consecutive observations (ten days) equalled or exceeded the temperature of that isotherm, except in a few instances elsewhere explained. The temperature of 40°, for example, might be reached at any station either within the first ten-day period indicated upon the special chart of that station (charts of ten-day means) as having a mean of more than 40°, or in the latter part of the previous ten-day period; but the mean temperature for the ten days following and including the date of the isotherm must not be under 40°. For the isotherms during the period of falling temperature in the last half of the year this order is reversed.

In constructing the charts, the names of the stations have been arranged vertically, in geographical sequence, on the left hand side of the chart. The remainder of the chart is divided into thirteen vertical spaces, each representing one month, that on the extreme right being for the month of January of the year following that to which the chart relates. Each month is further divided by the fainter lines into five equal parts, for convenience in reading the dates. The iso-

thermal lines are constructed for every five degrees of temperature from 40° to 80°, and are carried vertically from station to station, connecting the dates at which the temperatures they represent were reached at each station; the data for each separate station are to be read across the chart from left to right. Two series of isotherms are actually included on each chart, one relating to the period of rising temperatures in the first half of the year, the other to that of falling temperatures in the last half of the year. The space included between any two isotherms of equal value is supposed to represent a period during which the temperature was always equal to or above that indicated by the isotherms. Those portions of the isothermal lines consisting of dashes denote the lack of observations for the stations opposite them. Complete breaks in the lines generally indicate that the temperature did not reach the isotherm at that station during the year, or during the period of either rising or falling temperature.

In explanation of the arrangement, reference may be made to the isothermal chart for 1881 (No. 26). In that year the isotherm of 40° did not extend south of Body's Island, where the temperature reached 40° about the middle of February. At Winter Quarter Shoal the same temperature was reached March 20; at Five-Fathom Bank, April 15; at Absecon Inlet, March 20; at Sandy Hook, April 14; at Fire Island, April 8; at Block Island, April 16. The temperature remained above 40° throughout the rest of the year, and until after January, 1882, at Body's Island, Winter Quarter Shoal, Five-Fathom Bank, and Sandy Hook; until January 2, 1882, at Absecon Inlet; until December 31, at Fire Island; and until January 1, at Block Island. The isotherms of 45°, 50°, 55°, &c., are reached at successively later dates during the period of rising temperature, and at earlier dates during the period of falling temperature, but the intervals between them vary greatly at the different stations.

RANGES OF THE ISOTHERMS.

A detailed comparison of the isothermal charts would tend to confuse rather than to aid reference to them, and our remarks on the subject will be limited to a few statements respecting the range and general position of the isotherms.

The isotherms of 40° and 45° are generally co-extensive in their range. They always reach as far north as Petit Manan, and frequently as far south as Body's Island, but may stop at either Winter Quarter Shoal or Five-Fathom Bank; in 1882, the isotherm of 40° extended south only as far as Absecon Inlet. The isotherm of 50° begins at the north at Petit Manan, and at the south may terminate at Cape Lookout or Martin's Industry. The isotherms of 55° to 70°, inclusive, always reach south to Martin's Industry, but no farther; while those of 75° and 80° are the only ones ranging along the Florida Reef stations to the Tortugas. A temperature of 55° is often recorded at Petit Manan, but seldom at the next two stations to the westward—Mount Desert Rock and Matinicus Rock. South of here the isotherm of 55° is generally continuous. The temperature usually reaches 60° at Boon Island and Thatcher's Island (although at the latter station observations are wanting for 1884 and 1885), but during some years remains lower than this at Pollock Rip and Nantucket New South Shoal. The isotherm of 65° generally extends northward to Vineyard Sound, but in 1884 it began at Brenton's Reef; that of 70° extends north to Fire Island or Block Island. Absecon Inlet is the northern limit of the isotherm of 75°, which in some years, however, does not reach north of Body's Island or Cape Lookout. The isotherm of 80° does not pass north of Body's Island.

CHANGES IN POSITION OF THE ISOTHERMS IN DIFFERENT YEARS.

During the five years represented by the charts there is considerable change in the positions of the isotherms of equal value from year to year, frequently amounting to a month in time, and

occasionally to much more. The differences are greater at some stations than at others, and are seldom nearly the same at any station for two or more isotherms of different values. At Nantucket New South Shoal, for example, the isotherms of 40° for five years, during the periods of rising temperature, all appeared within four days of the same date, while those of 45° are distributed over a period of about eighteen days. At the next station to the north—Pollock Rip—the isotherms of 40° cover a period of over forty days, and those of 45°, a period of twenty-four days. At Petit Manan the isotherms of 40° and 45° are remarkably constant in position from year to year. The isotherms of 45° and 50° appear to be the most uniform in that respect for their entire range during the five years; but no two isotherms of equal value retain the same relative positions throughout their range. There may be comparative regularity with respect to several consecutive stations, but they generally cross one another one or more times, and while the isotherm of 40° for 1881 precedes that of 40° for 1882, between Mount Desert and Pollock Rip, at the more southern stations the reverse is true. The differences and irregularities in the positions of the yearly isotherms are so great that no definite laws respecting their relations over an extended range of coast can be deduced from the materials used in the preparation of this report.

GENERAL POSITIONS OF THE ISOTHERMS.

FORTY DEGREES.—The five isotherms of 40° (1881-'85), during the period of rising temperature in the spring, pass from Winter Quarter Shoal to Fire Island in March and the first half of April, from Block Island to Pollock Rip mostly in April, and reach the Gulf of Maine in the latter part of April or first half of May. At Petit Manan this temperature appears with great regularity about the middle of April. During the period of falling temperature, the isotherms of 40° are confined for the most part to the month of December, although they sometimes extend into January of the following year, and, as a whole, are more nearly vertical in their direction than those of the first half of the year.

FORTY-FIVE DEGREES.—From Winter Quarter Shoal to Fire Island the isotherms of 45°, during the period of rising temperature, fall mostly within the month of April, but during two years at Absecon Inlet, and one year at Winter Quarter Shoal, that temperature first appeared in the last half of March. From Block Island northward the same isotherms extend, in a general way, obliquely across the month of May into the first part of June at Matinicus Rock and Mount Desert Rock; they reach Petit Manan in the last of April or first part of May, or earlier than at any other station in the Gulf of Maine. During the period of falling temperature, the isotherms of 45° in the Gulf of Maine are mostly confined to the month of November, and farther south to the last part of November and December.

FIFTY DEGREES.—On the coast of South Carolina, the isotherms of 50° occur in January and February, during the rise of temperature; at Winter Quarter Shoal not until May, and at Absecon Inlet in the last part of April and first half of May. From this point they extend obliquely across the months of May and June, reaching Nantucket New South Shoal in the first part of June, Matinicus Rock in July, Mount Desert Rock between May 24 and July 12, and Petit Manan between June 8 and July 10. The same irregularities in the positions of the isotherms occur during the period of falling temperature in the Gulf of Maine, where they cover a period extending from September 10 to November 26. From Pollock Rip to Absecon Inlet the same isotherms are mostly limited to the month of November, and from Five-Fathom Bank to Martin's Industry they extend from the last of November into the first part of January.

FIFTY-FIVE DEGREES.—None of the isotherms of 55° can be plotted continuously east of Seguin Island, although at Petit Manan this temperature was recorded during all the four years

from 1882 to 1885, inclusive, and at Mount Desert Rock, during short periods in 1881 and 1883. South of Cape Lookout, the isotherms of 55°, during the season of rising temperature, occupy very different positions every year, ranging from January 1 to April 1. From Winter Quarter Shoal to Fire Island, they occur mostly between the 10th and last of May, from Block Island to Nantucket New South Shoal in June, and farther north in the last part of June or in July. During the period of falling temperature, they occur in the last part of August, September, or the first part of October, at Seguin Island, and in December or January on the coast of South Carolina.

SIXTY DEGREES.—The isotherms of 60° for 1885, are the only ones that extend northward continuously to Boon Island, the isotherms of that temperature during other years generally stopping at Nantucket New South Shoal. On the coast of South Carolina these isotherms are confined to March and April; from Winter Quarter Shoal to Fire Island, they occur during the last of May and first half of June; from Block Island to Vineyard Sound, in June; and at Nantucket New South Shoal, between July 14 and August 28. During falling temperature they appear at Nantucket New South Shoal between August 14 and October 1, and reach Martin's Industry between November 26 and December 18.

SIXTY-FIVE DEGREES.—The isotherms of 65°, during rising temperature, occur in April at Martin's Industry and Rattlesnake Shoal, in the first part of May at Frying Pan Shoals, but at Winter Quarter Shoal not until the middle of June or first part of July. Between Five-Fathom Bank and Fire Island they appear mostly in June, at Block Island in July, and at Brenton's Reef and Vineyard Sound in the last part of June and in July. During falling temperature, they occur at Vineyard Sound in August; at Block Island are exceedingly variable in position, ranging from August 8 to the last of September; and on the coast of South Carolina are mainly confined to the month of November.

SEVENTY DEGREES.—The isotherms of 70° sometimes extend to Block Island, but generally terminate at Fire Island. South of Cape Hatteras they are almost entirely confined to the month of May. From Winter Quarter Shoal northward they are exceedingly variable in position from year to year, during the periods of both rising and falling temperature, their extreme range in time in the former period being from June 18 to August 18, and in the latter from July 23 to October 14.

SEVENTY-FIVE DEGREES.—The isotherms of 75° are difficult to plot at the Florida Reefs on account of the frequent fluctuations in temperature, which generally occur between November and the following May. During those months there were often brief periods of higher temperature than 75°, which it was impossible to represent in connection with the isotherms, but they are all shown on the special charts of the three Florida stations. At Carysfort Reef and Fowey Rocks the isotherm of 75° may appear as late as the 18th of April, during rising temperature, and as early as the 24th of November during falling temperature. At Martin's Industry, during the period of rising temperature, they occur mostly in the extreme latter part of May and at Frying Pan Shoals in the first part of June. From Winter Quarter Shoal northward to Absecon, these isotherms, when they appear, are mainly confined to the last part of July and August.

EIGHTY DEGREES.—The period of higher temperature than 80° is shorter at the Tortugas than at the more northern stations of the Florida Reefs, and the isotherms of 80° of both series bend inward upon the chart at that place. At Carysfort Reef and Fowey Rocks these isotherms, on the rising temperature, were distributed, during the five years, between the 10th and the very last of May; at Martin's Industry and Rattlesnake Shoal between the 12th and last of June; and at Frying Pan Shoals between the 1st and middle of July. During the period of falling temperature they occupy a wider range in time, and extend obliquely from Frying Pan Shoals to Carysfort

Reef, at the former station occurring between August 1 and September 20, and at the latter between October 20 and December 8.

EIGHTY-FIVE DEGREES.—The surface waters seldom reach a temperature of 85° excepting for short periods at the extreme south, and it has been impossible to construct isotherms for more than one year at Martin's Industry and the Florida Reef stations. Temperatures of 85° and over were recorded between the 8th and last of July, 1881, at Rattlesnake Shoal, Fowey Rocks, and the Tortugas; between the first part of July and the last of August, 1883, at Carysfort Reef and Fowey Rocks; and in 1885, from August 2 to 26, at Martin's Industry, from July 29 to September 28, at Fowey Rocks, and from July 9 to September 25, at Carysfort Reef.

NINETY DEGREES.—A surface temperature of 90° was occasionally recorded at some of the extreme southern stations, but never for more than a day or two at a time.

MEAN ISOTHERMS BASED UPON FIVE YEARS' OBSERVATIONS.

In constructing chart No. 31, it was impossible, in all cases, to obtain the reductions of five years' observations, on account of occasional breaks in the records, but the number of years plotted is never less than three and generally more than four. The exact number in each instance may be determined by reference to the annual isothermal charts (Nos. 26–30).

On this chart the surface isotherms are represented as being much more regular and more uniformly distributed with reference to time than on any of the yearly charts. On the left-hand side of the chart, north of Body's Island, there is a wide area of low temperatures, bounded by the isotherms of 40°. From Winter Quarter Shoal to Fire Island, inclusive, this area represents a period of about seventy-five to one hundred days, being shortest at Five-Fathom Bank, and longest at Sandy Hook; from Block Island northward the length of this period varies from one hundred to one hundred and thirty-five days, being shortest at Brenton's Reef and longest at Boon Island. A narrower space of maximum temperatures extends vertically through the center of the chart, occupying principally the month of August, which is not crossed by any of the isotherms, although a few of them extend a short distance into it. The length of time elapsing between successive isotherms is generally from about twelve to twenty-four days, seldom less but often more. The isotherms are more numerous and follow one another more rapidly at the intermediate stations of the series than at the northern and southern stations; toward the north and south they diverge somewhat and become more widely separated. This naturally results from the fact that at the intermediate stations there is a much greater range of temperature (above a minimum of 40°) than at the northern and southern ones. In the eastern part of the Gulf of Maine there are only three continuous isotherms of the value of those plotted (40° to 50°, inclusive); in the western part four such isotherms (40° to 55°, inclusive). On the southern coast of New England there are five isotherms at Nantucket New South Shoal (40° to 60°, inclusive), and six from Vineyard Sound to Block Island (40° to 65°, inclusive); seven extend from Fire Island to Body's Island (40° to 70°, inclusive); four occur on the coast of South Carolina (55° to 70°, inclusive), and two at the Florida Reefs (75° to 80°, inclusive, and sometimes 85°).

North of Body's Island the isotherms of both series extend in a slightly oblique direction trending inward toward the north. At Cape Hatteras they bend abruptly, and the same isotherms appear much earlier in the year to the south of that important cape.

At Frying Pan Shoals, the first reliable station south of Hatteras, the isotherm of 55° appears about ninety days earlier than at Winter Quarter Shoal; the isotherm of 60° about sixty days earlier; the isotherm of 65° about fifty days earlier; and the isotherm of 70° also about fifty days earlier.

The isotherms of 75° and 80° also bend abruptly between South Carolina and the Florida Reefs, that of 75° occurring at Fowey Rocks about sixty days in advance of Martin's Industry, and that of 80° about twenty-six days in advance.

RELATIONS OF THE AIR AND SURFACE ISOTHERMS.

As stated in the explanation of Chart No. 32, there appears to be no constant relation between the air and surface isotherms at any of the light-house stations. During the periods of both rising and falling temperature, *the air temperature of any degree, as a rule, precedes the surface temperature* of the same degree, but the length of time intervening may vary from two or three days to over a month.

THE WIND RECORDS.

Very complete records respecting the direction of the winds were kept at all the stations excepting Thatcher's Island, the observations being taken twice each day, at the same time as the temperatures. The wind records are even more complete than are those for surface temperature, having fewer breaks at any of the stations; and as temperature is greatly influenced by the wind, it has been thought advisable to present in this connection a tabulation of the observations made. In this table (p. 176) the means of five years' observations for each month are arranged according to quadrants of the compass, beginning with the northeast quadrant. Northerly winds have been included in the same quadrant with northwesterly winds, to which they appear to be most nearly related in their effects upon temperature. The extent of the several quadrants is, therefore, as follows: *Northeast*, from NNE. to E., inclusive; *southeast* from ESE. to S., inclusive; *southwest* from SSW. to W., inclusive; *northwest* from WNW. to N., inclusive.

The general arrangement of the table scarcely requires an explanation. The data respecting the several stations are classified by quadrants under each month, and that for each station extends from left to right across the table. In the columns of figures, each one-tenth of a unit represents one observation, and each unit ten observations, extending through five years, the latter being equivalent to one day's observations for five years. The time ratio for each quadrant is, therefore, represented by days and fractions of a day. For example, at the Tortugas station in January, which has thirty-one days, the northeast quadrant shows a mean record of 14.9 days; the southeast of 7.2 days; the southwest of 2 days, and the northwest of 5.9 days, making a total of thirty days. The discrepancy of one day results from calms and variable winds. The terms used by the observers to express the velocity of the winds not being uniform at the different stations, it has been impossible to tabulate them.

At the Florida Reef stations northeasterly and southeasterly winds prevailed throughout the entire year, the records for the northwest and southwest quadrants being relatively small during nearly every month. Northeasterly winds predominated at the Tortugas during every month excepting June, in which the prevailing winds were southeasterly, and they afford an exceedingly high record during October, November, and December. The records for Carysfort Reef and Fowey Rocks, which are situated only about 23 miles apart, present some, though not considerable differences. At the former station northeasterly winds prevailed during February, May, September, October, and November; at the latter, during September, October, November, and December; the prevailing winds for the same stations during the other months being southeasterly. Northwesterly winds very rarely occur at the Florida Reefs during the summer months, and in only one instance did they exceed a mean of eight days during the winter months, that being at Carysfort Reef in December. Continuous winds from the north and northwest cause a marked reduction in

the temperature, as is strikingly illustrated in the chart for the Tortugas during March, 1881, and November and December, 1882. The same conditions of temperature prevailed to some extent at Carysfort Reef and Fowey Rocks during the same periods, but northwesterly winds were far less prevalent at those stations during 1881 and 1882 than at the Tortugas. This subject is further discussed in the explanations of the charts for the three Florida stations.

Passing northward from the Florida Reefs, the prevailing winds gradually change from northeasterly and southeasterly to northwesterly and southwesterly. From Martin's Industry Shoal, South Carolina, to Cape Lookout, North Carolina, northeasterly winds generally prevailed during January, February, April, May, August, September, October, November, and December; and southwesterly winds during March, June, and July. A few slight exceptions to this rule are presented by some of these stations, and the wind records for two or even three quadrants are sometimes nearly alike during the same month. Northwesterly winds are no more common than at the Florida Reefs.

Body's Island, North Carolina, and Winter Quarter Shoal, Virginia, occupy an intermediate position between the southern and northern stations with respect to the winds as well as geographically. Northeasterly winds are less prevalent and northwesterly winds more common, especially during the colder months. At Five-Fathom Bank, New Jersey, northeasterly winds prevailed only during October, but they also furnished a relatively high record during May, August, and September. The prevailing winds at that station for January, February, March, April, November, and December were northwesterly; for May, June, July, August, and September, southwesterly. At Absecon Inlet, New Jersey, northeasterly and southeasterly winds prevailed from April to October, inclusive, and northwesterly winds during the other months. North of this station, northeasterly winds rarely prevailed during any month, but northeasterly and southeasterly winds are of much more frequent occurrence at the northern stations than are northwesterly and southwesterly winds at the extreme southern ones. Northwesterly winds generally prevailed from November to April, and southwesterly from April to November, but there are numerous exceptions to this rule, and at some of the stations southwesterly winds continued to be the prevalent ones through November and December. At Boon Island and Petit Manan, in the Gulf of Maine, southeasterly winds predominated during most of the summer months, and the record of winds from the northeast quadrant is very high at Boon Island, as also at some of the other stations on the coasts of Massachusetts and Maine.

*Table showing the direction of the winds, by quadrants, for each month of the year, at the light-house temperature stations on the eastern coast of the United States, being the means of five years' observations, from 1881 to 1885, inclusive.**

Stations.	January.				February.				March.				April.			
	NE.	SE.	SW.	NW.	NE.	SE.	SW.	NW.	NE.	SE.	SW.	NW.	NE.	SE.	SW.	NW.
Petit Manan, Me	5.5	3.6	9.5	12.4	5	6	7.3	9.9	8.6	6	9.2	7.2	6.8	5.7	10.7	6.8
Mt. Desert Rock, Me	4.9	4.5	8.5	12.9	5.6	4.9	8	9.4	7.2	6.8	7.1	9.6	5.4	5.3	10.1	7
Matinicus Rock, Me	3.7	4.8	9.1	12.9	4.6	4.9	6.4	11.7	5.3	4.8	7.4	13.5	6.3	4.8	8	7.9
Seguin Island, Me	7.4	2.1	9.5	11.6	7.6	3.1	7.8	8.8	9	4.3	8	9.2	6.5	5.4	8.6	8.6
Boon Island, Me	7.8	3.2	9	10.9	9	3.6	7.2	6.4	9.3	5.9	5.5	10.5	9.1	8.8	3.9	8
Pollock Rip, Mass	4.5	5.3	7.7	13.4	5.4	3.9	8	10.7	5.7	4.1	10	10.7	6.6	4.1	10.5	7.6
Nantucket N. S. Shoal	4.8	4.4	7.1	13.7	4.1	4.2	5.7	12.6	5	4.5	5.8	13.8	7.3	3.6	8.2	8.8
Vineyard Sound light-ship, Mass	5.8	2.4	8.6	13.8	6.5	4.5	5.3	10.2	6.3	4.3	7.8	11.7	6.9	3.6	10.7	6.8
Brenton's Reef, R. I	4	3	8.7	14	5	3.3	6.3	12.1	5.5	4.4	6.4	13.2	6.2	4.6	9.6	8.5
Block Island, R. I	6.7	4.3	7.5	12.5	4.8	4.2	6.2	8.8	8.1	2.3	8.2	11.7	8.7	3.5	11	6.8
Fire Island, N. Y	5.8	1.7	7.3	11.6	4.6	4.2	6.4	9.6	5.3	3.8	6.6	10.9	4.5	4.6	8.9	7.6
Sandy Hook light-ship, N. Y	7	3	4.9	15.6	6.7	3.1	3.7	12.6	6	4.6	3.8	16	5.3	5.5	5.7	11.5
Absecon Inlet, N. J	5.2	2.8	6.9	16	7.2	2.8	5.3	12.9	7.8	4.3	6.2	12.7	9.7	6.7	4.9	8.5
Five-Fathom Bank, N. J	*5.2*	*1.8*	*7.8*	*14.4*	*6.1*	*2.9*	*6.3*	*11.5*	*6.9*	*3.7*	*6.8*	*13.4*	*6.8*	*5.2*	*6.6*	*8.9*
Winter Quarter Shoal, Va	9.5	2.7	8.6	8.9	7.7	4	7.8	7.9	8.1	5.3	6.8	9.9	9.4	5.7	6.9	6
Body's Island, N. C	8.4	3.5	10	9.1	8.2	5.3	6.4	7.5	9.6	5.1	8.9	7.4	12.9	6	6.7	5.2
Cape Lookout, N. C	11.5	2.9	7.5	7.7	10.2	2.7	9	4.6	8.6	3.9	10	6.8	10.8	3.2	8	4
Frying Pan Shoals, N. C	13.5	2.2	9.6	5	11.3	4.5	8.4	3.9	11	2.5	10.8	5.7	11.2	2	11.2	3.9
Rattlesnake Shoal, S. C	12.1	3	8.5	5.2	11.1	5.8	6.6	3.1	7	5.8	13.3	3.9	9.9	6.9	10	2.5
Martin's Industry Shoal, S. C	12	4.4	6.9	5.2	10.3	5.5	6.2	3.9	7.6	7.1	10.3	5.5	9.8	7.8	7.1	4.4
Fowey Rocks, Fla	11.6	13.1	2.9	3.3	9.1	10.3	2.3	5.9	8.9	10.5	4.2	6.8	9	12.1	4.5	3.7
Carysfort Reef, Fla	*8.4*	*18*	*2.6*	*4.8*	*11*	*7*	*2.2*	*8*	*8.6*	*11.9*	*4.5*	*5.4*	*8.2*	*12.8*	*3.6*	*5.4*
Tortugas, Fla	14.9	7.2	2	5.9	15.1	7	1.1	4.4	13.4	8.4	2.2	5.6	11.6	10.2	1.8	6

Stations.	May.				June.				July.				August.			
	NE.	SE.	SW.	NW.	NE.	SE.	SW.	NW.	NE.	SE.	SW.	NW.	NE.	SE.	SW.	NW.
Petit Manan, Me	*8.5*	*10.5*	*8.4*	*3.6*	*3.7*	*11.7*	*11.8*	*3.4*	*3*	*14.8*	*11.4*	*1.8*	*5.8*	*13.6*	*11.3*	*2.3*
Mt. Desert Rock, Me	7.1	8.3	10.9	3	2.5	8.9	13.3	3	1.7	9.9	14.3	2	3	7.3	14	3.1
Matinicus Rock, Me	6.6	9.6	9.2	4.3	2.7	8.5	12.8	4.4	2.4	9.4	13.9	2.9	3.7	7.8	12.9	3.4
Seguin Island, Me	9.3	8.8	9.2	2.9	4.9	6.8	13.8	3.4	3.9	7.4	15.6	3.2	4.9	7.5	14.2	3.4
Boon Island, Me	9.9	13	4.5	3.2	5.3	13.3	5.6	4.8	5.8	12.9	7.7	3.8	7.5	10	10.5	2.6
Pollock Rip, Mass.	9.9	5.1	9.9	4.2	4.3	5.9	14.6	4	4	6	15.8	3.3	6.7	5.7	12.2	3.5
Nantucket N. S. Shoal	9.4	5.1	9.9	4	5.2	3.9	14.8	2.2	4.1	5.4	13	2.1	8.1	4.6	10.5	3.9
Vineyard Sound light-ship, Mass	8.6	6.8	12.3	3	4.3	5.5	16.3	2.9	4.4	5.3	16	3.6	6.3	5.4	14.8	2.1
Brenton's Reef, R. I	7.1	7.6	10.8	4	2.7	6.2	15	3.8	2.8	6	15.5	4	4.6	4.8	15.9	4.1
Block Island, R. I	8.9	5.6	10.7	4.6	5.2	4	16.9	3.7	4.1	3.8	16.7	4.2	6	4	17.6	3.2
Fire Island, N. Y	5	8	8.7	3.9	3.3	4.7	12.7	3.6	3.2	4.7	13.2	4.9	5.3	5.5	12.5	2.1
Sandy Hook light-ship, N. Y	6.4	10.4	4.9	7	3.6	11	7.1	6.7	2.5	9.5	8.3	8.1	6.6	8.3	7.3	7
Absecon Inlet, N. J	10.3	11.2	4.8	4.5	7.9	12.1	6.3	3.5	8.5	10	7.5	4.6	9.8	9.4	6.9	4.6
Five-Fathom Bank, N. J	9	6	10	5	6	7	12.9	3.1	5.5	5.5	14.1	4.2	9.3	5.9	10.5	3.8
Winter Quarter Shoal, Va	11.6	3.6	10.8	1.9	7.5	9.3	9.6	1.8	5.5	5.1	14.1	2.8	12.2	5.4	9.5	2.2
Body's Island, N. C	*14.1*	*5.5*	*9.1*	*2.3*	*10*	*5*	*11.5*	*1.5*	*9.8*	*5.7*	*13.1*	*1.9*	*14.7*	*7*	*7.9*	*1.2*
Cape Lookout, N. C	12.7	5.2	10.5	1.6	9.2	5.4	13.9	.8	7.3	3.7	17.2	2.1	12.8	3.9	10.7	1.2
Frying Pan Shoals, N. C	8.5	4.1	8.7	2.8	9	3.3	15.2	1	5.8	1.5	21.1	.7	10.9	3.2	11.6	2.2
Rattlesnake Shoal, S. C	10.6	9	8.4	1.6	6.7	8.2	13	1.4	6.4	9	14.3	.8	10.9	8.1	9.3	1.6
Martin's Industry Shoal, S. C	11	9.9	7.1	2.4	7.8	10.6	9.4	1.5	7	7.8	13.5	1.4	10.5	7.5	8.6	2.6
Fowey Rocks, Fla	11.6	11.8	4.4	1.9	5.3	16.9	5.5	1.1	6.8	15.4	6.4	1.3	6.7	16.7	4.4	1.6
Carysfort Reef, Fla	11.6	16.1	6.4	2.8	8.8	17.1	3.2	.8	6.7	17.9	4.9	.9	9.1	17.3	2.8	1.9
Tortugas, Fla	14	8.2	2.4	5.2	9.6	15.6	2.2	2	11.4	10.8	5.2	2	12.8	9.4	3.6	4

* The northeast quadrant includes NNE. to E., inclusive; the southeast, ESE. to S., inclusive; the southwest, SSW. to W., inclusive; the northwest, WNW. to N., inclusive. In the columns of figures, each one-tenth of a unit represents one observation, and each unit ten observations extending through five years, the latter being equivalent to one day's observations for five years. The time ratio for each quadrant is, therefore, represented by days and fractions of a day.

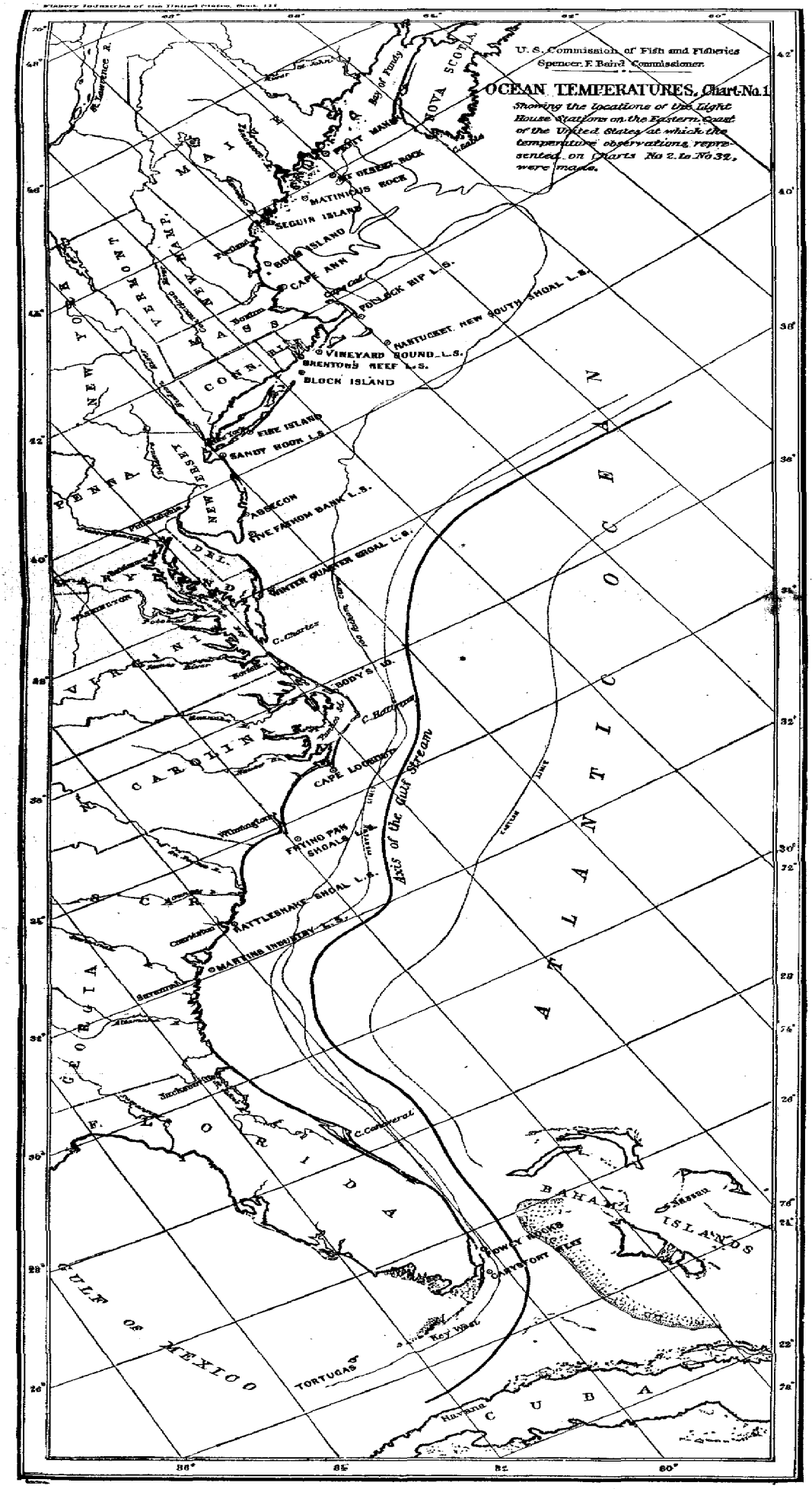

U. S. Commission of Fish and Fisheries
Spencer F. Baird Commissioner.
OCEAN TEMPERATURES, Chart No. 1
Showing the locations of the Light House Stations on the Eastern Coast of the United States at which the temperature observations represented on Charts No 2. to No 32, were made.
NOVA SCOTIA
Bay of Fundy
PETIT MANAN
MATINICUS ROCK
SEGUIN ISLAND
GOOSE ISLAND
CAPE ANN
POLLOCK RIP L.S.
NANTUCKET NEW SOUTH SHOAL L.S.
VINEYARD SOUND L.S.
BRENTON'S REEF L.S.
BLOCK ISLAND
FIRE ISLAND
SANDY HOOK L.S.
ABSECON
FIVE FATHOM BANK L.S.
WINTER QUARTER SHOAL L.S.
C. Charles
BODY'S I.D.
C. Hatteras
CAPE LOOKOUT
FRYING PAN SHOALS L.S.
RATTLESNAKE SHOAL L.S.
MARTINS INDUSTRY L.S.
C. Canaveral
FOWEY ROCKS
CARYSFORT REEF
Key West
TORTUGAS
Havana
Nassau
BAHAMA ISLANDS
CUBA
GULF OF MEXICO
ATLANTIC OCEAN
Axis of the Gulf Stream
MAINE
NEW HAMP.
VERMONT
NEW YORK
MASS.
CONN.
NEW JERSEY
PENNA.
DEL.
VIRGINIA
CAROLINA
GEORGIA
FLORIDA
Savannah
Jacksonville
Wilmington
Charleston
Philadelphia
Boston
Portland
Washington
Norfolk
Pamlico Sd.
Cape Cod
St. Lawrence R.
Atlantic Ocean
Gulf Stream
Cotton Line

Table showing the direction of the winds, by quadrants, for each month of the year, &c.—Continued.

Stations.	September.				October.				November.				December.			
	NE.	SE.	SW.	NW.	NE.	SE.	SW.	NW.	NE.	SE.	SW.	NW.	NE.	SE.	SW.	NW.
Petit Manan, Me	5.5	9.2	10.9	4.3	5.6	8.0	7.4	9.1	6.4	6.3	9.6	7.7	4.3	7.2	7.9	11.6
Mt. Desert Rock, Me	5.5	6.9	10.6	4.1	5.7	7.1	9.8	6.6	6.8	5.7	9.7	7.5	5.3	7.1	8.7	9.6
Matinicus Rock, Me	5.7	6	10.2	5.1	6.1	5.8	10	8.6	6.1	3.7	10.3	9.7	4.5	5.5	8.2	12.3
Seguin Island, Me	7.9	4.7	11.8	4.4	8.6	4.5	11.4	6.3	8.4	1.8	10.1	9	7	2.9	10.7	9.7
Boon Island, Me	10	10.1	6	3.1	11.4	7.3	7.7	4.2	9.7	4.3	9.1	6.8	8.8	4	9.6	8.6
Pollock Rip, Mass	9.4	6.2	8.5	4.5	10.8	4.7	8.3	5.9	6.8	3.1	9.1	10	5.1	4.4	10	10.3
Nantucket N. S. Shoal	10.1	5.3	11.3	3.5	9.3	5.2	9.4	7.6	6.1	2.9	7.2	11.9	4.7	4.6	7.2	13.8
Vineyard Sound light ship, Mass	9.3	4.5	11.3	4.1	10.2	4.1	9.4	6.5	6	1.9	11.1	10.2	5.5	2.3	9.3	13.8
Brenton's Reef, R. I	6	6.3	10.9	4.7	8.1	4.8	9.7	7.1	4.7	2	11	11.6	4.9	2.9	9.4	13.2
Block Island, R. I	9.8	5	11.3	3.9	10.9	4.1	12.1	3.9	5.4	2.7	9.9	9.8	7	3.2	9.7	9.9
Fire Island, N. Y	5.9	4.7	11.5	3.5	7	4.9	7.7	6.9	5.4	1.9	8.3	9.8	7.4	1.8	8.8	8.4
Sandy Hook light-ship, N. Y	7.6	8.8	6.8	5.7	8.6	6.4	5.7	9.5	6	3.9	6.1	13.6	6.5	3.7	5.8	14.6
Absecon Inlet, N. J	10.3	8.2	6.9	4.5	8.6	7.1	6.2	8.7	4.4	4.2	8.9	12.1	3.8	8.9	9.4	13.8
Five-Fathom Bank, N. J	9.4	4.6	11.7	3.8	9	4.2	8.6	7.9	6.3	2.1	9	12.1	4.2	3.2	9.7	12.7
Winter Quarter Shoal, Va	10.6	5.1	10.5	2.8	12	5.3	7.8	4.8	7.5	2.3	9.9	9.8	6.1	4	9.8	9.5
Body's Island, N. C	15.4	6.7	6.8	1.1	15.9	5.	6.2	3.8	8.6	4.4	7.3	9.7	7.5	5.3	9.3	8.6
Cape Lookout, N. C	13.2	6.1	6.5	2.3	13.6	4.2	5.9	6.1	10.2	3.7	4.5	8.9	10.2	4.3	6.6	7.7
Frying Pan Shoals, N. C	13.5	5.1	6.1	1.5	16	4	5.7	3.9	12.5	3.5	4.3	8.3	12	3.2	7.2	7.9
Rattlesnake Shoal, S. C	13.1	10.2	3	2.4	17.7	4.9	4.9	2.7	13.9	4.6	4.6	5.8	11.9	3.4	8.4	5
Martin's Industry Shoal, S. C	15.1	7.1	3.7	3.3	17.8	4.5	4.2	3.8	13.8	3.1	3.9	8.1	10.7	4.1	7.8	6.3
Fowey Rocks, Fla	13.5	9.7	4.4	1.5	17.3	5.7	2.8	4.5	15	7.1	1.4	5.9	12.2	9.2	2.1	6.9
Carysfort Reef, Fla	15.1	8.9	3.6	1.3	16.1	8.1	3.2	3.6	13.7	7.4	2.3	6.4	10.5	11	.7	8.7
Tortugas, Fla	14	10.2	4	1.6	23.2	2.3	2.4	3	21.2	2	.4	6	20	3.3	.2	6.3

EXPLANATION OF OCEAN TEMPERATURE CHART No. 2.

DRY TORTUGAS LIGHT-HOUSE, FLORIDA.

Observer: ROBERT H. THOMPSON.

Location of station.—The Dry Tortugas light-house is built on Loggerhead Key, the westernmost island of the Tortugas Reefs. These reefs are a westerly extension of the Florida Reefs, and are located about 1 degree from Key West. Loggerhead Key is about three-fourths of a mile long, and less than one-fifth as wide. It is situated on the southeasterly side of an elongate bank, bearing the same name, and trending in a northeasterly and southwesterly direction. The bank is about 5 miles long, and has an average width of three-fourths of a mile, inside of the 3-fathom line. The Southwest Channel, with depths of 10 to 12 fathoms, separates Loggerhead Bank from the Bird, Garden and Long Key Bank on the east. Strong tidal currents set through it, running northeast on the flood and southwest on the ebb. The channel between the Tortugas and Cuba is about 90 miles wide and is occupied by the Gulf Stream, the axis of which approaches much nearer the Cuban coast than the Tortugas. The depth of water in this channel exceeds 1,000 fathoms in some places, being greatest in its southern part. The 10-fathom curve passes close by the eastern side of Loggerhead Key, and the 100-fathom curve is distant only about 20 miles to the southward.

Geographical position of the light-house.—Latitude, 24° 38′ 04″ N.; longitude, 82° 55′ 42″ W.

Depth of water.—The depth of water where the observations were taken is 5 feet at mean low tide.

Range of temperature.—Air, 21°.5 (67° to 88°.5); surface, 20°.5 (65°.5 to 86°).

The depth of water where the observations were taken is probably too little, and the locality too much sheltered to afford satisfactory results respecting the temperature of the open waters surrounding the Keys. That such is the case will appear evident on comparing the temperature chart for the Tortugas with those for Carysfort Reef and Fowey Rocks. On the first mentioned, the more direct influence of the air upon the water temperature is made apparent by the manner in which each fluctuation in the curves of air temperature is repeated in the curves of water temperature. At the two more northern stations, although the depths are no greater, the curves of water temperature present fewer angles, probably due to the more open exposure of the places of observation.

The range of temperature given above is for 1881, that year having afforded the greatest extremes in temperature of any plotted. There is comparatively little difference between the air and surface temperatures at any period, and great uniformity in the curves of surface temperature during the summer and early fall months of all the years excepting 1884, in which year both the air and surface temperatures were constantly from 3 to 10 degrees lower between April and the middle of October. The collateral observations fail to explain the cause of this variation, the records for direction and force of the winds showing that essentially the same conditions in those particulars prevailed during 1884 and 1885, though both of those years differed more or less from the three preceding ones.

Between March 21 and April 10, 1881, and between November 26 and December 6, 1882, the temperature of both the air and water fell far below that for the corresponding periods of other years, affording the lowest observations recorded. The cause of these extreme variations, which are so clearly brought out by the curves of temperature on the chart, may be explained by the fact that during those two periods the winds were almost constantly from the north and northwest, and blowing fresh; the prevailing winds for the months in question are generally northeasterly. Low temperatures were recorded during the same periods at Carysfort Reef and Fowey Rocks, the next stations to the north.

Table showing the direction of the winds, by quadrants, for each month of the year, being the means of five years' observations

Quadrant.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
Northeast	14.0*	15.1	13.4	11.6	14	9.6	11.4	12.8	14	23.2	21.2	20
Southeast	7.2	7	8.4	10.2	8.2	15.6	10.8	9.4	10.2	2.2	2	3.8
Southwest	2	1.1	2.2	1.8	2.4	2.2	5.2	3.6	4	2.4	.4	.2
Northwest	5.9	4.4	5.6	8	5.2	2	2	4	1.6	3	6	6.8

OCEAN TEMPERATURE CHART No. 2

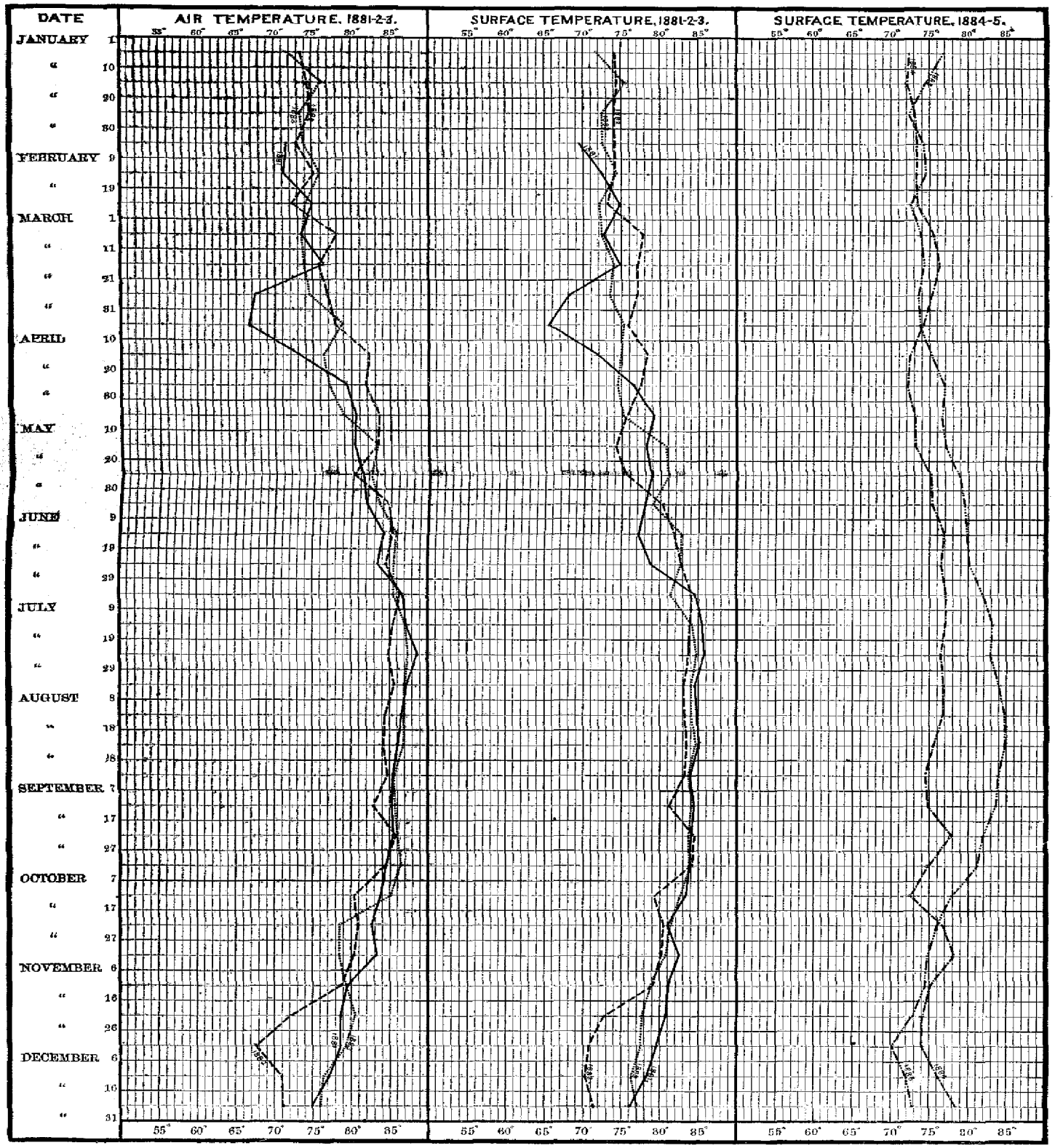
By RICHARD RATHBUN.

Station: Dry Tortugas Light House, Florida.

Representing, by means of curves, the temperature of the air from 1881 to 1883, inclusive, and of the water at the surface from 1881 to 1885, inclusive, reduced to means of ten days.

EXPLANATION OF THE CURVES: ——— 1881, — — — 1882, ... 1883, —·— 1884, —··— 1885.

(ISSUED IN 1886.)



Each vertical interspace represents one degree Fahrenheit, and the fractional parts of a degree are indicated as exactly as possible in the plotting of the curves. Each fifth degree is represented by a slightly heavier line. The transverse interspaces inclosed by the heavier lines represent periods of ten days each, as indicated by the dates on the left-hand side of the plate. The lighter transverse lines, intermediate between the heavier ones, are intended to represent the mean of each ten days, and the curves of temperature are plotted with reference to these lines. The left-hand vertical division is devoted to the air temperatures for 1881, 1882 and 1883, the middle division to the surface water temperatures for the same years, thus permitting of a comparison of the two; and the right-hand division to the water temperatures for 1884 and 1885.

EXPLANATION OF OCEAN TEMPERATURE CHART No. 3.

CARYSFORT REEF LIGHT-HOUSE, FLORIDA.

Observers: EDWARD BELL, F. A. BROST, MARTIN WEATHERFORD.

Location of station.—Carysfort Reef light-house is located on the outer side of Carysfort Reef, in front of Key Largo, and facing the Straits of Florida. It is about 158 miles northeasterly from the Dry Tortugas light-house. The water deepens rapidly from the outer edge of the reef, attaining a depth of 50 fathoms within a distance of about 2 miles. The 100-fathom curve is distant about 7 miles, and the axis of the Gulf Stream about 27 miles.

Geographical position.—Latitude, 25° 13′ 15″ N.; longitude, 80° 12′ 42″ W.

Depth of water.—Three feet.

Range of temperature.—Air, 18°.5 (65°.5 to 84°); surface, 15° (71°.5 to 86°.5).

The temperature is more equable at this station than at the Tortugas, both as regards the air and water. The air temperature is relatively lower throughout the year, the maximum being 4½° lower at Carysfort than at the Tortugas. The curves of surface temperature are more regular, and are very uniform for all the years, apparently indicating that the place at which the observations were taken was well suited for the purpose, although the depth of water was only 3 feet. The maximum surface temperature was practically the same at this station as at the Tortugas, and exceeds the air maximum by 2°.5.

The low temperatures recorded at the Tortugas for March, 1881, and November 26 to December 6, 1882, were also observed at this station, though in a relatively less degree, especially as regards the former period. During the first part of March, 1881, northerly and northwesterly winds prevailed, while during the latter part of the same month the winds were variable. During the ten days ending December 6, 1882, they were mostly from the north and northeast.

Table showing the direction of the winds, by quadrants, for each month of the year, being the means of five years' observations.

Quadrant.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
Northeast	8.4	11	8.6	8.2	11.6	8.8	6.7	9.1	15.1	16.1	13.7	10.5
Southeast	15	7	11.9	12.8	10.1	17.1	17.9	17.2	8.9	8.1	7.4	11
Southwest	2.6	2.2	4.5	3.6	6.4	3.2	4.9	2.3	3.6	3.2	2.3	.7
Northwest	*4.8*	*3*	*5.4*	*5.4*	*2.8*	*.8*	*.9*	*1.9*	*1.3*	*3.6*	*6.4*	*8.7*

OCEAN TEMPERATURE CHART No. 3

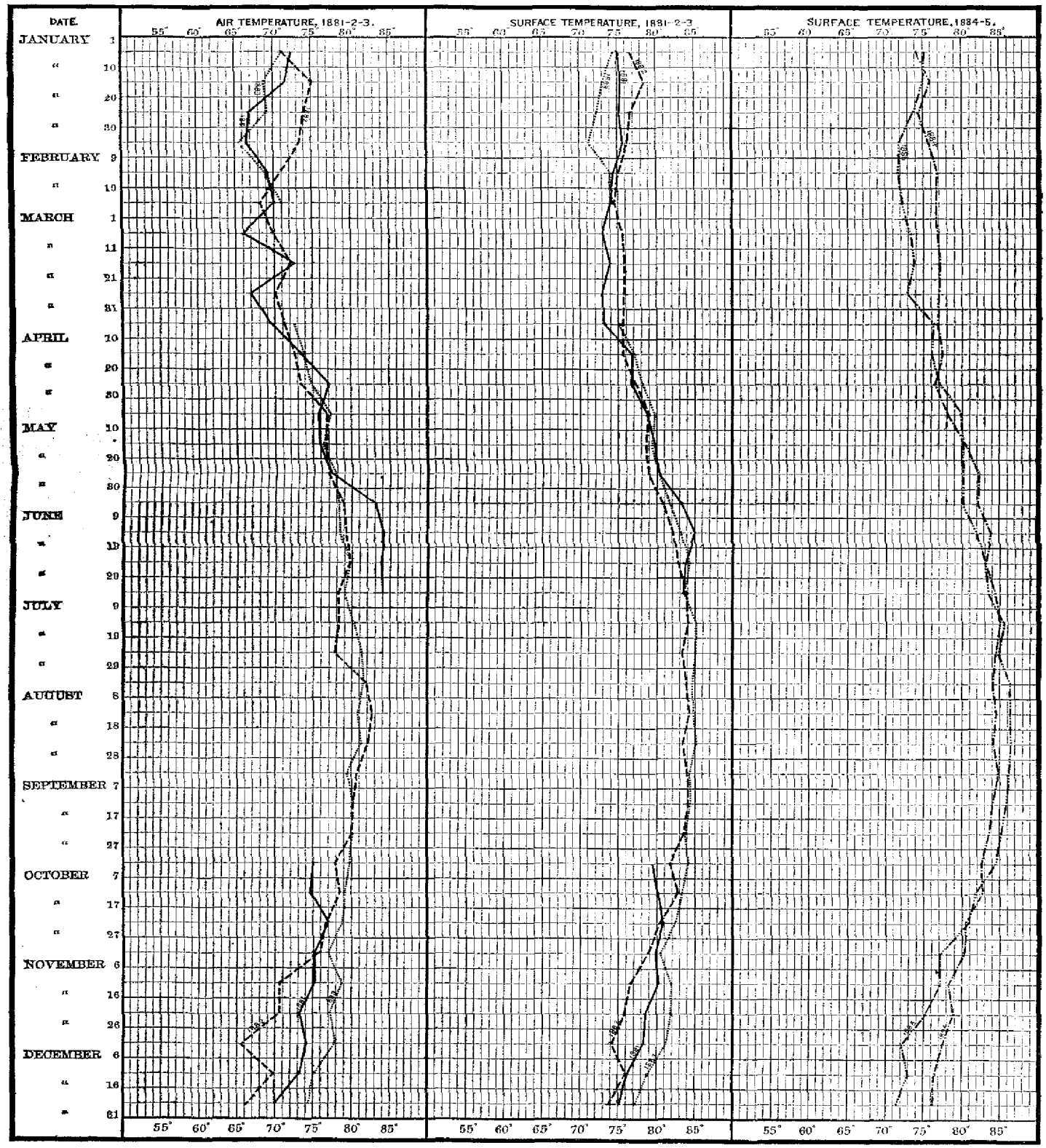
By RICHARD RATHBUN.

Station: Carysfort Reef Light House, Florida.

Representing, by means of curves, the temperature of the air from 1881 to 1883, inclusive, and of the water at the surface from 1881 to 1885, inclusive, reduced to means of ten days.

EXPLANATION OF THE CURVES: ——— 1881, — — — 1882, ... 1883, —.—.— 1884, —..—..— 1885.

(Issued in 1886.)



Each vertical interspace represents one degree Fahrenheit, and the fractional parts of a degree are indicated as exactly as possible in the plotting of the curves. Each fifth degree is represented by a slightly heavier line. The transverse interspaces inclosed by the heavier lines represent periods of ten days each, as indicated by the dates on the lefthand side of the plate. The lighter transverse lines, intermediate between the heavier ones, are intended to represent the mean of each ten days, and the curves of temperature are plotted with reference to these lines. The left-hand vertical division is devoted to the air temperatures for 1881, 1882 and 1883, the middle division to the surface water temperatures for the same years, thus permitting of a comparison of the two: and the right-hand division to the water temperatures for 1884 and 1885.

EXPLANATION OF OCEAN TEMPERATURE CHART No. 4.

FOWEY ROCKS LIGHT-HOUSE, FLORIDA.

Observer: JOHN J. LARNER.

Position.—Fowey Rocks light-house is built on Fowey Rocks, which are located very near the northeastern extremity of the Florida Reefs, about 6 miles southeasterly from Cape Florida, and 23 miles northerly from Carysfort Reef. These rocks are on the western side of the Straits of Florida, in their northern and narrowest portion, sometimes called the Straits of Bemini, the eastern border of which is formed by the northwestern extremity of the Great Bahama Bank. The light-house is situated on the outer edge of the rocks, which lie directly in front of the widest opening to Key Biscayne Bay. Depths of 7 to 16 fathoms occur close to the light; the 100-fathom line is distant only about 2½ miles, and the axis of the Gulf Stream about 24 miles.

Geographical position.—Latitude, 25° 35′ 25″ N.; longitude, 80° 05′ 41″ W.

Depth of water.—Five feet.

Range of temperature.—Air, 18° (68° to 86°); surface, 16°.5 (70° to 86°.5).

There is comparatively little difference between the temperatures at Fowey Rocks and Carysfort Reef, these two stations, located only 23 miles apart, being more closely related than are either of them to the Tortugas. The air temperatures range slightly higher at this station than at Carysfort, but the surface curves correspond very closely throughout each year, the greatest difference at any period being only 2° or 3°. The more prominent irregularities in the surface curves at one station are almost invariably repeated in those of the other at the same period. The angles indicating low temperatures for March, 1881, are more pronounced here than at Carysfort, but those for the last part of 1882 are less marked. The maximum air and surface temperatures at this station are very nearly identical.

Table showing the direction of the winds, by quadrants, for each month of the year, being the means of five years' observations.

Quadrant.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
Northeast	11.6	9.1	8.9	9	11.6	5.3	6.8	6.7	13.5	17.3	15	12.2
Southeast	13.1	10.3	10.5	12.1	11.8	16.9	15.4	16.7	9.7	5.7	7.1	9.2
Southwest	2.9	2.3	4.2	4.5	4.4	5.5	6.4	4.4	4.4	2.8	1.4	2.1
Northwest	3.3	5.9	6.8	3.7	1.9	1.1	1.3	1.6	1.5	4.5	5.9	6.9

OCEAN TEMPERATURE CHART No. 4

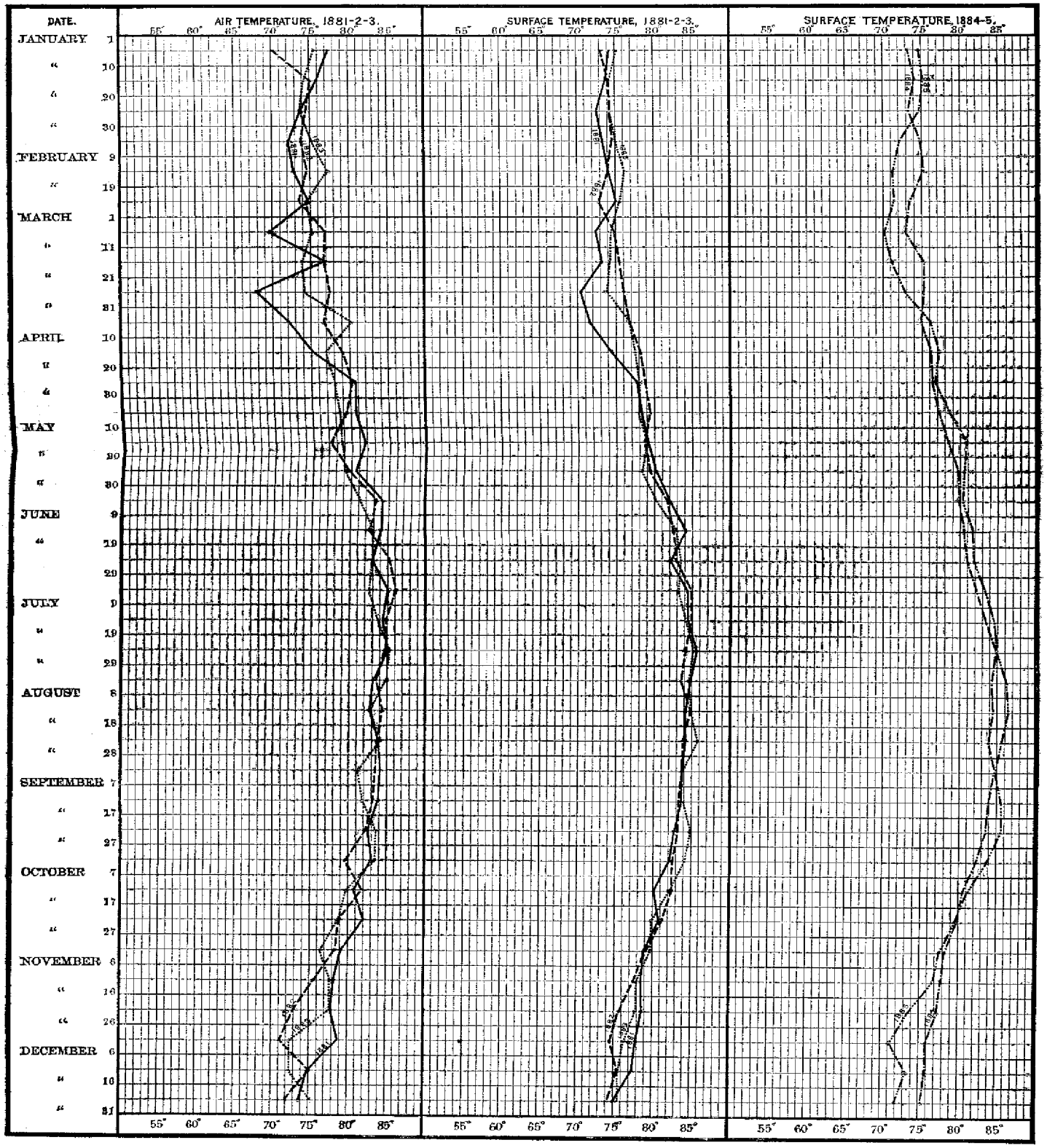
By RICHARD RATHBUN.

Station: Fowey Rocks Light House, Florida.

Representing, by means of curves, the temperature of the air from 1881 to 1883, inclusive, and of the water at the surface from 1881 to 1885, inclusive, reduced to means of ten days.

EXPLANATION OF THE CURVES: ——— 1881, — — — 1882, ····· 1883, —·— 1884, —··— 1885.

(Issued in 1886.)



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EXPLANATION OF OCEAN TEMPERATURE CHART No. 5.

MARTIN'S INDUSTRY LIGHT-SHIP, SOUTH CAROLINA.

Observer: JOHN MASSON.

Position.—This light-ship is located off the entrance to Port Royal Sound, South Carolina, and about 390 miles northerly from Fowey Rocks, Florida. It is anchored about 8½ miles from land, directly in front of Martin's Industry Shoal, from the outer edge of which it is distant a little more than a mile, the depths between ranging from 6½ to 8 fathoms. The 10-fathom curve is distant about 9 miles, the 20-fathom curve about 32 miles, and the 100-fathom curve about 62 miles.

Geographical position.—Latitude, 32° 05′ (31″) N.; longitude, 80° 35′ (07″) W.

Depth of water.—Nine fathoms.

Range of temperature.—Air, 41°.5 (45° to 86°.5); surface, 38° (47° to 85°).

The conditions influencing the temperature at Martin's Industry Shoal are very different from those prevailing at the Florida Reef stations. The range of temperature is very much greater, and the temperature plottings on the chart form much more pronounced curves. The surface curves, although more regular than those for the air, are nearly parallel with them throughout each year, and the difference between the surface and air temperatures are seldom great. The maximum and minimum temperatures are nearly the same for both the air and surface, the latter having a slightly smaller range than the former. The maximum temperatures are about the same here as at Fowey Rocks, and Carysfort Reef, but the minimums are over 20° lower.

Table showing the direction of the winds, by quadrants, for each month of the year, being the means of five years' observations.

Quadrant.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
Northeast	12	10.3	7.6	9.8	11	7.6	7	10.5	15.1	17.8	13.8	10.7
Southeast	4.4	5.5	7.1	7.8	9.9	10.6	7.8	7.5	7.1	4.5	8.1	4.1
Southwest	6.9	6.2	10.3	7.1	7.1	9.4	13.5	8.6	3.7	4.2	3.9	7.8
Northwest	5.3	3.9	5.5	4.4	2.4	1.5	1.4	2.6	3.8	3.8	8.1	6.3

OCEAN TEMPERATURE CHART No. 5

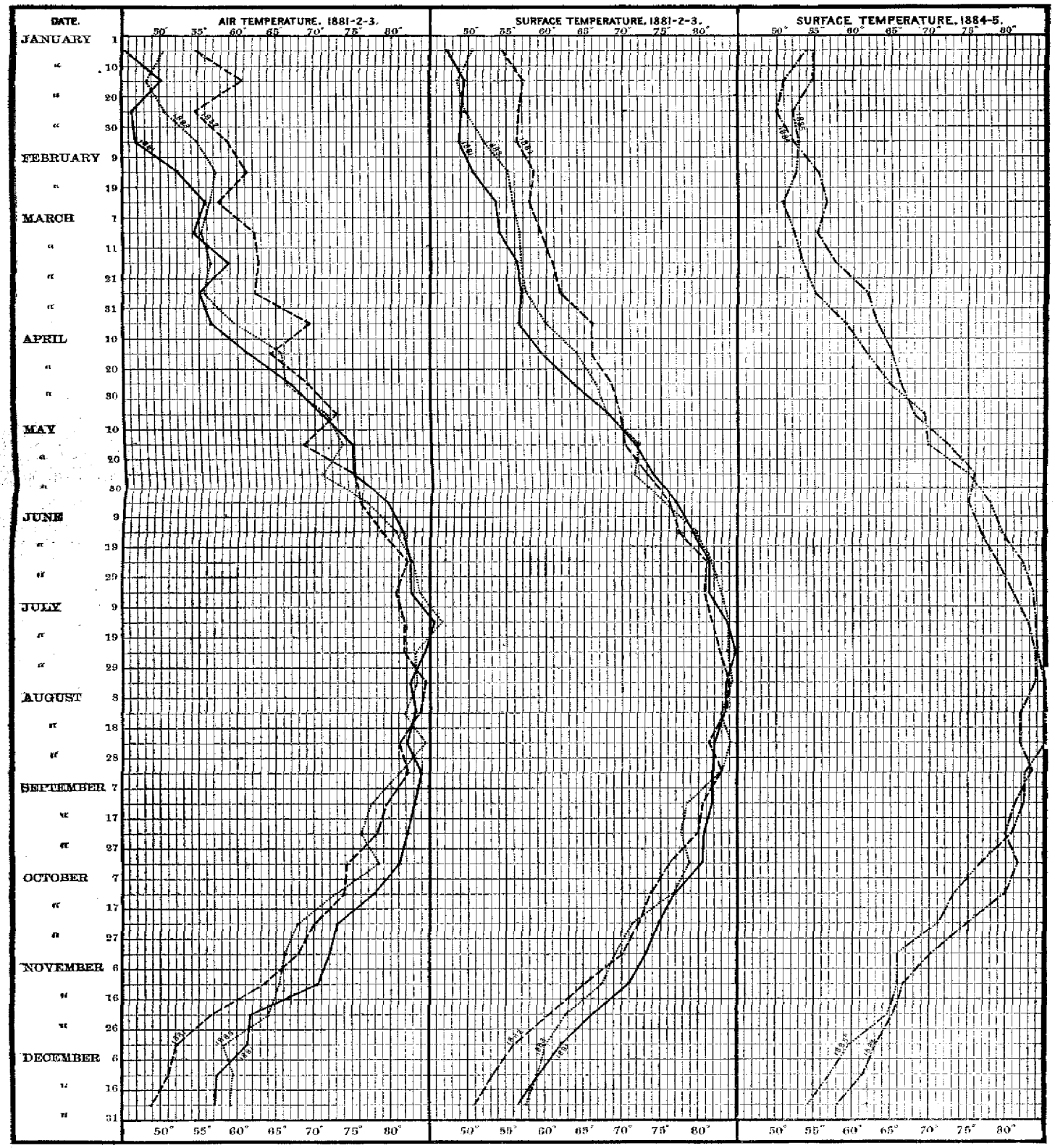
By RICHARD RATHBUN.

Station: Martin's Industry Shoal Light Ship, South Carolina.

Representing, by means of curves, the temperature of the air from 1881 to 1883, inclusive, and of the water at the surface from 1881 to 1885, inclusive, reduced to means of ten days.

EXPLANATION OF THE CURVES: ——— 1881, — — — 1882, ... 1883, —·— 1884, —··— 1885.

(ISSUED IN 1886.)



Each vertical interspace represents one degree Fahrenheit, and the fractional parts of a degree are indicated as exactly as possible in the plotting of the curves. Each fifth degree is represented by a slightly heavier line. The transverse interspaces inclosed by the heavier lines represent periods of ten days each, as indicated by the dates on the left-hand side of the plate. The lighter transverse lines, intermediate between the heavier ones, are intended to represent the mean of each ten days, and the curves of temperature are plotted with reference to these lines. The left-hand vertical division is devoted to the air temperatures for 1881, 1882, and 1883, the middle division to the surface water temperatures for the same years, thus permitting of a comparison of the two; and the right-hand division to the water temperatures for 1884 and 1885.

EXPLANATION OF OCEAN TEMPERATURE CHART No. 6.

RATTLESNAKE SHOAL LIGHT-SHIP, SOUTH CAROLINA.

Observer: JOHN McCORMICK.

Position.—Rattlesnake Shoal light-ship is placed just north of the entrance to Charleston Harbor, South Carolina, and about 56 miles northeasterly from Martin's Industry light-ship. It is anchored about 5 miles off shore, and 2 miles off the shoals of the same name, between which and the light-ship there are depths of 4 to 5 fathoms. The 10-fathom curve is distant about 11 miles, the 20-fathom curve about 30 miles, and the 100-fathom curve about 50 miles.

Geographical position.—Latitude, 32° 44′ (00″) N.; longitude, 79° 43′ (40″) W.

Depth of water.—Five fathoms.

Range of temperature.—Air, 41° (45°.5 to 86°.5); surface, 38° (47° to 85°).

The range of temperature at this station is almost precisely the same as at Martin's Industry, there being a difference of only half a degree in the air records. The curves as plotted also agree closely at the two stations, both as regards their general features and their details.

Table showing the direction of the winds, by quadrants, for each month of the year, being the means of five years' observations.

Quadrant.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
Northeast	12.1	11.1	7	9.0	10.6	6.7	6.4	10.9	13.1	17.7	12.9	11.9
Southeast	3	5.8	5.8	6.9	9	8.2	9	8.1	10.2	4.9	4.6	3.4
Southwest	8.5	6.6	13.3	10	8.4	13	14.3	8.3	3	4.9	4.0	8.4
Northwest	5.2	3.1	3.9	2.5	1.6	1.4	.8	1.6	2.4	2.7	5.8	5

OCEAN TEMPERATURE CHART No. 6

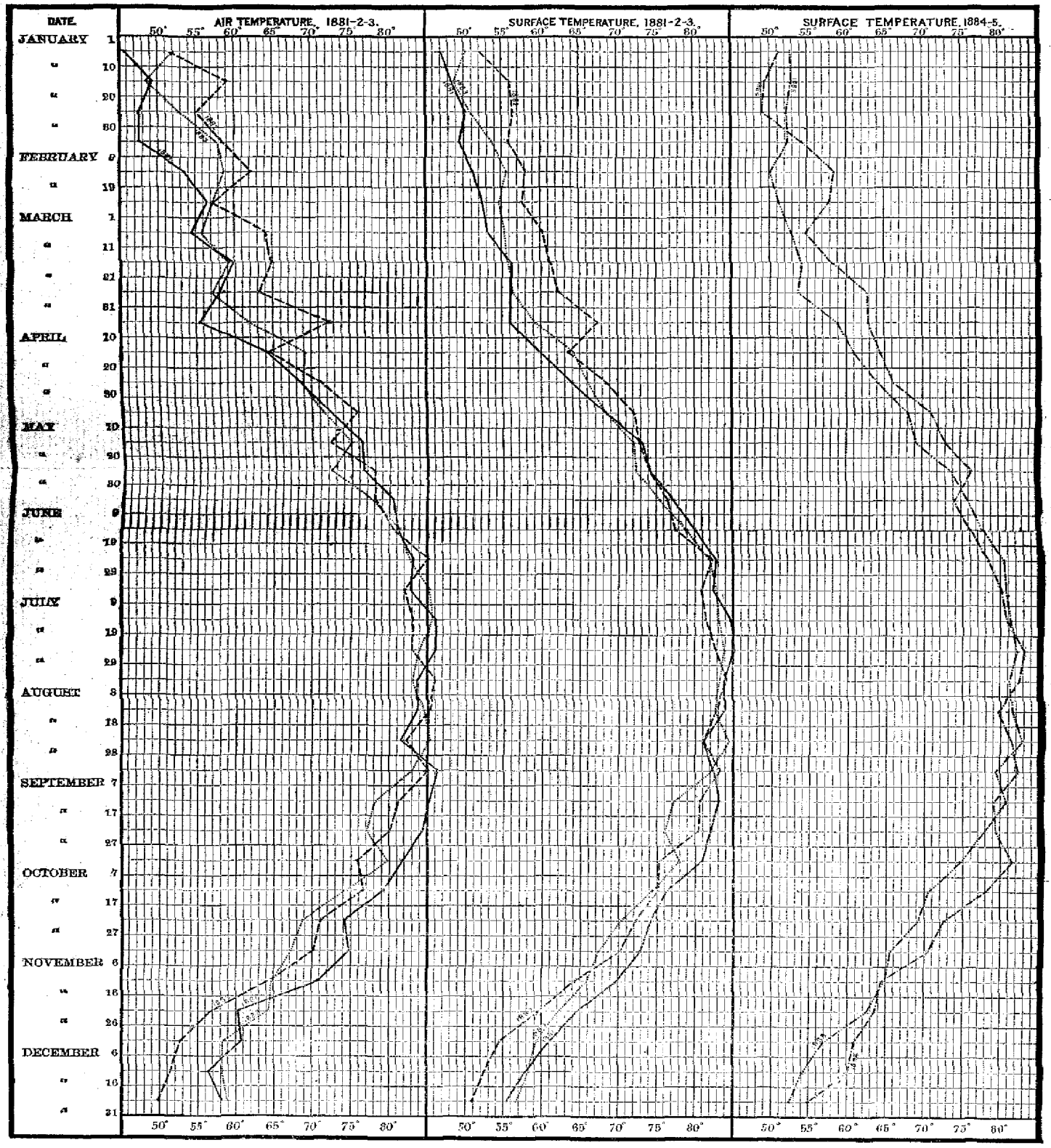
By RICHARD RATHBUN.

Station: Rattlesnake Shoal Light Ship, South Carolina.

Representing, by means of curves, the temperature of the air from 1881 to 1883, inclusive, and of the water at the surface from 1881 to 1885, inclusive, reduced to means of ten days.

EXPLANATION OF THE CURVES: ——— 1881, — — — 1882, ———— 1883, —·— 1884, —·····— 1885.

(Issued in 1886.)



Each vertical interspace represents one degree Fahrenheit, and the fractional parts of a degree are indicated as exactly as possible in the plotting of the curves. Each fifth degree is represented by a slightly heavier line. The transverse interspaces inclosed by the heavier lines represent periods of ten days each, as indicated by the dates on the left-hand side of the plate. The lighter transverse lines, intermediate between the heavier ones, are intended to represent the mean of each ten days, and the curves of temperature are plotted with reference to these lines. The left-hand vertical division is devoted to the air temperatures for 1881, 1882 and 1883, the middle division to the surface water temperatures for the same years, thus permitting of a comparison of the two; and the right-hand division to the water temperatures for 1884 and 1885.

EXPLANATION OF OCEAN TEMPERATURE CHART No. 7.

FRYING PAN SHOALS LIGHT-SHIP, NORTH CAROLINA.

Observers: D. W. MANSON, W. R. WALKER, J. H. DOSHER, J. D. DAVIS, G. D. WALKER, H. SWAN.

Position.—Frying Pan Shoals light-ship is located about 6½ miles from the outer extremity of the main part of Frying Pan Shoals, about 17 miles southeasterly from Cape Fear, North Carolina, and about 108 miles northeasterly from Rattlesnake Shoal light-ship. Within a radius of 3 miles on all sides depths of 6½ to 11 fathoms occur. The 20-fathom curve is distant 21 miles, the 100-fathom curve 36 miles.

Geographical position.—Latitude, 33° 35′ (00″) N.; longitude, 77° 50′ (04″) W.

Depth of water.—Ten to 11 fathoms.

Range of temperature.—Air, 41° (44° to 85°); surface, 33° (49°.5 to 82°.5).

The curves of air temperature do not differ essentially from those of the two preceding stations; the range of temperature is precisely the same, although the maximum and minimum records are each 1½° lower at this station. The surface temperatures, however, have a more limited range by 5°, reaching neither the same maximum nor minimum as at Rattlesnake Shoal.

Table showing the direction of the winds, by quadrants, for each month of the year, being the means of five years' observations.

Quadrant.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
Northeast	13.5	11.3	11	11.2	8.5	9	5.8	10.9	13.5	16	12.5	12
Southeast	2.2	4.5	2.5	2	4.1	8.3	1.5	3.2	5.1	4	3.5	3.2
Southwest	9.6	8.4	10.8	11.2	8.7	15.2	21.1	11.6	6.1	5.7	4.3	7.2
Northwest	5	3.9	5.7	3.9	2.8	1	.7	2.2	1.5	3.9	8.3	7.9

OCEAN TEMPERATURE CHART No. 7

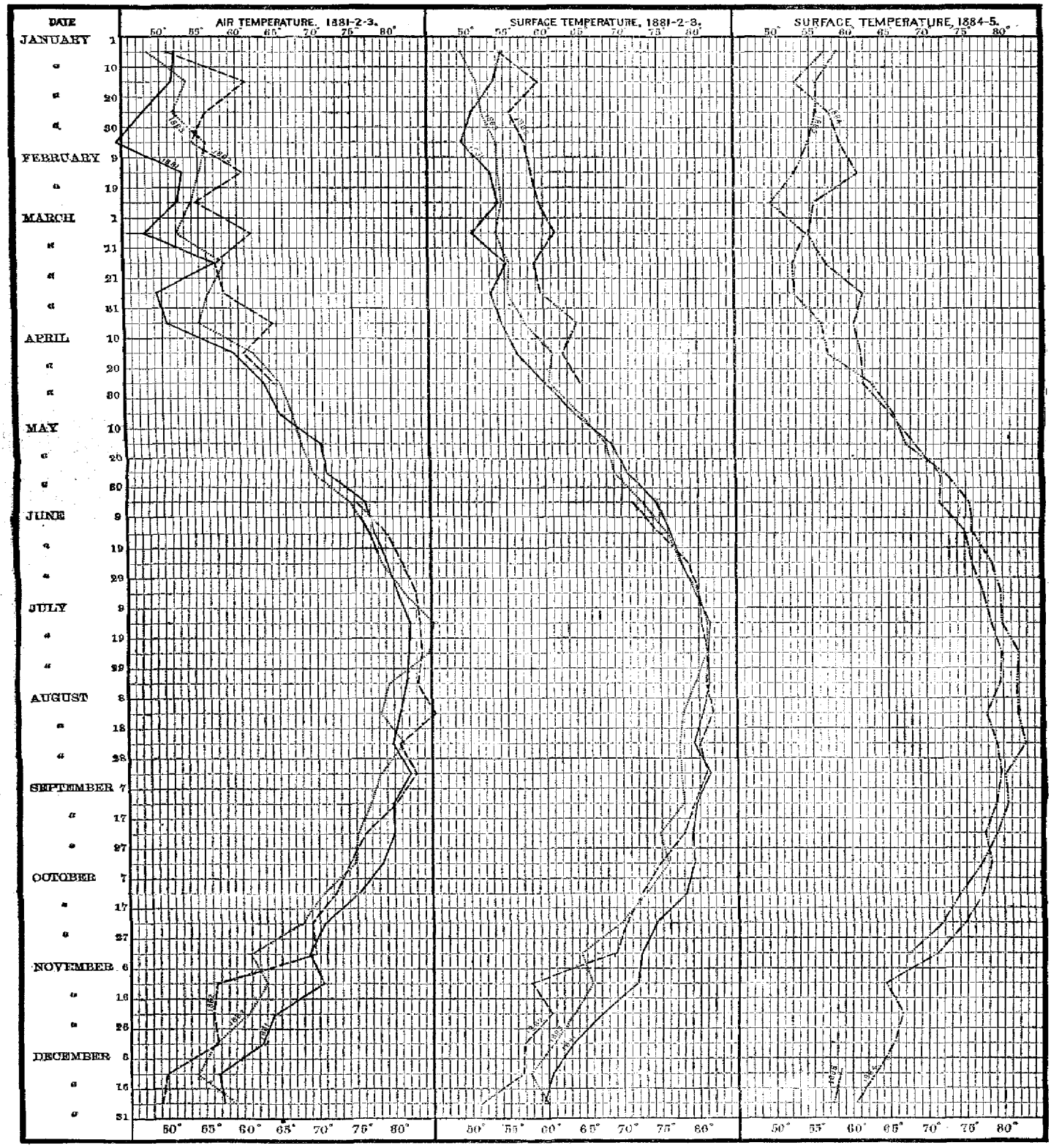
By RICHARD RATHBUN.

Station: Frying Pan Shoals Light Ship, North Carolina.

Representing, by means of curves, the temperature of the air from 1881 to 1883, inclusive, and of the water at the surface from 1881 to 1885, inclusive, reduced to means of ten days.

EXPLANATION OF THE CURVES: ——— 1881. — — — 1882. ..... 1883. —·—·— 1884. —··—··— 1885.

(ISSUED IN 1886.)



Each vertical interspace represents one degree Fahrenheit, and the fractional parts of a degree are indicated as exactly as possible in the plotting of the curves. Each fifth degree is represented by a slightly heavier line. The transverse interspaces inclosed by the heavier lines represent periods of ten days each, as indicated by the dates on the left-hand side of the plate. The lighter transverse lines, intermediate between the heavier ones, are intended to represent the mean of each ten days, and the curves of temperature are plotted with reference to these lines. The left-hand vertical division is devoted to the air temperatures for 1881, 1882 and 1883, the middle division to the surface water temperatures for the same years, thus permitting of a comparison of the two; and the right-hand division to the water temperatures for 1884 and 1885.

EXPLANATION OF OCEAN TEMPERATURE CHART No. 8.

CAPE LOOKOUT LIGHT-HOUSE, NORTH CAROLINA.

Observer: DENARD RUMLEY.

Location of station.—Cape Lookout light-house is situated on the easterly shore, facing the open ocean, about 3 miles north of the extremity of Cape Lookout, North Carolina, and is about 90 miles northeasterly from Frying Pan Shoals light-ship. The sandy shore slopes gradually for about half a mile before a depth of 3 fathoms is reached. The 10-fathom curve is distant about 5 miles, the 20-fathom curve 21 miles, and the 100-fathom curve 35 miles.

Geographical position.—Latitude, 34° 37′ (20″) N.; longitude, 76° 31′ (26″) W.

Depth of water.—One foot.

Range of temperature.—Air, 41° (43° to 84°); surface, 42° (42° to 84°).

The curves of air temperature correspond more or less closely with those of the three preceding stations; the range is precisely the same, and the maximum and minimum records are each but 1 degree lower than at Frying Pan Shoals. It will be observed, however, that the surface curves agree in nearly all their details with those of the air, having essentially the same range, and being much more irregular than at the three preceding light-ships. This is due to the fact that the observations were made in shallow water, close inshore, on a very gradually sloping beach.

Table showing the direction of the winds, by quadrants, for each month of the year, being the means of five years' observations.

Quadrant.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
Northeast	11.5	10.2	8.6	10.8	12.7	9.2	7.3	12.8	13.2	13.6	10.2	10.2
Southeast	2.9	2.7	3.9	3.2	5.2	5.4	3.7	3.9	6.1	4.2	3.7	4.3
Southwest	7.5	9	10	8	10.5	13.9	17.2	10.7	8.5	5.9	4.5	6.6
Northwest	7.7	4.6	6.8	4	1.6	.8	2.1	1.2	2.3	6.1	8.9	7.7

OCEAN TEMPERATURE CHART No. 8

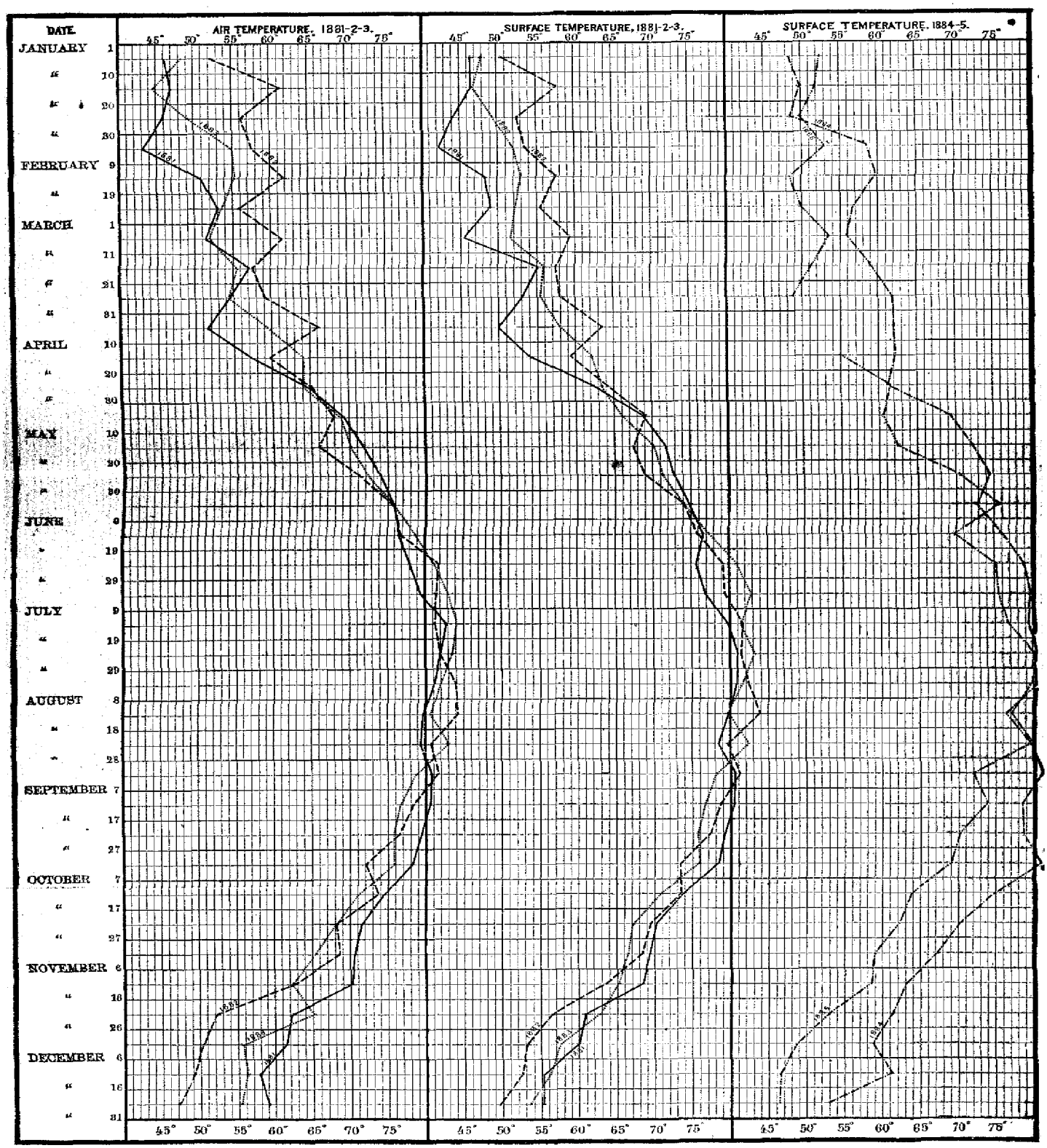
By RICHARD RATHBUN.

Station: Cape Lookout Light House, North Carolina.

Representing, by means of curves, the temperature of the air from 1881 to 1883, inclusive, and of the water at the surface from 1881 to 1885, inclusive, reduced to means of ten days.

EXPLANATION OF THE CURVES. ——— 1881, — — — 1882, ... 1883, —·— 1884; —··— 1885.

(ISSUED IN 1886.)



Each vertical interspace represents one degree Fahrenheit; and the fractional parts of a degree are indicated as exactly as possible in the plotting of the curves. Each fifth degree is represented by a slightly heavier line. The transverse interspaces inclosed by the heavier lines represent periods of ten days each, as indicated by the dates on the left-hand side of the plate. The lighter transverse lines, intermediate between the heavier ones are intended to represent the mean of each ten days, and the curves of temperature are plotted with reference to these lines. The left-hand vertical division is devoted to the air temperatures for 1881, 1882 and 1883, the middle division to the surface water temperatures for the same years thus permitting of a comparison of the two and the right-hand division to the water temperatures for 1884 and 1885.

EXPLANATION OF OCEAN TEMPERATURE CHART No. 9.

BODY'S ISLAND LIGHT-HOUSE, NORTH CAROLINA.

Observer: PETER G. GALLOP.

Location of station.—This light-house is situated near the southern end of Body's Island, north of Oregon Inlet, North Carolina, and is about 35½ miles north of Cape Hatteras, and about 86 miles northeasterly from Cape Lookout. The shore is similar to that at Cape Lookout, sandy, and shelving very gradually so as to afford but slight depths of water near land. The 10-fathom curve is distant 2 miles, the 20-fathom curve 24 miles, and the 100-fathom curve 35 miles.

Geographical position.—Latitude, 35° 49′ 07″ N.; longitude, 75° 33′ 49″ W.

Depth of water.—Seven to 9 feet.

Range of temperature.—Air, 64° (27° to 91°); surface, 63° (28° to 91°).

The records for this station show an extraordinary range of temperature. The air and surface curves are almost precisely alike and indicate the same range of temperature for both air and surface, within 1°. The lowest surface temperatures recorded are probably the result of careless reading; the higher ones indicate that the observations were probably made in very shallow and quiet water, directly influenced by the sun's rays during the heat of summer.

The highest mean plotted, 91°, is 2½° higher than the maximum for the air at the Tortugas, and 4° higher than the air maximum for any of the other stations to the south of Body's Island. The surface maximum also exceeds that of any of the more southern stations by 4½°.

Table showing the direction of the winds, by quadrants, for each month of the year, being the means of three years' observations.

Quadrant.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
Northeast	8.4	8.2	9.6	12.9	14.1	10	9.8	14.7	15.4	15.9	8.6	7.5
Southeast	3.5	5.3	5.1	6	5.6	5.5	5.7	7	6.7	5	4.4	5.3
Southwest	10	6.4	8.9	6.7	9.1	11.5	13.1	7.9	6.8	6.2	7.3	9.3
Northwest	9.1	7.5	7.4	5.2	2.3	1.5	1.9	1.2	1.1	3.8	9.7	8.6

OCEAN TEMPERATURE CHART No. 9

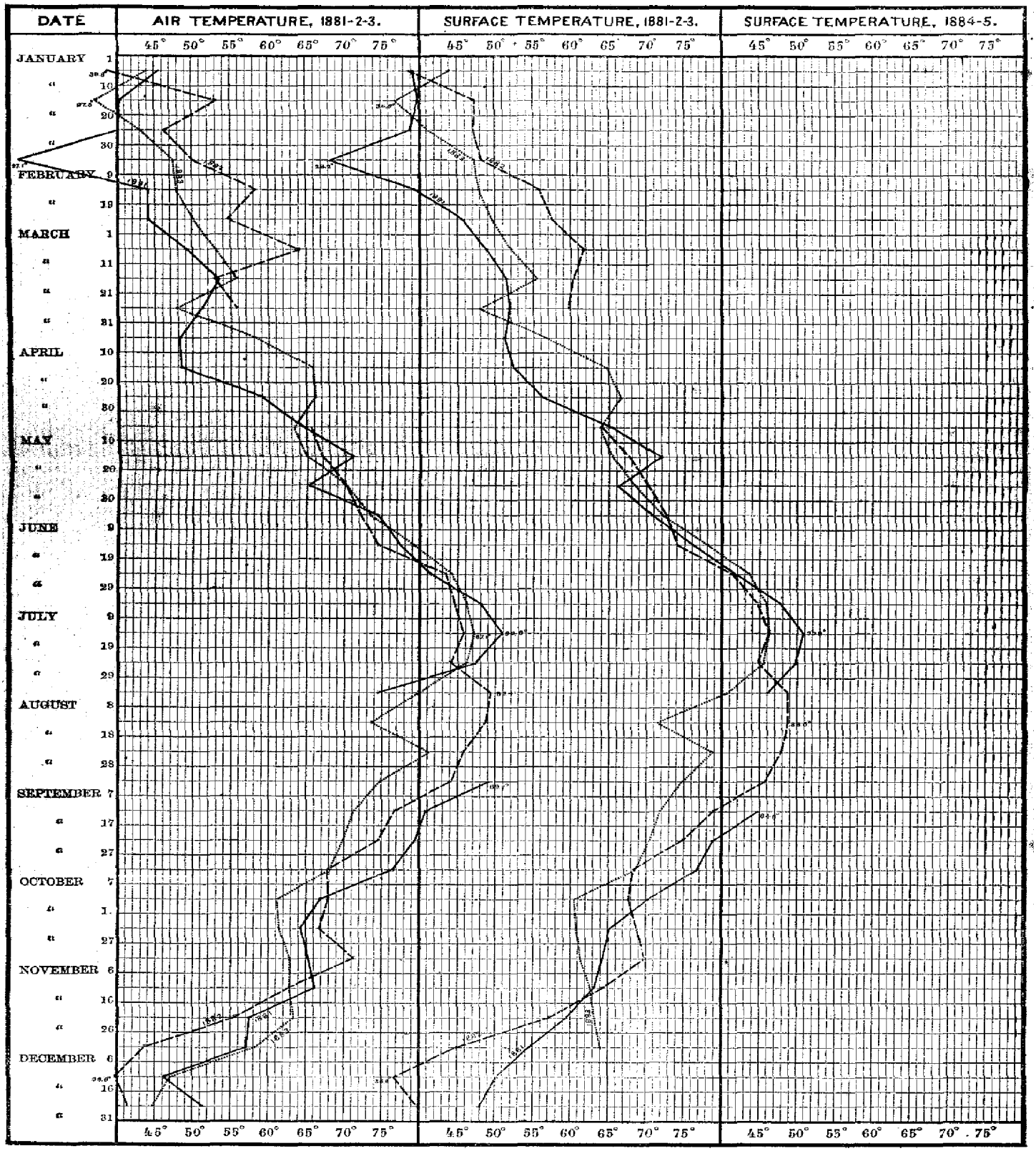
By RICHARD RATHBUN.

Station: Body's Island Light House, North Carolina.

Representing, by means of curves, the temperature of the air from 1881 to 1883, inclusive, and of the water at the surface from 1881 to 1883, inclusive, reduced to means of ten days.

EXPLANATION OF THE CURVES: ——— 1881, — — — 1882, ····· 1883, —·—·— 1884, —··—··— 1885.

(Issued in 1886.)



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EXPLANATION OF OCEAN TEMPERATURE CHART No. 10.

WINTER-QUARTER SHOAL LIGHT-SHIP, VIRGINIA.

Observer: C. LINDEMANN.

Location of station.—This light ship is anchored 2 miles SE. by E. ½ E. from Winter-Quarter Shoal, and 8½ miles off Assateague Island, on the coast of Virginia. It is about midway between Chesapeake Bay and Delaware Bay entrances, and about 128 miles north of Body's Island light. Between the light-ship and the mainland depths of 4 to 10 fathoms occur. The 20-fathom curve is distant about 20 miles, the 100-fathom curve nearly 50 miles.

Geographical position.—Latitude, 37° 57′ (03″) N.; longitude, 75° 05′ (29″) W.

Depth of water.—Ten and one-half fathoms.

Range of temperature (March 1 to January 1).—Air, 48° (33° to 81°); surface, 41° (35°.5 to 76°.5.)

Winter-Quarter Shoal light-ship may be regarded as the southernmost of a third series of stations in which the surface temperature seldom exceeds 75° F., and within the period plotted (March to January) may fall (according to the records) to nearly 35°. The surface curves are somewhat less uniformly parallel with the air curves than at the more southern stations, but the differences are not very marked.

Table showing the direction of the winds, by quadrants, for each month of the year, being the means of five years' observations.

Quadrant.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
Northeast	9.5	7.7	8.1	9.4	11.6	7.5	6.5	12.2	10.6	12	7.5	6.1
Southeast	2.7	4	5.3	5.7	5.6	9.3	5.1	5.4	5.1	5.3	2.3	4
Southwest	8.6	7.8	6.8	6.9	10.8	9.6	14.1	9.5	10.5	7.8	9.9	9.8
Northwest	9.9	7.9	9.9	6	1.9	1.8	2.8	2.2	2.8	4.8	9.8	9.5

OCEAN TEMPERATURE CHART No. 10

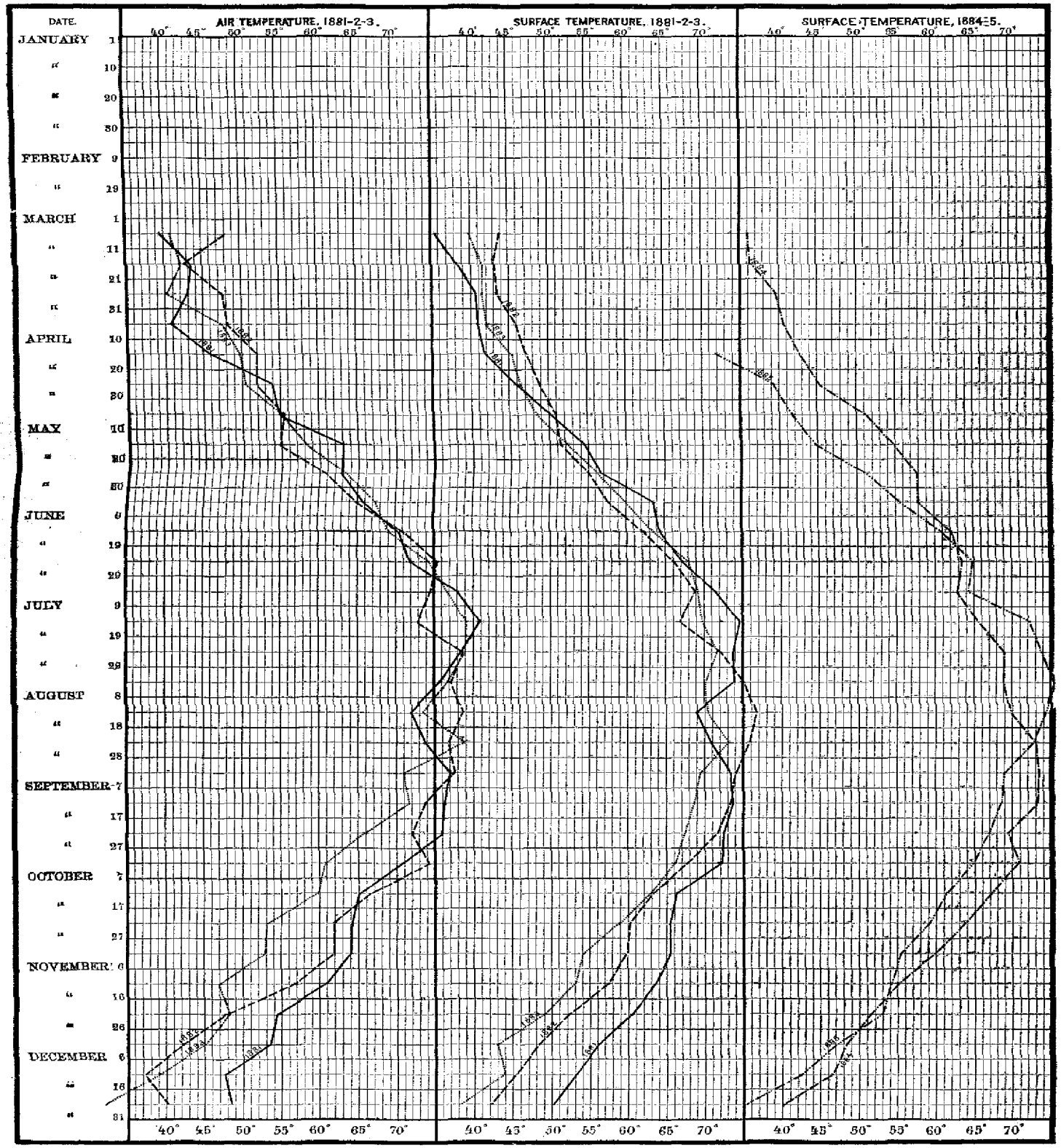
By RICHARD RATHBUN.

Station: Winter Quarter Shoal Light Ship, Virginia.

Representing, by means of curves, the temperature of the air from 1881 to 1883, inclusive, and of the water at the surface from 1881 to 1885, inclusive, reduced to means of ten days.

EXPLANATION OF THE CURVES: ——— 1881, — — — 1882, ...1883, —·—·— 1884, —··—··— 1885.

(Issued in 1886.)



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EXPLANATION OF OCEAN TEMPERATURE CHART No. 11.

FIVE-FATHOM BANK LIGHT-SHIP, NEW JERSEY.

Observers: JOHN REEVES, DANIEL MANLOVE, WILLIAM W. SMITH.

Location of station.—This light-ship is located about 14 miles from the nearest part of the New Jersey coast, just east of Cape May, north of the entrance to Delaware Bay, and about 56 miles northeasterly from Winter-Quarter Shoal light-ship. It is anchored about 1½ miles outside of the 10-fathom curve, in a depth of 12 fathoms. The 20-fathom curve is distant 13½ miles, the 100-fathom curve 55 miles.

Geographical position.—Latitude, 38° 48′ (23″) N.; longitude, 74° 36′ (09″) W.

Depth of water.—Twelve fathoms.

Range of temperature (March 1 to January 1).—Air, 47° (36°.5 to 83°.5); surface, 39° (37° to 76°).

The temperatures at this station differ somewhat from those at Winter-Quarter Shoal, and not constantly in the same direction, being sometimes slightly higher, at others slightly lower, during corresponding periods. With a single marked exception, the summer air temperatures average lower here; the surface curves are more nearly like those at Winter Quarter, but do not show so low a minimum in the colder months plotted. An unusually high air temperature was reached between June 19 and 29, 1882, accompanied mainly by southwesterly winds, which are the prevailing winds for that month. This extreme variation is not observable at the neighboring stations, and it apparently had no influence upon the temperature of the water at this place.

Table showing the direction of the winds, by quadrants, for each month of the year, being the means of five years' observations.

Quadrant.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
Northeast	5.2	6.1	6.3	6.8	9	6	5.5	9.3	9.4	9	6.3	4.2
Southeast	1.8	2.9	3.7	5.2	6	7	5.5	5.9	4.6	4.2	2.1	3.2
Southwest	7.8	6.3	6.8	6.6	10	12.9	14.1	10.5	11.7	8.6	9	9.7
Northwest	14.4	11.5	13.4	8.9	5	3.1	4.2	3.8	3.8	7.9	12.1	12.

OCEAN TEMPERATURE CHART No. 11

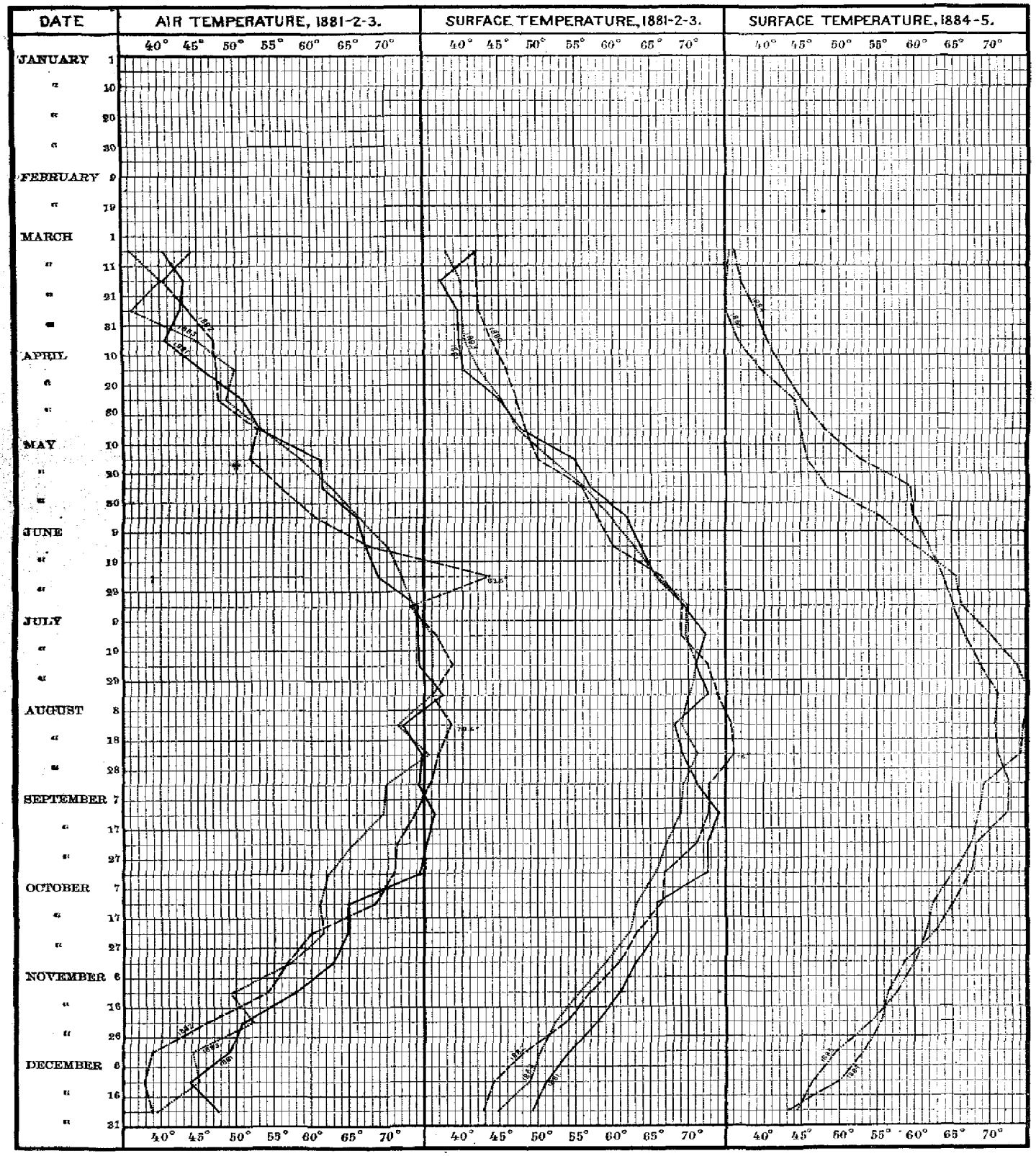
By RICHARD RATHBUN.

Station: Five Fathom Bank Light Ship, New Jersey.

Representing, by means of curves, the temperature of the air from 1881 to 1883, inclusive, and of the water at the surface from 1881 to 1885, inclusive, reduced to means of ten days.

EXPLANATION OF THE CURVES: ——— 1881, ——— 1882, ... 1883, —·— 1884, —·— 1885.

(ISSUED IN 1886.)



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EXPLANATION OF OCEAN TEMPERATURE CHART No. 12.

ABSECON LIGHT-HOUSE, NEW JERSEY.

Observer: A. G. WOLF.

Location of station.—Absecon light-house is located on the beach in front of Atlantic City, N. J., and just south of the entrance to Absecon Inlet. It is 34⅞ miles N. by E. ¾ E. of Five Fathom Bank light-ship. The shore in front of the light-house is faced with shoals. The 10-fathom curve is distant 6¼ miles, the 20-fathom curve 34 miles, the 100-fathom curve 70 miles.

Geographical position.—Latitude, 39° 21′ 59″ N.; longitude, 74° 24′ 52″ W.

Depth of water.—Nine to 15 feet.

Range of temperature (March 1 to January 1).—Air, 46°.5 (33° to 79°.5); surface, 45° (34°.5 to 79°.5).

Although located on the shore of an inlet, protected by shoals in front, this station affords more satisfactory results than either Body's Island or Cape Lookout. The ranges of temperature given above are essentially the same for both the air and surface, but if we except the surface curve for 1885, and compare only the air and surface curves for corresponding years, 1881–1883, we find that the maximum for the air exceeds that for the surface by nearly five degrees. The conditions are, therefore, very much the same at Absecon as at Five Fathom Bank, and the surface curves are nearly as regular.

Table showing the direction of the winds, by quadrants, for each month of the year, being the means of five years' observations.

Quadrant.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
Northeast	5.2	7.2	7.8	9.7	10.3	7.9	8.5	9.8	10.3	8.6	4.4	3.8
Southeast	2.8	2.8	4.3	6.7	11.2	12.1	10	9.4	8.2	7.1	4.2	3.9
Southwest	6.9	5.3	6.2	4.9	4.8	6.3	7.5	6.9	6.9	6.2	8.9	9.4
Northwest	16	12.9	12.7	8.5	4.5	2.5	4.6	4.6	4.5	8.7	12.1	13.8

OCEAN TEMPERATURE CHART No. 12

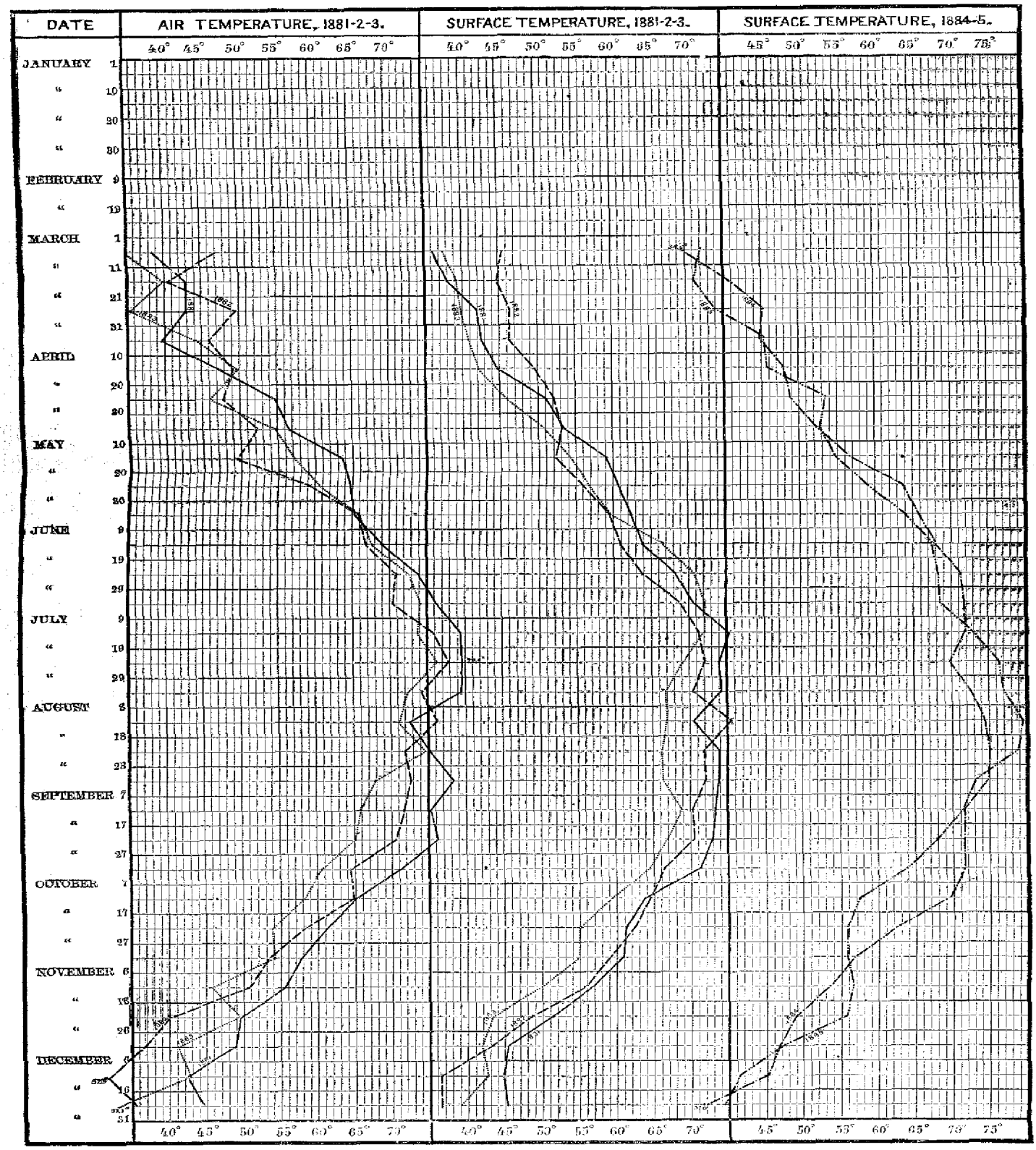
By RICHARD RATHBUN.

Station: Absecon Inlet Light House, New Jersey.

Representing, by means of curves, the temperature of the air from 1881 to 1883, inclusive, and of the water at the surface from 1881 to 1885, inclusive, reduced to means of ten days.

EXPLANATION OF THE CURVES: ——— 1881, — — — 1882, ····· 1883, —·— 1884, —··— 1885.

(Issued in 1886.)



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EXPLANATION OF OCEAN TEMPERATURE CHART No. 13.

SANDY HOOK LIGHT-SHIP, NEW YORK.

Observers: JAMES COSGROVE, R. H. PRITCHARD.

Location of station.—This light-ship is anchored in 14 fathoms of water, off the entrance to New York Bay, 6 miles east of Sandy Hook, N. J., the nearest land, and 8½ miles south of Rockaway Beach, Long Island. It is distant about 70 miles northeasterly from Absecon light. The 15-fathom curve forms a bight extending in towards New York Bay entrance, and reaching nearly to the light-ship, inside of which the depths decrease somewhat rapidly. The 20-fathom curve is distant 16 miles; the 100-fathom curve, 95 miles.

Geographical position.—Latitude, 40° 26′ (12″) N.; longitude, 73° 51′ (42″) W.

Depth of water.—Fourteen fathoms.

Range of temperature (March 1 to January 1).—Air, 50° (31°.5 to 81°.5); surface, 41°.5 (33° to 74°.5).

The range of air temperature is greater than at any of the three preceding stations, but the maximum is two degrees lower than at Five-Fathom Bank, about the same as at Winter Quarter Shoal, and two degrees higher than at Absecon. The maximum surface temperature is slightly lower than at the preceding stations.

Table showing the direction of the winds, by quadrants, for each month of the year, being the means of five years' observations.

Quadrant.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
Northeast	7	6.7	6	5.3	6.4	3.6	3.5	6.6	7.6	8.6	6	6.5
Southeast	3	3.1	4.6	5.5	10.4	11	9.5	8.3	8.8	6.4	3.9	3.7
Southwest	4.9	3.7	3.6	5.7	4.9	7.1	8.3	7.3	6.8	5.7	6.1	5.8
Northwest	15.6	12.6	15	11.5	7	6.7	8.1	7	5.7	9.5	13.6	14.6

OCEAN TEMPERATURE CHART No. 13

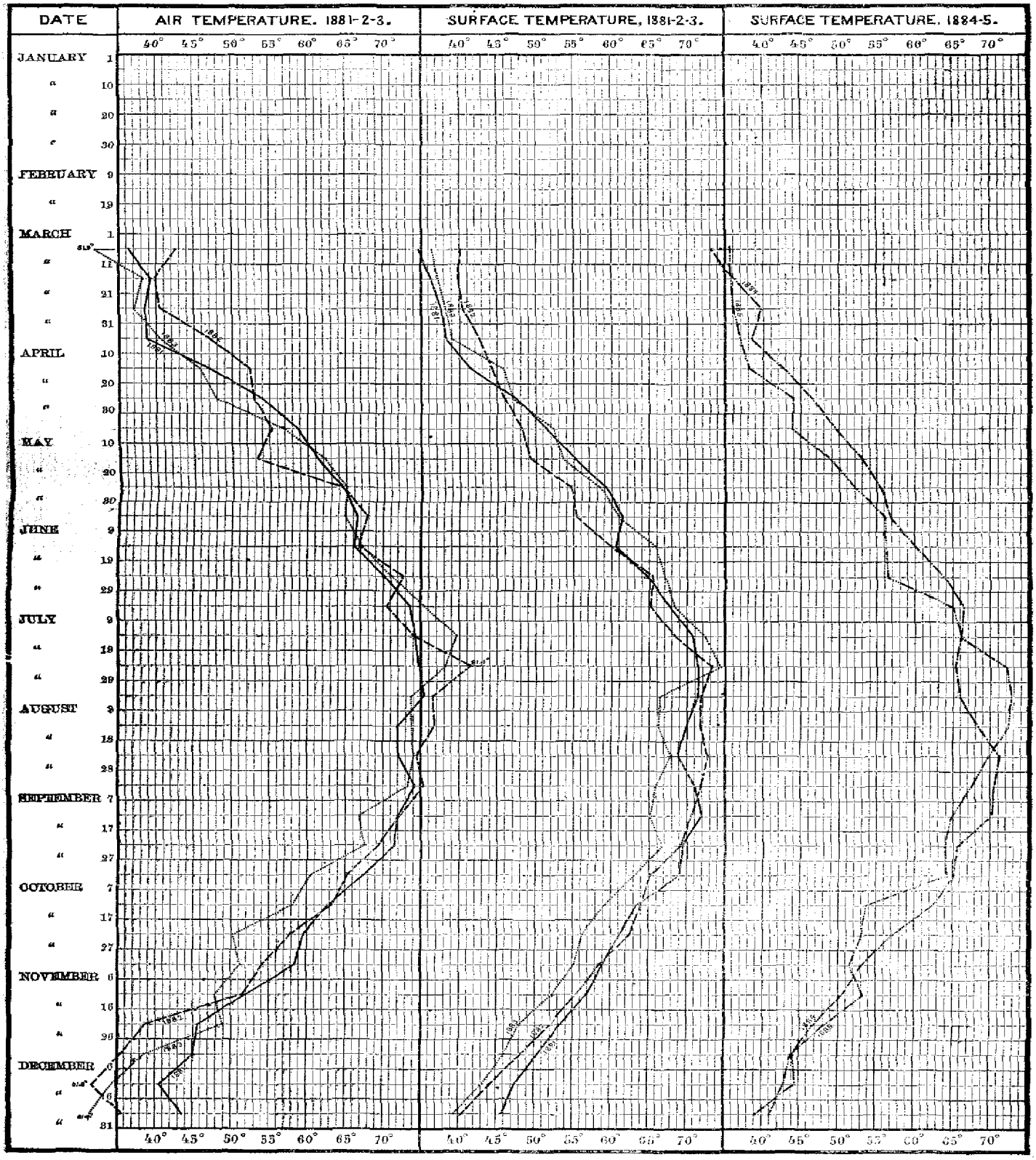
By RICHARD RATHBUN.

Station: Sandy Hook Light Ship, New York.

Representing, by means of curves, the temperature of the air from 1881 to 1883, inclusive, and of the water at the surface from 1881 to 1885, inclusive, reduced to means of ten days.

EXPLANATION OF THE CURVES: ——— 1881, — — — 1882, ····· 1883, ——— 1884, ——— 1885.

(Issued in 1886.)



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EXPLANATION OF OCEAN TEMPERATURE CHART No. 14.

FIRE ISLAND LIGHT-HOUSE, NEW YORK.

Observers: C. A. BLYDENBURGH, SETH R. HUBBARD.

Location of station.—This light-house is situated on the east side of Fire Island Inlet, south side of Long Island, 31 miles E. by N. from Sandy Hook light-ship; and the observations were taken in the narrow entrance to Great South Bay, between Fire Island and Oak Island. The 10-fathom curve is distant 1¾ miles from the outer beach; the 20-fathom curve, 18 miles; the 100 fathom curve, 85 miles.

Geographical position.—Latitude, 40° 37′ 57″ N.; longitude, 73° 13′ 09″ W.

Depth of water.—Three feet.

Range of temperature (March 1 to January 1).—Air, 48°.5 (35° to 83°.5); surface, 40° (35° to 75°).

The observations at this station were probably taken in rapidly running water, as the surface curves are comparatively regular, and the maximum surface temperature is 8° lower than the maximum for the air. In the range of both air and surface temperatures this station agrees most closely with Five-Fathom Bank, the differences being very slight.

Table showing the direction of the winds, by quadrants, for each month of the year, being the means of five years' observations.

Quadrant.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
Northeast	5.8	4.6	5.3	4.5	5	3.3	3.2	5.3	5.9	7	5.4	7.4
Southeast	1.7	4.2	3.8	4.6	8	4.7	4.7	5.5	4.7	4.9	1.9	1.8
Southwest	7.3	6.4	6.6	8.9	8.7	12.7	13.2	12.5	11.5	7.7	8.3	8.8
Northwest	11.6	9.6	10.9	7.6	3.9	3.6	4.9	2.1	3.5	6.9	9.8	8.4

OCEAN TEMPERATURE CHART No. 14

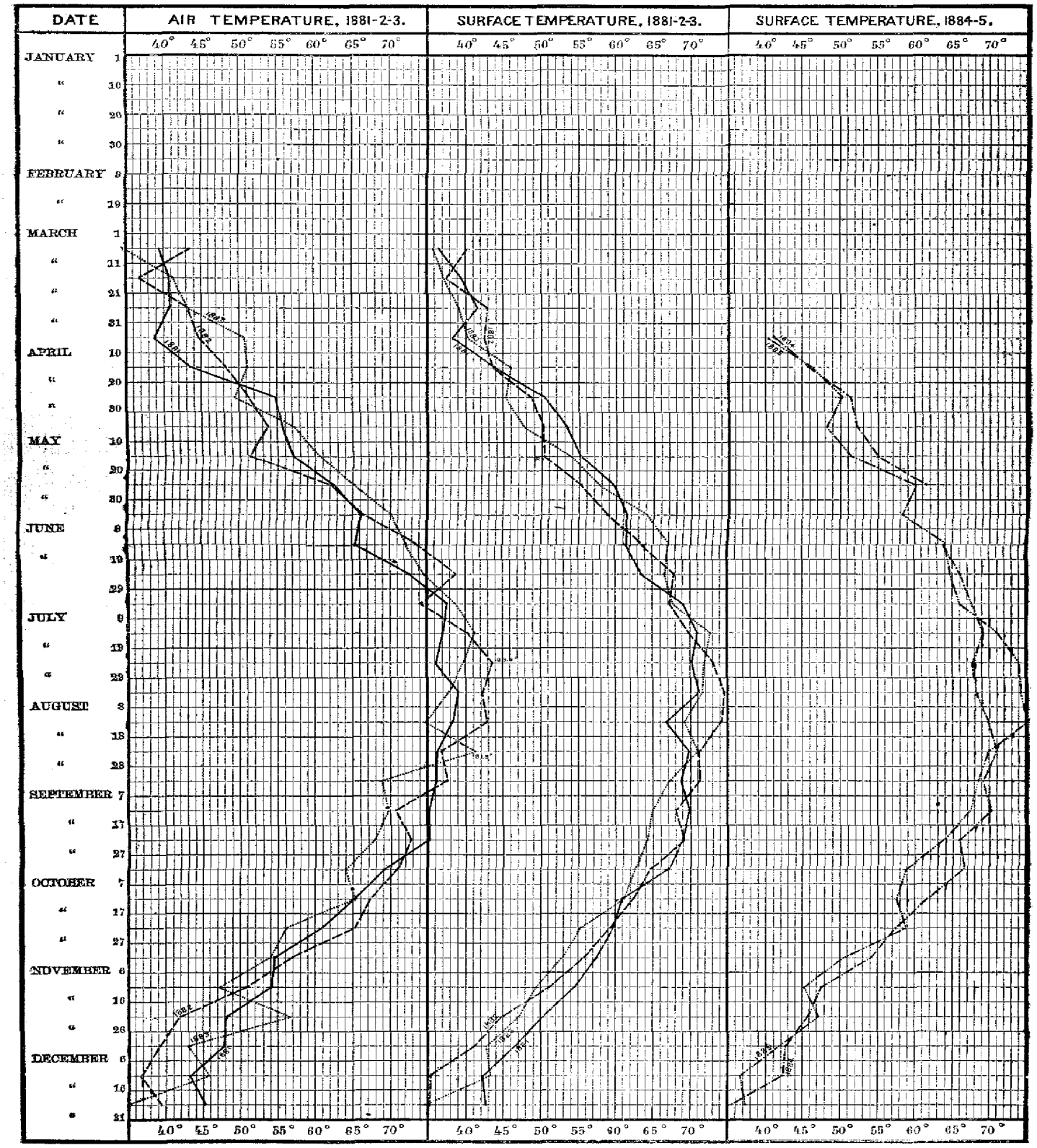
By RICHARD RATHBUN.

Station: Fire Island Light House, New York.

Representing, by means of curves, the temperature of the air from 1881 to 1883, inclusive, and of the water at the surface from 1881 to 1885, inclusive, reduced to means of ten days.

EXPLANATION OF THE CURVES: ——— 1881, — — — 1882, ... 1883, —.— 1884, —..— 1885.

(Issued in 1886.)



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EXPLANATION OF OCEAN TEMPERATURE CHART No. 15.

BLOCK ISLAND SOUTHEAST LIGHT-HOUSE, RHODE ISLAND.

Observer: H. W. CLARK.

Location of station.—This light-house is located on the high bluff at the southeastern extremity of Block Island, and is distant 82 miles northeasterly from Fire Island Light-house, and 78½ miles W. by N. ¼ N. from Nantucket New South Shoal light-ship. The water is very shallow off the southern end of the island, the depths increasing gradually seaward. The 20-fathom curve is distant about 5 miles; the 100-fathom curve, about 70 miles.

Geographical position.—Latitude, 41° 09′ 10″ N., longitude, 71° 33′ 09″ W.

Depth of water.—The observations were taken at the edge of the beach, below the light-house, facing the open sea to the south.

Range of temperature (March 1 to January 1).—Air, 57° (22° to 79°); surface, 41° (29°.5 to 70°.5).

Although the observations were taken from the beach, the surface curves show little direct influence of the air temperature upon the water, and are comparatively regular. The maximum air temperature is about the same as at Absecon, N. J., but the maximum for the surface is four degrees lower than at any of the stations to the west and south.

Table showing the direction of the winds, by quadrants, for each month of the year, being the means of five years' observations.

Quadrant.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
Northeast	6.7	4.8	8.1	8.7	8.9	5.2	4.1	6	9.8	10.9	5.4	7
Southeast	4.3	4.2	2.2	3.5	5.6	4	3.8	4	5	4.1	2.7	2.2
Southwest	7.5	6.2	8.2	11	10.7	16.9	16.7	17.6	11.3	12.1	9.9	9.7
Northwest	12.5	8.8	11.7	6.8	4.6	8.7	4.2	8.2	9.9	8.9	9.8	9.9

OCEAN TEMPERATURE CHART No. 15

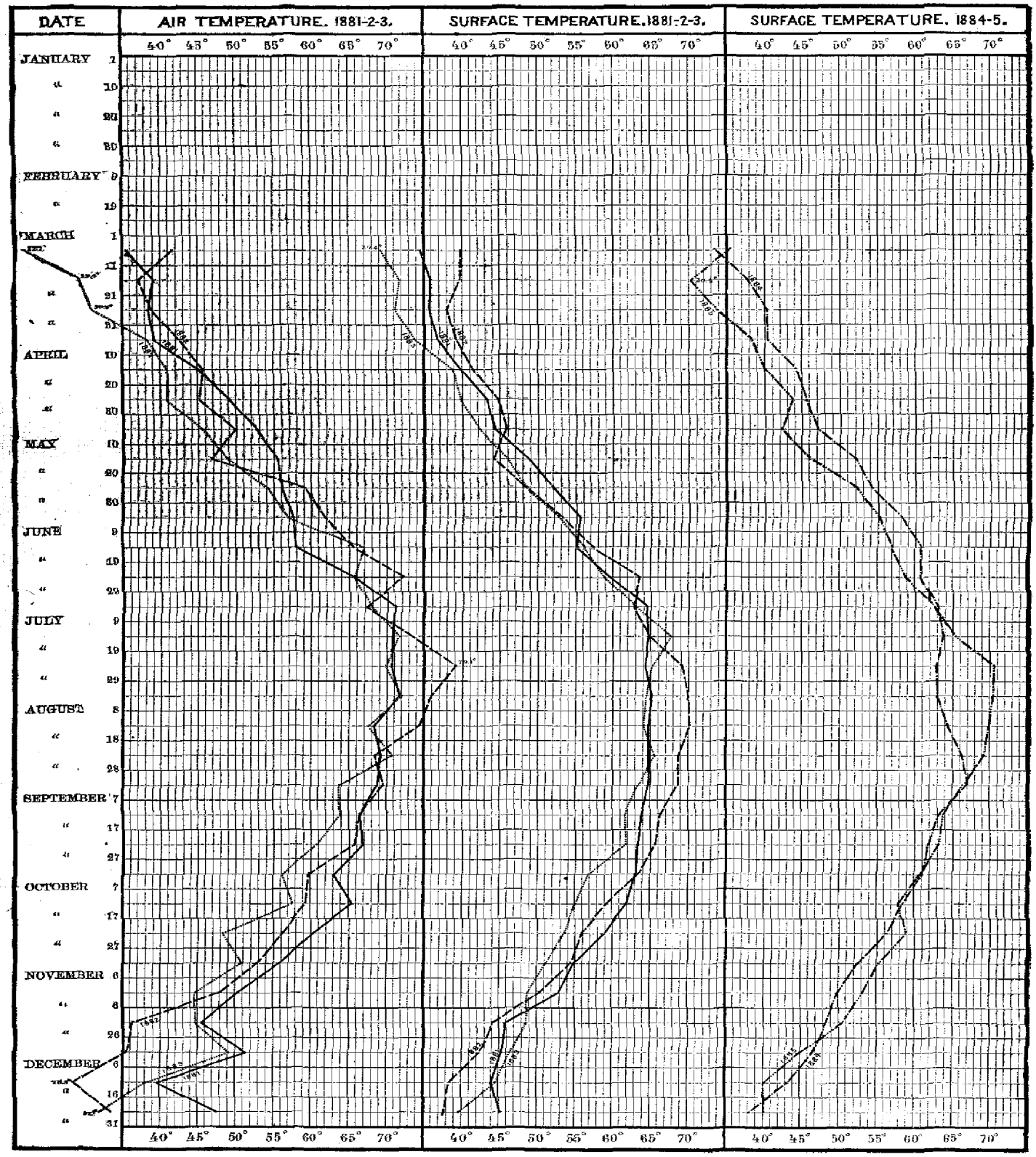
By RICHARD RATHBUN

Station: Block Island S. E. Light House, Rhode Island.

Representing, by means of curves, the temperature of the air from 1881 to 1883, inclusive, and of the water at the surface from 1881 to 1885, inclusive, reduced to means of ten days.

EXPLANATION OF THE CURVES: ——— 1881, — — — 1882, ... 1883, —·— 1884, —··— 1885.

(Issued in 1886.)



Each vertical interspace represents one degree Fahrenheit, and the fractional parts of a degree are indicated as exactly as possible in the plotting of the curves. Each fifth degree is represented by a slightly heavier line. The transverse interspaces inclosed by the heavier lines represent periods of ten days each, as indicated by the dates on the left-hand side of the plate. The lighter transverse lines, intermediate between the heavier ones, are intended to represent the mean of each ten days, and the curves of temperature are plotted with reference to these lines. The left-hand vertical division is devoted to the air temperatures for 1881, 1882 and 1883, the middle division to the surface water temperatures for the same years, thus permitting of a comparison of the two; and the right-hand division to the water temperatures for 1884 and 1885.

EXPLANATION OF OCEAN TEMPERATURE CHART No. 16.

BRENTON'S REEF LIGHT-SHIP, RHODE ISLAND.

Observer: CHARLES D. MARSH.

Location of station.—This light-ship is located in the middle of the entrance to Narragansett Bay, about 1¾ miles SW. of the southern point of the Island of Rhode Island, and a little over a mile off Brenton's Reef, the depths between ranging from 4½ to 14¾ fathoms. It is 17¾ miles NE. ¾ N. of Block Island southeast light, and faces the open sea to the south, the depths increasing gradually seaward. The 20-fathom curve is distant about 8½ miles; the 100-fathom curve, about 85 miles.

Geographical position.—Latitude, 41° 25′ (52″) N.; longitude, 71° 22′ (36″) W.

Depth of water.—Fourteen and one-half fathoms.

Range of temperature (March 1 to January 1).—Air, 45°.5 (29° to 74°.5); surface, 35° (34° to 69°).

The minimum temperatures are higher, the maximum lower at this station than at Block Island. The maximum surface temperatures, however, show a difference of only 1½° for the two stations. It is probable that the surface observations for Brenton's Reef are the more reliable, having been taken where the water is 14½ fathoms deep.

Table showing the direction of the winds, by quadrants, for each month of the year, being the means of five years' observations.

Quadrant.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
Northeast	4	5	5.5	6.2	7.1	2.7	2.8	4.6	6	8.1	4.7	4.9
Southeast	3	3.3	4.4	4.6	7.6	6.2	6	4.8	5.3	4.8	2	2.9
Southwest	8.7	6.3	6.4	9.6	10.8	15	15.5	15.9	16.9	9.7	11	9.4
Northwest	14	12.1	13.2	8.5	4	3.8	4	4.1	4.7	7.1	11.6	13.2

OCEAN TEMPERATURE CHART No. 16

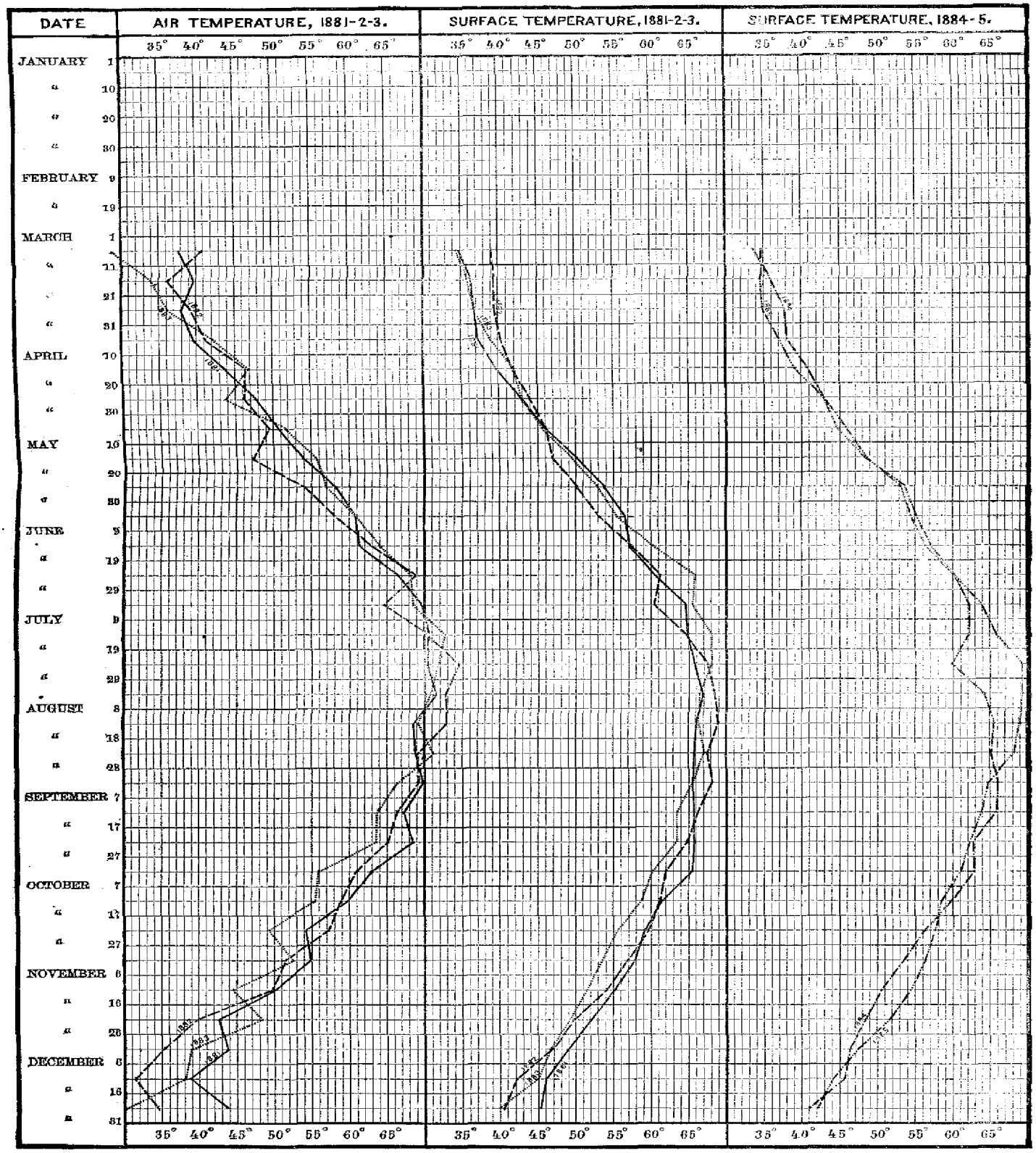
By RICHARD RATHBUN.

Station: Brenton's Reef Light Ship, Rhode Island.

Representing, by means of curves, the temperature of the air from 1881 to 1883, inclusive, and of the water at the surface from 1881 to 1885, inclusive reduced to means of ten days.

EXPLANATION OF THE CURVES: ——— 1881, — — — 1882, ... 1883, —·— 1884, —··— 1885.

(Issued in 1886.)



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EXPLANATION OF OCEAN TEMPERATURE CHART No. 17.

VINEYARD SOUND LIGHT-SHIP, MASSACHUSETTS.

Observers: WILLIAM H. DOANE, A. H. BRAY.

Location of station.—The Vineyard Sound, or "Sow and Pigs" light-ship, as it was formerly called, is anchored 1 mile to the southwestward of Sow and Pigs Reef, and 2½ miles SW. by W. of the light on Cuttyhunk Island, the southernmost of the Elizabeth Group. It is situated 17¼ miles E. by S. ¼ S. of Brenton's Reef light-ship, and on the western side of the southern entrance to Vineyard Sound. Within a radius of a mile the depths range from 4½ to 16½ fathoms. The 20-fathom curve is distant about 6 miles; the 100-fathom curve, about 80 miles.

Geographical position.—Latitude, 41° 23′ (02″) N.; longitude, 70° 59′ (01″) W.

Depth of water.—Fifteen fathoms.

Range of temperature (March 1 to January 1).—Air, 43° (28°.5 to 71°.5); surface, 37° (31° to 68°).

The temperatures for the colder months were evidently more carefully read here than at most of the northern stations, and the curves have been plotted on the chart for the entire year. In reckoning the ranges of temperature, however, January and February have been omitted to facilitate comparisons with the neighboring stations. Compared with Brenton's Reef, the maximum air record is 3° lower, the maximum surface only 1° lower, indicating closely corresponding conditions.

Table showing the direction of the winds, by quadrants, for each month of the year, being the means of five years' observations.

Quadrant.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
Northeast	5.8	6.5	6.8	6.9	8.6	4.8	4.4	6.3	9.3	10.2	6	5.5
Southeast	2.4	4.5	4.3	3.6	5.8	5.5	5.3	5.4	4.5	4.1	1.9	2.2
Southwest	8.6	5.3	7.8	10.7	12.3	16.3	16	14.8	11.3	9.4	11.1	9.3
Northwest	13.8	10.2	11.7	6.8	3	2.9	3.6	2.1	4.1	6.5	10.2	12.8

OCEAN TEMPERATURE CHART No. 17

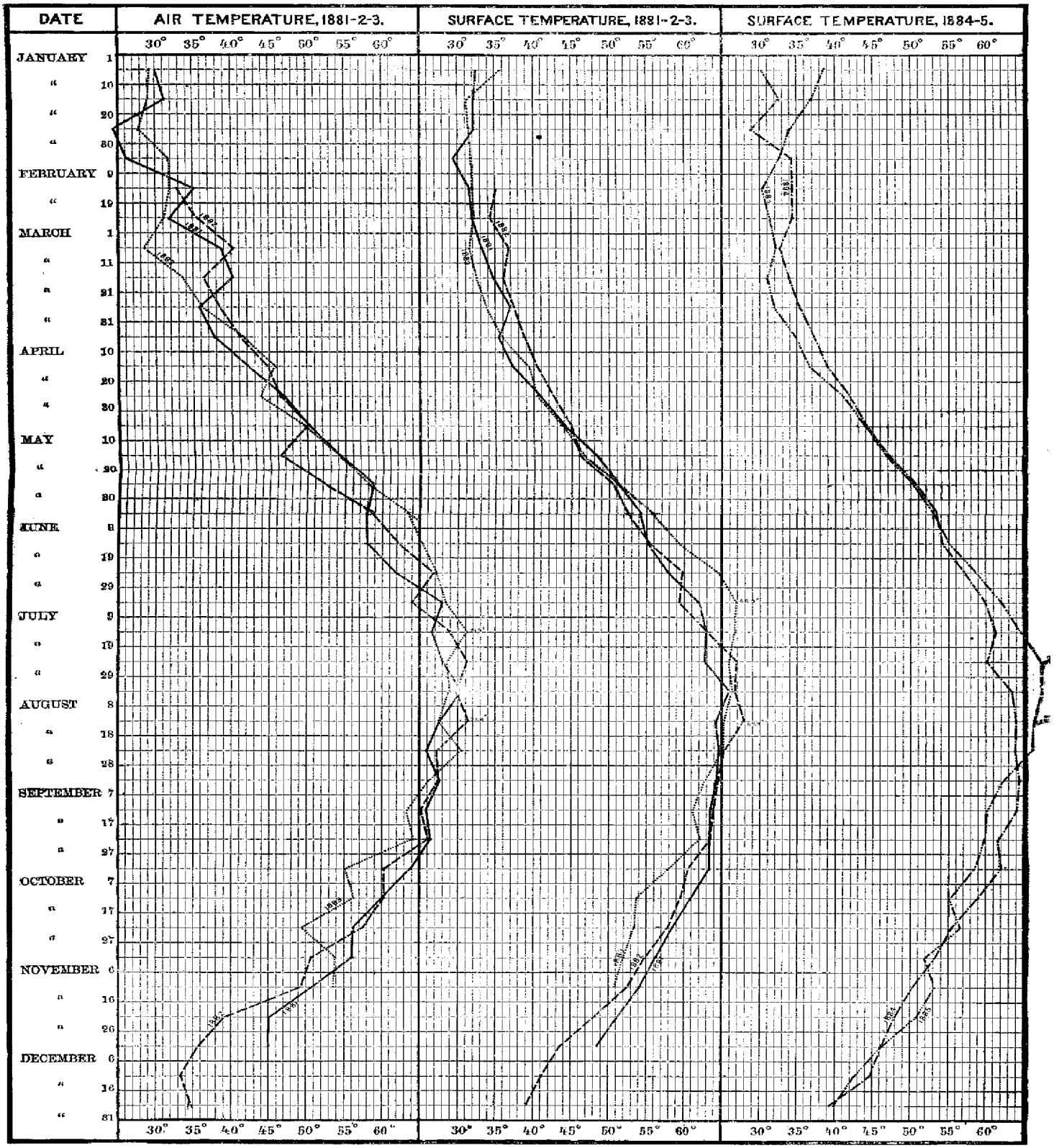
By RICHARD RATHBUN.

Station: Vineyard Sound Light Ship, Massachusetts.

Representing, by means of curves, the temperature of the air from 1881 to 1883, inclusive, and of the water at the surface from 1881 to 1885, inclusive, reduced to means of ten days.

EXPLANATION OF THE CURVES: ——— 1881, — — — 1882, ... 1883, —·— 1884, —··— 1885.

(ISSUED IN 1886.)



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EXPLANATION OF OCEAN TEMPERATURE CHART No. 18.

NANTUCKET NEW SOUTH SHOAL LIGHT-SHIP.

Observers: T. S. JAMES, A. J. SANDSBURG, ISAAC HAMBLEN.

Location of station.—Nantucket (or Davis') New South Shoal light-ship is placed at the southern end of Nantucket Shoals, about 3 miles SSE. of the shoalest part of Davis' New South Shoal, and 21 miles SE. of Nantucket Island, the nearest land. It is distant from Vineyard Sound light-ship about 58 miles in a southeasterly direction. In the immediate vicinity the depths range from 11 to 18 fathoms. The water deepens gradually seaward, attaining a depth of 30 fathoms at distances of 22 to 25 miles; the 100-fathom curve is distant about 60 miles.

Geographical position.—Latitude, 40° 54′ (51″) N.; longitude, 69° 49′ (26″) W.

Depth of water.—Sixteen to 18 fathoms.

Range of temperature (12 months).—Air, 43° (26° to 69°); surface, 28°.5 (33°.5 to 62°).

The position of this light-ship, over 20 miles from the nearest land, and in the course of those schools of surface fish that pass around or through the Nantucket Shoals in their migrations, especially fits it as a permanent station for temperature and other observations bearing upon the coast fisheries. The temperature of the surface water is more equable here than at any of the preceding stations north of the Florida Reefs, but the maximum surface temperature at Nantucket New South Shoal is 8° lower than the minimum at Fowey Rocks. The comparatively slight range of temperature throughout the year has made it possible to utilize the winter temperatures, all of which have been plotted on the chart.

The range of air temperature from March 1 to January 1 is 40° (29° to 69°), nearly the same as at Vineyard Sound light-ship, the maximum being 2½° lower at New South Shoal than at Vineyard Sound. The lowest air records for the winter months also differ only 2° at these two stations. The maximum surface temperature at New South Shoal is, however, 6° lower than at Vineyard Sound, and the minimum between March and January, about 3° higher. The range of surface temperature is, therefore, considerably less at New South Shoal.

Table showing the direction of the wind, by quadrants, for each month of the year, being the means of five years' observations.

Quadrant.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
Northeast	4.8	4.1	5	7.3	9.4	5.2	4.1	8.1	10.1	9.3	6.1	4.7
Southeast	4.4	4.2	4.5	3.6	5.1	3.9	5.4	4.6	5.3	5.2	2.9	4.6
Southwest	7.1	5.7	5.8	8.2	9.9	14.8	13	10.5	11.3	9.4	7.2	7.2
Northwest	13.7	12.6	13.8	8.8	4	2.2	2.1	3.9	3.5	7.6	11.9	13.8

OCEAN TEMPERATURE CHART No. 18

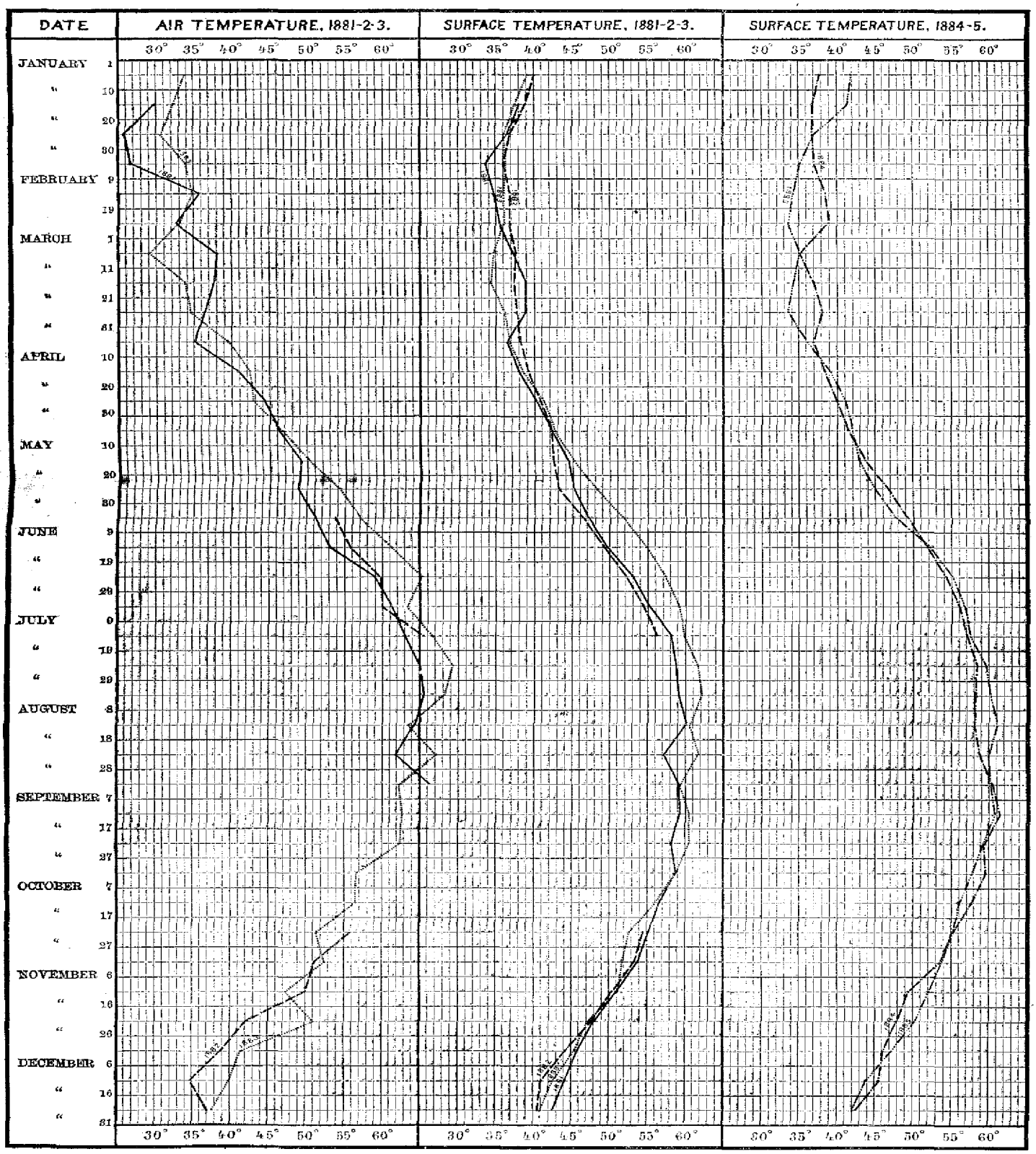
By RICHARD RATHBUN.

Station: Nantucket New South Shoal Light Ship.

Representing, by means of curves, the temperature of the air from 1881 to 1883, inclusive, and of the water at the surface from 1881 to 1885, inclusive, reduced to means of ten days.

EXPLANATION OF THE CURVES: ——— 1881, — — — 1882, ····· 1883, —·— 1884, —··— 1885.

(ISSUED IN 1886.)



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EXPLANATION OF OCEAN TEMPERATURE CHART No. 19.

POLLOCK RIP LIGHT-SHIP, MASSACHUSETTS.

Observers: WILLIAM HAFFARDS, JAMES F. KELLY, JOSEPH ALLEN, JR.

Location of station.—This light-ship is located in the northeastern entrance to Nantucket or Vineyard Sound, and 3¼ miles SE. by E. ½ E. from Monomoy Point light-house, at the southeastern extremity of Cape Cod. It is 1¼ miles distant from Pollock Rip Shoal proper, which lies between it and Monomoy Island, and is surrounded on nearly all sides, at different distances, by small shoals or groups of shoals. There is, however, no land to the northeast, east, or southeast of it. It is anchored in a depth of 5 fathoms, and the depths about it range from 4 to 7 fathoms. The bottom in this region consists of sand and gravel. Nantucket New South Shoal light-ship is about 26 miles nearly south.

Geographical position.—Latitude, 41° 32′ (27″) N.; longitude, 69° 55′ (15″) W.

Depth of water.—Five to 7 fathoms.

Range of temperature (March 1 to January 1).—Air, 39° (27° to 66°); surface, 30°.5 (32° to 62°.5).

The curves of surface temperature are more irregular and less uniform than at the three or four preceding stations, and in many cases the variations do not appear to be due to the influence of the air. They may be caused in part by the currents flowing through the numerous passageways between the surrounding shoals. The ranges of temperature correspond closely with the same at Nantucket New South Shoal, the maximum air temperature being 3° lower at this station, but the maximum and minimum for the surface are almost precisely alike at both. The maximum surface temperature at Pollock Rip, located at the eastern entrance to Vineyard Sound, is 5½° lower than at Vineyard Sound light-ship, at the southwestern entrance to the same body of water.

Table showing the direction of the winds, by quadrants, for each month of the year, being the means of five years' observations.

Quadrant.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
Northeast	4.5	5.4	5.7	6.8	5.9	4.3	4	6.7	9.4	10.8	6.8	5.1
Southeast	5.3	3.9	4.1	4.1	5.1	5.9	6	5.7	6.2	4.7	3.1	4.4
Southwest	7.7	8	10	10.5	9.9	14.6	15.8	12.2	8.5	8.3	9.1	10
Northwest	13.4	10.7	10.7	7.6	4.2	4	3.3	3.5	4.5	5.9	10	10.3

OCEAN TEMPERATURE CHART No. 19

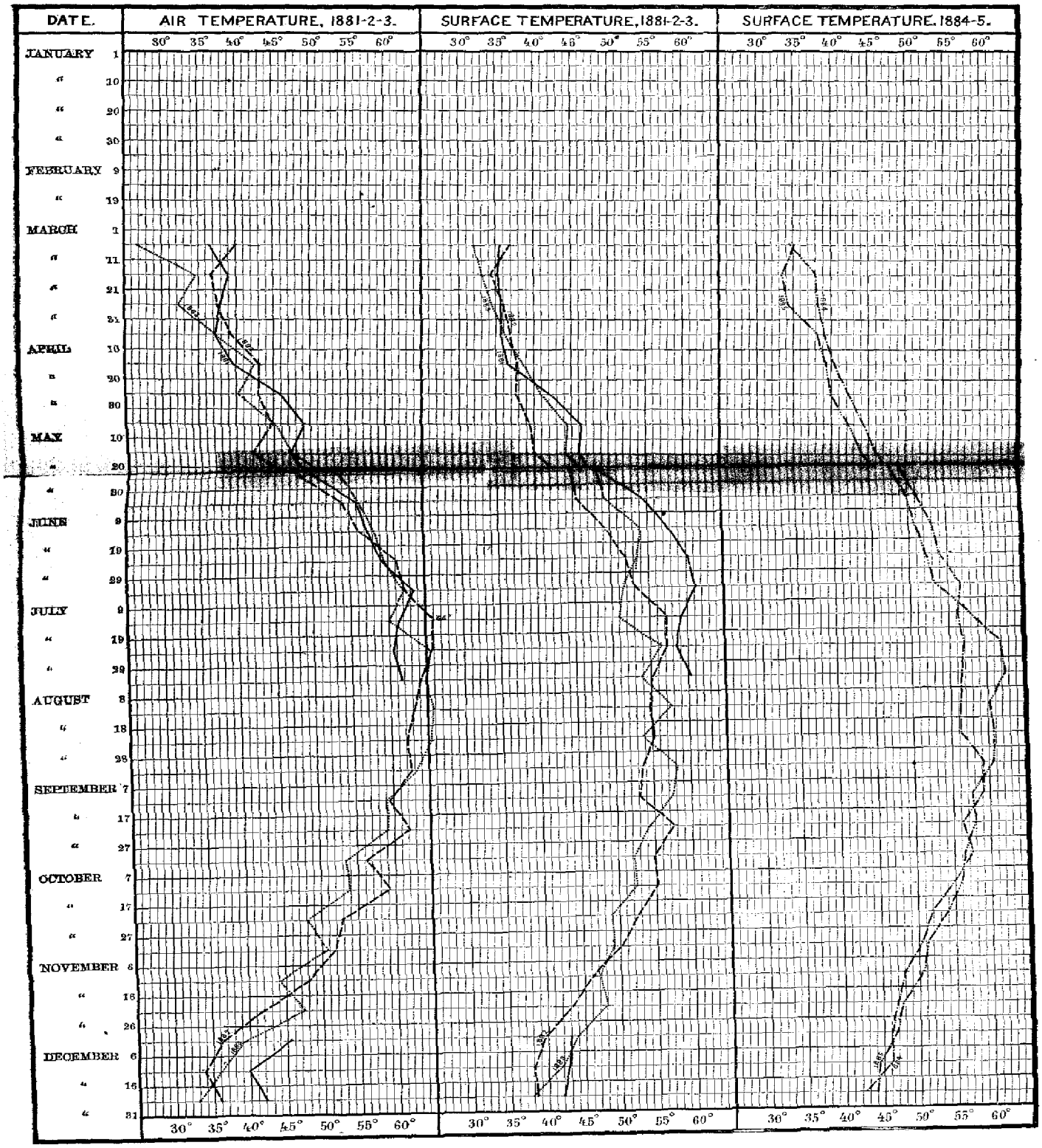
By RICHARD RATHBUN.

Station: Pollock Rip Light Ship, Massachusetts.

Representing, by means of curves, the temperature of the air from 1881 to 1883, inclusive, and of the water at the surface from 1881 to 1885, inclusive, reduced to means of ten days.

EXPLANATION OF THE CURVES: ——— 1881, — — — 1882, ... 1883, —·— 1884 —··— 1885.

(ISSUED IN 1886.)



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EXPLANATION OF OCEAN TEMPERATURE CHART No. 20.

THATCHER'S ISLAND LIGHTS, MASSACHUSETTS.

Observers: E. C. Goss, O. B. Cole, G. Liebmann, of the U. S. Signal Service.

Location of station.—The Cape Ann lights are located on Thatcher's Island, about three-fourths of a mile off the eastern extremity of Cape Ann, both being on the outer side of the island. There are several rocky ledges in front of the island, but otherwise depths of 3½ to 24 fathoms occur within a distance of 1 mile. A depth of 60 fathoms is reached 5½ miles to the eastward. Thatcher's Island is about 73 miles northwesterly from Pollock Rip light-ship.

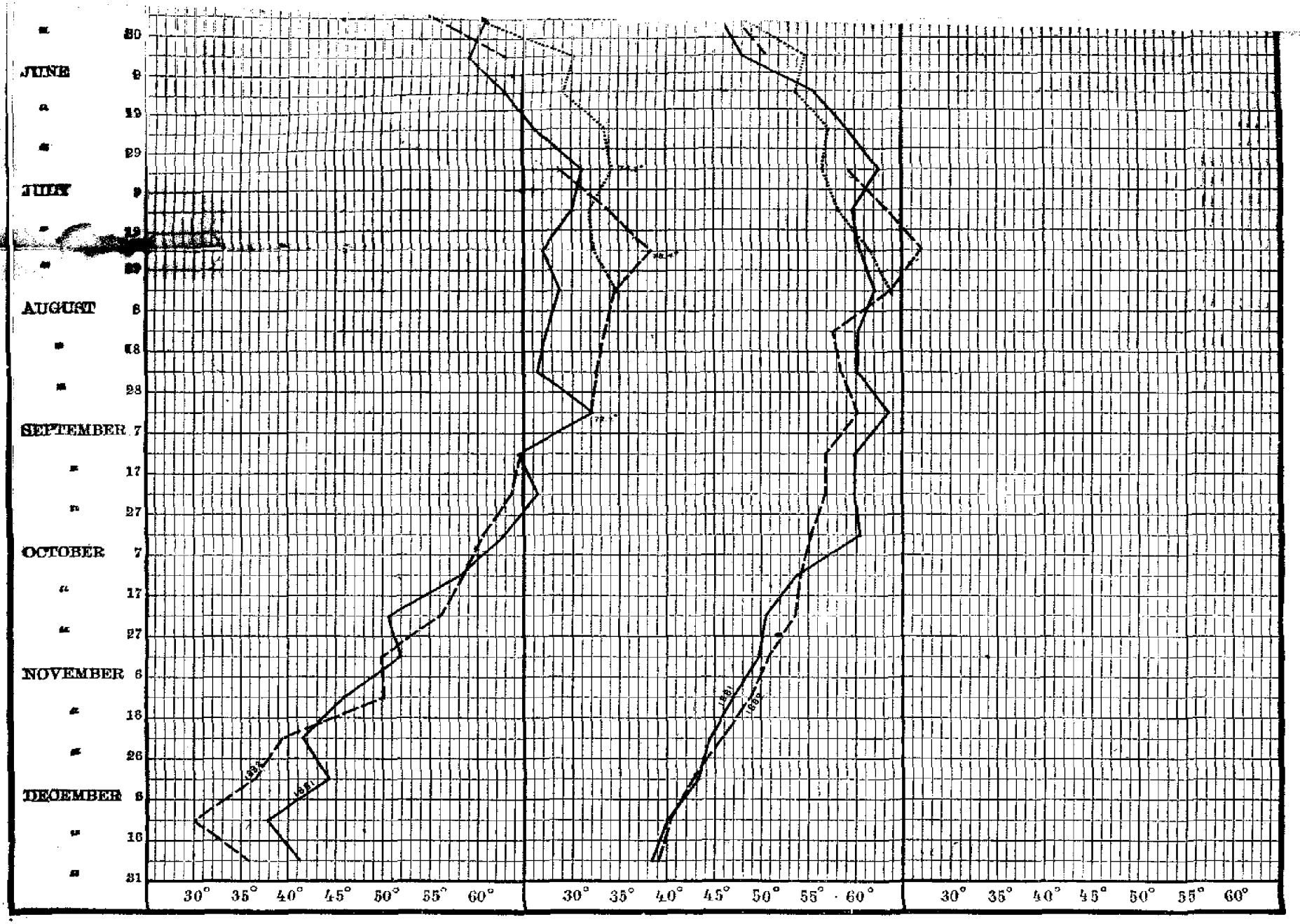
Geographical position.—The northern light is located in latitude 42° 38′ 21″ N.; longitude, 70° 34′ 31″ W.

Depth of water.—Seven feet.

Range of temperature (twelve months).—Air, 48°.5 (30° to 78°.5); surface, 32° (35° to 67°).

The observations at this station were taken by trained observers of the Signal Service, and the winter records, although covering only two years, are presumably accurate, and have been plotted. Observations were continued through only three years, and there are many gaps within that period, which is very unfortunate, considering the important geographical position of the station. Only one observation was taken daily, at 2 p. m. The surface curves are very irregular, and in many cases, especially during the warmer months, indicate direct atmospheric influence, from the similarity of the variations in both the air and surface curves. There is not always, however, a strict correspondence in the relative positions of the curves in different years, the air curve from May to July, 1883, being from 2° to 10° higher than the air curve for the same months in 1881, while the surface curve for a part of the same period, in 1883, is from 2° to 6° lower than in 1881. During the colder months the surface curves are very regular.

The maximum air temperature is higher at Thatcher's Island than at any of the preceding stations as far south as Block Island, with which latter this station corresponds approximately. In surface temperatures Thatcher's Island agrees most closely with Vineyard Sound and Brenton's Reef light-ships, but it is probable that the higher surface temperatures of Thatcher's Island are due to the observations having been taken in a sheltered place.



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OCEAN TEMPERATURE CHART No. 20

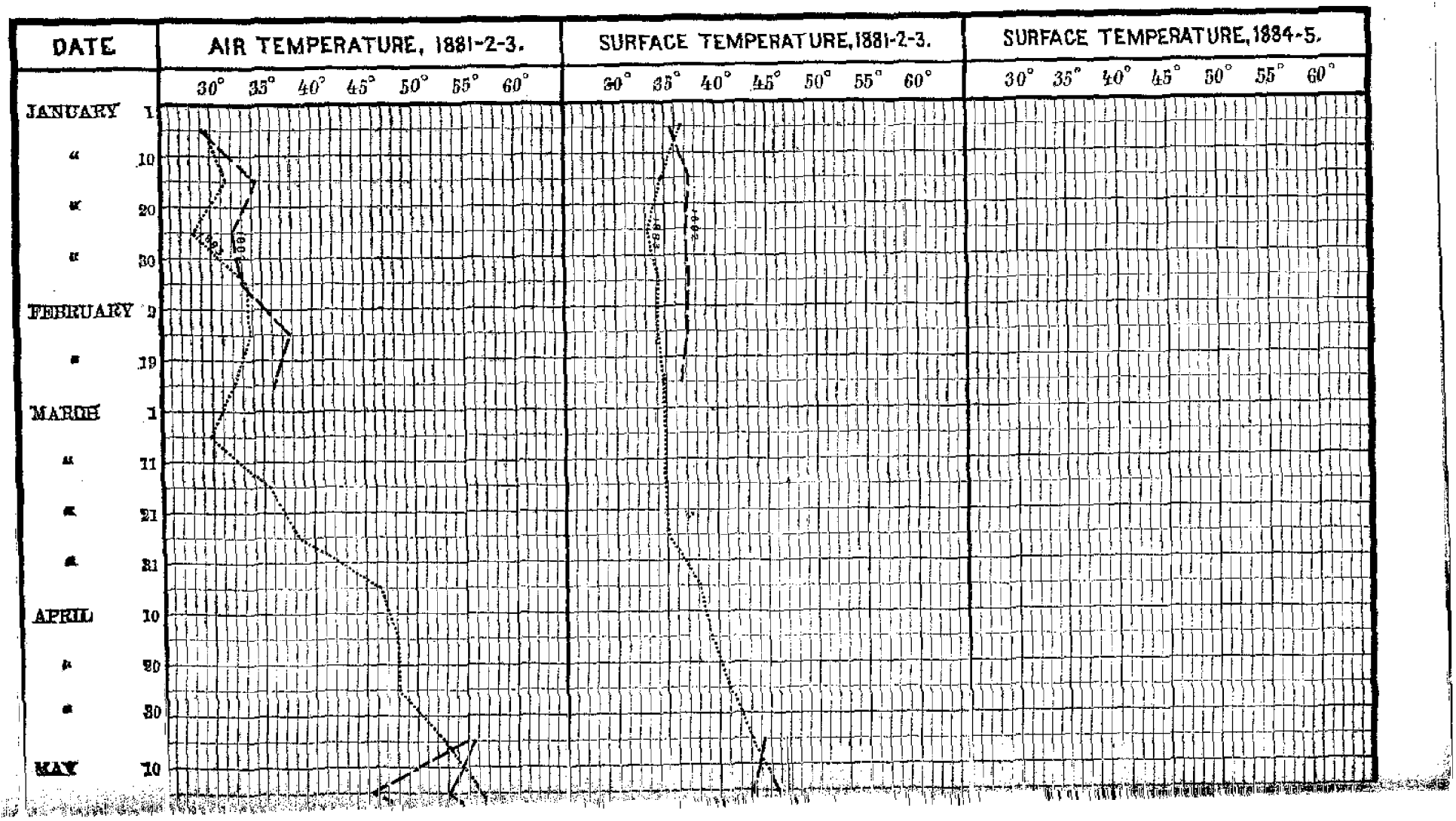
By RICHARD RATHBUN.

Station: Thatcher's Island Lights, Massachusetts.

Representing, by means of curves, the temperature of the air from 1881 to 1883, inclusive, and of the water at the surface from 1881 to 1883, inclusive, reduced to means of ten days.

EXPLANATION OF THE CURVES: ——— 1881, — — — 1882, ····· 1883, —·— 1884, —··— 1885.

(Issued in 1886.)



EXPLANATION OF OCEAN TEMPERATURE CHART No. 21.

BOON ISLAND LIGHT-HOUSE, MAINE.

Observer: ALFRED J. LEAVITT.

Location of station.—Boon Island is a small, low, rocky island, off York Harbor, Maine, and 5¾ miles from Cape Neddick, the nearest part of the mainland. From Thatcher's Island it is distant about 35 miles, in a northerly direction. Within a radius of 1 mile depths of 5½ to 25 fathoms occur, and a depth of 66 fathoms is reached at a distance of about 6¼ miles to the eastward and southeastward.

Geographical position of the light-house.—Latitude, 43° 07′ 17″ N.; longitude, 70° 28′ 37″ W.

Depth of water.—Nine fathoms.

Range of temperature (March 1 to January 1).—Air, 51° (22°.5 to 73°.5); surface, 29° (33° to 62°).

This station affords the highest maximum surface temperature of any of the stations located in the northern part of the Gulf of Maine. This maximum is 5° lower than at Thatcher's Island, but agrees exactly with the surface maximums at Pollock Rip and Nantucket New South Shoal. The maximum for the air is, however, somewhat higher at Boon Island than at the two light-ships mentioned. The surface curves are more irregular than at the other stations in the Gulf of Maine. It is necessary to explain, however, that the surface observations were not taken with any regularity at this station, omissions of several days, sometimes as many as five or six days, occurring in a majority of the ten-day periods. The omissions are much less frequent during the summer than the winter months. It is impossible to calculate to what extent the results may be vitiated by this fact.

Table showing the direction of the winds, by quadrants, for each month of the year, being the means of five years' observations.

Quadrant.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
Northeast	7.8	9	9.3	9.1	9.9	5.3	5.8	7.5	10	11.4	9.7	8.8
Southeast	3.2	3.6	5.9	8.8	13	13.3	12.9	10	10.1	7.3	4.3	4
Southwest	9	7.2	5.5	3.9	4.5	5.6	7.7	10.5	6	7.7	9.1	9.6
Northwest	10.9	6.4	10.5	8	3.2	4.8	3.8	2.6	3.1	4.2	6.8	8.6

OCEAN TEMPERATURE CHART No. 21

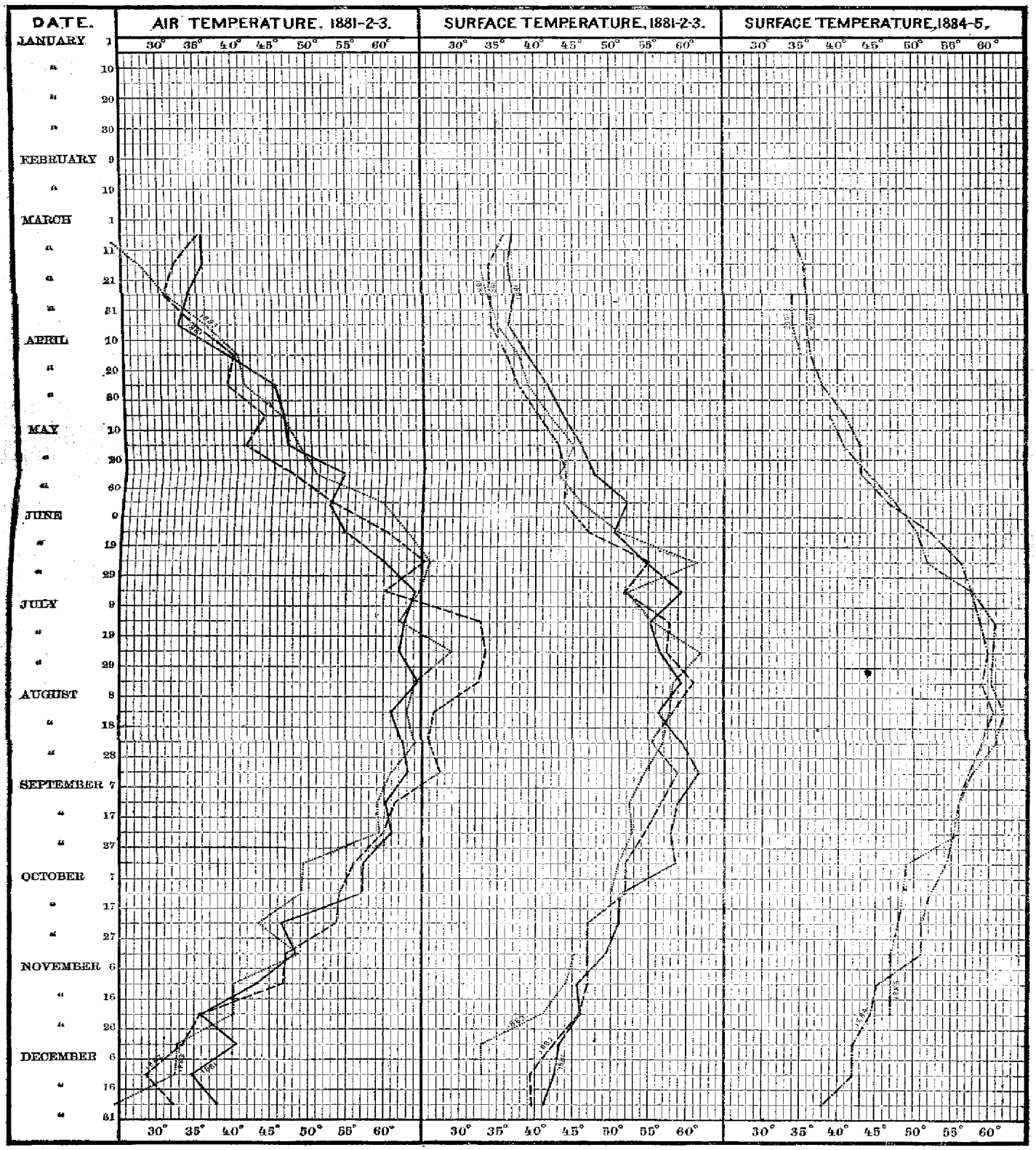
By RICHARD RATHBUN.

Station: Boon Island Light House, Maine.

Representing, by means of curves, the temperature of the air from 1881 to 1883, inclusive, and of the water at the surface from 1881 to 1885, inclusive, reduced to means of ten days.

EXPLANATION OF THE CURVES: ——— 1881. — — — 1882, ... 1883, —·— 1884, —··— 1885.

(ISSUED IN 1886.)



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EXPLANATION OF OCEAN TEMPERATURE CHART No. 22.

SEGUIN ISLAND LIGHT-HOUSE, MAINE.

Observer: THOMAS DAY.

Location of station.—Seguin Island is a small rocky island with precipitous shores, located about 2¼ miles off the nearest part of the mainland, on the east side of the entrance to Kennebec River, and about 47 miles northeasterly from Boon Island. Between Seguin Island and the shoals bordering the adjacent mainland depths of 3½ to 9 fathoms occur, and off the island a depth of 40 fathoms is reached within a distance of 3½ miles. The light is placed on the western side of the island where the water is from 6 to 8 fathoms deep close inshore.

Geographical position.—Latitude, 43° 42′ 26″ N.; longitude, 69° 45′ 32″ W.

Depth of water.—Six fathoms.

Range of temperature (March 1 to January 1).—Air, 46°.5 (24° to 70°.5); surface, 25° (33° to 58°).

This station has a shorter range of temperature for both the air and surface than Boon Island. The maximum air temperature is 3°, the maximum surface temperature 4°, lower than at Boon Island. Both the air and surface curves are more regular than at the preceding station, and more uniform for all the years.

Table showing the direction of the winds, by quadrants, for each month of the year, being the means of five years' observations.

Quadrant.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
Northeast	7.4	7.6	9	6.5	9.3	4.9	3.9	4.9	7.9	8.6	8.4	7
Southeast	2.1	3.1	4.3	5.4	8.8	6.8	7.4	7.5	4.7	4.5	1.8	2.9
Southwest	9.5	7.8	8	8.6	3.2	13.8	15.6	14.2	11.8	12.4	10.1	10.7
Northwest	11.6	8.8	9.2	8.6	2.9	3.4	3.2	3.4	4.4	6.1	9	9.7

OCEAN TEMPERATURE CHART No. 22

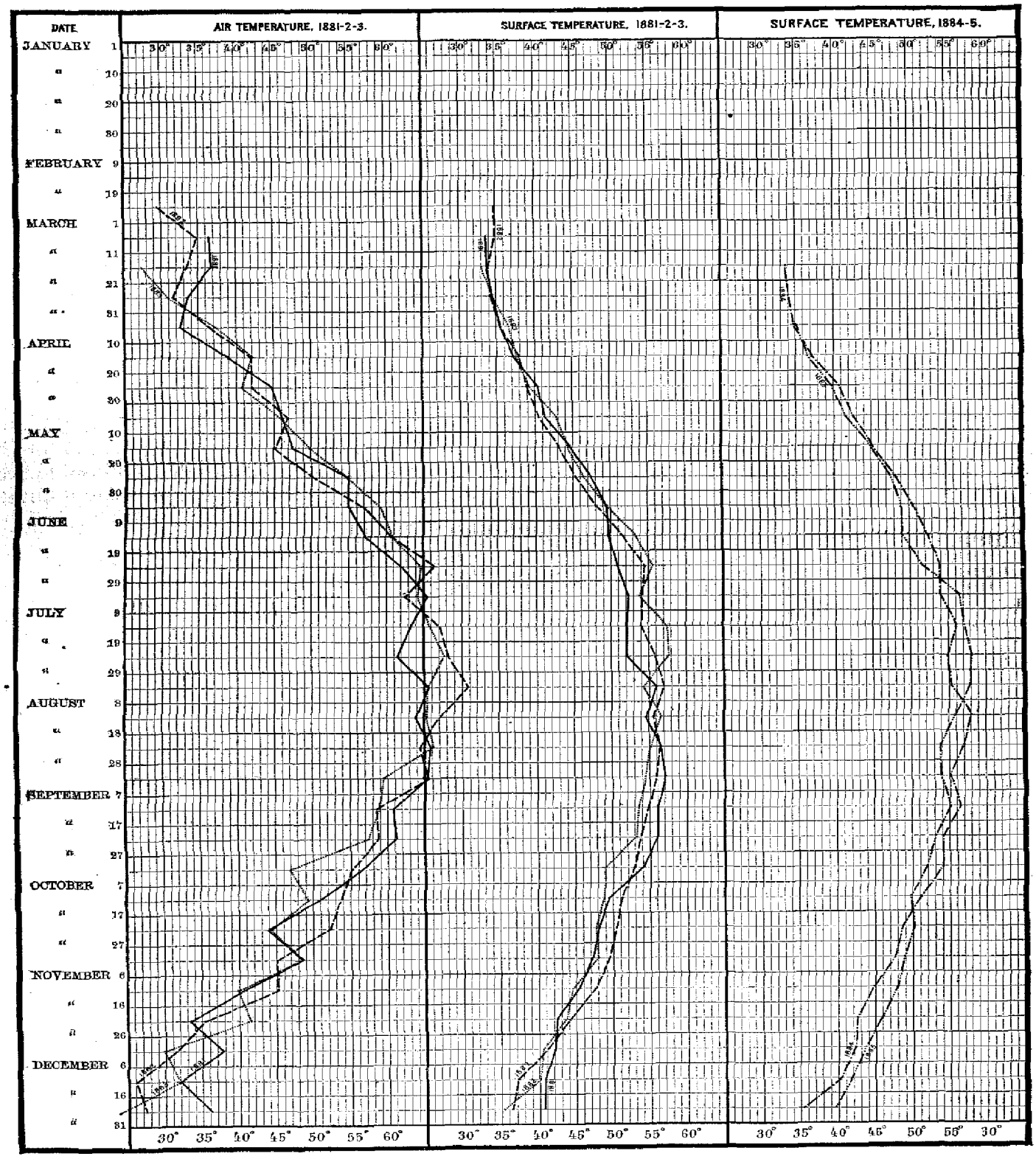
By RICHARD RATHBUN.

Station: Seguin Island Light House, Maine.

Representing, by means of curves, the temperature of the air from 1881 to 1883, inclusive, and of the water at the surface from 1884 to 1885, inclusive, reduced to means of ten days.

EXPLANATION OF THE CURVES: ——— 1881. — — — 1882, ... 1883, —·— 1884 —··— 1885.

(Issued in 1886.)



Each vertical interspace represents one degree Fahrenheit, and the fractional parts of a degree are indicated as exactly as possible in the plotting of the curves. Each fifth degree is represented by a slightly heavier line. The transverse interspaces inclosed by the heavier lines represent periods of ten days each, as indicated by the dates on the left-hand side of the plate. The lighter transverse lines, intermediate between the heavier ones, are intended to represent the mean of each ten days, and the curves of temperature are plotted with reference to these lines. The left-hand vertical division is devoted to the air temperatures for 1881, 1882 and 1883, the middle division to the surface water temperatures for the same years, thus permitting of a comparison of the two; and the right-hand division to the water temperatures for 1884 and 1885.

EXPLANATION OF OCEAN TEMPERATURE CHART No. 23.

MATINICUS ROCK LIGHT-HOUSE, MAINE.

Observer: WILLIAM G. GRANT.

Location of station.—Matinicus Rock is a bare, rocky islet, about 80 miles easterly from Seguin Island, and about 14 miles south of Vinal Haven Island, at the mouth of Penobscot Bay, the nearest large piece of land. It is about 2¾ miles SE. of Ragged Island, which is close to Matinicus Island and between the latter and Matinicus Rock. Within a radius of a mile the water deepens rapidly from 4 to 45 fathoms.

Geographical position.—Latitude, 43° 47′ 01″ N.; longitude, 68° 51′ 20″ W.

Depth of water.—Six to 12 fathoms.

Range of temperature (March 1 to January 1).—Air, 42° (23° to 65°); surface, 21°.5 (32°.5 to 54°).

Matinicus Rock and Mount Desert Rock present the shortest range of surface temperature of any of the stations north of the Florida Reefs, being 7° shorter than at Nantucket New South Shoal light-ship. The surface and air maximums for Matinicus Rock are also the lowest of any recorded. The surface curves are very regular and uniform from year to year. Unfortunately, there are nearly as many omissions in the surface records for this station as for Boon Island, but they are seldom frequent except during the colder months.

Table showing the direction of the winds, by quadrants, for each month of the year, being the means of five years' observations.

Quadrant.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
Northeast	3.7	4.6	5.3	6.3	6.6	2.7	2.4	3.7	5.7	6.1	6.1	4.5
Southeast	4.8	4.9	4.8	4.8	9.6	8.5	9.4	7.3	6	5.8	3.7	5.5
Southwest	9.1	6.4	7.4	8	9.2	12.8	13.9	12.9	10.2	10	10.3	8.2
Northwest	12.9	11.7	13.5	7.9	4.3	4.4	2.9	3.4	5.1	8.6	9.7	12.3

OCEAN TEMPERATURE CHART No. 23

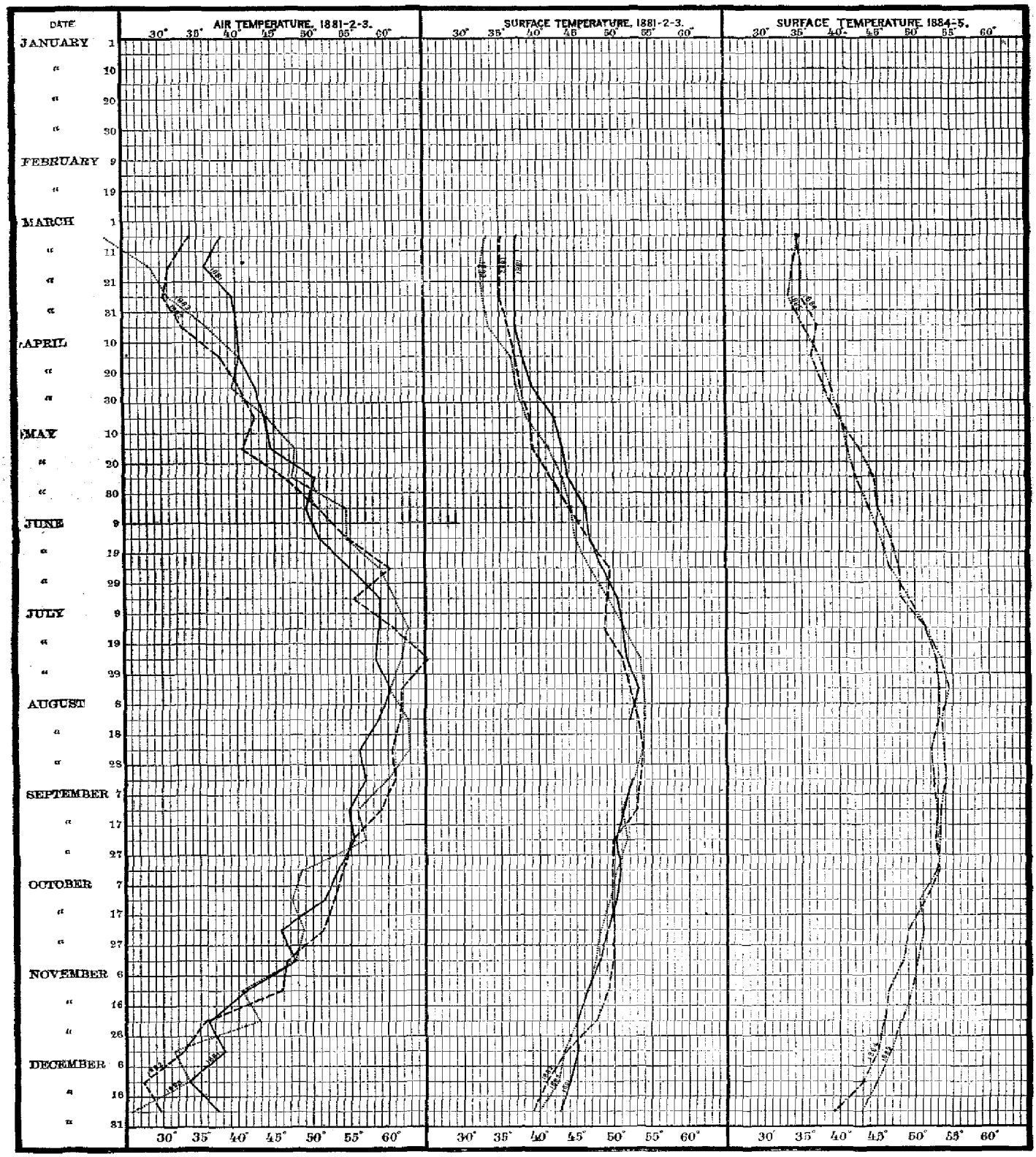
By RICHARD RATHBUN.

Station: Matinicus Rock Light House, Maine.

Representing, by means of curves, the temperature of the air from 1881 to 1883, inclusive, and of the water at the surface from 1881 to 1885, inclusive, reduced to means of ten days.

EXPLANATION OF THE CURVES: ——— 1881, — — — 1882, ... 1883, —·— 1884, —··— 1885.

(Issued in 1886)



Each vertical interspace represents one degree Fahrenheit, and the fractional parts of a degree are indicated as exactly as possible in the plotting of the curves. Each fifth degree is represented by a slightly heavier line. The transverse interspaces inclosed by the heavier lines represent periods of ten days each, as indicated by the dates on the left-hand side of the plate. The lighter transverse lines, intermediate between the heavier ones, are intended to represent the mean of each ten days, and the curves of temperature are plotted with reference to these lines. The left-hand vertical division is devoted to the air temperatures for 1881, 1882 and 1883, the middle division to the surface water temperatures for the same years, thus permitting of a comparison of the two; and the right-hand division to the water temperatures for 1884 and 1885.

EXPLANATION OF OCEAN TEMPERATURE CHART No. 24.

MOUNT DESERT ROCK LIGHT-HOUSE, MAINE.

Observers: AMOS B. NEWMAN, JAMES A. MORRIS, THOMAS MILAN.

Location of station.—Mount Desert Rock is a small, barren islet, 34 miles E. ¾ N. from Matinicus Rock, and about 18 miles off Mount Desert Island. The rock is surrounded with deep water, the depths ranging from 50 to 95 fathoms within a radius of 5 miles.

Geographical position.—Latitude, 43° 58′ 05″ N.; longitude, 68° 07′ 44″ W.

Depth of water.—Two to 10 fathoms.

Range of temperature (March 1 to January 1).—Air, 50° (25°.5 to 75°.5); surface, 21°.5 (33° to 54°.5).

This station presents the same surface range as Matinicus Rock, with practically the same maximum and minimum temperatures, but the surface curves are less regular and not uniform for all the years (especially from 1881 to 1883, inclusive), sometimes showing differences of 10° to 12° in corresponding periods. The maximum air temperature is 2° higher than at any other station in the Gulf of Maine, excepting Thatcher's Island, Brenton's Reef light-ship being the first station to the south with which it corresponds closely in this respect. The maximum air temperature at Matinicus Rock, the nearest station to the west, is 10° lower than at Mount Desert Rock. Excluding, however, the year 1883, in which the summer temperature was far above those of the two previous years, the maximum air temperature of this station would be only 68°.5.

Table showing the direction of the winds, by quadrants, for each month of the year, being the means of five years' observations.

Quadrant.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
Northeast	4.0	5.6	7.2	5.4	7.1	2.5	1.7	3	5.5	5.7	6.8	5.3
Southeast	4.5	4.9	6.8	5.3	8.3	8.9	9.9	7.3	6.9	7.1	5.7	7.1
Southwest	8.5	8	7.1	10.1	10.9	13.3	14.3	14	10.6	9.8	9.7	8.7
Northwest	12.9	9.4	9.6	7	3	3	2	3.1	4.1	6.6	7.5	9.6

OCEAN TEMPERATURE CHART No. 24

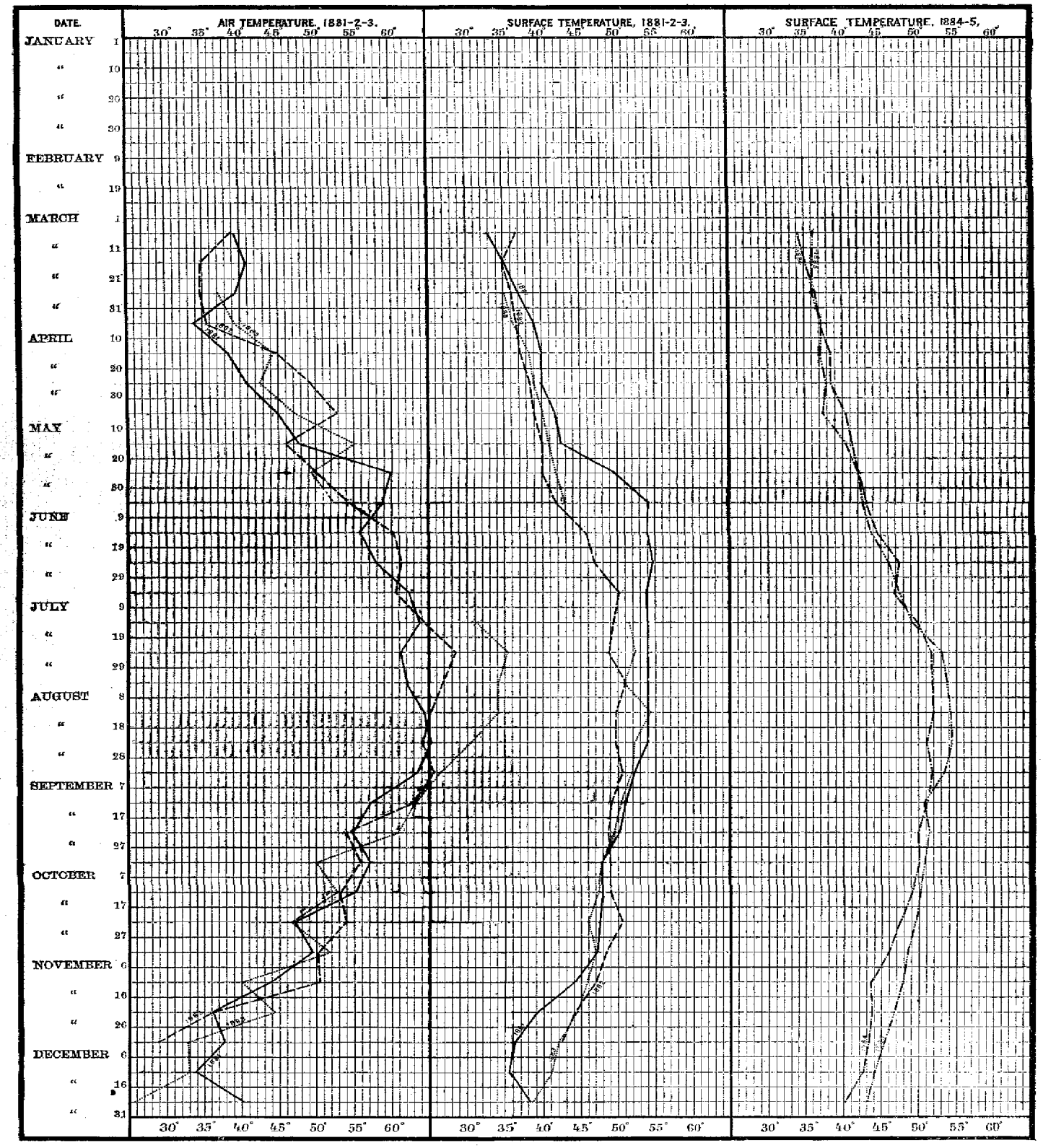
By RICHARD RATHBUN.

Station: Mount Desert Rock Light House, Maine.

Representing, by means of curves, the temperature of the air from 1881 to 1883, inclusive, and of the water at the surface from 1881 to 1885, inclusive, reduced to means of ten days.

EXPLANATION OF THE CURVES: ——— 1881, —·—·— 1882, ····· 1883, —·— 1884, —··— 1885.

(ISSUED IN 1886.)



Each vertical interspace represents one degree Fahrenheit, and the fractional parts of a degree are indicated as exactly as possible in the plotting of the curves. Each fifth degree is represented by a slightly heavier line. The transverse interspaces inclosed by the heavier lines represent periods of ten days each, as indicated by the dates on the left-hand side of the plate. The lighter transverse lines, intermediate between the heavier ones, are intended to represent the mean of each ten days, and the curves of temperature are plotted with reference to these lines. The left-hand vertical division is devoted to the air temperatures for 1881, 1882 and 1883, the middle division to the surface water temperatures for the same years, thus permitting of a comparison of the two; and the right-hand division to the water temperatures for 1884 and 1885.

EXPLANATION OF OCEAN TEMPERATURE CHART No. 25.

PETIT MANAN LIGHT-HOUSE, MAINE.

Observer: GEORGE L. UPTON.

Location of station.—Petit Manan light-house is located on the southernmost of a group of low, rocky islets, known, collectively, as Petit Manan Island. These islets are situated off the western entrance to Pigeon Hill Bay, near Gouldsborough, Me., and are distant about 2 miles from the nearest point of the mainland. They are immediately surrounded by ledges and shoals, but within a distance of 8 miles to the southward depths of 60 fathoms occur. The light is 27 miles NE. ¾ N. from Mount Desert Rock light-house.

Geographical position.—Latitude, 44° 22′ 03″ N.; longitude, 67° 51′ 51″ W.

Depth of water.—Eight to 15 fathoms.

Range of temperature (March 1 to January 1).—Air, 50° (20° to 70°); surface, 27°.5 (31° to 58°.5).

The range of air temperature is the same as at Mount Desert Rock, but with the maximum and minimum temperatures each 5½ degrees lower. Excluding the year 1883, the maximums of air temperature would be nearly the same at both places. The surface maximum is 4 degrees higher at this station. The surface curves for 1881 to 1883, inclusive, are fully as irregular as at Mount Desert Rock, and there is the same lack of uniformity between the different years, but the variations do not in any way correspond at the two stations, and the conditions by which they were produced were evidently not common to both. There is much greater correspondence between the years 1884 and 1885.

Table showing the direction of the winds, by quadrants, for each month of the year, being the means of five years' observations.

Quadrant.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
Northeast	5.5	5	8.6	6.8	8.5	3.7	3	3.8	5.5	5.6	6.4	4.3
Southeast	3.6	6	6	5.7	10.5	11.1	14.3	13.6	9.2	8.9	6.3	7.2
Southwest	9.5	7.3	9.2	10.7	8.4	11.8	11.4	11.3	10.9	7.4	9.6	7.9
Northwest	12.4	9.9	7.2	6.8	3.6	3.4	1.8	2.3	4.3	9.1	7.7	11.6

OCEAN TEMPERATURE CHART No. 25

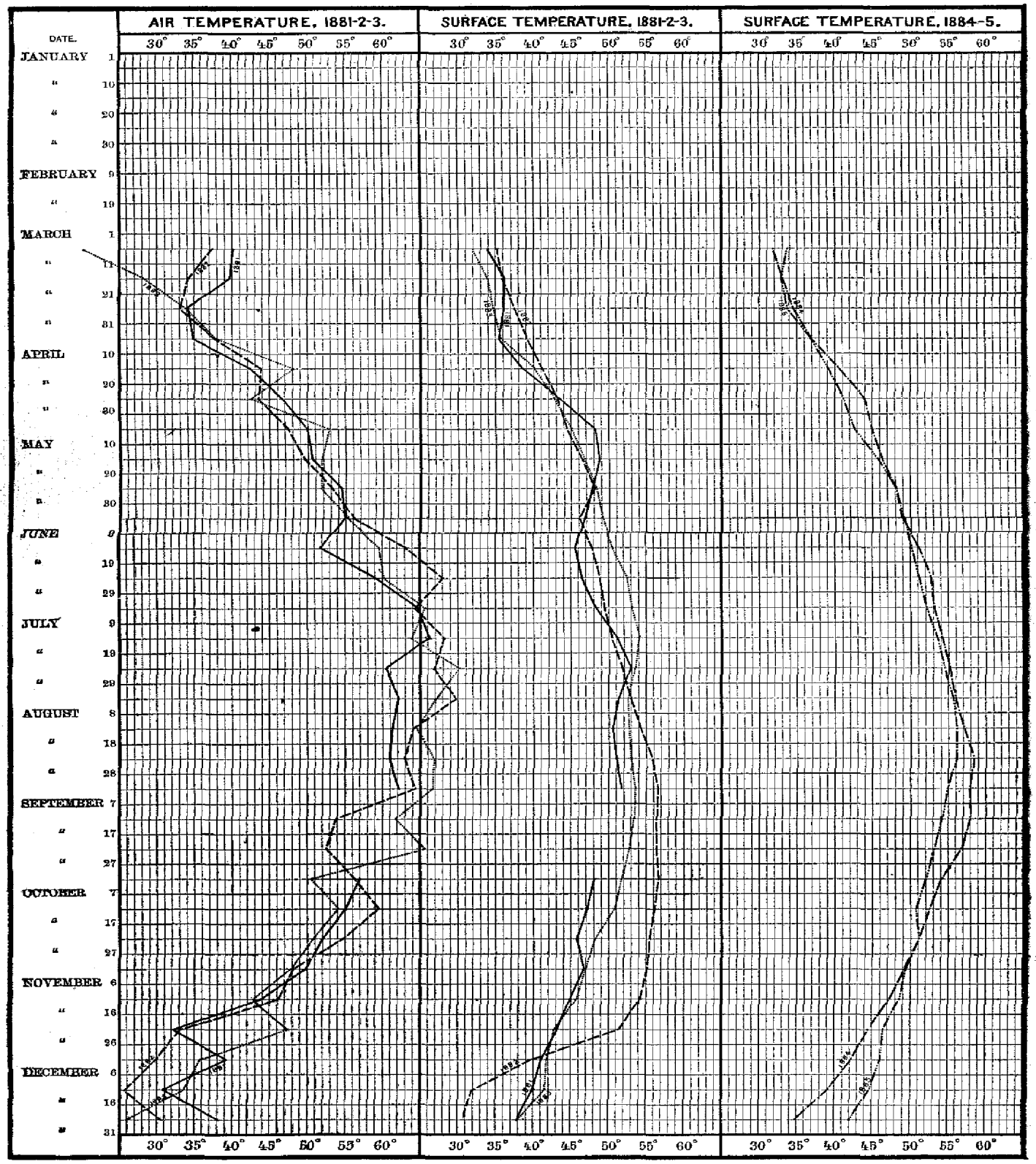
By RICHARD RATHBUN.

Station: Petit Manan Light House, Maine.

Representing, by means of curves, the temperature of the air from 1881 to 1883, inclusive, and of the water at the surface from 1881 to 1885, inclusive, reduced to means of ten days.

EXPLANATION OF THE CURVES: ——— 1881, — — — 1882, ... 1883, —·— 1884, —·····— 1885.

(ISSUED IN 1886.)



Each vertical interspace represents one degree Fahrenheit, and the fractional parts of a degree are indicated as exactly as possible in the plotting of the curves. Each fifth degree is represented by a slightly heavier line. The transverse interspaces inclosed by the heavier lines represent periods of ten days each, as indicated by the dates on the left-hand side of the plate. The lighter transverse lines, intermediate between the heavier ones, are intended to represent the mean of each ten days, and the curves of temperature are plotted with reference to these lines. The left-hand vertical division is devoted to the air temperatures for 1881, 1882 and 1883, the middle division to the surface water temperatures for the same years, thus permitting of a comparison of the two; and the right-hand division to the water temperatures for 1884 and 1885.

EXPLANATION OF OCEAN TEMPERATURE CHART No. 26.

Isothermal lines connecting the series of light-house stations on the eastern coast of the United States, represented on Chart No. 1, constructed for every 5° of temperature, Fahrenheit, from 40° to 80°, inclusive, for the year 1881.

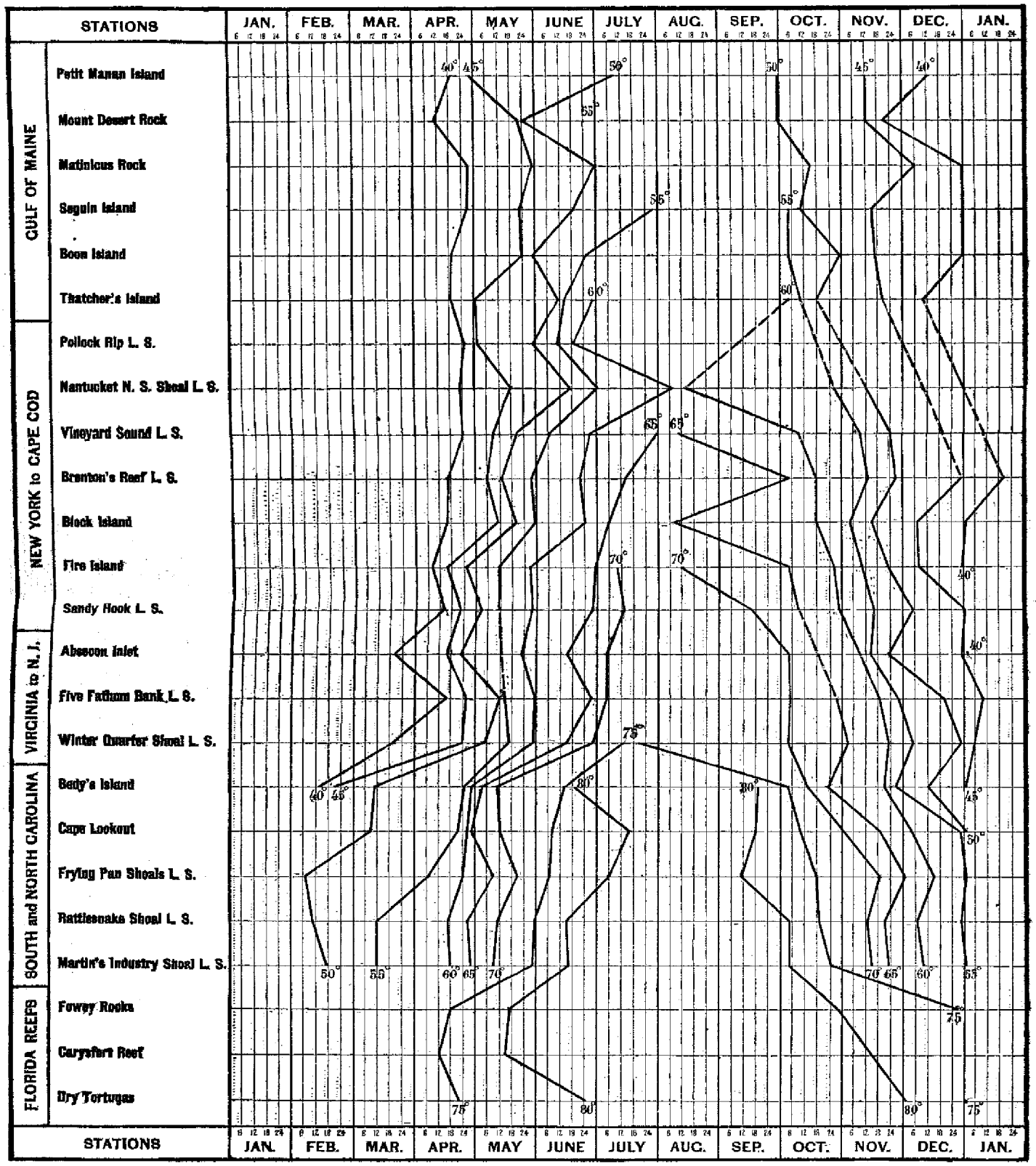
A temperature of 55° was reached at Mount Desert Rock between June 24 and 30, but otherwise the isotherms of 55° extend north only to Seguin Island. At Nantucket New South Shoal, 60° was recorded continuously for eight days only, or from August 7 to 14. Two very short periods of higher temperature than 75° occurred at Absecon Inlet (July 14 to 20, September 30 to October 24), but the isotherms of 75° begin regularly at Winter Quarter Shoal, where the interval between the two lines is only eight days (July 13-20). During the period of falling temperature, the isotherm of 40° extends south continuously within the year to Fire Island, although at Pollock Rip, Nantucket New South Shoal, and Vineyard Sound observations are lacking for that temperature. At Sandy Hook the isotherm of 40° was not reached until February, 1882, while at Five Fathom Bank and Winter Quarter Shoal the temperature remained above 40° during the entire winter of 1881 and 1882. The isotherm of 50° extends south only to Cape Lookout in the same winter, but in the early part of 1881 it reached to Martin's Industry. At the Tortugas the temperature fell below 70° during a short period just prior to February 8, and again between March 20 and April 15.

OCEAN TEMPERATURE CHART No. 26

By RICHARD RATHBUN.

Isothermal lines connecting the series of Light House Stations represented on Chart No. 1, constructed for every five degrees of temperature, Fahrenheit, from 40 degrees to 80 degrees, inclusive, for the year 1881.

(ISSUED IN 1896.)



This chart is divided vertically into thirteen months in order to include the first month of the following year. Each month is further divided, by the lighter lines, into periods of six days each, except in the case of those months having fewer or more days than 30, when the last division of the month may equal four, five, or seven days. The 1st, 6th, 12th, 18th, 24th and last days of the month fall on the vertical lines. The transverse lines represent the stations from which they extend. A complete break in the isothermal line opposite any station generally indicates that the temperature did not reach the isotherm at that station during the year. A line consisting of dashes denotes a lack of observations for the corresponding station.

EXPLANATION OF OCEAN TEMPERATURE CHART No. 27.

Isothermal lines connecting the series of light-house stations on the eastern coast of the United States represented on Chart No. 1, constructed for every 5° of temperature, Fahrenheit, from 40° to 80°, inclusive, for the year 1882.

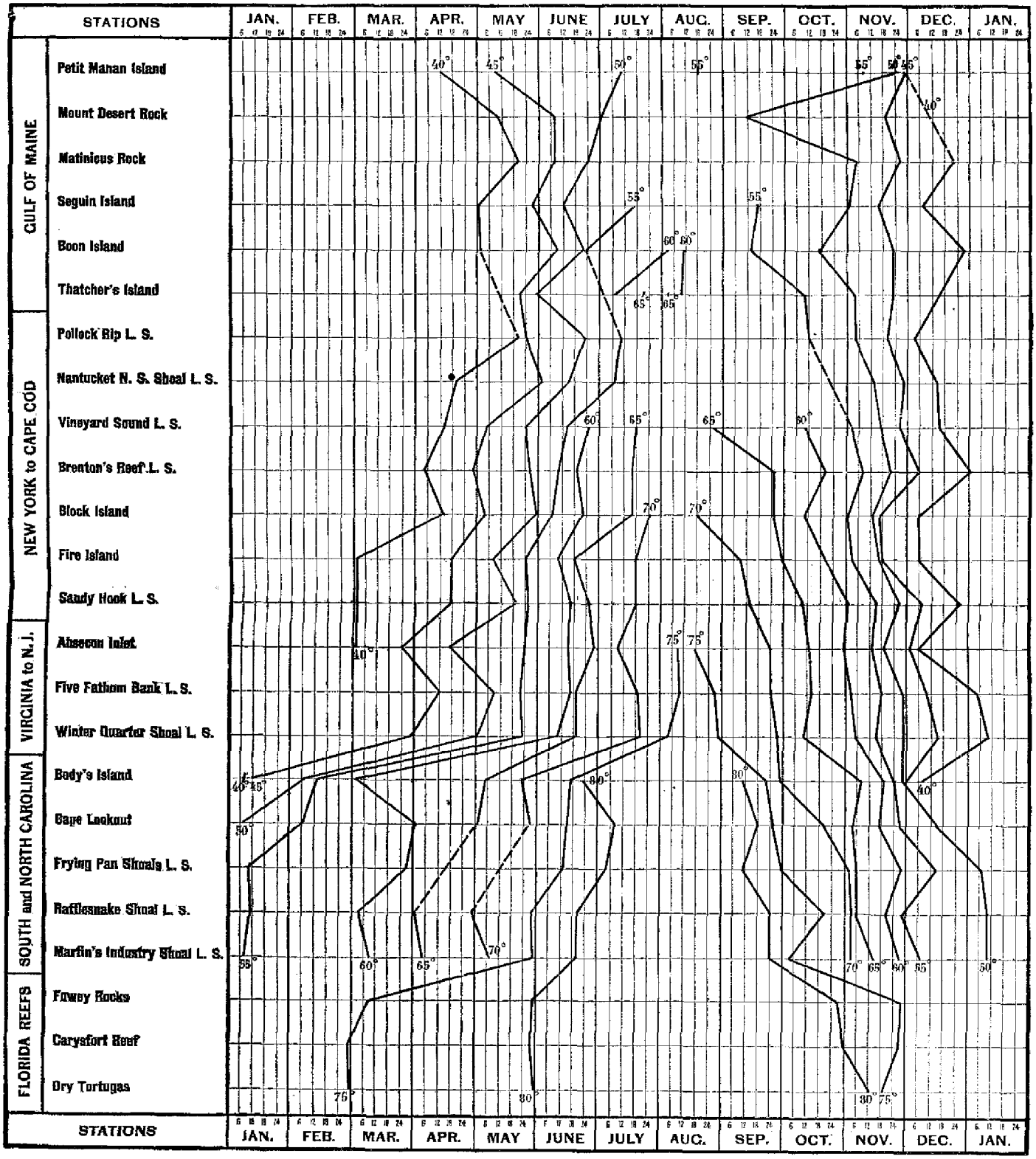
The isotherm of 40° extends south continuously in the spring only as far as Absecon Inlet; during the period of falling temperature, however, the isotherm of that value extends to Body's Island. Higher temperatures than 55° were recorded at Petit Manan, from August 18 to November 8, but the isotherms of 55° begin at Seguin Island. The isotherm of 60° appeared at Boon Island and Thatcher's Island, but not elsewhere north of Vineyard Sound, although the record is incomplete for Nantucket New South Shoal. The isotherms of 65° extend north continuously to Vineyard Sound, and the same temperature was also recorded at Thatcher's Island. At the Tortugas, the temperature was below 75° between May 9 and 21, and below 80° between October 8 and 14.

OCEAN TEMPERATURE CHART No. 27

By RICHARD RATHBUN.

Isothermal lines connecting the series of Light House Stations represented on Chart No. 1, constructed for every five degrees of temperature, Fahrenheit, from 40 degrees to 80 degrees, inclusive, for the year 1882.

(ISSUED IN 1886.)



This chart is divided vertically into thirteen months in order to include the first month of the following year. Each month is further divided, by the lighter lines, into periods of six days each, except in the case of those months having fewer or more days than 30, when the last division of the month may equal four, five, or seven days. The 1st, 6th, 12th, 18th, 24th and last days of the month fall on the vertical lines. The transverse lines represent the stations from which they extend. A complete break in the isothermal line opposite any station generally indicates that the temperature did not reach the isotherm at that station during the year. A line consisting of dashes denotes a lack of observations for the corresponding station.

EXPLANATION OF OCEAN TEMPERATURE CHART No. 28.

Isothermal lines connecting the series of light-house stations on the eastern coast of the United States, represented on Chart No. 1, constructed for every 5° of temperature, Fahrenheit, from 40° to 80°, inclusive, for the year 1883.

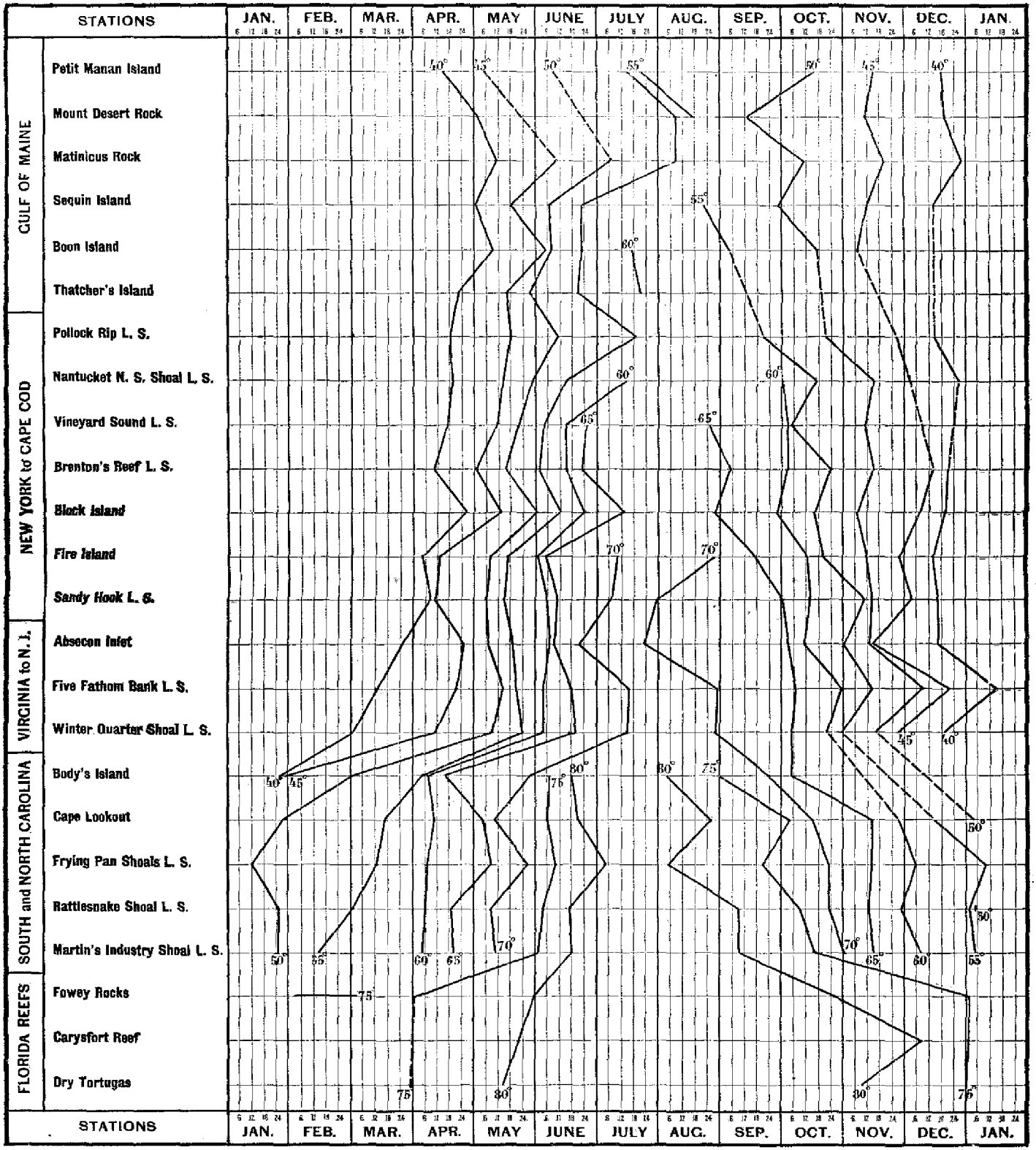
The two isotherms of 55° follow one another closely at Petit Manan and Mount Desert Rock; at Matinicus Rock the same temperature was recorded for two or three days, beginning August 9, and this point has been included in the first isotherm of 55°. At Boon Island the isotherm of 60° was reached July 17 (that temperature, however, continuing only until July 31), and at Thatcher's Island July 21, with no corresponding observations during the period of falling temperature; at Pollock Rip temperatures of 60° were occasionally recorded, but only for a day or two at a time. At Fowey Rocks the temperature was above 75° from February 3 to March 3, after which there was a period of lower temperature, continuing until April 1. At the Tortugas the temperatures of 75° and 80° were not continuous between the dates on which the isotherms of 75° and 80° are plotted.

OCEAN TEMPERATURE CHART No. 28

By RICHARD RATHBUN.

Isothermal lines connecting the series of Light House Stations represented on Chart No. 1, constructed for every five degrees of temperature, Fahrenheit, from 40 degrees to 80 degrees, inclusive, for the year 1883.

(ISSUED IN 1886.)



This chart is divided vertically into thirteen months in order to include the first month of the following year. Each month is further divided, by the lighter lines, into periods of six days each, except in the case of those months having fewer or more days than 30, when the last division of the month may equal four, five, or seven days. The 1st, 6th, 12th, 18th, 24th and last days of the month fall on the vertical lines. The *transverse lines represent the stations from which they extend. A complete break in the isothermal line opposite any station generally indicates* that the temperature did not reach the isotherm at that station during the year. A line consisting of dashes denotes a lack of observations for the corresponding station.

EXPLANATION OF OCEAN TEMPERATURE CHART No. 29.

Isothermal lines connecting the series of light-house stations on the eastern coast of the United States, represented on Chart No. 1, constructed for every 5° of temperature, Fahrenheit, from 40° to 80°, inclusive, for the year 1884.

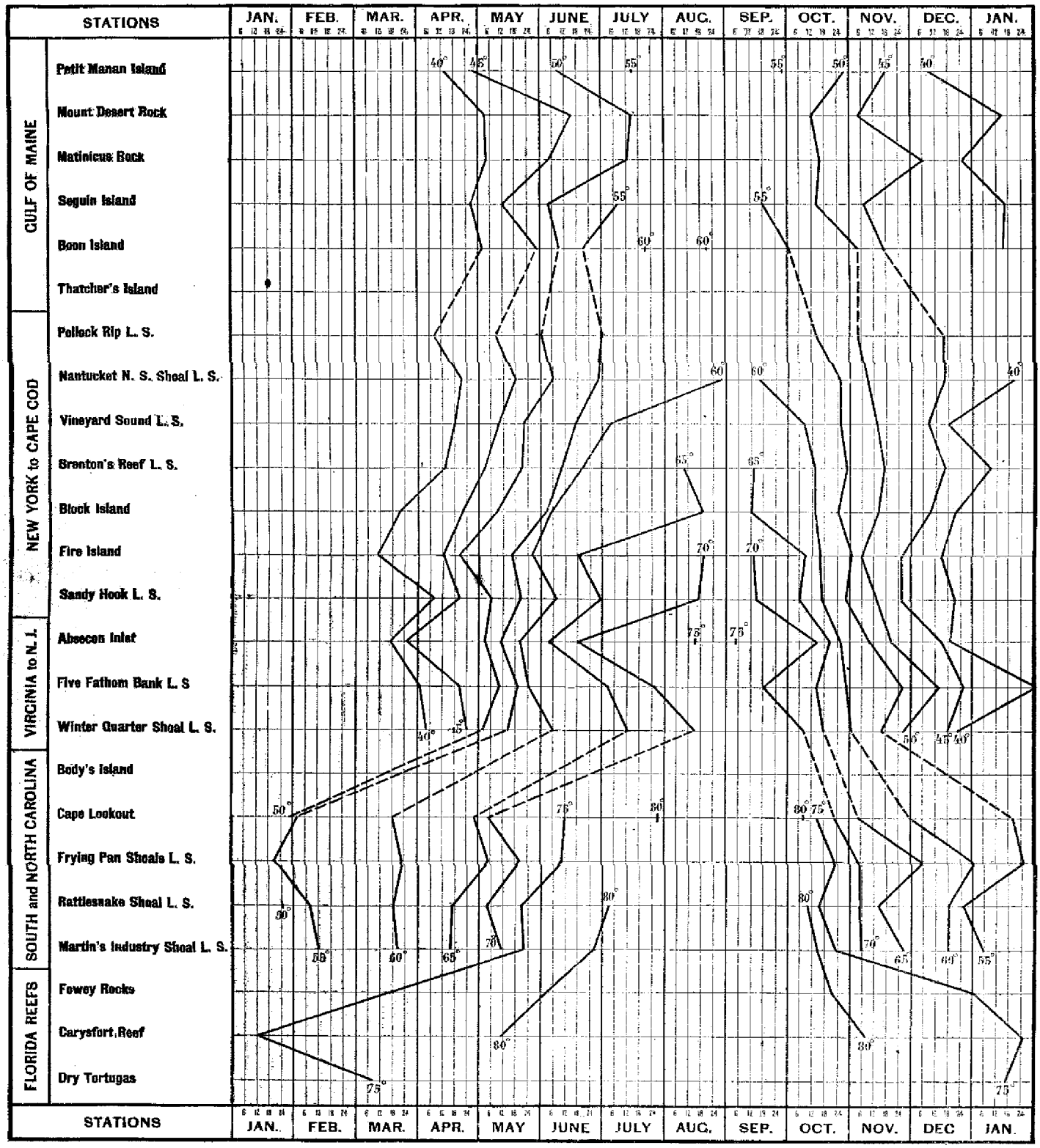
Higher temperatures than 55° were recorded at Petit Manan, but not at Mount Desert Rock and Matinicus Rock. The isotherm of 60° extends north continuously only to Nantucket New South Shoal, but the same temperature was recorded at Boon Island. Breaks of a similar character also occur in the isotherms of 75° and 80° at the southern stations. The temperature fell below 75° at the Tortugas several times during the year and reached 80° only between October 24 and 29.

OCEAN TEMPERATURE CHART No. 29

By RICHARD RATHBUN.

Isothermal lines connecting the series of Light House Stations represented on Chart No. 1, constructed for every five degrees of temperature, Fahrenheit, from 40 degrees to 80 degrees, inclusive, for the year 1884.

(ISSUED IN 1886.)



This chart is divided vertically into thirteen months in order to include the first month of the following year. Each month is further divided, by the lighter lines, into periods of six days each, except in the case of those months having fewer or more days than 30, when the last division of the month may equal four, five, or seven days. The 1st, 6th, 12th, 18th, 24th and last days of the month fall on the vertical lines. The transverse lines represent the stations from which they extend. A complete break in the isothermal line opposite any station generally indicates that the temperature did not reach the isotherm at that station during the year. A line consisting of dashes denotes a lack of observations for the corresponding station.

EXPLANATION OF OCEAN TEMPERATURE CHART No. 30.

isothermal lines connecting the series of light-house stations on the eastern coast of the United States, represented on Chart No. 1, constructed for every 5° of temperature, Fahrenheit, from 40° to 80°, inclusive, for the year 1885.

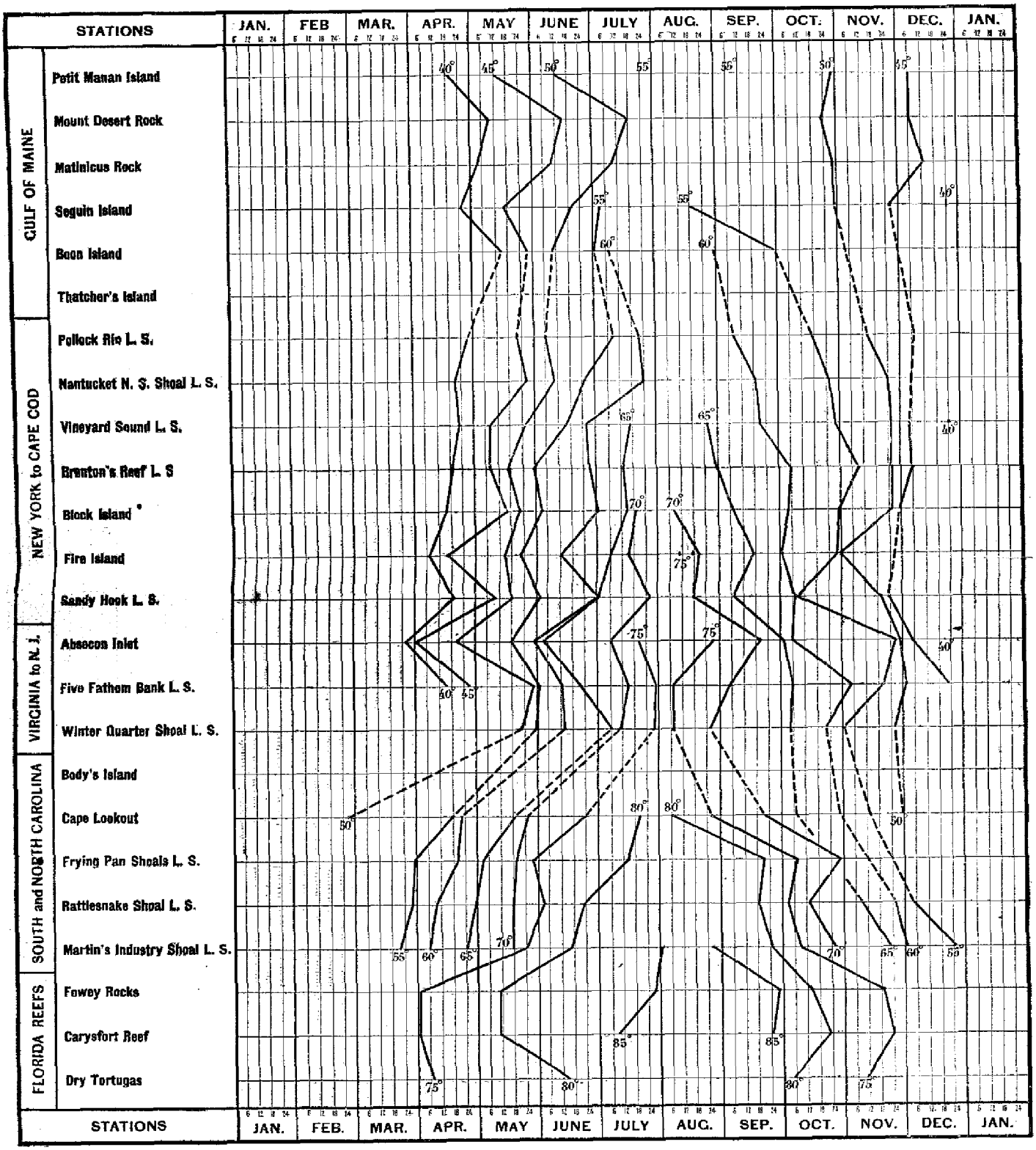
At the time this chart was prepared, the temperature records for 1886 were not available, and it was, therefore, impossible to plot the isotherm of 40° during the period of falling temperature, excepting for those stations at which that temperature was reached in December. As in most previous years, higher temperatures than 55° were recorded at Petit Manan, although the isotherms of 55° extended north continuously only as far as Seguin Island.

OCEAN TEMPERATURE CHART No. 30

By RICHARD RATHBUN.

Isothermal lines connecting the series of Light House Stations represented on Chart No. 1, constructed for every five degrees of temperature, Fahrenheit, from 40 degrees to 80 degrees, inclusive, for the year 1885.

(ISSUED IN 1886.)



This chart is divided vertically into thirteen months in order to include the first month of the following year. Each month is further divided, by the lighter lines, into periods of six days each, except in the case of those months having fewer or more days than 30, when the last division of the month may equal four, five, or seven days. The 1st, 6th, 12th, 18th, 24th and last days of the month fall on the vertical lines. The transverse lines represent the stations from which they extend. A complete break in the isothermal line opposite any station generally indicates that the temperature did not reach the isotherm at that station during the year. A line consisting of dashes denotes a lack of observations for the corresponding station.

EXPLANATION OF OCEAN TEMPERATURE CHART No. 31.

Isothermal lines connecting the series of light-house stations on the eastern coast of the United States, represented on Chart No. 1, constructed for every 5° of temperature, Fahrenheit, from 40° to 80°, inclusive, being the means of five years' observations, from 1881 to 1885, inclusive.

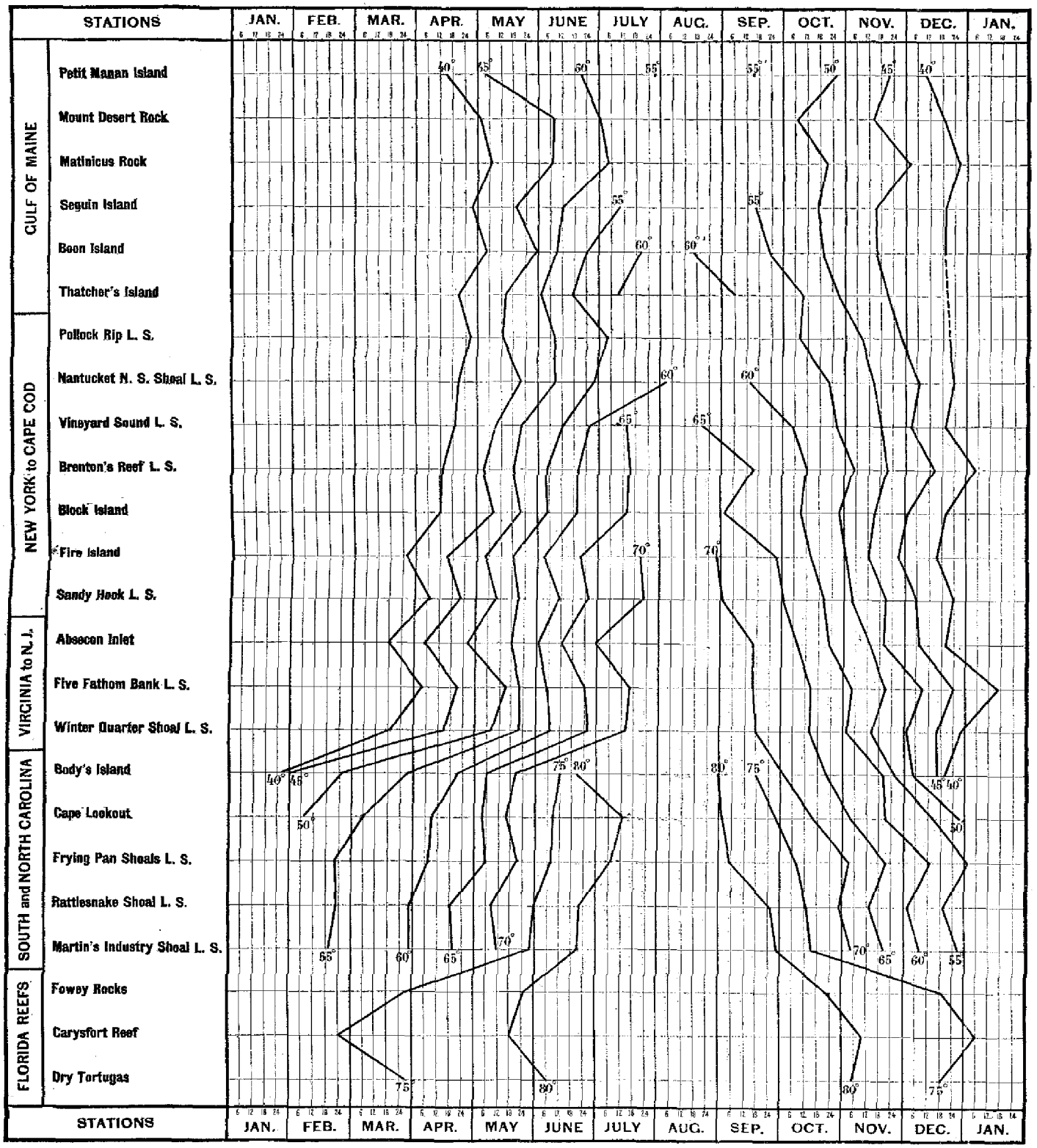
Most of the plottings on this chart are reductions of the observations of five years, but in some cases they represent a shorter period, though seldom less than four years, and never less than three years. The exact number of observations in each case, may be determined by reference to the five preceding charts (Nos. 26–30) on which the isotherms for each year are separately shown. At Thatcher's Island, Massachusetts, no records were kept after the summer of 1883, and at Body's Island, Virginia, observations ceased to be taken after October of the same year. At none of the other stations, however, do serious breaks in the records occur, and there are seldom more than one or two omissions at any station.

OCEAN TEMPERATURE CHART No. 31

By RICHARD RATHBUN.

Isothermal lines connecting the series of Light House Stations represented on Chart No. 1, constructed for every five degrees of temperature, Fahrenheit, from 40 degrees to 80 degrees, being the means of five years observations, from 1881 to 1885, inclusive.

(ISSUED IN 1886.)



This chart is divided vertically into thirteen months in order to include the first month of the following year. Each month is further divided, by the lighter lines, into periods of six days each, except in the case of those months having fewer or more days than 30, when the last division of the month may equal four, five, or seven days. The 1st, 6th, 12th, 18th, 24th and last days of the month fall on the vertical lines. The *transverse lines represent* the stations from which they extend. A complete break in the isothermal line opposite any station generally indicates that the temperature did not reach the isotherm at that station during the year. A line consisting of dashes denotes a lack of observations for the corresponding station.

EXPLANATION OF OCEAN TEMPERATURE CHART No. 32.

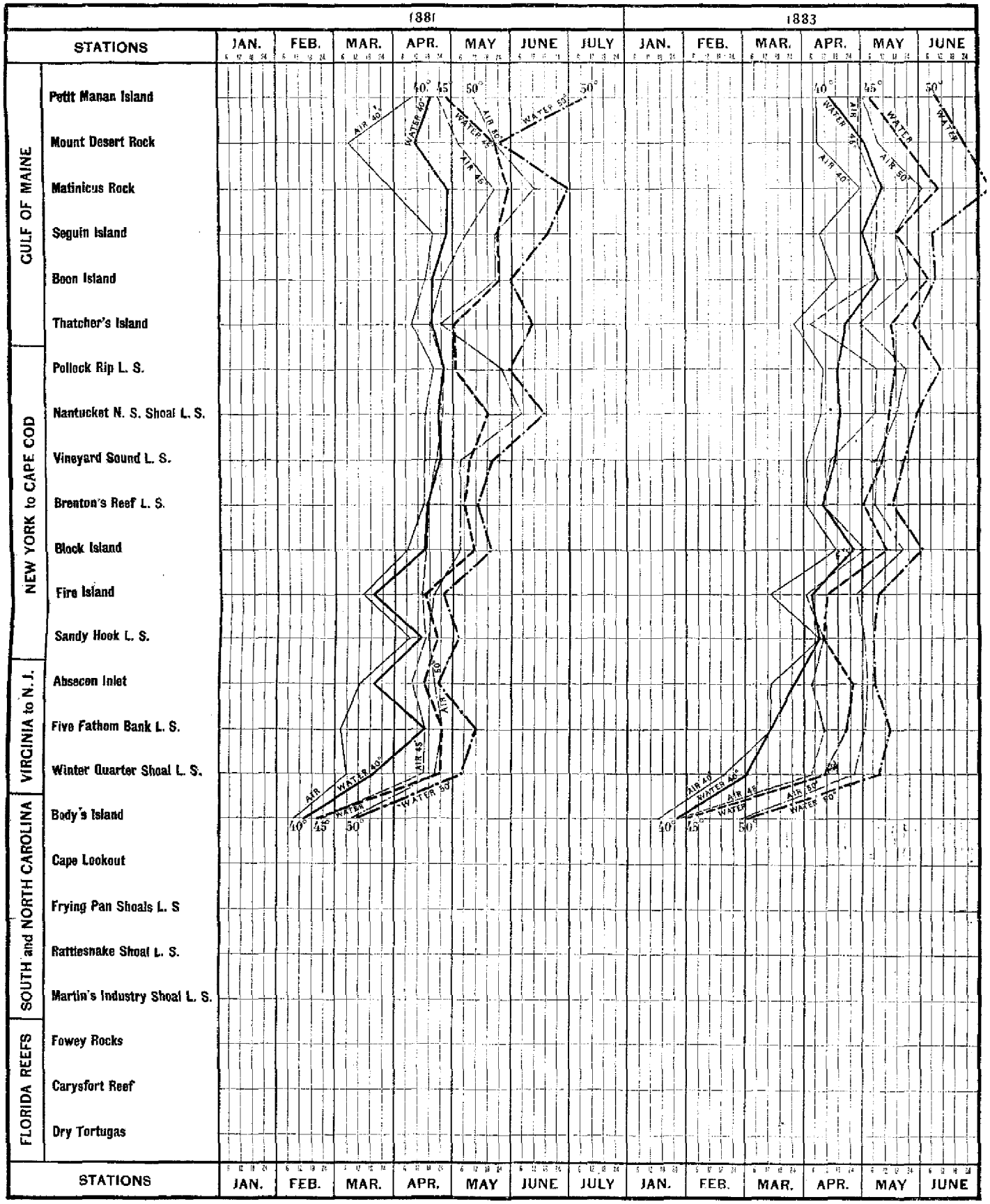
The air and surface isotherms of 40°, 45°, and 50°, Fahrenheit, at the light-house stations of the eastern coast of the United States, during the years 1881 and 1883.

This chart has been prepared to permit of a comparison of the surface with the air isotherms at the several light-houses and light-ships now under consideration. It has been noticed by previous observers that, in certain localities, the rise and fall in the surface temperatures maintain a nearly constant relation to the rise and fall in the air temperatures at the same place. For example, the surface temperatures of 40°, 45°, and 50° may follow the air temperatures of the same value at more or less regular intervals, and the length of these intervals may be sufficiently uniform to permit of a prediction of the surface temperature several days in advance, with approximate accuracy. Such predictions would be of great practical value in determining the time when schools of those fishes that regulate their migrations by the surface temperature of the water might be expected at certain fishing grounds. It is very probable, for example, that the spring migrations of mackerel and menhaden are regulated mainly, if not entirely, by changes of surface temperature.

The writer has made many plottings of the air and surface isotherms conjointly, without discovering a constant ratio at any of the stations. The two sets of isotherms shown on the accompanying chart are presented as illustrations of the variations that occur.

OCEAN TEMPERATURE CHART No. 32

By RICHARD RATHBUN.

The Air and Surface Isotherms of 40, 45 and 50 degrees, Fahrenheit, at the Light House Stations of the Eastern Coast of the United States, during the years 1881 and 1883.

(ISSUED IN 1886.)