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STUDIES OF THE WATERS ON THE CONTINENTAL SHELF, CAPE COD TO CHESAPEAKE BAY

I

The Cycle of Temperature

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INTRODUCTION

When the U. S. Bureau of Fisheries, in coöperation with the Museum of Comparative Zoölogy, commenced the oceanographic survey of the Gulf of Maine in the summer of 1912 (Bigelow, 1925–1927), it was in the hope that this might later be extended to the coastal waters thence southward; eventually even as far as the Gulf of Mexico.

Cruises carried out in connection with investigations of the biology of the mackerel, by the Fisheries' steamer "Albatross II" from 1927 to 1932, supplemented by those of the research ship "Atlantis" of the Woods Hole Oceanographic Institution, have made it possible to extend the detailed examination of the physical oceanography of the continental shelf as far as the offing of Chesapeake Bay, and to the offing of Cape Hatteras for some of the months.

The present account of the temperature of the region will, it is hoped, be followed shortly by corresponding accounts of salinity, of circulation and of the dominant planktonic communities.

Messrs. E. A. Bailey and H. R. Byers have collaborated in the analysis of the temperature records, and thanks are also due Mr. H. M. Bearse, Mr. R. A. Nesbit, Mr. W. C. Neville, Mr. W. C. Schroeder, Dr. Mary Sears, and Mr. O. E. Sette for assistance in the preparation of this report.

OCEANOGRAPHIC HISTORY AND SOURCES OF INFORMATION

The oceanographic history of the region is summarized in earlier publications (Bigelow, 1915, p. 234; 1927, p. 517): a brief résumé will therefore be sufficient here.

Great numbers of surface temperatures have been taken off the Atlantic coast of the United States, at all seasons of the year, by commercial vessels bound to and from American ports, as well as by various government services; forming the basis for the many isothermal charts of this part of the North Atlantic that have appeared during the past half century.[1]

During the past few years, much additional information with regard to the thermal state of the surface has been obtained from recording thermographs installed on steamers running across the continental shelf transversely and obliquely from North American ports to Bermuda and the West Indies. And while analysis of these is made difficult by the rapidity with which the weekly records accumulate, discussions have already been published of surface temperatures outside the continent, with special reference to the band of warmest water (Church, 1932), and of the monthly sequence of sea-surface temperature on the New York-San Juan Steamship route (Harwood and Brooks, 1933).

Many surface readings were also taken by the vessels of the U. S. Bureau of Fisheries, in the offing of southern New England during the period 1880–1889. Surface temperature has also been recorded for many years at various lightships and lighthouses, and data published for the periods 1881–1885 (Rathbun, 1887) and 1928–1931, the latter forming the basis of Parr's (1933) discussion of seasonal changes in shallow water along the coast.

But in spite of the variety of data, which had accumulated from these several sources, no special examination of thermal distribution and variation had been attempted for any extensive sector of the continental shelf as a whole, west or south from the offing of Cape Cod, until the U. S. Bureau of Fisheries (jointly with the Museum of Comparative Zoology) inaugurated periodic surveys of that region, in the summer of 1913, as outlined below.

The foregoing statement applies equally to the subsurface waters, for while many serial and bottom readings were taken between 1880 and 1891 by the U. S. Coast Survey steamer "Blake," the U. S. Fisheries steamers "Fish Hawk" and "Albatross," and the U. S. Fisheries schooner "Grampus" (Agassiz, 1881; Tanner, 1884 a, 1884 b; Verrill, 1884, 1884 a, Smith, 1889; Libbey, 1889, 1895 and Townsend, 1901) most of these early observations were concentrated in the offing of southern New England, and off North Carolina, or scattered along the lower part of the continental slope, and confined to the late summer or early autumn.

Modern oceanographic history of the waters over the offshore part of this sector of the continental shelf may therefore be dated from 1913 when the U. S. Bureau of Fisheries, in coöperation with the Museum of Comparative Zoölogy, carried out a general survey of the physical oceanography of the region on the "Grampus" during the month of July (Bigelow, 1915), which was followed by summer and autumn cruises in 1916 (Bigelow, 1922).

After a lapse of 10 years, the investigation was resumed in connection with various Fisheries' problems. And since 1927 surveys have been made of the sector between Cape Cod and North Carolina by the Fisheries steamer "Albatross II," or by the research ship

[1] For recent examples, see Conseil Internat. pour l'Exploration de la Mer (1930); Dickson (1901); Deutsche Seewarte (1902); Helland-Hansen and Nansen (1920); Kon. Niederlandsch Meterologisch Institut (1922); Schott (1902, 1926).

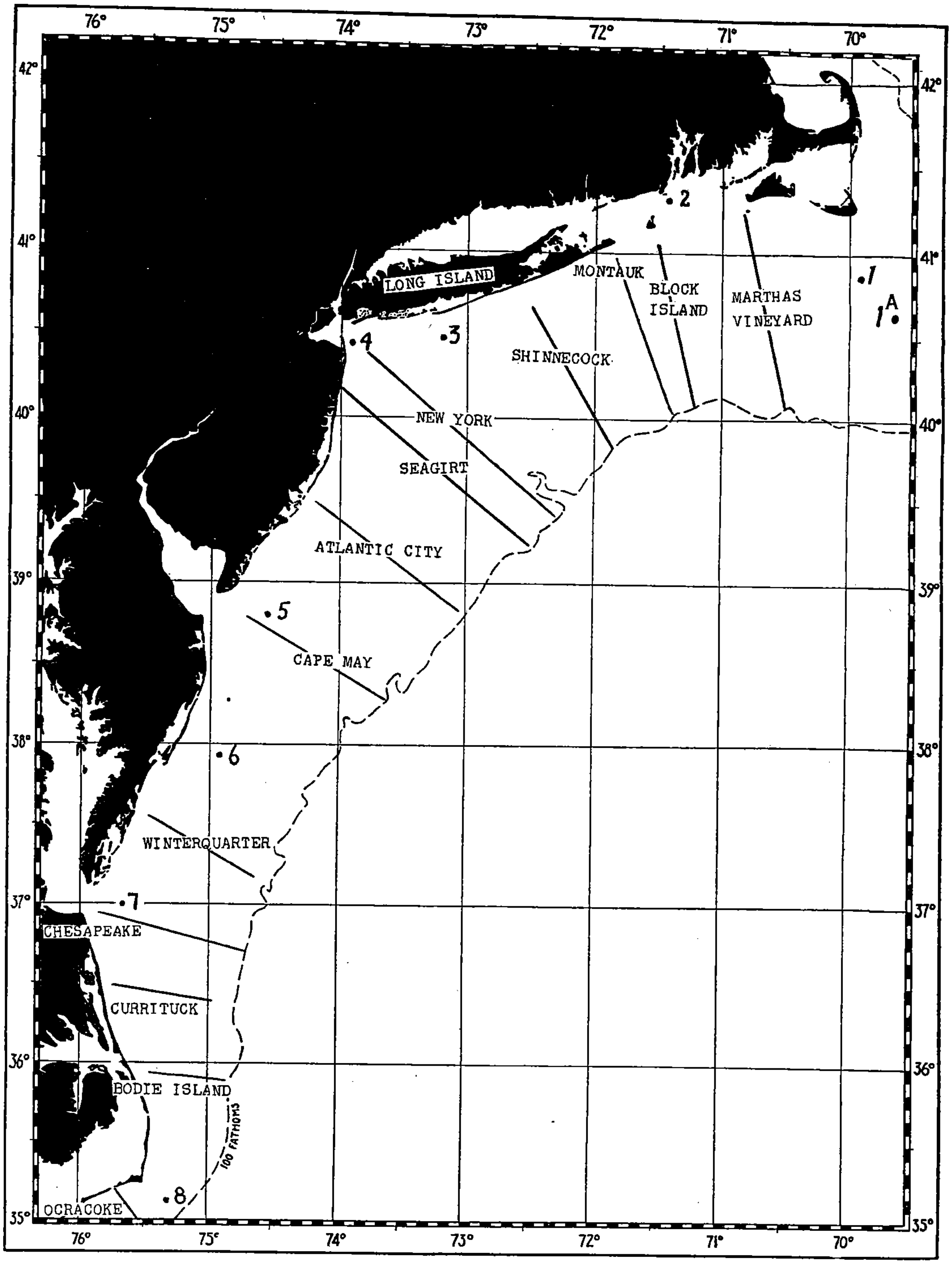

FIG. 1.—Chart of the area, showing general locations of principal profiles. The numbered points are lightship stations, as follows:—1, Nantucket (old position); 1A, Nantucket (new position); 2, Brenton Reef; 3, Fire Island; 4, Sandy Hook; 5, Five Fathom; 6, Winterquarter; 7, Cape Charles (Chesapeake); 8, Diamond Shoal.

"Atlantis" of the Woods Hole Oceanographic Institution, in the following years and months, some covering the areas as a whole, some only part of it:—1927, May, November; 1928, February, May, July, November; 1929, February-March, April, May, June, July; 1930, February, April, May, June, July; 1931, February-March, April, May, June, July, October; 1932, February-March, May, June, July, December.

Part of the available data have already been published, as follows:—years 1875–1887, in Tanner (1884–1889b), Smith (1889) and Townsend (1901); 1913–1916, in Bigelow (1915–1922); 1919 and 1920, in U. S. Bureau of Fisheries (1921). Station data by U. S. Bureau of Fisheries vessels, and by "Atlantis" since 1923, are tabulated on page 104.

The offshore data, as the foregoing list shows, are much more extensive for the period February–July, when successive cruises were made at short intervals in several years, than for other seasons of the year.

In order to facilitate comparison from cruise to cruise, and to cover the area adequately within the minimum of time, observations were usually taken along profiles crossing the continental shelf off Chesapeake Bay, off Cape May, off New York, off Montauk Point, and off Martha's Vineyard (Fig. 1), the number of stations (4–6) depending on the breadth of the continental shelf at that point. Successive stations on each profile were numbered from I, commencing nearest the coast, and are so referred to in the text. The regular serial station numbers of the U. S. Bureau of Fisheries are also listed in the tables (p. 104).

Thermal conditions in Chesapeake Bay, tributary to the southern end of the area, and in the Vineyard sound-Buzzards Bay region, tributary to the northern end, are summarized by Cowles (1930); by Fish (1925), and by Sumner, Osburn and Cole (1913).

LIMITS AND TOPOGRAPHY OF THE REGION STUDIED

Limits: Most of the profiles extended only a few miles out beyond the 200 meter contour; some of them not so far. Therefore the account is necessarily limited to the waters over the continental shelf proper, with only such cursory discussion of conditions over the continental slope as scattering data allow.

The longitude of the eastern slope of Nantucket Shoals (Long. about 69°) is taken as the eastern limit, thus overlapping somewhat on the earlier account of the Gulf of Maine (Bigelow, 1927). In most cases the cruises extended southward to the offing of Chesapeake Bay (lat. about 37°)—some not so far—but a few reached the offing of Cape Hatteras.

Topography: The topography of the continental shelf, west of Longitude 70°, contrasts strongly with that of the Gulf of Maine to the northward in the smoothness and even slope of the sea floor, and in the absence of any extensive offshore banks or enclosed submarine basins. The only important sculpture (except for various shoals close to the coast) is the oft-mentioned "Hudson" trough or gorge, which crosses the shelf off New York. The breadth of the shelf from the land out to the 200 meter contour is about 75 miles off Martha's Vineyard, about 100 miles off New York harbor (to the mouth of the Hudson gorge), about 70 miles off Cape May, about 60 miles off Chesapeake Bay, but only about 20 miles off Cape Hatteras, where the distance from the 40 meter to the 200 meter contour is only 4–6 miles. Nantucket Shoals form a topographic boundary on the northeast to this sector of smooth bottom, the shoals off Cape Hatteras to the south. The area included between the outer coast line and the 200 meter contour, from Longitude 70° to the offing of Chesapeake Bay (Lat. 37°) is, roughly, 27,000 square miles. It has long been a matter of common knowledge that the gentle slope of the continental shelf, along this part of the coast, gives place, near the 200 meter contour, to the much steeper declivity of the continental slope. Off Chesapeake Bay, for example, and northward along the coasts of Maryland and New Jersey, it is, on the average, about 10 times as far from the shore line out to the 200 meter contour as from the latter out to the 1000 meter contour, approximate distances from the inner to the outer of these two contour lines being only 9–16 miles off Martha's Vineyard, 3–6 miles off Delaware and Chesapeake Bays.

THE CYCLE OF TEMPERATURE

Winter Minimum

I. *Surface:* Offshore data for the years 1928, 1929, 1930 and 1931, combined with observations taken off Chesapeake Bay by the "Bache" in January, 1914, by the "Roosevelt" in January-February, 1916 (Bigelow, 1917), with observations at lightships (Rathbun, 1887, Parr, 1933) and with thermograph records (Church, 1932) show that the coastwise waters, southward to the offing of Chesapeake Bay are usually at their coldest during the last week of February, or first days of March.[1]

In normal years the band of water next the coast chills to a temperature at least as low as about 3° along the sector New York-Nantucket Shoals; sometimes (as in 1929) to 2°, or even fractionally colder.[2]

Off Delaware Bay surface temperatures at the stations nearest land, for the years 1928–1931,[3] have varied, at the coldest season, between about 3° and about 5°; between about 4° and 5.5° at the mouth of Chesapeake Bay.

The average minima, for five day periods,[4] at representative lightships, were about as follows for the winters of 1928, 1929 and 1930:—Cape Charles (off Chesapeake Bay), 4.5°–5.5°; Winter Quarter (off coast of Virginia), 4.5°–5°; Five Fathom Bank (off Delaware Bay), 3.5°–4°; Fire Island, 2°–3.5°; Brenton Reef (off Narragansett Bay), 2°–4°; Nantucket, 2°–3°. The mean winter minimum of surface temperature is about $-1°$ at Woods Hole, representative of enclosed sounds tributary to the northeastern extremity of the area (Fish, 1925, Fig. 6); but has not yet been determined for the mouth of Chesapeake Bay at the opposite extremity.[5]

Farther out at sea, surface temperatures, for late February–early March of 1928–1930, were as follows:—

	Off Martha's Vineyard	Off New York	Off Cape May	Off Chesapeake Bay
Midway of shelf	3°–5°	4°– 7°	5°– 7°	5°–8°
Continental edge	5°–8°	7°–11°	9°–10.5°	about 9°

Thus the latitudinal range of temperature, at the coldest season, at equal distances out from the land, averages only some 1.5°–3° between the offings of southern New England and of Chesapeake Bay—a distance of some 300 miles—and may be even less, as in 1931, when surface readings taken near land, on these two profiles in February–March were almost precisely alike. On the other hand, the surveys for that season have all shown a considerable and regular transition from lowest readings near land to considerably higher off shore, the result being that the isothermal arrangement at the end of the winter parallels the trend of the continent in general, except as interrupted by irregularities such as the expansion of low temperature between longitudes 70°30′ and 71°30′ that appears on the charts for 1929 and 1930 (Figs. 2, 3; see also Church, 1932, Fig. 4).

The close coincidence of 7°–9° water with the 200 meter contour line, from the offing of Chesapeake Bay to the offing of New York, shown also on Church's chart (Church,

[1] See especially Parr, 1933, Figs. 8–10.

[2] Temperatures at, or just below freezing point occur in sheltered bays and it is a matter of common knowledge that small amounts of ice may form there in periods of cold weather. But the areas where this occurs are so small in extent that offshore temperatures do not show any definite foci of influence by them.

[3] Cruise records combined with Parr's (1933) compilation of lightship records.

[4] Scaled, to nearest 0.5°, from Parr's diagrams (Parr, 1933, Figs. 8–10).

[5] Cowles' (1930) survey of Chesapeake Bay did not cover the critical season—late February.

1932, Fig. 4) for February 19–25, 1931, contrasts with a less regular state along this zone farther east, resulting from cold expansions, seaward, of the sort just mentioned, or from encroachments of water warmer than 11° in over the edge of the shelf, of which an

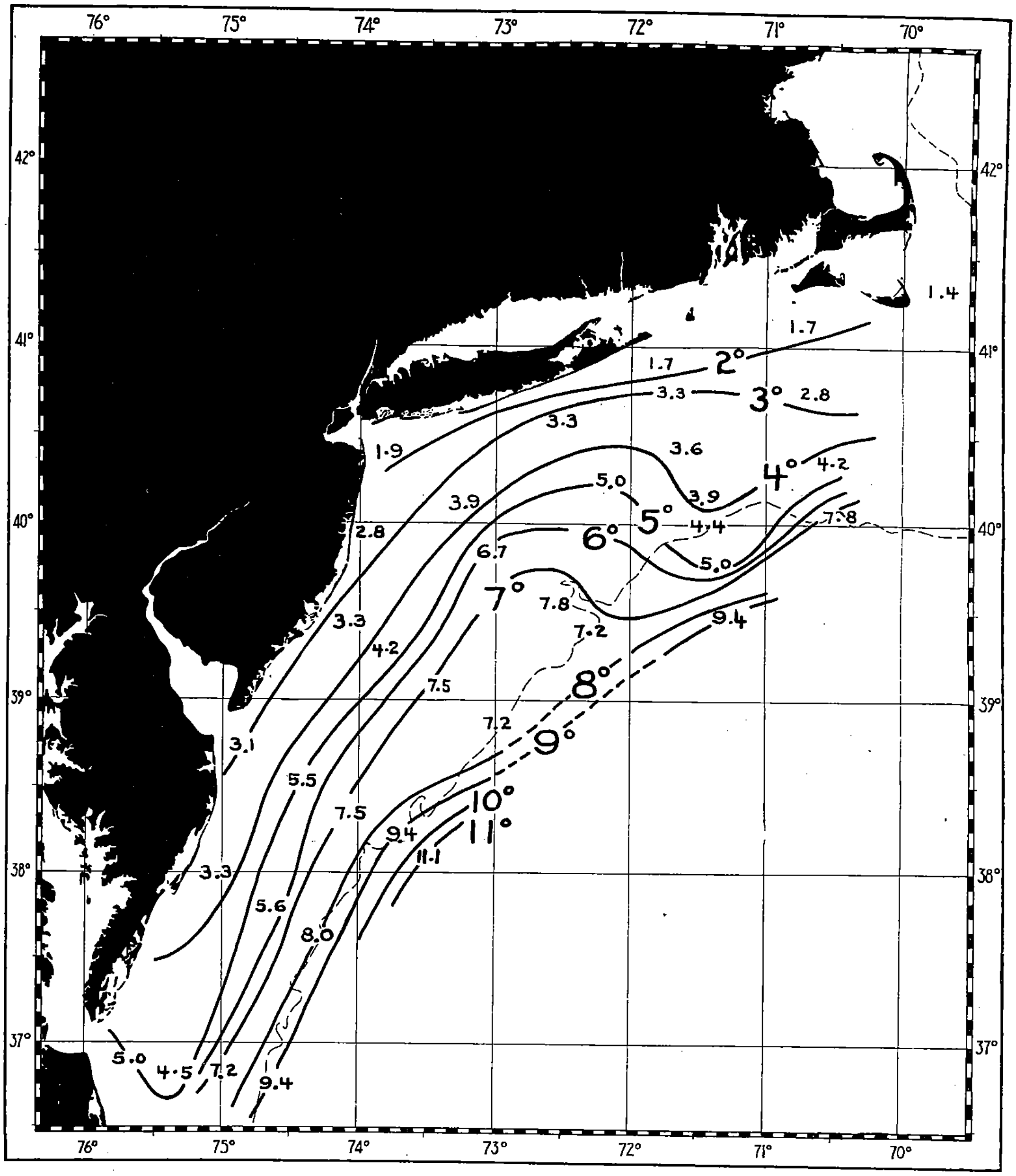

FIG. 2.—Temperature at the surface, February 25–March 5, 1929.

example was encountered between longitudes 70° and 71° at the time of our late winter survey in 1930. But since the isothermal arrangement offshore, as shown in the February chart for 1930 (Fig. 3), agrees closely with previous but more generalized plottings of the

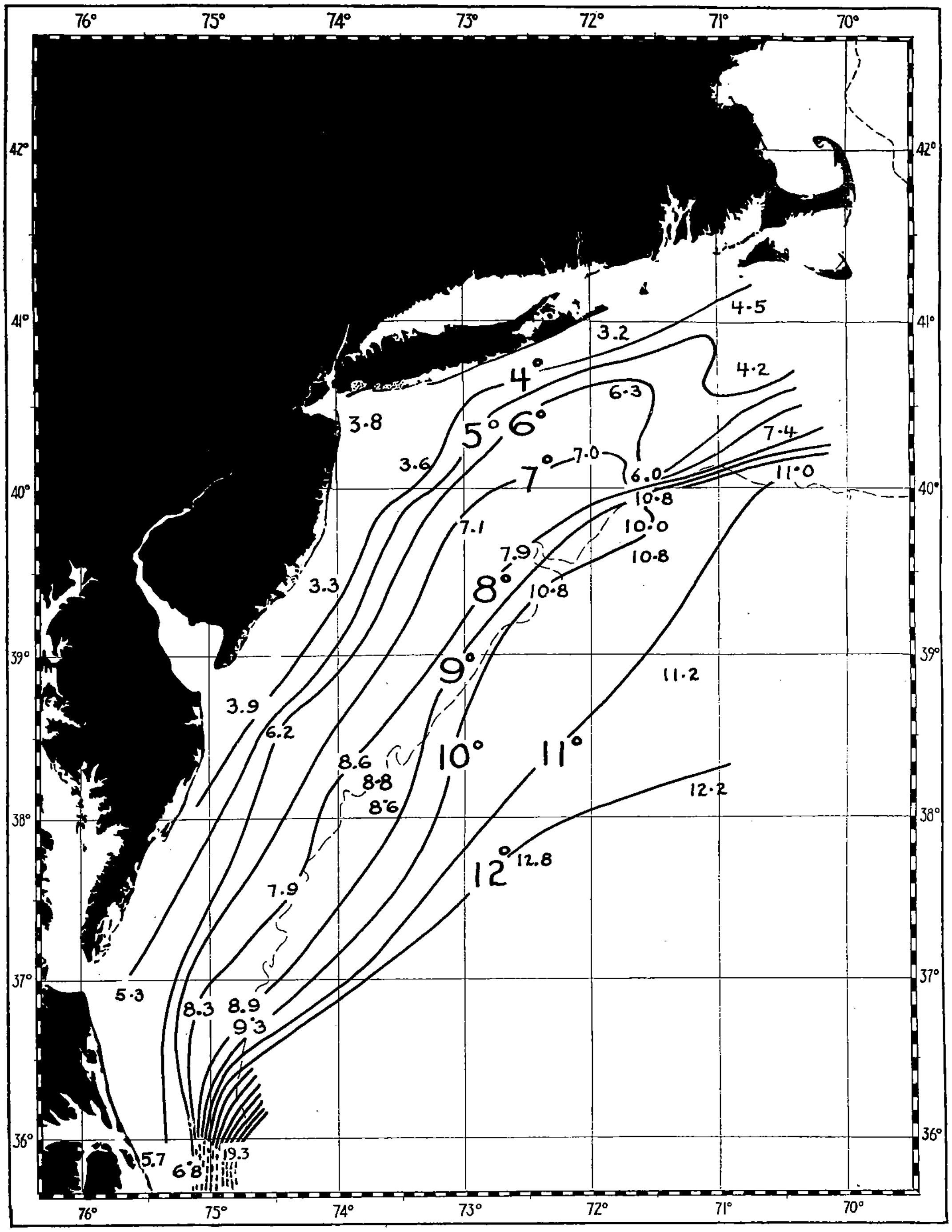

Fig. 3.—Temperature at the surface, February 5–13, 1930.

surface temperature for the Northwest Atlantic, it seems that surface water colder than 12° normally extends for at least 80–90 miles out from the edge of the continent in the offing of New York at that season,[6] but not more than 20–40 miles in the offing of Chesapeake Bay.

At this season there is very little variation in surface temperature near the land, eastward across Nantucket Shoals, and into the neighboring parts of the Gulf of Maine. Parr's (1933, Figs. 8–10) diagrams, indeed, show the mean minimum for the three-year period 1928–1930, as almost precisely the same (about 37°F. or 2.8°C.) at Brenton Reef Lightship at the mouth of Narragansett Bay, as at Pollock Rip Lightship off the elbow of Cape Cod, and at Boston Lightship in Massachusetts Bay (about 35°F. or 2.2°C). That is to say, there is, at the coldest season, no thermal barrier at the eastern boundary of the area of the sort that develops there in spring. But as Parr (1933) has pointed out, there is a very abrupt transition at the opposite (southern) end between Chesapeake Bay, where the winter minimum averages about 5.5° (Cape Charles Lightship) near the land, and the vicinity of Cape Hatteras, where it averages 15°–16° (Diamond Shoal Lightship).

In February 1931 (Figs. 4, 5; Church, 1932, Fig. 4) this transition was condensed into a narrow zone in the immediate vicinity of the cape, with a still more abrupt transition immediately to the south of the latter. The profile off Ocracoke Inlet is especially instructive as proving that this temperature barrier extended right across the shelf, a point which Parr (1933, p. 51) could not establish from the lightship records alone. And it seems that the situation was similar in 1930, when readings near land did not differ much from Chesapeake Bay southward to within some 30 miles of Cape Hatteras.

Assuming the situation as existing in the particular years of record to be representative, the immediate vicinity of Cape Hatteras may therefore be regarded as the southern boundary in winter to the cold boreal coast water, which at this season extends with only a very gradual latitudinal transition northward to the Gulf of Maine and beyond.

Further illustration of the abruptness of the Cape Hatteras convergence of colder water with warmer appears in the isothermal pattern along the edge of the continent, for while in February oceanic surface water of 19° or warmer, and correspondingly high salinity (>35.00 per mille), lies close in along the edge of the continent off Cape Hatteras or even for a few miles further north (Figs. 2, 6), the isotherms for values higher than 11° have swung sharply off shore, away from the continental edge, before reaching the latitude of Chesapeake Bay, in all the winters of record.

Subsurface: In winter the region falls into two sub-areas from the standpoint of the vertical distribution of temperature, the one comprising the whole shelf out to the edge of the continent; the other the upper part of the continental slope, from the 150 meter contour, downward.

On the shelf the difference in temperature between surface and bottom is much smaller at the end of the winter than in summer, as was to be expected. And as the water then has little or no vertical stability, the precise type of vertical distribution varies from station to station, depending on the balance between the loss of heat from the surface by back radiation (also by evaporation), and the gain of heat from solar radiation at the time of observation, combined with the rapidity with which changes experienced at the surface are being transmitted to the underlying strata by vertical movements of the

[6] See, for example, Sumner, Osborn and Cole, 1913, p. 437.

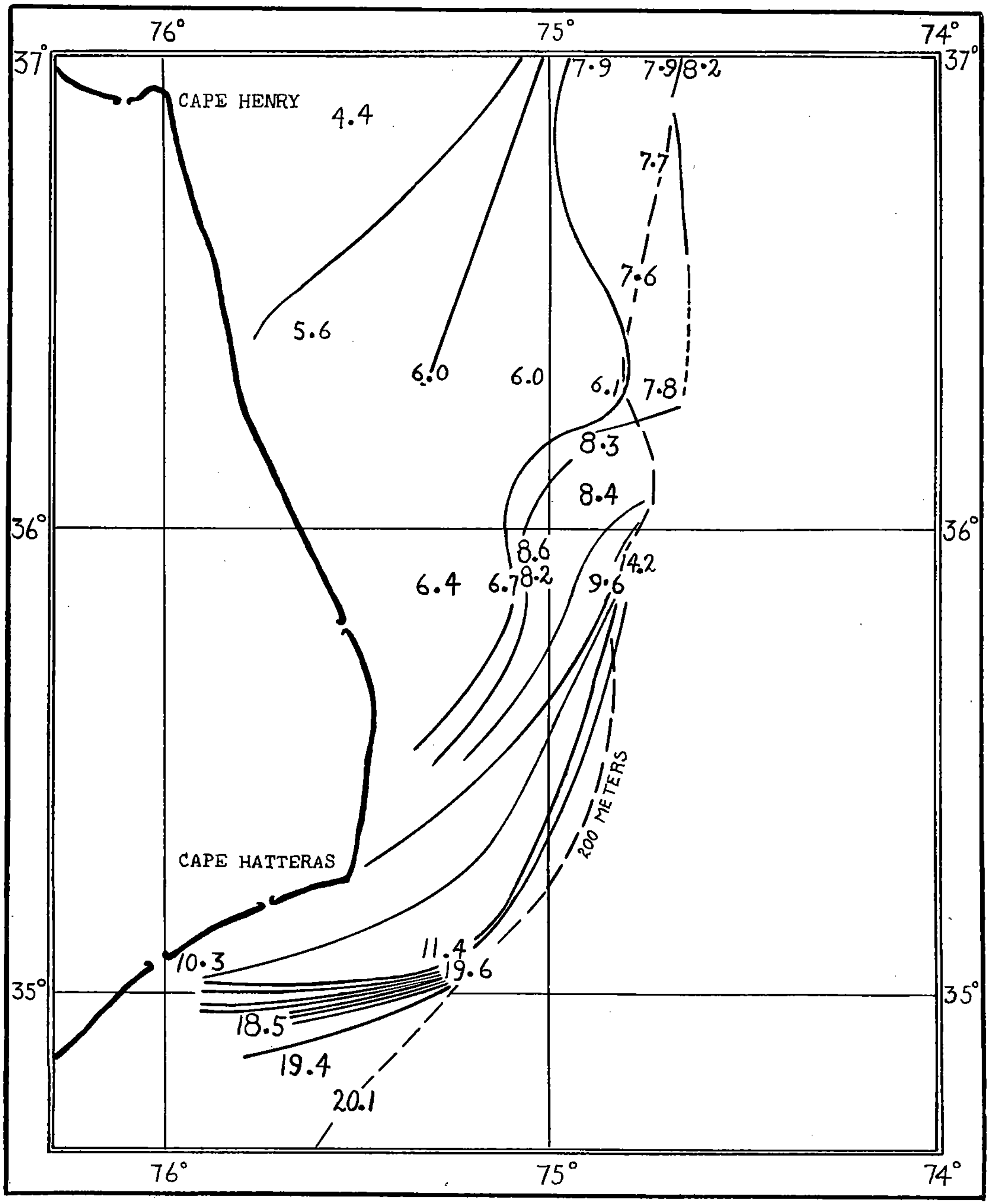

FIG. 4.—Temperature at the surface, Chesapeake Bay profile to Cape Hatteras, February 22–26, 1931.

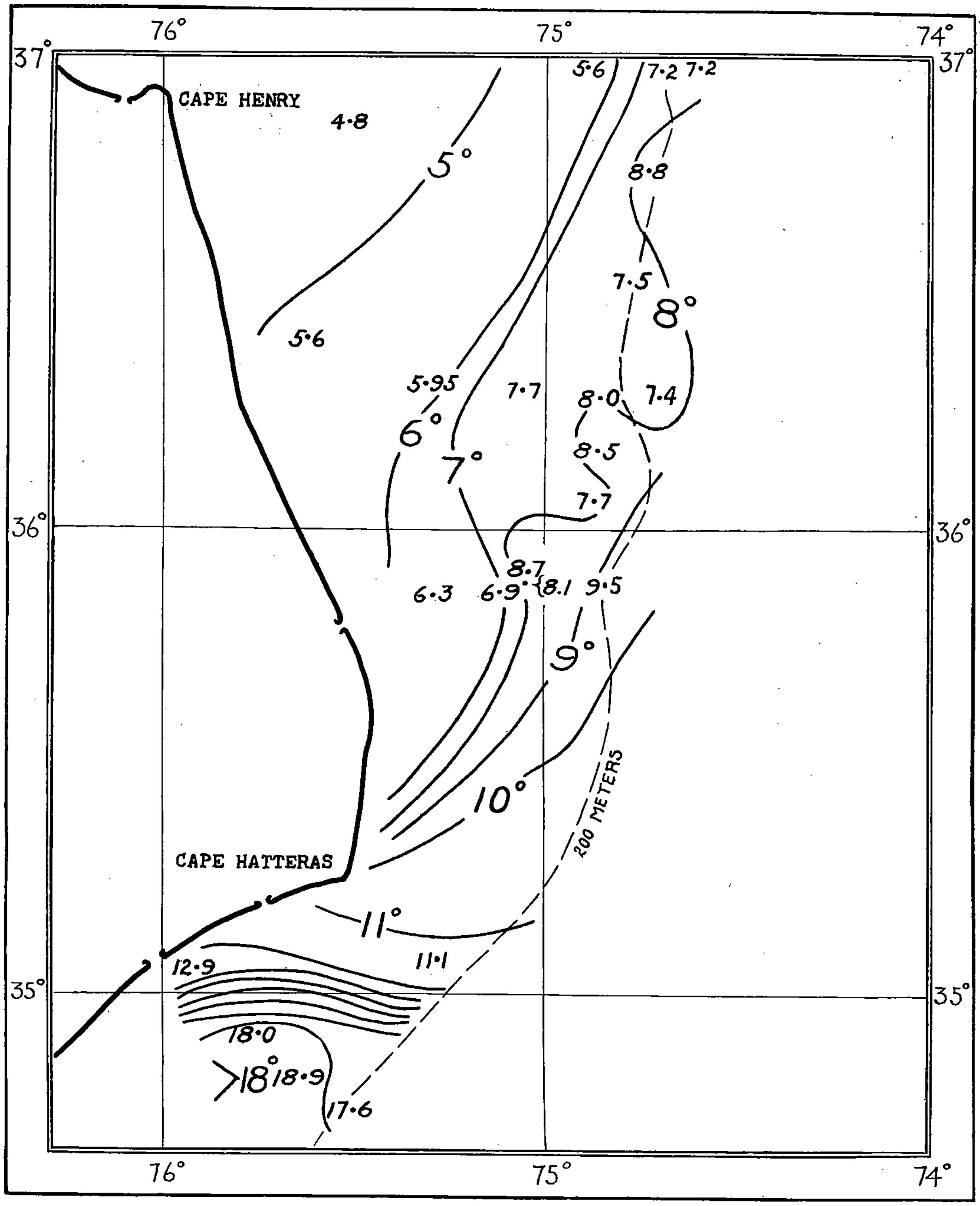

Fig. 5.—Temperature near the bottom, Chesapeake Bay profile to Cape Hatteras, February 22–26, 1931.

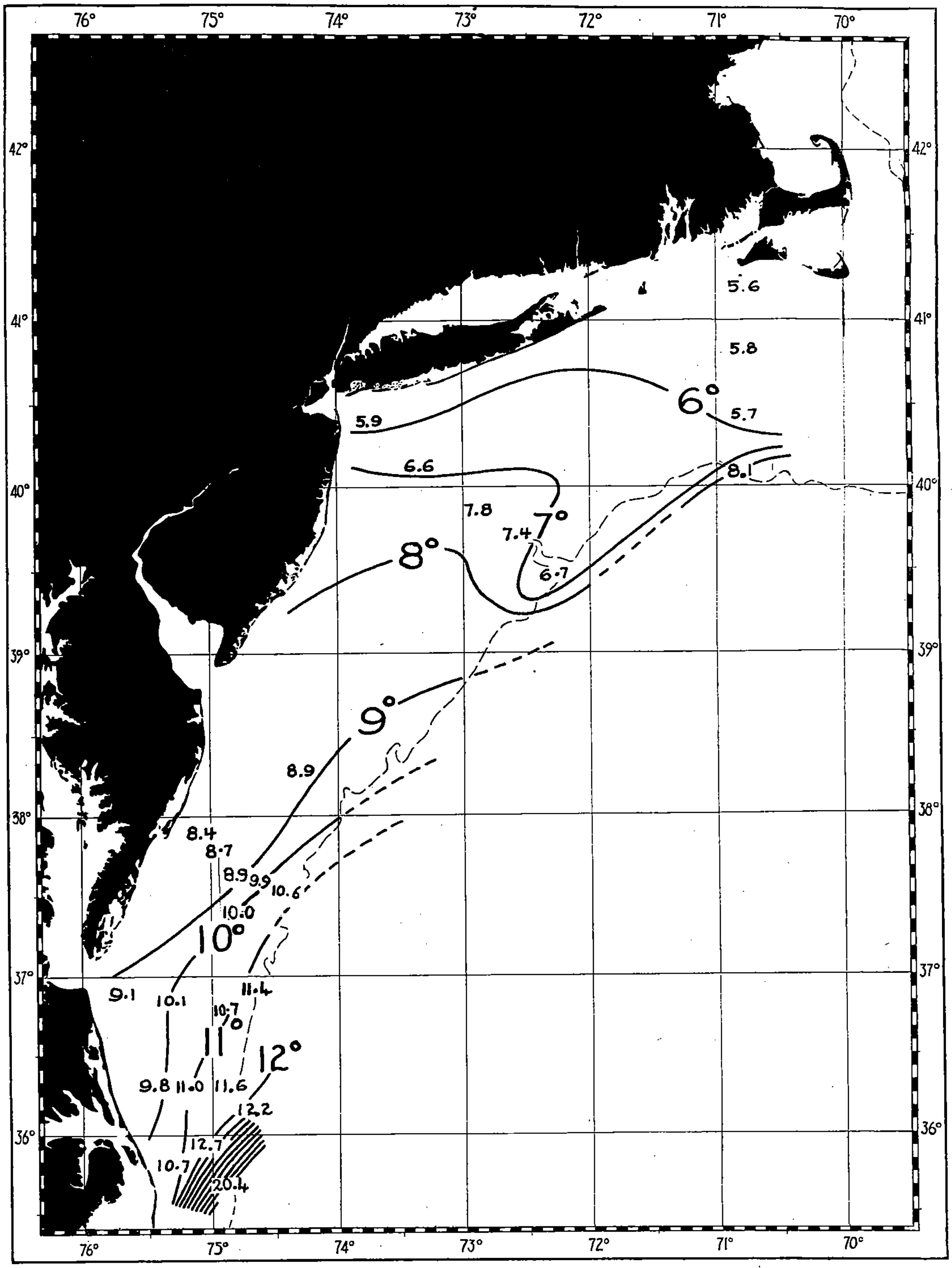

Fig. 6.—Temperature at the surface, February 25–March 1, 1932.

water. And the picture may be further complicated by indrafts at one level or another of water from the south, from outside the edge of the continental shelf, or from the northeast; or by discharges from large rivers. In winter, consequently, stations close together may either be slightly colder or slightly warmer at the surface than deeper, or may be practically homogeneous from top to bottom.

Variations of this sort are, however, so small that in normal years the temperatures of February–March can in general be described either as close to homogeneous, vertically, from the surface downward, or as showing some increase with depth, i.e. with the bottom water as a rule either very nearly the same as the surface in temperature, or slightly warmer. In 1929 the latter state characterized the eastern part of the area, likewise the continental edge off Cape May (though not off New York), whereas bottom and surface temperatures were almost precisely alike throughout the whole southern part of the area, as far south as the offing of Chesapeake Bay (cf. Fig. 2 with Fig. 7). In 1930, however, it was only at the outer stations on the shelf, in the offing of Martha's Vineyard, that the bottom was as much as 1° warmer than the surface, the whole area elsewhere being more nearly homogeneous vertically in temperature than we had found it two weeks later in the season of the preceding year.[7]

One station, close to Cape May, February 8, 1930, stands alone, surface and bottom (20 meters) readings being almost precisely alike (3.9°), but the mid-stratum about 1° warmer, a condition suggesting a local indraft in the mid-level, of water from off shore, where the whole column was more than 1° warmer still.

The average thermal gradient from the surface downward, for the late winter-early March stations inside the 150 meter contour (127 in number, years 1929, 1930, 1931 and 1932) was at the rate of about 0.4° per 20 meters of depth, the least gradient practically nil. And while the steepest gradient was about 1.8° per 20 meters, 82 of the stations or 65%, showed vertical gradients no greater than 1° per 20 meters.

It follows from this vertical homogeneity, combined with the narrowness of the latitudinal gradient, that in winter the temperature of any chosen depth-stratum, like that of the surface, increases from the coastline seaward, reproducing the surface picture not only in the location of successive isotherms (i.e. in the general parallelism between isothermal arrangement and trend of the coastline) but even in actual values (cf. Figs. 2, 3 with Fig. 8). Consequently the isothermal pattern, as seen in section across the shelf is fundamentally steeply oblique, or even vertical at this season, except that individual isotherms in the upper layers may run nearly horizontal, demarking the thickness of the surface station at times and places where the latter is either appreciably colder than the water below it, or warmer (Fig. 9, 10).

The distribution and values of temperature on the bottom have considerable biologic interest at the coldest season, as controlling the distribution of bottom-dwelling animals. They also deserve attention from the more strictly hydrologic viewpoint as giving a picture of the water masses that must be shifted along the bottom from one depth level to another by any circulatory movements that may take place, transverse to the angle of slope and extending down to the sea floor.

If the years 1929–1931 can be taken as representative of the lowest temperatures that bottom animals are apt to experience at different depths in normal years, it is evident that in spite of the increase in depth, they find a warmer and warmer habitat, pass-

[7] Vernal warming seems definitely to have been in progress at the time of our February-March survey of 1931.

ing off shore (Fig. 7). And what data are available for 1920 (p. 24) show that this is also the case in abnormally cold winters. Thus animals living close to land, at depths of 10 meters or so, must be able to survive temperatures at least as low as 2° as far southward

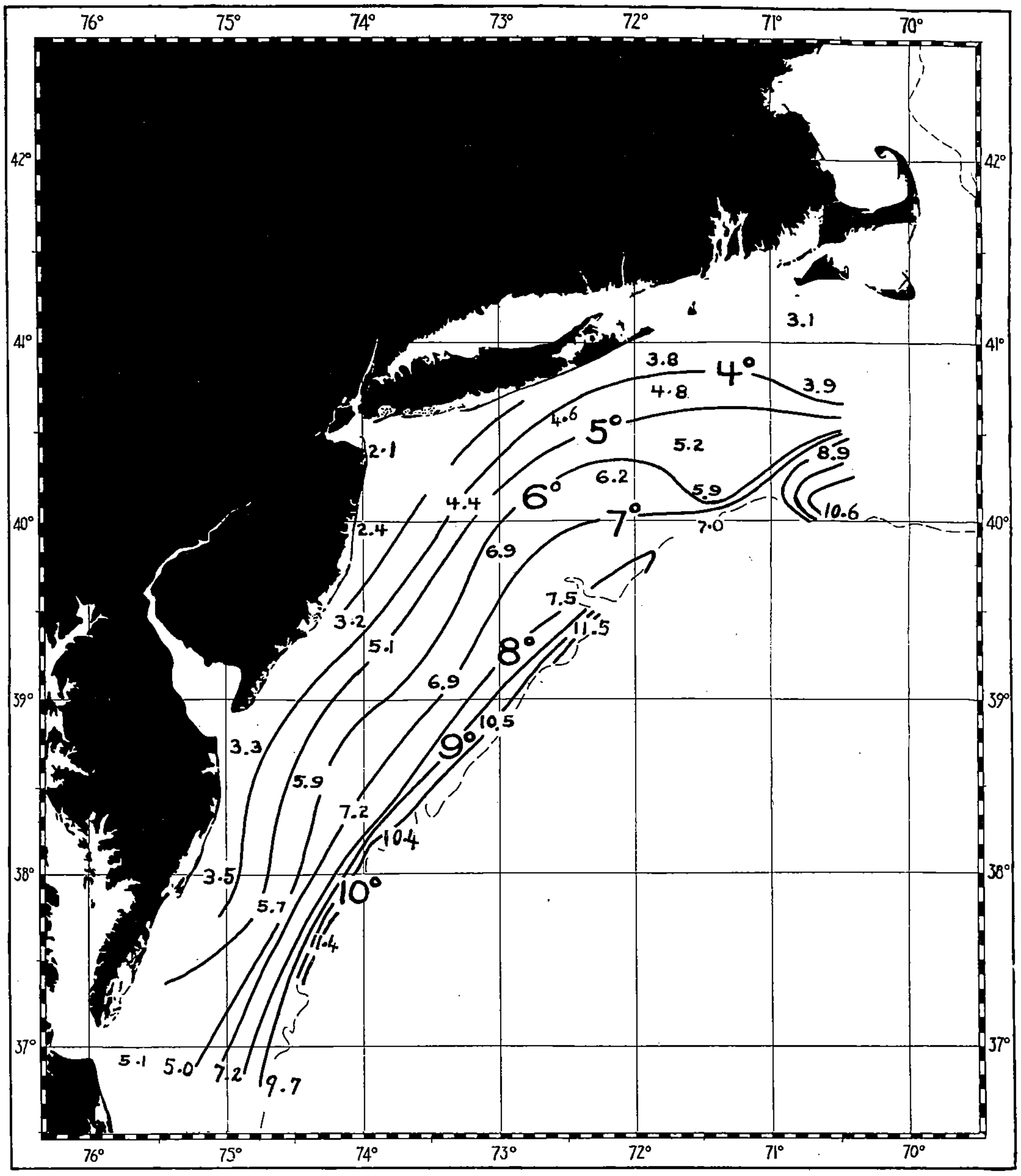

FIG. 7.—Temperature near the bottom out to the 250 meter contour, February 25–March 5, 1929.

as Cape May; as low as 3°–4° from that point to the mouth of Chesapeake Bay; 5°–6° thence to Cape Hatteras. Midway out on the shelf, in depths of 20–60 meters, bottom temperatures range from 3°–5° off southern New England to 4°–7° off Chesapeake Bay;

perhaps a degree or two lower in cold years. And as the abrupt transition in temperature from north to south, characterizing the surface in the vicinity of Cape Hatteras, involves the whole column of water right down to the bottom (Fig. 5), an effective barrier evi-

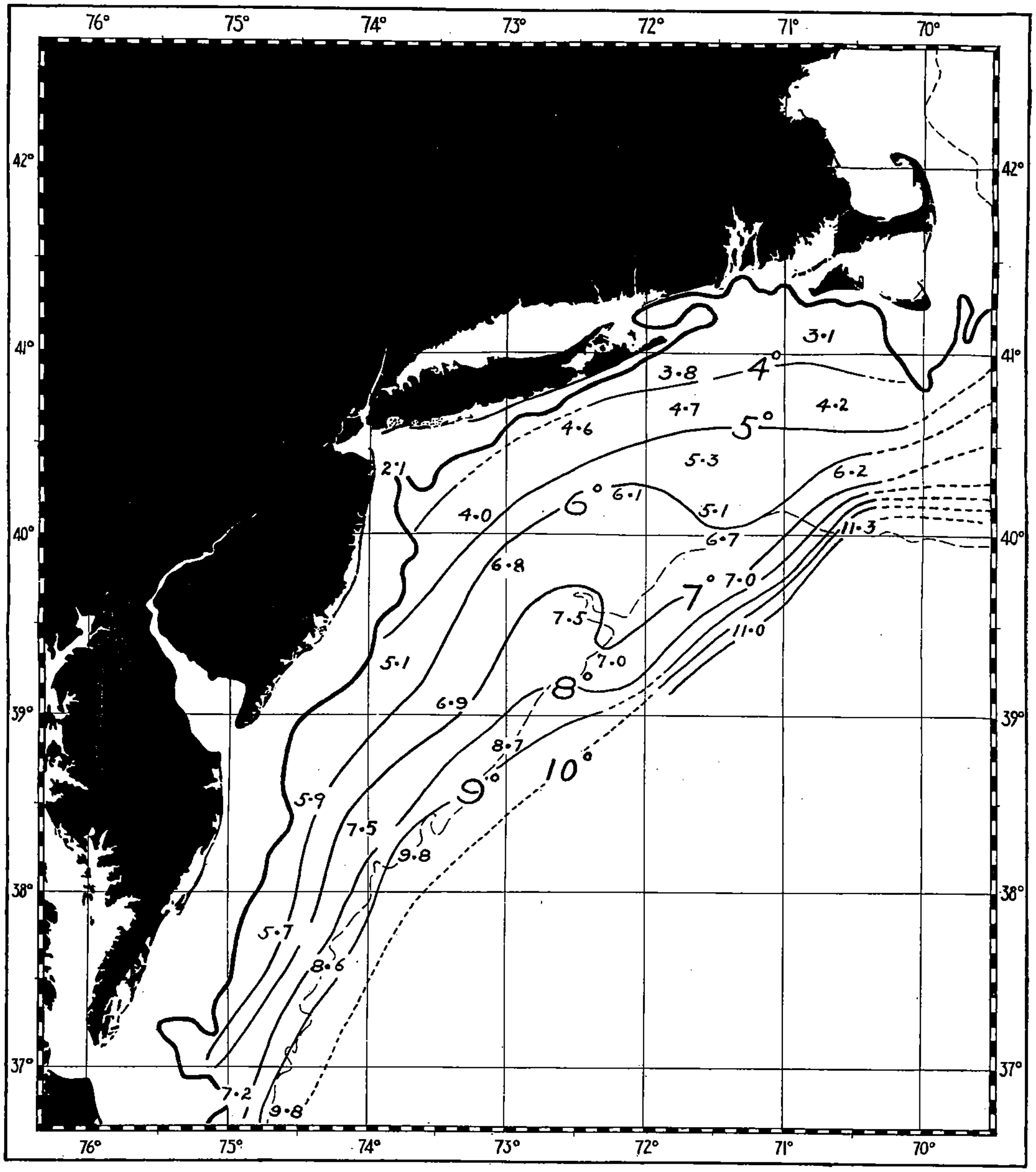

FIG. 8.—Temperature at a depth of 30 meters, February 25–March 5, 1929.

dently exists there, at this season, to coastwise migrations, in either direction. But no such barrier then exists at the opposite (eastern) boundary of the area, for bottom temperatures for February and March are about the same on Nantucket Shoals (and in the

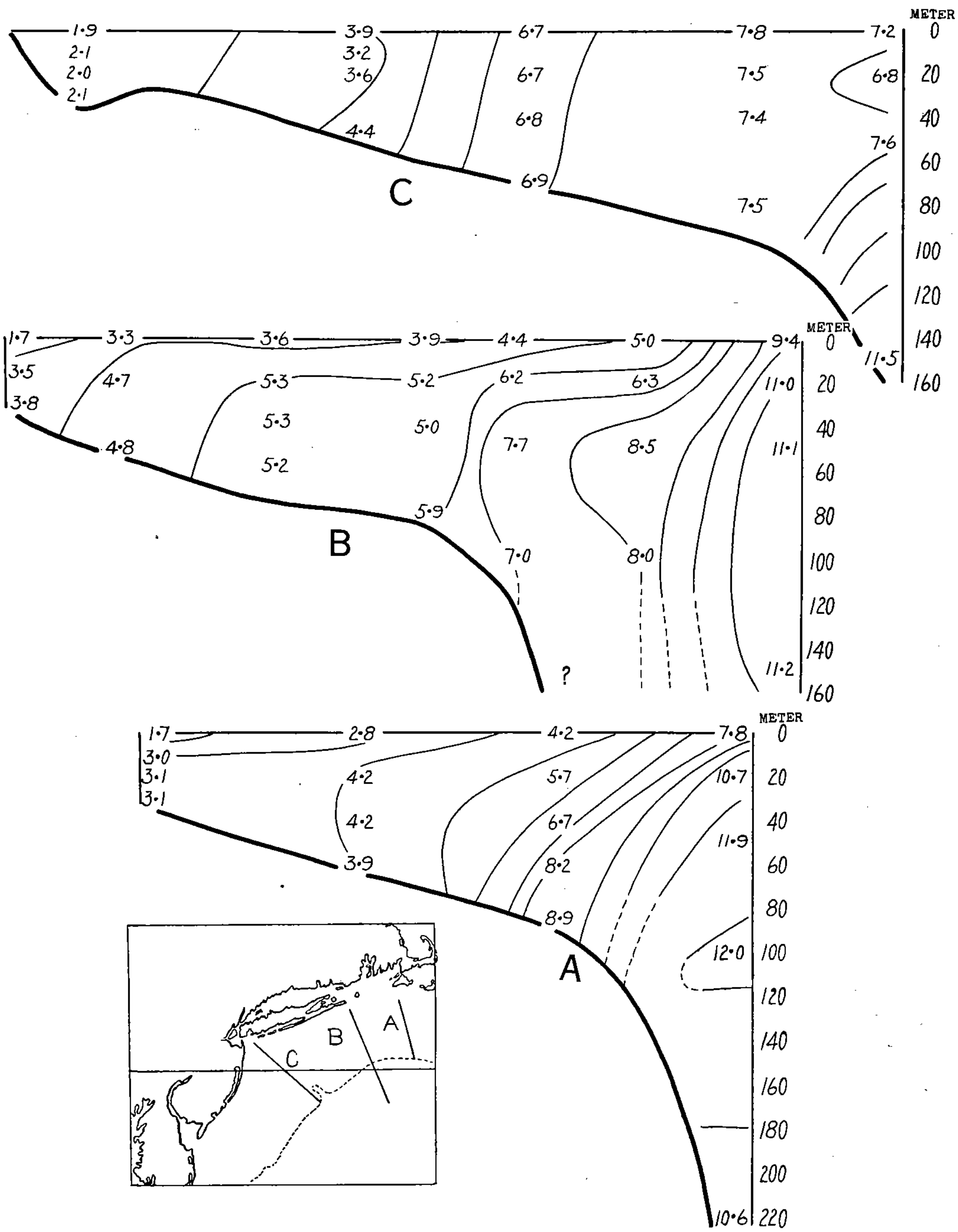

Fig. 9.—Temperature profiles across the continental shelf, February 25–28, 1929:—A, off Martha's Vineyard; B, off Montauk; C, off New York.

nearby parts of the Gulf of Maine for that matter) as off New York at equal depths and distances from land.

The state of the bottom water along the edge of the continent just inside and just outside the 200 meter contour line deserves special attention, because it now seems that this belt is the winter home of various species of fishes that pass the summer inshore. Previous explorations off the Gulf of Maine on the one hand, and in the offing of Chesapeake Bay on the other (Bigelow, 1917, 1927) had already shown that bottom tempera-

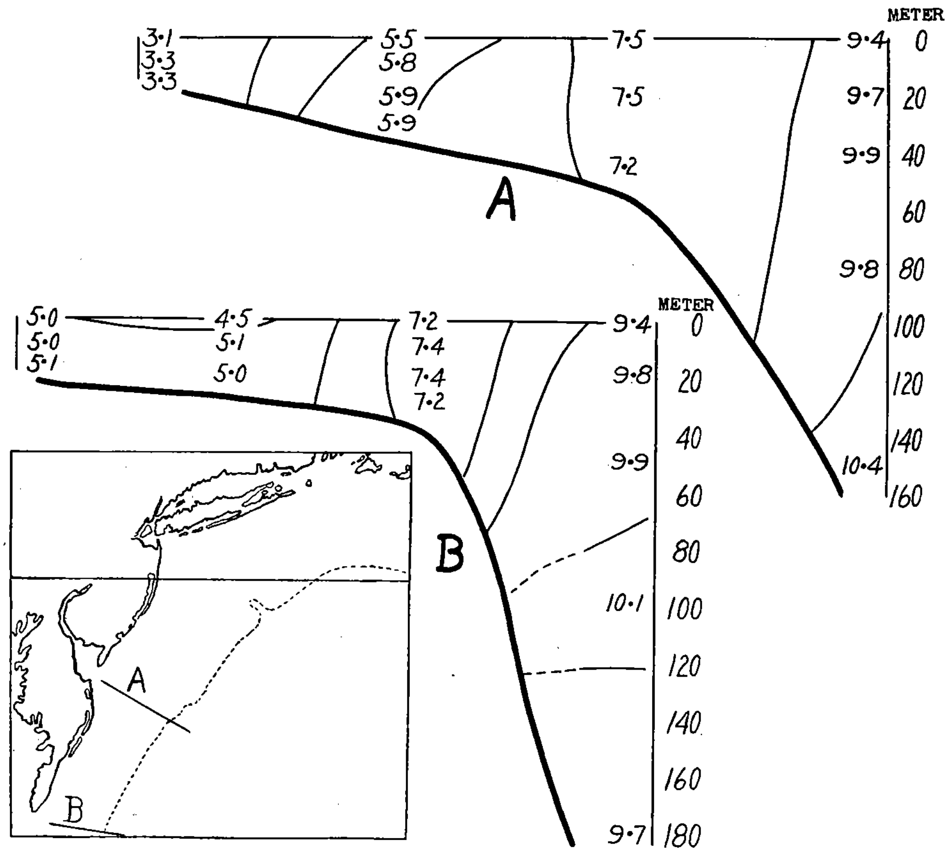

FIG. 10.—Temperature profiles across the continental shelf, March 3–4, 1929:—A, off Cape May; B, off Chesapeake Bay.

tures are higher along this zone, in winter, than close into the land on the one hand or deeper down the slope on the other, just as has long been known to be the case in summer. And this generalization is corroborated by recent observations. Thus all readings taken close to bottom at the edge of the continent on the February profiles in 1929 and 1930, from the offing of Chesapeake Bay to the offing of Martha's Vineyard, were close to 10°–11°, except perhaps at one station on the Montauk profile, February 26, 1929, where the water may have been slightly colder, judging from a reading of 7° at 100 meters over the 120 meter contour. Even in 1920, a "cold" year, the bottom water at 150–200 meters was 9°–10°, from the offing of Virginia to the offing of New York (p. 25). On the other hand, bottom temperatures along this zone were only slightly higher than usual in February of 1932 (12.3°–13.3°), though this was an abnormally warm winter along the coast (p. 25).

It seems that in February the inshore boundary of this warm bottom zone (isotherms

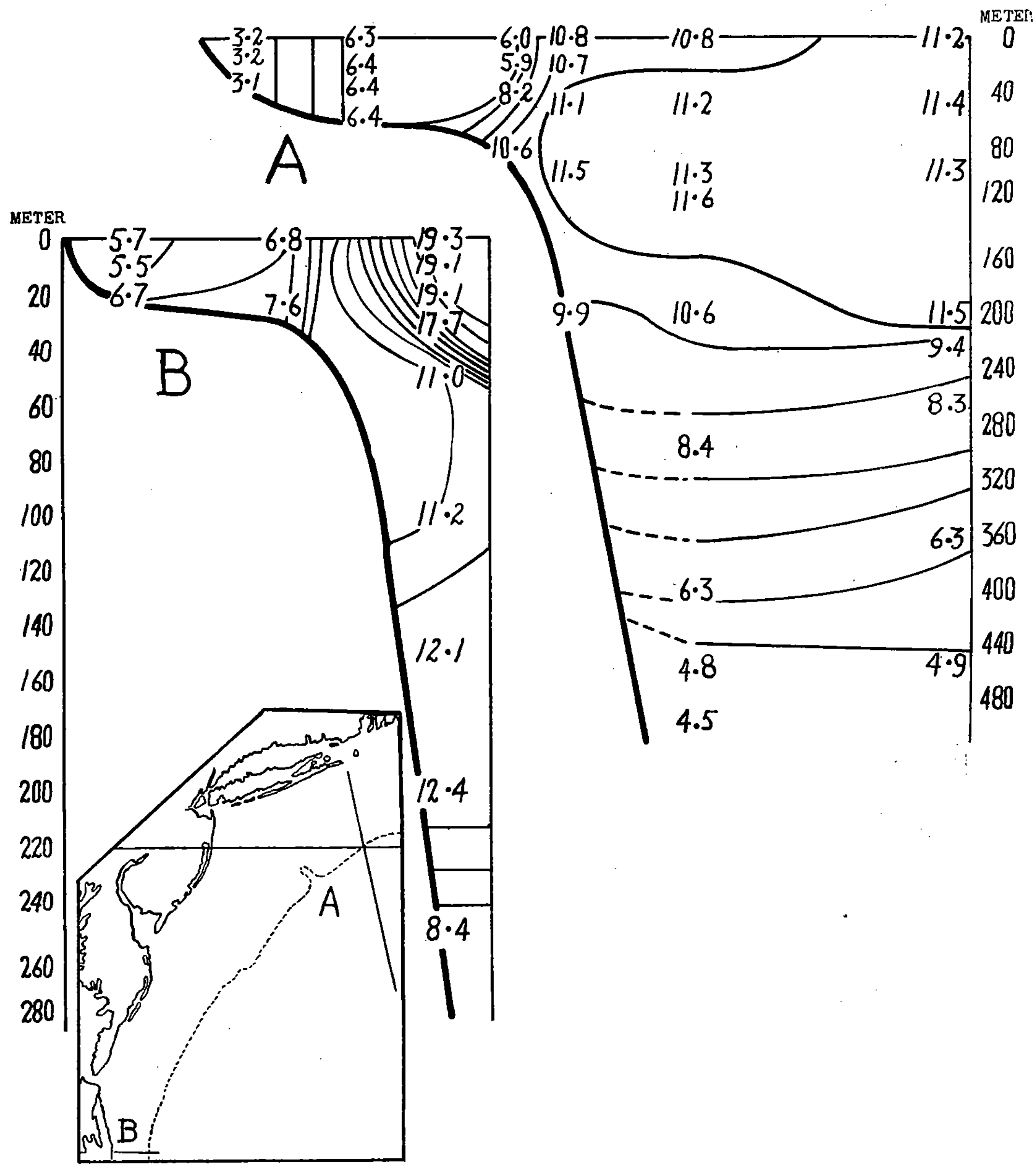

Fig. 11.—Temperature profiles across the continental shelf:—A, off Montauk, February 6–13, 1930; B, off Bodie Island Lighthouse, North Carolina, February 11, 1930.

for 9.5°–10°) varies but little in geographic location from year to year, for it lay near, or a few miles out to sea from the 100 meter contour line, all along, both in 1929 and in 1930, except in the offing of Martha's Vineyard where it was somewhat closer inshore in these two years but farther out (at about the 200 meter contour) in 1931. But as the bottom slopes steeply here, small distances on- or offshore correspond to considerable differences in the depth of water. Thus water of 10° washed the bottom up to the 100 meter line, or nearby, off Martha's Vineyard at the end of the winter of 1929, but to 80 meters in 1930; to about 120 meters off New York in 1929, but to 90 meters in 1930; to 140 and 170

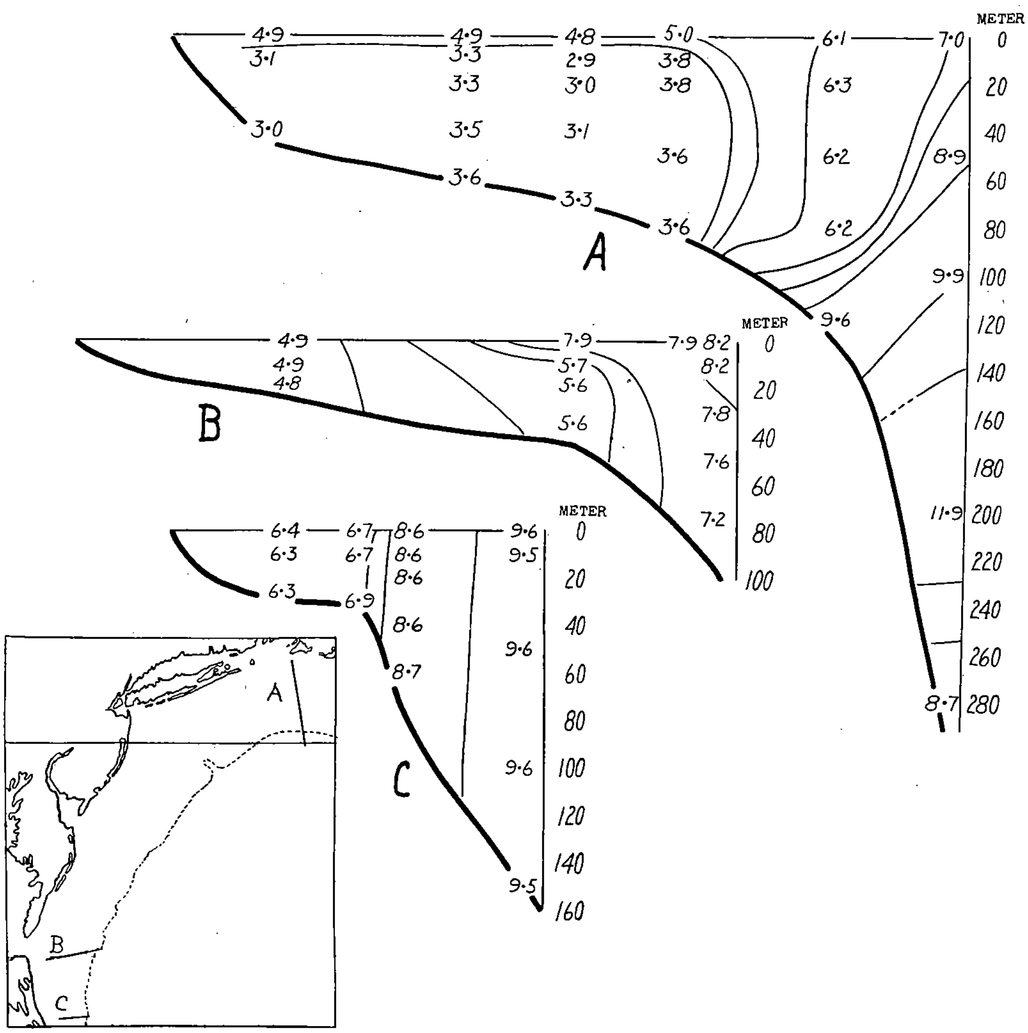

FIG. 12.—Temperature profiles crossing the continental shelf, February 17–26, 1931:—A, off Martha's Vineyard; B, off Chesapeake Bay; C, off Bodie Island Lighthouse, North Carolina—at the localities indicated on the attached chart.

meters off Cape May and to 100 and 60 meters off Chesapeake Bay in these two years. In 1932, bottom water of 10° was encountered near the 70 meter, 65 meter, and 30 meter contours on these three profiles respectively, while the whole breadth of the shelf farther south was warmer than 10°.

How stable the offshore (i.e. lower) boundary of this warm zone may be in location is doubtful; the most that can be said is that water as warm as 9.5°–10° was apparently in contact with the sea floor at more than 200 meters off Martha's Vineyard in February 1929; at more than 160–180 meters off Cape May and off Chesapeake Bay (Figs. 9, 10); at about 240 meters on the easterly profiles in February of 1930 and 1931 (Fig. 11, 12). But so steep is this part of the continental slope that this vertical thickness corresponds to a horizontal breadth seldom if ever greater than 12–15 miles, and sometimes less than 8 miles, as seems to have been the case off Chesapeake Bay, early in March of 1929. Deeper down the slope, the temperature of the bottom water decreases continuously with increasing depth, until the nearly uniform cold water (3.9°–4°) that fills the deeper levels of the Atlantic basin is encountered.

Our only positive information as to the location of the eastern boundary of the warm bottom zone along the continental edge at the end of winter is that in February 1920 water of 10°–11° extended as far as longitude 68° but was separated from the slope farther east by a considerably colder wedge (Bigelow, 1927, p. 352, Figs. 15, 16). The widespread destruction of fish, presumably by chilling, that took place along the edge of the continent in March 1882,[8] suggests, however, that the eastern sector of the "warm zone" is subject to flooding by abnormally low temperatures, on rare occasions southward even to the latitude of Delaware Bay.

This is perhaps an appropriate place to caution the reader that profiles (e.g. Fig. 9–12) in which the vertical scale is exaggerated sufficiently to bring out the isothermal gradients, may give a totally erroneous impression as to the spacial relations of this warm bottom zone, for they suggest that it lies on an extremely steep declivity. While this is *relatively* true, the mean bottom slope there is only about one in ten, which would correspond to a very moderate gradient, indeed, on land.

No data had previously been at hand to show whether a warm bottom band (as contrasted with lower bottom readings closer in to land) continues on southward past Chesapeake Bay in the cold season, in the same position relative to the slope that it occupies further north. Observations taken off the coast of North Carolina in February of 1930, 1931 and 1932 show that such is the case at least past Cape Hatteras, with bottom readings some 3°–4° warmer at the outer edge of the shelf than closer into land in years when winter chilling is normal (Fig. 9), but only 1°–2° warmer in unusually warm winters as exemplified by 1932 (Fig. 13).

The thermal relationship between the waters along the continental edge and over the slope farther out is interesting because of the mass-interchanges that may be expected to take place there. Unfortunately, little precise information has been obtained concerning this. Earlier explorations (Libbey, 1891, 1895; Bigelow, 1927) had shown that in summer the cool bottom water of the coastal zone usually juts out more or less from the continental shelf at the 30–70 meter level, indenting into the higher temperatures offshore, and this is corroborated by more recent work (p. 73). But our profiles show nothing of the sort at the coldest time of the year, when, on the contrary, the cold water-mass from the shelf extends seaward more or less above the warmer offshore water, usually with a comparatively definite transition zone from the one to the other, indicated by crowding of the isotherms (Figs. 9–11A).

[8] Many accounts of this event have appeared. See especially Collins (1884). Bigelow and Welsh (1925, p. 354) give a recent summary.

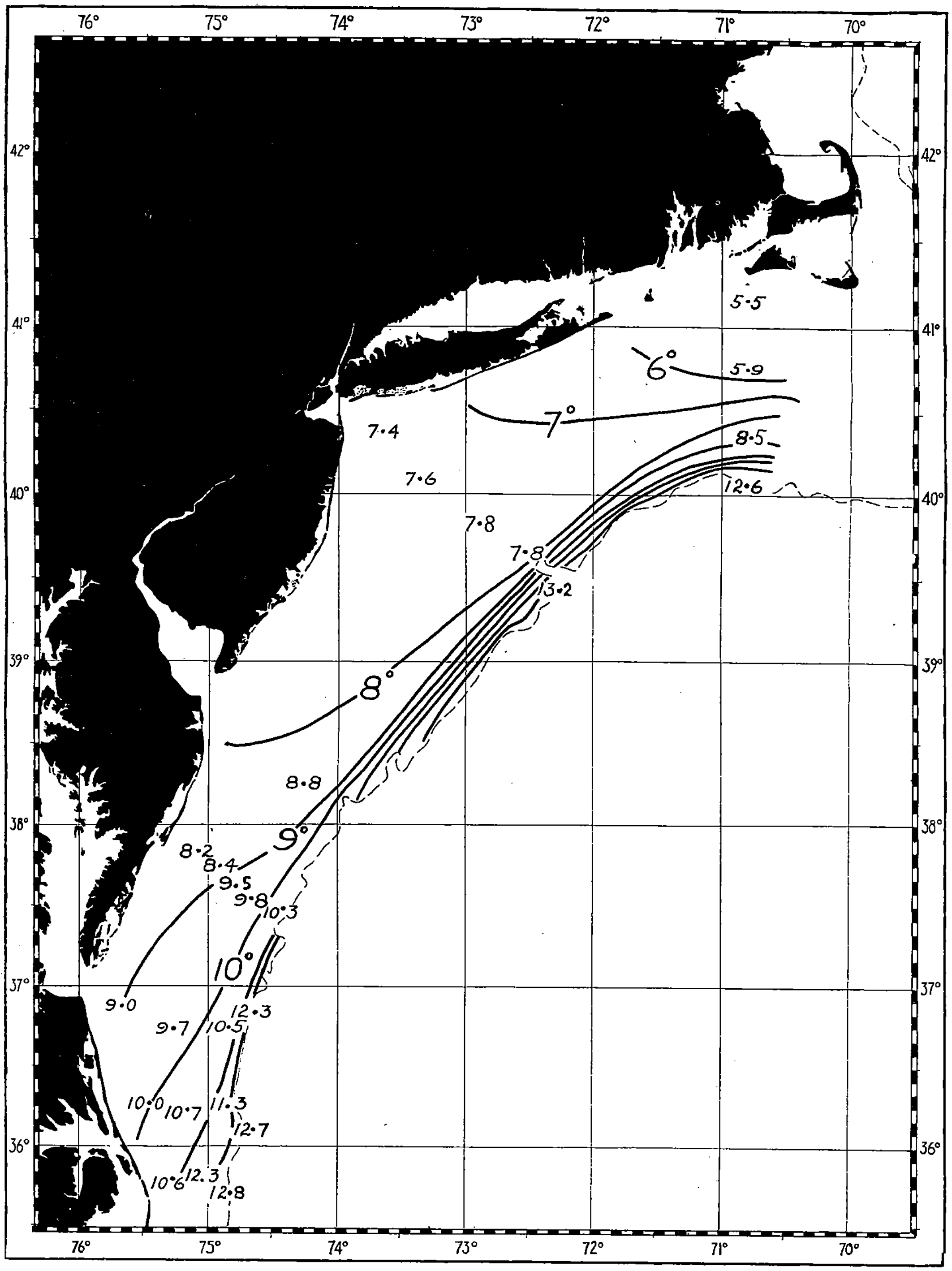

FIG. 13.—Temperature near the bottom out to the 200 meter contour line, February 25–March 1, 1932.

Annual Variations in Winter Minimum

Lightship records (Rathbun, 1887, Parr, 1933) have already shown that considerable variations take place from year to year, not only in the minimum to which the temperature falls, but also in the date at which the minimum is reached—as indeed happens wherever, in boreal seas, the thermal cycle has been studied. The period of study, for the shelf as a whole, has not included any abnormally cold winter, so there is no means of knowing the extreme to which this sector of the coast water may occasionally be chilled. But it is obvious that the water next the coast cannot be more than a couple of degrees

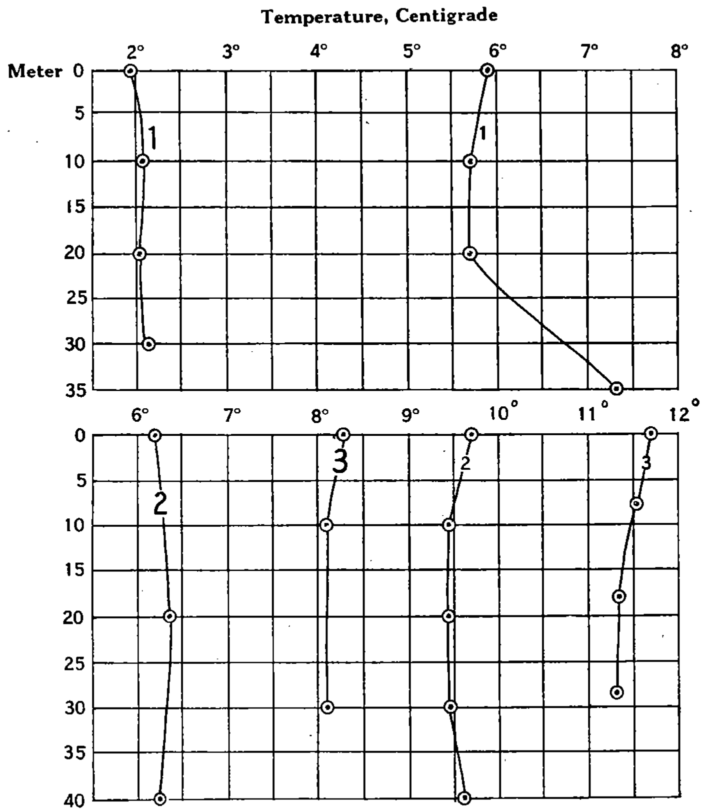

Fig. 14.—Vertical distribution of temperature in February of different years. Above—Station New York I, February 28, 1929 (**1**) and February 29, 1932 (1). Below—Station Cape May II, February 8, 1930 (**2**) and February 12, 1932 (2); Stations Chesapeake II, February 10, 1930 (**3**) and Chesapeake III, February 13, 1932 (3).

colder than usual even in the coldest winters, in a region where temperatures normally fall to within 3°–5° of the freezing point, but where ice never forms in the open sea. Farther out on the shelf, however, the possibility in this direction is wider and it would not be surprising to find the whole water-mass out to the 60 meter contour chilled below, say, 4° in an exceptional year. In 1920 (following several weeks of very severe weather) the "Albatross" did, in fact, have surface readings along the 150–200 meter contour of 3-4° off the coast of Virginia, 5-6° off Delaware Bay and off New York, on February

20–21, which is some 3°–6° colder than is usual for the date and location.[9] But this unusual chilling was confined to the upper strata, for at 100 meters the temperature was only about 0.5° lower off Cape May (9.5°) in that February than at the beginning of March of 1929 (Fig. 10A). And the bottom water along the 150–200 meter zone had about the same temperature at this season in 1920 (about 9.0°–10°) as in the other years of record (p. 19), except for 1932 when it was 2°–3° warmer (p. 27).

At the other extreme, February of 1932 was so warm that higher winter temperatures are unlikely to occur for many years. The regional distribution of temperature in that month was of the type normal for the season (Figs. 6, 13), the parallelism with other winters extending even to the presence of a tongue of cool water extending from northeast to southwest off New York. Neither was there anything abnormal in the vertical distribution, the water on the shelf as a whole being either very close to homogeneous as to temperature, from surface to bottom, or with the upper stratum definitely colder than the bottom, just as we have found it in other winters. But at the end of that February, i.e. so late in the year that little if any further cooling was to be expected, the surface next the coast was 4°–5° warmer than at the corresponding season in 1929, as appears in the following table of surface readings at the inshore station on each profile:—

Profile	Feb. 25–Mar. 5 1929	Feb. 25–Mar. 1 1932	Approximate Annual Variation
Off Martha's Vineyard	1.7°	5.6°	4°
Off New York	1.9°	5.9°	4°
Off Winter Quarter Light Ship, Va.	3.3°	8.4°	5°
Off Chesapeake Bay	5.0°	9.1°	4°

The range of surface temperature, on given profiles running out from the land, was also considerably narrower in February 1932 than in the same month either of 1929 or of 1930, with the surface averaging only 1.5°–2.5° colder near land than at the outer edge of the continent, instead of some 3°–6° colder, as in more normal years (cf. Figs. 2 and 3 with Fig. 6). Surface readings were in fact higher at some offshore localities in 1930 than in 1932.

Approximate surface temperatures at the outer edge of the continental shelf on different profiles in late February

Profile	1929	1930	1932
Off Martha's Vineyard	7.8°	11.0°	8.1°
Off New York	7.2°	10.8°	6.7°–7°
Off Winter Quarter Light Ship, Va.	8.0°	8.0°	10.6°
Off Chesapeake Bay	9.4°	9.3°	11.4°

Pairs of corresponding stations (Fig. 14) show that the thermal difference between 1932 and more normal winters involved the whole column of water, so that the bottom over the inner parts of the shelf (like the surface) was not only more uniform than usual for the season, but 3°–5° warmer; i.e. 7°–8° over a considerable area in the offing of New York, 8°–9° near the land off Delaware and Chesapeake Bays, and 10°–11° along northern North Carolina where it was only 5°–7° in 1930 (cf. Fig. 13 with Fig. 4, 7). In a winter of this type when the shoaler bottoms inshore are so warm, the presence of a band of bottom water warmer than 8°, along the outer edge of the shelf is biologically less significant than usual. In the winter of 1932, for example, the whole continental shelf, from the offing of Long Island southward, was open to any fish able to survive a temperature of 7°–8°.

[9] "Albatross" stations 20041–20043 (App. III, Rept. U. S. Fish Commission for 1920 (1921)). Unfortunately the "Albatross" made no observations farther in on the shelf west of longitude 69° in that month.

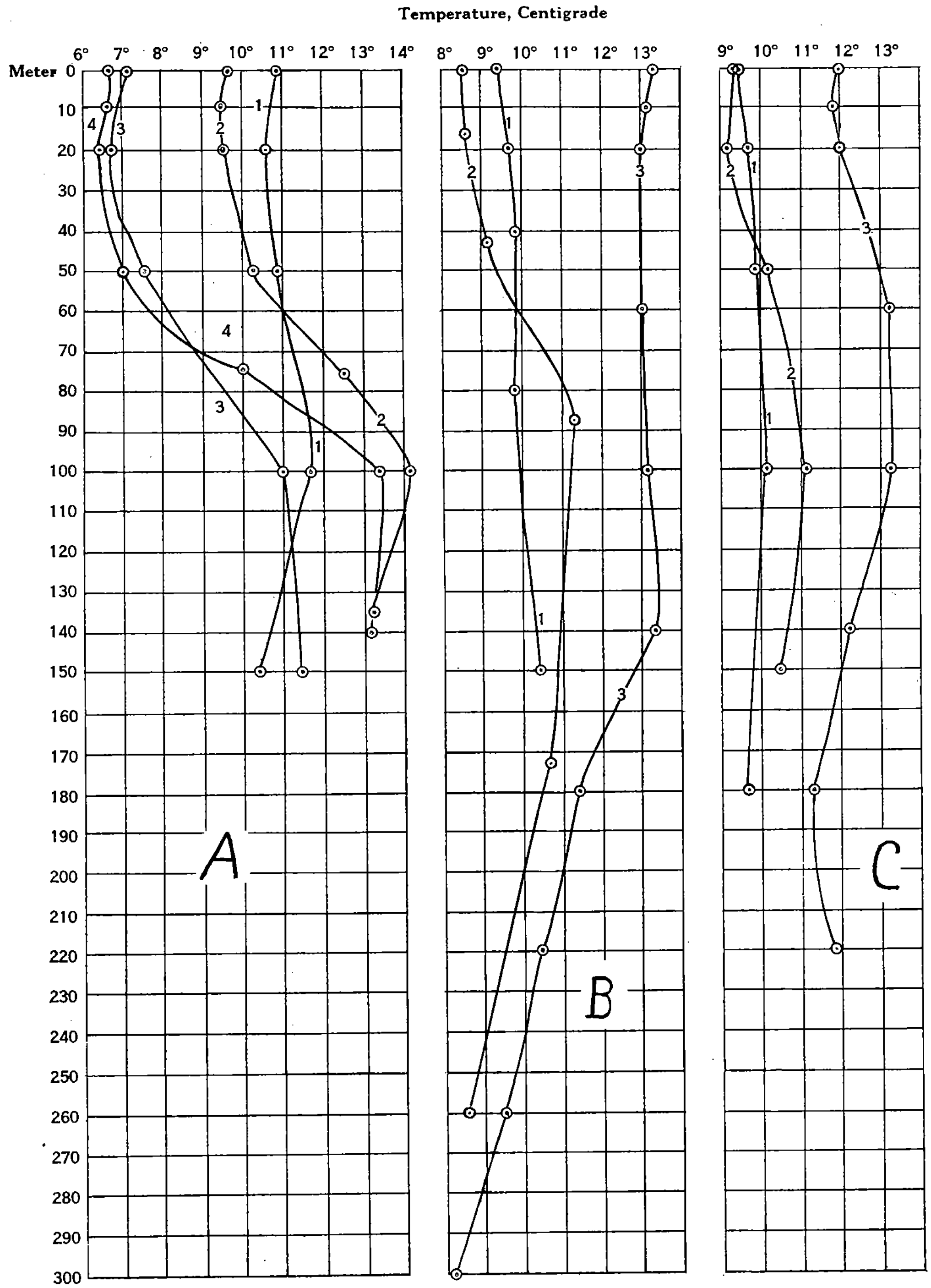

FIG. 15.—Vertical distribution of temperature along the edge of the continent. A (left), Station New York V, February 7, 1930 (1), February 10, 1932 (2), February 27, 1929 (3), and February 29, 1932 (4); B (center), Station Cape May IV, March 4, 1929 (1), Cape May V, February 9, 1930 (2), and February 11, 1932 (3); C (right) Station Chesapeake IV, March 3, 1929 (1), February 10, 1930 (2), and February 12, 1932 (3).

The fact that the abnormality in the unusually warm winter of 1932 was widest near land, this being as is apparently true of unusually cold winters also suggests that year to year differences having their immediate origin in the land climate over the neighboring continent, are chiefly confined to the continental shelf. And this is corroborated by the corresponding fact that farther out at sea over the continental slope one February was found warmest at one locality and depth, another at another, but with all fallings close together at 250 meters and deeper. Thus the upper stratum down to 150 meter was 1°–3° warmer on the Chesapeake and Cape May profiles in 1932 than in 1929 or 1930, but further north, off New York, this applied only to depths greater than 70 meters, while off Martha's Vineyard the 30–100 meter stratum was 3°–4° colder in February in 1932 (much the warmer year inshore) than in 1929, but with little difference at the surface (Fig. 15).

Vernal Warming

MARCH–APRIL

Lightship records, combined with the offshore cruises show that in different years the surface water may begin to warm at any time between the middle of February and middle of March; also that this may happen two to three weeks earlier in the southern part of the area than in the northern, as in 1930 (Parr, 1933, Fig. 10), or nearly simultaneously all along the coast from Chesapeake Bay to Nantucket Shoals, as in 1929 and 1931.

Vernal warming is at first an irregular and spasmodic process. And while the whole column may warm from the beginning right down to the bottom in small depths next to the land, the warming of the surface may at first be accompanied by continued lowering of temperature in the underlying strata at stations further out on the continental shelf; or the deep temperature may at least continue stationary, if tides or currents continue for a time to bring colder water thither either from inshore or from the north.

In 1931, for example, the whole column still continued homogeneous, surface to bottom and close to the winter minimum at the innermost station off Chesapeake Bay (4.8°–4.9°) until the last week of February, though the water midway out on the shelf was then already a degree or more warmer at the surface than on bottom (Fig. 12B). And a warm surface stratum was established equally early in that year in the eastern part of the area, where homogeneous water of 3°–3.7° was already overlaid by temperatures some 1°–2° warmer (Fig. 12A), evidently as the result of vernal warming, because salinity was too low (about 32.7 per mille) to accord with any recent influx of surface water from offshore.

One might perhaps expect that in a year such as 1931, when a warm surface stratum is established off New York as early in the season as it is off Chesapeake Bay, this would likewise apply to the intervening sector. Actually, however, the type of vertical distribution characteristic of the coldest season persisted later there in that year; later, too, off North Carolina to the south (Fig. 12C). Without detailed knowledge of the course of events, this apparent anomaly can be explained only in general terms as due, in some way, to local variation in the interaction between controlling factors, i.e., intake of heat at the surface, activity of vertical turbulence, and horizontal movements at different levels. And there is nothing in the tabulations of surface readings at lightships and lighthouses, by Rathbun (1887) and by Parr (1933), to suggest that the regions where the temperature schedule was the most forward in the first days of spring in 1931, serve regu-

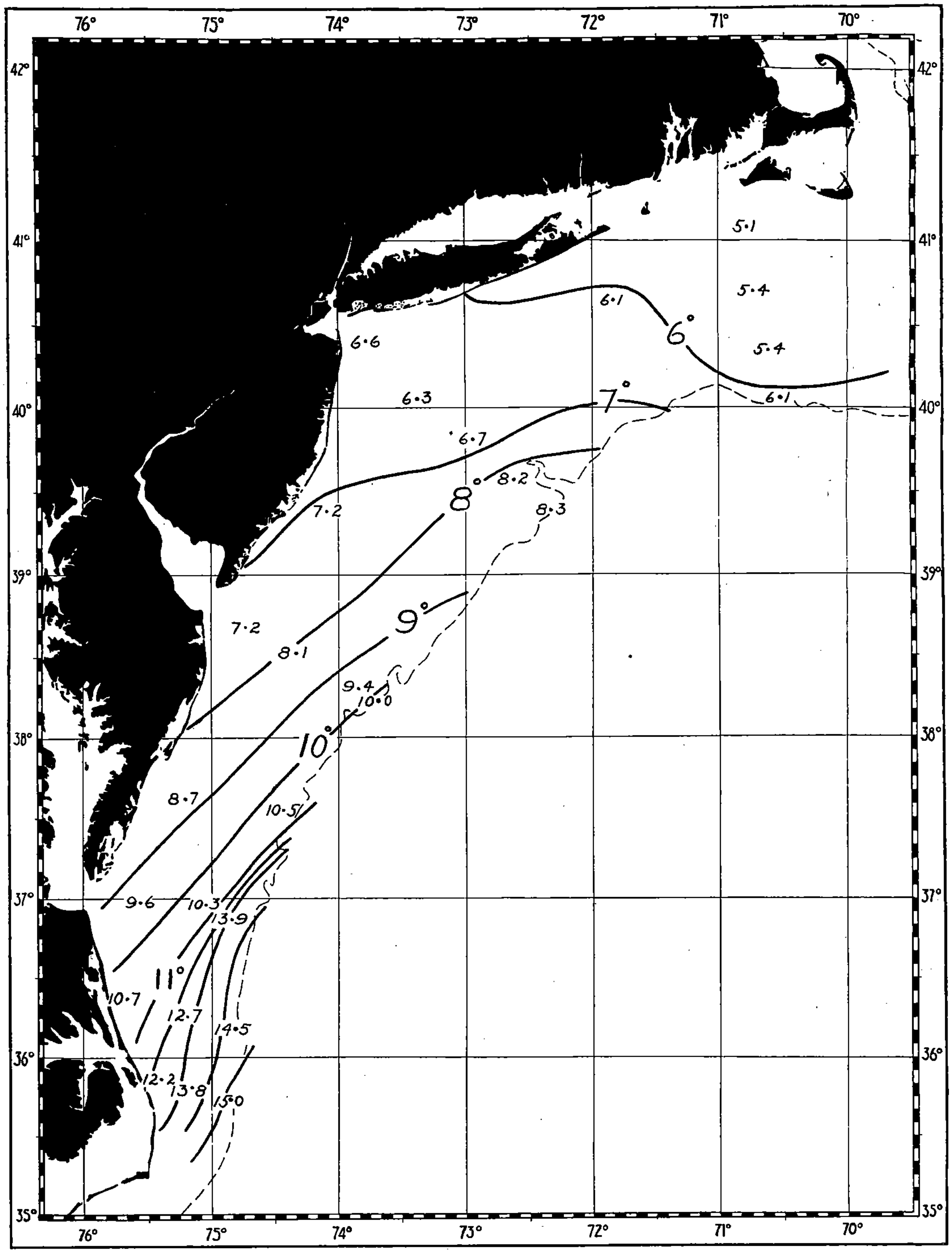

Fig. 16.—Temperature at the surface, April 3–11, 1930.

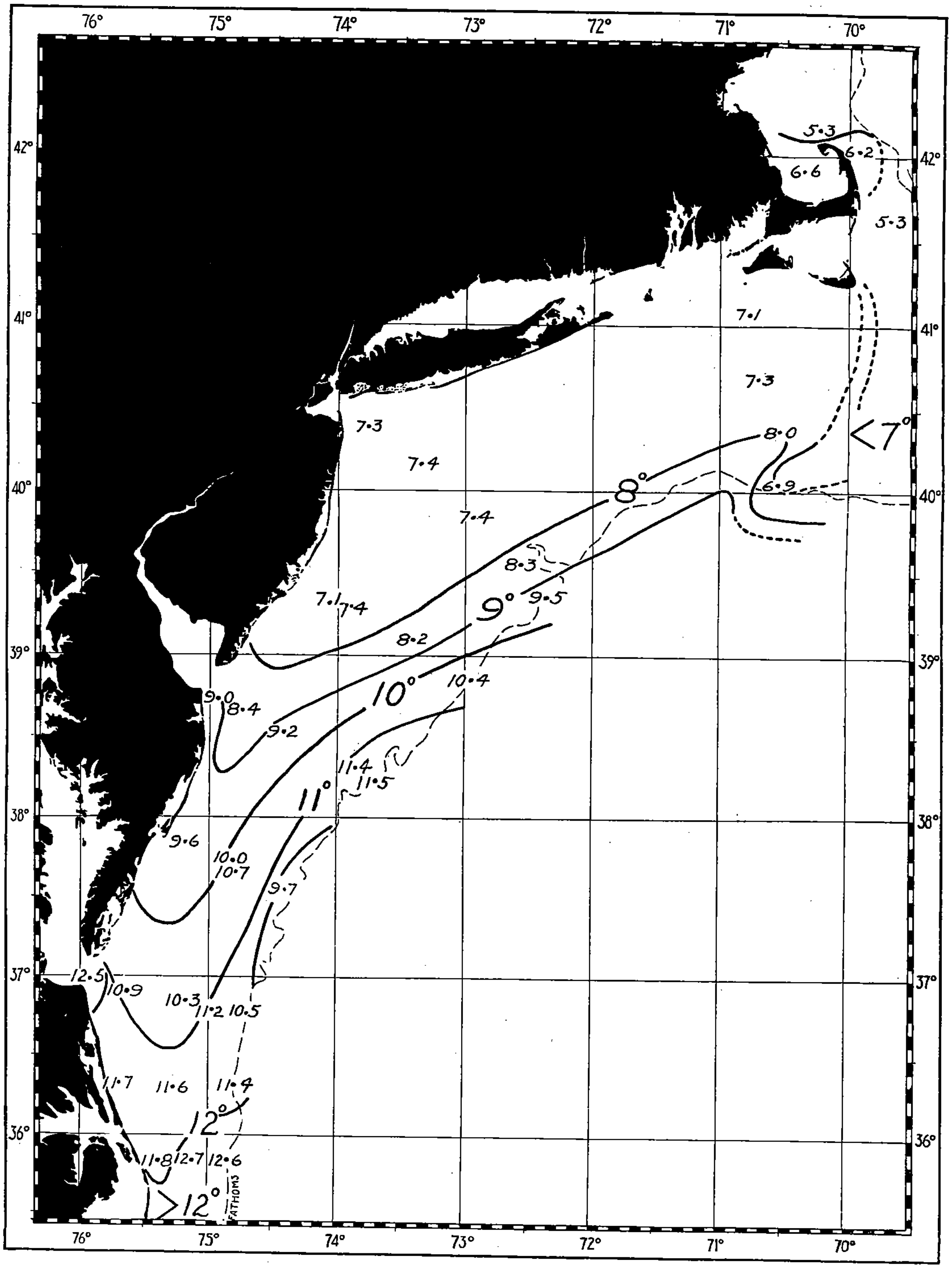

FIG. 17.—Temperature at the surface, April 23–May 1, 1930.

larly as thermal foci of this sort.[10] In any case, a regional contrast of this sort could be only briefly transitory.

The outstanding feature of the spring is, of course, the warming of the water, first and most rapid at the surface, later and much more gradual in the underlying strata. But this fundamental progression is greatly complicated in the particular part of the sea here discussed, by intrusions of cold water from the east on the one hand, and of warm water from offshore on the other.

Events of the first of these categories may show widespread effects during the first two months of spring, as well as later in the season (p. 38). In the offing of Martha's Vineyard, for example, in 1930, the whole column next the land warmed by 0.5°–2.5° between February 5 and April 3, but the upper strata farther out on the shelf actually chilled by 2°–5° meantime, following an expansion of low temperature offshore and westward from the offing of Cape Cod (cf. Fig. 3 with Fig. 16). This cold drift then diminished, until by the end of April the water in the zone most affected by it had again warmed to about the temperature that had been recorded there in February, the only unmistakable evidence of it still persisting to the west of longitude 70°, being a low reading (6.9°) at the edge of the shelf off Martha's Vineyard shown on the surface chart (Fig. 17).

It seems certain that vernal warming was somewhat delayed, by this same cause, in the eastern part of the area in 1932—in the deeper strata in this case—for the bottom water midway out on the shelf was about a degree colder off Martha's Vineyard (4.6°–5.6°) and off New York (about 7°) in the last week of that April than it had been at the end of the preceding February (Fig. 13). And temporary chilling of this sort was still more effective in that May (p. 39). But it was certainly less so in the early spring of 1929, the only evidence of it in the last week of that April being that the temperature of a narrow core of water near land, crossed by a profile near longitude 72° was still about the same (±5°) as it had been in the preceding February, though considerable warming had already taken place elsewhere. Nor can much cold water have drifted westward past Nantucket during the early spring of 1931, for in that year temperatures across the shelf off Martha's Vineyard averaged about 2° higher in the last half of April than at the end of March.[11]

It seems clear that but little water from this eastern source spread beyond latitude 72° between February and April of 1929, or in 1930, for it is probable that slight surface chilling suggested on successive profiles run off New York early and late in April of that year was actually due to the precise location of the observing stations, rather than to any mass drift from the east. In 1932 its effects may have extended somewhat farther west and south, to judge from the fact that surface temperatures, over the southern part of the area in general, were about the same at the end of April in that year as in 1930, whereas 1932 had been considerably the warmer year of the two in February. But it is not yet possible to state how far to the westward these expansions of cold water from the east may appreciably affect sea temperatures in the years when they are most strongly developed.

While drifts from the east act, as chilling agents, any indrafts over the shelf from offshore act in early spring as warming agents, just as does the increasing strength of the

[10] Unfortunately our subsurface and offshore data for the last half of March have been limited to a few serial off Martha's Vineyard and Nantucket Shoals in 1931.

[11] The readings were as follows, at successive stations out from the land to the continental edge, March 30 and April 20:—Sta. I, 3.8° and 7.8°; Sta. II, 5.0° and 7.9°; Sta. III, 8.2° and 8.3°; Sta. IV, 10.4° and 12°.

sun. But as events of this sort also increase the salinity of the coastal water (which solar warming does not), it is not difficult to identify them.

Earlier investigation by the vessels of the Bureau of Fisheries (Bigelow, 1915, 1922) had made it sufficiently clear that events of this sort must be taken into account. And the fact that it is not yet possible to associate them with any definitely seasonal schedule, or to state the cause in any given instance, makes it the more desirable to describe any that come under observation.

Judging from the combined criteria of temperature and of salinity, it seems that a widespread encroachment of slope water took place to the westward of longitude 72° and southward between February and early April of 1930 and in such volume as to warm

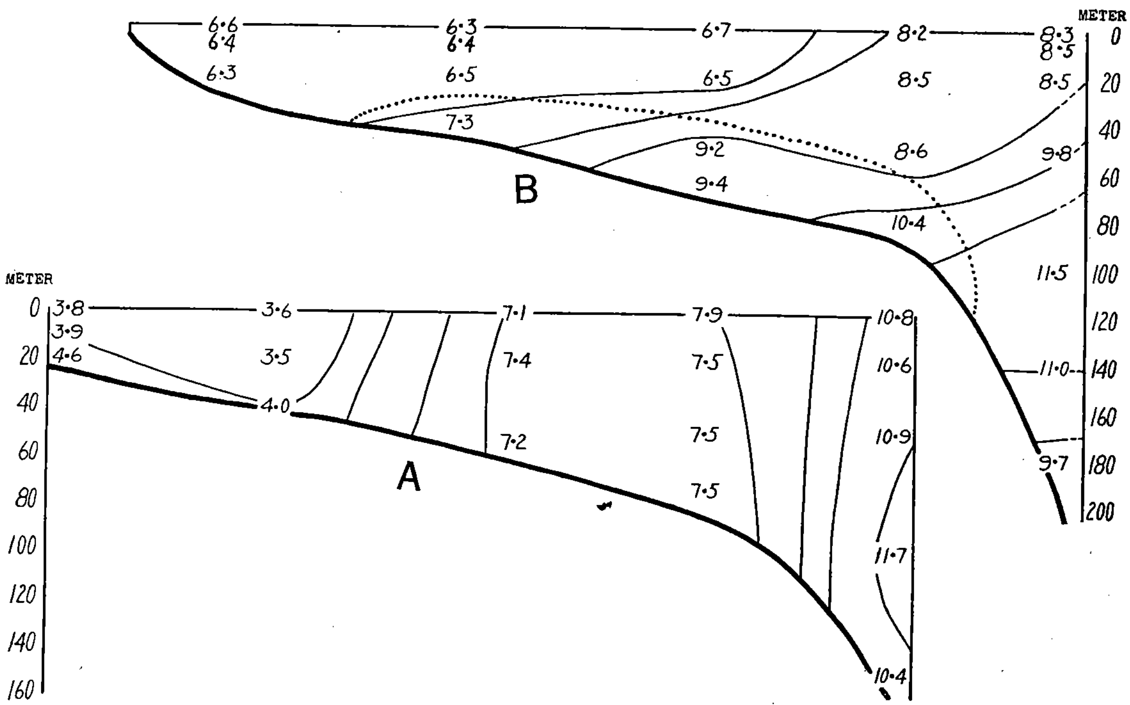

FIG. 18.—Temperature profiles crossing the continental shelf off New York.—A, February 8, 1930; B, April 10–11, 1930. The area enclosed by the dotted curve experienced an increase of 1.0 per mille in salinity between February and April.

the bottom by 2°–3°, right in to the 40 meter line off New York (Fig. 18), making this now considerably the warmest stratum, for the surface layers had been temporarily chilled by flooding from the east as just described. The inshore boundary of bottom water warmer than 10° had also been moved inshore from the 120 meter contour to about the 60–70 meter contour in the same way[12] off Delaware Bay (Fig. 19), between February 9 and April 15; its offshore boundary lifted from about the 230 meter level to within 175 meters of the surface, in which situation it continued until the last week of the month. And an increase in salinity—more pronounced in the upper strata than deeper—showed that some inshore drift of the same sort took place synchronously off Chesapeake Bay, though the whole water column had warmed so much more uniformly there that temperature was not as reliable a criterion as further north in this instance.

[12] Note the coincident increase in salinity illustrated on Figures 18, 19.

In the year 1930 this movement of slope water inshore seems to have come to an end by the middle of April.

Some slight encroachment of offshore water seems also to have taken place during the early spring of 1929, judging from the facts that the bottom temperature along the edge of the continent off Atlantic City increased from 10.5° on March 5 to 13.3° on April 20th,

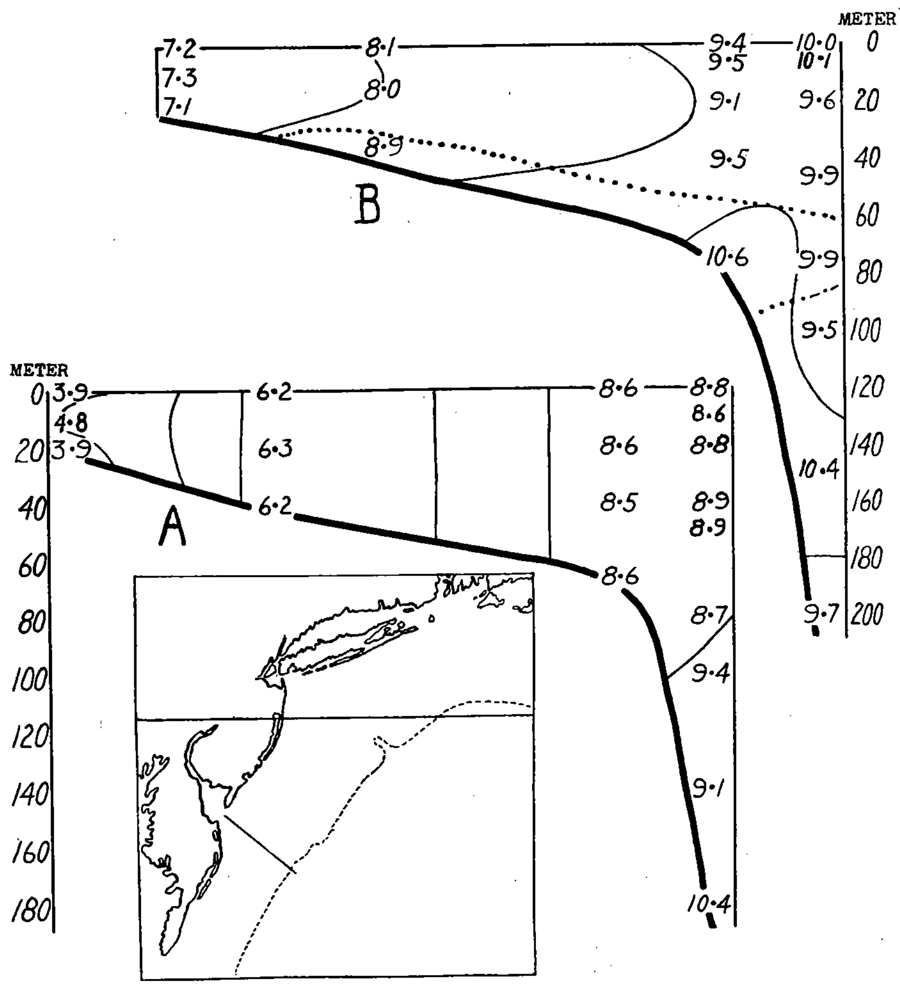

FIG. 19.—Temperature profiles crossing the continental shelf off Cape May:—A, February 9, 1930; B, April 5, 1930. The area enclosed by the dotted curve experienced an increase of 0.6 per mille in salinity between February and April.

bottom water warmer than 10° having crept in over the shelf, meantime, to the 60 meter contour in the offing of Delaware Bay, where it had been confined to the extreme edge of the continent at the end of the preceding winter and to the 70 meter contour off Montauk (cf. Fig. 7 with Fig. 20). But in this particular spring no clear evidence of this indraft (whether in temperature or in salinity) was detected off New York. And bottom readings for February, compared with those for April and May, show that nothing of the sort happened in the spring of 1932, for a slight chilling instead of a warming, took place along the zone in question.

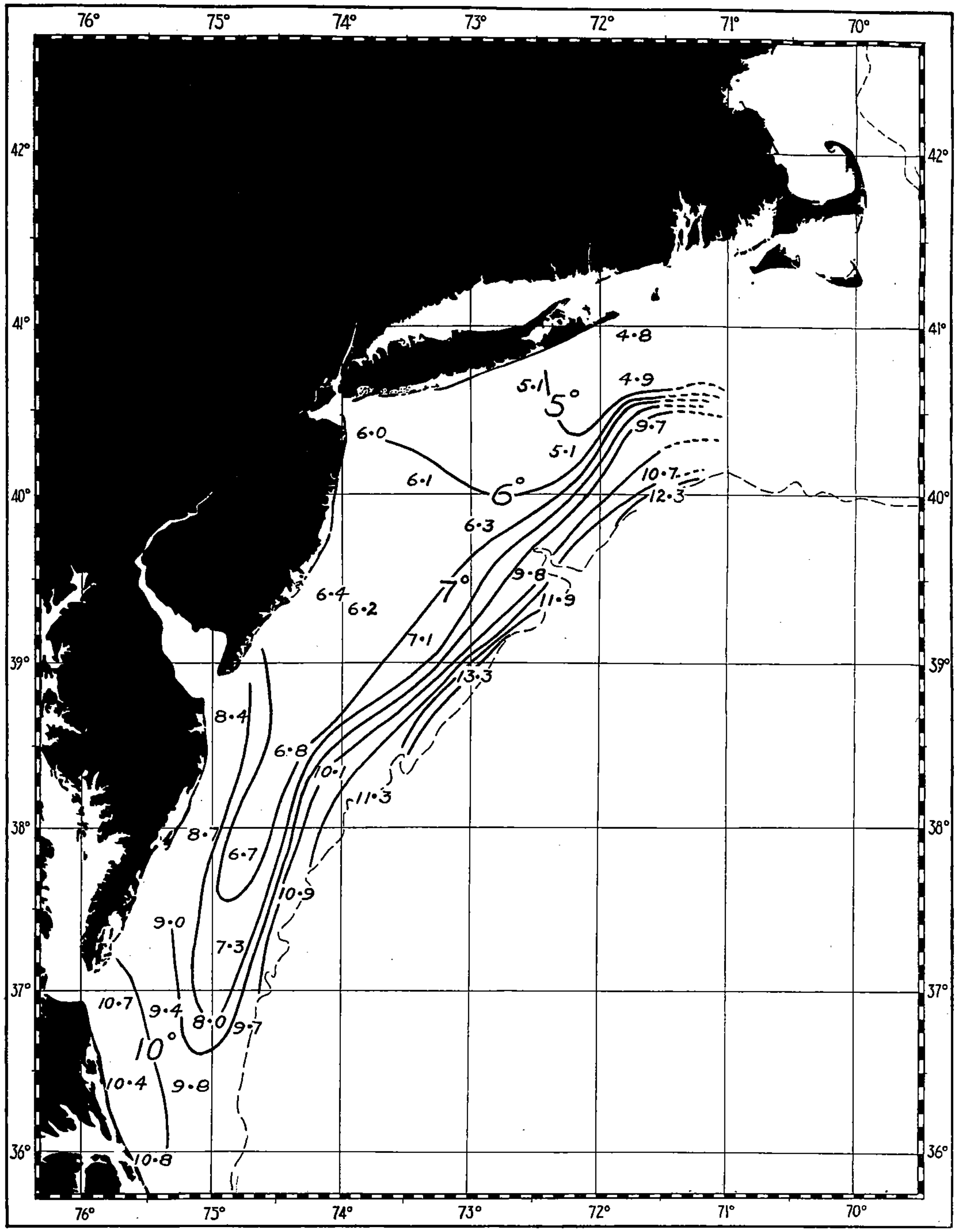

Fig. 20.—Temperature near the bottom out to the 200 meter contour line, April 14–24, 1929.

These scattering data show that some increase in bottom temperature from offshore takes place along the outer edge of the continental shelf in most years—but not in all—between the offings of New York and of Cape May in March or early April. Present indications are that events of this sort are of brief duration at this season; that their direct effect seldom, if ever, extends shoreward much beyond the 50 meter contour line, and they do not much affect the temperature of the water on the shelf as far south as the offing of Chesapeake Bay—certainly not as a regular annual event. But their importance in the thermal cycle is much greater than might appear from the actual rise in temperature caused in any given instance, because they are responsible for the persistence of the so-called "warm zone" (p. 19), which bottom-drifts in the opposite direction would otherwise tend to obliterate.

The progression that results during the first two months of spring from the interaction between solar warming and the effects of intrusive water masses may be outlined broadly as follows:—solar warming, constantly increasing in strength, tends at first to reduce the thermal gradient transverse to the shelf that is so charactersistic of winter (p. 8). This results from the fact that as long as vertical mixings continue active enough to keep the whole column thoroughly stirred as (in general) they do through April, the rapidity with which the temperature rises varies inversely with the total depth of water, i.e. with the distance out from land. That is to say, it is the zone which is coldest in winter (next the land) that warms the most rapidly in early spring (Fig. 21). And cold drifts from the east similarly tend to reduce the difference that exists in winter between inshore and offshore stations, for it is the latter that are the most affected by them, and at the time when the inshore waters are commencing to warm rapidly.

All this tends to cause a widespread alteration in the isothermal arrangement as illustrated in horizontal projection. In winter the successive isotherms run, in general, parallel to the trend of the continent as already described. But with the water, from New York southward, warming most rapidly next the land, while off Martha's Vineyard the surface may chill for a time, the isotherms assume a pattern more latitudinal in character (cf. Figs. 2, 3, with Figs. 16, 17). Thus, by the last week of April, the surface was about 3° warmer off Chesapeake Bay (10°–12°) than off Martha's Vineyard (7°–8°) in 1930 (Fig. 17); about 4.5°–5.5° warmer in 1932, when surface temperatures were 5.8°–6.7° on the more northerly and 10.7°–12.2° on the more southerly of these two profiles, with intermediate values (8°–10°) along the intervening sector of the shelf.

According to lightship records, combined with data from the cruises of 1929 and 1930, the surface temperature averages approximately as follows, in the last week of April, in normal years:—

Profile	Inshore	Midway of Shelf	Edge of Continent
Martha's Vineyard	6°– 7°	7°– 8°	7°– 8°
Narragansett Bay	7°	7°– 8°	8°– 9°
New York	6°– 7°	7°– 8°	9°
Cape May	8°	9°	11°–12°
Chesapeake Bay	11°	10°–11°	11°–13°

Lightship records show that the thermal barrier that exists in the vicinity of Cape Hatteras in winter (p. 11) loosens during April, and has entirely broken down by the end of May (Parr, 1933).[13] On the other hand, this same season sees the development of a

[13] No offshore data are available for the critical region for April and May.

similar barrier at the northeastern boundary of our area where there is none in winter, for the rapid warming of the water off southern New England, that follows the slackening of cold drifts from the east, results in an abrupt transition from higher temperatures there to lower temperatures on Nantucket Shoals, foreshadowing the wider contrast of this same sort that has long been known to exist in summer. In some years, as in 1930, a difference of some 3° may develop between Brenton Reef and Nantucket lightships as early as the middle of March. But in 1928 and 1929 this thermal barrier did not form until the first part of April; nor until after the middle of May in 1932.

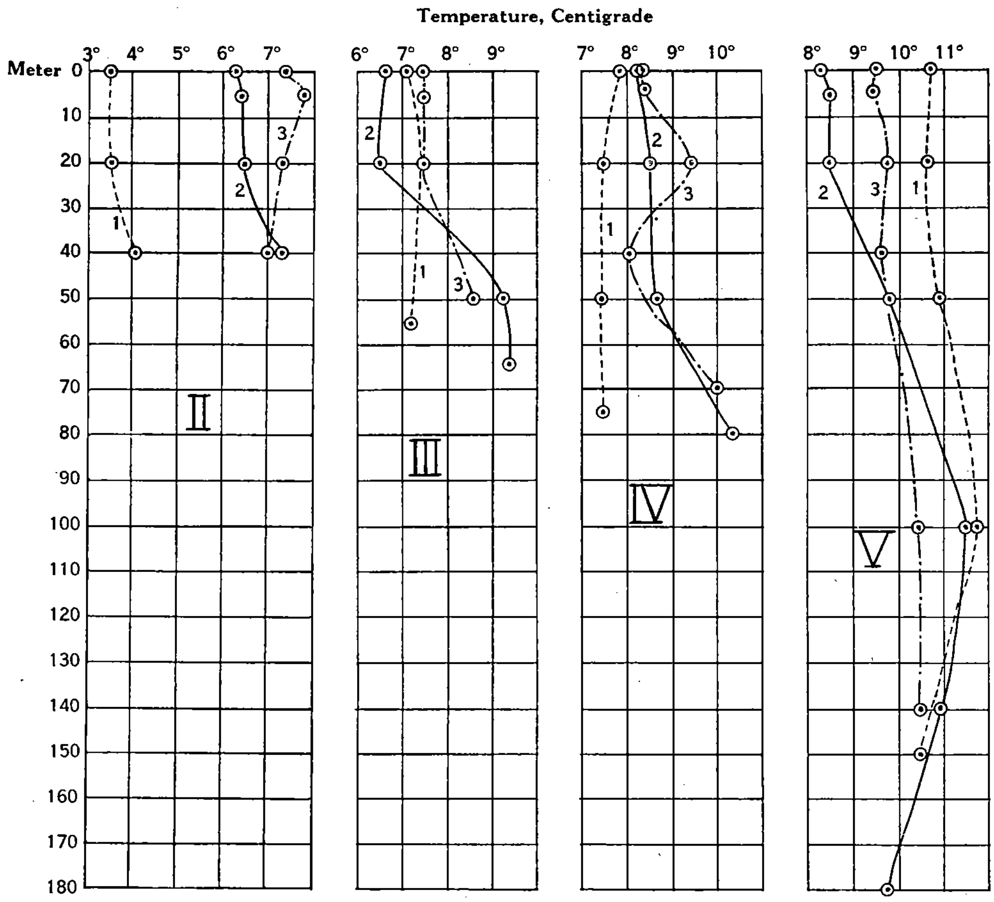

FIG. 21.—Vertical distribution of temperature. Station New York II (II), New York III (III), New York IV (IV) and New York V (V) on February 7–8 (1), April 10–11 (2) and April 28 (3), 1930.

Vernal warming ordinarily does not greatly affect the preëxisting type of vertical distribution of temperature before the end of April, the water over the shelf still continuing close to homogeneous from surface to bottom, as it is in winter (Fig. 27), or being slightly warmer on bottom if warm water, from offshore, be creeping in over the shelf, or cold surface water be drifting down from the north and east (p. 30, 31). Consequently the seasonal alterations in the isothermal pattern just described for the surface, apply in general down to the 40–50 meter level through April. But the shelf slopes at such an angle that the distribution of temperature on the bottom at depths greater than this continues practically of the winter type until well until April, i.e. continues to increase seaward to a zone of 9°–11° along the outer edge of the continent, centering usually at about the 100–200 meter belt. But, by the last of April or first part of May, warming from above commences to reduce the gradient of bottom temperature across the shelf by attacking the cool mid-zone from the landward side. And the vernal advance evidently varies considerably in this respect, from year to year, for, while the whole column of water midway out on the shelf off Virginia had warmed to upwards of 10° by mid-May in 1930 (p. 45), in 1883 it still was only 8.3°–7.5°, surface to bottom, on the 5th of the month, or about the same as in the third week of April of 1929 (Fig. 20).

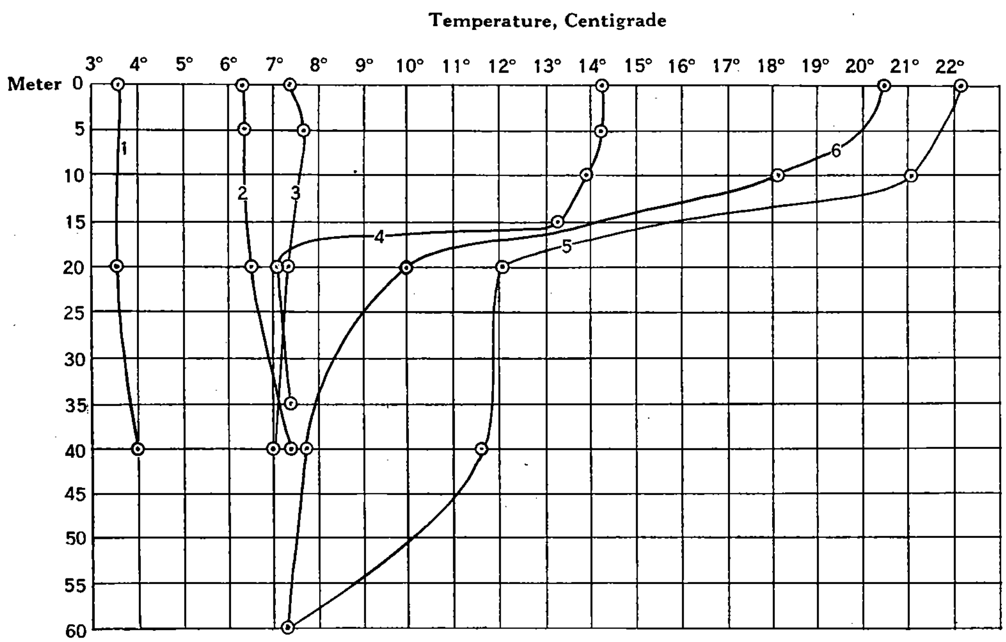

FIG. 22.—Vertical distribution of temperature at Station New York II at successive dates during 1930:—1, February 8; 2. April 10; 3, April 28; 4, June 8; 5, July 12; also 6, Station New York I, July 12.

Only one of our April stations of recent years has been located more than a few miles beyond the 200 meter contour line, consequently they throw no light on the location of the inner boundary of tropically high temperatures at this season; not even off northern North Carolina where these are to be expected closer in to the edge of the continent than anywhere farther to the north. Off Cape Hatteras, on April 27, 1883, the "Albatross" met water of 22.2°–24.0° at the edge of the continent, with temperatures close to homogeneous vertically, down to the bottom there in 168 meters.

MAY

Surface. The rapidity with which the water is absorbing heat during May is illustrated by the fact that surface readings off Cape May and to the southward were about 6° higher by the middle of that month of 1930 than in the last week of April; about 5° higher off New York; 3°–4° higher in the offing of Martha's Vineyard. In 1932, also, the surface water midway out on the shelf averaged some 4°–5.5° warmer at the end of May than in

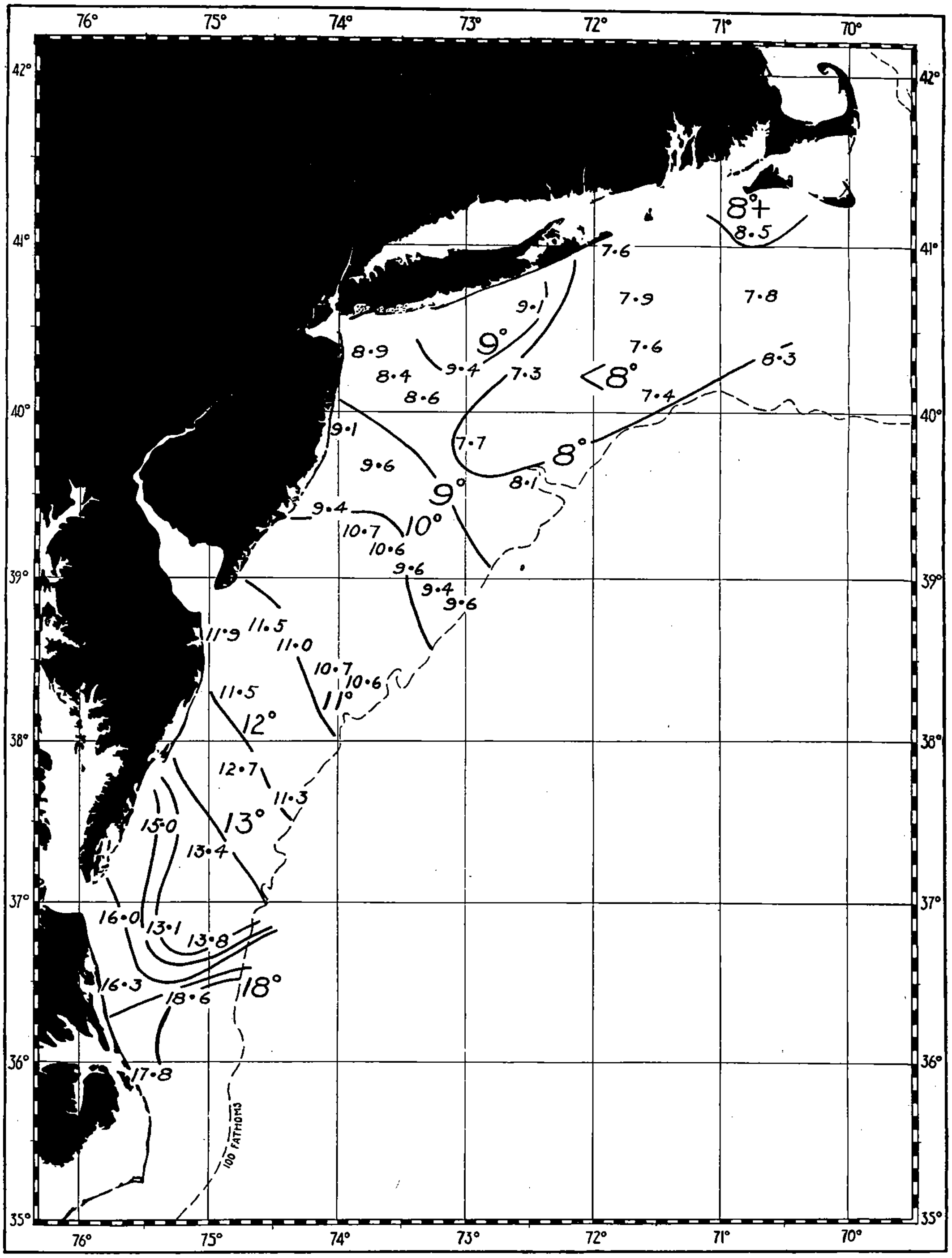

FIG. 23.—Temperature at the surface, May 10–16, 1929.

the first week of the month, while in 1927 the inshore water, off Atlantic City, New Jersey, warmed by more than 1° (from 11°–12° to 13.3°) between May 20 and 23.

This normal progression may be temporarily interrupted or at least delayed by cold drifts from the east in May, just as in April (p. 30). Thus in 1927 the surface temperature in the eastern part of the area remained stationary from May 18 to May 25 although farther to the south it was then rising measurably from day to day, as just stated. And,

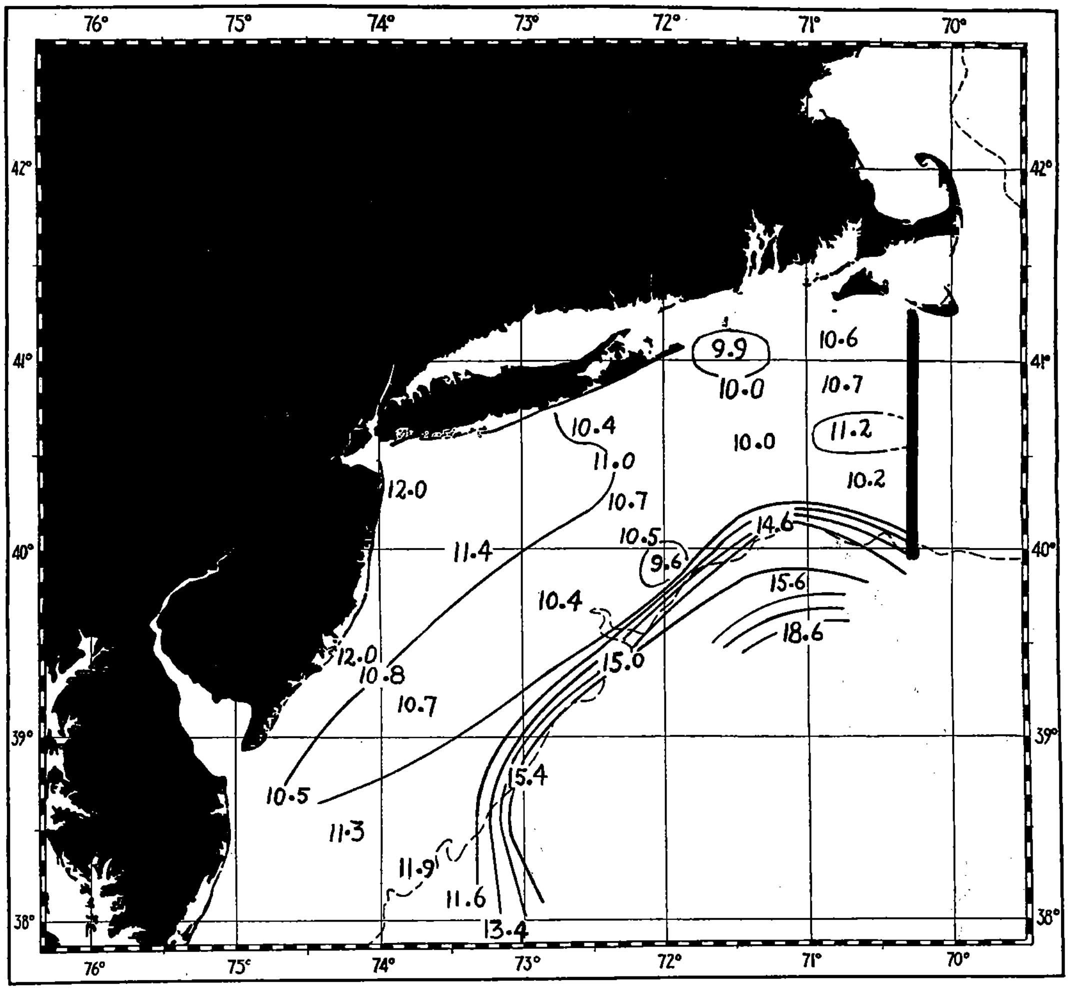

FIG. 24.—Temperature at the surface, May 22–30, 1928.

while May stations for 1928 gave no indication of anything of the sort, cold water from the east must have entered in considerable volume during the last part of that month, in 1929, to account for the tongue of low temperature outlined by the isotherm for 8° on Figure 23. In 1930 the water had certainly warmed much less rapidly to the eastward of New York, where the surface was 10°–11° in the middle of May, than to the southward in the sector between the offings of Cape May and of Chesapeake Bay (15°–17°, May 17–19). It also seems that a considerable volume of cold water was drifting southward beyond the offing of New York in the first days of May, of 1932, for the surface cooled by 0.4°–1.9° over most of the shelf between latitudes about 39°30′ and 37°30′, between the first and second weeks of that month, instead of warming as it did at most of the stations farther north and east.

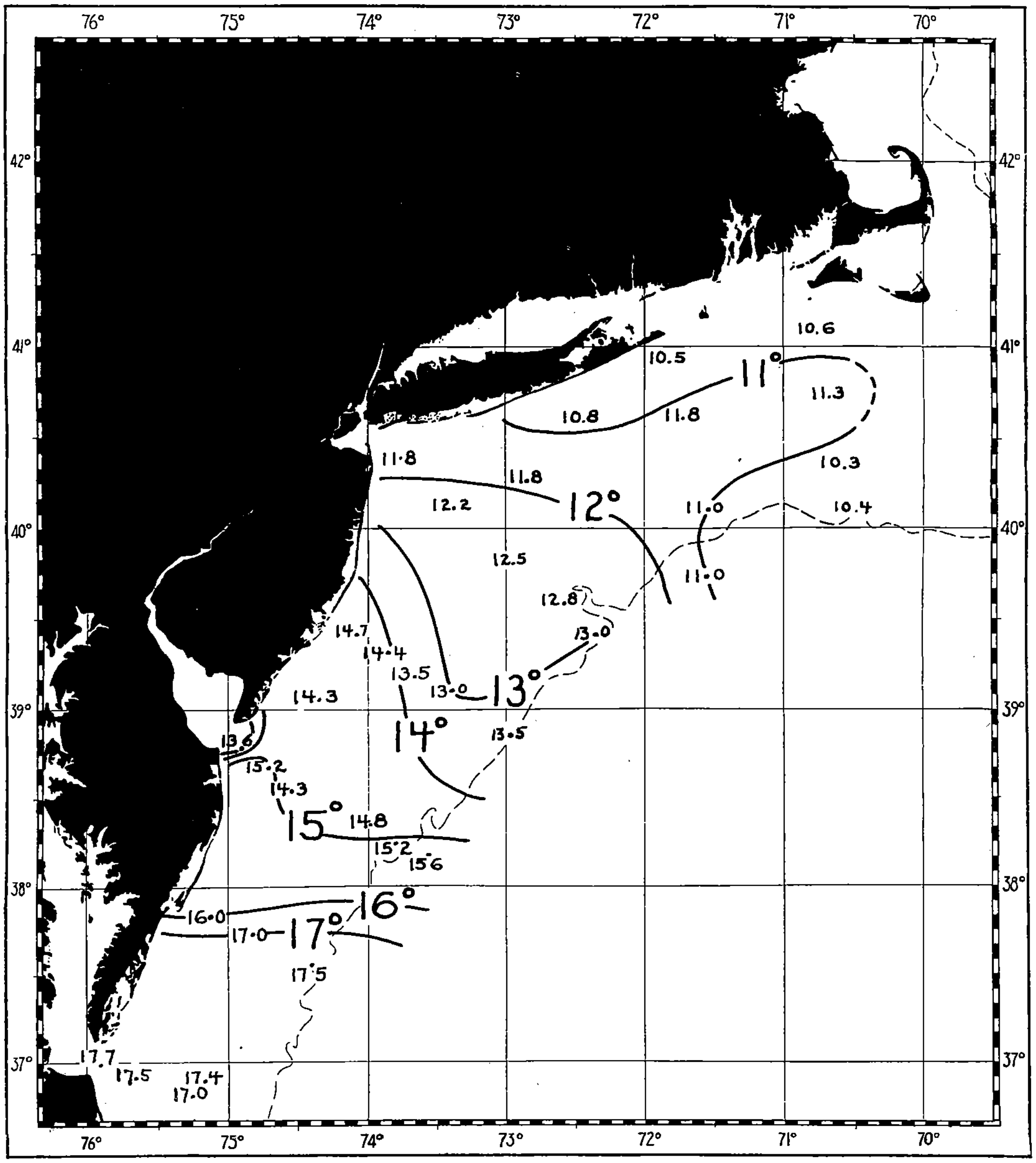

FIG. 25.—Temperature at the surface, May 12–23, 1930.

In years when such drifts are weak or perhaps fail to develop at all, the temperature may continue close to uniform all along from the offing of Martha's Vineyard to the offing of Cape May until late in May, as was the case in 1928, when the surface temperature of this sector of the shelf as a whole had risen to 10°–12° by the last week of the month (Fig. 24). But it is obvious that any influx of cold water into the eastern part of the area, at a season when the surface farther south is gaining heat rapidly must tend to strengthen the latitudinal gradient in surface temperature that commences to develop earlier in the spring. And Parr's (1933) diagrams do, in fact show an average difference of about 5.5° between Cape Charles Lightship, and Brenton Reef Lightship in May, whereas in February the mean difference between these two localities is only about 1°–2°. In years when the vernal chilling from the east is most effective the north-south gradient may even reach its maximum for the year in the last part of May, as seems to have been the case in 1929, when the difference in surface temperature along the mid-belt of the shelf, between the offings of Chesapeake Bay and Martha's Vineyard, increased from about 1.5° in February (Fig. 2) to about 8° in mid-May (Fig. 23), then decreased again to about 3° in the third week of July (p. 53).

The picture, for May, is further complicated by the fact that the surface in the southern part of the area, as illustrated by the offing of Chesapeake Bay, may attain a considerably higher temperature at a given date in some years than in others. Thus the surface along the inner two-thirds of this profile had warmed to 17°–17.5° by May 12–23 in 1930 (Fig. 25); to 13°–16° at about the same date in 1929, but only to 12°–14.6° in 1932. In 1929, too, a rather definite temperature barrier developed in May on the outer part of the shelf off Chesapeake Bay, indicated on the chart (Fig. 23) by the close crowding of five successive isotherms (14°–18°) within a north-south distance of some twelve miles, while our data suggest a similar, though less definite development, a few miles further north at about the same date in 1930.

As a result of these variations, surface temperature for May at any given date and locality shows considerable variations from year to year. But the following tabulation of available data for various years at least approximates the average state to be expected about the third week of the month, in years that do not depart very greatly, in either direction, from the normal. The records for Brenton Reef Light Ship can be considered here as representative of the inshore end of the Martha's Vineyard profile, for while these stations are some 30 miles apart, the general distribution of temperature at this season is such that the regional difference in this case is probably less than 1°.

Profile	Inshore[1]		Midway of Shelf[2]		Along 100–200 Meter Contour	
	mean	*extremes*	*mean*	*extremes*	*mean*	*extremes*
Martha's Vineyard	10°	9.0°–12.0°	10.0°–11.0°	7.8°–11.3°	11°–12°	8°–14.5°
New York	11°	10.5°–11.5°	10.5°–11.5°	7.7°–12.0°	11°–12°	8°–14.0°
Cape May	12°	10.5°–14.0°	12.0°–13.0°	11.0°–14.8°	12°–13°	10°–15.0°
Chesapeake	15°	14.0°–16.0°	14.0°–15.0°	12.5°–17.2°	15°–16°	14°–17.5°

[1] Scaled to nearest 0.5° from Parr's (1933, Figs. 8–10) diagrams for the years 1928–1930 for Brenton Reef, Fire Island, Five Fathom Bank and Cape Charles Lightships.

At this date there is an average difference of about 3°–4° in surface temperature between Brenton Reef Lightship where the mean for the date is about 10°, and Nantucket Lightship, where it is only about 6.5°, while our observations in 1931 for the last week in May show about this same difference between the inshore stations off Martha's Vineyard (10°–11°) and the eastern side of Nantucket Shoals (about 8°, Fig. 26A). That is to say, the temperature barrier that forms, at Nantucket Shoals, in April (p. 35), continues about equally strong through May.

To judge from the foregoing table, the on- and offshore gradation, which is considerable during late winter and early spring (p. 8, Figs. 2, 3), then decreases until the surface stratum on any given profile normal to the coast is as a rule included with a 2° or at most a 3° interval by the middle of May, out at least to the 150 meter contour (Figs. 24–25). In May of 1927 this was also the case for some 25–30 miles out across the upper part of the continental slope, as far south as the offing of Cape May.[14] And the general distribution

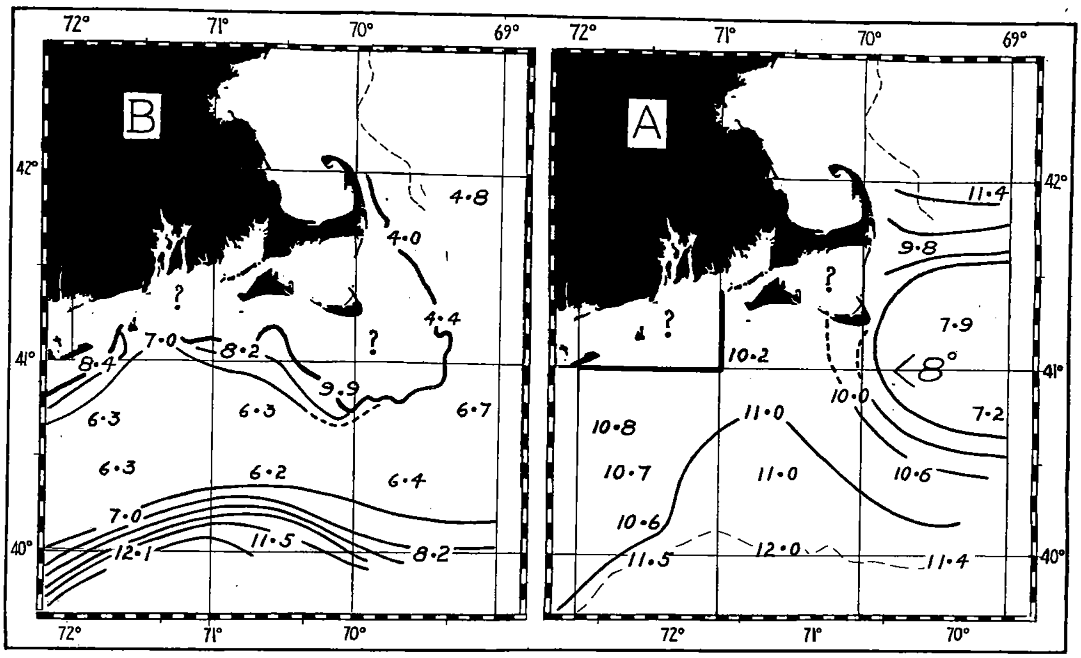

FIG. 26.—Temperature off southern New England and in the region of Nantucket Shoals, May 21–June 3, 1931:—A, (right) surface; B (left), near the bottom from the 40 meter contour line (heavy curve) to the 200 meter contour line.

of surface temperatures over the North Atlantic at this season makes it likely that this represents the usual condition. But in 1928, in the last week of the month, surface water warmer than 15° had pressed in close to the 200 meter contour, between the offing of Martha's Vineyard and latitude about 38°30';—apparently as a part of a broadscale oceanic eddy, for water of such high temperature then lay considerably farther offshore on the Delaware Bay profile, only a few miles to the southward (Fig. 24).

Subsurface. In normal years the alteration from the winter type of vertical distribution (either vertically homogeneous, or warmest on bottom) to the summer type (warmest at the surface) takes place between the first and third weeks of May.

Thus in 1930, a vertical range of 4°–6° had developed over the mid-sector of the shelf generally by the 13th to the 23rd of the month, most of this gradient being already

[14] The profiles were not run far enough out on the May cruises of 1929, 1930 or 1931 to throw any light on this question.

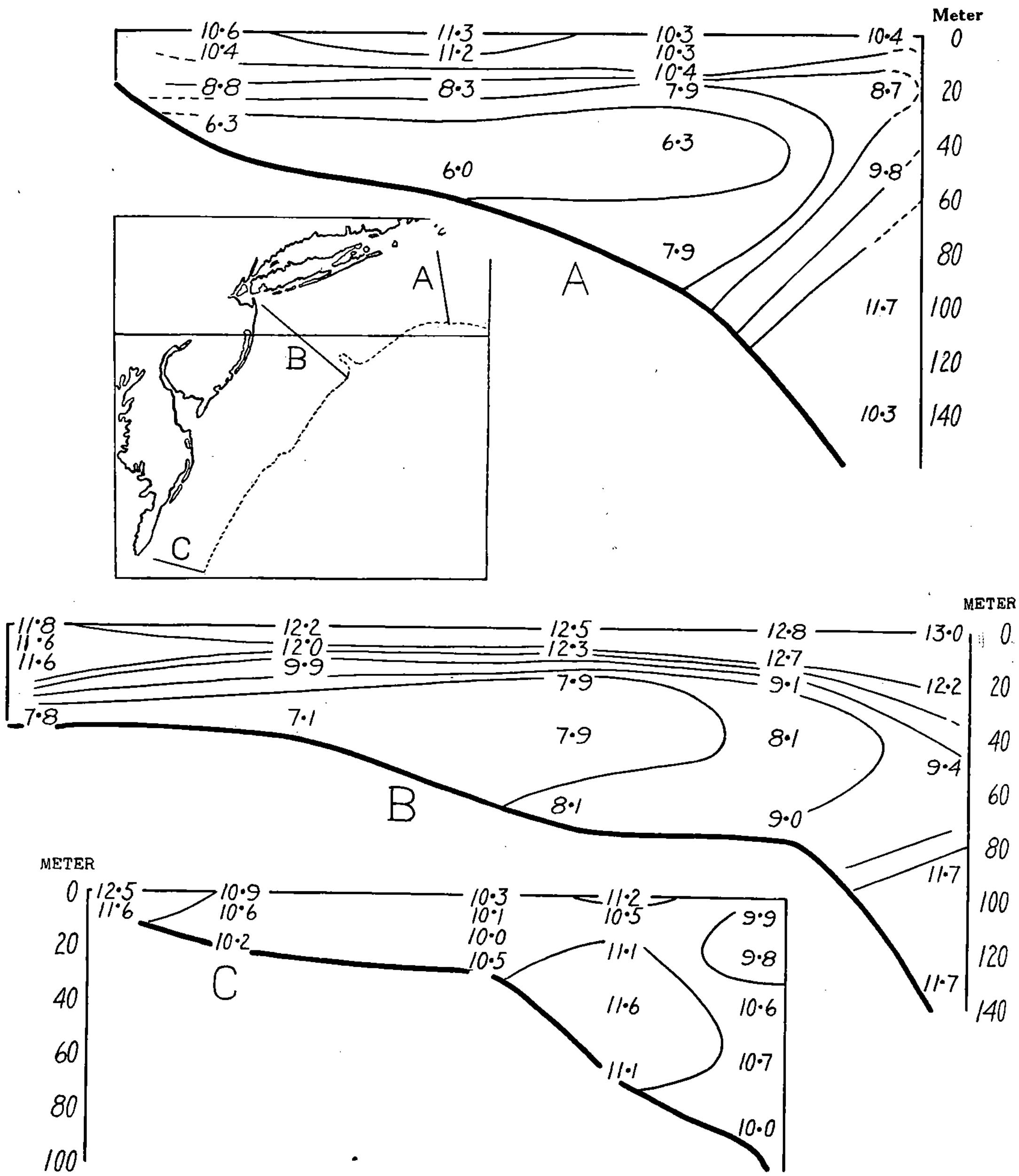

FIG. 27.—Temperature profiles crossing the continental shelf:—A, off Martha's Vineyard, May 13–14, 1930; B, off New York, May 16, 1930; C, off Chesapeake Bay, April 25, 1930.

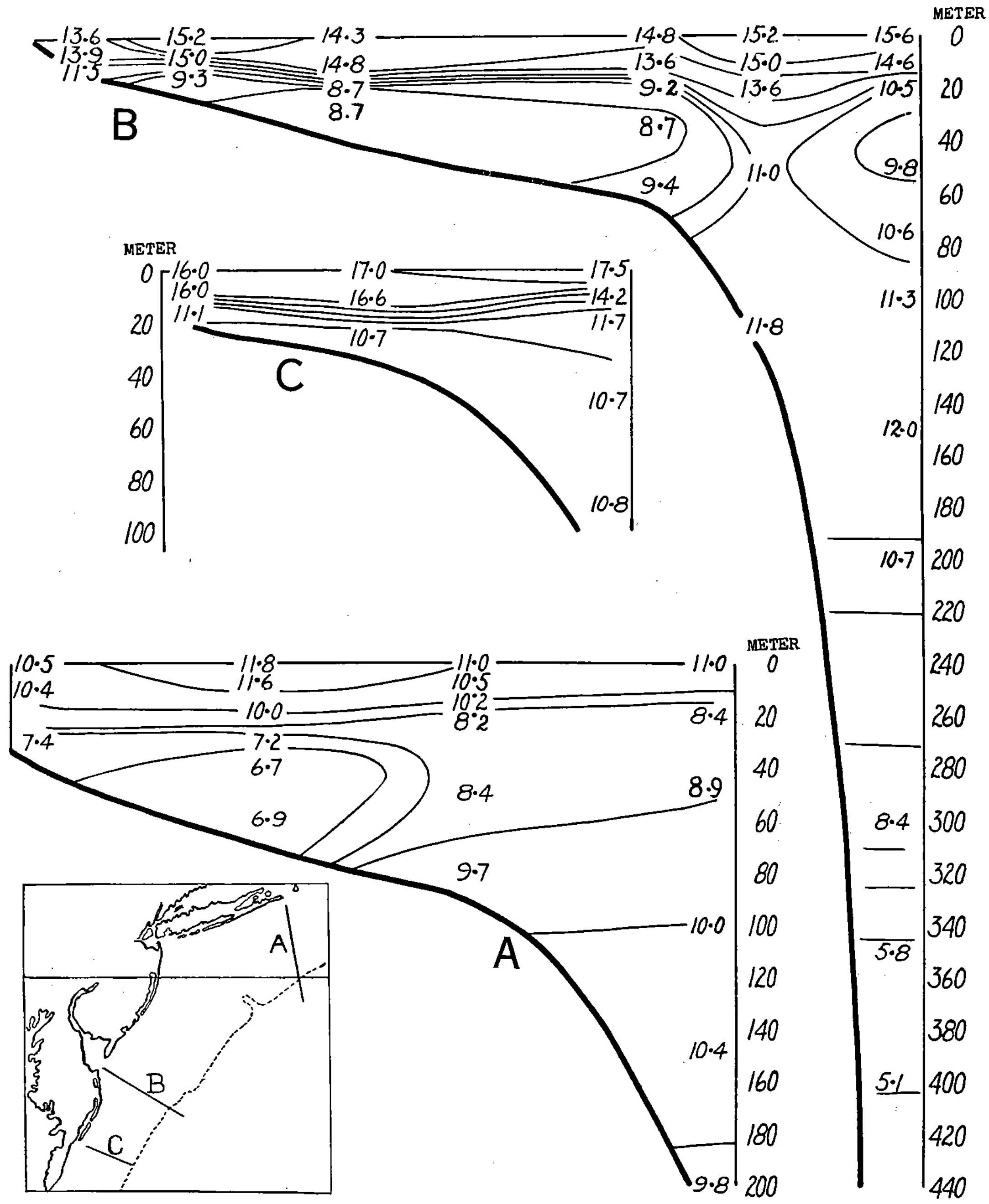

FIG. 28.—Temperature profiles crossing the continental shelf, May 17–20, 1930: A, off Montauk; B, off Cape May; C, off Winterquarter Lightship, Virginia.

included between the 5–10 meter and 20 meter levels (Figs. 27, 28). But in 1932 this state, developing earliest to the eastward of New York (about May 15–20), did not extend to the southern part (offings of Cape May and of Chesapeake Bay) until the last of the month.

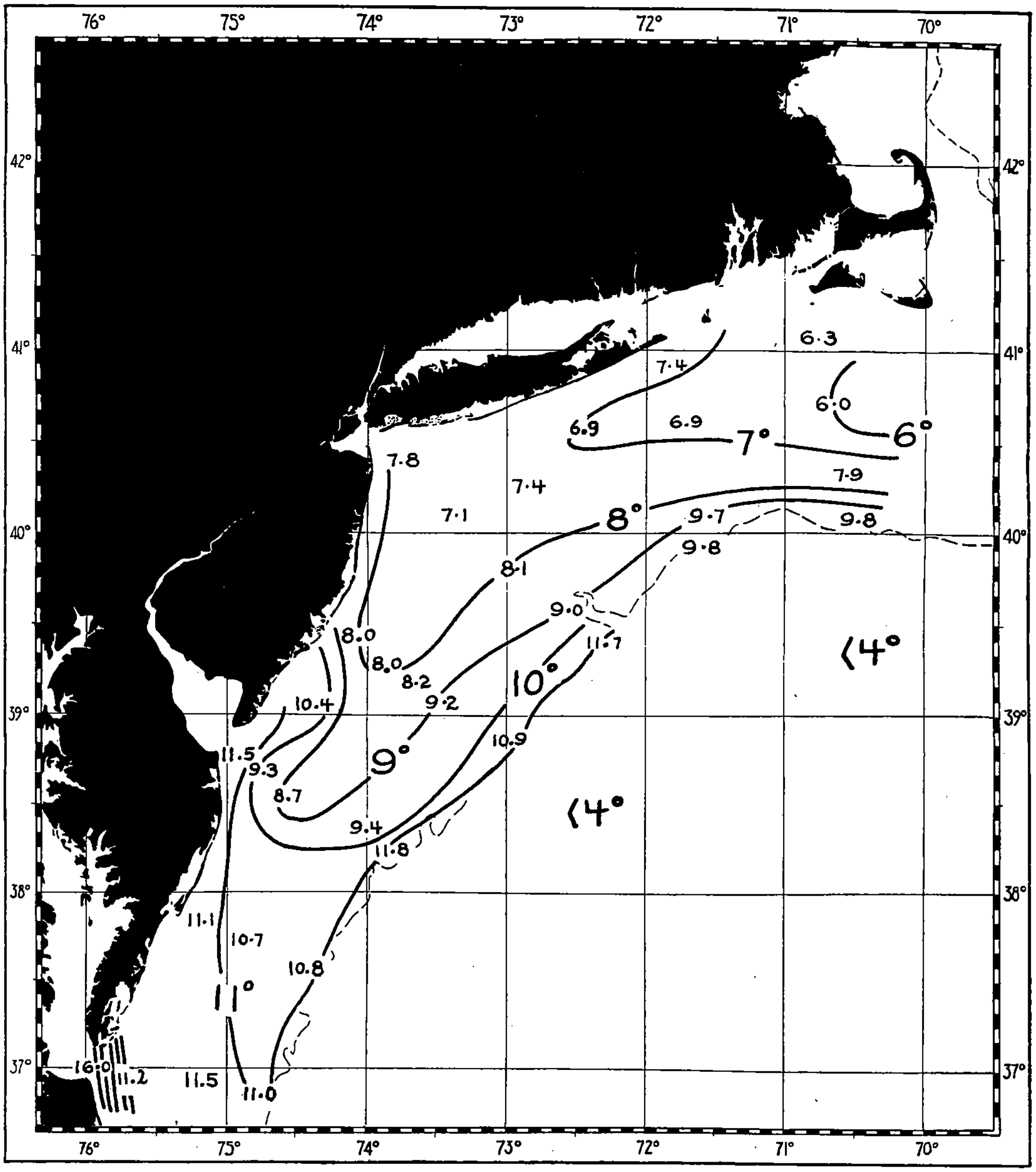

FIG. 29.—Temperature near the bottom out to the 200 meter contour line, May 12–23, 1930.

So effective is the insulation of the bottom water by the warm (hence light) surface stratum, once the latter is established, that horizontal projections of temperature, at depths of 30 meters or so, show much the same pattern at the end of May as in April except for temporary and local distortion of the isotherms such, for example, as was caused in 1930 by an intrusion of warm (>11°) offshore water over the edge of the shelf off Cape May (Fig. 19B), the effects of which were, however, so transitory that no evidence of it was found there a month later (Fig. 28B). But the distribution of temperature over the bottom is made more complex by the middle of May (Fig. 29) than at any time earlier in the season, by the warming that has taken place in small depths next the land, combined with insulation against the penetration of heat from above in deeper water farther out; combined also with the effects of chilling from the east—at least in some years.

The net result in most years (e.g. 1928, 1930, 1931, 1932) is that by the last half of May the low bottom temperatures that persist along the mid- and outer zones of the shelf from the offing of Delaware Bay northward[15] have become enclosed by water warmer than 9°–10°, not only offshore as previously, but right across the shelf to the south as well, and likewise on the inshore side, where the belt within which the bottom has warmed above 9°, by this date, is of considerable width as far north as latitude about 39°30′ in most years (Fig. 29). To the eastward of New York, however, it is still so narrow that none of the stations there, for May, have fallen within it. And 1927 was a tardy season all along the coast, so far as the warming of the inshore belt was concerned.

As a result of these events, the extent of bottom water warmer than 10° greatly expands during the late spring (cf. Fig. 20 with Fig. 29). On the other hand, the warm (>9°) water along the edge of the continent is wedged away from actual contact with the bottom as far west as longitude 70° in late spring, at least in some years (e.g. 1920—see Bigelow, 1927, p. 571), by expansions of much colder slope water from the east; to press back once more against the slope to the eastward as this cold water mass contracts during the early summer (p. 81). But there is no evidence that a definite separation of warm bottom water from actual contact with the slope ever extends past longitude 70°, for all bottom readings so far recorded in May along the critical zone farther to the westward, whether of late years or by the "Albatross" in 1883, have been higher than 8.4°.

The late spring also sees alteration of another sort near the outer edge of the shelf (helping to explain the summer state) in the assumption of a wedge-like conformation by the offshore boundary of the coldest bottom water, indenting more or less into the warmer waters farther out; and most of the profiles that have been run after the middle of May have shown something of this sort.

In 1928, this development had commenced all along the slope north of latitude 38° sometime prior to the last week in May, for evidence of it appeared both off Cape May and off Montauk, the latter profile (May 25–30) being made especially interesting by a very abrupt transition from low temperatures (6°–8°) along the 80–100 meter contour zone to considerably higher (12°–15°) temperatures only five miles farther out at sea.

In May of 1930, this shelf-like extension, seaward, of the water colder than 8°–9° was most pronounced off New York and for a few miles to the southward (Figs. 27, 28), but seems not to have extended much to the south of Cape May. In 1932, however, the outermost stations showed some evidence of it on the southern profiles (Cape May and Winterquarter Lightship) by the 3–5th of May, as well as on the northern (Martha's Vineyard, New York).

[15] 4°–5° in 1927, 6°–7° in 1928, 7°–8° in 1930, 5°–6° in 1931 and 5°–8° in 1932. Surface readings only were taken in May, 1929.

Annual Variations in Vernal Warming

The variations in the seasonal schedule and in the thermal efficiency of two of the processes that effect the progress of vernal warming—chilling by drifts from the east and warming by water from offshore—are discussed above (p. 30, 31). Since mass-movements of water of these two categories have their causes outside of the geographic limits of the area now under discussion, there is no *a priori* reason to assume that such abnormalities as they may cause from year to year in the rate of vernal warming within these limits would correspond to abnormalities resulting from local variations in the amount of sunshine, temperature of the air, or strength and prevailing direction of the wind. Consequently the combination of all these disturbing factors might tend either to increase or to decrease whatever abnormality—one way or the other—might exist at the season of winter minimum in any given year. The difference between 1929 and 1932 did, in fact, decrease during the early spring over the inner half of the shelf, from late February, when 1929 was 2°–5° the colder year (surface to bottom) to late April, when surface temperatures averaged only 1°–2° lower in 1929 than in 1932 and when the average difference between the two years was less than 1° at the bottom. But the change was of the reverse order over the outer edge of the shelf in the eastern part of the area, where the surface, differing little between the two years in February, was 3°–4° colder in April of 1932 than in April of 1929, and where an indraft of ocean water in 1929 (p. 32, cf. Fig. 7 with Fig. 20) was responsible for bottom temperatures some 5° higher in April of that year than in April of 1932, instead of about 2° lower, as had been the case in February.

A more general survey of annual differences can be made for May, because so many years are represented in the observational series for that month,[16] that the resultant means (p. 40) for the third week of the month may be accepted as representative within a degree or two, though differences, from year to year in date and location of observing stations, preclude any great degree of precision. According to this calculation the surface continued about 1°–1.5° warmer than usual through May of 1932 along the coastwise belt as far south as Cape May, but was about of average May temperature near Chesapeake Bay, and about 2° below average over the outer part of the shelf in the offing of the latter in the third week of the month.

On bottom,[17] the May readings for 1932 about equalled the six years average over the shelf as a whole outside the 20 meter contour, between the offings of Cape May and of New York, were fractionally lower than usual further east, and about 1° higher than usual off Chesapeake Bay to the south.

That is to say, the considerable plus-abnormality of temperature which characterized the late winter of 1932 among the years of record had been largely obliterated by the last week of May at the surface, almost entirely obliterated at the bottom. In fact, 1930 —a year in which the winter minimum was several degrees lower over the whole inner half of the shelf than in 1932 (cf. Fig. 3 with Fig. 6)—was appreciably the warmer year at the surface by late May, being about 1°–2° warmer than the mean across the shelf out to the 150 meter contour off Martha's Vineyard; about 0°–1.5° warmer off New York; about 1°–2° warmer off Cape May and about 1.7°–3° warmer than usual off Chesapeake Bay. On bottom, however, the late May readings for 1930 were within 1° of the average

[16] 1927–1932.

[17] Available data do not allow annual comparison of bottom temperatures for May in shallow water close in to land, because of differences in the depths at which readings were taken at the stations nearest the coast.

over most of the shelf. But in 1928, when the surface readings for May were on the whole close to the average over the inner half of the shelf, water warmer than 14° lay closer in than in any other year of record at this season (cf. Fig. 24 with Fig. 25), while the bottom was about 1° warmer than average, from the offing of Delaware Bay northward and eastward.

Turning now to years showing abnormalities of the opposite order—i.e. cold—we find 1929 averaging between 1° and 3° colder than usual at the surface over the outer part of the shelf as a whole in May, though inshore this was true only as far west as the vicinity of New York (Fire Island Lightship), to the south of which the Lightship values for that May were close to the mean. Unfortunately no subsurface temperatures were obtained in that month. In May of 1927, however, when the surface was similarly 1°–2° colder than usual along the offshore parts of the shelf as far west as the New York profile, this abnormality extended to the deeper waters as well, with bottom temperatures averaging 1°–1.7° below the mean for the month and with the transition abrupt from bottom water colder than 6° over the shelf, generally, to the usual bottom values of 9°–10° along the continental edge.

This rough annual comparison is enough to show that in no year of record has the water of this region as a whole been much colder than usual in May, or much warmer. And this applies, in particular, to the warm bottom zone along the edge of the continent, between the 150 and 250 meter contours, where the extreme range recorded for May has been only from 9.4° to 12.1°.[18] This leads to the generalization that abnormalities—whether cold or warm—that may develop in the winter, usually tend to vanish during the spring.

SUMMER

JUNE

Surface. In the year 1932 vernal warming had raised the surface temperature to 12°–14° right across the shelf off Martha's Vineyard by June 15th–19th; to 17°–18° off New York; to 19°–20° off Cape May and the Coast of Virginia.

This agrees closely with the following average temperatures for mid-June at representative lightships:[19]—

LIGHTSHIP	1928	1929	1930	MEAN
Cape Charles	18.5°	20.0°	21.0°	20.0°
Five Fathom Bank	17.0°	18.5°	19.5°	18.5°
Fire Island	15.0°	15.5°	15.5°	15.5°
Brenton Reef	14.0°	13.5°	16.0°	14.5°
Nantucket	9.0°	9.0°	11.0°	9.5°

These values combined with the isothermal distribution indicated for 1932 (Fig. 30) show that the mean latitudinal difference (about 6°–8°) between the northern extreme of the area (lat. about 41°) and the southern (lat. about 37°) is about the same in June as it is in May of years such as 1929 (Fig. 23) and 1930, with the temperature now close to uniform from the land seaward along any given profile normal to the coast line.

According to scattered observations for different years, the thermal contrast which develops in April or May between the surface waters to the westward of longitude about 70°30′ and the Nantucket Shoals region to the eastward (p. 35, Fig. 26) increases through

[18] Ten determinations in May, in five different years.
[19] Scaled to the nearest 0.5° from Parr's (1933 Figs. 8–10) diagrams.

June, until readings 4°–6° higher are to be expected by the last week of the month in the offing of Martha's Vineyard and to the west than over the Shoals nearby. Thus, surface readings over the Shoals for various dates during the last half of June, of the years 1923, 1925, 1927, 1929 and 1930, have ranged between 9° and 12°. It seems, however, that the

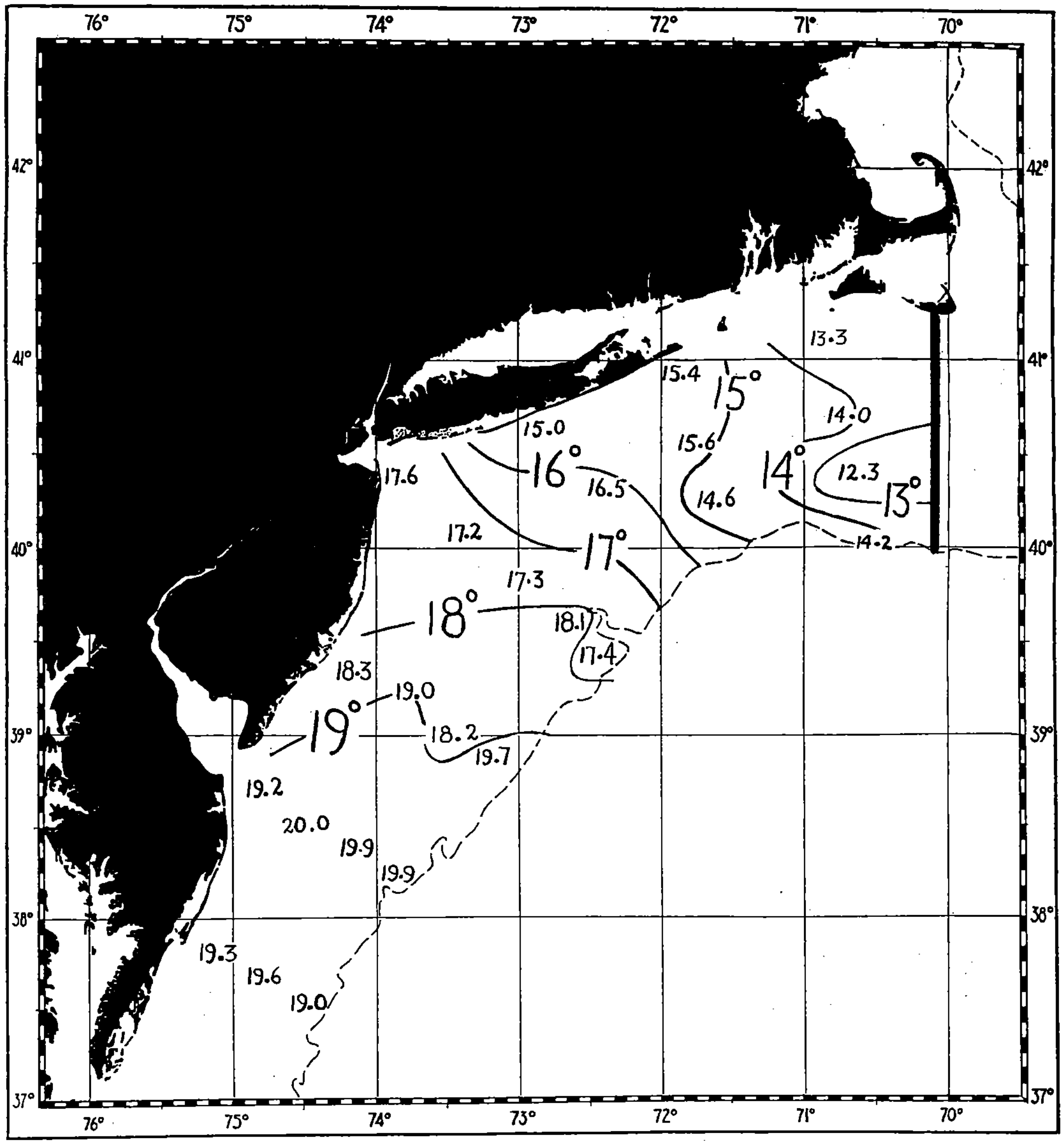

FIG. 30.—Temperature at the surface, June 15–21, 1932.

zone of most abrupt transition shifts some miles to the eastward during the last half of the month; judging, at least, from 1932, when the surface along a profile abreast of Martha's Vineyard warmed from 12°–14° on June 19th to 15°–17° on the last day of the month.

On the other hand, the Cape Hatteras convergence is entirely obliterated by June, as Parr (1933) has pointed out.

Subsurface. The chief alteration in subsurface temperature that takes place over the shelf from May through June is that the steepness of the vertical thermal gradient increases in the upper strata, with the preëxisting state persisting in the deeper levels. The result is that by mid-June the shelf as a whole is characterized by the presence of a stra-

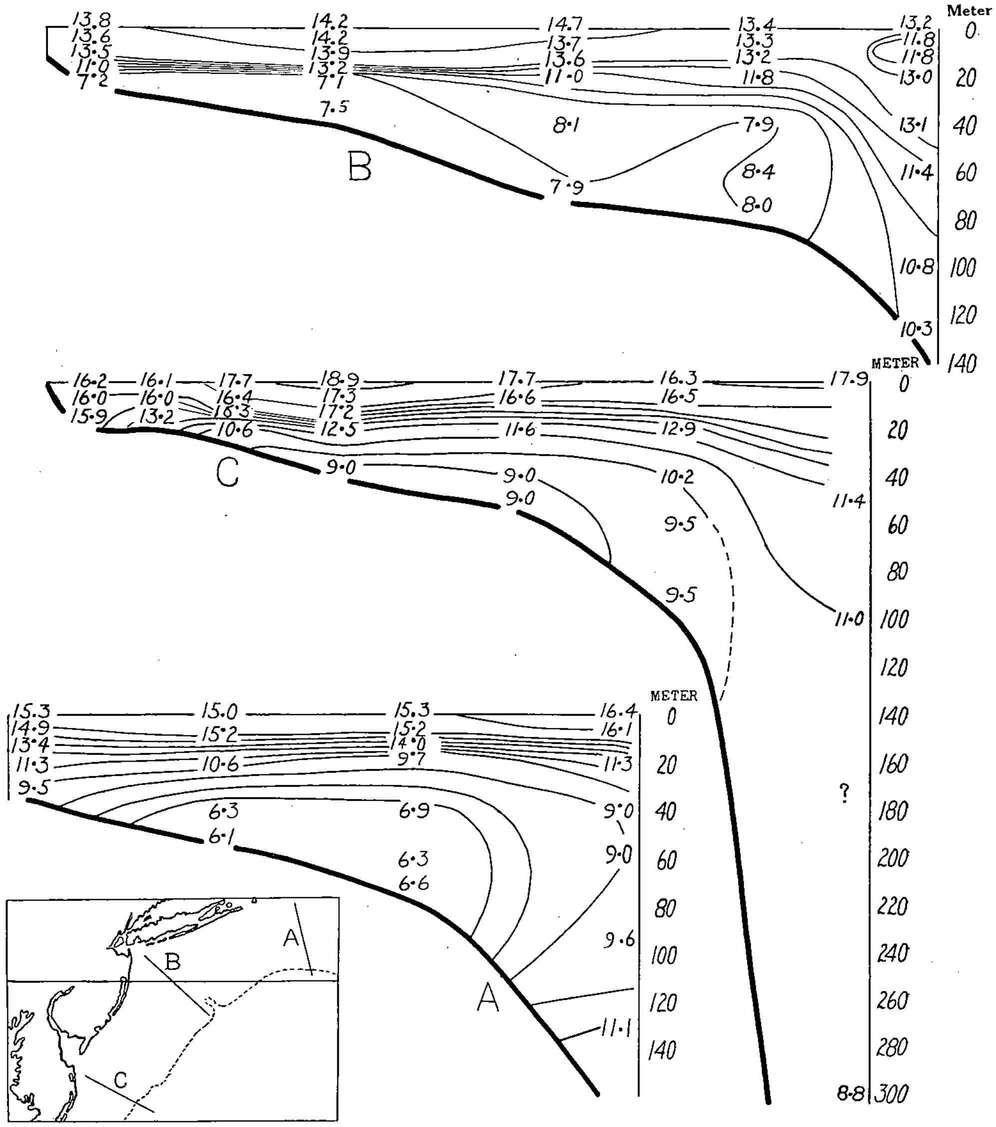

FIG. 31.—Temperature profiles crossing the continental shelf, June 8–14, 1930:—A, off Martha's Vineyard; B, off New York; C, off Cape May.

tum of comparatively homogeneous bottom water of low temperature, projecting, more or less shelf-like, into warmer waters over the slope offshore and overlain by a stratum in which temperature changes very abruptly with decreasing depth to the much higher surface values just discussed (Fig. 31). In the years 1930 and 1932 the mid-June temperature of this homogeneous bottom water along the mid-zone of the shelf ranged from 5°–7° eastward of New York to 8°–9° off Cape May; presumably to 9°–10° off Chesapeake Bay (Figs. 31, 32). In June its upper boundary generally lies near the 30 meter level, but the stratum within which the thermal gradient is most abrupt varies from station to station in its depth below the surface.

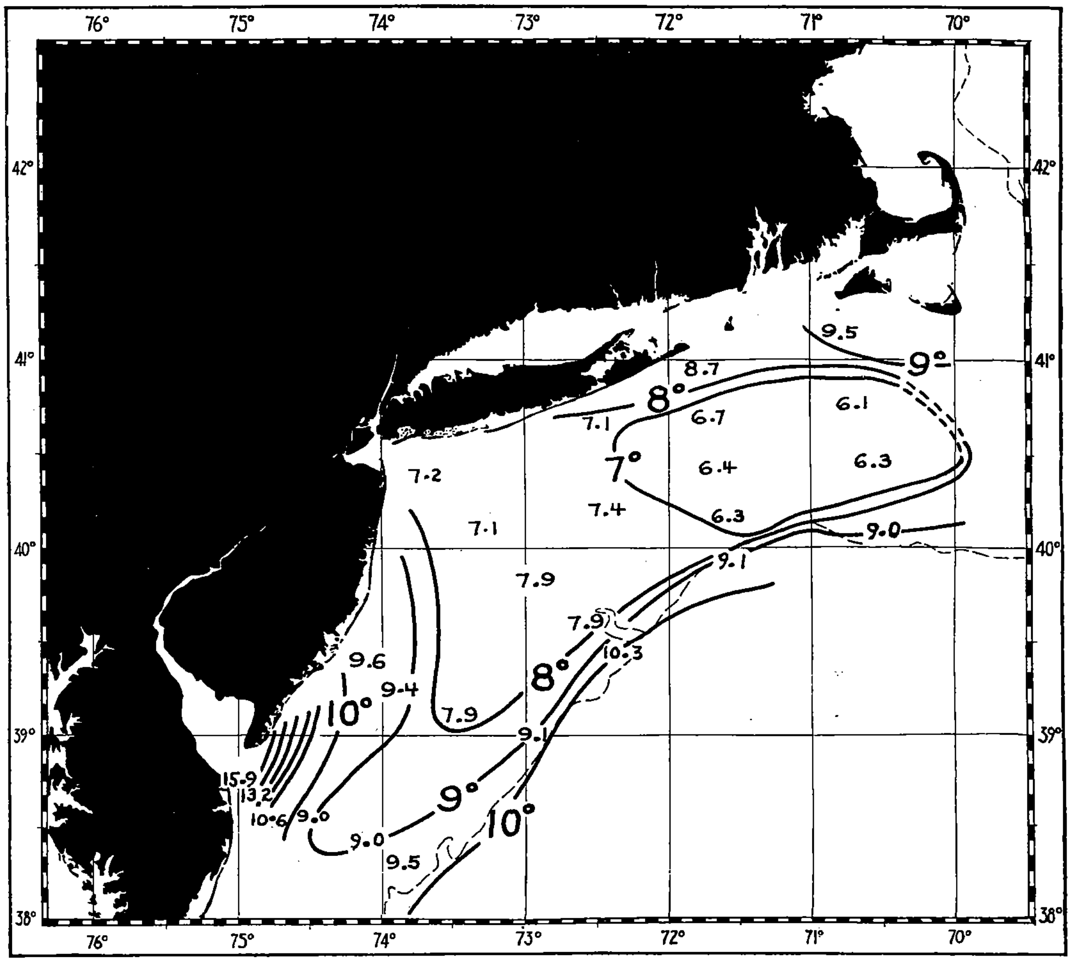

FIG. 32.—Minimum temperature irrespective of depth in the upper 200 meters, June 6–14, 1930.

This development of the vertical gradient with the advance of the season is better illustrated by temperature curves for successive stations (Fig. 22) than verbally.

In general, our profiles for June (Fig. 31) have shown the thermal gradient as most abrupt midway out on the shelf, with the successive isotherms spaced more widely along the edge of the continent offshore on the one hand, sometimes close in to land on the other as well. But considerable variation has been recorded in this respect, on corresponding profiles for the month in different years. Off New York, for example, where nearly the whole thermal range (13.9°–7.1°) was included between the 15 and 20 meter levels on June 8, 1930, the gradient was nearly uniform from 10 meters down to bottom in 35 meters on June 7, 1932. Nor have our surveys been sufficiently detailed to associate variations of this sort with definite causes in individual cases.

By the first part of June the waters over Nantucket Shoals have become as definitely

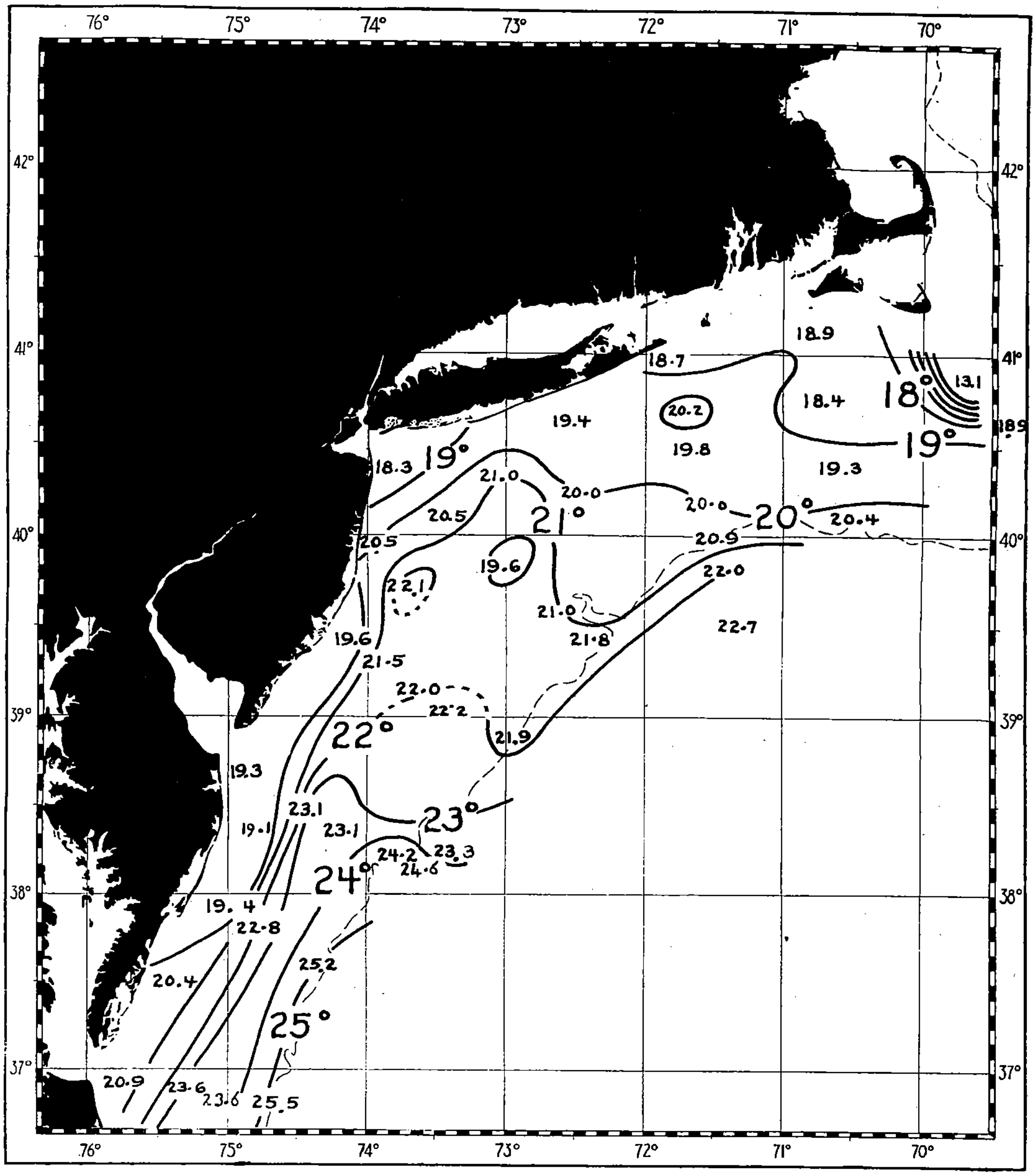

FIG. 33.—Temperature at the surface, July 14–25, 1929.

set apart from the regions farther west by the vertical distribution of temperature as they are by low surface values (p. 48), for, while we have found a wide difference between surface and bottom temperatures at some June stations on the Shoals, the water has been close to homogeneous at others close at hand, as may be illustrated by the situation at three representative localities on June 16–17, 1927:—

	A	B	C	D
Depth in Meters	Round Shoal Buoy	10 Miles ENE from A	17 Miles ESE from A	Near B
0	9.4°	11.7°	9.7°	7.8°
16–18	—	5.8°	6.5°	7.6°
23	9.1°	—	—	—
27–29	—	5.6°	—	7.6°
32	—	—	6.4°	—

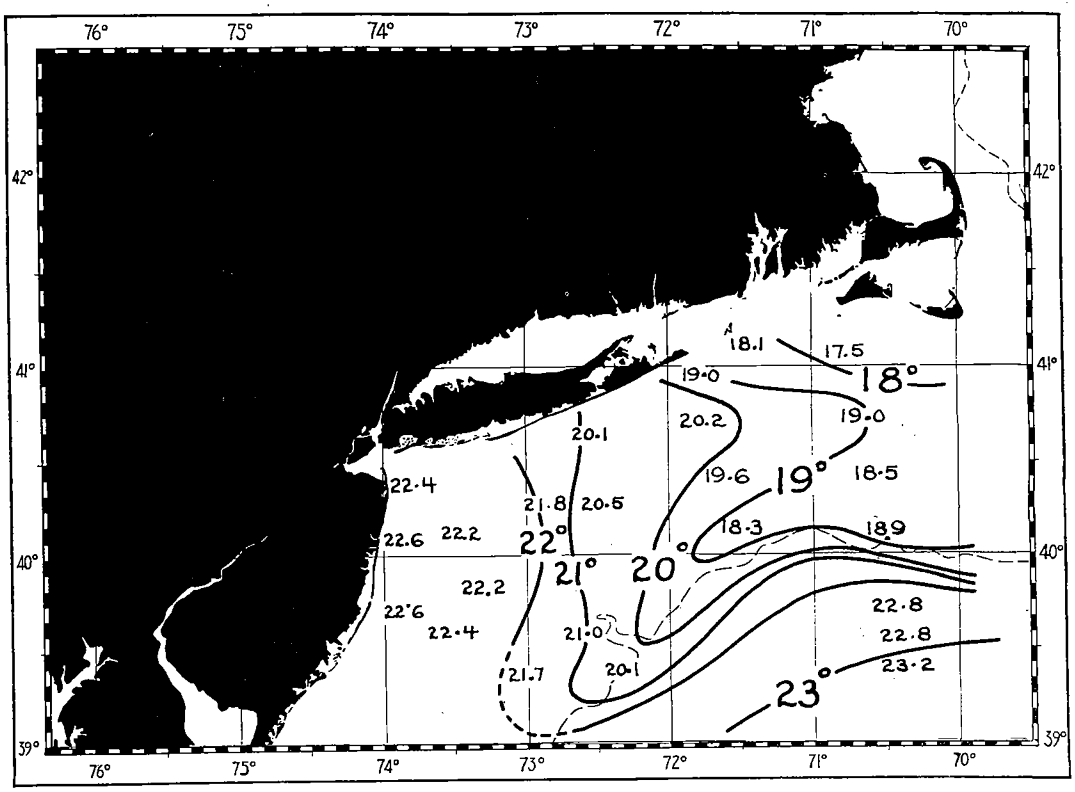

Fig. 34.—Temperature at the surface, July 10–16, 1931.

JULY–AUGUST

Surface. General surveys of the area in July of 1913 (Bigelow, 1915) and of 1929, with a less extensive examination in 1930, combined with surface temperature-records at lightships, show a somewhat narrower latitudinal difference between the southern and northern parts of the area (4°–5°) than prevails in June (6°–8°, p. 47), but on the average a somewhat more pronounced gradient along any given profile, from lowest readings next to land to temperatures 2°–5° higher at the edge of the continent (Figs. 33–34).

By the last half of July surface readings of 18°–21° are usual in the coastwise belt from Martha's Vineyard to Cape May in normal summers. The lowest surface reading actually recorded within these geographic limits on the recent July cruises has been 17.2°,[20] while the lowest recorded by Libbey between longitudes 70° and 72° for August was 18°. But it would not be at all surprising if still lower surface values should occur close in along the coast, during periods of offshore wind and consequent upwelling. Such an event was, in fact, reported early in July of 1932, along the coast of New Jersey, but without exact data.

The surface temperature next to land reaches 20°–24° abreast of the northern headland of Chesapeake Bay by mid-July. But it is evident that conditions close in to the mouth of the Bay are widely variable at this season—more so than they are anywhere out at sea or to the northward—for warmer surface water (26°) was encountered there in July of 1913 than in that month of 1929, or than is recorded by Parr (1933) for Cape Charles Lightship. No doubt this high reading was caused by surface discharge from the Bay, for Cowles (1930) records water as warm as 27° on the southern side of its mouth in August. But it seems that the outflow from Delaware Bay has little effect on sea temperatures off Cape May at its mouth, where mean values for July fall between 20° and 23°.

By the middle of July temperatures as high as 24° are to be expected along the continental edge about as far north as the latitude of Cape May, with 21°–22° at the same relative position off New York and 19°–20° off Martha's Vineyard. In unusually cold summers as illustrated by 1916 equal values may not be reached along this zone until a month later.

Observations taken at lightships and lighthouses through the five year period 1881–1885 (Rathbun, 1887), and again from 1928 to 1930 (Parr, 1933) show that the surface temperature of the coastwise belt from Chesapeake Bay to southern New England reaches its annual maximum sometime between the last week of July and the middle of August—occasionally even later—any latitudinal difference that may exist in this respect between these boundaries being overshadowed in the available data by much wider fluctuations from station to station and from year to year. On Nantucket Shoals, however, the maximum ordinarily is not reached until well into August, or even in September. The rate of alteration declines as the surface temperature approaches its maximum and there then ensues a period when it remains close to stationary. In the northern part of the area this state may endure for two to three weeks or even longer, according to Parr's (1933, Fig. 13) diagram of mean temperatures, but only for a week or so in the southern, as represented by temperatures at Cape Charles Lightship. The existence of this quiescent period offers opportunity for detailed study of the thermal situation at the one extreme of the annual cycle, just as the quiescent period at the end of winter does at the other extreme.

Judging from the regional conformity encountered, as well as from the facts that surface values were appreciably higher than are to be expected in July, and that they did not differ much from the thermograph records for Sept. 3–9, 1929 (Church, 1932, Fig. 5), it is probable that profiles run by the "Atlantis" between the offings of Chesapeake Bay and of New York, September 3–10, 1932 (Fig. 35) fell before appreciable cooling had occurred. These data combined with the numerous observations taken off Martha's Vineyard in 1889 (Libbey, 1891) and at lightships for the periods 1881–1885 (Rathbun, 1887) and 1929–1930 (Parr, 1933) show the following approximate maxima:—

[20] Off New York Harbor, July 13, 1913 (Fig. 43).

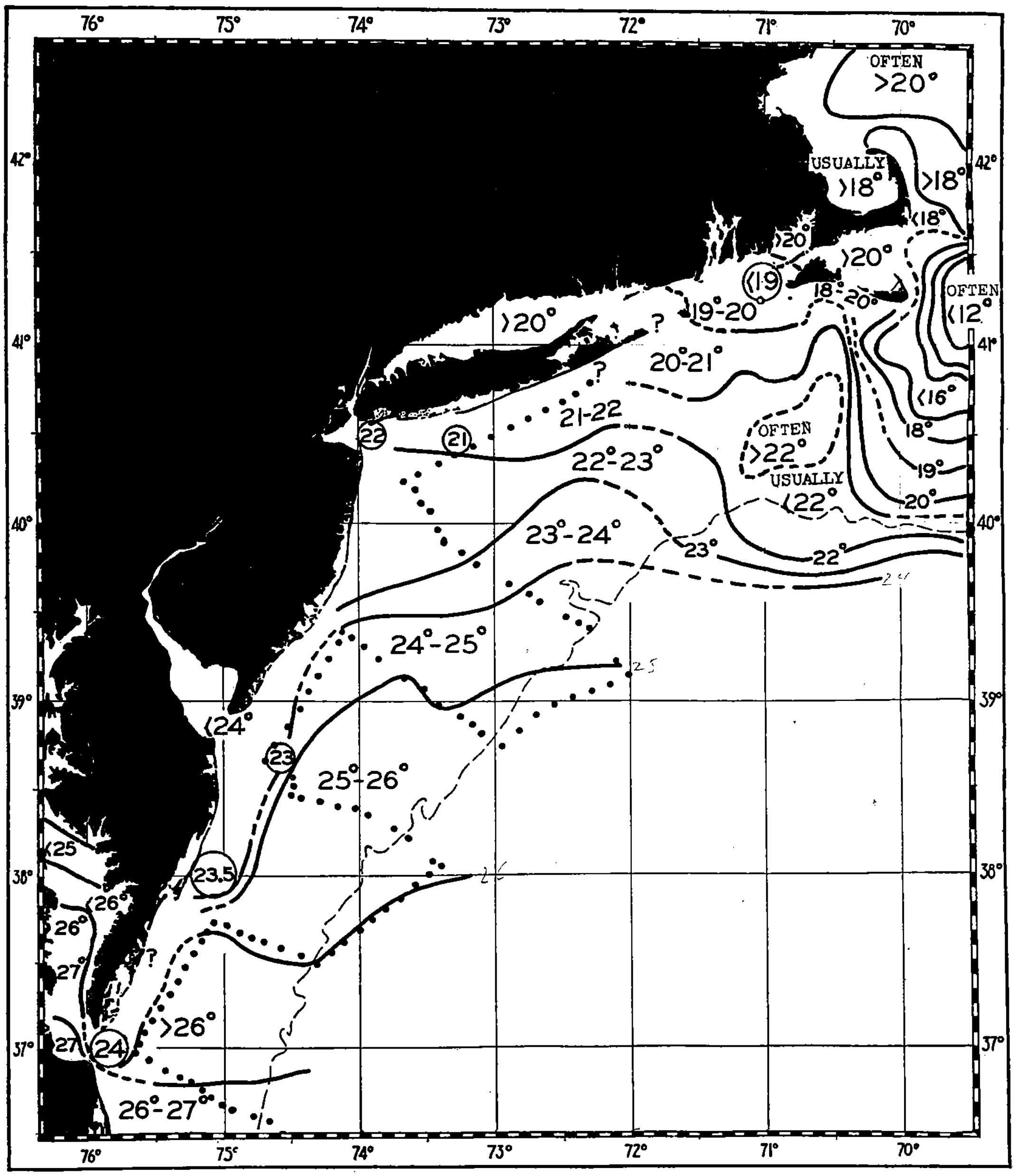

Fig. 35.—General distribution of temperature at the surface at the warmest season. The isothermal pattern to the westward of longitude 72° is based on hourly readings taken by the "Atlantis," September 3–8, 1932, at the localities marked by small dots combined with mean values at lightships (readings enclosed in circles) for the summers of 1928–1930, scaled to the nearest 1.0° from Parr's diagrams (Parr, 1933, Figs. 8–10). Readings in Chesapeake Bay are from Cowles (1930). Isotherms to the eastward of longitude 71°30′ are based on observations of the U.S. Bureau of Fisheries in various years, as described on page 56.

Lightship		Profile	Midway out	Edge of Shelf
(Close to land)	18.0°–20.0°	Martha's Vineyard[1]	21°–22.0°	21°–22.0°
Brenton Reef[2]	19.0°–20.5°		—	—
Sandy Hook[3]	21.4°–23.5°	New York	22°–24.4°[5]	24.4°[5]
Fire Island[4]	20.5°–22.0°		—	—
Five Fathom Bank[2]	21.5°–24.5°	Cape May	25°–25.3°[5]	±25.0°[5]
Winterquarter[2]	23.0°–24.5°	Latitude about 38°	±26.0°[5]	±26.0°[5]
Cape Charles[4]	23.0°–24.5°	Chesapeake Bay	26°–27.0°[5]	26.6°[5]

[1] U.S. Bureau of Fisheries records, 1875–1889.
[2] Scaled to nearest 0.5° from Rathbun's (1887) and Parr's (1933) diagrams.
[3] 1881–1885 only.
[4] 1928–1930 only.
[5] Sept. 3–8, 1932.

Available data show that the maximum surface temperatures are only slightly higher southward from Chesapeake Bay along the coast past Cape Hatteras, the mean maximum at Diamond Shoal Lightship being about 28° (Parr, 1933).

The latitudinal gradient in surface temperature at the warmest season is thus about 4°–5° for the sector between the offings of Martha's Vineyard and Chesapeake Bay, whether close to land, midway out on the shelf, or along the slope of the continent. This is a difference of about 1° per degree of latitude, which corresponds closely to Krummel's (1907, p. 401) calculation that over the oceans as a whole at about this latitudinal belt, the mean change of surface temperature per degree of latitude is 0.8°. The south-north difference is also of about this same magnitude in enclosed bays. Thus the surface warms to 25°–27° in Chesapeake Bay (Fig. 35; Cowles, 1930), but only to about 20°–22° in Buzzards Bay and in Vineyard Sound near Woods Hole.

Such evidence as is at hand suggests that as the surface temperature approaches its maximum, the thermal gradient transverse to the shelf decreases throughout the sector to the west and south of the offing of New York, but there is little alteration in this respect farther east. And, it is not till considerably later in the season that this tendency toward equalization causes any serious alteration of the isothermal pattern described on page 52 as characteristic of July, the water still continuing 2°–3° cooler close in along the shore than it is midway out on the shelf (cf. Fig. 35 with Fig. 33).

The data allow only generalized plotting of the isotherms for maximum temperature to the southward of New York, it being doubtful how closely the state existing in the first week of September of 1932 agrees with the mean for the particular series of years for which the lightship maxima were calculated (see table above). We also lack definite information as to whether the low temperature off the northern side of the mouth of Chesapeake Bay (mean maximum about 24° at the lightship) is continuous northward along the coast with the still cooler surface belt off Delaware Bay, as seems likely; or whether these are cool pools resulting from local causes as the cool pool (<19°) off the mouth of Vineyard Sound certainly is. Neither is it certain whether the transition from low coastwise to higher offshore temperatures to the southward of Cape May is normally as abrupt as the combination of data for 1932 with those for 1928–1930 would make it appear. It is probable, however, that the thermal distribution outlined in Figure 35 is at least a fair approximation of the average state for the warmest season. And this seems certainly the case to the eastward of longitude 72° where the surface temperature was recorded by the vessels of the U. S. Bureau of Fisheries at many localities in August and early September of 1880–1882, 1884–1885 and 1889, as well as more recently.

In some years—1929 for example—cool tongues develop along the outer part of the shelf from the north east at the warmest season (Church 1932, Fig. 5) much as happens in Spring (p. 30). But no trace of this was encountered in September of 1932 (Fig. 35).

The data for 1889 (apparently a normal summer), when Libbey (1891) made his well known survey from the coast out across the continental shelf, may serve as representative of the offing of Martha's Vineyard. In analyzing these, diurnal variation must be taken into account, for the difference between the coldest and warmest period of the 24 hours at a given locality may be wider than the on- and offshore gradient across this part of the continental shelf at this time of year.[21] The stage of the tide may also be a disturbing factor. In order to arrive at median values the readings for the midnight and mid-day periods (10 P.M. to 2 A.M., and 11 A.M. to 2 P.M.) have therefore been plotted separately for successive ten mile zones out from the land. And the means for these two series proved to agree closely with corresponding means for all the stations in each of the several zones, including other times of day as well.[22]

According to these calculations, combined with earlier observations by the vessels of the U. S. Bureau of Fisheries and with the very extensive series taken more recently in Vineyard Sound and Buzzards Bay (Sumner, Osborne and Cole, 1913, Chart 211; Fish, 1925), the surface in enclosed bays along this part of the coast warms to upward of 20°–21°. But next the coast, outside, where the effects of tidal stirrings, and of upwellings caused by transport of surface water offshore by the wind, are most apparent, the summer maximum is usually only 18°–20°. In 1889 this cool coastal band averaged some 20 miles in breadth off Martha's Vineyard. Farther out over the shelf as a whole, the summer maximum on this profile is 21°–22° (locally often >22°), the isotherm for 22° usually lying a few miles out beyond the continental edge, with the surface temperature rising above 23° some 10–15 miles farther offshore.

An apparent tendency of surface water warmer than 21° to approach the coast more closely off Martha's Vineyard than immediately to the westward deserves attention, because of the frequency with which pelagic fishes, invertebrates and algae of tropical origin have been recorded along just this part of the coast. In August of 1889 also, a rather definite pool of surface water warmer than 22° developed midway out on the shelf on this same profile.

The most striking feature of the thermal pattern to the east of longitude 71°, in summer, is the abrupt transition from the comparatively warm (>20°) surface water off Martha's Vineyard and the much colder water (<14°) over Nantucket Shoals thirty miles or so to the eastward, emphasized on the chart (Fig. 35) by the courses and by the close crowding of the isotherms for 19°, 20° and 21°.

General information is to the effect that conditions existing in August 1889, when these isotherms crossed the shelf from north to south near longitude 70°30′ (Fig. 35), approximated the average state for the month. And the boundary marked by this convergence belt may be regarded as dividing the continental shelf into two major regions, for to the westward of it there are no extensive cool surface pools (caused by turbulence) of the sort that are such prominent hydrologic features farther east, i.e. on Nantucket Shoals, on Georges Bank and in the Bay of Fundy.

The presence of cold surface water, in summer, over the irregular bottom off Nantucket Island, known as Nantucket Shoals (representing the end result of the thermal contrast developing in spring as described above) has long been a matter of common

[21] For details see Libbey's (1891) graphs.

[22] Libbey's 84 stations were arranged at 10 mile intervals, along lines normal to the coast, 10′ of longitude apart, between 70° and 71°30′.

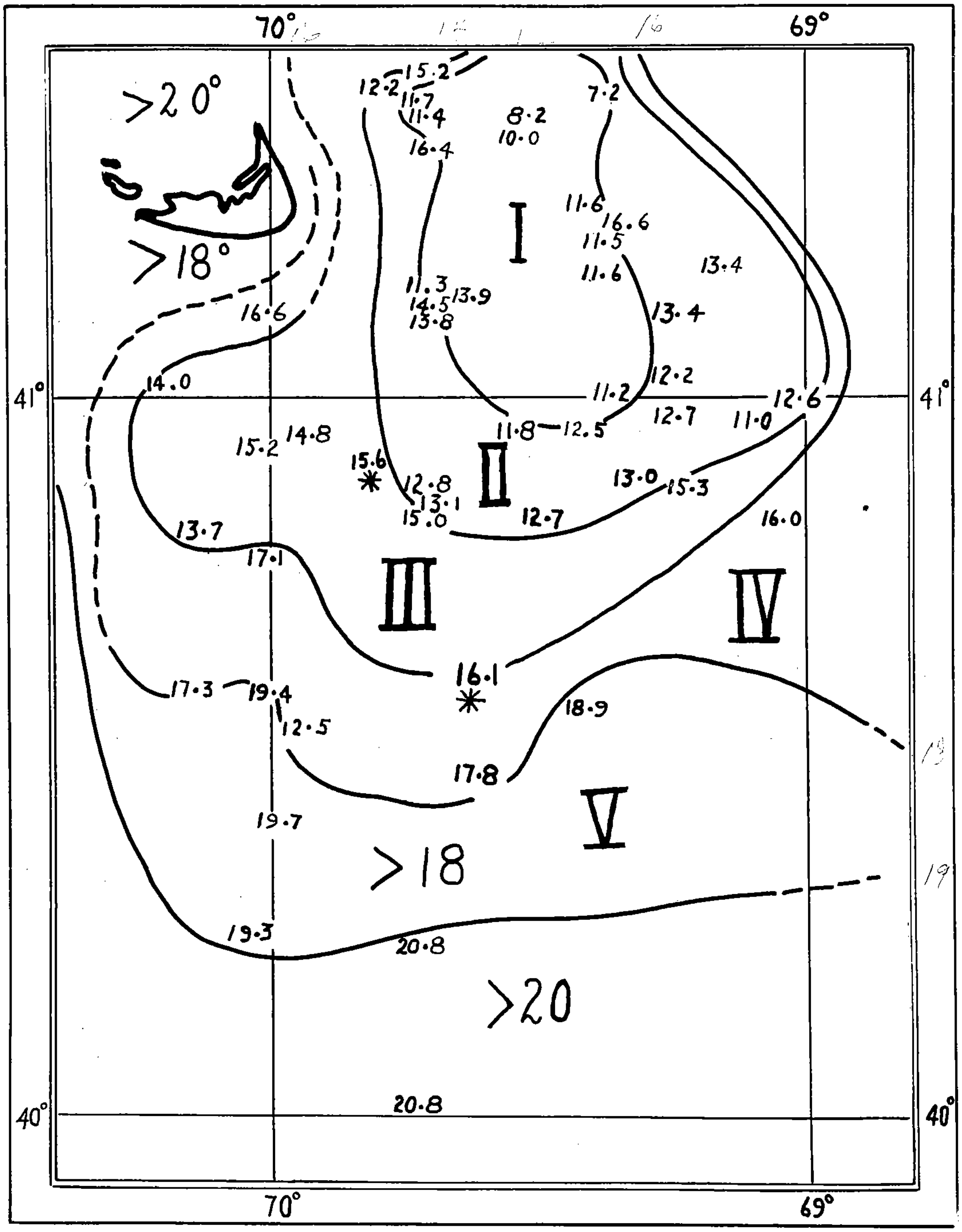

FIG. 36.—Normal distribution of temperature at the surface in the region of Nantucket Shoals for July–August, from the records for 1923–1932 combined. The starred readings are the mean maxima at Nantucket Lightship, old and new positions, for the summers of 1881–1885 and 1928–1930, scaled from Rathbun's (1887) and Parr's (1933) diagrams.

knowledge, and this locality is so important from the standpoint of the fisheries that a detailed account of our observations there seems called for.

It is at the end of the summer, i.e. when the surface water is warmest, that the distribution of surface temperature over the Nantucket Shoals region is most complex and most variable, as might indeed be expected.

However, a consistent regional pattern results when all the surface readings for mid-July to mid-August of the several years of record are plotted (Fig. 36), most of the readings cooler than 12° being concentrated in a roughly oval area, near and to the southeast of Nantucket Island. It is also here that the lowest mid-summer readings have been recorded, namely 10° (July 15, 1924), 8.2° (July 16, 1928) and 7.2° (July 22, 1916). On the other hand, considerably higher readings have also been recorded there at times, as indicated on figure 36. In fact this region experiences the widest range of surface temperature (8.2°–16.6°, July-August) so far recorded in summer for any area of comparable extent between Chesapeake Bay and the Bay of Fundy—also the most rapid alterations.

Proceeding radially from this (usually) cool centre, we find the surface temperature rising until summer values of 16° and upwards are reached over the basin of the Gulf of Maine to the northeast, over the South Channel to the east, and over the smooth bottom along the inshore zone of the continental shelf to the west; upwards of 18° over the offshore zone of the latter, and upwards of 20° outside the 100 meter contour line.

This distribution shows a rather definite correlation with the topography of the bottom, the lowest readings being on the whole concentrated where the latter is the most broken by shoals less than 20 meters deep, and nearest to the cold water reservoir in the deep basin of the Gulf of Maine, with the surface averaging warmer and warmer out over smoother bottom.

It is perhaps worth emphasis that this area of cold surface water on Nantucket Shoals is surrounded on the north and east, as well as on the west and south, by much warmer water, being thus entirely separated from the cool pool which overlies the shoalest part of Georges Bank; still further separated, and by water warmer than 18°, from the cold surface in the northeastern part of the Gulf of Maine.[23] This bars out any possibility that cold water comes thither in summer at the surface. Hence, as the low readings occasionally recorded over the Shoals are considerably colder than the mean temperature of the water column in equal depths in neighboring localities either to the north or to the west at this season,[24] there is clear evidence of upwelling from the deep basin of the Gulf of Maine, as is discussed further, on page 78, in relation to bottom temperatures.

Rapid changes, within a few hours time, that have been recorded along the eastern edge of the shoals—as from 15.5° at 10.00 A.M. to 12.2° at 4.30 P.M. at Round Shoal Buoy on August 10, 1931—indicate that the effective agent for this upwelling is the pumping effect of the tides, which (at certain stages) drives cold bottom water up the sloping bottom, as has long been known to happen off Cape Sable, Nova Scotia (Dawson, 1922, p. 85; Bigelow, 1927, p. 593). On the other hand, the occasional high readings over the parts of the Shoals where surface temperatures rule low, show that other stages of

[23] These recent observations show that the earlier chart of summer temperature of the Gulf of Maine (Bigelow, 1927, p. 587, Fig. 46) needs correction, for the Nantucket Shoals region should be stated "8.5°–16°" instead of "14°–16°," and expanded in extent.

[24] Mean temperatures for the whole column at the 40 meter contour are about 12°–14° in Massachusetts Bay, and between 11° and 15° south of Martha's Vineyard.

the tide bring warm water surface water thither, either from the basin of the Gulf of Maine to the east or northeast, where a high degree of thermal stratification exists in summer, or perhaps from Nantucket Sound.

Surface readings of 19°–19.5°, one to two miles out from the southeast angle of Nantucket, but 14°–15° at distances of 5–10 miles out, recorded many years ago,[25] make it likely that a narrow band of surface water warmer than 18° normally intervenes between the coast line of Nantucket Island and the cold surface water of the Shoals, as indicated on Fig. 36. As this is a matter of considerable biologic interest from the standpoint of possible dispersal routes for animals of high temperature affinity, more detailed observations in this region are desiderata.

Annual variations in surface temperature in summer. Rathbun's (1887) graphs for 1881–1885 long ago showed that surface temperature varies considerably from summer to summer all along the coast, not only at any given date, but also in the maximum attained.

Lightship means for surface temperature for mid-July and approximate maxima for the year, for the periods 1881–1885, and 1928–1930, are as follows:—[26]

Lightship	1881	1882	1883	1884	1885	1928	1929	1930
Nantucket,[1] Mean.	14.5	15.0	15.5	14.0	14.5	13.5	14.0	12.5
Max.	15.5	—	16.0	16.0	16.0	18.0	16.5	18.0
Brenton Reef, Mean.	18.5	18.5	20.0	16.5	19.0	17.0	17.0	19.5
Max.	19.5	20.5	20.0	19.0	20.5	20.0	19.5	20.0
Fire Island, Mean.	—	—	—	—	—	20.0	20.0	20.0
Max.	—	—	—	—	—	22.0	20.5	20.0
Sandy Hook, Mean.	21.5	20.0	21.5	19.0	19.0	—	—	—
Max.	21.5	23.0	23.5	21.5	23.0	—	—	—
Five Fathom Bank, Mean	22.0	20.5	21.0	19.5	21.0	20.5	20.5	22.0
Max.	23.5	24.5	21.5	23.0	24.0	23.5	22.0	23.5
Winterquarter,[1] Mean.	23.5	21.0	19.5	19.0	22.5	21.5	21.5	22.0
Max.	23.5	25.5	23.0	23.0	24.0	23.5	23.0	24.0

[1] Old position, 1881–1885, new position 1928–1930.

It needs only a cursory glance at the preceding table to show that the series did not include any summer that could be classed as abnormally hot or cold, or abnormally advanced or tardy in seasonal progression for the coastal belt as a whole. Analyzed on the basis of the number of stations at which seasonal advance had progressed farthest, or least far by mid-July, and at which the maximum for the summer was highest or lowest, it appears that on the whole, the years 1881, 1883 and 1930 experienced the most rapid, 1884 and 1928 the slowest vernal warming; while the maximum for the summer was relatively high at most of the inshore localities in 1882 and 1928, relatively low in 1884, 1929 and 1930.

The following table summarizes the year to year differences that have been recorded at representative localities midway out on the continental shelf at approximately the same dates; several weeks, however, before the water is at its warmest.

	1913	1916	1929	1930	1931
	July 9–29	July 25–Aug. 21	July 11–31	July 11–14	July 11–14
Offing of Martha's Vineyard	19°–20°	16°–19°	18°–20°	19.0°–20°	18°–19.0°
Offing of New York	20°–22°	20°–21°	20°–22°	21.5°–22°	21°–22.5°
Offing of Cape May	21°–23°	21°–24°	20°–24°	—	—
Offing of Chesapeake Bay	24°–26°	22°–23°	20°–24°	—	—

[25] "Blue Light" Stations, 637–639, 671, 672, 674, 675; Smith, 1889, p. 898–899.
[26] Temperatures scaled to the nearest 0.5° from Rathbun's (1887) and Parr's (1933) diagrams of 5 day averages.

The fact that surface temperatures were no higher in August of 1916 (i.e. when near their highest for the summer), than in July of other years, or even lower, is one of the many clear evidences that this was an abnormal summer.

Vertical distribution. The distribution of temperature in the deeper strata, at one extreme at the end of the winter, when the water on the shelf is nearly homogeneous verti-

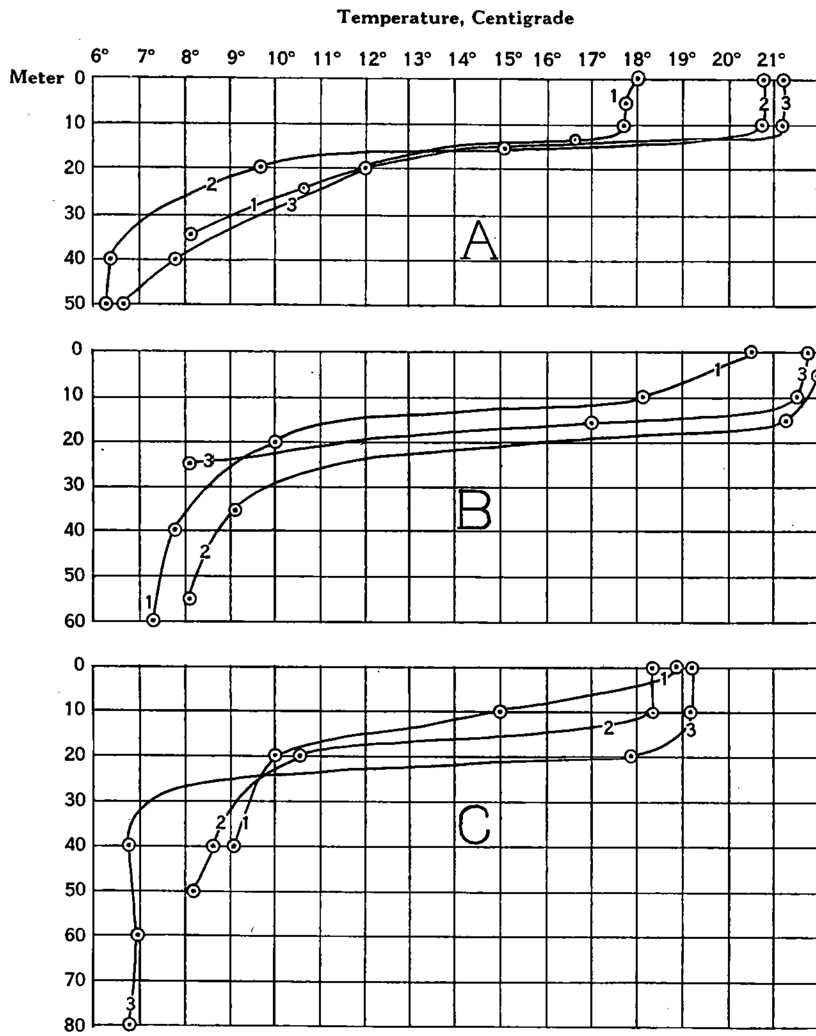

FIG. 37.—Vertical distribution of temperature:—A (above), off Montauk, Stations I (1), II (2) and III (3), July 10–11, 1930; B (center), off New York, Stations I (1), III (2) and Barnegat (3), July 12, 1930; C (below), off Martha's Vineyard, Stations I (1), II (2), and III (3), July 24–25, 1929.

cally, is at the other extreme between mid-July and early September, when the difference between surface and bottom temperatures is widest. In 1930, for example, the vertical range, in 35 meters of water in the immediate offing of New York, which was $<1°$ from February through April, about 5° in mid-May (p. 41) and about 7° by the first week of June, had increased to 12.5° by mid-July (Fig. 22). The vertical distribution prevailing over the shelf as a whole in July and August is a further development of the state characteristic of June. That is to say, we encounter, successively, a warm surface stratum within which temperature is close to homogeneous vertically, below this a stratum some 10 to 20 meters thick within which temperature decreases very rapidly with increasing depth, and below this thermocline a stratum extending down to the bottom within which the further decrease in temperature is gradual. In fact the bottom stratum some

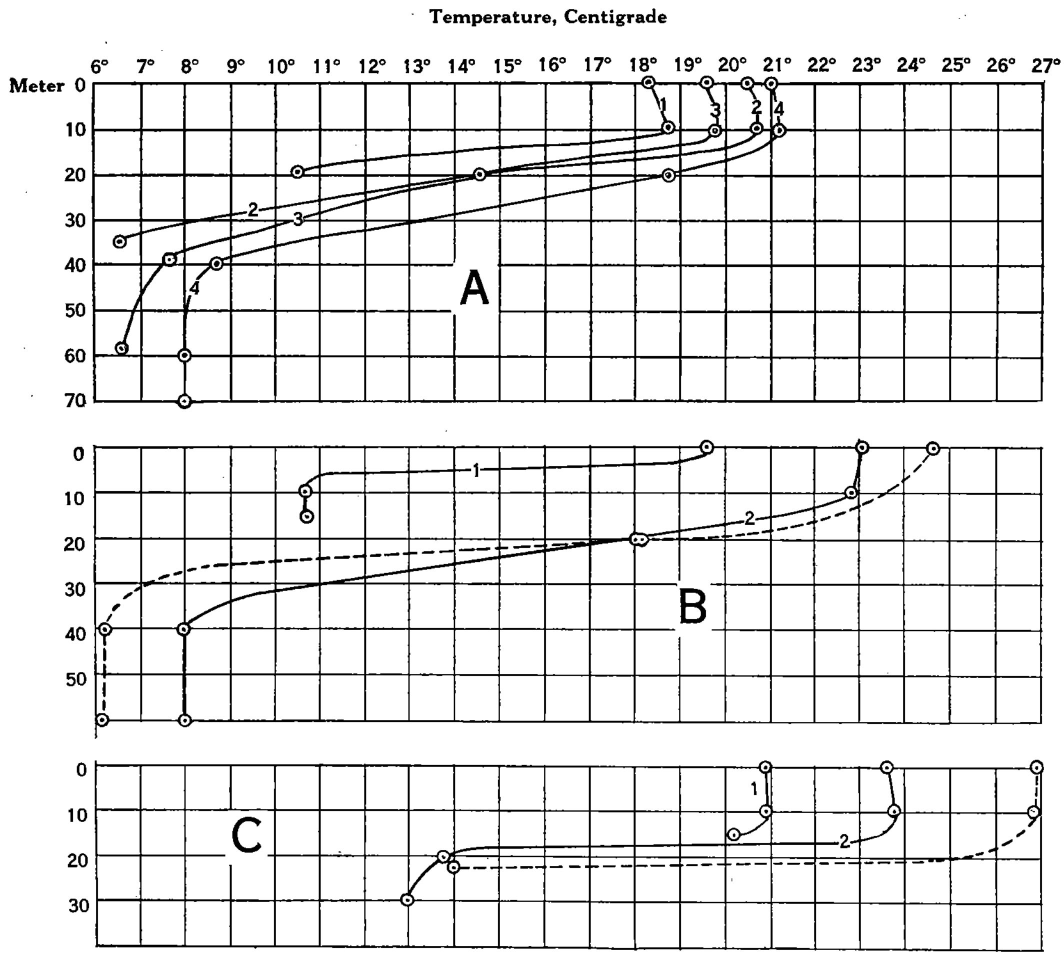

FIG. 38.—Vertical distribution of temperature:—A, off New York, Stations I (1), II (2), III (3) and IV (4), July 22, 1929; B, off Atlantic City, New Jersey, Station I (1) and Cape May Station III (2), July 14–18, 1929; also Atlantic City III, September 6, 1932 (broken curve); C, off Chesapeake Bay, Stations I (1), and III (2), July 17, 1929; also Station II, September 3, 1932 (broken curve).

20–40 meters thick may be nearly as homogeneous as the surface stratum (Figs. 37–39).

The thickness of the homogeneous surface stratum[27] is of interest from the biological standpoint as well as from the hydrodynamic. Parr (1933), from his study of lightship records and from serial temperatures previously published, concluded that in summer the surface temperature is representative of the whole column of water from the coast out at least to the 10 meter contour, and the cruise data generally corroborate this. But,

[27] Defined as the layer within which the vertical range of temperature was less than 1°.

since this thickness is determined by factors (tidal transport and turbulence, direction and strength of wind) that vary not only regionally but within short intervals of time, the states existing at different times and places may be expected to vary within considerable limits (Fig. 40). Data for mid-July of 1929—the one year since 1913 in which the

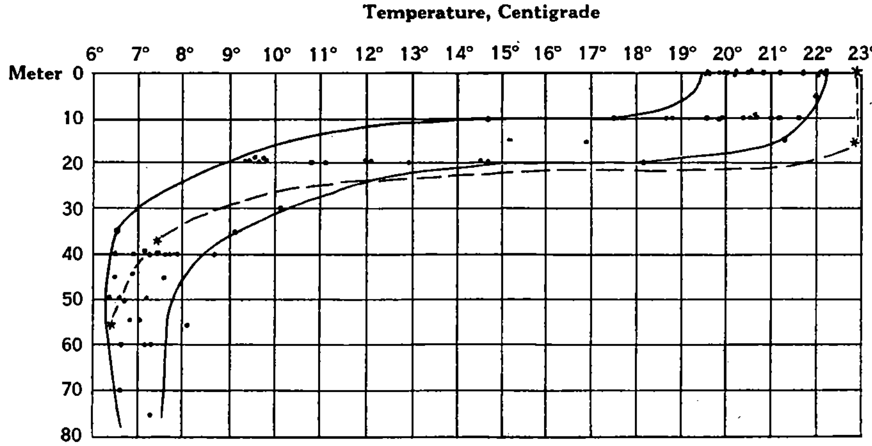

FIG. 39.—Limits of variation in vertical distribution of temperature (solid curves) off Long Island, New York, from data for Stations Montauk II and III, Shinnecock II and III, and New York II and III, July 1929, 1930 and 1931; also vertical distribution at Station Shinnecock III, September 8, 1932 (broken curve).

survey covered the area as a whole in that month—do in fact show that such is often the case, for the thickness of the stratum in question was on the whole least next the land where it varied in different sectors from 5–6 meters to 12–16; and increased along every profile across the shelf to 20–25 meters at the continental edge.

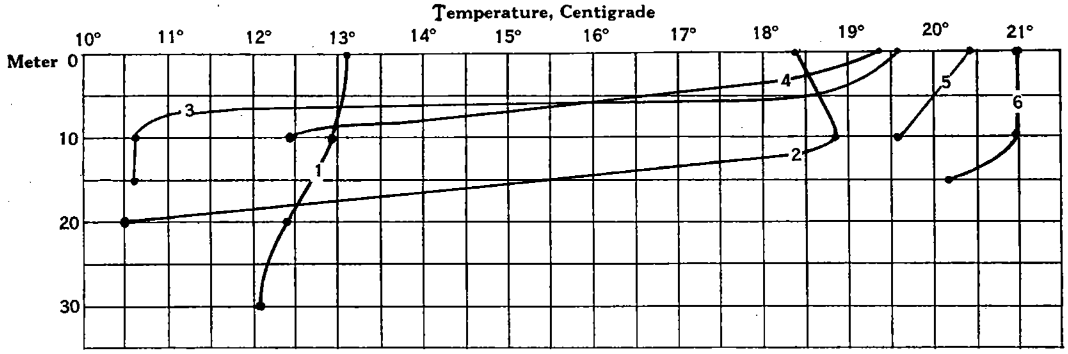

FIG. 40.—Vertical distribution of temperature at inshore stations, July 14–25, 1929:—1, Nantucket Shoals (Albatross Sta. 20592); 2, New York, I; 3, Atlantic City I; 4, Cape May I; 5, Hog Island I; 6, Chesapeake I.

In a region where tidal turbulence is not active, this distribution accords with the theoretic expectation, for upwellings of cold water are most frequent close in to the coast and most widespread there. Serial observations taken in the offing of Martha's Vineyard (long. 70°30′–71°30′) in August 1889 (Libbey) show a small average gradient of this same sort, the mean thickness of the homogeneous layer being about 9 meters for 20 miles out from the land, and 15–17 meters thence seaward past the edge of the continent.[28] But Libbey met such wide variations, in this respect, within short distances and periods of time[29] as to show that it would depend on weather (perhaps also tide) how closely the gradient appearing on any given profile would correspond to the average. And this is corroborated by our recent profiles (Figs. 41–44) which similarly show that at any given date the homogeneous superficial stratum may or may not be somewhat thicker along the edge of the continent than nearer land.

The temperature on the shelf as a whole decreases even more abruptly, with increasing depth below the homogeneous surface stratum, in July and August than in June. Thus the difference between surface (representative of the superficial 5–15 meters) and bottom has varied between 12° and about 16.3° along the 35–50 meter depth zone between the offings of Chesapeake Bay and of New York, averaging about 14°,[30] while the vertical gradient along this same depth zone to the eastward of the New York profile and as far as the offing of Martha's Vineyard has averaged about 13° (9.9°–15°) on our recent summer cruises.

The situation, in this respect, at different distances out from the land, just before autumnal cooling commences, is illustrated for normal years by the following table for August 1889 and the first week of September of 1932, combined:—

Profile	Station	Total Depth in Meters	Gradient Surf. to Bottom
Martha's Vineyard[1]		30–40	9.2
		60–80	14.4
		175–200	11.6
New York[2]	I	25	12.2
	II	40	15.5
	III	65	18.4
	IV	140	12.4
Cape May[2]	I	20	10.4
	II	40	15.9
	III	65	18.3
	IV	150	13.3
Winterquarter L.S.[2]	I	25	10.9
	II	45	16.95
Chesapeake Bay[2]	I	15	2.3
	II	23	12.9
	III	25	9.4
	IV	249	16.7

[1] Data for this profile are the means for the respective depth zones at Libbey's (1891) stations for August 1889.
[2] September 1932.

As just stated, the greater part of this considerable gradient is included within a stratum so thin (often less than 20 meters) that it fairly merits to be named a "thermocline." The lower boundary of the latter may vary, regionally, from approximately horizontal—the usual state—to steeply oblique as appears on the profiles. But in general the thickness of the bottom stratum, within which temperature is nearly as uniform

[28] Scaled from temperature curves for 88 stations, omitting a few doubtful readings. For complete data see Libbey, 1891, p. 414–424.

[29] The maximum and minimum thickness of the homogeneous stratum was as follows for successive belts out from the land:—0–20 miles, 5–20 meters; 21–40 miles, 5–29 meters; 41–60 miles, 7–29 meters; 61–80 miles, 5–29 meters; 81–100 miles, 11–22 meters; 101–120 miles, 7–22 meters.

[30] Five stations for 1913, 7 for 1916, 8 for 1929, 3 for 1930 and 3 for 1931.

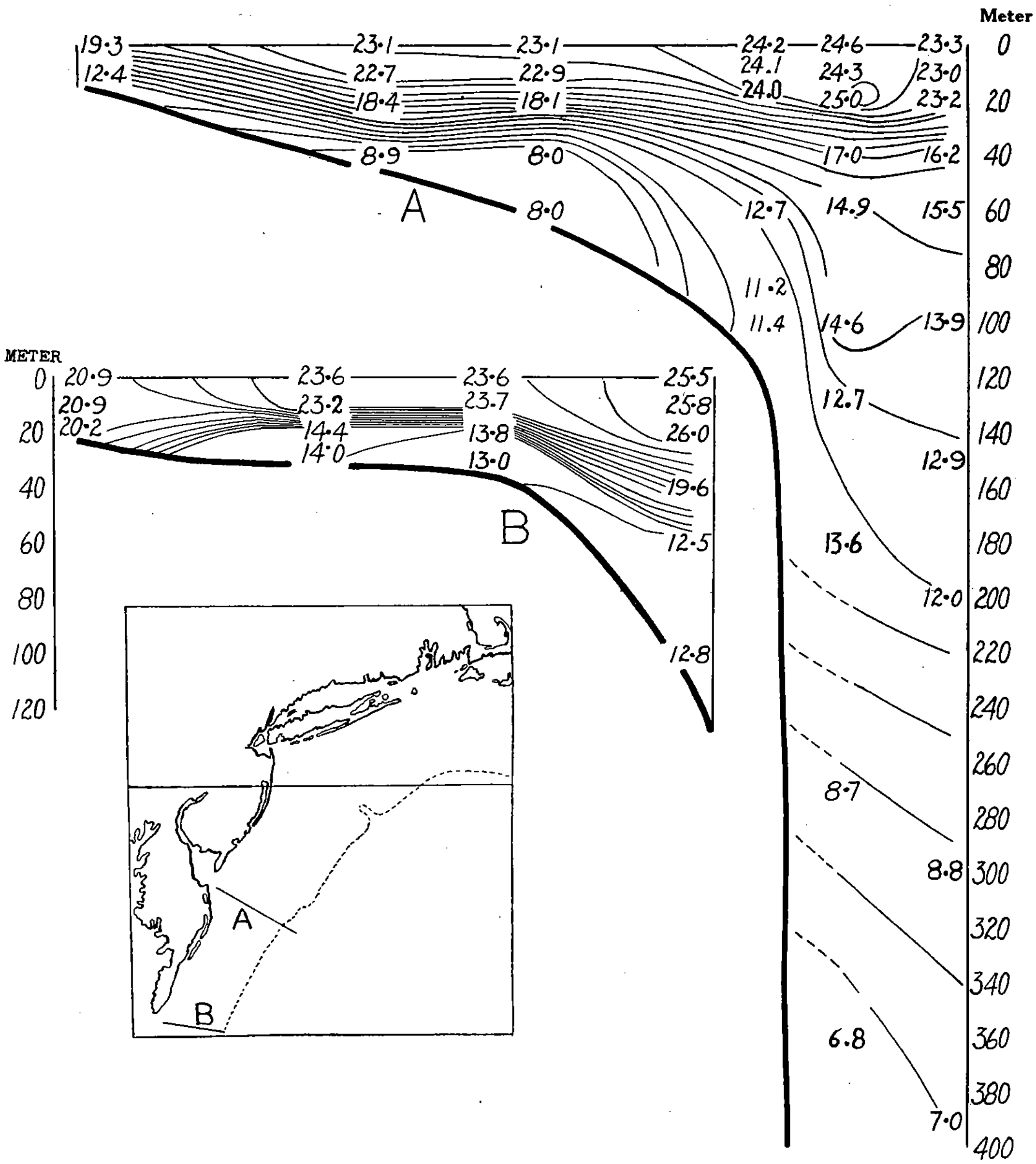

FIG. 41.—Temperature profiles crossing the continental shelf, July 14–19, 1929:—A, off Cape May; B, off Chesapeake Bay.

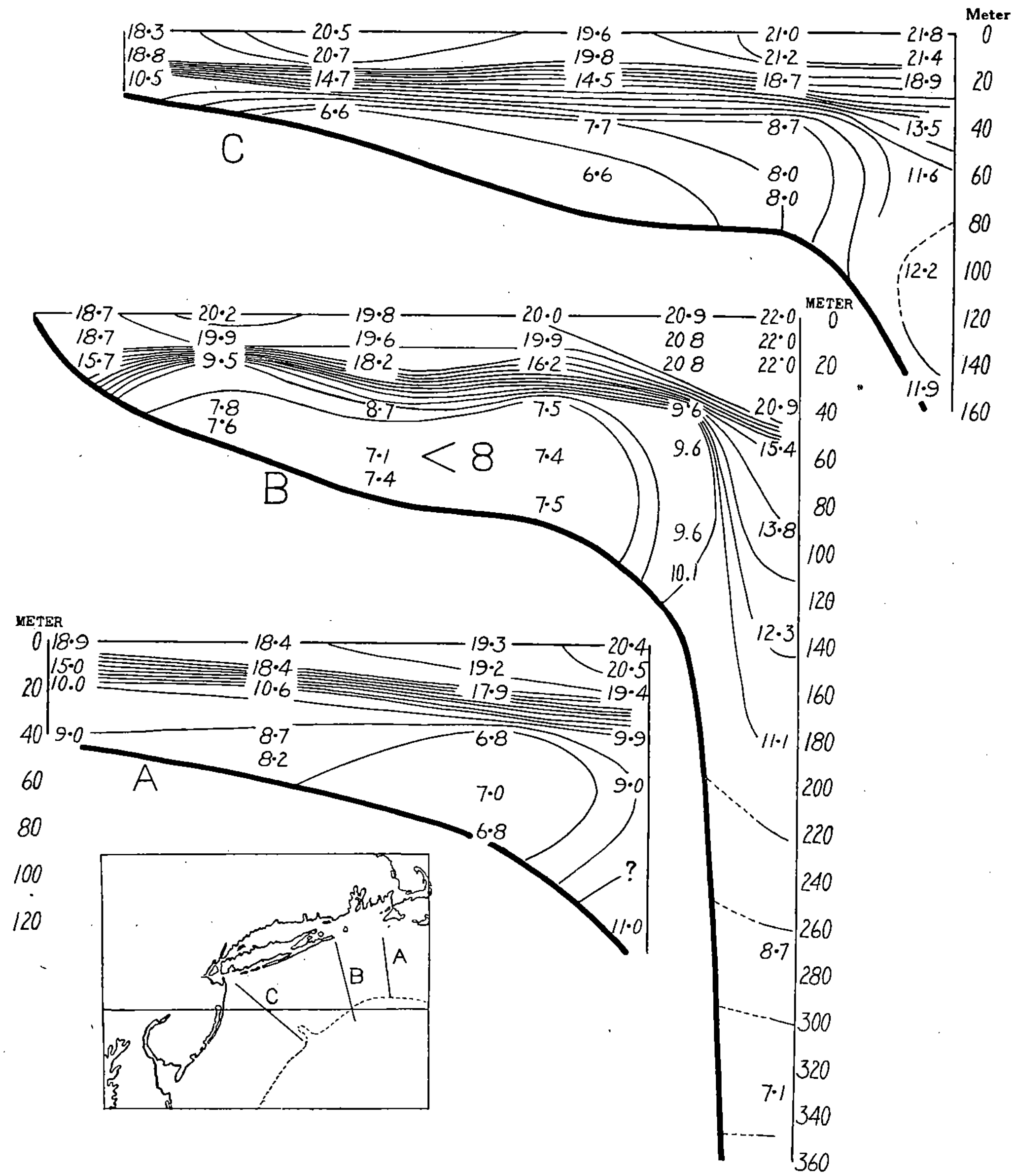

FIG. 42.—Temperature profiles crossing the continental shelf, July 22–24, 1929:—A, off Martha's Vineyard; B, off Montauk; C, off New York.

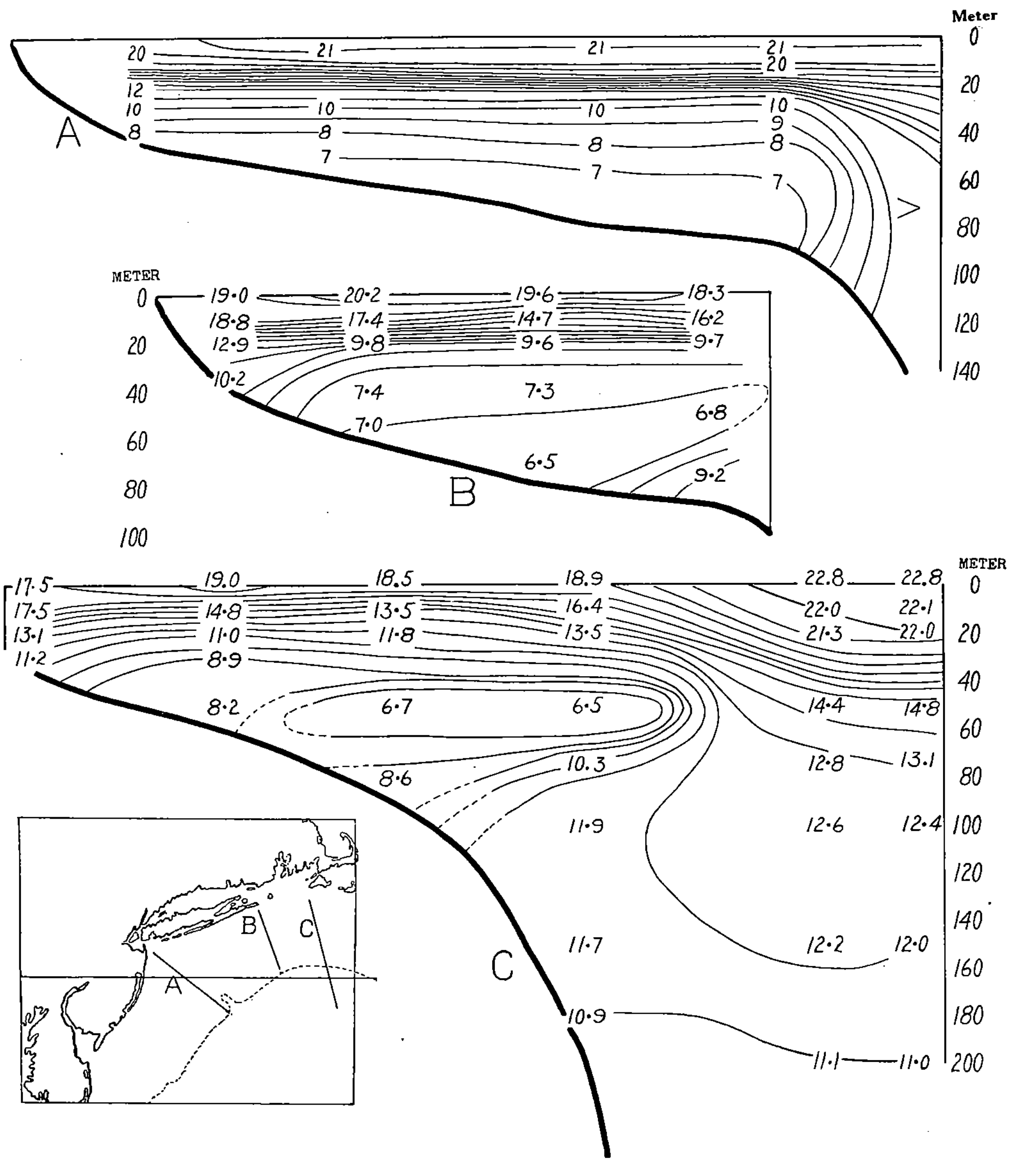

FIG. 43.—Temperature profiles crossing the continental shelf:—A, off New York, mean for July stations for 1929, 1930, and 1931; B, off Montauk, July 10–13, 1931; C, off Martha's Vineyard, July 13–14, 1913.

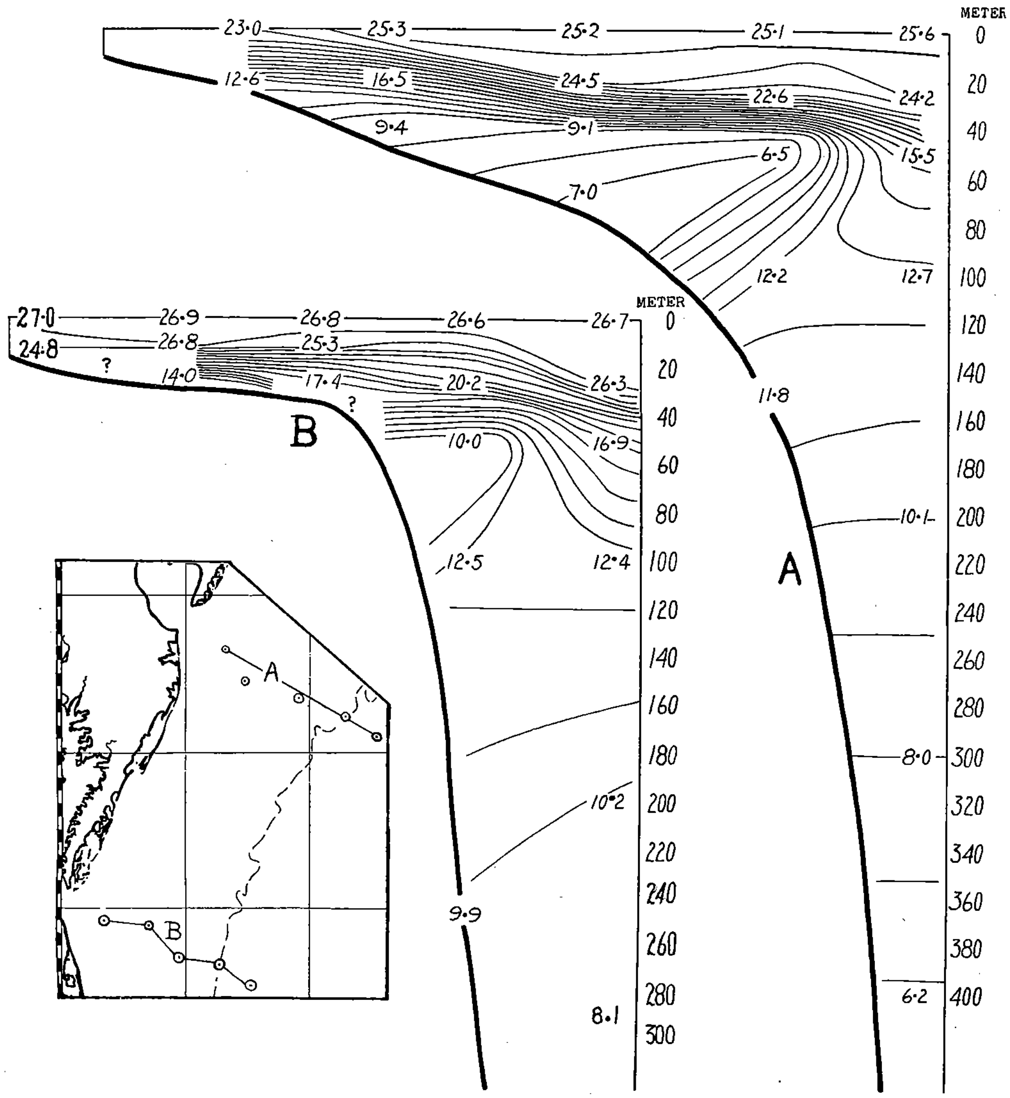

FIG. 44.—Temperature profiles crossing the continental shelf, September 3–5, 1932:—A, off Cape May; B, off Chesapeake Bay.

vertically as it is in the surface stratum, increases out across the shelf proportionately to the increasing depth of water, i.e. to the slope of the bottom, its thickness in mid-July, 1929, being as follows for successive depth zones on representative profiles (Figs. 42, 43):—

Profile	Station	Depth in Meters	Thickness in Meters of Bottom Stratum
Martha's Vineyard	I	40– 45	about 25–30
	II	55– 60	about 35–40
	III	80– 85	about 55
	IV	120–130	about 80–90
Montauk	I	25– 30	about 5–10
	II	50– 55	about 30–35
	III	75– 80	about 35–40
	IV	85– 90	about 55–60
	V	130–135	about 100
New York	I	25– 30	about 10–15
	II	40– 45	about 15–20
	III	70– 75	about 35–40
	IV	80– 85	about 45–50
	V	150–160	about 110–120
Cape May	II	40– 45	about 10–15
	III	60– 65	about 30–35
	IV	125–135	about 65–70
Chesapeake	II	25– 30	about 10–15
	III	30– 35	about 15–20
	IV	100–110	about 50–60

As stated above, the types of vertical distribution just described prevail over the shelf as a whole out about to the 150 meter contour and as far east as the offing of Martha's Vineyard. The region of Nantucket Shoals is, however, set sharply apart by the fact that the difference between surface and bottom has averaged less than 1° there, wherever surface temperatures between 12°–14° (i.e. close to the expectation if due to active turbulence alone) have been recorded at localities more than 50 meters deep. This state usually prevails all around the southeastern, southern and probbaly also the western margins of the Shoals proper (Zone II, Fig. 36). But on the eastern and northeastern part (Zone I, Fig. 36) where the lowest surface temperatures have been found, very low bottom readings may be responsible for a steep vertical gradient (see also p. 51). And a considerable thermal gradient has also been encountered wherever the surface temperature has been as high as 15°–16°, as it usually is in Zone III (Fig. 36), often with a more or less developed thermocline centering between the 15 meter and 30 meter levels, which grades into the state characteristic of the waters to the westward of longitude 70°30′.

The vertical distribution of midsummer temperatures in the deeper strata along the outer edge of the continental shelf is given special interest by the alternation that develops there, earlier in the season, between the warm surface, cold mid-depths and warm bottom (p. 45). All but one of our 17 stations along this zone from July to September, in the several recent summers of record, show this same type of distribution (Figs. 42–44); nor is there anything novel in this, for Libbey (1891, 1895) encountered much the same thing at 21 out of 26 stations between the 100 meter and 300 meter contours off southern New England (longitude 70°30′ to 71°30′) in the summer of 1889 and again in 1890, with individual thermal curves of much the same type as in 1929 (Fig. 45–47).

In most cases, the belt so characterized has followed the 150–200 meter contour zone, often extending for some distance down the steeper slope below this level. So few, in fact, have been the exceptions in the offing of New York or to the southward, that the rule seems as nearly invariable for this sector as any that can be applied to boreal seas. But the data for the several years show that to the eastward of New York, the zone so characterized may be considerably closer in to the coast in some summers than in others. When this type of vertical distribution extends seaward much beyond the 200 meter contour line it encroaches upon depths so much greater that the warm sub-stratum is in turn underlain by colder water, as is illustrated by stations off Cape May and off Chesapeake

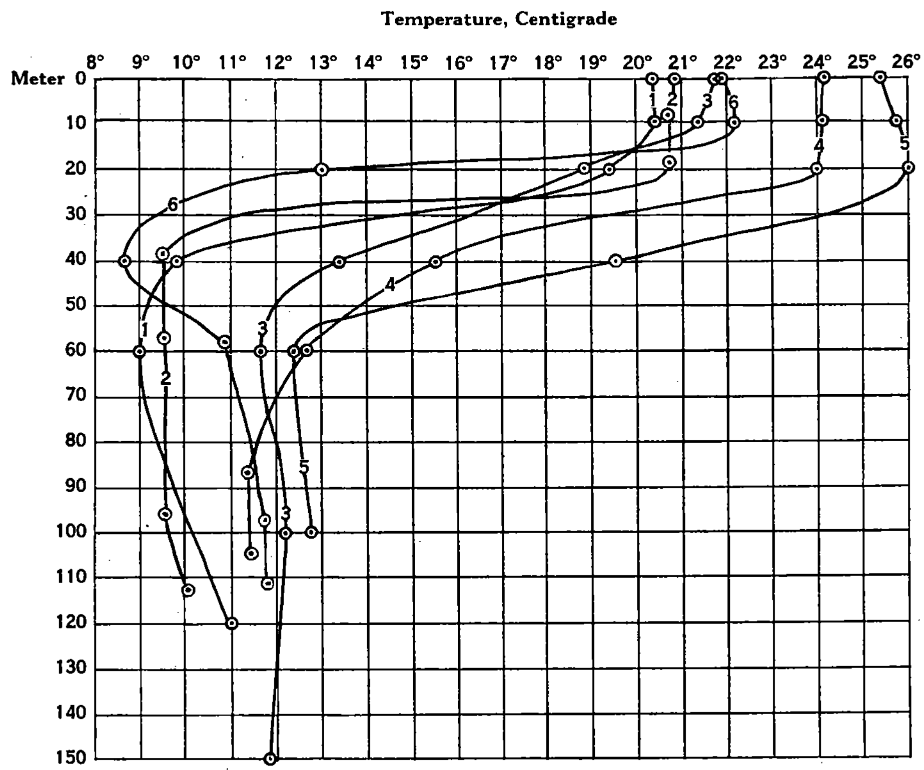

FIG. 45.—Vertical distribution of temperature between the 100 and 150 meter contour lines, July 17–24, 1929:—1, Stations Martha's Vineyard IV; 2, Montauk V; 3, New York V; 4, Cape May IV; 5 Chesapeake IV; 6, Atlantic City V.

Bay, August 1916 (Bigelow, 1922, Fig. 35); also off the coast of Virginia in September 1932.

Farther out still on the continental slope (the location of the transition is variable) the types of vertical distribution just described give place to one more typically oceanic, where the thermocline (at 20–60 meters) is succeeded by continuous though much more gradual cooling down to abyssal depths (Fig. 48). Similar gradients have already been recorded at this season at Libbey's (1891) outermost stations, also off Cape May and off Chesapeake Bay in July 1913, and off New York on August 2, 1916 (Bigelow, 1915, Figs. 5, 6; 1922, Fig. 35).

Spacial relationships of subsurface temperature. The spacial relationships of temperature that result from the values and from the types of vertical distribution just discussed, follow a definite basic pattern, whatever part of the shelf any individual profile may cross, or in whatever year, from which only minor variations have been recorded. The thermal constancy from summer to summer is, in fact, somewhat surprising in view of the variety of factors involved.

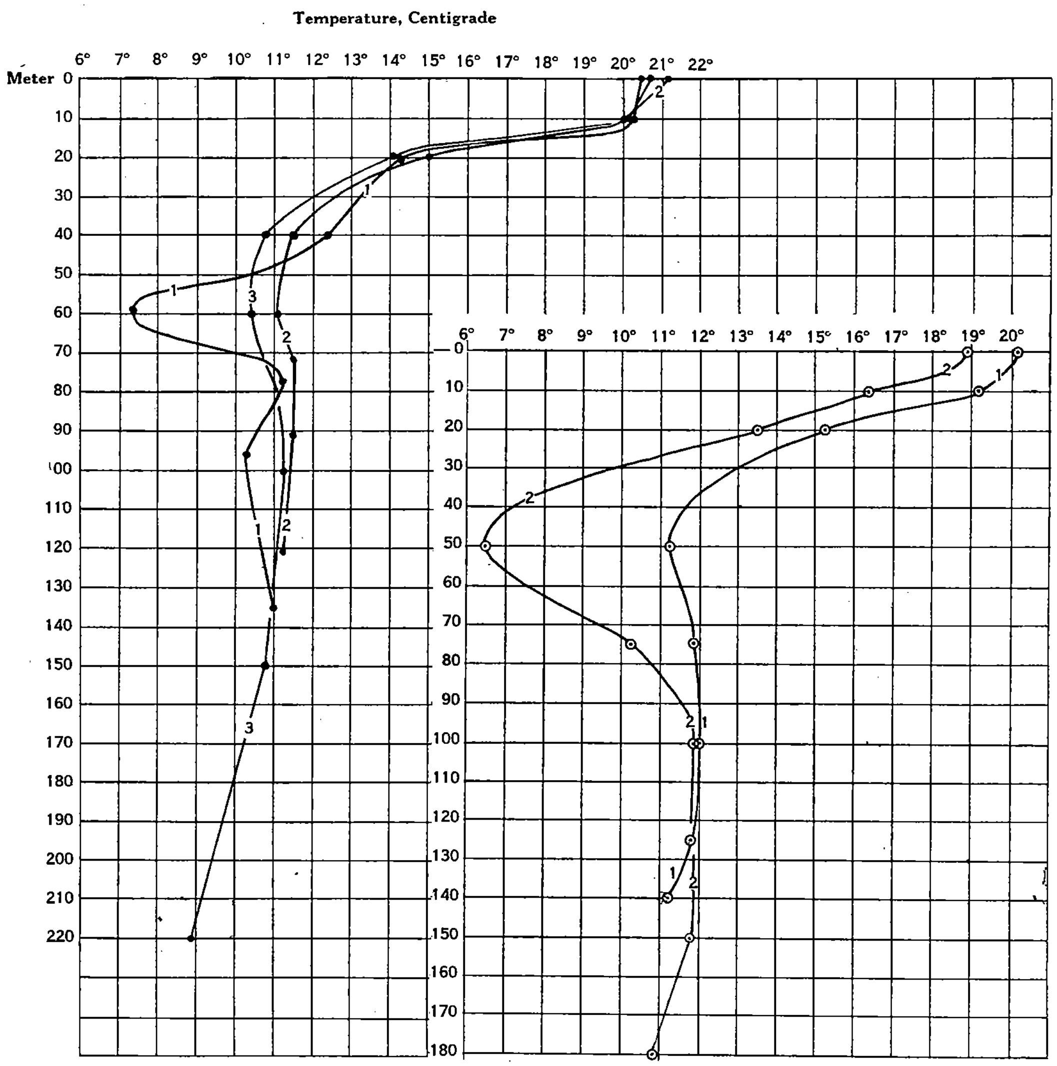

FIG. 46.—Vertical distribution of temperature along the edge of the continent:—Left—Stations Montauk V (1), New York V (2), and Martha's Vineyard IV (3), July 11–13, 1930. Right—Stations New York V (1), and Martha's Vineyard IV (2), July 11–13, 1931.

Thus every one of our July profiles between the offings of Martha's Vineyard and of Chesapeake Bay, whether for 1929, 1930 or for 1931, shows the warm and homogeneous superficial stratum and the thermocline below it, extending right across the shelf, the mass of cool bottom water below being close to homogeneous in temperature between

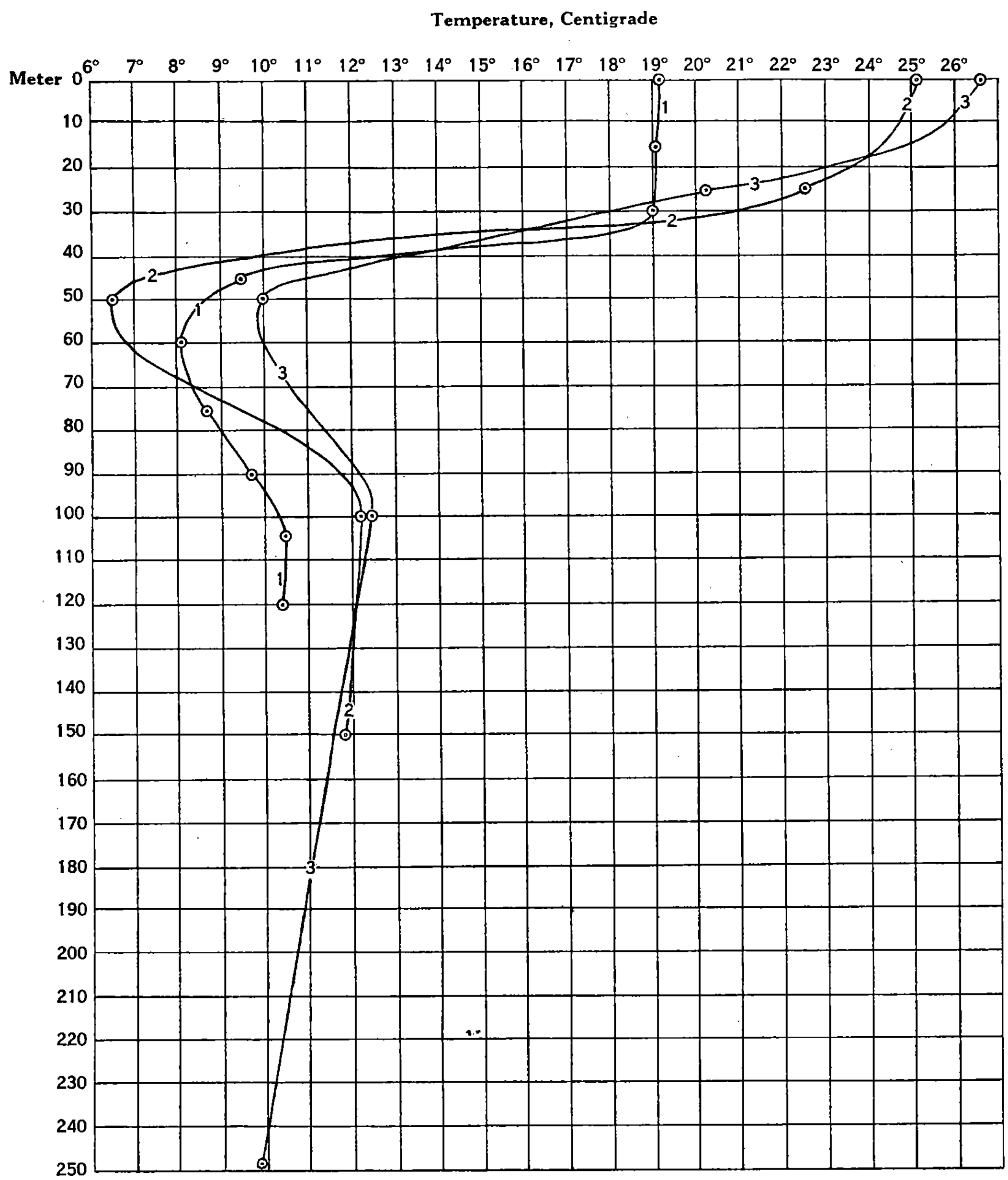

FIG. 47.—Vertical distribution of temperature at the edge of the continent:—Stations New York IV, September 9, 1932 (1); Cape May IV, September 5, 1932 (2) and Chesapeake IV, September 3, 1932 (3).

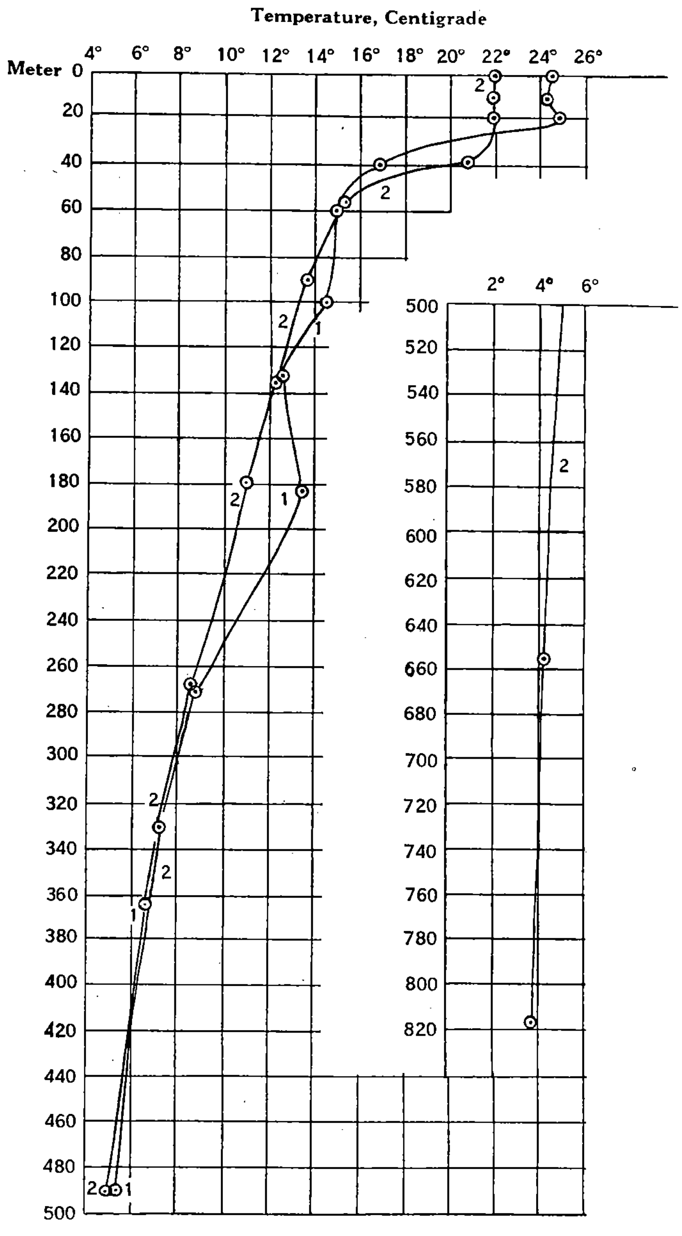

FIG. 48.—Vertical distribution of temperature on the continental slope, July 18–24, 1929:—1, Station Cape May V; 2, Montauk VI.

the 30 meter and the 80 meter levels, vertically as well as horizontally—much as in June.

Libbey (1891) long ago emphasized the significance of the isotherm for 10° as outlining the offshore boundary of this cold bottom mass in cross-section. But recent work has shown that in different summers 9°, 10° or even 11° may the most clearly delimit its boundary off Martha's Vineyard, while further to the west and south it has been outlined most definitely by the isothermal belt of 7°–9° in normal summers, as represented by 1929, 1930 and 1931. In July of 1916, however,—an unusually cold year—it was the transition zone between 5° and 10° that marked this boundary.

Most of the profiles for July, August and September that have been run off Cape May, or to the northward or eastward of the latter, have shown some indication of a wedge-like projection of the cold bottom water of the shelf seaward into the warmer water masses over the continental slope, a state that develops in June (p. 49), and which is responsible for the presence of higher temperatures below as well as above the cold mid-stratum at individual stations along the continental edge (p. 68, Figs. 42–44). But the precise condition has varied widely in this respect from profile to profile, as well as from summer to summer on given profiles and may, in fact, so vary through short periods of time as Libbey (1891, 1895) long ago found. In the offing of Martha's Vineyard, for example, the coldest shelf-water (<7°) extended for some 20 miles seaward above warmer bottom water in July of 1931 (Fig. 43C) but for only a short distance, if at all, in that same month of 1929 (Fig. 42A) or of 1930.[31]

In some summers (exemplified by 1916 and 1932) this wedge-like offshore contour continues southward past the offing of Chesapeake Bay (Fig. 44; Bigelow, 1922, Figs. 24–26). On the whole, however, the profiles show the cold mass as projecting less far seaward beyond the edge of the shelf in the offing of New York than farther to the eastward. And in some summers (e.g. 1913 and 1929) there is little if any evidence of this along the zone between the offings of New York and of Cape May, to the southward of which the cold bottom water was entirely pinched off in these particular summers (Bigelow, 1915, Figs. 12, 14).

This cold water also extends farther south and farther east along the shelf in the mid-depths than on bottom in some summers but not in others (Bigelow, 1915, Fig. 15).

The persistence of bottom water so cold in such small depths through the season when the surface temperature is close to its maximum for the year, is an outstanding feature in the thermal character of the region. Charts of the geographic limits of this water, irrespective of depth, for the several summers of record, (Figs. 49, 50; Bigelow, 1922, Fig. 21) agree in showing it as entirely surrounded by higher temperatures, not only inshore and on the south, but also offshore by the warm zone at the edge of the continent, and likewise on the east by the warmer water that washes the neighboring side of Nantucket Shoals (p. 77). Thus it seems clear that it receives no replenishment at this season.

Uniformity of temperature prevails from year to year within the cold pool over considerable distances from northeast to southwest; while regional variation within it has at most been a matter of a degree or two in any given summer. Its temperature has also varied only between 6° and 7° from summer to summer in all the years of record, except in the very cold year 1916 when the minimum (recorded off Delaware Bay) was close to

[31] For details of the situations as existing off Martha's Vineyard in August of 1889 and 1891, see Libbey (1889, 1895).

4°. In each summer, again, the isotherms for the lowest values have outlined a definite cold pool, centering in the offing of New York or a few miles further east, the outer boundary of which, as it projects wedge-like seaward, may be some miles out beyond the

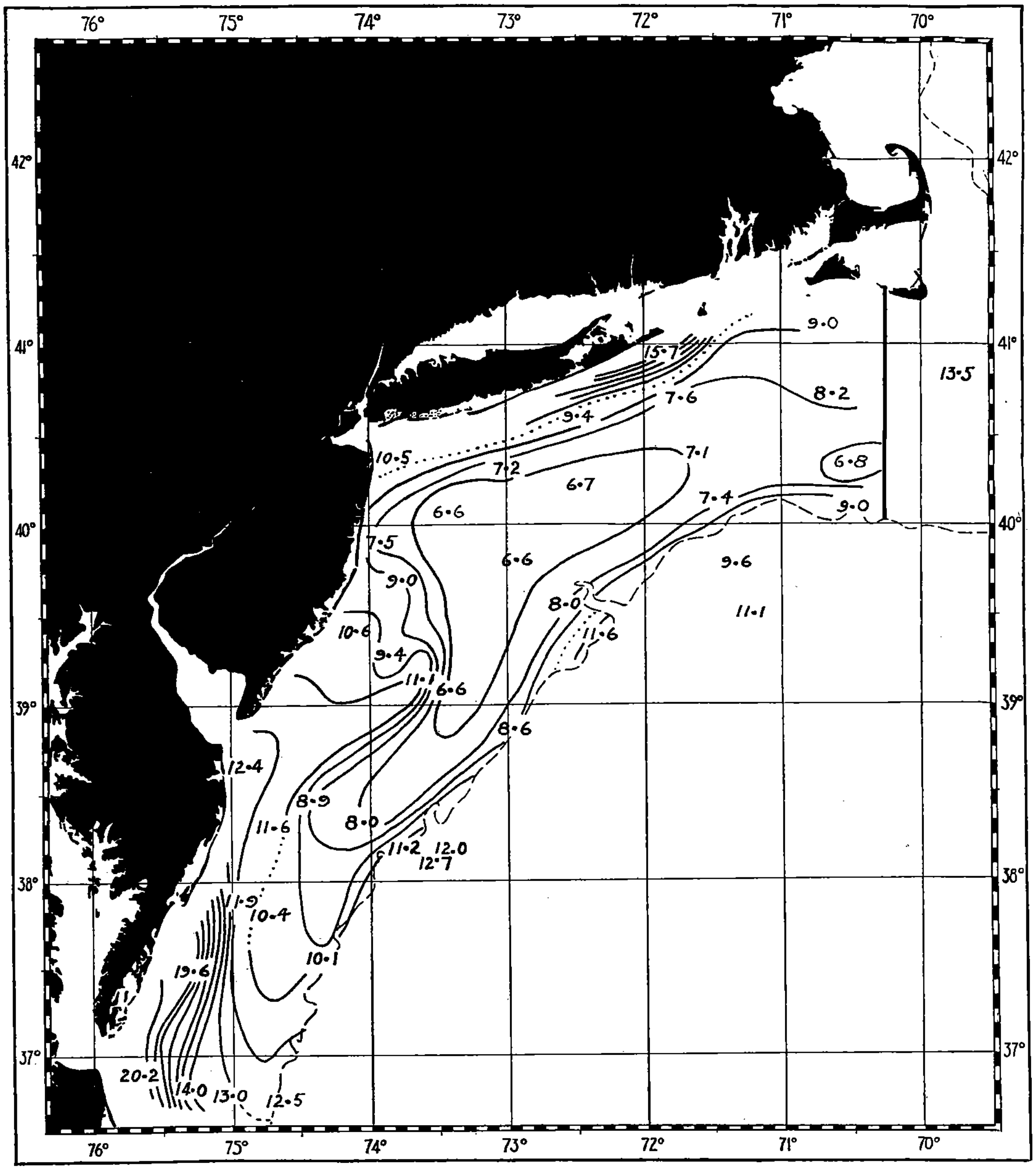

FIG. 49.—Minimum temperature irrespective of depth in the upper 200 meters, July 14–25, 1929.

200 meter contour as we found it in 1931 and 1916, or may lie well in on the shelf as was the case in 1929, 1930 and 1932. Its inner boundary (as identified by the isotherm for the lowest value) may be close in to the Long Island shore (e.g. July 1930) or con-

siderably further out (e.g. 1916, 1931, 1932). The locations of its northeastern and southwestern boundaries, marking its lengthwise extent along the shelf, have also shown considerable variation. In July 1929 it reached eastward only as far as longitude 72° but southward nearly to the offing of Cape May (Fig. 49), while in September 1932 its southern boundary lay equally far south, but its eastern somewhere to the eastward of longitude 72°. In July of 1913, 1930 and 1931, the coldest water was confined to the sector east of the offing of New York, extending to the offing of Martha's Vineyard (Fig. 50).

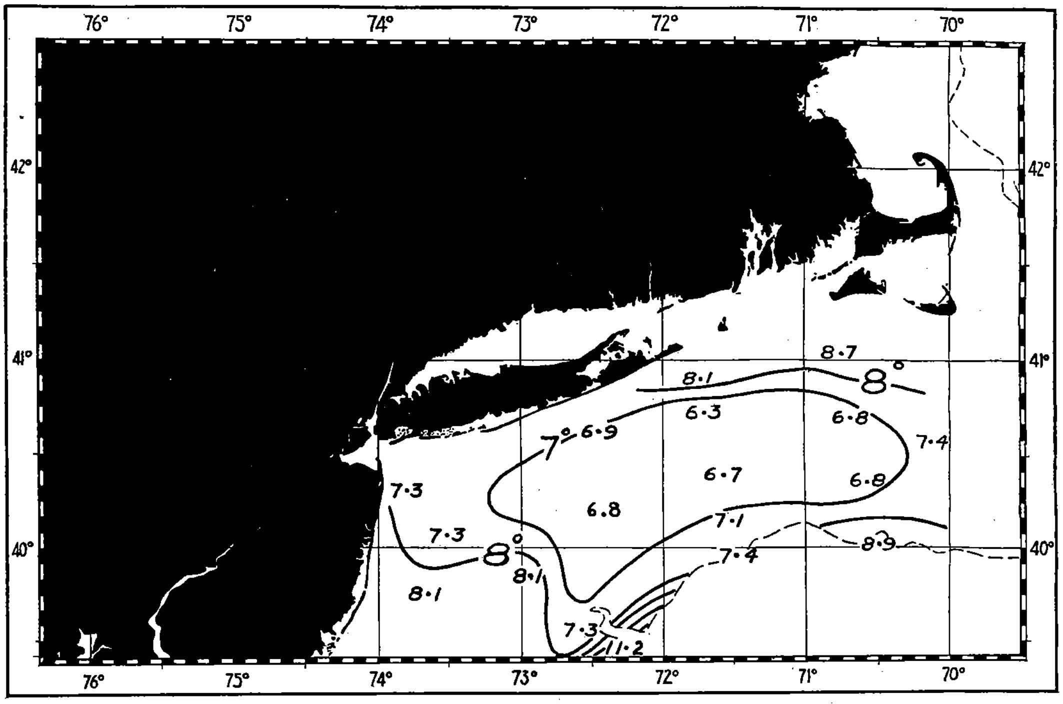

FIG. 50.—Minimum temperature irrespective of depth in the upper 220 meters, July 10–14, 1930.

The mean for the coldest water on the shelf between the offings of Block Island and of Nantucket for the years 1880, 1881, and 1889 was about 7.4°. But in normal summers the coldest water on the shelf south of Cape May is everywhere warmer than 8° by July (Figs. 49, 50; Bigelow, 1915, Fig. 8); warmer than 10° across the whole breadth of the shelf off Chesapeake Bay where it reaches 20° close in to the land, or is perhaps even warmer in some summers (Fig. 49, 51).[32] But in very cold summers, as exemplified by 1916, the bottom area enclosed by the coldest isotherm (5° in that instance) may reach southward nearly as far as the offing of Chesapeake Bay as late as August; water colder than 7° even farther along the outer part of the shelf (Bigelow, 1922, Fig. 21).

Nantucket Shoals. As just remarked, the eastern boundary of the coldest bottom water on the shelf lies some distance to the westward of Nantucket Shoals. And bottom temperatures on the latter in summer are of special interest from the standpoint of fisheries biology, because this is the most southerly and westerly locality off the east coast

[32] In 1929, the bottom water at the innermost station off Chesapeake Bay was 20.2° at a depth of about 15 meters on July 17; 13.6° at 22 meters on July 29, 1913.

of America, where cod and other boreal fishes of similar biological status continue through the warm season in numbers sufficient to support an important commercial fishery.

In this region of active tidal churning the bottom temperature not only shows wide

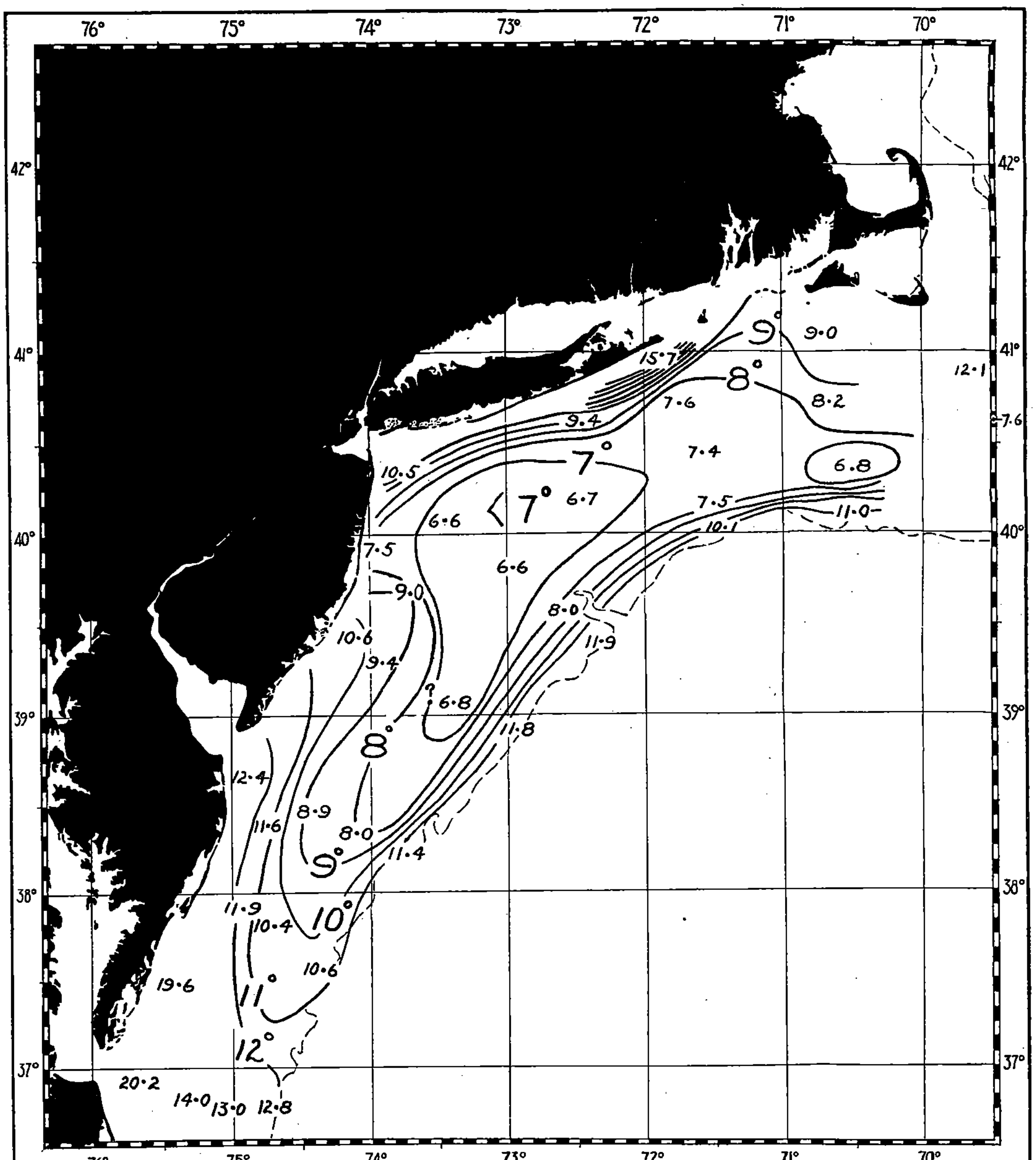

FIG. 51.—Temperature near the bottom between the 10–15 meter and the 150 meter contours, July 14–25, 1929.

variations in summer within short distances, according to bottom contour, depth, and relative proximity to the cold water in the bottom of the basin of the Gulf of Maine, but may also experience considerable variations at a given locality within short intervals of time. In general the bottom temperature of the Shoals is kept relatively high where that of the surface is low by turbulence (Fig. 52). But with cold upwellings from the Gulf of Maine basin affecting the bottom more directly than the surface, the zone of highest

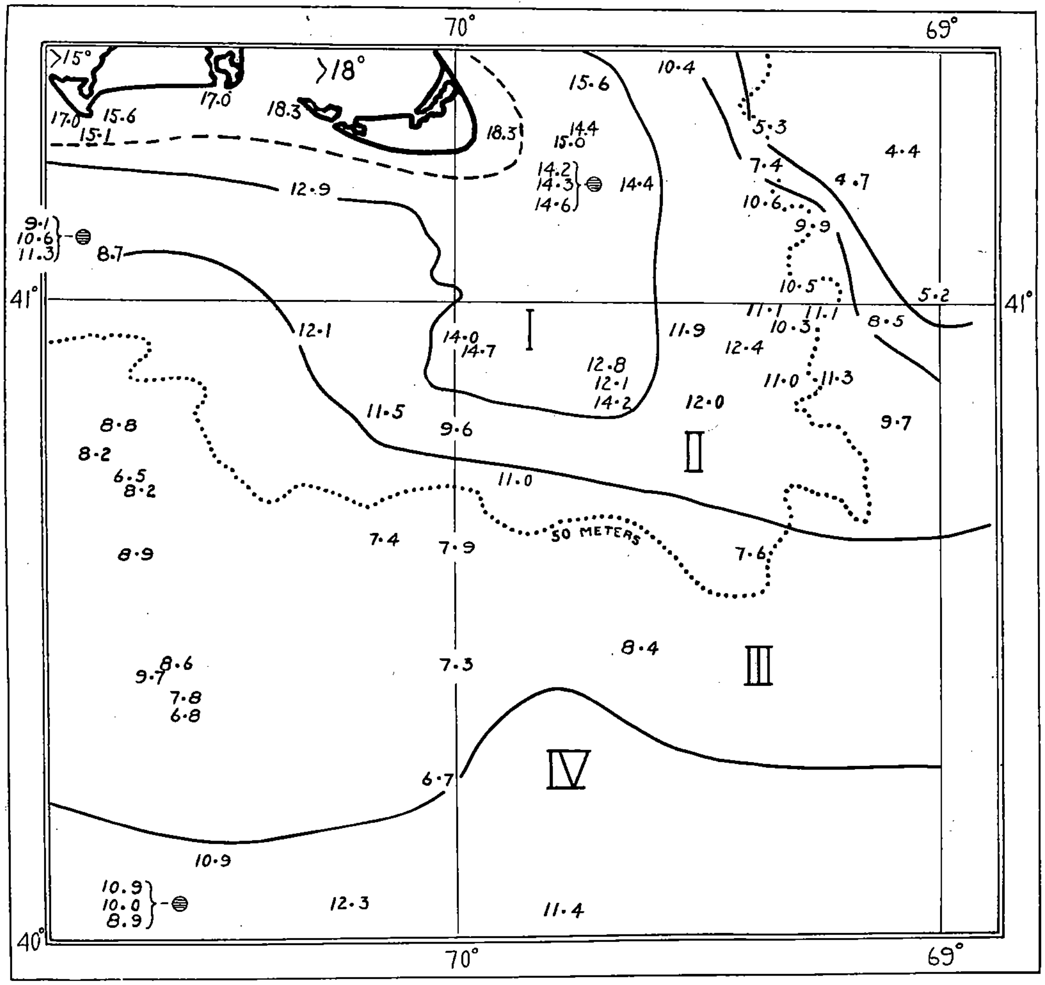

FIG. 52.—General distribution of temperature on the bottom, region of Nantucket Shoals, July–August, from data for the years 1923–1932, combined.

bottom temperature on the Shoals lies definitely to the west of the area of coldest surface water (see locations of Zones I on Figs. 36 and 52), while the banks and ridges average some 2° colder on bottom along the eastern side of the Shoals than along the western. Temperature also shows a much more abrupt gradation at the bottom than at the surface, passing eastward from the Shoals into the basin of the Gulf of Maine where (thanks to the deepening of the water) 9°–10° may lie within 5 or 6 miles of 4°–5° on the bottom.

Close in to the southeast shore of Nantucket Island in 15 to 20 meters of water, the older observations for August[33] show the temperature on the bottom as 18°–19°, or about the same as along the shore to the westward at corresponding depths.

[33] "Blue Light" Stations 675, 677, Smith, 1889, p. 899.

Farther out in depths of 18–25 meters the bottom readings on the Shoals to the east of longitude 70° have averaged about 12.9° (maximum 15.6°, minimum 10.7°) in August (16 stations), while a change of 2° (from 13.2° to 11.2°) was recorded on bottom at Round Shoal, on July 10, 1928, between 10.00 A.M. and 4.30 P.M., with the change of the tide (see also p. 58). The few midsummer readings so far obtained on the Shoals west of 70° longitude at this depth have shown the bottom somewhat warmer (14°–16.9°, Fig. 52).

Bottom temperatures within the depth zone of 40–60 meters have averaged about 8.3° (maximum 12.75°, minimum 5.2°) around the slopes of the Shoals in July and August (14 stations), the lowest reading not being near the lower limit of this depth zone, but at a depth of only 45 meters on the eastern edge of the Shoals, where upwelling from the greater depths of the neighboring basin of the Gulf of Maine was no doubt responsible. Bottom readings higher than 12° in this depth zone have been confined to the southern side of the Shoals. Bottom temperatures at two stations in depths of 70 and 90 meters on the eastern slope of the Shoals, August 9, 1931, were 5.22° and 4.66°, whereas the bottom water at this depth to the southward of the Shoals ordinarily averages between 7.5° and 10° at this season (Fig. 52), warming to 10°–12° along the 100–150 meter contour belt. This distribution results from the geographic location relative to the warm bottom water along the edge of the continent on the one hand, and to the cold bottom water of the Gulf of Maine on the other.

Warm offshore bottom zone. The persistence of temperatures as low as 6°–8° on the outer part of the shelf between the offings of Martha's Vineyard and of Delaware Bay,[34] discussed above (p. 73), makes the presence of a belt of considerably warmer bottom water along the edge of the continent as striking a feature of the thermal pattern for late summer as it is earlier in the season.

The contrast in actual temperature between these two types of bottom water, and their spacial relationship one to the other, may best be illustrated by the situation existing in the general offing of Martha's Vineyard between longitudes 70° and 71°30′, because enough temperatures were taken there in August during the early years of the U. S. Bureau of Fisheries to allow calculations of mean bottom values for successive depth zones out across the shelf and down the upper part of the continental slope. And, as the scattering of individual readings to either side of the mean curve, from which the values given on Figure 53 have been scaled, is in most cases less than 1°, the gradation shown there, from 17°–18° near land to 7°–8° over the outer part of the shelf in 70–100 meters, warming to 10°–11° along the continental edge in 120–250 meters, may be accepted as closely approximating the state normal for the time of year.

Recent cruises have shown that a similar gradient, transverse to the shelf, extends southward in normal summers, at least as far as the offing of Cape May, with the minimum readings even slightly lower (6°–7°) in the general offing of New York (Fig. 51). But to the southward of latitude about 38° this type of distribution gives place (with the more rapid vernal warming of the water) to a progressive decrease in bottom temperature out from the land, with increasing depth, illustrated in July 1929 by readings of 20.2° near shore in about 15 meters, about 13°–14° midway of the shelf in 30–35 meters, and 12.8° still farther out in about 100 meters.

Readings taken in the warm offshore zone of bottom water in different summers since its discovery by the "Blake" in July 1880 (Verrill, 1884[b]), have all fallen between

[34] Still farther south in some years (p. 75).

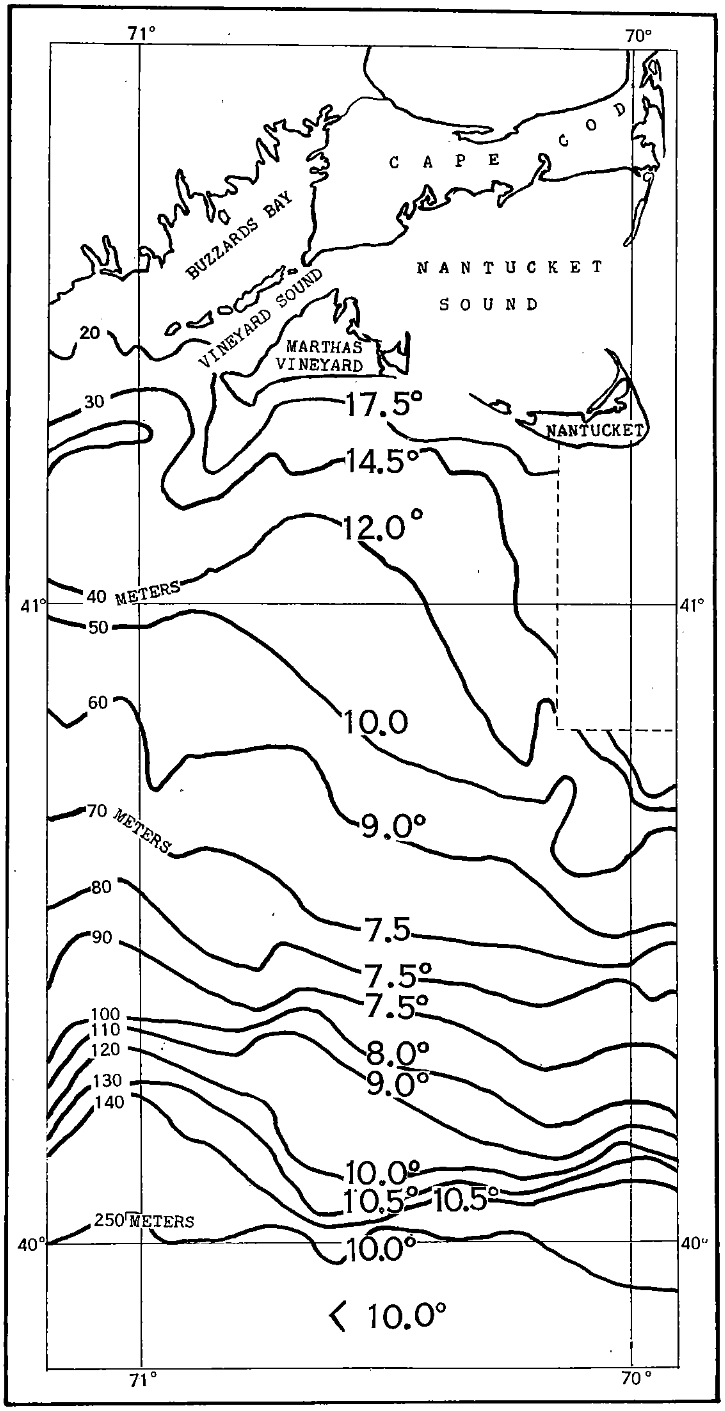

FIG. 53.—Mean bottom temperature at successive 20 meter contours in the offing of Martha's Vineyard, for August of the years 1880, 1881, 1884, 1885 and 1889, scaled to the nearest 0.5° from a curve of individual readings plotted against depth.

9° and about 13°, usually between 9.5° and 11°. And as the record covers various locations from the offing of Virginia to the offing of Cape Cod in July and August of 16 different summers,[35] including the "cold" year 1916, and also 1882 when flooding by cold water seems to have taken place during the spring, the summer temperature of this warm zone must be remarkably constant, not only regionally along the edge of the continent, but from year to year. And we have no evidence, either direct or indirect (effect on the local fauna) that it is ever seriously displaced in summer by water either much colder or much warmer.

In normal summers the mean location of the inner boundary of this warm (>10°) bottom water is near the 120 meter contour line off southern New England (Fig. 53). The situation of this boundary was about the same in 1882, though in that summer the maximum temperature of this band was about 1° lower than normal (about 9°). In July of 1913 the inshore boundary lay at about the 80–90 meter contour line off New York. In 1916 we encountered it at about the 120 meter contour line off New York, and close to the 130 meter contour line off Cape May. In July 1929 it closely coincided with the 100–110 meter contour line all along from longitude 70°30′ to the offing of Cape May, as was again the case from the New York profile eastward to longitude 70°30′ in July 1931. But in that same month of 1930 it was somewhat more undulating between the 90 meter contour line off New York, and the 130 meter contour line off the eastern extremity of Long Island.

Thus the inshore boundary of the warm bottom zone usually lies along the 100–120 meter contour line from the offing of Cape May eastward in normal summers, but may, or may not, lie slightly deeper down the slope after an unusually cold or tardy spring.

The situation is more variable to the southward, depending on the location of the southern boundary of the cold bottom pool on the shelf. In summers when this lies about abreast of Cape May (1913, 1929, and apparently 1930) the 10°–11° water along the continental edge, further south, simply forms the offshore limit to still higher temperatures that reach in right across the shelf to the land as just described (p. 75). But in the summer of 1916, when bottom water colder than 6° extended along the shelf past Chesapeake Bay, the warmer water along the edge of the continent had a definite inshore boundary equally far to the southward (Bigelow, 1922, Fig. 21), and the spacial relationship seems to have been essentially of this same sort in September 1932.

Scattered data for July–August of 1916, 1920, and 1930–1932, combined with the older records (Fig. 53) for the offing of southern New England, locate the mean situation of the lower (offshore) boundary of bottom water warmer than 10° as not far from the 200–250 meter contour at the end of the summer in the eastern part of the region in normal years;[36] and at about this same contour line to the south of latitude 39°.

If the 100–120 meter contour be taken as the average location of the inshore edge of this zone, in the offing of Cape May and to the eastward, the 250 meter contour line as its offshore boundary, the mean breadth included is some 10–12 miles.

Additional information as to how far to the eastward water warmer than 10° normally washes the bottom along the edge of the continent at different seasons is much to be desired. Its withdrawal from actual contact with the bottom in the easternmost sector of our area in spring is discussed on page 45. And it is certain that in some years, at any

[35] 10.1°–12.8° at 12 stations in the summers of 1913, 1929, 1930 and 1931.

[36] Libbey's stations were not so spaced as to clarify this point, most of those along the edge of the continent being either at about the 100 meter, the 150 meter, or the 300 meter contour.

rate, this contact is subsequently reestablished along the slope off Georges Bank, as far east as longitude 66°20′ by July, for such was the case in 1920 (Bigelow, 1927, p. 614, Fig. 59). But in cold years, when the vernal schedule is delayed, 10° water may not touch the edge of the continent to the eastward of New York until August, as was the case in 1916 (Bigelow, 1922)—apparently also in 1882. Available data suggest that the deep channel which separates Georges Bank from the Nova Scotian Banks is the extreme eastern boundary to bottom temperatures as warm as 10° along the zone in question.

Continental slope. Further down the continental slope below the warm belt the bottom water cools continuously with increasing depth. In the late summer of 1889, bottom temperatures for successive depths off Martha's Vineyard were approximately as follows:—300 meters, 7°; 400 meters, 5.5°; 500 meters, 4.5°; 600 meters, 4.0°.[37] Mean values for the same depths calculated in the same way from the numerous observations taken in the same general region from 1880 to 1886, range about 1° higher. But individual readings taken with the instruments then in use were so often greatly in error that no weight can be given to this apparent difference.[38]

Most of the bottom temperatures recorded by the "Fish Hawk" and the "Albatross" to the west of longitude 72°, and southward from the offing of New York, were either in small depths in on the shelf, or so far down the slope in depths so great as to fall far outside the limits of the present survey. But the few pertinent observations in this zone show that at given depths between the 300 and 600 meter contours, the bottom temperature shows very little latitudinal variation along the slope between the offings of Martha's Vineyard and of Chesapeake Bay.

Recorded values are as follows:—

300–350 meters	Off Cape May 7.6°–8.2° (mean 8°)
	Off Coast of Virginia 6.7°–8.9° (mean 7.8°)
400–450 meters	Off Cape May 5.4°–6.8° (mean 6.1°)
	Off Coast of Virginia about 6.8°
600–700 meters	Scattered readings 4.3°–5.0° (mean 4.6°)

The profiles run by Libbey (1891) off Martha's Vineyard showed that the 10–20 mile belt out from the 200–220 meter contour-line is the site of abrupt transition from the temperatures just described for the upper part of the continental slope, to much higher values at equal depths farther out at sea. The problem of the thermal relationship and interchanges along this zone between cooler slope water on the one hand and warmer oceanic water on the other is one of great interest that has been the subject of much discussion in the past.[39] But as it falls well beyond the scope of the present study, I need only point out that the offshore ends of profiles run in summer and in early autumn at various localities between the offings of Martha's Vineyard and of Chesapeake Bay have repeatedly shown the isotherms as following a steep gradient at depths greater than, say, 50 meters, much as Libbey's (1891, 1895) profiles did (Figs. 41A, 42B, 43C). The most striking contrast in this respect between the summer and the winter states is that during the cold half of the year the thermal gradient between warm offshore and cold inshore water extends right up to the surface (Fig. 11) whereas in summer the surface stratum is nearly as warm right in to the coast line as it is over the continental slope.

[37] Scaled to the nearest 0.5° from a curve plotted from Libbey's (1891) profiles.
[38] The older observations show a scattering up to >2° from the mean curve.
[39] It is now being studied at the Woods Hole Oceanographic Institution.

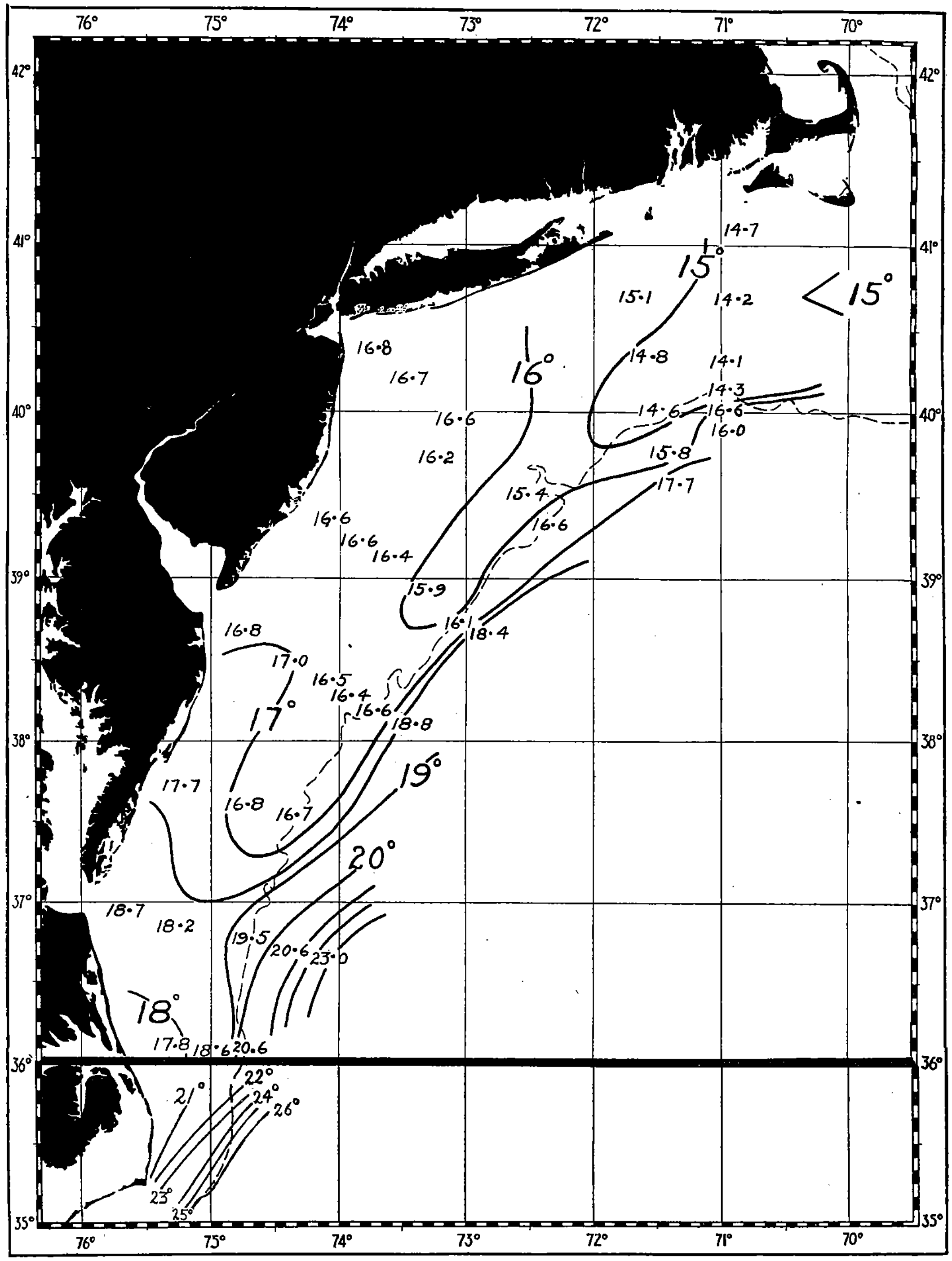

FIG. 54.—Temperature at the surface, to the north of latitude 36°, October 19–26, 1931; and in the vicinity of Cape Hatteras for October 19–21, 1884 ("Albatross" stations 2226–2310, Smith, 1889, p. 943–944).

Autumnal Progression

SEPTEMBER–OCTOBER

Our data for autumn, though not so extensive as for summer, show that autumnal progression is of the type that may be expected to result from the loss of heat from the surface, in a region where temperatures are not much affected by water movements from offshore, and to only a slight degree by indrafts from cooler regions to the north.

Unfortunately no survey has yet been made during the last part of September. Surface temperatures, however, at various lightships, and thermograph readings on commercial steamships, show that heat is lost more rapidly from the surface in the southern part of the area (where the water is then warmest) than in the northern, during the first few weeks after the surface temperature passes its maximum.

Thus the surface cooled on the average by about 2.9° off the coast of Virginia (Winterquarter Lightship), by about 2.7° near Cape May (Five Fathom Bank Lightship), by about 2.0° near New York (Sandy Hook and Fire Island Lightships), by about 1° at Brenton Reef Lightship, between the date of maximum temperature and the last week of September during the years 1881–1885 and 1928–1930 (Rathbun, 1887, Parr, 1933).[40] But surface temperatures recorded in 1884 by the "Albatross" off Martha's Vineyard and Nantucket already ranged some 3–5° lower midway out on the shelf (15°–18°) though only 1°–2° lower along the edge of the continent and outer parts of the continental slope (19°–22°) by September 26–28 than the summer maxima usual for those localities (p. 56), and any severe storm at this time of year may cause a sudden cooling of the surface, by stirring the water. Thus, in 1932, the surface temperature was about 24.4° over the outer edge of the shelf off New York on September 6–7, with a steep thermal gradient between the 20 and 30 meter levels, but had dropped to 19.2° two days later—i.e. had cooled by about 5°—after the passage of a severe northeast gale, the column having become practically homogeneous as to temperature, meantime, down to a depth of 30 meters. In the same way, in 1889, the surface over the inner half of the shelf off Martha's Vineyard cooled by about 2° during the last week of August when the sea was very rough (Libbey, 1891, p. 404).

By mid-October the temperature of the surface in the offing of Martha's Vineyard has fallen some 7° below the summer maximum. But the surface waters over Nantucket Shoals[41] show little or no cooling before the end of that month, mean values at the lightship, and readings at individual stations being about the same then (10.8°–14.4°) as is usual in summer. But as the surface temperature of the waters to the westward has not yet fallen as low as this, the region of the Shoals still continues through October as a potential reservoir, drifts from which may hasten autumnal cooling to the west and south as seems certainly to have happened along the outer part of the shelf in October, 1931 (Fig. 54).

But the abrupt transition between lower surface temperatures on the Shoals to higher over the smoother bottom to the westward, that develops in early spring (p. 35), and persists throughout the summer, becomes obliterated during October or early November at latest.

[40] The mean surface temperatures at these localities at the end of September are respectively, about 20.4°, 20°' 18.3° and 17.4°.

[41] Autumnal data for Nantucket Shoals are so far confined to three serial observations on Round Shoal and Rose and Crown Shoal, October 1, 1925; others nearby on the 22d; two stations in this same general region in October 1927 and six stations in October 1930; besides the data for the old and new locations of Nantucket Lightship.

On the other hand, as Parr (1933) has already shown, the convergence zone that characterizes the vicinity of Cape Hatteras in winter but breaks down in spring, forms again there during October, when the average south-north gradient between Diamond Shoal and Cape Charles Lightships increases from about 2° to about 4°, rising to about 6° by mid-November. And observations taken by the "Albatross" at 47 stations between latitudes 36° and 35°, October 19–21, 1884, show a rather abrupt thermal transition oblique to the continental shelf just north of the cape (Fig. 55).

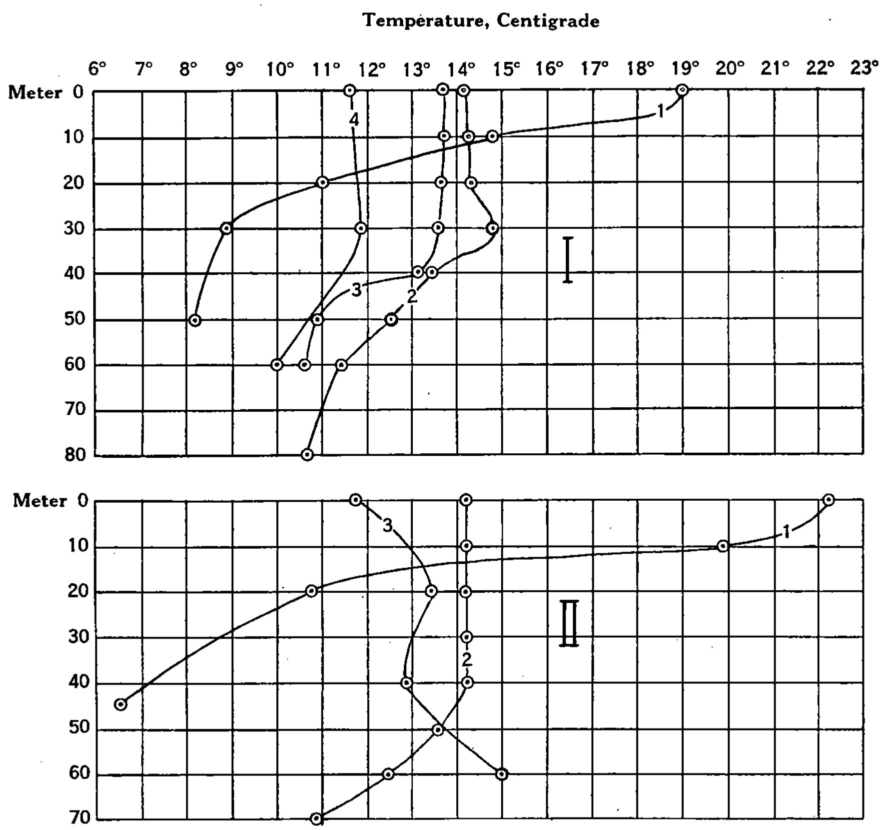

FIG. 55.—Vertical distribution of temperature at successive dates summer to autumn. Above:—1, Station Martha's Vineyard II, July 14, 1931; 2, same station, October 19, 1931; 3, Station Montauk I, October 28, 1931; and, 4, same general location, November 11, 1916 (Grampus, Sta. 10406). Below:—1, Station New York III, July 11, 1931; 2, same station, October 28, 1931; 3, Station Seagirt III, November 14, 1928.

According to the observations for 1931 (apparently a representative year), combined with the lightship data, and with the old "Albatross" records just mentioned, the surface water across the whole breadth of the shelf cools to 14°–16° in the offing of southern New England by the third week of October, to 16°–18° off New York and Cape May, to 18°–20° off Chesapeake Bay and to 18°–21° off northern North Carolina, but still continues warmer than 22° off Cape Hatteras, with 25° close in to the edge of the continent there (Fig. 54).

The most striking alteration in the vertical distribution of temperature, over the shelf as a whole to the west and south of the offing of Martha's Vineyard, that accompanies the loss of heat from the surface during the first part of autumn, is that the temperature becomes vertically equalized to a greater and greater depth from the surface downward as vertical stability decreases, with the substratum warming as the surface cools. This process may be abrupt, as was the case in September 1932 (p. 83), or gradual, chiefly depending on the strength of the wind and roughness of the sea. In 1931, the temperature had become practically uniform, vertically, down to a depth of about 40 meters, from the coast out to the 200 meter contour line by the third week of October in the offing of New York (Fig. 55); to a depth of about 30 meters over the sector between the offings of Cape May and of Chesapeake Bay (Fig. 56). And the fact that the lower boundary of this homogeneous stratum sank 10 meters deeper still, at the more easterly stations during the ensuing week, illustrates the further progress of vertical equalization characteristic of the season.

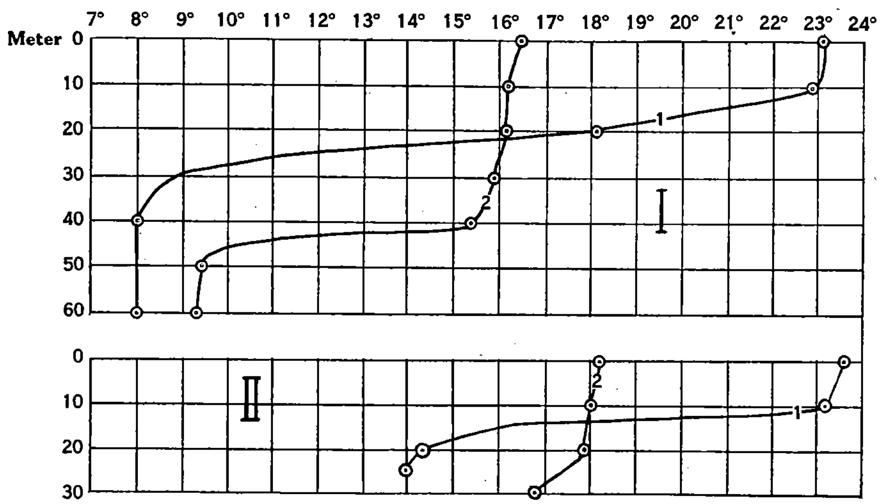

FIG. 56.—Vertical distribution of temperature:—I, off Cape May, Station III, July 18, 1929 (1) and October 23, 1931 (2); II, off Chesapeake Bay, Station II, July 17, 1929 (1) and October 25, 1931 (2).

This process, combined with some slight warming of the bottom water over most of the shelf (caused no doubt by encroachments from offshore) causes the thermocline not only to lose in definition as illustrated by the number of successive isotherms most closely crowded together, but to become centered at a greater and greater depth. Thus on the more easterly profiles run in 1931, where the temperature gradient in on the shelf was steepest in the upper 20 meters in July (Fig. 43, A, B), it was steepest in the 40–60 meter stratum in October (Fig. 57A), while the profiles further to the west and south show a seasonal contrast of the same order between July of 1929 and October of 1931 (Fig. 58).

The fact that the autumnal cooling of the surface is accompanied by this vertical equalization shows how erroneous it would be to use the drop in surface temperature alone as a measure of the amount of heat lost meantime from the water to the air by back radiation. Close in to the land, it is true, where the total depth of the water is less than 15–20 meters, cooling at the surface may, from the beginning represent a cooling of the whole column. But farther out, over greater depths, where increasingly active vertical circulation brings a longer and longer water column under the direct influence of solar irradiation, the mean temperature of the ever thickening homogeneous stratum

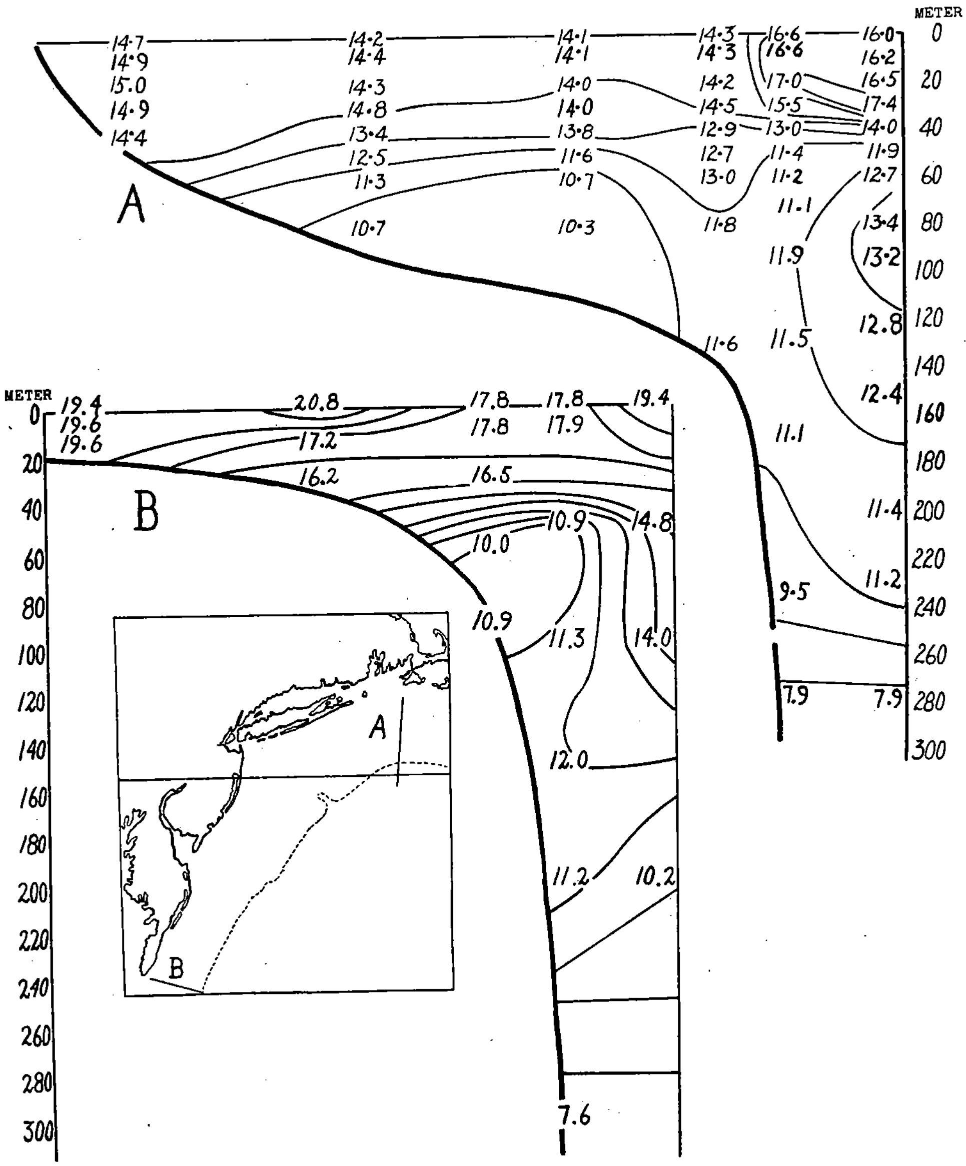

FIG. 57.—Temperature profiles crossing the continental shelf:—A, off Martha's Vineyard, October 19, 1931, and B, off Chesapeake Bay, October 30–31, 1919 ("Albatross" stations C 2001–2005, see U. S. Bureau of Fisheries, 1921, p. 142).

continues to rise until it comes to equal the mean temperature of the overlying air, which may not happen for a considerable period after the surface has commenced to cool. It appears, for example, (taking corresponding pairs of stations midway out on the shelf as criteria) that in 1931 the mean temperature of the upper 40 meters over the sector between the offings of New York and of Martha's Vineyard warmed by 2°–3° between July and late October, the 40–50 meter level having warmed by 3°–5°, whereas the surface over the same region generally had cooled by 2°–5° in the meantime (Fig. 55).

This is, in fact, the sequence of events that might be expected to result from the local

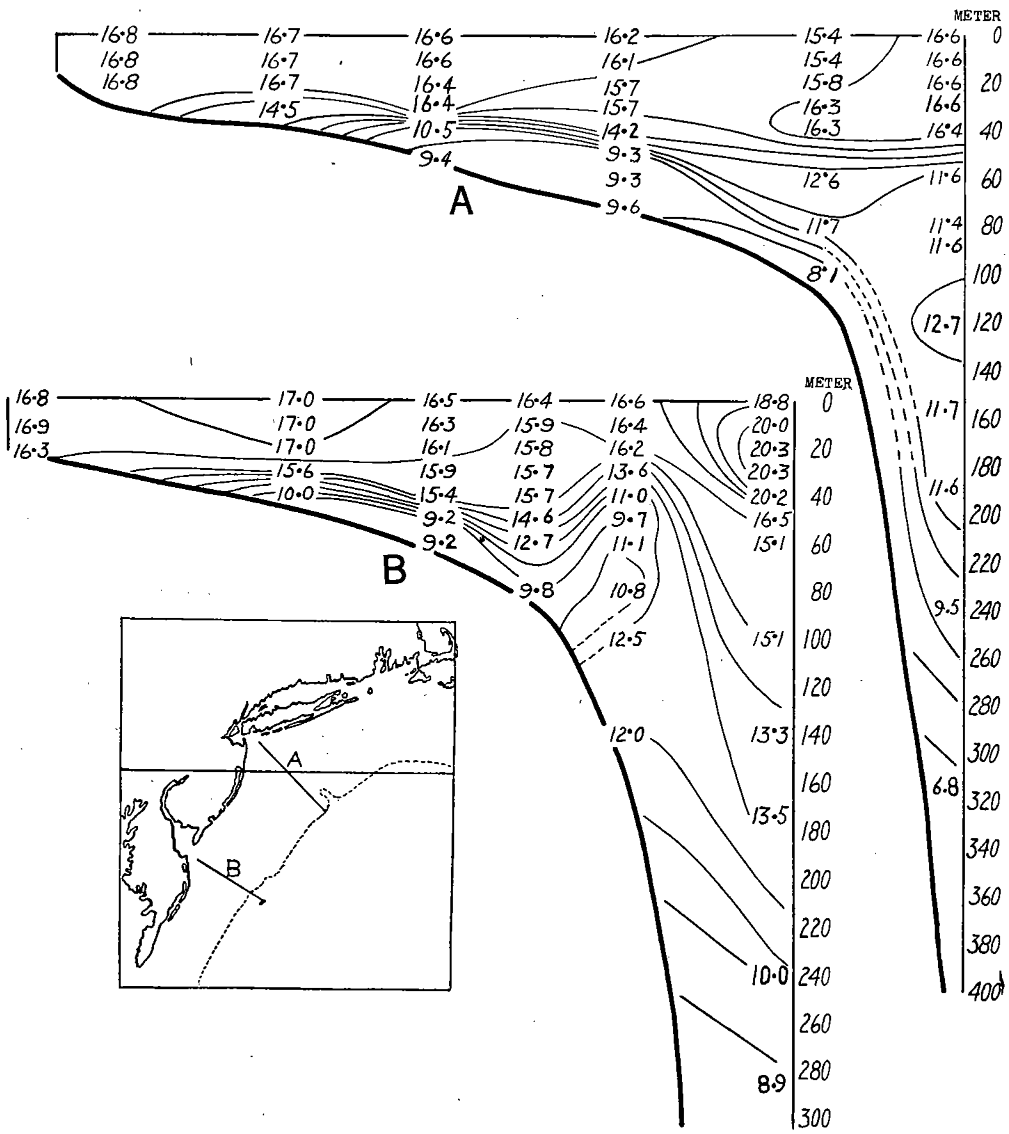

FIG. 58.—Temperature profiles crossing the continental shelf:—A, off New York; B, off Cape May, October 21–23, 1931.

interplay of factors that control the thermal cycle in this particular part of the sea. Consequently, we need not invoke an indraft of warm water, whether from the south or from offshore, to explain it. The period toward the end of summer when surface temperature is near a standstill is one of balance between receipt of heat at the surface, loss of heat to and through the atmosphere by back radiation, and dispersal of heat downward into the water by convection. This last process continues to bring a thicker and thicker stratum to an homogeneous temperature (cooling the surface while it warms the deeps) not only while surface temperature is at a standstill, but for some time after the surface commences to cool, i.e. after the water column commences to lose vertical stability, and vertical mixings to become more free. The result is constantly to increase the mean temperature of this homogeneous stratum until, as just remarked, it rises to equal the mean temperature of the air above it. In the sector to the east of New York this usually happens about the middle of October, by which time the average thickness of the homogeneous upper-stratum has increased to about 30–40 meters, as just described; this stratum now contains more heat than at any date earlier in the season.

This seasonal schedule applies not only over the smooth bottom to the west of longitude 70°, but to Nantucket Shoals as well, where our October readings at depths of 20 to 50 meters have all fallen between 12.3° and 13.6°, except for one, so cold (9.4°, with 10.8° at the surface) as clearly to indicate some local upwelling of the sort often recorded there in summer. And the fact that the water on the Shoals has averaged about 0.3° warmer on bottom in October (about 12.35°) than at the surface (about 12.05°) suggests either that these updrafts slacken by this season, or—more likely—that they now draw from a stratum where temperature has risen to such a point that they no longer chill the bottom appreciably, on the Shoals.

After the critical date when (except for temporary reversals) the average temperature of the air falls below that of the water,[42] so that the latter loses heat by back radiation faster than it gains heat from the sun, the mean temperature of the homogeneous upper-stratum decreases while its thickness continues to increase (Fig. 55).

The picture so far gained of autumnal progression is less satisfactory for the offshore and subsurface waters along the sector between the offings of Cape May and of Chesapeake Bay than for the more northern sector, because necessarily based on a comparison of summer data for one year (1929) with October data for another year (1931). Corresponding pairs of stations off Cape May (Fig. 56) show much the same seasonal relationship, however, over the outer part of the shelf as is described above, i.e. vertical equalization combined with mean warming of the deeper half of the column about equal to the mean cooling of the shoaler half. Closer in to the shore on this profile, however, and also off Chesapeake Bay the mean warming below the level at which the successive temperature curves cross each other was relatively less. But, when comparative data are drawn from different years, it is only the broad-scale progression that can be accepted as representative of the normal yearly cycle.

In 1931, at least, equalization of temperature from the surface downward did not progress far enough before the end of October to obliterate the wedge-like offshore contour of the coldest water on the shelf that is characteristic of summer (p. 73), for profiles run off Cape May in the third week of October of that year (Fig. 58B), and off Chesapeake Bay, October 30–31, 1919 (Fig. 57B) still showed more or less indication of it.[43] In fact, the isotherm for 10° follows a similar course on the only available November profile for the eastern part of the area (Bigelow, 1922, Fig. 37). According to the "Al-

[42] Rathbun's (1887) diagrams for 1881–1883 show the date of this reversal as varying between September 17 and November 1 at Five Fathom Bank, between October 12 and 27 at Sandy Hook Lightship, between September 25 and October 27 at Brenton Reef Lightship, between September 27 and October 27 at Nantucket Lightship, with 1883 on the whole the earliest year of the series, and 1881 the latest.

[43] The October profiles off New York and off Chesapeake Bay for 1931 lack data at the critical location, hence are not demonstrative in this respect.

batross" stations for 1919, the southern limit of bottom water on the shelf colder than 12°, in mid-autumn, is at about latitude 36°, temperatures then being much higher off Cape Hatteras, out to the 200 meter contour, than off Chesapeake Bay, not only at the surface (p. 84, Fig. 54), but right down to the bottom as shown by the following readings taken midway out on the Shelf and at the edge of the continent, on the two profiles, October 30–November 1 ("Albatross" stations 20002, 20004, 20006 and 20007):—

Midway of Shelf—Surface, off Chesapeake 20.8°, off Hatteras 24.4°; 30 meters, off Chesapeake 16.2°, off Hatteras 24.7°.

Continental Edge—Surface, off Chesapeake 17.8°, off Hatteras 27.8°; 50 meters, off Chesapeake 10.9°, off Hatteras 27.5°; 100 meters, off Chesapeake 11.3°, off Hatteras 26.9°; 200 meters, off Chesapeake 11.2°, off Hatteras 16.1°.

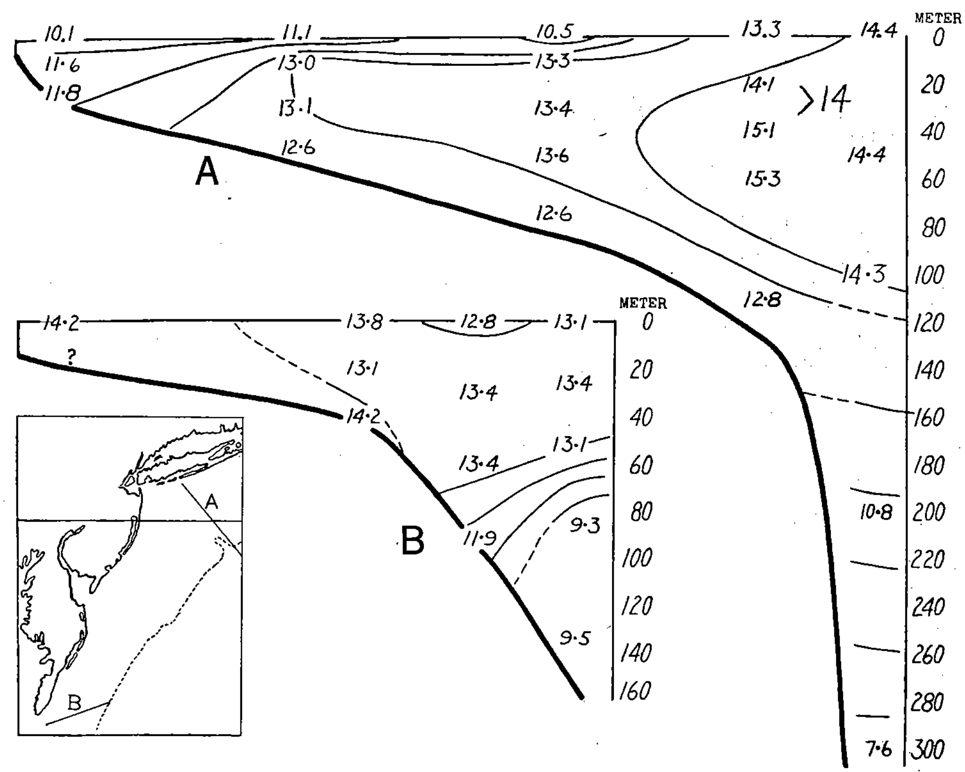

FIG. 59.—Temperature profiles crossing the continental shelf:—A, off Fire Island, November 13–14, 1928; B, off Chesapeake Bay, Nov. 17, 1916.

To the northward of latitude 38°, however, bottom temperatures over the mid and outer zone of the Shelf continue below 10–12° throughout October—such at least was the case in 1931 (Fig. 60). But, while in that year, the isotherms for the lowest bottom values (9° and 10°) still outlined a definite pool between the offing of Delaware Bay and longitude 71°30′ as late as the third week of the month, the eastern limits of this pool had withdrawn some fifty miles toward the west since July, the minimum bottom temperature having risen, meantime, by about 2° (July, 6°–7°, October, 8°–9°). And, the fact that in 1884, the bottom water was 10°–11° in the last week of September, midway out on the Shelf off Nantucket Shoals (Longitude about 70°), where it is ordinarily two de-

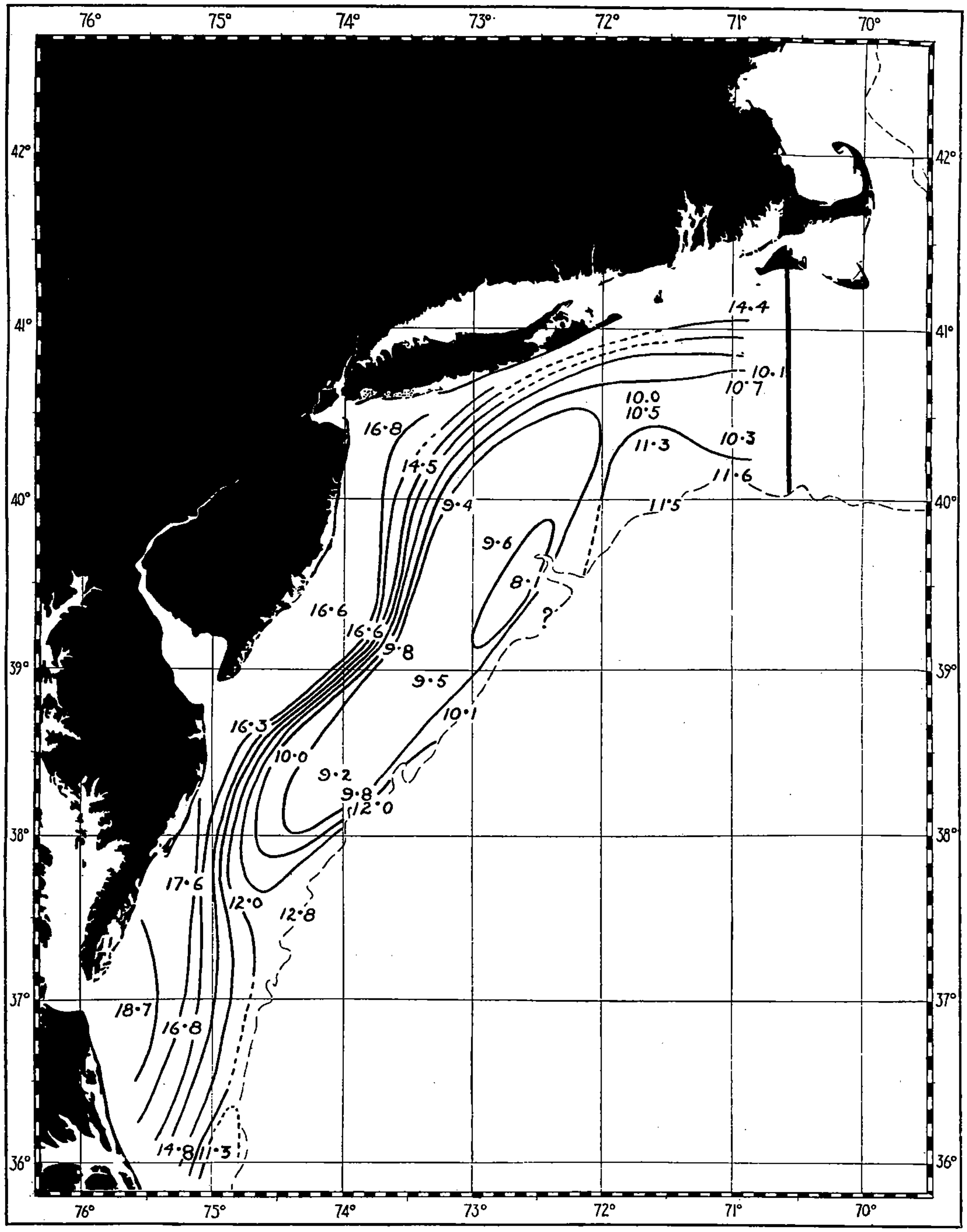

FIG. 60.—Temperature at the bottom from the 20 meter contour line out to the 150 meter contour line, October19–29, 1931.

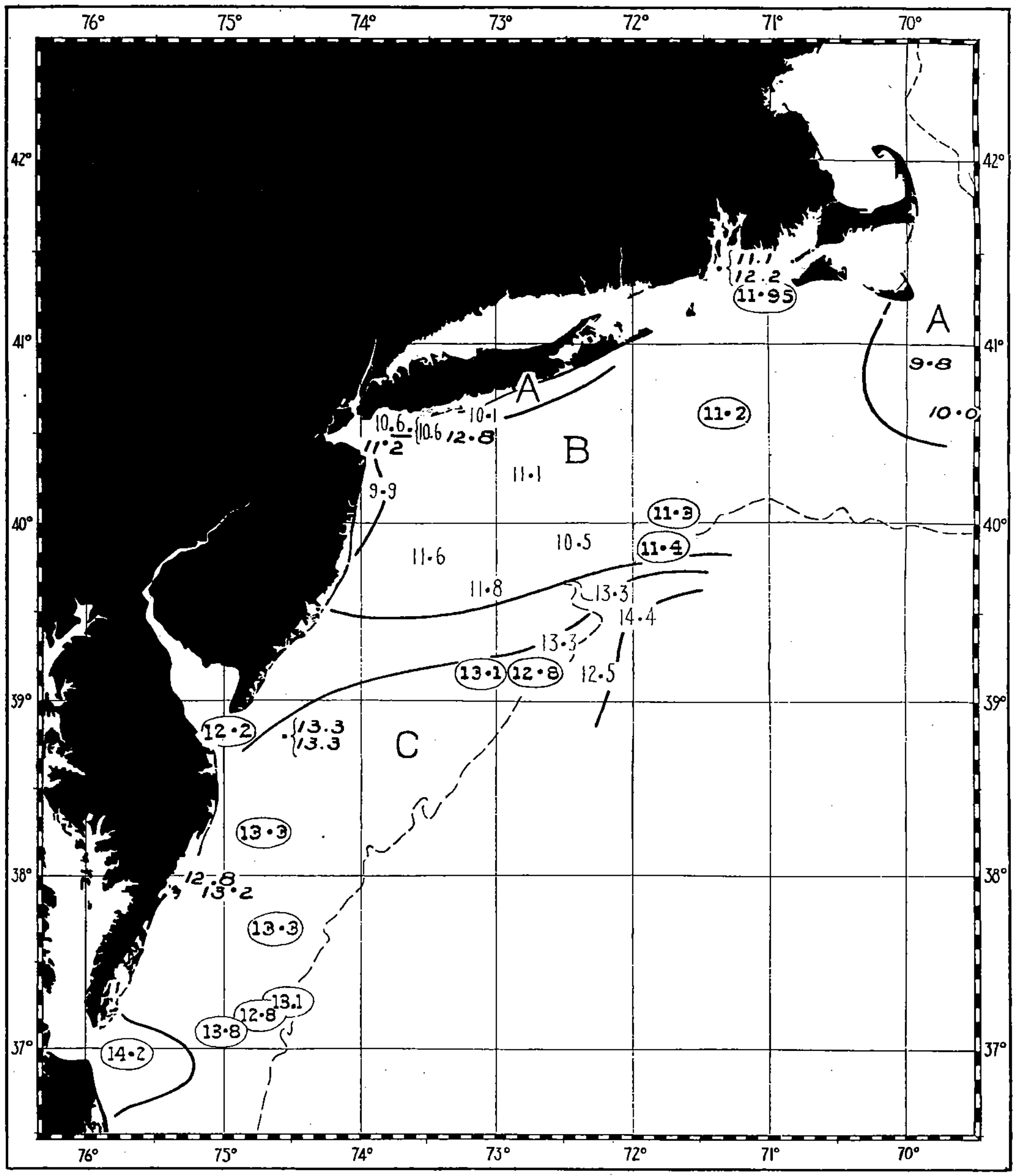

FIG. 61.—Temperature at the surface for mid-November. The readings in circles are for November 10–17, 1916; those in bold-faced type are the means at lightships for the middle of the month; those in italics are for November 10–14, 1928. Area A, usually 9°–10°; B, usually 10°–12°; C, usually 13°–14°.

grees or so colder than that in summer, is evidence that this warming of the deeper strata on the shelf is a normal accompaniment of the first two months of autumn.[44]

Owing to this autumnal increase in bottom temperature along the mid zone of the shelf, combined with the fact that the temperature of the bottom water along the edge of the continent (150–250 meters) is about the same in October[45] as it is in summer, there is no thermal barrier at this season, between the offings of Chesapeake Bay and of Martha's Vineyard, in depths less than, say, 250 meters, to on- or offshore migrations for animals having their lower temperature limit at 8°–9°. This also applies out across Nantucket Shoals where bottom readings at 14 stations, at depths varying from 20 meters to 45 meters, ranged between 9.4° and 13.6° (average about 12.4°) on various dates in October of the years 1925, 1927 and 1930. And while the bifid distribution of bottom water warmer than this, which is characteristic of summer (p. 73, Fig. 51), continued recognizable through October of 1931, it seems that when the whole column of water on the shelf finally becomes close to homogeneous vertically down to the bottom, as happens during the first half of November (p. 94), a period ensues (its duration still to be determined) when little or no thermal distinction can be drawn with regard to bottom temperature between the edge of the continent, and smaller depths nearer land, anywhere between the offings of Martha's Vineyard and latitude about 36°. But only in late autumn is such the case.

NOVEMBER

Recent cruise data for late autumn are confined to scattered observations for mid-November of 1916, affording profiles off Long Island and Chesapeake Bay, and to two profiles run across the shelf in the offing of New York on the 13–14th of that month in 1928.

These records, combined, illustrate the rapidity with which the water is losing heat at this time of year, in the fact that the surface was not only 3°–4° colder than is to be expected a month earlier; but was appreciably colder than the underlying strata, instead of warmer as it is earlier in the season.

During the period November 10–17 of 1916, the surface temperature at four stations in on the shelf in the offings of New York and of southern New England ranged between 11.3° and 12°. The November records for that year show a latitudinal range of surface temperature of about 1°–2° between the offings of Cape May (12.2°–13.3°) and of Chesapeake Bay (13.8°–14.2°). And the surface values prevailing off New York (about 10°–13°) in 1928 are about what would have been expected there at the same date in 1916, judging from the readings just listed.

Mean surface temperatures for the middle of November scaled from Rathbun's (1887) and Parr's (1933) diagrams for the periods 1881–1885 and 1928–1930 are approximately as tabulated on page 93 (to nearest 0.5°).

The mean rate of cooling of the surface, from mid-October to mid-November may then be set at about 2°–4° for our area as a whole, apparently averaging slightly more rapidl (3°–4°) in the southern part than in the northern (about 2°–3°) as at Nantucket

[44] Approximate bottom temperatures, at successive depths, out across the profile, were as follows:—33 meters, 13.3°; 46 meters, 12.4°; 60 meters, 11.1°; 70 meters, 10.2°; 80 meters, 10.5°; 106 meters, 12.2°; 143 meters, 11.1°; 179 meters, 10.5°; 223 meters, 9.3°; 457 meters, 5.3°.

[45] 10.2°–12.8° at 120–140 meters, all along from offing of Martha's Vineyard to Latitude 36°, October 19–24, 1931; 10°–12.2° at 100–200 meters, off Nantucket, September 26–28, 1884.

LIGHTSHIP	MEAN	EXTREMES
Cape Charles[1]	14.5°	14.0°–15.5°
Winterquarter[2]	13.0°	10.5°–17.0°
Five Fathom Bank	13.5°	12.0°–15.5°
Sandy Hook[3]	11.0°	9.0°–13.5°
Fire Island[1]	12.0°	12.0°–13.0°
Brenton Reef	11.5°	10.0°–13.0°
Vineyard Sound[3]	10.5°	9.5°–11.5°
Nantucket	10.0°	9.0°–10.5°

[1] 1928–1930 only.
[2] These lightships were situated a few miles farther offshore in 1928–1930 than in 1881–1885.
[3] 1881–1885 only.

and Brenton Reef Lightships. But it seems that the regional distribution of surface temperature shows little alteration meantime, for the extreme range of about 5° recorded on the continental shelf between the offings of Martha's Vineyard and of Chesapeake Bay in October, 1931 agrees closely with the range (4.3°) within these same geographic limits in November of 1916 and of 1928 combined.

The lightship records agree closely enough with the offshore values for about the same dates for 1916 and 1928 to justify the accompanying mid-November chart of surface temperature (Fig. 61), the discrepancies between individual readings being no wider than is naturally to be expected when data for different years are combined. The most interesting features in which this chart contrasts with the October chart and which illustrate the progress of autumnal cooling are:—

a) The development of a narrow cool belt (±10°) next to the land in the apex of the triangle formed by the coasts of New Jersey and of Long Island, and of slightly lower values on Nantucket Shoals:

b) The facts that by November the surface temperature has fallen slightly lower, next the coast, than offshore, throughout the sector bounded by the offings of New York and of Cape May, but that temperature still continues slightly higher at the mouth of Chesapeake Bay than a few miles farther out.

This difference in offshore-inshore relationship between the offings of New York and of Chesapeake Bay at this season no doubt reflects the effects of the water (summer heated) from the bay.

Individual isotherms for November afford no evidence of drifts from the northeast, of the sort that have so frequently been encountered during the half year April–October. Whether (or how frequently) events of this category occur in late autumn, but were missed by our cruises, is an interesting problem for the future.

By the middle of November the isotherms for 15° and for higher values have withdrawn so far outside the edge of the continent that none of the lines run across the shelf during that month have reached water as warm as 15°.

Unfortunately, no observations have been taken on Nantucket Shoals in November, in recent years. But the records for Nantucket Lightship given by Rathbun (1887) for the period 1881–1885 may be taken as representative, because her station was close in to the Shoals during that period. These show the surface averaging about 0.5° colder there than at the entrance to Vineyard Sound, and 1° or more colder than near New York for the middle of the month.

By November the water is losing heat so rapidly by back radiation that the surface has been slightly colder than the mid-depths at most of the stations for that month, occasionally as much as 2°–3° colder than the surface, as was the case midway out on the shelf off Long Island (Fire Island Profile) on November 13, 1928 (Fig. 59). And the recurving of the isotherms on this particular profile is a graphic illustration of the general rule that autumnal cooling, to leeward of the continent, proceeds from the shore seaward in these latitudes. But series of observations taken between November 14 and 21, 1927, on Cholera Bank off New York Harbor (Lat. 40°24′ N; Long. 73°34′ W) show that the thermal interchange between air and water is made so variable, at this season, by variations in wind and weather, that either surface, midstratum, or even bottom (if in moderate depths) may be the coldest level at any given time (Fig. 62) though the water column as a whole is constantly cooling off.

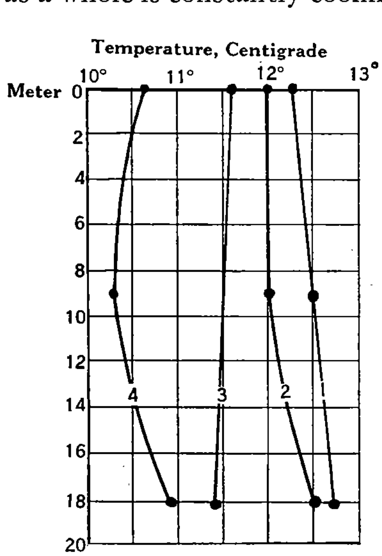

Fig. 62.—Vertical distribution of temperature on Cholera Bank, near New York on November 14 (1), November 15 (2), November 20 (3), and November 21 (4), 1927.

Apart from small variations of the sort just mentioned, the vertical distribution of temperature in mid-November, as compared with October (p. 85), illustrates the progressive equalization from the surface downward that is characteristic of advancing autumn in boreal coastal seas. In the two years of record, this equalization had progressed so far by mid-November that the mean vertical range of temperature, between the 10 meter level and the 40 meter level, was then only about 0.6° (6 stations in 1916 and 10 stations in 1928 combined), contrasting with a vertical range averaging about 2.6° in October. That is to say, the thermocline is entirely obliterated by November (cf. Fig. 59 with Figs. 57, 58). This change also results in the final obliteration of the cool bottom pool so characteristic of the sector between the offings of New York and of Cape May in summer (p. 74). In a tardy season, some trace of it may persist through the first week of November, as was the case in 1916, when the bottom water on the outer edge of the shelf off Long Island continued as cold as 8° as late as the 11th of that month, with the water-mass colder than 10° still showing something of a shelf-like contour offshore (Bigelow, 1922, Fig. 37). And under such conditions, the vertical distribution of temperature at the edge of the continent may, for a brief period, show an extremely complex alternation between lower and higher readings at different levels. But conditions in 1928, when the bottom temperature had become practically uniform right across the whole breadth of the continental shelf by the middle of November, (Fig. 59), with readings of 12°–13° off New York, 13°–14° off Chesapeake Bay, may probably be accepted as representative of the seasonal schedule for a normal year.

Some latitudinal equalization of subsurface temperature also takes place during November, as illustrated by the fact that while the highest and lowest bottom temperatures, in depths of 30–100 meters differed by about 8° in October 1931, between the offings of Martha's Vineyard and of Chesapeake Bay, they have differed by only some 4° at our November stations, if one reading of 7.7° recorded off New York on November 11, 1916 be left out of account (Bigelow, 1922, Fig. 37).

No subsurface records have been obtained for the region of Nantucket Shoals in November. But judging from the probability that some water wells up onto the Shoals right through the year, from the north and east, from depths greater than 100 meters it seems likely that the whole column continues slightly colder on the Shoals than just to the westward, until the surface temperature has fallen to about 7°–8°, which, by present indications, may be expected to happen early in December in most years (p. 96). From that date on through the winter, water temperatures, at equal depths and distances from the land, are about the same on the Shoals, surface to bottom, as along the coast to the westward.

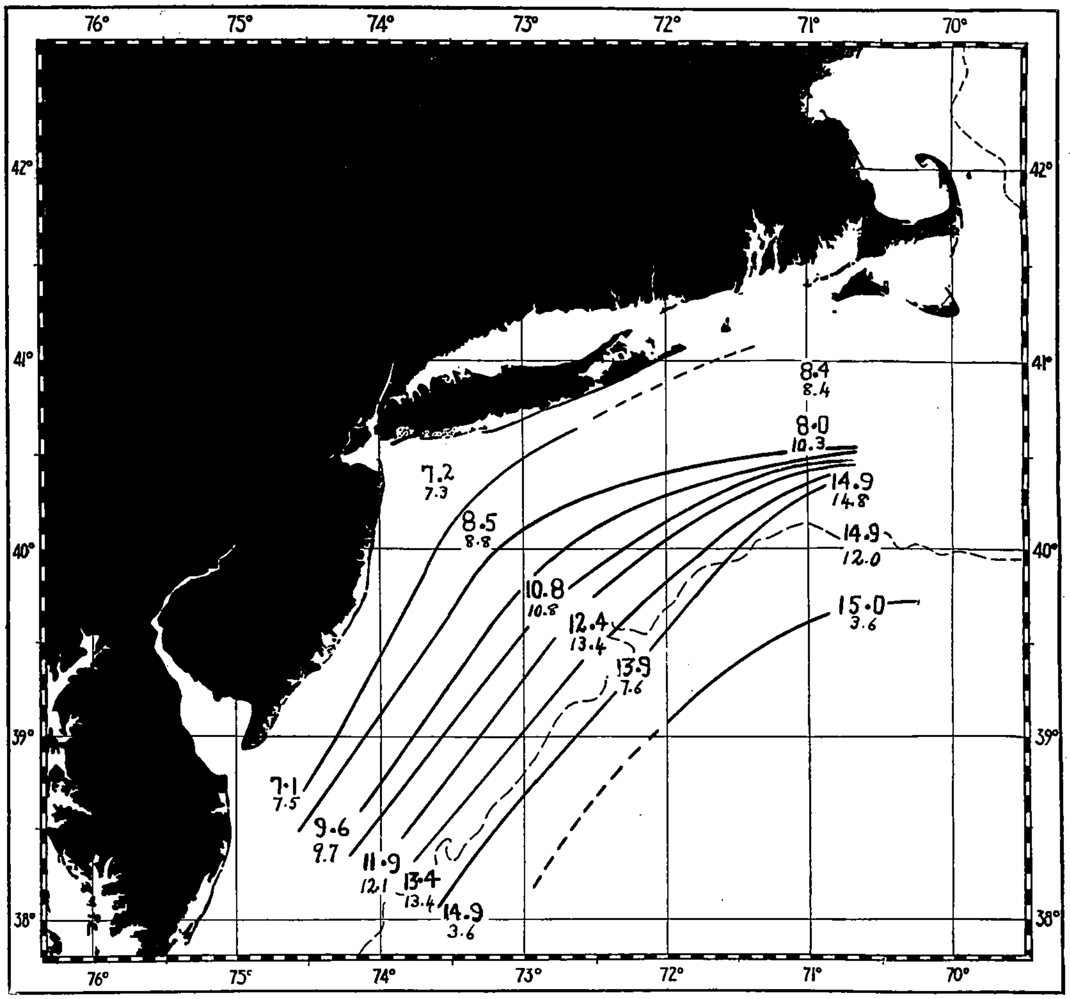

FIG. 63.—Temperature, December 19–21, 1932, "Atlantis" Sta. 1436–1450. The upper reading of each pair is the surface and marks the station locality, the lower of each pair is the bottom reading. Isotherms are for the surface.

DECEMBER–JANUARY

The cooling of the surface that takes place during the first half of December is illustrated by the following averages for the mid-period of the month at several lightships for the five year period 1881–1885, from Rathbun's (1887) diagrams (to the nearest 0.5°).

Nantucket	6.0°	Sandy Hook	6.0°
Vineyard Sound	5.0°	Five Fathom Bank	8.0°
Brenton Reef	7.0°	Winterquarter	7.5°

Approximate mean values as scaled (to the nearest 0.5°) from Parr's (1933) diagrams for the same date over the three year period, 1928 to 1930, were somewhat higher at neighboring localities, as follows:

Nantucket Lightship	7.0°	Five Fathom Bank Lightship	8.5°
Brenton Reef Lightship	7.5°	Winterquarter Lightship	9.5°
Fire Island Lightship	8.0°		

But the differences between the two sets of observations are no wider than is to be expected for different years and for slightly different situations.[46]

From late November onward, the chilling proceeds more rapidly inshore than offshore as appears from the fact that thermograph records taken during the week of December 10–16 of 1929 and 1930, on commercial steamships from New York to Bermuda and from New York to the West Indies, showed a gradient of about 3°–5° between lower readings next the coast and higher at the continental edge. The "Atlantis" also had readings about 6° lower inshore (7°–8°) between the offings of Martha's Vineyard and of Cape May than offshore (13°–15°) on the 19–21st of the month in 1932 (Fig. 63).

If we accept the mean for the several years of record as normal, the surface water may thus be expected to cool to about 6°–8° along shore, and to 10°–13° along the outer edge of the shelf, all along from longitude 71° to the offing of Chesapeake Bay, by the third week of December, with 14°–15° only a few miles outside the 200 meter contour line. By this date, also, the successive isotherms have come in general to lie parallel to the trend of the coast line, the latitudinal range being only about 2° next the land between Martha's Vineyard and Virginia,[47] i.e. have assumed the state characteristic of late winter and early spring (cf. Fig. 63 with Figs. 2 and 3). Considerable variations are, however, to be expected from year to year in the exact surface temperatures at given localities on any given date, depending on variations in the temperature of the air and on the direction of the wind, especially close in to land, as appears from the following average maxima and minima (to nearest 1.0°) for mid-December at different lightships, scaled from Rathbun's (1887) and Parr's (1933) diagrams.

Lightship	Max.	Min.
Nantucket[1]	8°	5°
Brenton Reef[2]	8°	5°
Fire Island and Sandy Hook[2] combined	8°	5.0°
Five Fathom Bank[2]	10.0°	6°
Winterquarter[3]	11.0°	4°

[1] 1881–1885 and 1928–1930; old and new locations combined.
[2] 1881–1885 and 1928–1930.
[3] Old location, 1881–1885 only.

Thermograph records also show that the surface temperature may be a degree or so lower in partially enclosed locations such as the mouth of New York Harbor at this season than it is only a mile or two out to sea—depending, again, upon the weather.

The vertical equalization of temperature, already progressing rapidly through October and November, is so nearly complete by mid-December that the maximum difference

[46] The stations of Nantucket and Winterquarter Lightships have been shifted farther offshore, where higher surface temperatures are to be expected at this season than at their former stations.

[47] We have no data for the offing of Chesapeake Bay for December, except well out to sea.

between surface and bottom at 9 out of 10 stations between the coast line and the 150 meter contour line was only 0.48° during the third week of the month, in 1932; the one exception was off Martha's Vineyard where bottom water warmer than 10° lay farther in on the shelf than elsewhere, below surface water of about 8°. Consequently a chart of

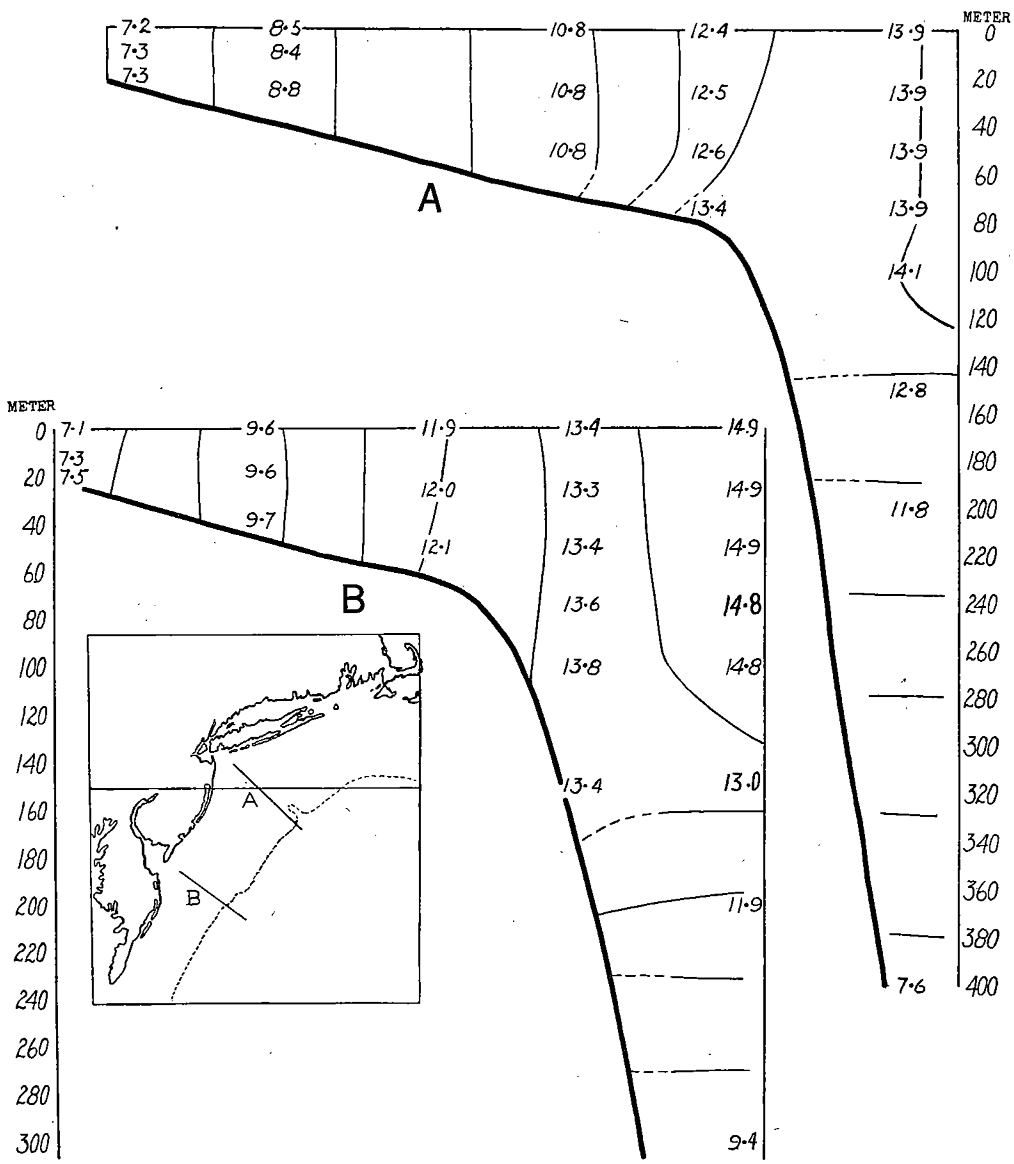

FIG. 64.—Temperature profiles crossing the continental shelf:—A, off New York and B, off Cape May, December 19–21, 1932.

bottom temperature for that cruise would practically reproduce the surface chart (Fig. 63), except for the one station just noted. Successive isotherms on profiles normal to the coast line also come to lie roughly vertical by this date, i.e. at right angles to their situation in summer (cf. Fig. 64 with Figs. 41–44), so to continue until well into the spring, and December profiles show little, if any indication of the shelf-like extension, offshore, of cold water from the shelf, that recurs so frequently on profiles for the warm half of the year (p. 73).

The profiles for mid-December further show that vertical equalization of the entire water column on the shelf, combined with the fact that the water cools off much the most rapidly next the land, lead, by this date to the reestablishment of a cold inshore boundary to the bottom water warmer than 10° that continues to wash the edge of the continent. Thus the latter can again properly be described as a "warm" zone, the brief period when bottom temperature is close to uniform right across the shelf (p. 92), having come to an end, not to recur until the next October.

The only wide-scale thermal alteration that takes place from December on through the later winter is the loss of heat that continues until the minimal temperatures for the year are reached, and the parallelism persists, between coastal trend and isothermal arrangement, that is established in November. Average values, scaled from Parr's (1933, Figs. 8–10) diagrams, for mid-January 1928–1930 are as follows (to the nearest 0.5°)[48]:—

Locality	Mean	Max.	Min.
Winterquarter Lightship (new location)	7.0°	7.0°	6.5°
Five Fathom Bank Lightship	6.0°	6.5°	5.5°
Fire Island Lightship	5.5°	6.5°	4.5°
Brenton Reef Lightship	5.5°	6.0°	5.0°
Nantucket Lightship	4.5°	5.0°	4.0°

Lightship and thermograph records, combined with observations taken off Chesapeake Bay by the "Bache" in 1914, by the "Roosevelt" in 1916, indicate that the surface temperature next the coast ordinarily falls as low as 4° along the sector Martha's Vineyard—New York by the last week of January; to 5°–6° off Cape May and to the southward, though the surface water over the outer part of the shelf still continues warmer than 8° (Fig. 65), with 12° close in to the edge of the continent, or even encroaching a few miles in over the shelf. Subsurface observations for January have so far been confined to a belt some 45 miles wide (north and south) off Chesapeake Bay, surveyed by the "Roosevelt" during the last three days of the month in 1916, to a profile across the same sector by the U. S. Coast and Geodetic Survey steamer "Bache," January 20–27, 1914, and to one station by the "Roosevelt" near the 200 meter contour line off Cape May, February 1, 1916.[49] These, as seen in profile, (Fig. 66) show the same type of distribution that develops off Cape May and to the northward in December (Fig. 64), but with actual temperatures about 2° lower, i.e. 6°–7° near land, rising to 10°–12° at the edge of the continent.

Thus temperatures throughout our area, from surface to bottom, have fallen to within 1°–2° of the usual winter minimum by the end of January. When the minimum is reached at the end of the winter as described above (p. 8) the cycle for the year is complete.

Summary

This study covers the area bounded on the northeast by the region of Nantucket Shoals, on the south by the offing of Chesapeake Bay, and by the 200 meter contour line offshore. Available data are tabulated on pages 4 and 104.

[48] The series for 1881–1885 (Rathbun, 1887) includes only occasional data for January.
[49] These data are discussed in detail in an earlier publication (Bigelow, 1917).

WINTER MINIMUM

Temperature is at its minimum for the year late in February or early in March, with no constant latitudinal difference in this respect between the northern and southern parts of the area, though the precise date varies considerably, both regionally and from year to year.

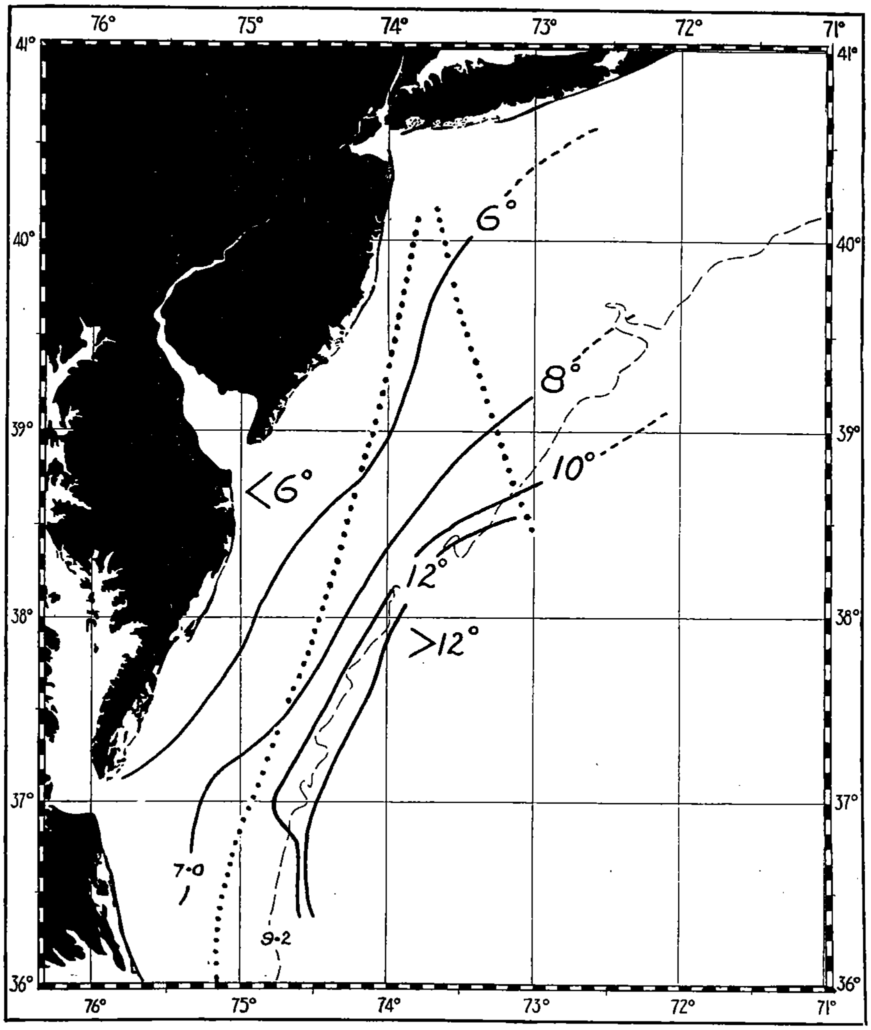

FIG. 65.—Mean temperature at the surface for the last week of January, combined from readings taken off Chesapeake Bay by the "Bache," January 20–27, 1914; by the "Roosevelt" off Virginia, January 7–13, 1916 (Bigelow, 1917); and from the thermograph readings along the routes marked by the dotted lines by commercial steamships during the week of January 14–21, 1931.

At this season the temperature is lowest next the land, highest along the outer edge of the shelf; and as the latitudinal difference between the offings of Martha's Vineyard and of Chesapeake Bay is then only 1°–3°, successive isotherms at any chosen depth run roughly parallel to the trend of the continent. In normal winters, the temperature falls to about 2°–3° next the coast and to 7°–11° along the 200 meter contour as far west as New York; to 3°–4° and 9°–10° respectively off Cape May; to 5°–5.5° and 9°–10° at the same relative positions off Chesapeake Bay.

The water next the coast has about the same temperature from Chesapeake Bay southward nearly to Cape Hatteras, but there is then an abrupt transition to higher values just south of the Cape; and while offshore water of 19°–20° may skirt the edge of the continent as far north as latitude 36°, the isotherms there trend sharply offshore, to the northeastward, at this season with surface readings lower than 12° normally extending at least 80–90 miles out beyond the 200 meter contour line off New York.

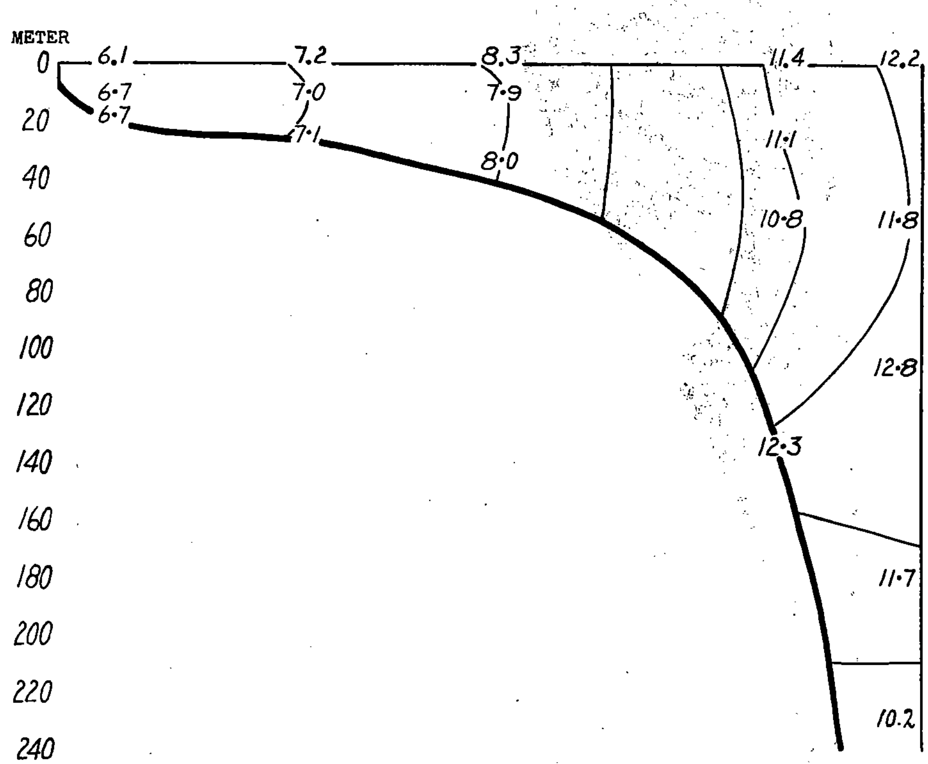

FIG. 66.—Temperature profile crossing the continental shelf off Chesapeake Bay, January 27–28, 1916 ("Roosevelt" stations—see Bigelow, 1917, p. 60).

At the coldest season the whole column of water is close to homogeneous, in temperature from the surface down to the bottom (usually the surface is fractionally coldest), over the entire continental shelf out to the 100 meter contour line.

In normal winters the bottom water along the 150–250 meter zone at the edge of the continent is about 9°–11°, and this warm zone is bounded inshore by colder bottom water (2°–6° in depths of 20–30 meters) southward nearly to the latitude of Cape Hatteras. Deeper down the slope, bottom temperature declines progressively to abyssal values.

The observational series did not include any unusually cold winter, but in 1931–1932 the minimum temperature next the coast was 2°–4° higher than normal, being in general upwards of 7° over the whole inner half of the shelf, from latitude 40°30′ southward.

VERNAL WARMING

Vernal warming, commencing late in February, or early in March, is at first irregular, or may be even temporarily reversed, while subsurface temperatures midway out on the shelf may continue to decline slowly for some days after the surface has commenced to warm. When warming is definitely in progress, the temperature of the water on the shelf at first increases through the whole column, most rapidly so next the land. After late April or early May the surface warms much more rapidly than the deeper levels so that a thermocline of increasing steepness develops over the whole shelf to the west of the offing of Martha's Vineyard.

In the extreme southern part of the area the temperature of the whole column of water across the shelf rises to a value as high as that of the warm bottom zone along the edge of the continent (9°–10°), or higher, before the thermocline is established. And on Nantucket Shoals, at the opposite end of the area, the whole column, surface to bottom, continues to warm at a nearly uniform rate right through the spring. But the thermocline develops throughout the intervening sector before the bottom water on the deeper half of the shelf has warmed more than 1°–2° above its winter minimum, and while it still continues some 4°–6° colder than the bottom along the continental edge.

The thermal convergence that exists near Cape Hatteras in winter loosens through the spring. After the end of May the south-north transition from higher surface temperatures to lower is no more abrupt there than elsewhere along the coast. On the other hand, a transition zone of this same order develops in spring at the opposite (N.E.) end of the area in the region of Nantucket Shoals.

During May, the latitudinal gradient of temperature along the continental shelf between the offings of Martha's Vineyard and of Chesapeake Bay increases to about 6°– at the surface, and to about 4°–5° on bottom, whereas the gradient from the coast line out to the edge of continent decreases to some 2 °at the surface, and the offshore boundary of the cold (4°–6°) bottom water on the shelf assumes a wedge-like contour, jutting seaward into the warmer water offshore. Average temperatures for late May are given on page 40.

The vernal advance is complicated, on the one hand, by intrusions of cold water from the east at the surface; and on the other hand, by indrafts of warm water over the bottom from offshore. Available data are not sufficient to show how regularly recurrent these cold surface intrusions are. When well developed they result in the development of tongues of low temperature spreading westward and southward from the offing of Cape Cod, along the outer zone of the shelf, but seldom if ever passing the offing of New York. A widespread encroachment of warm water took place in over the bottom in the early spring of 1930, along the outer edge of the shelf; a less pronounced movement of the same sort in 1929.

SUMMER

Surface temperature continues to rise rapidly over the entire area during June, except on Nantucket Shoals, where surface warming is so retarded by active turbulence that the surface is some 4°–5° colder there than to the westward, after the middle of the month. Cold surface pools, of small extent, may also develop temporarily near land, from local upwellings. Data for June of 1929 and 1930 suggest the following normal surface values across the shelf for the first to second week of the month:—Nantucket Shoals

8°–11°; offings of Martha's Vineyard and of New York, 12°–14°; offing of Cape May, 16°–18°; offing of Chesapeake Bay, 19°–20°.

During June the thermocline increases in steepness over the greater part of the area, except on Nantucket Shoals, where a thermocline develops only locally and sporadically, if at all.

Surface temperature normally reaches its annual maximum throughout the area early in August; it then continues close to stationary throughout that month, and sometimes into the first week of September. The latitudinal gradient, between the offings of Chesapeake Bay and of Martha's Vineyard, is then 4°–5°; the gradient, transverse to the shelf, usually less than 3°. Normal temperatures for representative localities for this season of the year are given on page 55.

In summer, the surface temperature is much more variable on Nantucket Shoals than to the westward and southward, both regionally and with changes of the tide, as well as averaging several degrees lower. Details are given on page 58.

The thermal gradient between surface and bottom throughout the region generally reaches its maximum, and the thermocline is steepest, shortly before autumnal cooling of the surface begins. The surface, along the 35–50 meter contour zone, is then some 9°–11° warmer than the bottom in the offing of Chesapeake Bay; 13°–16° warmer than the bottom off Cape May and New York. The superficial 10–15 meters are now close to homogeneous, the greater part of the vertical gradient is condensed between the 15 meter and 30 meter levels, and the underlying water, like the surface stratum, is close to homogeneous, not only vertically but transversely to the shelf down to a depth of about 70–80 meters. Details regarding the steepness of the vertical gradient, on Nantucket Shoals, are given on page 68.

In normal summers the bottom, southward as far as latitude about 38°, is considerably colder midway out on the shelf than it is either in small depths nearer land on the one hand, or along the outer edge of the shelf on the other hand. This cold belt usually extends from about the 30 meter contour out about to the 80 meter contour, and there is little variation in temperature within it, either transverse to the slope or over considerable distances along the shelf. In the summers of 1913, 1930 and 1931 the northeastern and southwestern boundaries of the pool enclosed by the isotherm for the lowest value lay off Martha's Vineyard and off New York, respectively; in 1929 it extended from longitude about 72° southwestward to the offing of Cape May; but in the very cold summer of 1916 it reached southward along the outer part of the shelf nearly to the offing of Chesapeake Bay, and this was also the case in September 1932.

The minimum bottom temperature within this coldest area was 6°–7° in the summers of 1913, 1929, 1930, 1931 and 1932; and close to 4° in 1916. This contrasts with average bottom temperatures on Nantucket Shoals, to the eastward, of about 12.9° in depths of 18–25 meters, of about 8.3° at 40–60 meters; and, in most summers, with bottom temperatures higher than 10° across the shelf off Chesapeake Bay. The offshore boundary of this cold bottom-mass continues to show a wedge-like conformation indenting more or less into the warmer water offshore throughout the summer.

The thermal transition is comparatively abrupt between the cold water in on the shelf and bottom water some 4°–5° warmer all along the edge of the continent, where the bottom temperature is about the same in July and August (9°–13°) as at other times of the year.

In most summers the inshore boundary to this warm offshore bottom-belt coincides roughly with the 90–120 meter contour line, its offshore (lower) boundary with the 200–

250 meter contour line. In late summer it extends eastward along Georges Bank, but the channel separating the latter from Browns Bank is normally its limit in that direction.

AUTUMNAL PROGRESSION

The rate at which the surface cools during the early autumn varies locally and through short periods with the strength of the wind and with the roughness of the sea.

In 1931, apparently a representative autumn, the surface had cooled to 18°–19° across the shelf off Chesapeake Bay; to 15°–17° off New York; and to 14°–15° off Martha's Vineyard by the third week of October. But the surface over Nantucket Shoals (cooler than elsewhere in this general vicinity in summer) shows little or no cooling before the end of October, all our surface readings there having fallen between 10.8° and 14.4° for that month. Thus, the abrupt transition between lower surface temperatures on the Shoals and higher to the westward, that exists from spring through summer, is obliterated in October or early November. On the other hand, this same season sees the redevelopment of the Cape Hatteras convergence, which exists through the winter but breaks down in spring.

During autumn, the temperature becomes increasingly equalized from the surface downward. Available data suggest complete mixture down to a depth of 40–50 meters by the end of October in normal years, the deeper strata warming as the surface cools, except where counteracted by local upwellings, such as occur on the eastern side of Nantucket Shoals.

By the middle of November, temperatures of 10°–12° are to be expected right across the shelf from surface to bottom off southern New England and off New York; 12°–14° off Cape May; 13°–14° off Chesapeake Bay, usually with the surface fractionally the coldest level, this being the season when temperature is most nearly uniform regionally, annually, and with depth, and when the thermal pattern is simplest. The whole mass of water is then so close to uniform, out about to the 80 meter contour line, both from surface to bottom and from the shore line seaward, that there is no thermal separation between the bottom water along the continental edge ("warm zone" of winter, spring and summer) and farther in on the shelf. But this state lasts for only a brief period.

In late autumn and early winter cooling proceeds most rapidly near the land. By mid-December the water is coldest inshore, surface to bottom, the thermal pattern is of the winter type with the isotherms paralleling the coastal trend at all depths, and a cold inshore boundary has been reestablished to the bottom water warmer than 8°–9° that washes the edge of the continent. By the middle of the month, mean temperatures are about 5°–8° along shore, and 10°–13° along the outer edge of the shelf, with a latitudinal range of about 2° between southern New England and Chesapeake Bay, and with vertical equalization so nearly complete that the difference between surface and bottom is in most cases less than 0.5° at given stations.

Cooling proceeds through January until, by the end of the month, the temperature, surface to bottom, has ordinarily fallen below 5°–6° all along the coast; to 8°–9° midway out on the shelf; but is still 10°–12° along the outer edge of the latter. And cooling continues through the later winter until the minimum for the year is reached late in February, or early in March, at the values stated on page 99.

No thermal evidence has been found of any widespread influx of warm coastal water into the region from the south, of any floodings of the surface with pure oceanic water of high temperature, nor of upwellings onto the shelf of cold abyssal water, such as have sometimes been postulated in the past on theoretic grounds.

TEMPERATURES AND SALINITIES, TAKEN BY U.S. BUREAU OF FISHERIES VESSELS AND BY "ATLANTIS," ON THE CONTINENTAL SHELF AND SLOPE, WEST OF LONGITUDE 69° W., BETWEEN LATITUDES 42°20′ N., AND 35° N., 1923–1932[1]

Arrangement:—Temperatures are in degrees Centigrade, salinities in parts per mille; depths in meters. The data for each station are given in the following order;—Serial number; Profile (Fig. 1); Station number on the Profile (p. 6); Latitude (N); Longitude (W); month (in Roman numerals); day of month; time of day to nearest even hour, standard time; bottom depth in meters; depth in meters for each observation, followed by the temperature and salinity.

Example: [Serial no.] 21076 [Profile] Block I [station] I, [Latitude] 41.05 [N], [Longitude] 71.23 [W]; [Month] VI [day] 12, [Time] 9 h:—[Total Depth] D 44; [depth of observation] 0, [Temperature] 13.8, [Salinity] 32.14; [Depth of observation] 5, [Temperature] 13.3, [Salinity] 32.18; [depth of observation] 15, [Temperature] 11.8, [salinity] no. sal.; [Depth of observation] 35, [Temperature] 9.1, [Salinity] 32.48.

Standards of accuracy:—All temperatures were taken with reversing thermometers of modern type, provided with auxiliary to determine the temperature of the instrument at the time of reading. But owing to difficulties under which many of the observations were obtained, it has been thought wise not to claim accuracy closer than 0.1°. All determinations of salinity have been by titration by the usual method, and most of the samples were titrated twice; hence accuracy conforms to modern requirements. Depths of observations were measured by the length of wire outboard, corrected for wire angle as observed at the surface, whenever this angle was 15° or greater. (Example, serial no. 21341, [Depth] 464 c.) The depth of observation being about 3.4% less than the length of wire outboard, with this angle, the average error in the stated depths is not more than 4%, which may be regarded as negligible in the shallow waters over the continental shelf

Halcyon Series, 1923, 1924 and 1925

Nantucket Shoals, 41.20, 69.48; IV/24/23:—0, 3.3.
Nantucket Shoals, 41.27, 69.43; IV/20/25:—0, 11.6; 13, 11.4; 22, 11.2.
Nantucket Shoals, 41.25, 69.41; VI/7/25:—0, 8.3; 13, 8.4; 24, 9.1.
10692 Nantucket Shoals, 41.27, 69.43; VIII/20/25, 18h:—D24: 0, 11.6; 13, 11.4; 22, 11.2.
10693 Nantucket Shoals, 41.26, 69.42; VIII/21/25, 7h:—D21: 0, 11.7; 9, 11.6; 20, 11.6.
10694 Nantucket Shoals, 41.29, 69.42; VIII/21/25, 8h:—D27: 0, 11.7; 15, 11.5; 26, 11.7.
10695 Nantucket Shoals, 41.25, 69.41; VIII/21/25, 9h:—D26: 0, 13.4; 24, 13.2.
10696 Nantucket Shoals, 41.24, 69.42; VIII/21/25, 10h:—D27: 0, 15.0; 26, 13.2.
10697 Nantucket Shoals, 41.21, 69.43; VIII/23/25, 7h:—D24: 0, 16.4; 22, 15.6.
10699 Nantucket Shoals, 41.10, 69.44; VIII/23/25, 12h: D24: 0, 14.5; 22, 14.6.
10700 Nantucket Shoals, 41.10, 69.44; VIII/24/25, 4h:—D24: 0, 13.8; 13, 14.2; 24, 14.3.
10701 Nantucket Shoals, 41.11, 69.39; VIII/24/25, 10h:—D25: 0, 13.9; 22, 14.4.
10720 Nantucket Shoals, 41.25, 69.43; X/1/25, 8h:—D26: 0, 11.6; 13, 12.0; 24, 12.0.
10721 Nantucket Shoals, 41.22, 69.43; X/1/25, 10h:—D27: 0, 12.2; 13, 12.7; 26, 12.8.
10722 Nantucket Shoals, 41.26, 69.35; X/1/25, 12h:—D27: 0, 11.6; 13, 11.9; 26, 13.5.

[1] For other "Atlantis" observations, see Conseil. Internat. Explor. de la mer, 1933; for places of publication of earlier U. S. Bureau of Fisheries records, see p. 4.

10726 Nantucket Shoals, 41.24, 69.42; X/22/25, 20h:—D24: 0, 10.8; 11, 9.4; 22, 9.4.
10727 Vineyard Sound, 41.18, 71.00; X/27/25, 9h:—D35: 0, 13.3; 16, 11.9; 33, 11.9.
10728 Block Island, 41.11, 71.28; X/27/25, 12h:—D24: 0, 13.0; 11, 11.2; 22, 11.7.
10729 Martha's Vineyard I, 41.12, 70.51; X/28/25, 12h:—D19: 0, 13.3; 18, 12.1.

Cruise of May 3 to 7, 1927, Station 20221, Albatross II Series

20221 Nantucket Shoals, 41.25, 69.40; V/4:—D24: 0, 5.0; 15, 5.4; 24, 5.4.
Nantucket Sound, 41.26, 70.10; V/5:—0, 7.8; 15, 7.9.
Nantucket Shoals, 41.20, 69.48; V/7:—0, 5.5; 22, 5.9.
Nantucket Shoals, 41.19, 69.47; V/7:—0, 5.5; 20, 5.6.
Nantucket Shoals, 41.10, 69.44; V/7:—D23: 0, 5.5; 13, 6.0; 22, 6.0.

Cruise of May 18 to 28, 1927, Stations 20222 to 20262, Albatross II Series

20222 Block Island I, 41.03, 71.31; V/18, 0h:—D43: 0, 10.0, 31.95; 20, 7.5, 32.28; 40, 4.8, 32.58.
20223 Block Island II, 40.34, 71.23; V/18, 5h:—D68: 0, 9.5, 31.90; 10, 10.7, no. sal.; 30, 6.2, 32.47; 60, 4.6, no sal.
20224 Block Island III, 40.04, 71.13; V/18, 11h:—D207: 0, 8.4, 32.22; 20, 7.8, 32.62; 40, 7.3, 32.86; 100, 11.4, 34.86; 200, 9.5, 34.53.
20225 Block Island IV, 39.46, 71.08; V/18, 15h:—D1000+: 0, 9.0, 32.34; 40, 8.2, 33.63; 100, 11.8, 35.07; 160, 10.5, 34.94; 360, 7.1, 34.46; 600, 4.3, 34.82; 800, 4.0, 34.79; 1000, no temp., 34.47.
20226 Block Island V, 39.31, 71.03; V/18, 18h:—D1000+: 0, 14.0, 34.43; 40, 14.9, 35.13; 100, 12.5, 35.35; 246c, 8.7, 34.74; 410c, 5.4, 34.66; 570c, 4.7, 34.80; 737c, 4.1, 34.87.
20227 New York VI, 39.24, 72.17; V/19, 5h:—D195: 0, 10.1, 32.52; 40, 12.4, 34.61; 100, 12.0, 35.16; 175, 9.6, 35.07.
20228 New York V, 39.42, 72.47; V/19, 10h:—D65: 0, 10.9, 32.23; 30, 6.2, 32.51; 60, 4.8, 32.56.
20230 New York III, 40.00, 73.20; V/19, 15h:—D60: 0, 10.5, 31.62; 25, 5.3, 32.64; 50, 5.2, 32.78.
20232 New York I, 40.20, 73.48; V/19, 19h:—D48: 0, 11.7, 30.79; 20, 6.5, 32.12; 45, 4.7, 32.38.
20235 Atlantic City I, 39.26, 74.14; V/20, 5h:—D18: 0, 11.2, 31.36; 15, 7.3, 32.01.
20236 Atlantic City II, 39.17, 73.57; V/20, 8h:—D77: 0, 12.0, no sal.
20237 Atlantic City III, 39.11, 73.43; V/20, 10h:—D42: 0, 11.9, 32.16; 20, 9.5, 32.27; 40, 5.8, no sal.
20238 Atlantic City IV, 39.01, 73.18; V/20, 13h:—D60: 0, 11.8, no sal.
20239 Atlantic City V, 38.49, 72.59; V/20, 17h:—D200: 0, 11.3, 32.59; 20, 11.9, 34.01; 40, 11.3, 34.51; 100, 11.4, 34.66; 200, 9.4, 34.83.
20240 Cape May VII, 37.54, 73.04; V/21, 0h:—D1000+: 0, 12.5, 33.26; 40, 12.0, 34.58; 100, 10.9, 34.70; 200, 10.7, 34.66; 400, 4.9, 34.43; 600, 5.5, 34.44; 800, 4.4, 34.76; 1000, 3.8, no sal.
20241 Cape May VI, 38.04, 73.25; V/21, 4h:—D1000+: 0, 11.2, 32.55; 20, 6.9, 33.09; 40, 6.6, no sal.; 100, 10.5, 34.54; 200, 9.1, 34.80; 400, 5.2, 34.74; 600, no temp., 34.38; 800, 4.2, 34.89; 1000, no temp. 34.68.
20242 Cape May V, 38.11, 73.48; V/21, 7h:—D450+: 0, 11.2, 32.66; 20, 10.4, 32.80; 40, 6.2, no sal.; 100, 11.5, 34.83; 200, 9.7, 34.93; 400, 5.5, 34.73.
20244 Cape May III, 38.25, 74.16; V/21, 14h:—D46: 0, 13.3, 32.17; 20, 8.7, 32.55; 40, 6.5, 32.73.
20246 Cape May I, 38.41, 74.42; V/21, 19h:—D14: 0, 13.5, 30.98; 10, 9.5, 31.94.
20247 Corson Inlet, 39.05, 74.15; V/23, 11h:—D27: 0, 13.3, 31.97.
20248 Atlantic City II, 39.21, 73.54; V/23, 14h:—D32: 0, 13.3, no sal.
20249 Barnegat, 39.41, 73.34; V/23, 18h:—D38: 0, 13.3, 31.52.
20251 Fire Island II, 40.12, 72.40; V/24, 4h:—D55: 0, 11.9, no sal.
20252 Fire Island I, 40.31, 72.57; V/24, 7h:—D40: 0, 11.1, no sal.
20253 Shinnecock I, 40.39, 72.34; V/24, 10h:—D35: 0, 9.8, 31.19; 15, 9.8, 31.08; 30, 5.0, 32.29.
20255 Shinnecock III, 40.19, 72.18; V/24, 17h:—D59: 0, 10.9, no sal.
20256 Shinnecock IV, 40.10, 72.15; V/24, 20h:—D73: 0, 10.0, no sal.
20257 Shinnecock V, 39.55, 72.00; V/24, 23h:—D95: 0, 10.5, no sal.
20258 Martha's Vineyard IV, 40.23, 70.40; V/25, 10h:—D95: 0, 8.3, 32.17; 20, 8.1, 32.26; 40, 4.2, 32.54; 80, 3.9, 32.74.
20259 Martha's Vineyard III, 40.36, 70.40; V/25, 13h:—D65: 0, 9.2, 32.38; 15, 9.1, 32.36; 30, 7.8, 32.41; 60, 4.2, 32.60.
20260 Martha's Vineyard II, 40.51, 70.43; V/25, 16h:—D53: 0, 9.4, 32.41; 20, 9.2, 32.37; 50, 4.9, 32.54.
20261 Martha's Vineyard I, 41.06, 70.47; V/25, 18h:—D34: 0, 8.6, 31.92; 10, 8.8, 32.09; 30, 7.7, 32.20.
20262 Nantucket Sound, 41.28, 70.10; V/28, 7h:—D18: 0, 10.8, no sal.

Cruise of June 15 to 25, 1927, Station 20269, Albatross II Series

Chatham, 41.34, 69.33; VI/16:—D33: 0, 11.7; 18, 5.8; 29, 5.6.
Chatham, 41.22, 69.25; VI/16:—D29: 0, 7.8; 18, 7.6; 27, 7.6.

Chatham, 41.21, 69.29; VI/17, 6h:—D35: 0, 9.7; 18, 6.4; 33, 6.4.
Chatham, 41.24, 69.26; VI/17:—D44: 0, 10.6; 18, 7.0; 37, 6.8.
Nantucket Shoals, 41.27, 69.43; VI/17, 16h:—D26: 0, 9.4; 24, 9.1.
20269 Chatham, 41.27, 69.30; VI/22, 9h:—D38: 0, 10.6; 18, 8.3; 37, 7.4.
Chatham, 41.29, 69.31; VI/22, 0, 10.6; 18, 8.3.
Nantucket Shoals, 41.27, 69.43; VI/22, 17h:—D26: 0, 10.6; 24, 9.6.
Nantucket Shoals, 41.10, 69.44; VI/24:—0, 9.4; 18, 9.6.
Nantucket Shoals, 41.16, 69.44; VI/24:—0, 9.4; 24, 9.6.
Nantucket Shoals, 41.19, 69.45; VI/25:—0, 11.7; 26, 11.5.

Cruise of August 31 to September 4, 1927, Albatross II Series

Nantucket Shoals, 41.27, 69.43; VIII/31:—0, 11.1; 22, 10.7.
Nantucket Shoals, 41.27, 69.43; IX/2:—D22: 0, 10.0; 20, 10.3.

Cruise of October 3 to 16, 1927, Station 20300, Albatross II Series

Nantucket Shoals, 41.20, 69.48; X/14:—0, 12.8; 20, 12.7.
Nantucket Shoals, 41.17, 69.43; X/15:—0, 12.2; 20, 12.3.
Nantucket Shoals, 41.18, 69.41; X/16:—0, 11.7; 22, 12.2.
20300 Nantucket Shoals, 41.10, 69.44; X/16:—D24: 0, 12.3.

Cruise of November 14 to 21, 1927, Stations 20302 to 20303, Albatross II Series

Cholera Bank, 40.24, 73.37; XI/14, 14h:—D18: 0, 12.2; 9, 12.4; 18, 12.7.
Cholera Bank, 40.24, 73.37; XI/15:—D18: 0, 12.0; 9, 12.2; 18, 12.5.
Cholera Bank, 40.24, 73.37; XI/20:—0, 11.7; 18, 11.4.
20302 Cholera Bank, 40.27, 73.32; XI/20, 15h:—D22: 0, 11.7.
20303 Cholera Bank, 40.27, 73.32; XI/21, 13h:—D22: 0, 10.6, 30.77; 9, 10.3, 31.15; 18, 10.8, 32.25.

Cruise of February 17 to 21, 1928, Stations 20304 to 20310, Albatross II Series

20304 Cape May I, 38.46, 74.38; II/17, 16h:—D29: 0, 4.4, 31.85; 5, 4.8, 31.80; 15, 4.2, 32.00; 28, 4.6, 32.48.
20305 Cape May II, 38.24, 74.13; II/17, 20h:—D48: 0, 7.2, 33.68; 10, 7.0, 33.66; 20, 7.4, 34.02; 47, 8.9, 34.33.
20306 Cape May III, 38.06, 73.49; II/19, 0h:—D600+: 0, 10.3, 33.82; 30, 10.2, 34.97; 50, 10.3, 34.92; 100, 11.5, 35.17; 150, 10.4, 34.34; 310, 8.4, 35.12.
20307 Cape May I—South, 38.40, 74.54; II/20, 9h:—D24: 0, 3.6, no sal.
20308 Cape May I, 38.46, 74.38; II/20, 13h:—0, 4.4, no sal.
20309 Cape May I—North, 38.49, 74.31; II/20, 16h:—D26: 0, 3.9, no sal.
20310 Cape May IA, 38.59, 74.47; II/21, 13h:—D14: 0, 3.3, no sal.

Cruise of May 22 to 30, 1928, Stations 20311 to 20339, Albatross II Series

20311 New York I, 40.19, 73.48; V/22, 12h:—D55: 0, 12.0, 30.16; 8, 10.5, 31.26; 32, 7.2, no sal.; 48, 7.0, 31.91.
20312 New York II, 39.58, 73.21; V/22, 17h:—D53: 0, 11.4, 32.86; 8. 11.2, 32.90; 18, 9.2, 33.04; 38, 7.3, 33.18.
20313 New York III, 39.42, 72.45; V/22, 22h:—D75: 0, 10.4, 33.30; 8, 10.4, 33.30; 18, 9.8, 33.33; 38, 7.2, 33.35; 68, 7.8, 33.71.
20314 New York IV, 39.23, 72.15; V/23, 3h:—D188: 0, 15.0, 33.82; 12, 12.2, 33.86; 26, 11.4, no sal.; 49, 11.0, 34.78; 96, 11.0, 35.41; 180, 10.1, no sal.
20315 Atlantic City IV, 38.46, 73.00; V/23, 12h:—D297: 0, 15.4, 33.86; 18, 9.5, 33.82; 38, 9.0, 33.95; 78, 10.3, 34.90; 148, 11.4, 35.43; 268, 9.6, 35.43.
20316 Atlantic City III, 39.09, 73.44; V/23, 17h:—D35: 0, 10.7, 33.06; 8, 10.2, 33.08; 18, 8.0, 33.55; 28, 8.0, 33.55.
20317 Atlantic City II, 39.18, 73.58; V/23, 19h:—D33: 0, 10.8, no sal.
20318 Atlantic City I, 39.25, 74.10; V/23, 22h:—D18: 0, 12.0, 30.56; 13, 10.4, 31.17.
20319 Cape May I, 38.41, 74.38; V/24, 4h:—D27: 0, 10.5, 31.91; 7, 10.4, 31.89; 22, 10.2, 32.07.
20321 Cape May III, 38.28, 74.14, V/24, 7h:—D46: 0, 11.3, 33.33; 8, 11.1, 33.33; 18, 8.6, 33.33; 38, 8.8, 33.68.
20322 Cape May IV, 38.14, 73.45; V/24, 11h:—D106: 0, 11.9, 33.75; 23, 10.4, 34.09; 48, 9.2, 34.18; 93, 9.7, 34.67.
20323 Cape May V, 38.05, 73.26; V/24, 14h:—D1000+: 0, 11.6, 33.75; 23, 9.9, 33.86; 48, 11.2, 33.71; 98, 10.6, 34.57; 148, 11.2, 35.30; 200, 10.6, 35.37; 300, 6.5, 35.03; 400, 5.7, 35.06; 600, 4.7, 34.99; 1000, 4.0, 34.97.

20324 Cape May VI, 37.56, 73.07; V/24, 17h:—D1000+: 0, 13.4, 34.81; 23c, 13.4, 35.28; 48c, 13.4, no sal.; 95c, 12.2, 35.44; 143c, 11.2, 35.43; 192c, 9.4, 35.25; 290c, 7.1, 35.08; 386c, 5.4, 35.05; 580c, 4.3, 35.03; 970c, 3.2, 35.08

20325 Shinnecock V, 39.55, 72.00; V/25, 9h:—D96: 0, 9.6, 32.70; 18, 8.0, 32.94; 38, 6.7, 33.08; 78, 9.4, 34.60.

20326 Shinnecock IV, 40.03, 72.08; V/25, 11h:—D75: 0, 10.5, no sal.

20327 Shinnecock III, 40.16, 72.14; V/25, 13h:—D62: 0, 10.7, 32.94; 13, 9.8, 32.97; 33, 7.3, 33.04; 53, 6.2, 33.46.

20328 Shinnecock II, 40.27, 72.21; V/25, 17h:—D53: 0, 11.0, 31.56.

20329 Shinnecock I, 40.38, 72.30; V/25, 20h:—D37: 0, 10.4, 31.24; 8, 10.3, 31.35; 18, 8.4, 32.63; 33, 7.1, 32.66.

20330 Block Is. I, 41.03, 71.33; V/26, 3h:—D42: 0, 9.9, 31.91; 8, 9.8, 32.25; 18, 8.6, 32.45; 33, 6.6, 32.59.

20331 Block Is. II, 40.50, 71.27; V/26, 6h:—D64: 0, 10.0, 32.59.

20332 Block Is. III, 40.34, 71.23; V/26, 10h:—D67: 0, 10.0, 32.79; 25, 7.0, 33.01; 50, 6.0, 32.99.

20333 Martha's Vineyard I, 41.06, 70.47; V/29, 9h:—D37: 0, 10.6, 32.65; 10, 10.2, 32.63; 20, 8.8, 32.65; 35, 7.6, 32.63.

20334 Martha's Vineyard II, 40.52, 70.44; V/29, 11h:—D57: 0, 10.7, 32.74; 10, 9.7, 32.75; 25, 6.8, 32.86; 50, 6.3, 32.86.

20335 Martha's Vineyard III, 40.38, 70.42; V/29, 13h:—D66: 0, 11.2, 32.86; 15, 9.6, 32.86; 30, 6.2, 32.96; 60, 6.0, 33.06.

20336 Martha's Vineyard IV, 40.25, 70.38; V/29, 16h:—D80: 0, 10.2, 32.99; 10, 9.3, 33.04; 25, 6.5, 33.13; 50, 6.2, 33.22; 70, 6.6, 33.31.

20337 Block Island VI, 39.33, 71.03; V/29, 21h:—D1000+: 0, 18.6, 35.16; 14c, 18.6, 35.52; 23c, 18.0, 35.55; 46c, 15.2, 35.59; 91c, 12.3, 35.35; 137c, 12.2, 35.48; 183c, 11.8, 35.53; 228c, 10.2, 35.30; 274c, 9.0, 35.25; 320c, 7.9, 35.17; 457c, 5.8, 35.07; 910c, 3.8, 34.99.

20338 Block Island V, 39.50, 71.08; V/30, 0h:—D750: 0, 15.6, 35.16; 24c, 14.7, 35.25; 48c, 14.0, 35.35; 96c, 11.8, 35.17; 144c, 11.8, 35.39; 192c, 10.7, 35.39; 240c, 9.5, 35.26; 288c, 8.2, 35.08; 336c, 7.6, 35.05; 385c, 6.8, 35.03; 673c, 4.3, 34.99

20339 Block Island IV, 40.06, 71.15; V/30, 4h:—D152: 0, 14.6, 33.30; 15, 13.6, 34.72; 40, 13.4, 35.25; 80, 12.1, 35.39; 140, 12.5, 35.43.

Cruise of July 12 to 22, 1928, Stations 20344 to 20361, Albatross II Series

20344 South Channel I, 41.25, 69.32; VII/16, 7h:—D31: 0, 8.2, 32.41; 10, 8.2, 32.43; 25, 8.1, 32.43.

20345 South Channel II, 41.16, 69.23; VII/16, 9h:—D51: 0, 11.5, 32.32; 19c, 7.0, 32.70, 42c, 5.2, 32.81.

20346 South Channel III, 40.58, 69.06; VII/16, 13h:—D82: 0, 11.0, 33.16; 19c, 10.2, 32.86; 38c, 9.1, 32.79; 66c, 8.4, 32.84.

20347 South Channel IV, 40.42, 68.52; VII/16, 15h:—D68: 0, 13.0, 32.94; 15, 11.1, 33.19; 30, 10.5, 33.03; 60, 9.9, 33.03.

20348 South Channel V, 40.27, 68.38; VII/16, 18h:—D88: 0, 17.0, 33.17; 20, 9.4, 33.35; 40, 7.8, 33.37; 80, 7.8, 33.37.

20349 South Channel VI, 40.14, 68.26; VII/16, 21h:—D174: 0, 20.6, 33.66; 20, 15.8, 34.47; 40, 13.6, 35.16; 80, 12.5, 35.16; 160, 10.8, 35.43.

20350 Nantucket VI, 39.57, 69.49; VII/17, 5h:—D187: 0, 20.8, 33.77; 10, 21.2, no sal.; 20, 18.2, 35.72; 30, 13.1, no sal.; 40, 11.5, 34.61; 80, 11.8, 35.48; 170, 11.4, 35.08.

20351 Martha's Vineyard V, 40.01, 70.33; VII/17, 10h:—D220: 0, 20.8, 33.53; 10, 16.4, 33.49; 20, 16.0, 34.27; 40, 11.8 34.61; 60, 12.8, 35.14; 100, 11.8, 35.16; 190, 9.9, 35.14.

20352 Martha's Vineyard IV, 40.23, 70.38; VII/17, 13h:—D84: 0, 18.8, 32.66; 20, 11.5, 33.48; 40, 8.9, 33.55; 80, 9.6, 34.09.

20353 Martha's Vineyard III, 40.35, 70.41; VII/17, 16h:—D66: 0, 20.3, 33.49; 18c, 10.6, 32.65; 37c, 8.8, 32.83; 60c, 8.8, 33.55.

20354 Martha's Vineyard II, 40.47, 70.43; VII/17, 18h:—D57: 0, 19.4, 32.68; 10, 19.2, 33.95; 25, 11.0, 34.02; 50, 8.6, 33.19.

20355 Martha's Vineyard I, 41.05, 70.47; VII/17, 22h:—D36: 0, 18.0, 31.62; 15, 12.0, 32.25; 30, 10.5, 32.41.

20356 Nantucket I, 41.11, 70.19; VII/18, 3h:—D28: 0, 16.2, 31.98; 11, 14.0, no sal.; 26, 13.0, 32.03.

20357 Nantucket II, 41.01, 70.12; VII/18, 5h:—D31: 0, 14.0, no sal.; 10, 14.0, no sal.; 25, 12.3, no sal.

20358 Nantucket III, 40.49, 70.08; VII/18, 7h:—D38: 0, 13.6, 32.13; 13, 13.4, 32.03; 28, 11.5, 32.35.

20359 Nantucket IV, 40.32, 69.58; VII/18, 10h:—D44: 0, 12.4, no sal.; 15, 10.2, no sal.; 35, 10.2, no sal.

20360 Nantucket V, 40.12, 69.46; VII/18, 14h:—D97: 0, 20.8, 33.33; 10c, 20.5, 33.39; 24c, 11.4, 33.89; 39c, 10.4, 34.16; 78c, 10.9, 34.74.

20361 Nantucket Shoals, 40.53, 69.40; VII/21, 8h:—D40: 0, 12.8, 31.89; 10, 12.8, 31.89; 20, 12.8, no sal.; 40, 12.8, no sal.
Nantucket Shoals, 41.10, 69.44; VII/19:—0, 11.3; 9, 11.6; 18, 11.2.
Nantucket Shoals, 41.27, 69.43; VII/19, 12h:—0, 11.7; 22, 11.9.

Cruise of November 10 to 15, 1928, Stations 20372 to 20383, Albatross II Series

20372 New York IA, 40.31, 73.37; XI/10, 14h:—D16: 0, 10.6, no sal.; 16, 12.1, no sal.

20373 New York IA, 40.34, 73.45; XI/11, 15h:—D11: 0, 10.6, no sal.

20374 Fire Island I, 40.36, 73.05; XI/13, 14h:—D26: 0, 10.1, 32.90; 10, 11.6, 32.86; 22, 11.8, 32.91.

20375 Fire Island II, 40.16, 72.46; XI/13, 18h:—D51: 0, 11.1, 32.95; 10, 13.0, 32.82; 30, 13.1, 32.84; 50, 12.6, 33.31.
20376 Fire Island III, 39.51, 72.23; XI/13, 22h:—D79: 0, 10.5, 33.21; 10, 13.3, 33.21; 30, 13.4, 33.48; 50, 13.6, 33.86; 75, 12.6, 34.09.
20377 New York V, 39.27, 72.09; XI/14, 1h:—D124: 0, 13.3, 35.00; 20, 14.1, 34.99; 40, 15.1, 35.03; 60, 15.3, 35.14; 110, 12.8, 35.53.
20378 Fire Island IV, 39.28, 71.57; XI/14, 3h:—D1372: 0, 14.4, 35.35; 50, 14.4, 35.36; 100, 14.3, 35.73; 200, 10.8, 35.28; 300, 7.6, 35.02; 500, 4.9, 34.85.
20379 Seagirt V, 39.11, 72.14; XI/14, 5h:—D1000+: 0, 12.5, 34.70; 50, 15.0, 35.24; 100, 13.3, 35.55; 200, 10.4, 35.26; 300, 7.1, 35.23; 500, 4.6, 34.99.
20380 Seagirt IV, 39.19, 72.30; XI/14, 7h:—D140: 0, 13.3, 35.01; 20, 15.0, 35.03; 50, 15.2, 35.22; 80, 14.4, 35.54; 130, 12.5, 35.60.
20381 Seagirt III, 39.35, 73.02; XI/14, 11h:—D62: 0, 11.8, 33.57; 20, 13.4, 33.50; 40, 12.9, 33.60; 60, 15.0, 33.89.
20382 Seagirt II, 39.49, 73.30; XI/14, 15h:—D36: 0, 11.6, 33.30; 10, 13.1, 32.95; 20, 13.1, 33.02; 30, 13.0, 33.04.
20383 Seagirt I, 40.10, 73.51; XI/14, 18h:—D22: 0, 9.9, 32.48; 10, 11.6, 32.38; 20, 12.3, 32.83.
Cholera Bank, 40.24, 73.37; XI/15:—0, 10.9; 18, 12.1.

CRUISE OF FEBRUARY 24 TO MARCH 5, 1929, STATIONS 20385 TO 20420, ALBATROSS II SERIES

20385 Nantucket Shoals, 41.27, 69.43; II/24, 22h:—D24: 0, 1.4, 33.22; 20, 2.6, no sal.
20386 Martha's Vineyard I, 41.05, 70.47; II/25, 7h:—D35: 0, 1.7, no sal.; 10, 3.0, no sal.; 20, 3.1, no sal.; 30, 3.1, 33.05.
20387 Martha's Vineyard II, 40.43, 70.40; II/25, 10h:—D62: 0, 2.8, no sal.; 20, 4.2, no sal.; 40, 4.2, 33.27; 60, 3.9, 33.27.
20388 Martha's Vineyard III, 40.21, 70.33; II/25, 13h:—D88: 0, 4.2, no sal.; 20, 5.7, no sal.; 40, 6.7, no sal.; 60, 8.2, 34.30; 85, 8.9, 34.38.
20389 Martha's Vineyard IV, 40.02, 70.29; II/25, 16h:—D252: 0, 7.8, no sal.; 20, 10.7, no sal.; 50, 11.9, no sal.; 100, 12.0, 35.43; 220, 10.6, 35.31.
20390 Montauk VII, 39.27, 71.16; II/25, 22h:—D1500+: 0, 9.4, 35.16; 20, 11.0, no sal.; 50, 11.1, 35.27; 150, 11.2, no sal.; 250, 8.5, 35.19; 300, 7.5, 35.16; 600, 4.5, 34.96; 1000, 3.9, 34.93; 1500, 3.5, 34.96.
20391 Montauk VI, 39.43, 71.22; II/26, 1h:—D1000+: 0, 5.0, no sal.; 20, 6.3, 33.67; 50, 8.5, 34.36; 100, 8.0, 34.32; 200, 11.5, 35.35; 500, 5.4, no sal.; 900, 7.2, no sal.
20392 Montauk V, 39.58, 71.27; II/26, 4h:—D121: 0, 4.4, 33.66; 20, 6.2, 33.61; 50, 7.7, no sal.; 100, 7.0, no sal.
20393 Montauk IV, 40.07, 71.30; II/26, 6h:—D84: 0, 3.9, no sal.; 20, 5.2, no sal.; 40, 5.0, 33.39; 80, 5.9, 33.69.
20394 Montauk III, 40.25, 71.37; II/26, 8h:—D75: 0, 3.6, 33.48; 20, 5.3, 33.45; 40, 5.3, 33.44; 60, 5.2, 33.40.
20395 Montauk II, 40.43, 71.43; II/26, 10h:—D55: 0, 3.3, 33.31; 20, 4.7, no sal.; 50, 4.8, no sal.
20396 Montauk I, 40.57, 71.48; II/27, 6h:—D37: 0, 1.7, 32.79; 15, 3.5, 32.80; 30, 3.8, 33.02.
20397 Shinnecock I, 40.38, 72.29; II/27, 11h:—D40: 0, 3.3, 33.51; 15, 4.7, 33.46; 30, 4.6, 33.56.
20398 Shinnecock II, 40.13, 72.17; II/27, 14h:—D66: 0, 5.0, 33.87; 20, 6.2, 33.89; 40, 6.1, 33.95; 60, 6.2, 33.94.
20399 New York V, 39.23, 72.18; II/27, 20h:—D159: 0, 7.2, 33.66; 20, 6.8, 33.69; 50, 7.6, 33.74; 100, 11.0, 35.04; 150, 11.5, no sal.
20400 New York IV, 39.32, 72.33; II/28, 0h:—D96: 0, 7.8, 33.95; 20, 7.5, 34.07; 40, 7.4, 34.08; 80, 7.5, 34.14.
20401 New York III, 39.49, 72.58; II/28, 3h:—D71: 0, 6.7, 33.97; 20, 6.7, 34.10; 40, 6.8, 34.16; 70, 6.9, 34.19.
20402 New York II, 40.04, 73.14; II/28, 7h:—D51: 0, 3.9, 33.11; 10, 3.2, 33.14; 20, 3.6, 33.23; 45, 4.4, 33.55.
20403 New York I, 40.23, 73.52; II/28, 11h:—D34: 0, 1.9, 32.73; 10, 2.1, 32.70; 20, 2.0, 32.80; 30, 2.1, 33.10.
20404 Barnegat, 39.55, 73.56; III/2, 11h:—D21: 0, 2.8, 31.05; 10, 2.4, 31.24; 15, 2.4, 31.99.
20405 Atlantic City I, 39.25, 74.05; III/2, 15h:—D20: 0, 3.3, 32.85; 10, 3.2, 32.85; 15, 3.2, 32.87.
20406 Cape May I, 38.42, 74.51; III/3, 0h:—D18: 0, 3.1, 32.22; 10, 3.3, 32.20; 15, 3.3, 32.24.
20407 Winterquarter I, 37.58, 75.02; III/3, 7h:—D22: 0, 3.3, no sal.; 10, 3.4, 32.82; 15, 3.5, 32.83.
20408 Winterquarter II, 37.47, 74.40; III/3, 9h:—D50: 0, 5.6, 33.90; 10, 5.6, 33.96; 20, 5.6, 33.94; 40, 5.7, 33.97.
20409 Winterquarter III, 37.36, 74.17; III/3, 13h:—D183: 0, 8.0, 34.26; 20, 8.6, 34.25; 40, 8.5, 34.22; 80, 9.3, 34.52; 160, 11.4, 35.23.
20410 Chesapeake IV, 36.45, 74.36; III/3, 19h:—D205: 0, 9.4, 34.65; 20, 9.8, 34.65; 50, 9.9, 34.72; 100, 10.1, 34.79; 180, 9.7 34.89.
20411 Chesapeake III, 36.49, 75.00; III/3, 22h:—D40: 0, 7.2, 34.44; 10, 7.4, 34.29; 20, 7.4, no sal.; 30, 7.2, 34.38.
20412 Chesapeake II, 36.52, 75.20; III/4, 0h:—D27: 0, 4.5, 33.88; 10, 5.1, 33.75; 20, 5.0, 33.64.
20413 Chesapeake I, 36.47, 75.44; III/4, 2h:—D22: 0, 5.0, 33.26; 10, 5.0, 33.21; 15, 5.1, 33.29.
20414 Cape May II, 38.30, 74.25; III/4, 15h:—D37: 0, 5.5, 33.98; 10, 5.8, 34.02; 20, 5.9, no sal.; 30, 5.9, 34.16.
20415 Cape May III, 38.20, 74.04; III/4, 17h:—D55: 0, 7.5, no sal.; 20, 7.5, no sal.; 45, 7.2, 34.35.
20416 Cape May IV, 38.12, 73.42; III/4, 20h:—D170: 0, 9.4, 34.65; 20, 9.7, 34.61; 40, 9.9, 34.66; 80, 9.8, 34.68; 150, 10.4, 34.90.
20417 Cape May V, 38.05, 73.28; III/4, 22h:—D1000±: 0, 11.1, 34.97; 20, 10.3, 34.79; 50, 10.6, 34.85; 100, 11.1, 34.88; 200, 10.9, no sal.; 300, 10.1, 35.25; 600, 10.8, 35.14; 800, no temp., 35.00; 900, 11.1, 34.94.

20418 Atlantic City IV, 38.50, 73.00; III/5, 7h:—D157: 0, 7.2, 34.00; 20, 8.1, 34.17; 40, 9.2, 34.40; 80, 9.9, 34.40; 130, 10.5, no sal.

20419 Atlantic City III, 39.04, 73.25; III/5, 10h:—D55: 0, 7.5, no sal.; 20, 6.8, no sal.; 45, 6.9, 34.05.

20420 Atlantic City II, 39.17, 73.50; III/5, 13h:—D35: 0, 4.2, 33.05; 15, 4.0, 33.42; 30, 5.1, no sal.

Cruise of April 14 to 24, 1929, Stations 20421 to 20456, Albatross II Series

20421 Cape May I, 38.41, 74.51; IV/14, 9h:—D26: 0, 8.6, 32.44; 10, 8.6, 32.35; 20, 8.4, 32.63.

20422 Fenwick I, 38.18, 74.46; IV/14, 13h:—D20: 0, 8.0, 33.11.

20423 Winterquarter I, 37.58, 75.02; IV/14, 16h:—D18: 0, 8.8, 32.71; 10, 8.8, 32.72; 15, 8.7, 32.74.

20424 Hog Island I, 37.26, 75.17; IV/14, 21h:—D31: 0, 9.0, 33.09; 10, 9.0, 33.06; 20, 9.0, 33.04.

20425 Chesapeake I, 36.55, 75.41; IV/14, 22h:—D18: 0, 10.6, 33.08; 10, 10.7, 33.04; 15, 10.7, 33.05.

20426 Currituck I, 36.26, 75.39; IV/17, 20h:—D24: 0, 10.8, 31.92; 10, 10.6, 33.10; 20, 10.4, 32.86.

20427 Bodie Island, 35.55, 75.26; IV/18, 0h:—D22: 0, 10.5, 32.63; 10, 10.7, 32.58; 18, 10.8, 32.59.

20428 Currituck II, 36.24, 75.08; IV/18, 4h:—D34: 0, 9.4, 33.88; 10, 9.8, 33.86; 20, 9.8, 33.85; 30, 9.8, 33.87.

20429 Chesapeake IV, 36.46, 74.37; IV/18, 9h:—D113: 0, 10.3, 34.75; 10, 10.6, 34.78; 20, 10.5, 34.72; 40, 10.5, 34.77; 60, 10.3, 34.73; 100, 9.7, 34.64.

20430 Chesapeake III, 36.48, 74.59; IV/18, 12h:—D36: 0, 8.3, 33.57; 10, 8.2, 33.58; 20, 8.0, 33.59; 30, 8.0, 33.56.

20431 Chesapeake II, 36.52, 75.20; IV/18, 14h:—D27: 0, 9.4, 33.54; 10, 9.4, 33.55; 20, 9.4, 33.62.

20432 Hog Island II, 37.17, 74.51; IV/18, 18h:—D42: 0, 7.7, 33.29; 10, 7.7, 33.25; 20, 7.3, 33.29; 40, 7.3, 33.27.

20433 Winterquarter II, 37.50, 74.44; IV/18, 22h:—D42: 0, 7.2, 33.09; 10, 7.2, 33.02; 20, 6.8, 33.05; 40, 6.7, 33.09.

20434 Winterquarter III, 37.36, 74.18; IV/19, 2h:—D108: 0, 9.5, 34.47; 10, 9.5, 34.43; 20, 9.8, 35.02; 40, 10.3, no sal.; 60, 10.8, no sal.; 90, 10.9, 34.51.

20435 Cape May V, 37.55, 73.06; IV/19, 8h:—D1000+: 0, 11.0, 35.49; 9c, 13.2, no sal.; 17c, 13.2, 35.38; 35c, 12.5, 35.33; 52c, 10.1, 35.29; 87c, 12.5, 35.52; 130c, 11.7, 35.34; 173c, 12.5, 35.40; 346c, 6.5, 35.11: 606c, 4.4, 34.96; 866c, 4.7, 34.88; 1126c, 9.8, 34.89.

20436 Cape May IV, 38.11, 73.43; IV/19, 16h:—D175: 0, 9.6, 34.56; 10, 9.7, 34.50; 20, 9.9, 34.60; 40, 12.1, 35.19; 60, 10.5, 34.86; 100, 12.0, 35.34; 150, 11.8, no sal.; 170, 11.3, 35.41.

20437 Cape May III, 38.21, 74.03, IV/19, 19h:—D66: 0, 7.9, 33.91; 10, 7.9, 33.92; 20, 7.6, 33.90; 40, 7.7, 33.96; 60, 10.1, 34.65.

20438 Cape May II, 38.30, 74.25; IV/19, 22h:—D36: 0, 7.3, 33.36; 10, 7.4, 33.36; 20, 6.9, 33.34; 30, 6.8, 33.39.

20439 Atlantic City I, 39.25, 74.06; IV/20, 4h:—D18: 0, 6.5, 30.77; 10, 6.4, 30.98; 15, 6.4, 32.16.

20440 Atlantic City II, 39.19, 73.50; IV/20, 7h:—D36: 0, 6.4, 32.82; 10, 6.2, 32.86; 20, 6.1, 33.23; 30, 6.2, 33.48.

20441 Atlantic City III, 39.08, 73.23; IV/20, 10h:—D56: 0, 7.3, 33.59; 10, 7.0, 33.58; 20, 7.0, 33.65; 40, 7.1, 33.68; 50, 7.1, 33.71.

20442 Atlantic City IV, 38.56, 72.55; IV/20, 13h:—D112: 0, 9.4, 34.20; 10, 9.0, 34.14; 20, 9.1, 34.29; 40, 12.8, 35.48; 60, 13.5, 35.78; 100, 13.3, 35.80.

20443 New York V, 39.23, 72.17; IV/20, 18h—D170: 0, 10.0, 34.56; 10, 9.8, 34.52; 20, 9.7, 34.54; 40, 9.6, 34.59; 60, 10.7, 34.83; 100, 10.9, 34.96; 160, 11.9, 35.47.

20444 New York IV, 39.32, 72.33; IV/20, 21h:—D98: 0, 8.4, 33.94; 20, 8.3, 34.02; 40, 8.1, 34.10; 60, 8.2, 34.12; 90, 9.8, 34.64.

20445 New York III, 39.49, 72.54; IV/21, 1h:—D66: 0, 6.7, 33.42; 20, 6.6, 33.40; 50, 6.3, 33.44.

20446 New York II, 40.06, 73.22; IV/21, 4h:—D40: 0, 6.2, 33.21; 20, 6.3, 33.23; 35, 6.1, 33.32.

20447 New York I, 40.22, 73.47; IV/21, 8h:—D40: 0, 6.3, 29.84; 20, 6.1, 32.65; 35, 6.0, 33.09.

20448 Shinnecock I, 40.38, 72.30; IV/23, 8h:—D38: 0, 5.1, 32.38; 10, 5.3, 32.37; 20, 5.2, 32.39; 33, 5.1, 32.60.

20449 Shinnecock II, 40.15, 72.16; IV/23, 12h:—D62: 0, 5.4, 33.12; 10, 5.0, 33.11; 20, 5.1, 33.12; 40, 5.1, 33.12; 55, 5.1, 33.13.

20450 Montauk VII, 39.42, 71.25; IV/23, 17h:—D1000+: 0, 13.8, 35.83; 10c, 13.9, 35.72; 19c, 13.9, 35.70; 39c, 13.9, 35.74; 58c, 13.8, 35.73; 77c, 13.9, 35.73; 97c, 12.8, 35.52; 193c, 11.0, 35.40; 290c, 9.0, 35.12; 386c, 6.2, 35.02; 483c, 5.8, 34.98; 579c, 4.6, 34.94; 676c, 3.8, 34.96; 772c, 3.8, 34.95; 869c, 4.0, 34.94; 966c, 4.1, 34.96; 1062c, 5.2, 34.95.

20451 Montauk VI, 39.53, 71.26; IV/23, 21h:—D500: 0, 11.4, 35.07; 20, 11.5, 35.06; 40, 12.5, 35.42; 60, 12.6, 35.44; 80, 12.7, 35.45; 100, 12.7, 35.48; 136c, 12.8, 35.49; 181c, 12.4, 35.51; 272c, 11.9, 35.21; 363c, 7.4, 35.03; 453c, 6.8, 34.96.

20452 Montauk V, 39.59, 71.28; IV/23, 23h:—D138: 0, 9.5, 34.46; 10, 9.5, 34.38; 20, 12.8, 35.50; 40, 12.9, 35.52; 60, 12.9, 35.51; 100, 12.7, 35.48; 130, 12.3, 35.45.

20453 Montauk IV, 40.08, 71.30; IV/24, 2h:—D92: 0, 8.0, 33.92; 20, 8.5, 34.04; 40, 9.6, 34.38; 60, 10.8, 34.78; 80, 10.7, 34.84.

20454 Montauk III, 40.25, 71.37; IV/24, 4h:—D80: 0, 6.5, 33.48; 20, 6.6, 33.46; 40, 6.4, 33.48; 75, 9.7, 34.57.

20455 Montauk II, 40.42, 71.43; IV/24, 7h:—D66: 0, 5.1, 32.97; 20, 4.9, 32.99; 40, 4.9, 32.99; 60, 4.9, 33.04.

20456 Montauk I, 40.57, 71.47; IV/24, 10h:—D42: 0, 5.7, 31.29; 10, 5.5, 31.59; 20, 5.0, 32.36; 35, 4.8, 32.55.

Cruise of May 10 to 18, 1929, Stations 20457 to 20498, Albatross II Series

20457 Martha's Vineyard I, 41.05, 70.47; V/10, 18h:—D40: 0, 8.5, 32.43.
20458 Martha's Vineyard II, 40.43, 70.41; V/10, 21h:—D60: 0, 7.8, 32.72.
20459 Martha's Vineyard III, 40.21, 70.33; V/11, 0h:—D84: 0, 8.3, 33.61.
20460 Montauk IV, 40.07, 71.30; V/11, 5h:—D92: 0, 7.4, 33.21.
20461 Montauk III, 40.25, 71.36; V/11, 7h:—D72: 0, 7.6, 32.83.
20462 Montauk II, 40.42, 71.41; V/11, 10h:—D56: 0, 7.9, 31.87.
20463 Montauk I, 40.58, 71.50; V/11, 13h:—D32: 0, 7.6, 30.77.
20464 Shinnecock I, 40.38, 72.29; V/11, 17h:—D40: 0, 9.1, 31.09.
20465 Shinnecock II, 40.13, 72.30; V/11, 20h:—D57: 0, 7.3, 32.28.
20466 New York IV, 39.34, 72.31; V/12, 3h:—D97: 0, 8.1, 33.41.
20467 New York III, 39.48, 72.58; V/12, 6h:—D63: 0, 7.7, 33.44.
20468 New York II, 40.06, 73.21; V/12, 10h:—D40: 0, 8.6, 32.04.
20469 New York IA, 40.12, 73.35; V/12, 12h:—0, 8.4, 32.29.
20470 New York I, 40.22, 73.46; V/12, 14h:—D23: 0, 8.9, 33.63.
20471 Seagirt I, 39.54, 73.57; V/12, 19h:—D20: 0, 9.1, 31.92.
20472 Barnegat I, 39.41, 73.41; V/12, 22h:—D31: 0, 9.6, 32.21.
20473 Atlantic City I, 39.25, 74.05; V/13, 2h:—D23: 0, 9.4, 31.84.
20474 Atlantic City II, 39.17, 73.50; V/13, 4h:—D34: 0, 10.7, 31.84.
20475 Atlantic City IIA, 39.10, 73.37; V/13, 6h:—D43: 0, 10.6, 32.10.
20476 Atlantic City III, 39.04, 73.25; V/13, 8h:—D58: 0, 9.6, 32.89.
20477 Atlantic City IIIA, 38.57, 73.13; V/13, 10h:—D74: 0, 9.4, 32.86.
20478 Atlantic City IV, 38.51, 73.02; V/13, 12h:—D85: 0, 9.6, 33.53.
20479 Cape May IV, 38.22, 73.47; V/13, 18h:—D81: 0, 10.6, 33.35.
20480 Cape May III, 38.27, 74.01; V/13, 19h:—D54: 0, 10.7, 32.99.
20481 Cape May II, 38.36, 74.21; V/13, 22h:—D41: 0, 11.0, 32.88.
20482 Cape May IA, 38.42, 74.34; V/14, 0h:—D26: 0, 11.5, 32.04.
20483 Cape May I, 38.41, 74.52; V/14, 2h:—D21: 0, 11.9, 31.02.
20484 Fenwick, 38.19, 74.46; V/14, 5h:—D25: 0, 11.5, 32.61.
20485 Winterquarter I, 37.58, 75.02; V/14, 8h:—D18: 0, 12.4, 32.63.
20486 Winterquarter II, 37.50, 74.45; V/14, 10h:—D41: 0, 12.7, 31.92.
20487 Winterquarter III, 37.39, 74.22; V/14, 13h:—D68: 0, 11.3, 33.21.
20488 Hog Island II, 37.19, 75.00; V/14, 17h:—D34: 0, 13.4, 32.09.
20489 Chesapeake I, 36.54, 75.41; V/14, 23h:—D23: 0, 16.0, 27.30.
20490 Chesapeake II, 36.51, 75.19; V/15, 1h:—D31: 0, 13.1, 33.19.
20491 Chesapeake III, 36.47, 74.59; V/15, 5h:—D34: 0, 13.8, 33.08.
20492 Chesapeake IV, 36.44, 74.37; V/15, 7h:—D153: 0, 16.3, 35.44.
20493 Currituck II, 36.24, 75.08, V/15, 11h:—D34: 0, 18.6, 35.50.
20494 Bodie Island, 35.55, 75.26; V/15, 15h:—D22: 0, 17.8, 30.90.
20495 Currituck I, 36.29, 75.40; V/15, 20h:—D20: 0, 16.3, 32.01.
20496 Hog Island I, 37.29, 75.22; V/16, 2h:—D27: 0, 15.0, 31.67.
20497 Winterquarter I, 37.58, 75.02; V/16, 7h:—D20: 0, 13.2, 32.09.
20498A Fire Island, 40.17, 73.01; V/17, 3h:—D40: 0, 9.4, no sal.
20498B Fire Island, 40.17, 73.01; V/17, 11h:—D41: 0, 10.5, no sal.
20498C Fire Island, 40.17, 73.01; V/17, 15h:—D40: 0, 10.1, 31.94; 5, 10.9, 31.92; 10, 9.8, 31.94; 20, 8.3, 32.58; 35, 6.5, 33.24.
20498D Fire Island, 40.17, 73.01; V/17, 18h:—D44: 0, 10.0, no sal.
20498E Fire Island, 40.17, 73.01; V/17, 23h:—D43: 0, 9.7, no sal.

Cruise of May 28 to June 5, 1929, Stations 20499 to 20538, Albatross II Series

20499 Martha's Vineyard I, 41.05, 70.47; V/28, 10h:—D34: 0, 12.2, 32.46.
20500 Martha's Vineyard II, 40.43, 70.40; V/28, 13h:—D60: 0, 12.2, 32.83.
20501 Martha's Vineyard III, 40.21, 70.33; V/28, 17h:—D92: 0, 11.6, no sal.
20502 Montauk IV, 40.07, 71.31; V/28, 22h:—D90: 0, 12.6, 33.37.
20503 Montauk III, 40.23, 71.36; V/29, 1h:—D77: 0, 12.1, 33.08.

20504 Montauk II, 40.40, 71.42; V/29, 4h:—D68: 0, 12.2, 31.92.
20505 Montauk I, 40.55, 71.45; V/29, 7h:—D40: 0, 11.1, no sal.
20506 Shinnecock I, 40.38, 72.29; V/29, 13h:—D35: 0, 12.3, 31.44.
20507 Shinnecock II, 40.13, 72.31; V/29, 16h:—D56: 0, 12.3, no sal.
20508 New York IV, 39.33, 72.33; V/29, 22h:—D90: 0, 13.0, 33.22.
20509 New York III, 39.49, 72.58; V/30, 1h:—D65: 0, 12.4, 32.41.
20510 New York II, 40.06, 73.23; V/30, 5h:—D39: 0, 13.5, 32.07.
20511 New York I, 40.23, 73.44; V/30, 8h:—D27: 0, 13.6, 31.67.
20512 Barnegat I, 39.55, 73.51; V/30, 12h:—D23: 0, 12.9, 31.93.
20513 Barnegat II, 39.41, 73.41; V/30, 15h:—D31: 0, 14.8, 31.92.
20514 Atlantic City I, 39.25, 74.05; V/30, 18h:—D20: 0, 15.9, 32.29.
20515 Atlantic City II, 39.17, 73.51; V/30, 20h:—D36: 0, 14.8, 32.52.
20516 Atlantic City III, 39.10, 73.39; V/30, 22h:—D43: 0, 15.0, 32.56.
20517 Atlantic City IV, 39.04, 73.25; V/30, 23h:—D61: 0, 14.9, 32.54.
20518 Atlantic City V, 38.50, 73.00; V/31, 3h:—D101: 0, 14.2, 33.24.
20519 Cape May IV, 38.08, 73.48; V/31, 8h:—D135: 0, 15.5, 33.55.
20520 Cape May IIIA, 38.12, 73.55; V/31, 10h:—D81: 0, 15.1, 33.09.
20521 Cape May III, 38.18, 74.07; V/31, 12h:—D63: 0, 16.4, 32.74.
20522 Cape May II, 38.28, 74.26; V/31, 14h:—D38: 0, 17.8, 32.03.
20523 Cape May I, 38.41, 74.51; V/31, 17h:—D14: 0, 16.2, 31.58.
20524 Fenwick I, 38.18, 74.46; V/31, 20h:—D22: 0, 17.2, 32.21.
20525 Winterquarter I, 37.57, 74.59; V/31, 23h:—D31: 0, 18.3, 32.10.
20526 Hog Island I, 37.29, 75.21; VI/1, 3h:—D24: 0, 19.9, 29.31.
20527 Chesapeake I, 36.54, 75.41; VI/1, 8h:—D18: 0, 20.6, 29.81.
20528 Chesapeake II, 36.52, 75.19; VI/1, 10h:—D26: 0, 20.2, 30.72.
20529 Chesapeake III, 36.48, 75.00; VI/1, 12h:—D31: 0, 19.2, 32.63.
20530 Hog Island II, 37.18, 75.00; VI/1, 16h:—D39: 0, 20.7, 30.44.
20531 Winterquarter II, 37.50, 74.45; VI/1, 20h:—D43: 0, 18.5, 32.48.
20532 Fire Island, 40.19, 73.03; VI/2, 16h:—D40: 0, 15.0, 31.40.
20533 Shinnecock A, 40.45, 72.30; VI/2, 20h:—D27: 0, 10.3, 31.94.
20534 Montauk A, 41.01; 71.49; VI/3, 0h:—D26: 0, 10.0, 30.37.
20535 Block Island, 41.12, 71.18; VI/3, 4h:—D38: 0, 12.4, 31.76.
20536 Martha's Vineyard I, 41.04, 70.47; VI/4, 10h:—D40: 0, 14.2, 32.39.
20537 Nantucket Shoals, 40.34, 69.36; VI/4, 17h:—D65: 0, 11.8, 33.00.
20538 Nantucket Shoals, 40.51, 69.40; VI/4, 20h:—D39: 0, 9.1, 32.48.

Cruise of June 13, 1929, Station 20545, Albatross II Series

20545 South Channel II, 41.17, 69.24; VI/13:—D 46: 0, 9.0; 9, 8.4; 18, 7.0; 27, 6.2; 46, 5.4.

Cruise of July 11 to August 1, 1929, Stations 20551 to 20594, Albatross II Series

20551 Chatham, 41.38, 69.42; VII/11, 14h:—D37: 0, 16.5, 31.62; 10, 10.9, 31.96; 25, 7.3, 32.38.
20552A Fire Island, 40.20, 72.59; VII/13, 1h:—D43: 0, 19.1, 31.67; 10, 16.6, 31.80; 20, 8.6, 33.10; 35, 7.2, 33.01.
20552B Fire Island, 40.20, 72.59; VII/13, 11h:—D43: 0, 20.9, no sal.
20552D Fire Island, 40.20, 72.59; VII/13, 18h:—D43: 0, 21.9, no sal.
20552E Fire Island, 40.20, 72.59; VII/13, 23h:—D43: 0, 21.0, no sal.
20553 Seagirt I, 39.54, 73.55; VII/14, 8h:—D27: 0, 20.5, 32.30; 10, 14.4, 32.43; 25, 7.5, 32.86.
20554 Barnegat I, 39.41, 73.41; VII/14, 11h:—D29: 0, 22.1, 31.98; 10, 22.2, 32.03; 25, 9.0, 32.84.
20555 Atlantic City I, 39.25, 74.06; VII/14, 15h:—D20: 0, 19.6, 32.47; 10, 10.6, 32.63; 15, 10.6, 32.66.
20556 Cape May I, 38.41, 74.51; VII/14, 22h:—D15: 0, 19.3, 31.85; 10, 12.4, 32.94.
20557 Fenwick I, 38.19, 74.45; VII/15, 2h:—D26: 0, 19.1, 32.39; 10, 18.7, 32.49; 20, 11.6, 33.19.
20558 Winterquarter I, 37.57, 74.59; VII/15, 5h:—D29: 0, 19.4, 32.74; 10, 19.6, 32.68; 25, 11.9, 33.28.
20559 Hog Island I, 37.29, 75.22; VII/15, 9h:—D19: 0, 20.4, 32.56; 10, 19.6, 32.81.
20560 Chesapeake I, 36.55, 75.40; VII/17, 12h:—D21: 0, 20.9, 32.12; 10, 20.9, 32.14; 15, 20.2, 32.48.
20561 Chesapeake II, 36.51, 75.20; VII/17, 15h:—D30: 0, 23.6, 31.78; 10, 23.2, 31.95; 20, 14.4, 33.58; 25, 14.0, 33.64.

20562 Chesapeake III, 36.48, 75.01; VII/17, 17h:—D33: 0, 23.6, 33.16; 10, 23.7, 32.92; 20, 13.8, 33.71; 30, 13.0, 33.86.

20563 Chesapeake IV, 36.47, 74.37; VII/17, 21h:—D109: 0, 25.5, 35.28; 10, 25.8, 35.22; 20, 26.0, 35.48; 40, 19.6, 35.71; 60, 12.5, 35.04; 100, 12.8, 35.37.

20564 Winterquarter III, 37.34, 74.18; VII/18, 3h:—D98: 0, 25.2, 34.97; 10, 25.2, 34.98; 20, 23.7, 34.61; 40, 13.0, 34.42; 60, 10.1, 35.01; 90, 10.6, 34.45.

20565 Winterquarter II, 37.49, 74.46; VII/18, 7h:—D38: 0, 22.8, 31.83; 10, 21.7, 32.72; 20, 12.4, 33.58; 35, 10.4, 33.60.

20566 Cape May II, 38.29, 74.23; VII/18, 13h:—D44: 0, 23.1, 32.32; 10, 22.7, 32.30; 20, 18.4, 32.74; 40, 8.9, 33.33.

20567 Cape May III, 38.20, 74.04; VII/18, 16h:—D64: 0, 23.1, 32.18; 10, 22.9, 32.36; 20, 18.1, 32.72; 40, 8.0, 33.53; 60, 8.0, 33.51.

20568 Cape May IV, 38.12, 73.43; VII/18, 19h:—D123: 0, 24.2, 32.63; 10, 24.1, 33.06; 20, 24.0, 33.24; 40, 15.6, 34.49; 60, 12.7, 34.72; 87c, 11.2, 34.52; 105c, 11.4, 35.08.

20569 Cape May V, 38.09, 73.34; VII/18, 22h:—D1000+: 0, 24.6, 33.71; 10, 24.3, 32.97; 20, 25.0, 34.16; 40, 17.0, 35.44; 60, 14.9, 35.48; 100, 14.6, 35.62; 130c, 12.7, 35.59; 181c, 13.6, 35.53; 272c, 8.7, 35.57, 363c, 6.8, 35.12; 491c, 5.3, 34.99; 819c, 5.1, 34.99.

20570 Cape May VI, 38.12, 73.24; VII/19, 3h:—D1000+: 0, 23.3, 34.06; 10, 23.1, 33.98; 20, 23.2, 33.90; 40, 16.2, 35.59; 60, 15.5, 35.50; 100, 13.9, 35.66; 150, 12.9, 35.66; 200, 12.0, 35.50; 300, 8.8, 35.15; 394c, 7.0, 35.12; 591c, 4.8, 34.97; 772c, 4.3, 34.97; 966c, 4.0, 35.03.

20571 Atlantic City V, 38.52, 72.57; VII/19, 12h:—D124: 0, 21.9, 31.51; 10, 22.2, 31.56; 20, 13.0, 32.12; 40, 8.6, 33.77; 58c, 10.9, 34.92; 97c, 11.7, 35.05; 111c, 11.8, 35.12.

20572 Atlantic City IV, 39.05, 73.24; VII/19, 16h:—D62: 0, 22.2, 30.95; 10, 22.4, 31.58; 20, 14.4, 31.93; 40, 6.6, 33.32; 55, 6.8, 31.60.

20573 Atlantic City III, 39.09, 73.35; VII/19, 19h:—D51: 0, 22.0, 31.65; 10, 22.0, 32.09; 20, 14.6, 32.32; 40, 11.1, 33.24.

20574 Atlantic City II, 39.17, 73.51; VII/19, 22h:—D36: 0, 21.5, 32.18; 10, 21.8, 32.18; 20, 16.0, 32.47; 30, 9.4, 33.01.

20575 New York I, 41.12, 73.48; VII/22, 3h:—D27: 0, 18.3, 31.65; 10, 18.8, 31.64; 20, 10.5, 32.10.

20576 New York II, 40.05, 73.22; VII/22, 7h:—D42: 0, 20.5, 32.03; 10, 20.7, 32.05; 20, 14.7, 31.92; 35, 6.6, 32.99.

20577 New York III, 39.49, 72.58; VII/22, 11h:—D78: 0. 19.6, 32.00; 10, 19.8, 31.94; 19, 14.5, 32.10; 39, 7.7, 33.35; 58, 6.6, 33.33.

20578 New York IV, 39.33, 72.35; VII/22, 16h:—D82: 0, 21.0, 33.08; 10, 21.2, 33.12; 20, 18.7, 33.24; 40, 8.7, 33.58; 60, 8.0, 33.79; 70, 8.0, 33.82.

20579 New York V, 39.23, 72.19; VII/22, 19h:—D160: 0, 21.8, 32.47; 10, 21.4, 32.59; 20, 18.9, 33.22; 40, 13.5, 35.02; 60, 11.6, 34.97; 100, 12.2, 35.37; 150, 11.9, 35.48.

20580 Shinnecock II, 40.13, 72.25; VII/23, 2h:—D68: 0, 20.0, 32.10; 10, 20.6, 32.03; 20, 9.5, 33.04; 40, 6.9, 33.22; 50, 6.7, 33.25.

20581 Shinnecock I, 40.37, 72.30; VII/23, 7h:—D38: 0, 19.4, 32.02; 10, 19.3, 32.27; 20, 14.8, 32.43; 30, 9.4, 32.95.

20582 Montauk I, 40.58, 71.50; VII/23, 12h:—D30: 0, 18.7, 32.27; 10, 18.7, 32.30; 20, 15.7, 32.45.

20583 Montauk II, 40.41, 71.44; VII/23, 14h:—D54: 0, 20.2, 32.48; 10, 19.9, 32.50; 20, 9.5, 32.99; 40, 7.8, 33.17; 45, 7.6, 33.19.

20584 Montauk III, 40.25, 71.36; VII/23, 17h:—D78: 0, 19.8, 32.83; 10, 19.6, 32.85; 20, 18.2, 32.99; 40, 8.7, 33.37; 60, 7.1, 33.44; 70, 7.4, 33.46.

20585 Montauk IV, 40.08, 71.30; VII/23, 20h:—D87: 0, 20.0, 33.01; 10, 19.9, 33.16; 20, 16.2, 33.15; 40, 7.5, 33.38; 60, 7.4, 33.51; 80, 7.5, 33.51.

20586 Montauk V, 39.59, 71.28; VII/24, 0h:—D136: 0, 20.9, no sal.; 9c, 20.8, 33.75; 18c, 20.8, 33.58; 38c, 9.6, 33.75; 57c, 9.6, 34.09; 95c, 9.6, 34.42; 113c, 10.1, 34.60.

20587 Montauk VI, 39.44, 71.22; VII/24, 3h:—D1000+: 0, 22.0, 34.61; 9c, 22.0, 34.60; 19c, 22.0, 34.62; 38c, 20.9, 35.50; 56c, 15.4, 35.93; 90c, 13.8, 35.59; 135c, 12.3, 35.48; 180c, 11.1, 35.16; 270c, 8.7, 34.99; 328c, 7.1, 35.07; 491c, 4.8, 34.96; 655c, 4.1, 34.97; 819c, 3.8, 34.81.

20588 Montauk VII, 39.29, 71.16; VII/24, 8h:—D1000+: 0. 22.7, 34.96.

20589 Martha's Vineyard IV, 40.03, 70.30; VII/24, 16h:—D131: 0, 20.4, 33.57; 10, 20.5, 33.66; 20, 19.4, 33.51; 40, 9.9, 33.88; 60, 9.0, 34.01; 100, 20.0, 34.97; 120, 11.0, 34.97.

20590 Martha's Vineyard III, 40.21, 70.34; VII/24, 19h:—D85: 0, 19.3, 33.06; 10, 19.2, 33.09; 20, 17.9, 33.37; 40, 6.8, 32.86; 60, 7.0, 33.37; 80, 6.8, 33.53.

Nantucket Shoals, 41.07, 70.00; VII/24:—0, 16.6; 24, 16.6.

A20591 Nantucket Shoals, 40.34, 69.24; VII/25, 0h:—D58: 0, 18.9, 33.16; 10, 19.1, 33.03; 20, 13.0, 33.04; 40, 7.6, 33.21; 50, 7.6, 33.21.

B20592 Nantucket Shoals, 40.51, 69.40; VII/25, 2h:—D34: 0, 13.1, 32.30; 10, 12.9, 32.40; 20, 12.3, 32.32; 30, 12.1, 32.50.

20593 Martha's Vineyard II, 40.43, 70.40; VII/25, 7h:—D58: 0, 18.4, 33.04; 10, 18.4, 33.08; 20, 10.6, 33.03; 40, 8.7, 33.03; 50, 8.2, 33.03.

20594 Martha's Vineyard I, 41.05, 70.46; VII/25, 10h:—D44: 0, 18.9, 32.15; 10, 15.0, 32.48; 20, 10.0, 32.97; 40, 9.0, 33.09.

CRUISE OF FEBRUARY 5 TO 13, 1930, STATIONS 20618 TO 20651, ALBATROSS II SERIES

20618 Martha's Vineyard I, 41.05, 70.48; II/5, 12h:—D35: 0, 4.5, 32.70; 5, 4.2, 32.74; 15, 4.2, 32.73; 30, 4.2, 32.71.

20619 Martha's Vineyard II, 40.43, 70.41; II/5, 17h:—D62: 0, 4.2, 32.73; 5, 4.1, 32.74; 20, 4.0, 32.73; 50, 4.5, 32.81.

20620 Martha's Vineyard III, 40.22, 70.35; II/5, 20h:—D90: 0, 7.4, 33.49; 5, 7.5, 33.48; 20, 7.6, 33.54; 40, 8.1, 33.63; 80, 10.2, 34.07.

20621 Martha's Vineyard IV, 40.05, 70.30; II/5, 23h:—D132: 0, 11.0, 34.69; 19c, 11.7, no sal.; 38c, 11.7, 34.87; 75c, 12.0, 34.92; 113c, 12.3, 34.54.

20622 Montauk V, 39.47, 71.27; II/6, 9h:—D1000+: 0, 10.0, 34.66; 20, 10.5, no sal.; 50, 11.1, 34.65; 100, 11.6, 34.82; 260c, 7.7, 34.97; 433c, 4.8, 34.87; 650c, 4.3, 34.90; 866c, 4.0, 34.92.

20623 Montauk IV, 39.57, 71.32; II/6, 14h:—D205: 0, 10.8, 34.60; 20, 10.7, 34.58; 50, 11.1, 34.68; 100, 11.5, 34.84; 200, 9.9, 35.16

20624 Montauk III, 40.07, 71.35; II/6, 17h:—D88: 0, 6.0, 33.17; 20, 5.9, 33.17; 40, 8.2, 33.78; 80, 10.6, 34.41.

20625 Montauk II, 40.35, 71.44; II/6, 21h:—D63: 0, 6.3, 33.15; 20, 6.4, 33.16; 36, 6.4, 33.15; 60, 6.4, 33.16.

20626 Montauk I, 40.55, 71.50; II/7, 0h:—D37: 0, 3.2, 32.21; 10, 3.2, 32.18; 30, 3.1, 32.22.

20627 Shinnecock II, 40.12, 72.03; II/7, 5h:—D70: 0, 7.0, 33.36; 20, 6.9, 33.36; 40, 7.0, 33.35; 60, 7.0, 33.33.

20628 New York V, 39.23, 72.19; II/7, 11h:—D161: 0, 10.8, 34.63; 20, 10.6, 34.60; 50, 10.9, 34.65; 100, 11.7, 35.03; 150, 10.4, 35.22.

20629 New York IV, 39.35, 72.36; II/7, 16h:—D84: 0, 7.9, 33.47; 20, 7.5, 33.47; 50, 7.5, 33.49; 75, 7.5, 33.51.

20630 New York III, 39.49, 72.56; II/7, 21h:—D64: 0, 7.1, 33.34; 20, 7.4, 33.42; 55, 7.2, 33.44.

20631 New York II, 40.07, 73.23; II/8, 0h:—D42: 0, 3.6, 32.44; 20, 3.5, 32.40; 40, 4.0, 32.52.

20632 New York I, 40.24, 73.47; II/8, 4h:—D26: 0, 3.8, 32.41; 10, 3.9, 32.39; 20, 4.6, 32.57.

20633 Atlantic City I, 39.24, 74.05; II/8, 12h:—D22: 0, 3.3, 32.25; 10, 3.1, 32.22; 20, 3.1, 32.20.

20634 Cape May I, 38.41, 74.44; II/8, 19h:—D23: 0, 3.9, 32.54; 10, 4.8, 32.53; 20, 3.9, 32.55.

20635 Cape May II, 38.32, 74.24; II/8, 22h:—D42: 0, 6.2, 33.23; 20, 6.3, 33.26; 40, 6.2, 33.22.

20636 Cape May III, 38.18, 73.51; II/9, 3h:—D70: 0, 8.6, 33.97; 20, 8.6, 33.94; 40, 8.5, 33.94; 65, 8.6, 33.97.

20637 Cape May IV, 38.13, 73.41; II/9, 6h:—D192: 0, 8.8, 34.04; 10, 8.6, 33.97; 20, 8.8, no sal.; 40, 8.9, 34.05; 50, 8.9, 34.05; 80, 8.7, 34.05; 100, 9.4, no sal.; 140, 9.1, 34.43; 180, 10.4, 34.68.

20638 Cape May V, 38.07, 73.36; II/9, 12h:—D1000+: 0, 8.6, 33.89; 17c, 8.7, 33.95; 43c, 9.2, 34.10; 87c, 11.4, 34.88; 173c, 10.7, 35.26; 260c, 8.6, 35.10; 346c, 6.4, 34.96; 433c, 5.2, 34.94; 520c, 4.6, 34.93; 650c, 4.4, 34.96; 866c, 3.9, 34.94.

20639 Winterquarter III, 37.33, 74.27; II/9, 19h:—D80: 0, 7.9, 33.80; 20, 7.8, 33.75; 40, 8.0, 33.79; 70, 8.2, 33.79.

20640 Chesapeake I, 36.56, 75.34; II/10, 10h:—D22: 0, 5.3, 31.09; 10, 5.4, 31.77; 20, 5.8, 32.72.

20641 Chesapeake II, 36.50, 75.02; II/10, 15h:—D37: 0, 8.3, 33.81; 10, 8.1, 33.77; 30, 8.1, 33.77.

20642 Chesapeake III, 36.47, 74.46; II/10, 18h:—D73; 0, 8.9, 34.00; 20, 8.9, 34.07; 40, 9.2, 34.23; 65, 10.3, 34.60.

20643 Chesapeake IV, 36.46, 74.41; II/10, 21h:—D170: 0, 9.3, 34.19; 20, 9.2, 34.23; 50, 10.2, 34.58; 100, 11.1, 34.90; 150, 10.5, 35.26.

20644 Bodie Island I, 35.50, 75.26; II/11, 12h:—D22: 0, 5.7, 29.96; 10, 5.5, 29.92; 20, 6.7, 32.91.

20645 Bodie Island II, 35.52, 75.09; II/11, 15h:—D29: 0, 6.8, 32.47; 2, 6.6, 32.46; 23, 7.6, 33.39.

20646 Bodie Island III, 35.54, 74.50; II/11, 20h:—D285: 0, 19.3, 35.91; 10, 19.1, 35.86; 20, 19.1, 35.83; 35, 17.7, no sal.; 50, 11.0, 34.71; 100, 11.2, 34.90; 150, 12.1, 35.31; 200, 12.4, 35.47; 250, 8.4, 35.50.

20647 Cape May VI, 37.43, 72.27; II/12, 14h:—D1000+: 0, 12.8, 35.04; 50, 11.8, 35.10; 100, 11.9, 35.15; 150, 12.1, 35.47; 200, 11.9, 35.31; 250, 8.2, 35.05; 300, 7.4, 35.06; 400, 5.4, 34.95; 500, 4.7, 34.96; 600, 4.7, 34.96; 700, 4.2, 34.95; 900, 3.9, 34.95; 1100, no temp., 34.94.

20648 Montauk VIII, 38.11, 71.03; II/12, 23h:—D1000+: 0, 12.2, 35.18; 91c, 12.0, 35.11; 182c, 11.2, 35.39; 227c, 9.5, 35.22; 272c, 8.3, 35.08; 363c, 7.2, 35.02; 454c, 6.2, 35.00; 909c, 4.2, 34.96.

20649 Montauk VII, 38.52, 71.15; II/13, 4h:—D1000+: 0, 11.2, 35.05; 45c, 11.4, 35.04; 91c, 11.3, 35.07; 182c, 11.5, 35.42; 227c, 9.4, 35.16; 272c, 8.3, 35.05; 363c, 6.3, 34.94; 454c, 4.9, 34.92; 909c, 3.8, 34.94.

20650 Montauk VI, 39.37, 71.27; II/13, 9h:—D1000+: 0, 10.8, 34.79; 50, 11.2, 34.94; 100, 11.3, 35.25; 125, 11.6, 35.41; 200, 10.6, 35.13; 300, 8.4, 35.05; 400, 6.3, 35.08; 450, 4.8, 34.89; 500, 4.5, 34.90; 1000, 3.9, 34.96.

20651 Montauk III, 40.07, 71.38; II/13, 15h:—D92: 0, 8.3, 33.96; 20, 8.3, 33.88; 40, 8.5, 34.00; 80, 10.6, 34.70.

CRUISE OF APRIL 3 TO 11, 1930, STATIONS 20652 TO 20678, ALBATROSS II SERIES

20652 Martha's Vineyard I, 41.05, 70.47; IV/3, 20h:—D40: 0, 5.1, 32.70; 5, 5.2, 32.72; 20, 5.3, 32.76; 35, 5.2, 32.92.

20653 Martha's Vineyard II, 40.43, 70.42; IV/4, 0h:—D59: 0, 5.4, 32.79; 5, 5.3, 32.77; 20, 5.4, 32.79; 50, 7.4, 33.78.

20654 Martha's Vineyard III, 40.22, 70.36; IV/4, 4h:—D92: 0, 5.4, 33.03; 5, 5.4, 33.11; 20, 5.2, 33.10; 50, 5.9, 33.29; 80, 11.0, 35.01.

20655 Martha's Vineyard IV, 40.04, 70.30; IV/4, 8h:—D201: 0, 6.1, no sal.; 5, 6.0, 33.32; 20, 6.0, no sal.; 50, 6.4, 33.37; 100, 9.8, 34.53; 150, 11.0, 35.11; 175, 10.7, 35.23; 200, 8.6, no sal.

20656 Cape May I, 38.40, 74.44; IV/5, 10h:—D24: 0, 7.2, 32.24; 5, 7.3, 32.37; 10, 7.3, 32.39; 20, 7.1, 32.46.
20657 Cape May II, 38.32, 74.24; IV/5, 14h:—D42: 0, 8.1, 33.37; 15, 8.0, 33.40; 35, 8.9, 34.14.
20658 Cape May III, 38.17, 73.50; IV/5, 18h:—D80: 0, 9.4, 34.17, 5, 9.5, 34.16; 20, 9.1, 34.34; 40, 9.5, 34.23; 75, 10.6, 34.97.
20659 Cape May IV, 38.14, 73.41; IV/5, 21h:—D220: 0, 10.0, 34.42; 5, 10.1, 34.39; 20, 9.6, 34.44; 50, 9.9, 34.60; 75, 9.9. 35.05; 100, 9.5, 34.45; 150, 10.4, 35.06; 200, 9.7, 35.26.
20660 Winterquarter III, 37.33, 74.26; IV/6, 4h:—D82: 0, 10.5, 34.36; 20, 10.8, 34.58; 40, 11.3, 35.04; 75, 10.4, 35.21
20661 Chesapeake IV, 36.49, 74.42; IV/6, 10h:—D102: 0, 13.9, 35.49; 5, 14.0, 35.49; 20, 13.2, 35.32; 50, 11.9, 35.06; 90, 11.8, 35.18.
20662 Chesapeake III, 36.52, 74.50; IV/6, 12h:—D68: 0, 13.9, 35.49; 5, 13.8, no. sal.; 20, 14.8, 35.37; 40, 13.5, 35.39; 60, 10.8, 35.29.
20663 Chesapeake II, 36.57, 75.02; IV/6, 14h:—D46: 0, 10.3, 33.55; 15, 10.4, 34.04; 30, 10.7, 33.99.
20664 Chesapeake I, 36.57, 75.34; IV/8, 10h:—D20: 0, 9.6, 32.44; 5, 9.5, 32.45; 15, 9.4, 32.46.
20665 Currituck I, 36.21, 75.41; IV/8, 15h:—D18: 0, 10.7, 31.75; 5, 10.6, 31.67; 15, 11.0, 33.26.
20666 Bodie Island I, 35.50, 75.23; IV/8, 19h:—D24: 0, 12.2, 32.72; 5, 12.2, 32.72; 20, 12.7, 33.25.
20667 Bodie Island II, 35.47, 75.08; IV/8, 21h:—D35: 0, 13.8, 34.46; 5, 13.7, 34.43; 15, 13.7, 34.46; 30, 14.6, 35.41.
20668 Bodie Island III, 35.44, 74.52; IV/9, 0h:—D62: 0, 15.0, 35.71; 5, 15.0, 35.70; 20, 14.9, 35.70; 50, 13.7, 35.58.
20669 Currituck III, 36.10, 74.50; IV/9, 3h:—D84: 0, 14.5, 35.70; 20, 14.1, 35.67; 50, 14.6, no sal.; 75, 11.6, 35.36.
20670 Currituck II, 36.15, 75.12; IV/9, 7h:—D27: 0, 12.7, 35.12; 5, 13.9, no. sal.; 20, 13.9, 35.05.
20671 Hog Island I, 37.31, 75.16; IV/9, 19h:—D27: 0, 8.7, no sal.; 10, 8.7, 32.46; 25, 8.8, 33.46.
20672 Atlantic City I, 39.24, 74.05; IV/10, 11h:—D23: 0, 7.2, 32.36; 5, 6.4, 32.36; 20, 6.4, 32.52.
20673 New York I, 40.25, 73.47; IV/10, 18h:—D27: 0, 6.6, 31.95; 5, 6.4, 31.92; 20, 6.3, 32.46.
20674 New York II, 40.05, 73.21; IV/10, 22h:—D46: 0, 6.3, 32.93; 5, 6.4, 32.92; 20, 6.5, 32.95; 40, 7.3, 33.70.
20675 New York III, 39.48, 72.56; IV/11, 2h:—D73: 0, 6.7, 33.13; 20, 6.5, 33.21; 50, 9.2, 34.49; 65, 9.4, 34.52.
20676 New York IV, 39.33, 72.37; IV/11, 6h:—D93: 0, 8.2, 33.90; 20, 8.5, 34.07;50, 8.6, 34.13; 80, 10.4, 34.87.
20677 New York V, 39.24, 72.19; IV/11, 10h:—D190: 0, 8.3, 33.94; 5, 8.5, 33.96; 20, 8.5, 34.06; 50, 9.8, 34.52; 100, 11.5, 35.21; 140, 11.0, 35.32; 180, 9.7, 35.15.
20678 Montauk II, 40.40, 71.45; IV/11, 20h:—D57: 0, 6.1, 32.80; 5, 5.9, 32.77; 20, 6.0, 32.77; 50, 6.2, 33.26.

Cruise of April 22 to May 1, 1930, Stations 20679 to 20715, Albatross II Series

20679 New York I, 40.25, 73.46; IV/23, 12h:—D33: 0, 7.3, 32.45; 5, 7.2, 32.64; 15, 7.2, 32.69; 30, 7.1, 32.65.
20680 Atlantic City I, 39.24, 74.05; IV/23, 20h:—D20: 0, 7.1, 32.47; 5, 7.1, 32.48; 20, 8.1, 32.54.
20681 Atlantic City II, 39.18, 73.53; IV/23, 23h:—D35: 0, 7.4, 32.90; 5, 7.3, 32.96; 15, 6.0, 32.98; 30, 7.1, 32.98.
20682 Cape May II, 38.41, 74.44; IV/24, 6h:—D26: 0, 8.4, 32.38; 5, 8.3, 32.88; 10, 8.3, 32.57; 20, 8.4, 32.65.
20683 Cape May I, 38.45, 74.57; IV/24, 9h:—D22: 0, 9.0, 30.46, 15, 8.4, 31.73.
20684 Winterquarter I, 37.50, 75.10; IV/24, 17h:—D18: 0, 9.6, 32.16; 5, 9.6, 32.16; 15, 9.3, 33.01.
20685 Winterquarter II, 37.43, 74.50; IV/24, 21h:—D44: 0, 10.0, 34.04; 5, 10.0, 33.96; 20, 10.0, 33.93; 40, 9.8, 33.98.
20686 Winterquarter III, 37.34, 74.25; IV/24, 23h:—D92: 0, no temp., 33.96; 5, 9.7, 34.05; 20, 9.7, 34.10; 40, 9.7, 34.14; 60, 10.0, 34.68; 85, 10.8, 35.00.
20687 Chesapeake IV, 36.47, 74.44; IV/25, 7h:—D93: 0, no temp., 34.10, 5, 9.9, 34.04; 20, 9.8, 34.35; 40, 10.6, 34.75; 60, 10.7, no sal.; 85, 10.0, 34.72.
20688 Chesapeake III, 36.48, 74.49; IV/25, 9h:—D72: 0, 11.2, 34.23; 5, 10.5, 34.27; 20, 11.1, 34.22; 40, 11.6, 35.00; 65, 11.1, 35.05.
20689 Chesapeake II, 36.51, 75.10; IV/25, 12h:—D27: 0, 10.3, 33.29; 5, 10.1, 33.33; 15, 10.0, 33.55; 25, 10.5, 33.96.
20690 Chesapeake I, 36.56, 75.38; IV/25, 15h:—D20: 0, 10.9, 32.71; 5, 10.6, 32.20; 18, 10.2, 32.43.
20691 Chesapeake O, 36.59, 75.55; IV/25, 18h:—D9: 0, 12.5, 27.90; 5, 11.6, 30.42.
20692 Currituck I, 36.21, 75.41; IV/26, 0h:—D18: 0, 11.7, 30.91; 5, 11.6, 31.56; 15, 11.1, 32.56.
20693 Bodie Island I, 35.50, 75.25; IV/26, 4h:—D27: 0, 11.8, 31.06; 12, 11.9, 31.94; 22, 11.9, 32.88.
20694 Bodie Island II, 35.51, 75.09; IV/26, 7h:—D37: 0, 12.7, 31.91; 5, 12.3, 33.16; 15, 11.7, 33.22; 30, 12.2, 34.34.
20695 Bodie Island III, 35.50, 74.52; IV/26, 9h:—D139: 0, 12.6, 33.60; 5, 12.4, 33.53; 20, 12.0, 33.89; 40, 12.1, 34.67; 60, 13.8, 35.67; 100, 10.7, 35.17; 130, 11.3, 35.26.
20696 Currituck III, 36.19, 74.49; IV/26, 14h:—D99: 0, 11.4, 34.42; 5, 11.5, 34.40; 20, 11.0, 34.53; 40, 11.0, 34.72; 60, 11.8, 35.13; 95, 11.0, 35.10.
20697 Currituck II, 36.20, 75.17; IV/26, 17h:—D35: 0, 11.6, 33.93; 5, 11.5, 34.19; 15, 11.4, 34.13; 30, 11.4, 34.52.
20698 Winterquarter II, 37.41, 74.50; IV/27, 2h:—D44: 0, 10.7, no sal.
20699 Cape May III, 38.32, 74.24; IV/27, 10h:—D44: 0, 9.2, 33.28; 5, 9.2, 33.22; 20, 8.6, 33.28; 40, 8.5, 33.42.
20700 Cape May IV, 38.18, 73.52; IV/27, 14h:—D77: 0, 11.4, 34.19; 5, 11.2, 34.18; 20, 10.4, 34.50; 40, 10.1, 34.27; 70, 10.2, 34.73.

20701 Cape May V, 38.14, 73.43; IV/27, 16h:—D114: 0, 11.5, 34.33; 5, 11.2, 34.25; 20, 10.2, 34.33; 40, 10.2, 34.54; 80, 10.4, 34.69; 110, 10.9, 35.08.

20702 Atlantic City IV, 38.51, 72.59; IV/27, 22h:—D98: 0, 10.4, 34.10; 5, 10.4, 34.17; 20, 12.9, 35.12; 40, 13.2, 35.10, 60, 13.2, 35.32; 90, 11.6, 34.99.

20703 Atlantic City III, 39.07, 73.26; IV/28, 2h:—D56: 0, 8.2, 33.40; 5, 8.1, 33.29; 20, 8.1, 33.39; 50, 8.6, 34.28.

20704 New York V, 39.22, 72.19; IV/28, 9h:—D154: 0, 9.5, 34.02; 5, 9.4, 34.15; 20, 9.8, 34.36; 40, 9.6, 34.20; 100, 10.4, 34.87; 140, 10.4, 34.97.

20705 New York IV, 39.35, 72.36; IV/28, 13h:—D74: 0, 8.3, 33.86; 5, 8.3, 33.75; 20, 9.4, 33.57; 40, 8.1, 34.24; 70, 10.0, 34.89.

20706 New York III, 39.50, 72.56; IV/28, 16h:—D56: 0, 7.4, 32.97; 5, 7.4, 32.84; 20, 7.4, 33.17; 50, 8.5, 34.15.

20707 New York II, 40.10, 73.20; IV/28, 19h:—D45: 0, 7.4, 32.91; 5, 7.8, 32.86; 20, 7.3, 32.85; 40, 7.0, 33.41.

20708 Martha's Vineyard IV, 40.03, 70.31; IV/29, 12h:—D177: 0, 6.9, 33.07; 5, 6.8, 33.17; 20, 6.4, 33.04; 40, 7.0, 33.57; 60, 8.0, 33.97; 80, 6.7, 34.58; 100, 7.8, 34.95; 120, 10.8, 35.13; 140, 10.7, 35.14; 170, 10.5, 35.16.

20709 Martha's Vineyard III, 40.23, 70.35; IV/29, 16h:—D90: 0, 8.0, 33.40; 5, 7.8, 33.35; 20, 7.3, 33.38; 40, 7.7, 33.77; 60, 8.9, 34.23; 85, 10.5, 34.92.

20710 Martha's Vineyard II, 40.42, 70.43, IV/29, 19h:—D63: 0, 7.3, 33.01; 2, 7.1, 32.88; 20, 6.6, 32.96; 40, 6.5, 32.92; 60, 6.5, 33.39.

20711 Martha's Vineyard I, 41.06, 70.47; IV/29, 22h:—D34: 0, 7.1, 32.69; 5, 7.2, no sal.; 15, 7.3, 32.76; 30, 6.3, 32.86.

20712 Chatham, 41.38, 69.41; V/1, 10h:—D51: 0, 5.3, 32.94; 5, 5.0, 32.91; 15, 5.0, 32.76; 30, 4.2, 32.97; 50, 4.1, 32.94.

20713 Highland Lt., 42.03, 69.58; V/1, 16h:—D56: 0, 6.2, 32.63; 5, 5.9, 32.57; 15, 5.5, 32.74; 30, 5.3, 32.55; 50, 4.6, 32.55.

20714 Stellwagen Bank, 42.10, 70.17; V/1, 18h:—D26: 0, 5.3, no sal.; 5, 5.2, 32.56; 10, 5.2, 32.47; 20, 5.1, 32.70.

20715 Cape Cod Bay, 41.57, 70.22; V/1, 20h:—D38: 0, 6.6, 32.94; 5, 6.6, 31.99; 15, 6.1, 32.32; 35, 4.0, 32.68.

Cruise of May 12 to 23, 1930, Stations 20719 to 20756, Albatross II Series

20719 Chatham, 41.38, 69.39; V/13, 2h:—D52: 0, 7.8, 32.55; 5, 7.6, no sal.; 20, 5.1, 32.59; 45, 4.1, 32.99.

20720 Martha's Vineyard I, 41.05, 70.47; V/13, 12h:—D43: 0, 10.6, 32.67; 5, 10.4, 32.63; 20, 8.8, 32.61; 35, 6.3, 32.66.

20721 Martha's Vineyard II, 40.43, 70.41; V/13, 16h:—D59: 0, 11.3, 32.75; 5, 11.2, 32.75; 20, 8.3, 32.77; 50, 6.0, 32.95.

20722 Martha's Vineyard III, 40.21, 70.35; V/13, 20h:—D92: 0, 10.3, 32.92; 5, 10.3, 32.80; 10, 10.4, 32.83; 20, 7.9, 32.95; 40, 6.3, 33.10; 80, 7.9, 33.91.

20723 Martha's Vineyard IV, 40.05, 70.29; V/13, 23h:—D180: 0, 10.4, 33.15; 20, 8.7, 33.39; 50, 9.8, 34.09; 100, 11.7, 35.27; 140, 10.3, 35.19; 175, 9.8, 35.12.

20724 Montauk IV, 39.46, 71.35; V/14, 6h:—D215: 0, 11.0, 33.19; 20, 8.4, 33.28; 50, 8.9, 34.32; 100, 10.0, 34.67; 150, 10.4, 35.07; 200, 9.8, 35.25.

20725 Montauk III, 40.07, 71.34; V/14, 10h:—D92: 0, 11.0, 32.83; 5, 10.5, 32.88; 10, 10.2, 32.84; 20, 8.2, 33.13; 50, 8.4, 34.03; 80, 9.7, 34.60.

20726 Montauk II, 40.37, 71.43; V/14, 13h:—D72: 0, 11.8, 32.49; 5, 11.6, 32.66; 20, 10.0, 32.82; 30, 7.2, 33.14; 40, 6.7, 33.02; 60, 6.9, 33.17.

20727 Montauk I, 40.55, 71.51; V/14, 16h:—D40: 0, 10.5, 31.82; 10, 10.4, 31.78; 30, 7.4, 33.13.

20728 Shinnecock I, 40.35, 72.27; V/14, 21h:—D51: 0, 10.8, 32.41; 20, 8.4, 32.66; 40, 6.9, 33.51.

20729 New York I, 40.24, 73.46; V/16, 6h:—D35: 0, 11.8, 31.73; 5, 11.6, 31.80; 15, 11.6, 31.98; 35, 7.8, 32.82.

20730 New York II, 40.07, 73.22; V/16, 9h:—D40: 0, 12.2, 32.03; 5, 12.0, 32.03; 15, 9.9, 32.66; 35, 7.1, 33.11.

20731 New York III, 39.48, 72.57; V/16, 13h:—D75: 0, 12.5, 32.59; 5, 12.3, 32.67; 20, 7.9, 32.79; 40, 7.9, 33.89; 65, 8.1, 33.82.

20732 New York IV, 39.35, 72.34; V/16, 16h:—D77: 0, 12.8, 33.16; 10, 12.7, 33.06; 20, 9.1, 33.68; 40, 8.1, no sal.; 70, 9.0, 34.42.

20733 New York V, 39.24, 72.19; V/16, 19h:—D145: 0, 13.0, 33.98; 20, 12.2, 34.05; 50, 9.4, 34.23; 90, 11.7, 34.94; 130, 11.7, 35.10.

20734 Atlantic City IV, 38.52, 72.58; V/17, 0h:—D101: 0, 13.5, 32.99; 10, 13.4, 33.06; 20, 9.9, 33.84; 50, 10.3, 34.59; 90, 10.9, 34.92.

20735 Atlantic City III, 39.05, 73.27; V/17, 4h:—D64: 0, 13.0, 32.96; 10, 12.8, 33.06; 20, 8.9, 33.40; 50, 9.2, 34.40.

20736 Atlantic City IIa, 39.11, 73.40; V/17, 8h:—D43: 0, 13.5, 32.43; 10, 13.9, 32.65; 20, 8.2, 33.16; 35, 8.2, 33.79.

20737 Atlantic City II, 39.18, 73.52, V/17, 10h:—D36: 0, 14.4, 32.43; 10, 13.8, 32.47; 20, 11.1, 32.86; 30, 8.0, 32.48.

20738 Atlantic City I, 39.25, 74.05; V/17, 12h:—D24: 0, 14.7, 32.03; 10, 13.9, 32.04; 20, 8.0, 32.86.

20739 Cape May I, 38.45, 74.55; V/17, 21h:—D13: 0, 13.6, 31.47; 5, 13.9, 31.33; 10, 11.5, 32.38.

20740 Cape May II, 38.40, 74.44; V/17, 22h:—D22: 0, 15.2, 31.64; 5, 15.0, 31.71; 15, 9.3, 33.28.

20741 Winterquarter I, 37.50, 75.10; V/18, 7h:—D22: 0, 16.0, 32.43; 5, 16.0, no sal.; 15, 11.1, 32.54.

20742 Winterquarter II, 37.43, 74.50; V/18, 10h:—D34: 0, 17.0, 32.59; 10, 16.6, 33.10; 25, 10.7, 34.11.

20743 Winterquarter III, 37.33, 74.25; V/18, 14h:—D99: 0, 17.5, 33.58; 10, 14.2, 34.21; 20, 11.7, 34.42; 50, 10.7, 34.49; 90, 10.8, 34.85.

20744 Chesapeake IIIA, 36.48, 74.45; V/18, 22h:—D77: 0, 17.0, 33.02; 10, 15.0, 33.66; 20, 13.6, 34.74; 30, 12.3, no sal.; 40, 11.0, 34.92; 65, 11.0, 34.97.

20745 Chesapeake II, 36.54, 75.11; V/19, 2h:—D33: 0, 17.4, 31.87; 10, 16.6, 32.20; 25, 11.5, 31.89.

20746 Chesapeake I, 36.55, 75.40; V/19, 6h:—D22: 0, 17.5, 30.33; 5, 17.3, 30.72; 15, 11.2, 33.48.

20747 Chesapeake A, 36.59, 75.55; V/19, 10h:—D9: 0, 17.7, 27.31, 5, 16.0, 30.26.

20748 Winterquarter I, 37.49, 75.11; V/19, 17h:—D13: 0, 16.0, no sal.

20749 Cape May III, 38.32, 74.23; V/20, 1h:—D38: 0, 14.3, 32.24; 10, 14.8, 32.37; 20, 8.7, 33.63; 30, 8.7, 33.62.

20750 Cape May IV, 38.20, 74.00; V/20, 5h:—D64: 0, 14.8, 33.16; 10, 13.6, 33.44; 20, 9.2, 33.51; 35, 8.7, 33.84; 55, 9.4, 34.37.

20751 Cape May V, 38.14, 73.48; V/20, 8h:—D123: 0, 15.2, 33.58; 10, 15.0, 33.60; 20, 13.6, 34.36; 50, 11.0, 34.68; 110, 11.8, 35.30.

20752 Cape May VI, 38.10, 73.35; V/20, 10h:—D1000+: 0, 15.6, 33.97; 10, 14.6, 34.33; 20, 10.5, 34.05; 50, 9.8, 34.40; 75, 10.6, 34.69; 100, 11.3, 35.05; 150, 12.0, 35.45; 200, 10.7, 35.35; 300, 8.4, 34.95; 350, 5.8, 34.90; 400, 5.1, 34.99; 500, 4.7, 35.03; 600, 5.1, 35.07; 800, 4.7, 35.01; 1000, 4.3, 34.96.

20753 Corson III, 38.44, 73.58; V/20, 17h:—D48: 0, 13.9, no sal.

20754 Corson II, 38.56, 74.10; V/20, 19h:—D38: 0, 13.9, no sal.

20755 Corson I, 39.06, 74.22; V/20, 21h:—D31: 0, 13.4, no sal.

20755A Corson I-South, 39.03, 74.22; V/20, 23h:—D29: 0, 13.5, 32.65; 5, 13.5, 32.66; 15, 13.0, 32.90; 27, 9.2, 33.21.

20755C Corson I-South, 39.03, 74.22; V/21, 11h:—D27: 0, 14.3, 32.70; 5, 14.1, 32.77; 10, 13.6, 32.70; 15, 13.3, 32.88; 20, 10.4, 33.10.

20756 Fire Island, 40.17, 72.51; V/22, 0h:—D48: 0, 11.8, 32.75; 10, 11.8, 32.76; 20, 8.4, 33.25; 40, 7.4, 33.63.

Cruise of June 7 to 18, 1930, Stations 20765 to 20791, Albatross II Series

20765 Shinnecock I, 40.38, 72.30; VI/7, 21h:—D37: 0, 13.4, 32.13; 5, 13.4, 32.14; 10, 13.0, 32.26; 20, 8.9, 33.12; 30, 7.1, 33.33.

20766 Shinnecock II, 40.09, 72.25; VI/8, 2h:—D68: 0, 14.2, 32.09; 15, 14.2, 33.08; 25, 14.6, 32.97; 35, 8.6, 33.53; 60, 7.4, 32.23.

20767 New York V, 39.24, 72.22; VI/8, 9h:—D130: 0, 13.2, 32.75; 5, 11.8, 33.10; 10, 11.8, 33.20; 20, 13.0, 33.62; 40, 13.1, 34.56; 60, 11.4, 34.69; 100, 10.8, 34.81; 125, 10.3, 34.87.

20768 New York IV, 39.35, 72.36; VI/8, 13h:—D82: 0, 13.4, 32.79; 5, 13.3, 32.86; 10, 13.2, 32.95; 20, 11.8, 32.99; 40, 7.9, 32.94; 60, 8.4, 33.42; 75, 8.0, 33.75.

20769 New York III, 39.49, 72.56; VI/8, 16h:—D73: 0, 14.7, 32.94; 5, 13.7. no sal.; 10, 13.6, 33.12; 20, 11.0, 33.21; 40, 8.1, 33.69; 65, 7.9, 33.22.

20770 New York II, 40.07, 73.22, VI/8, 20h:—D40: 0, 14.2, 31.98; 5, 14.2, 31.98; 10, 13.9, 31.94; 15, 13.2, 32.14; 20, 7.1, 33.35; 35, 7.5, 33.55.

20771 New York I, 40.24, 73.46; VI/9, 1h:—D24: 0, 13.8, 31.44; 5, 13.6, 32.10; 10, 13.5, 32.21; 15, 11.0, 32.47; 20, 7.2, 32.99.

20772 Atlantic City I, 39.24, 74.05; VI/9, 11h:—D21: 0, 15.5, 32.25; 5, 15.3, 32.25; 10, 15.2, 31.92; 15, 9.6, 32.84.

20773 Atlantic City II, 39.16, 73.54; VI/9, 14h:—D32: 0, 16.0, 31.92; 5, 15.8, 31.94; 10, 15.2, 32.00; 25, 9.4, 33.13.

20774 Atlantic City III, 39.04, 73.25; VI/9, 19h:—D60: 0, 14.9, 32.47; 15, 14.6, 32.50; 35, 7.9, 33.68; 50, 7.9, 33.78.

20775 Atlantic City IV, 38.52, 73.01; VI/9, 22h:—D82: 0, 15.0, 30.44; 5, 14.9, 32.59; 20, 13.3., 33.73; 40, 10.6, 34.46; 70, 9.1, 34.20.

20776 Cape May IA, 38.43, 74.58; VI/11, 5h:—D20: 0, 16.2, 30.96; 5, 16.0, 31.03; 15, 15.9, 31.27.

20777 Cape May IIA, 38.36, 74.53; VI/11, 7h:—D18: 0, 16.1, 31.55; 5, 16.0, 31.51; 15, 13.2, 32.56.

20778 Fenwick, 38.29, 74.48; VI/11, 10h:—D27: 0, 17.7, 32.36; 5, 16.4, 32.32; 10, 16.3, 32.25; 20, 10.6, 33.39.

20779 Cape May III, 38.32, 74.24; VI/11, 13h:—D40: 0, 18.9, 32.01; 5, 17.3, 32.03; 10, 17.2, 31.91; 20, 12.5, no sal.; 35, 9.0, 33.49.

20780 Cape May IV, 38.24, 74.04; VI/11, 16h:—D55: 0, 17.7, 32.34; 5, 16.6, 32.38; 20, 11.6, 33.30; 40, 9.0, 34.09; 50, 9.0, 34.09.

20781 Cape May V, 38.15, 73.46; VI/11, 19h:—D99: 0, 16.3, 32.68; 5, 16.5, 32.77; 20, 12.9, 33.62; 40, 10.2, 34.33; 60, 9.5, 34.40; 90, 9.5, 34.45.

20782 Cape May VI, 38.08, 73.27; VI/11, 22h:—D900+: 0, 17.9, 33.05; 5, no temp., 32.95; 20, no temp., 33.17; 40, no temp., 34.11; 50, 11.4, 34.33; 60, no temp., 34.36; 100, 11.0, 35.03; 200, no temp., 35.17; 300, 8.8, no sal.; 600, 4.3, no sal.; 900, 3.8, 34.87.

20783 Montauk V, 39.57, 71.34; VI/12, 18h:—D137: 0, 14.5, 32.81; 5, 14.5, 32.84; 20, 11.9, 33.13; 40, 9.1, 34.05; 60, 9.7, 34.52; 100, 10.5, 34.88; 130, 10.7, 34.83.

20784 Montauk IV, 40.08, 71.35; VI/12, 20h:—D86: 0, 13.3, 32.94; 5, 14.2, 32.79; 17c, 12.8, 32.84; 40, 8.8, 33.22; 52c, 6.3, 33.35; 80, 8.1, 33.93.

20785 Montauk III, 40.25, 71.41; VI/13, 0h:—D77: 0, 14.9, 32.35; 5, 14.9, 32.25; 20, 11.3, 32.72; 40, 6.4, 33.16; 60, 7.1, 33.47; 70, 7.1, no sal.

20786 Montauk II, 40.42, 71.45; VI/13, 3h:—D59: 0, 15.0, 32.01; 5, 15.0, 32.00; 20, 11.5, 32.20; 40, 6.7, 32.10; 55, 6.9, 32.82.

20787 Montauk I, 40.57, 71.48; VI/13, 6h:—D37: 0, 14.4, 31.36; 5, 13.8, 31.74; 10, 12.1, 31.59; 20, 10.7, 32.32; 30, 8.7, 32.72.

20788 Martha's Vineyard III, 40.25, 70.36; VI/13, 15h:—D79: 0, 15.3, 32.95; 5, 15.2, 32.87; 10, 14.0, 32.90; 20, 9.7, 32.94; 40, 6.9, 33.22; 60, 6.3, 33.26; 70, 6.6, 33.10.

20789 Martha's Vineyard IV, 40.04, 70.31; VI/13, 19h:—D176: 0, 16.4, 33.27; 5, 16.1, 33.25; 19c, 11.3, 33.47; 38c, 9.0, 33.73; 56c, 9.0, 34.11, 94c, 9.6, 34.93; 132c, 11.1, 35.16; 160c, 11.0, 35.15.

20790 Martha's Vineyard II, 40.43, 70.42; VI/14, 1h:—D57: 0, 15.0, 32.70; 5, 15.2, 32.66; 20, 10.6, 32.84; 40, 6.3, 33.00; 50, 6.1, 32.97.

20791 Martha's Vineyard I, 41.07, 70.49; VI/14, 5h:—D38: 0, 15.3, 32.38; 5, 14.9, 32.52; 10, 13.4, 32.57; 20, 11.3, 32.59; 30, 9.5, 32.71.

Cruise of June 24 to July 1, 1930, Stations 20800 to 20827B, Albatross II Series

20800 Nantucket Shoals, 40.53, 69.40; VI/24, 13h:—D27: 0, 12.2, 32.38; 5, 12.7, 32.39; 10, 12.0, 32.32; 20, 11.9, 32.38.

20801 Nantucket Shoals, 40.33, 69.35; VI/24, 16h:—D62: 0, 18.3, 32.68; 5, 18.4, 32.63; 10, 17.1, 32.69; 20, 9.1, 32.54; 40, 8.6, 32.68; 50, 8.2, 32.83.

20802 Martha's Vineyard IV, 40.05, 70.29; VI/24, 22h:—D137: 0, 18.9, 32.87; 5, 18.9, 32.86; 10, 18.9, 33.00; 25, 10.8, 33.03; 40, 10.4, 33.98; 45, 9.7, 34.02; 60, 10.0, 34.45; 100, 11.0, 34.83; 125, 11.0, 34.90.

20803 Martha's Vineyard III, 40.22, 70.35; VI/25, 1h:—D90: 0, 18.3, 32.94; 5, 18.4, 32.86; 10, 18.1, 32.92; 20, 10.7, 32.90; 40, 6.8, 33.10; 60, 6.5, 34.04; 80, 8.0, 33.64.

20804 Martha's Vineyard II, 40.44, 70.40; VI/25, 5h:—D55: 0, 18.1, 32.55; 5, 18.1, 32.66; 10, 18.1, 32.57; 20, 8.8, 32.83; 40, 6.8, 32.96; 50, 6.8, 32.62.

20805 Martha's Vineyard I, 41.05, 70.45; VI/25, 8h:—D38: 0, 18.2, 32.65; 5, 18.1, 32.56; 10, 17.8, 32.53; 20, 9.2, 32.66; 30, 7.8, 32.86.

20806 Montauk I, 40.56, 71.49; VI/25, 15h:—D46: 0, 15.0, 31.47; 10, 14.0, 31.58; 20, 11.2, 32.23; 30, 8.9, 32.64; 40, 7.0, 32.94.

20807 Montauk II, 40.43, 71.46; VI/25, 18h:—D68: 0, 19.8, 32.05; 10, 14.8, 32.46; 20, 10.6, 32.74; 40, 6.3, 33.07; 60, 6.5, 33.21.

20808 Montauk III, 40.25, 71.41; VI/25, 22h:—D80: 0, 19.5, 32.19; 10, 18.8, 32.19; 20, 11.2, 32.77; 30, 9.8, 32.77; 40, 6.3, 33.15; 75, 6.9, 33.56.

20809 Montauk IV, 40.07, 71.35; VI/26, 1h:—D86: 0, 19.6, no sal.; 10, 16.1, 32.84; 20, 11.0, 33.04; 30, 9.3, 33.20; 40, 7.9, 33.36; 60, 6.9, 33.43; 80, 8.2, 33.93.

20810 Montauk V, 33.59, 71.33; VI/26, 3h:—D102: 0, 19.3, 32.52; 5, 19.0, 32.62; 10, 12.1, 32.84; 20, 9.4, 33.10; 30, 8.5, 33.22; 50, 7.1, 33.48; 90, 9.4, 34.33.

20811 New York IV, 39.34, 72.35; VI/26, 10h:—D82: 0, 20.1, 32.56; 5, 20.0, 32.57; 10, 17.1, 32.57; 20, 12.7, 32.84; 40, 8.2, 33.21; 60, 7.8, 33.59; 75, 8.4, 34.04.

20812 New York III, 39.49, 72.55; VI/26, 13h:—D57: 0, 22.8, no sal.; 5, 20.4, 32.04; 10, 19.9, 32.06; 20, 12.8, 32.99; 40, 7.7, 33.69; 50, 7.6, 33.86.

20813 New York II, 40.07, 73.19; VI/26, 17h:—D42: 0, 21.7, 31.53; 5, 21.5, 31.56; 10, 19.9, 31.61; 20, 10.2, 33.00; 35, 7.0, 33.51.

20814 New York I, 40.25, 73.47; VI/26, 21h:—D26: 0, 19.2, 29.09; 5, 19.2, 29.52; 10, 15.5, 31.87; 15, 12.2, 32.37; 20, 13.6, 32.75.

20815 Barnegat, 39.43, 73.40; VI/27, 3h:—D29: 0, 20.8, 31.95; 5, 20.6, 31.91; 10, 20.6, 31.88; 15, 17.8, 32.31; 20, 8.7, 32.97; 25, 8.6, 33.01.

20816 Atlantic City I, 39.24, 74.05; VI/27, 7h:—D22: 0, 19.9, 31.85; 5, 19.8, 31.78; 10, 19.8, 31.76; 15, 9.4, 32.81; 20, 9.4, 31.81.

20817 Atlantic City II, 39.18, 73.53; VI/27, 10h:—D30: 0, 21.6, 31.99; 5, 21.5, 32.21; 10, 21.4, 32.05; 20, 8.4, 32.04.

20818 Atlantic City III, 39.05, 73.27; VI/27, 14h:—D57: 0, 21.7, 32.48; 10, 21.5, 31.95; 20, 14.2, 32.57; 30, 9.9, 33.58; 50, 8.1, 33.56.

20819 Cape May II, 38.41, 74.44; VI/27, 22h:—D15: 0, 21.1, 31.65; 5, 19.4, 32.54; 10, 11.5, 33.40.

20820 Fenwick, 38.28, 74.45; VI/28, 0h:—D29: 0, 22.3, 32.63; 5, 22.3, 32.55; 10, 20.6, 32.57; 15, 11.7, 33.30; 25, 10.0, 32.50.

20821 Cape May IIA, 38.37, 74.51; VI/28, 3h:—D26: 0, 19.4, 31.69; 5, 19.4, 31.53; 10, 13.3, 33.32; 15, 10.9, no sal.; 20, 10.9, 31.69.

20822 Cape May IA, 38.40, 74.59; VI/28, 6h:—D22: 0, 17.2, 32.03; 5, 17.3, 32.09; 10, 16.9, 32.10; 15, 16.4, 32.09; 20, 15.9, 32.20.

20823 Shinnecock II, 40.12, 72.27, VI/28, 22h:—D57: 0, 20.5, 31.88; 10, 20.3, 32.05; 20, 14.8, 32.90; 30, 9.3, 32.84; 50, 7.3, 32.01.

20824 Shinnecock I, 40.37, 72.28; VI/29, 2h:—D37: 0, 19.4, 31.76; 5, 19.3, 31.78; 10, 17.7, 32.01; 20, 9.6, 32.95; 30, 7.0, 33.05.

20825 Montauk IA, 40.50, 71.51; VI/29, 7h:—D40: 0, 15.5, 31.66; 5, 15.3, 31.76; 10, 14.2, 32.12; 20, 9.4, 43.66; 35, 6.6, 32.86.

20826 Block Island, 41.03, 71.27; VI/29, 11h:—D42: 0, 19.1, no sal.

20827A Martha's Vineyard I, 41.03, 71.01; VI/29, 14h:—D37: 0, 19.2, 32.56; 5, 18.3, 32.52; 10, 17.7, 32.37; 20, 11.0, 32.70; 30, 10.0, 32.64.

20827B Martha's Vineyard I, 41.03, 71.01; VI/29, 23h:—D37: 0, 17.5, 32.59; 5, 17.6, 32.52; 10, 16.8, 32.52; 20, 10.6, 32.74; 30, 8.6, 32.81.

Cruise of July 10 to 18, 1930, Stations 20836 to 20854B, Albatross II Series

20836 Montauk I, 40.50, 71.49; VII/10, 14h:—D40: 0, 18.0, 31.64; 5, 17.8, 31.70; 10, 17.7, 32.12; 15, 16.7, 32.38; 20, 12.0, 32.59; 25, 10.7, 32.72; 35, 8.1, 32.82.

20837 Montauk II, 40.43, 71.46; VII/10, 19h:—D57: 0, 20.8, 32.04; 10, 20.7, 32.03; 15, 15.1, 32.53; 20, 9.7, 32.95; 40, 6.4, 33.14; 50, 6.3, 33.01.

20838 Montauk III, 40.25, 71.40; VII/10, 23h:—D75: 0, 21.2, 32.23; 10, 21.2, 32.11; 15, 15.0, 32.73; 20, 12.1, 32.79; 40, 7.8, 33.23; 50, 6.7, 33.42; 70, 11.1, 33.77.

20839 Montauk IV, 40.08, 71.36; VII/11, 4h:—D92: 0, 20.1, 32.66; 10, 20.1, 32.71; 15, 20.1, 32.74; 20, 17.1, 33.15; 40, 12.3, 33.28; 70, 8.1, 33.98; 85, 7.1, 34.11.

20840 Montauk V, 39.56, 71.30; VII/11, 9h:—D146: 0, 20.5, 32.84; 10, 20.3, 32.87; 20, 14.3, 33.15; 40, 12.4, 33.21; 58c, 7.4, 33.73; 77c, 11.3, 34.33; 96c, 10.3, 34.79; 135c, 11.0, 35.27.

20841 New York V, 39.30, 72.21; VII/11, 18h:—D146: 0, 21.1, 32.73; 10, 21.0, 32.61; 20, 15.0, 33.76; 40, 11.5, 34.35; 60, 11.1, 34.83; 72c, 11.5, 35.07; 91c, 11.5, 35.08; 121c, 11.2, 34.97.

20842 New York IV, 39.35, 72.36; VII/11, 22h:—D80: 0, 21.6, 32.20; 10, 20.8, 32.14; 20, 11.8, 32.95; 40, 8.5, 33.28; 52c, 7.3, 33.65; 69c, 7.7, 33.65.

20843 New York III, 39.50, 72.58; VII/12, 4h:—D66: 0, 22.1, 32.03; 5, 22.0, 32.00; 15, 21.3, 32.30; 35, 9.1, 33.04; 55, 8.1, 33.59.

20844 Barnegat, 39.45, 73.40; VII/12, 11h:—D29: 0, 21.8, 31.51; 10, 21.6, 31.27; 15, 17.0, 32.33; 25, 8.1, 33.12.

20845 New York II, 40.04, 73.32; VII/12, 15h:—D64: 0, 22.1, 31.60; 10, 21.0, 31.58; 20, 12.0, 32.88; 40, 11.6, 33.50; 60, 7.3, 33.48.

20846 New York I, 40.18, 73.49; VII/12, 19h:—D63: 0, 20.5, 28.68; 10, 18.1, 31.91; 20, 10.0, 32.86; 40, 7.8, 33.16; 60, 7.3, 33.31.

20847 Shinnecock I, 40.36, 72.28; VII/13, 2h:—D40: 0, 20.3, 31.98; 10, 18.7, 32.17; 15, 10.7, 32.99; 20, 9.3, 33.04; 35, 6.9, 33.14.

20848 Shinnecock II, 40.12, 72.26; VII/13, 7h:—D60: 0, 21.7, 31.88; 10, 21.6, 31.85; 15, 16.9, 32.81; 20, 12.9, 32.96; 30, 10.1, 32.95; 40, no temp., 33.30; 55, 6.8, 33.55.

20849 Martha's Vineyard IV, 40.01, 70.30; VII/13, 19h:—D225: 0, 20.6, 33.03; 10, 20.1, 33.03; 20, 14.2, 33.37; 40, 10.8, 34.38; 60, 10.4, 34.77; 100, 11.3, 35.16; 150, 10.7, 35.35; 220, 8.9, 35.28.

20850 Martha's Vineyard III, 40.21, 70.35; VII/14, 0h:—D92: 0, 18.9, 32.84; 10, 14.7, 32.96; 15, 16.8, 32.93; 17, 14.8, no sal.; 20, 7.9, 33.30; 40, 6.8, 33.34; 60, 7.5, 33.62; 85, 7.8, 34.00.

20851 Nantucket Shoals, 40.36, 70.10; VII/14, 5h:—D51: 0, 19.3, 32.77; 10, 17.3, 32.78; 15, 10.2, 33.16; 20, 8.8, 33.17; 36, 7.6, 33.14; 46, 7.4, 33.12.

20852 Martha's Vineyard II, 40.42, 70.42; VII/14, 10h:—D59: 0, 19.2, 32.70; 10, 19.1, 32.62; 15, 9.1, 32.93; 20, 9.2, no sal.; 39c, 6.8, 33.25; 48c, 6.8, 33.20.

20853 Martha's Vineyard I, 41.04, 70.46; VII/14, 13h:—D44: 0, 16.1, 32.57; 10, 15.8, 32.56; 20, 9.6, 32.99; 30, 9.2, 32.97; 40, 8.7, 32.98.

20854A South Channel, 41.20, 69.14; VII/16, 13h:—D108: 0, 17.2, 32.27; 5, 18.0, 32.34; 10, 16.2, 32.39; 15, 10.4, 32.62; 20, 5.2, 33.07; 40, 4.8, 32.89; 60, 4.5, 32.95; 100, 4.1, no sal.

20854B South Channel, 41.20, 69.14; VII/16, 23h:—D106: 0, 17.7, 32.30; 5, 17.9, 32.16; 10, 16.0, 32.28; 15, 17.9, 32.41; 20, 13.3, 32.54; 40, 4.8, 32.89; 60, 4.4, 32.95; 100, 4.0, 33.10.

Cruise of September 15 to 18, 1930, Stations 20872A to 200873B, Albatross II Series

20872A South Channel I, 41.27, 69.25; IX/17, 1h:—D45: 0, 17.6, 32.21; 5, 17.4, 32.07; 10, 17.4, 32.14; 20, 13.9, 32.33; 30, 7.9, 32.72; 40, 7.8, 32.71.

20872B South Channel I, 41.27, 69.25; IX/17, 9h:—D42: 0, 17.1, 32.20; 5, 17.2, 32.16; 10, 16.9, 32.22; 15, 12.3, 32.48; 20, 10.9, 32.56; 30, 8.7, 32.65; 40, 8.4, 32.66.

20873A South Channel II, 41.11, 69.10; IX/17, 14h:—D88: 0, 19.5, 32.34; 5, 19.3, 32.36; 10, 19.3, 32.32; 20, 19.2, 32.31; 40, 8.3, 32.73; 60, 6.3, 32.84; 90, 5.9, 32.97.

20873B South Channel II, 41.11, 69.10; IX/17, 19h:—D90: 0, 18.8, 32.26; 5, 18.8, 32.29; 10, 18.7, 32.30; 20, 13.1, 32.48; 40, 8.2, 32.91; 60, 7.0, 33.03; 100, 5.1, 33.02.

Cruise of October 17 to 21, 1930, Albatross II Series

Chatham, 41.29, 69.34; X/18:—0, 11.8; 45, 12.6.
Chatham, 41.23, 69.34; X/18:—0, 11.8; 34, 13.2.
Nantucket Shoals, 41.22, 69.42; X/18:—0, 12.2; 22, 13.6.
Nantucket Shoals, 41.25, 69.42; X/18:—0, 14.4; 20, 13.6.
Nantucket Shoals, 41.10, 69.44; X/21:—0, 11.9; 22, 12.3.

Cruise of February 13 to March 5, 1931, Stations 20884 to 20922, Albatross II Series

20884 Martha's Vineyard I, 41.05, 70.45; II/17, 13h:—D46: 0, 4.9, no sal.; 10, 3.1, 32.83; 40, 3.0, 32.86.
20885 Martha's Vineyard II, 40.44, 70.39; II/17, 18h:—D64: 0, 4.9, 32.66; 10, 3.3, 32.68; 20, 3.3, 32.70; 40, 3.5, 32.74; 60, 3.6, 32.79.
20886 Martha's Vineyard III, 40.32, 70.37; II/17, 20h:—D72: 0, 4.8, no sal.; 10, 2.9, 32.65; 20, 3.0, 32.65; 40, 3.1, 32.68; 70, 3.3, no sal.
20887 Martha's Vineyard IV, 40.22, 70.33; II/17, 22h:—D84: 0, 5.0, 32.72; 10, 3.8, 32.68; 20, 3.8, 32.75; 50, 3.6, 32.72; 80, 3.6, 32.74.
20888 Martha's Vineyard V, 40.06, 70.29; II/18, 0h:—D128: 0, 6.1, 33.04; 20, 6.3, 33.08; 50, 6.2, 33.12; 80, 6.2, 33.19; 120, 9.6, 34.79.
20889 Martha's Vineyard VI, 39.55, 70.25; II/18, 4h:—D293: 0, 7.0, 33.48; 50, 8.9, 34.31; 100, 9.9, 34.56; 200, 11.9, 35.37; 280, 8.7, 35.12.
20890 Chesapeake I, 36.52, 75.30; II/22, 13h:—D24: 0, 4.9, 33.26; 10, 4.9, 33.24; 20, 4.8, 33.22.
20891 Cape Hatteras I, 35.04, 75.16; II/23, 2h:—D80: 0, 11.4, 34.18; 10, 10.3, 33.95; 30, 11.8, 34.33; 50, 11.5, 34.34; 75, 11.1, 34.20.
20892 Cape Hatteras II, 35.02, 75.13; II/23, 4h:—D236: 0, 19.6, 36.22; 10, 20.2, 36.27; 20, 19.9, 36.22; 40, 19.5, 36.20; 50, 19.6, 36.18; 75, 11.9, 35.95; 100, 16.9, 35.25; 135, 14.7, 35.08; 175, 15.6, 35.74; 225, 18.9, 35.75.
20893 Ocracoke IV, 34.45, 75.30; II/23, 8h:—D143: 0, 20.1, 36.26; 10, 20.3, 36.22; 30, 20.2, 36.20; 50, 20.0, 36.24; 100, 17.9, 36.09; 135, 17.6, 36.15
20894 Ocracoke III, 34.49, 75.37; II/23, 9h:—D51: 0, 19.4, 36.22; 10, 19.4, 36.20; 30, 19.4, 36.20; 45, 18.9, 36.17.
20895 Ocracoke II, 34.55, 75.44; II/23, 11h:—D31: 0, 18.5, 36.24; 10, 18.4, 36.27; 25, 18.0, 36.27.
20896 Ocracoke I, 35.03, 75.54; II/23, 13h:—D18: 0, 10.3, 34.04; 5, 10.3, 35.41; 15, 12.9, 33.93.
20897 Bodie Island I, 35.51, 75.17; II/23, 23h:—D29: 0, 6.4, 33.75; 10, 6.3, 33.71; 25, 6.3, 33.71.
20898 Bodie Island II, 35.51, 75.07; II/24, 2h:—D33: 0, 6.7, 33.82; 10, 6.7, 33.78; 30, 6.9, 33.91.
20899 Bodie Island III, 35.52, 75.02; II/24, 5h:—D48: 0, 8.2, 34.29; 10, 8.2, 34.31; 30, 8.1, 34.33; 45, 8.1, 34.31.
20900 Bodie Island IV, 35.53, 75.02; II/24, 7h:—D82: 0, 8.6, 33.58; 10, 8.6, 34.43; 20, 8.6, 34.47; 40, 8.6, 34.52; 60, 8.7, 34.54.
20901 Bodie Island V, 35.52, 74.51; II/24, 10h:—D183: 0, 9.6, 34.65; 10, 9.5, 34.65; 50, 9.6, 34.67; 100, 9.6, 34.65; 150, 9.5, 34.69.
20902 Bodie Island VI, 35.53, 74.49, II/24; 13h:—D183+: 0, 14.2, no sal.
20903 Bodie Island VI-North, 36.02, 74.52; II/24, 15h:—D70: 0, 8.4, 34.36; 30, 8.4, no sal.; 50, 7.7, no sal.
20904 Bodie Island VI-North, 36.09, 74.52; II/24, 20h:—D64: 0, 8.3, 34.27; 60, 8.5, no sal.
20905 Currituck I, 36.24, 75.37; II/25, 6h:—D24: 0, 5.6, 33.58; 10, 5.0, 33.55; 20, 5.6, 33.55.
20906 Currituck II, 36.18, 75.18; II/25, 10h:—D27: 0, 6.0, no sal.; 10, 5.6, 33.57; 20, 6.0, 33.58.
20907 Currituck III, 36.17, 75.03; II/25, 14h:—D40: 0, 6.0, 34.14; 10, 7.7, 34.14; 20, 7.9, 34.18; 35, 7.7, 34.20.
20908 Currituck IV, 36.16, 74.51; II/25, 18h:—D79: 0, 6.1, 34.16; 10, 8.1, 34.16; 25, 6.9, 34.20; 55, 8.0, 34.27.
20909 Currituck V, 36.16, 74.48; II/25, 21h:—D9: 0, 7.87, 34.09; 10, 7.8, 34.09; 50, 7.9, 34.09; 90, 7.4, 34.16.
20910 Currituck V-North, 36.31, 74.47; II/26, 3h:—D88: 0, 7.6, no sal.; 85, 7.5, 34.02.
20911 Currituck V-North, 36.45, 74.44; II/26, 8h:—D93: 0, 7.7, 34.05; 90, 8.8, no sal.
20912 Chesapeake IV, 36.59, 74.36; II/26, 12h:—D93: 0, 8.2, 34.04; 10, 8.2, 34.04; 30, 7.8, 33.98; 50, 7.6, 33.96; 75, 7.2, 33.87.
20913 Chesapeake III, 36.58, 74.40; II/26, 15h:—D79: 0, 7.9, no sal.; 60, 7.2, no sal.
20914 Chesapeake II, 36.59, 74.53; II/26, 17h:—D42: 0, 7.9, no sal.; 10, 5.7, 33.71; 20, 5.6, 33.71; 35, 5.6, 33.73.
20915 Winterquarter I, 37.51, 74.48; II/2, 6h:—D37: 0, 4.4, no sal.; 33, 5.2, no sal.
20916 Winterquarter II, 37.45, 74.36; III/2, 10h:—D57: 0, 7.0, no sal.; 55, 6.4, no sal.
20917 Winterquarter III, 37.37, 74.20; III/2, 14h:—D92: 0, 7.2, no sal.; 90, 8.2, no sal.
20918 Cape May IV, 38.13, 73.49; III/2, 21h:—D95: 0, 7.1, 33.64; 10, 6.8, 32.68; 30, 6.9, 32.65; 50, 6.8, 33.57; 85, 6.7, 33.62.
20919 Cape May III, 38.21, 74.08; III/3, 2h:—D55: 0, 7.0, 33.64; 10, 6.7, 33.60; 30, 6.7, 33.55; 50, 5.9, 33.58.
20920 Cape May I, 38.44, 74.45; III/4, 11h:—D24: 0, 3.1, 32.81; 10, 2.9, 32.81; 18, 2.9, 32.81.
20921 Cape May II, 38.36, 74.21; III/4, 14h:—D38: 0, 4.6, 33.48; 10, 4.5, 33.46; 30, 4.5, 33.48.
20922 Barnegat, 39.05, 72.49; III/5, 1h:—D121: 0, 7.7, no sal.; 115, 11.0, no sal.

Cruise of March 19 to 31, 1931, Stations 20926 to 20963, Albatross II Series

20926 South Channel II, 41.14, 69.24; III/19, 23h:—D46: 0, 3.8, 32.81; 20, 3.8, 32.83; 40, 3.8, 32.81.
20954 Nantucket Shoals II, 40.27, 69.40; III/27, 13h:—D70: 0, 4.4, 32.75; 60, 4.3, 32.74.
20955 Nantucket II, 40.49, 70.07; III/27, 17h:—0, 4.6, 32.90; 35, 4.2, 32.90.
20956 Martha's Vineyard I, 41.04, 70.49; III/27, 22h:—D37: 0, 3.8, 32.70; 35, 3.8, 32.66.
20957 Martha's Vineyard II, 40.44, 70.42; III/30, 13h:—D64: 0, 5.0, 32.88; 40, 4.8, 32.94; 60, 4.8, 32.88.
20958 Martha's Vineyard III, 40.22, 70.36; III/30, 17h:—D99: 0, 8.2, 33.95; 40, 9.8, 34.43; 90, 11.0, 34.88.
20959 Martha's Vineyard IV, 40.02, 70.30; III/30, 23h:—D183: 0, 10.4, 34.63; 40, 10.6, 34.74; 80, 12.8, 35.53; 120, 12.3, 35.74; 175, 11.8, no sal.
20960 Nantucket Shoals III, 39.56, 69.24; III/31, 8h:—D210: 0, 10.0, 34.61; 200, 11.8, 35.34.
20963 South Channel III, 40.48, 69.07; III/31, 21h:—D59: 0, 4.8, 32.88; 40, 4.7, 32.86; 55, 4.8, 32.90.

Cruise of April 17 to 21, 1931, Stations 20967 to 20975, Albatross II Series

20967 South Channel II, 41.14, 69.22; IV/17, 21h:—D53: 0, 4.8, 32.63; 15, 4.8, 32.61; 45, 4.7, 32.59.
20968 South Channel III, 40.49, 69.06; IV/18, 2h:—D73: 0, 5.8, 32.65; 40, 5.3, 32.65; 70, 5.2, 32.65.
20969 Nantucket Shoals II, 40.24, 69.40; IV/18, 7h:—D70: 0, 6.2, 32.68; 40, 5.3, 32.79; 65, 5.6, 32.97.
20970 Nantucket Shoals I, 40.53, 69.59; IV/18, 12h:—D16: 0, 6.1, 32.59; 12, 6.1, 32.54.
20971 Martha's Vineyard I, 41.05, 70.48; IV/20, 13h:—D37: 0, 7.8, 32.45; 20, 5.9, 32.61; 35, 5.1, 32.63.
20972 Martha's Vineyard II, 40.43, 70.41; IV/20, 17h:—D64: 0, 7.9, 32.75; 20, 6.4, 32.75; 40, 5.2, 32.75; 60, 6.7, 33.46.
20973 Martha's Vineyard III, 40.22, 70.34; IV/20, 20h:—D86: 0, 8.3, 32.79; 20, 5.7, 32.79; 40, 6.2, 33.19; 80, 12.3, 35.41.
20974 Martha's Vineyard IV, 40.01, 70.29; IV/21, 0h:—D229: 0, 12.0, 34.70, 20, 11.7, 34.85; 40, 12.5, 35.35; 60, 12.6, 35.48; 100, 12.7, 35.59; 120, 12.5, 35.59; 150, 12.7, 35.61; 200, 12.2, 35.57; 220, 12.6, 35.39.
20975 Nantucket Shoals III, 39.57, 69.24; IV/21, 8h:—D186: 0, 7.5, 32.99; 180, 11.6, 35.35.

Cruise of May 16 to 22, 1931, Stations 21004 to 21038, Albatross II Series

21004 Block Island, 41.05, 71.22; V/16, 10h:—D46: 0, 9.4, 32.40; 10, 9.3, 32.36; 20, 8.3, 32.60; 40, 7.0, 32.50.
21005 Montauk I, 40.57, 71.47; V/16, 14h:—D40: 0, 9.1, 31.14; 10, 8.9, 31.15; 20, 8.6, 32.12; 35, 8.4, 32.44.
21006 Shinnecock I, 40.37, 72.29; V/16, 20h:—D42: 0, 9.4, 31.99; 10, 9.3, 31.99; 20, 9.1, no sal.; 40, 6.0, no sal.
21007 Fire Island, 40.16, 72.49; V/17, 0h:—D53: 0, 9.2, 31.72; 7.5, 9.1, 31.72; 17.5, 8.8, 31.87; 47.5, 4.9, 32.73.
21008 Shinnecock II, 40.01, 72.16; V/17, 4h:—D79: 0, 9.0, 32.79; 10, 9.0, no sal.; 20, 7.7, 33.04; 40, 6.3, 32.87; 55, 7.0, 33.47; 70, 9.0, 34.11; 75, 9.1, 32.77.
21009 New York V, 39.25, 72.20; V/17, 10h:—D152: 0, 10.4, 33.24; 10, 10.2, 33.27; 20, 12.4, 34.77; 40, 12.5, 35.15; 80, 12.2, 35.32; 140, 11.1, 35.38.
21010 New York IV, 39.33, 72.38; V/17, 14h:—D88: 0, 9.6, 32.52; 10, 9.3, 32.56; 20, 9.0, 32.80; 40, 7.8, 33.27; 80, 9.9, 34.50.
21011 New York III, 39.48, 72.56; V/17, 17h:—D75: 0, 9.8, 31.95; 10, 12.2, 32.16; 20, 9.3, 32.20; 40, 7.6, 32.86; 65, 7.0, 33.25.
21012 New York II, 40.07, 73.22; V/17, 21h:—D40: 0, 10.0, 31.86; 10, 9.0, 32.01; 20, 6.8, 32.26; 35, 5.2, 32.37.
21013 New York I, 40.24, 73.47; V/18, 1h:—D26: 0, 11.5, 30.24; 10, 8.8, 31.70; 20, 8.5, 31.81.
21014 Seagirt, 40.11, 73.52; V/18, 3h:—D24: 0, 11.0, 29.80; 8, 10.3, 31.30; 18, 8.3, 31.75.
21015 Barnegat, 39.46, 73.54; V/18, 7h:—D24: 0, 10.6, 31.65; 5, 10.4, 31.67; 15, 8.8, 31.80.
21016 Atlantic City I, 39.24, 74.07; V/18, 10h:—D20: 0, 11.9, 30.33; 5, 11.8, 30.34; 15, 9.9, 31.82.
21017 Atlantic City II, 39.19, 73.55; V/18, 13h:—D27: 0, 11.3, 31.72; 10, 10.7, 31.86; 20, 8.5, 32.20.
21018 Atlantic City III, 39.12, 73.40; V/18, 15h:—D35: 0, 10.1, 32.65; 10, 9.5, 32.56; 20, 7.1, 32.64; 30, 7.0, 32.70.
21019 Atlantic City IV, 39.04, 73.27; V/18, 17h:—D55: 0, 10.3, 32.48; 10, 9.6, 32.53; 20, 7.3, 32.60; 45, 5.5, 32.82.
21020 Atlantic City V, 38.55, 73.08; V/18, 21h:—D82: 0, 11.0, 32.92; 10, 10.3, 33.04; 20, 8.6, 33.51; 40, 11.4, 34.75; 55, 11.1, 34.86; 75, 11.4, 35.12.
21021 Cape May III, 38.13, 73.53; V/19, 5h:—D75: 0, 11.6, 32.75; 10, 10.9, 32.73; 20, 8.1, 32.82; 40, 7.4, 33.40; 65, 8.3, 33.90.
21022 Cape May IIA, 38.21, 74.07; V/19, 8h:—D44: 0, 11.9, 32.71; 10, 11.2, 32.80; 20, 7.5, 32.72; 35, 7.6, 32.77.
21023 Cape May II, 38.30, 74.25; V/19, 12h:—D37: 0, 11.8, 32.53; 10, 10.4, 32.53; 20, 9.5, 32.59; 30, 9.4, 32.60.
21024 Cape May I, 38.41, 74.45; V/19, 15h:—D13: 0, 12.3, 32.26; 7, 12.1, 32.27.
21025 Fenwick, 38.19, 74.46; V/19, 18h:—D22: 0, 13.2, 31.94; 5, 13.0, 32.04; 15, 10.5, 32.26.
21026 Winterquarter I, 37.48, 75.04; V/20, 0h:—D29: 0, 13.3, 31.69; 9, 13.2, 31.72; 24, 9.7, 32.44.
21027 Winterquarter II, 37.43, 74.50; V/20, 2h:—D40: 0, 12.2, 32.66; 10, 12.1, 32.69; 20, 9.5, 32.70; 35, 8.1, 32.72.

21028 Fenwick II, 38.13, 74.30; V/20, 7h:—D37: 0, 11.8, 32.72; 10, 11.7, 32.76; 20, 7.9, 32.81; 30, 7.8, 32.84.
21029 Corson II, 38.53, 74.04; V/20, 13h:—D40: 0, 11.6, 32.62; 10, 11.5, 32.59; 20, 8.8, 32.70; 35, 7.5, 32.72.
21030 Corson I, 39.05, 74.22; V/20, 16h:—D22: 0, 12.1, 31.97; 5, 12.0, 31.97; 15, 10.8, 32.21.
21031 Barnegat II, 39.38, 73.29; V/20, 23h:—D35: 0, 11.2, 31.91; 10, 11.0, 31.92; 20, 9.3, 32.10; 30, 6.0, 32.54.
21032 Montauk II, 40.41, 71.44; V/21, 11h:—D59: 0, 10.8, 31.95; 10, 10.7, 31.95; 20, 9.0, 32.68; 50, 6.3, 32.74.
21033 Montauk III, 40.24, 71.39; V/21, 14h:—D75: 0, 10.7, 32.60; 10, 10.6, 32.63; 20, 9.1, 32.68; 40, 6.9, 32.83; 60, 6.3, 33.31.
21034 Montauk IV, 40.08, 71.34; V/21, 18h:—D86: 0, 10.6, 32.65; 10, 10.4, 32.66; 20, 7.7, 32.72; 40, 6.1, 33.08; 60, 6.1, 33.24; 75, 7.0, 33.56.
21035 Montauk V, 39.57, 71.30; V/21, 23h:—D174: 0, 11.5, 32.79; 10, 11.5, 32.92; 20, 8.6, 33.02; 50, 9.7, 34.47; 75, 11.6, 35.08; 100, 12.5, 35.55; 160, 12.1, 35.57.
21036 Martha's Vineyard IV, 40.02, 70.32; V/22, 5h:—D174: 0, 12.0, 33.11; 10, 12.9, 33.43; 20, 11.3, 33.72; 50, 11.5, no sal.; 75, 12.3, 35.33; 100, 12.3, 35.41; 160, 11.5, 35.86.
21037 Martha's Vineyard III, 40.23, 70.36; V/22, 9h:—D82: 0, 11.0, 32.34; 10, 8.8, 32.57; 20, 7.2, 32.62; 40, 6.5, 32.76; 70, 6.2, 33.03.
21038 Martha's Vineyard II, 40.44, 70.41; V/22, 12h:—D62: 0, 11.0, 32.60; 5, 10.9, 32.65; 15, 8.7, 32.62; 35, 6.3, 32.70; 55, 6.3, 32.74.

Cruise of May 26 to June 9, 1931, Stations 21039 to 21046, Albatross II Series

21039 Martha's Vineyard I, 41.05, 70.48; V/26, 9h:—D33: 0, 10.2, 32.43; 10, 10.1, 32.39; 20, 10.0, 32.39; 30, 8.2, 32.46.
21040 Nantucket Shoals I, 40.49, 70.02; V/26, 14h:—D26: 0, 10.0, 32.18; 10, 9.9, 32.15; 20, 9.9, 32.21.
21041 Nantucket Shoals II, 40.26, 69.38; V/26, 20h:—D64: 0, 10.6, 32.44; 60, 6.4, 32.62.
21042 Nantucket Shoals III, 39.57, 69.23; V/27, 2h:—D221: 0, 11.4, 32.73; 215, 8.2, 35.11.
21045 South Channel III, 40.45, 69.08; V/27, 15h:—D55: 0, 7.2, 32.37; 5, 7.0, 32.38; 20, 6.8, 32.41; 45, 6.7, 32.44.
21046 South Channel II, 41.15, 69.23; V/27, 21h:—D51: 0, 7.9, 31.91; 5, 7.6, 31.98; 20, 5.4, 32.04; 40, 4.4, 32.31.

Cruise of June 12 to 19, 1931, Stations 21076 to 21112, Albatross II Series

21076 Block Island I, 41.05, 71.23; VI/12, 9h:—D44: 0, 13.8, 32.14; 5, 13.3, 32.18; 15, 11.8, no sal.; 35, 9.1, 32.48.
21077 Montauk I, 40.57, 71.47; VI/12, 13h:—D44: 0, 13.8, 32.10; 10, 13.0, 32.12; 20, 11.9, 32.18; 35, 9.8, 32.46.
21078 Shinnecock I, 40.35, 72.29; VI/12, 18h:—D75: 0, 14.3, 32.21; 10, 13.3, 32.27; 20, 12.9, 32.29; 30, 9.6, 32.40.
21079 Shinnecock II, 40.15, 72.26; VI/12, 21h:—D53: 0, 14.4, 32.28; 10, 14.1, 32.24; 20, 8.7, 32.74; 45, 6.4, 32.84.
21080 New York V, 39.27, 72.21; VI/13, 5h:—D146: 0, 14.8, 32.91; 5, 14.6, 32.92; 20, 14.1, 32.95; 50, 12.2, 35.16; 75, 12.0, 35.27; 100, 12.0, 35.35; 120, 12.0, 35.12; 125, 12.0, 35.46.
21081 New York IV, 39.37, 72.37; VI/13, 9h:—D73: 0, 13.5, 32.47; 10, 13.0, 32.49; 20, 8.0, 32.65; 40, 6.0, 32.94; 60, 6.5, 33.35.
21082 New York III, 39.46, 72.57; VI/13, 12h:—D60: 0, 14.7, 32.40; 10, 13.8, 32.27; 20, 8.8, 32.83; 50, 6.4, 33.04.
21083 New York II, 40.01, 73.23; VI/13, 16h:—D75: 0, 16.0, 31.21; 10, 14.3, 31.87; 20, 9.8, 31.90; 40, 7.0, 32.67; 60, 6.7, 32.74.
21084 New York I, 40.22, 73.48; VI/13, 20h:—D35: 0, 15.6, 31.26; 10, 13.1, 31.53; 20, 9.3, 31.85; 30, 8.3, 31.89.
21085 Seagirt I, 40.06, 73.52; VI/13, 22h:—D20: 0, 16.4, 29.38; 5, 16.4, 29.52; 15, 9.4, 31.79.
21086 Barnegat I, 39.46, 73.50; VI/14, 1h:—D26: 0, 16.3, 31.62; 10, 15.3, 31.51; 20, 7.5, 32.18.
21087 Atlantic City I, 39.24, 74.06; VI/14, 5h:—D20: 0, 16.1, 30.99; 3, 15.4, 31.36; 13, 14.2, 31.40.
21088 Atlantic City II, 39.19, 73.52; VI/14, 7h:—D31: 0, 16.3, 31.64; 10, 15.2, 31.73; 25, 9.0, 32.22.
21089 Atlantic City III, 39.11, 73.40; VI/14, 10h:—D35: 0, 16.0, 31.33; 10, 15.5, 31.34; 20, 8.2, 32.48; 30, 7.0, 32.57.
21090 Atlantic City IV, 39.03, 73.29; VI/14, 12h:—D53: 0, 15.9, 32.13; 10, 15.2, 31.86; 20, 8.4, 32.41; 45, 5.9, 32.81.
21091 Atlantic City V, 38.53, 73.07; VI/14, 15h:—D80: 0, 15.8, 32.52; 10, 13.6, 32.79; 20, 12.4, 32.82; 50, 6.2, 33.17; 75, 7.1, 33.57.
21092 Cape May III, 38.21, 74.04; VI/14, 22h:—D60: 0, 16.4, 32.23; 10, 14.9, 32.25; 20, 11.4, 32.64; 50, 6.7, 33.08.
21093 Cape May II, 38.30, 74.24; VI/15, 0h:—D38: 0, 16.7, 31.78; 10, 15.2, 31.85; 20, 9.9, 32.44; 30, 7.7, 32.65.
21094 Cape May I, 38.40, 74.46; VI/15, 3h:—D18: 0, 16.8, 32.22; 5, 16.8, 32.16; 15, 14.4, 32.11.
21095 Fenwick I, 38.19, 74.45; VI/15, 6h:—D27: 0, 17.5, 31.85; 10, 15.8, 32.26; 20, 13.6, 32.33.
21096 Winterquarter I, 37.48, 75.04; VI/15, 11h:—D27: 0, 17.6, 32.11; 10, 15.8, 32.22; 20, 15.5, 32.21.
21097 Winterquarter II, 37.44, 74.50; VI/15, 13h:—D33: 0, 16.8, 32.31; 10, 14.5, 32.44; 25, 9.9, 32.72.
21098 Winterquarter III, 37.40, 74.32; VI/15, 16h:—D55: 0, 17.1, 32.38; 10, 15.9, 32.23; 20, 8.2, 32.84; 50, 7.4, 33.02.
21099 Hog Island II, 37.22, 74.57; VI/15, 20h:—D37: 0, 18.2, 32.36; 10, 13.7, 32.45; 20, 9.4, 32.76; 30, 9.2, 32.93.
21100 Chesapeake III, 36.46, 74.51; VI/16, 0h:—D38: 0, 17.6, 32.56; 10, 16.4, 32.46; 20, 11.4, 32.79; 30, 8.5, 32.91.

21101 Chesapeake II, 36.48, 75.13; VI/16, 3h:—D31: 0, 18.4, 32.48; 10, 17.8, 32.35; 20, 11.6, 32.65.
21102 Hog Island I, 37.28, 75.23; VI/16, 7h:—D27: 0, 18.0, 32.16; 10, 17.3, 32.29; 20, 14.6, 32.38.
21103 Fenwick II, 38.13, 74.29; VI/16, 15h:—D35: 0, 17.6, no sal.; 10, 17.5, 31.28; 20, 11.9, no sal.; 30, 8.0, 31.94.
21104 Corson Inlet II, 38.52, 74.02; VI/16, 21h:—D38: 0, 17.0, 31.86; 10, 16.7, 31.94; 20, 11.3, 32.40; 30, 7.0, 32.65.
21105 Barnegat II, 39.35, 73.30; VI/17, 4h:—D38: 0, 16.6, 31.12; 10, 15.4, 31.53; 20, 8.9, 32.51; 30, 5.9, 32.55.
21106 Fire Island I, 40.15, 72.51; VI/17, 10h:—D53: 0, 15.8, 31.54; 10, 15.1, 31.70; 20, 11.3, 32.23; 30, 7.1, 32.67; 40, 6.6, 32.64.
21107 Montauk II, 40.42, 71.42; VI/17, 18h:—D57: 0, 15.8, 32.25; 10, 14.8, 32.41; 20, 12.5, 32.43; 30, 7.7, 32.60; 40, 7.3, 32.65.
21108 Montauk III, 40.26, 71.36; VI/17, 21h:—D73: 0, 15.4, 32.30; 10, 14.4, 32.34; 20, 11.9, 32.44; 40, 6.3, 32.77; 60, 6.2, 32.88.
21109 Montauk IV, 40.08, 71.30; VI/18, 0h:—D86: 0, 13.6, 32.18; 10, 11.8, 32.48; 20, 8.9, 32.61; 50, 6.0, 32.81; 75, 6.9, 32.84.
21110 Martha's Vineyard III, 40.21, 70.35; VI/18, 5h:—D101: 0, 12.4, 32.45; 10, 11.7, 32.54; 20, 9.4, 32.51; 50, 6.3, 32.78; 75, 6.1, 32.84; 90, 6.2, 33.06.
21111 Martha's Vineyard II, 40.44, 70.41; VI/18, 9h:—D62: 0, 13.2, 32.23; 10, 11.9, 32.27; 20, 8.3, 32.48; 30, 6.8, 32.61; 50, 6.3, 32.73.
21112 Martha's Vineyard I, 41.05, 70.47; VI/18, 12h:—D44: 0, 13.7; 32.05; 10, 11.7, 32.12; 20, 8.9, 32.39; 35, 7.6, 32.51.

Cruise of July 10 to 16, 1931, Stations 21121 to 21148, Albatross II Series

21121 Block Island I, 41.05, 71.22; VII/10, 12h:—D48: 0, 18.1, 32.07; 10, 16.1, 32.08; 20, 11.6, 32.01; 40, 9.5, 32.25.
21122 Montauk I, 40.56, 71.46; VII/10, 15h:—D40: 0, 19.0, 31.63; 10, 18.8, 31.63; 20, 12.9, 31.97; 35, 10.2, 32.18.
21123 Shinnecock I, 40.38, 72.30; VII/10, 21h:—D37: 0, 20.1, 31.96; 10, 19.3, 31.94; 20, 12.1, 32.08; 30, 9.1, 32.43.
21124 Shinnecock II, 40.16, 76.26; VII/11, 1h:—D57: 0, 20.5, 31.88; 10, 20.4, 31.80; 20, 9.8, 32.28; 40, 7.2, 32.70; 50, 7.2, 32.77.
21125 New York V, 39.23, 72.20; VII/11, 8h:—D146: 0, 20.1, 33.48; 10, 19.2, 33.54; 20, 15.2, 34.10; 50, 11.2, 34.80; 75, 11.9, 35.20; 100, 12.0, 35.47; 125, 11.8, 35.52; 140, 11.2, 35.38.
21126 New York IV, 39.36, 72.37; VII/11, 12h:—D86: 0, 21.0, 33.03; 10, 18.2, 33.17; 20, 13.2, 33.32; 50, 6.4, 32.99; 75, 5.9, 33.04.
21127 New York III, 39.48, 73.00; VII/11, 15h:—D53: 0, 22.2, 31.54; 10, 19.9, 31.83; 20, 10.8, 32.74; 45, 6.5, 32.85.
21128 New York II, 40.04, 73.26; VII/11, 19h:—D51: 0, 22.2, 31.43; 10, 18.8, 31.77; 20, 11.2, 32.40; 45, 6.8, 32.73.
21129 New York I, 40.22, 73.48; VII/11, 22h:—D31: 0, 22.4, 31.20; 10, 20.4, 31.21; 20, 13.4, 31.77; 25, 13.1, 31.99.
21130 Seagirt I, 40.06, 73.52; VII/12, 1h:—D24: 0, 22.6, 39.66; 10, 20.5, 31.46; 20, 13.4, 31.77.
21131 Barnegat I, 39.45, 73.52; VII/12, 3h:—D24: 0, 22.6, 30.09; 10, 19.5, 30.82; 20, 11.7, 32.02.
21132 Barnegat II, 39.37, 73.31; VII/12, 6h:—D42: 0, 22.4, 31.39; 10, 19.8, 31.64; 20, 11.1, 32.56; 35, 7.7, 32.52.
21133 Barnegat III, 39.22, 73.00; VII/12, 10h:—D70: 0, 21.7, 32.19; 10, 21.0, 32.22; 20, 14.5, 32.52; 40, 11.9, 32.60; 60, 6.3, 32.92.
21134 Fire Island I, 40.15, 72.52; VII/12, 18h:—D48: 0, 21.8, 31.65; 10, 18.5, 31.83; 20, 12.3, 32.47; 30, 8.6, 32.46; 40, 7.9, 32.61.
21135 Montauk II, 40.43, 71.43; VII/13, 1h:—D62: 0, 20.2, 32.06; 10, 17.4, 32.21; 20, 9.8, 32.48; 40, 7.4, 32.50; 55, 7.0, 32.56.
21136 Montauk III, 40.24, 71.36; VII/13, 4h:—D79: 0, 19.6, 32.38; 10, 14.7, 32.36; 20, 9.6, 32.50; 40, 7.3, 32.61; 70, 6.5, 32.77.
21137 Montauk IV, 40.07, 71.29; VII/13, 7h:—D88: 0, 18.3, 32.30; 10, 16.2, 32.32; 20, 9.7, 32.45; 50, 6.8, 32.61; 75, 9.2, 34.16.
21138 Martha's Vineyard VII, 39.23, 70.18; VII/13, 14h:—D1000+: 0, 23.2, 34.47; 4, 22.4, 34.25; 10, 22.0, 35.56; 20, 21.3, 35.68; 50, 13.8, 35.46; 75, 13.4, 35.53; 100, 12.2, 35.35; 150, 12.1, 35.49; 200, 11.1, 35.34.
21139 Martha's Vineyard VI, 39.33, 70.21; VII/13, 16h:—D1000+: 0, 22.8, 34.41; 4, 23.1, 34.34; 10, 22.1, 34.43; 20, 22.0, 35.42; 50, 14.8, 35.46; 75, 13.1, 35.42; 100, 12.4, 35.42; 150, 12.0, 35.50; 200, 11.0, 35.38.
21140 Martha's Vineyard V, 39.43, 70.24; VII/13, 18h:—D1000+: 0, 22.8, 34.34; 4, 22.9, 34.35; 10, 22.0, 34.45; 20, 21.3, 35.58; 50, 14.4, 35.52; 75, 12.8, 35.31; 100, 12.6, 35.44; 150, 12.2, 35.54; 200, 11.1, 35.39.
21141 Martha's Vineyard IV, 40.05, 70.30; VII/13, 20h:—D201: 0, 18.9, 32.98; 10, 16.4, 33.36; 20, 13.5, 33.51; 50, 6.5, 33.09; 75, 10.3, 34.48; 100, 11.9, 35.24; 150, 11.7, 35.45; 180, 10.9, 35.39.
21142 Martha's Vineyard III, 40.24, 70.36; VII/14, 0h:—D88: 0, 18.5, 32.33; 10, 13.5, 32.10; 20, 11.8, 32.35; 50, 6.7, 32.74; 80, 8.6, 33.85.
21143 Martha's Vineyard II, 40.44, 70.41; VII/14, 3h:—D60: 0, 19.0, 32.20; 10, 14.8, 32.11; 20, 11.0, 32.38; 30, 8.9, 32.43; 50, 8.2, 32.53.
21144 Martha's Vineyard I, 41.05, 70.47; VII/14, 7h:—D35: 0, 17.5, 31.73; 10, 17.5, 31.71; 20, 13.1, 31.70; 30, 11.2, 31.94.

21145 Nantucket Shoals I, 40.55, 69.57; VII/15, 14h:—D22: 0, 14.8, 31.58; 10, 14.7, 31.44; 15, 14.7, 31.44.

21146 Nantucket Shoals II, 40.26, 69.37; VII/15, 18h:—D64: 0, 17.8, 32.53; 10, 13.6, 32.43; 20, 10.4, 32.39; 40, 8.4, 32.60; 55, 8.4, 33.13.

21147 South Channel III, 40.48, 69.04; VII/15, 23h:—D88: 0, 16.0, 32.38; 10, 12.8, 32.39; 20, 12.5, 32.40; 50, 10.1, 32.40; 75, 9.7, 32.45.

21148 South Channel II, 41.14, 69.22; VII/16, 4h:—D51: 0, 16.6, 31.65; 10, 8.2, 31.90; 20, 7.4, 31.92; 30, 6.2, 32.13; 45, 7.4, 31.97.

Cruise of August 9 to 11, 1931, Stations 21181 to 21195, Albatross II Series

21181 South Channel, 41.15, 69.05; VIII/9, 6h:—D156: 0, 19.0, 31.42; 10, 14.4, 31.80; 20, 7.5, 31.99; 30, 6.5, 32.10; 50 4.6, 32.38; 75, 4.4, 32.47; 100, 4.2, 32.65; 150, 4.3, 32.95.

21182 South Channel, 41.11, 69.09; VIII/9, 8h:—D95: 0, 13.9, 31.98; 10, 12.2, 32.00; 20, 10.7, 32.21; 30, 9.1, 32.22; 50, 6.5, 32.32; 90, 4.6, 32.65.

21183 South Channel, 41.07, 69.15; VIII/9, 9h:—D51: 0, 13.4, 31.92; 10, 11.6, 32.12; 20, 11.0, 32.32; 30, 9.8, 32.36; 45, 9.8, 32.41.

21184 Nantucket Shoals, 41.02, 69.18; VIII/9, 10h:—D55: 0, 12.2, 31.94; 10, 11.8, 32.01; 20, 11.3, 32.12; 30, 11.2, 32.27; 45, 10.4, 32.39.

21185 Nantucket Shoals, 40.58, 69.15; VIII/9, 11h:—D64: 0, 12.7, 32.00; 10, 12.1, 32.03; 20, 11.9, no sal.; 30, 11.7, 32.11; 45, 11.2, 32.45; 60, 10.9, 32.45.

21186 Nantucket Shoals, 40.53, 69.13; VIII/9, 12h:—D70: 0, 15.3, 32.42; 10, 13.3, 32.38; 20, 12.0, 32.48; 30, 11.7, 32.61; 45, 11.6, 32.42; 60, 11.2, 32.44.

21187 Nantucket Shoals, 40.53, 69.19; VIII/9, 13h:—D40: 0, 13.0, 31.99; 10, 12.0, 32.03; 20, 11.7, no sal.; 35, 11.5, 32.13.

21188 Nantucket Shoals, 40.50, 69.30; VIII/9, 14h:—D37: 0, 12.9, 32.20; 10, 12.4, 32.20; 20, 12.1, 32.24; 30, 12.0, 32.25.

21189 Nantucket Shoals, 40.52, 69.42; VIII/9, 16h:—D33: 0, 15.0, 31.80; 6, 14.7, 31.80; 16, 14.2, 31.83; 26, 14.2, 31.89.

21190 South Channel, 41.10, 69.23; VIII/11, 11h:—D49: 0, 11.6, 32.00; 10, 11.4, 32.00; 20, 10.9, 32.16; 40, 10.5, 32.29.

21191 Nantucket Shoals, 40.57, 69.32; VIII/11, 13h:—D29: 0, 11.8, 31.89; 10, 11.7, 31.92; 20, 11.8, 31.96; 25, 11.8, 31.91.

21192 Nantucket Shoals, 40.56, 69.25; VIII/11, 13h:—D19: 0, 12.5, 31.85; 5, 12.4, 31.85; 15, 12.3, 31.85.

21193 Nantucket Shoals, 40.59, 69.22; VIII/11, 14h:—D13: 0, 11.2, 31.92; 10, 11.0, 31.92.

21194 Nantucket Shoals, 40.59, 69.18; VIII/11, 15h:—D40: 0, 11.2, 31.82; 10, 11.0, 31.92; 20, 10.5, 32.10; 35, 10.2; 32.11.

21195 South Channel, 41.00, 69.01, VIII/11, 17h:—D80: 0, 12.6, 32.05; 10, 12.3, 32.05; 20, 10.8, 32.16; 40, 6.4, 32.32, 70, 5.1, 32.47.

Cruise of August 27, 1931, Stations 21196 to 21199, Albatross II Series

21196 Chatham, 41.32, 69.45; VIII/27, 6h:—D24: 0, 17.3, no sal.; 10, 11.9, 31.64; 20, 10.5, 31.76.

21197 South Channel I, 41.26, 69.33; VIII/27, 8h:—D37: 0, 10.6, 31.87; 10, 9.9, 31.89; 20, 9.1, 31.96; 35, 8.9, 31.92.

21198 South Channel II, 41.20, 69.20; VIII/27, 11h:—D86: 0, 17.5, 31.64; 10, 16.1, 31.67; 20, 10.0, 31.89; 50, 6.0, 32.23; 80, 5.7, 32.38.

21199 South Channel III, 41.05, 69.04; VIII/27, 14h:—D157: 0, 18.1, 31.80; 10, 16.1, 31.86; 20, 15.0, 31.92, 50, 7.8, 32.38; 100, 4.3, 32.94; 150, 4.5, 33.08.

Cruise of February 10 to March 1, 1932, Stations 21234 to 21275, Albatross II Series

21234 New York I, 40.22, 73.48; II/10, 9h:—D38: 0, 6.8; 10, 6.7; 20, 6.7; 35, 7.9.

21235 New York II, 40.05, 73.23; II/10, 13h:—D42: 0, 7.9; 10, 7.8; 20, 7.8; 35, 7.7.

21236 New York III, 39.49, 72.58; II/10, 17h:—D71: 0, 8.9; 10, 8.7; 20, 8.8; 40, 8.8; 65, 10.0.

21237 New York IV, 39.36, 72.36; II/10, 20h:—D84: 0, 8.6; 10, 8.3; 20, 8.4; 50, 8.4; 75, 9.5.

21238 New York V, 39.25, 72.20; II/10, 23h:—D141: 0, 9.6; 10, 9.3; 20, 9.6; 50, 10.2; 75, 12.6; 100, 14.2; 135, 13.3.

21239 New York VI, 39.16, 72.05; II/11, 3h:—D915: 0, 9.5; 10, 9.2; 20, 9.4; 60, 13.2; 100, 13.9; 140, 14.4; 180, 13.1; 220, 11.5; 260, 11.4; 300, 10.2.

21240 Cape May V, 38.06, 73.30; II/11, 16h:—D1000±: 0, 13.3; 10, 13.1; 20, 13.0; 60, 13.0; 100, 13.2; 140, 13.3; 180, 11.3; 220, 10.5; 260, 9.4; 300, 8.1.

21241 Cape May IV, 38.15, 73.51; II/11, 21h:—D72: 0, 10.2; 10, 10.0; 20, 10.1; 50, 10.9; 70, 11.5.

21242 Cape May III, 38.23, 74.08; II/12, 0h:—D59: 0, 9.4; 10, 9.3; 20, 9.2; 40, 9.7; 55, 9.2.

21243 Cape May II, 38.30, 74.26; II/12, 3h:—D43: 0, 9.7; 10, 9.4; 20, 9.4; 30, 9.4; 40, 9.6.

21244 Cape May I, 38.39, 74.43; II/12, 6h:—D27: 0, 7.7; 10, 7.5; 25, 8.0.
21245 Chesapeake IV, 36.43, 74.34; II/12, 23h:—D1000+: 0, 12.0; 10, 11.8; 20, 12.0; 60, 13.2; 100, 13.2; 140, 12.2; 180, 11.3; 220, 11.9.
21246 Chesapeake III, 36.46, 74.55; II/13, 3h:—D33: 0, 11.7; 8, 11.5; 18, 11.4; 28, 11.3.
21247 Chesapeake II, 36.46, 75.18; II/13, 6h:—D22: 0, 10.8; 10, 10.6; 20, 10.4.
21248 Chesapeake I, 36.53, 75.38; II/13, 9h:—D20: 0, 10.3; 10, 9.6; 20, 9.8.
21249 Chesapeake I, 36.53, 75.38; II/25, 15h:—D20: 0, 9.1; 10, 8.9; 15, 9.0.
21250 Chesapeake II, 36.46, 75.16; II/25, 18h:—D24: 0, 10.1; 10, 9.8; 20, 9.7.
21251 Chesapeake III, 36.48, 74.54; II/25, 20h:—D33: 0, 10.7; 10, 10.6; 20, 10.5; 30, 10.5.
21252 Currituck III, 36.14, 74.50; II/26, 0h:—D59: 0, 11.6; 10, 11.3; 20, 11.3; 40, 11.2; 55, 11.3.
21253 Currituck II, 36.16, 75.10; II/26, 2h:—D33: 0, 11.0; 10, 10.7; 20, 10.7; 30, 10.7.
21254 Currituck I, 36.18, 75.30; II/26, 5h:—D29: 0, 9.8; 10, 9.9; 25, 10.0.
21255 Bodie Island I, 35.47, 75.17; II/26, 9h:—D31: 0, 10.7; 10, 10.5; 20, 10.8; 30, 10.6.
21256 Bodie Island II, 35.44, 75.03; II/26, 12h:—D46: 0, 12.7; 10, 12.4; 20, 12.2; 30, 12.2; 40, 12.3.
21257 Bodie Island III, 35.43, 74.52; II/26, 13h:—D101: 0, 20.4; 10, 16.2; 20, 13.8; 40, 13.4; 60, 13.0; 90, 12.8.
21258 Bodie Island III-North, 36.06, 74.44; II/26, 18h:—D146: 0, 12.2; 25, 11.6; 50, 12.0; 100, 12.9; 140, 12.7.
21259 Chesapeake III-North, 36.53, 74.45; II/27, 6h:—D82: 0, 11.4; 20, 10.7; 40, 10.7; 60, 11.4; 75, 12.3.
21260 Hog Island II, 37.23, 74.46; II/27, 12h:—D51: 0, 10.0; 10, 10.0; 20, 10.1; 30, 10.2; 45, 10.3.
21261 Winterquarter V, 37.30, 74.30; II/27, 16h:—D73: 0, 10.6; 10, 10.4; 20, 10.3; 40, 10.2; 60, 10.3.
21262 Winterquarter IV, 37.36, 74.40; II/27, 19h:—D51: 0, 9.9; 48, 9.8.
21263 Winterquarter III, 37.39, 74.47; II/27, 20h:—D40: 0, 8.9; 10, 9.2; 20, 9.2; 35, 9.5.
21264 Winterquarter II, 37.43, 74.56; II/27, 22h:—D29: 0, 8.7; 24, 8.4.
21265 Winterquarter I, 37.47, 75.04; II/27, 23h:—D26: 0, 8.4; 10, 8.3; 20, 8.2.
21266 Cape May III-South, 38.13, 74.21; II/28, 7h:—D49: 0, 8.9; 10, 8.7; 20, 8.8; 30, 9.1; 45, 8.8.
21267 New York I, 40.22, 73.48; II/29, 4h:—D38: 0, 5.9; 10, 5.7; 20, 5.7; 35, 7.4.
21268 New York II, 40.05, 73.23; II/29, 7h:—D44: 0, 6.6; 10, 6.5; 20, 6.5; 40, 7.6.
21269 New York III, 39.50, 72.57; II/29, 10h:—D73: 0, 7.8; 10, 7.6; 20, 7.6; 40, 7.7; 65, 7.8.
21270 New York IV, 39.37, 72.35; II/29, 14h:—D86: 0, 7.4; 10, 7.3; 20, 7.4; 50, 7.4; 75, 7.8.
21271 New York V, 39.27, 72.20; II/29, 16h:—D150: 0, 6.7; 10, 6.6; 20, 6.5; 50, 7.0; 75, 10.0; 100, 13.4; 140, 13.2.
21272 Martha's Vineyard IV, 40.02, 70.45; III/1, 2h:—D196: 0, 8.1; 10, 11.6; 20, 10.3; 50, 8.4; 75, 8.5; 100, no temp.; 125, 8.2; 150, 12.5; 190, 12.6.
21273 Martha's Vineyard III, 40.21, 70.45; III/1, 7h:—D92: 0, 5.7; 10, 5.8; 20, 5.7; 50, 5.6; 85, 8.5.
21274 Martha's Vineyard II, 40.41, 70.49; III/1, 11h:—D64: 0, 5.8; 10, 5.7; 20, 5.8; 40, 5.8; 60, 5.9.
21275 Martha's Vineyard I, 41.02, 70.54; III/1, 15h:—D42: 0, 5.6; 10, 5.5; 20, 5.5; 35, 5.5.

Cruise of April 5 to 16, 1932, Stations 21276 to 21326, Albatross II Series

21276 Martha's Vineyard I, 41.05, 70.48; IV/5, 15h:—D36: 0, 4.3, 32.27; 18, 4.1, 32.30; 33, 4.1, 32.30.
21277 Martha's Vineyard II, 40.41, 70.41; IV/5, 18h:—D66: 0, 5.7, 32.87; 15, 5.5, 32.91; 60, 5.6, 33.02.
21278 Nantucket II, 40.46, 70.06; IV/5, 22h:—D42: 0, 5.2, 32.69; 20, 5.3, 32.73; 38, 5.1, 32.75.
21279 Nantucket Shoals II, 40.31, 69.46; IV/6, 1h:—D70: 0, 4.2, 32.63; 18, 4.2, 32.57; 65, 3.7, 32.81.
21280 Nantucket Shoals III, 40.08, 69.34; IV/6, 6h:—D97: 0, 4.7, 32.98; 20, 4.8, 33.02; 90, 6.4, 33.04.
21281 Nantucket Shoals IV, 39.57, 69.25; IV/6, 10h:—D166: 0, 4.9, 32.88; 20, 4.7, 32.86; 155, 5.5, 32.90.
21285 South Channel III, 40.44, 69.08; IV/7, 5h:—D62: 0, 4.1, 32.98; 20, 4.2, 33.00; 55, 4.2, 33.02.
21320 South Channel II, 41.16, 69.18; IV/16, 20h:—D68: 0, 4.2, 32.89; 20, 4.2, 33.03; 50, 4.2, 32.91; 65, 4.3, 33.00.

Cruise of May 2 to 6, 1932, Stations 21327 to 21352, Albatross II Series

21327 Martha's Vineyard I, 41.02, 70.49; V/2, 19h:—D42: 0, 7.5, 32.36; 10, 6.9, 32.50; 20, 6.4, 32.45; 35, 5.6, 32.47.
21328 Martha's Vineyard II, 40.43, 70.46; V/2, 22h:—D66: 0, 7.6, 32.40; 10, 7.5, 32.45; 20, 7.0, 32.48; 40, 6.3, 32.65; 60, 4.9, 32.83.
21329 Martha's Vineyard III, 40.21, 70.41; V/3, 1h:—D101: 0, 6.9, 32.77; 20, 6.7, 32.81; 50, 5.8, 32.81; 90, 8.9, 34.20.
21330 Martha's Vineyard IV, 40.03, 70.41; V/3, 5h:—D165: 0, 6.8, no sal.; 20, 6.8, 32.68; 50, 5.5, 32.93; 100, 10.6, 34.65; 160, 10.9, 35.21.
21331 New York VI, 39.21, 72.12; V/3, 15h:—D332: 0, 9.1, 33.54; 47c, 10.0, 34.38; 94c, 12.0, 35.23; 188c, 11.7, 35.30; 301c, 9.8, 34.99.

21332 New York V, 39.27, 72.20; V/3, 17h:—D141: 0, 9.0, 33.39; 20, 9.3, 33.60; 50, 9.8, 34.48; 130, 10.8, 34.96.
21333 New York IV, 39.35, 72.36; V/3, 19h:—D82: 0, 7.8, 33.03; 20, 7.7, 33.05; 50, 9.5, 34.29; 75, 10.0, 34.67.
21334 New York III, 39.50, 72.58; V/3, 23h:—D71: 0, 8.4, 33.04; 20, 7.9, 33.07; 40, 10.0, 33.18; 60, 8.2, 34.04.
21335 New York II, 40.01, 73.24; V/4, 2h:—D80: 0, 8.9, 32.30; 20, 7.9, 32.91; 40, 6.8, 33.20; 70, 7.7, 33.86.
21236 Barnegat I, 39.44, 73.49; V/4, 5h:—D24: 0, 9.2, 31.80; 10, 9.2, 31.82; 20, 7.3, 32.23.
21337 Atlantic City I, 39.21, 74.09; V/4, 9h:—D22: 0, 10.0, 31.60; 10, 9.7, 31.62; 20, 7.4, 32.28.
21338 Atlantic City II, 39.11, 73.48; V/4, 12h:—D38: 0, 9.6, 31.92; 10, 9.2, 31.93; 20, 8.4, 32.21; 35, 7.2, 33.03.
21339 Atlantic City III, 39.02, 73.25; V/4, 14h:—D60: 0, 10.4, 33.08; 20, 9.4, 33.31; 55, 7.4, 33.56.
21340 Atlantic City IV, 38.52, 73.07; V/4, 17h:—D86: 0, 9.6, 33.33; 20, 9.0, 33.35; 50, 8.2, 33.87; 80, 9.0, 34.27.
21341 Cape May VI, 38.09, 73.38; V/4, 23h:—D500+: 0, 11.4, 33.80; 19c, 11.1, 34.05; 48c, 11.1, 34.78; 95c, 12.2, 35.21; 185c, 12.0, 35.37; 278c, 9.4, 35.16; 371c, 7.1, 34.92; 464c, 5.6, 43.87.
21342 Cape May V, 38.14, 73.50; V/5, 1h:—D106: 0, 10.6, 33.19; 20, 9.8, 34.17; 50, 10.0, 34.49; 90, 11.3, 35.08.
21343 Cape May IV, 38.22, 74.08; V/5, 3h:—D68: 0, 9.9, 32.67; 15, 9.6, 32.74; 35, 8.5, 33.82; 55, 8.7, 34.03.
21344 Cape May III, 38.30, 74.27; V/5, 6h:—D42: 0, 10.3, 32.92; 10, 10.0, 33.00; 35, 8.3, 33.70.
21345 Cape May II, 38.39, 74.44; V/5, 8h:—D22: 0, 10.8, 31.88; 7, 10.7, 31.93; 17, 8.9, 32.75.
21346 Fenwick I, 38.10, 74.48; V/5, 11h:—D29: 0, 11.7, 31.25; 7, 11.7, 31.27; 22, 9.5, 32.38.
21347 Winterquarter I, 37.46, 75.04; V/5, 15h:—D29: 0, 12.4, 31.92; 10, 11.8, 31.94; 20, 9.8, 32.65.
21348 Winterquarter II, 37.40, 74.47; V/5, 17h:—D44: 0, 12.2, 32.38; 10, 11.7, 32.36; 35, 9.0, 33.96.
21349 Winterquarter III, 37.31, 74.30; V/5, 19h:—D68: 0, 12.1, 33.58; 20, 10.2, 34.01; 40, 9.3, 34.08; 60, 10.6, 34.71.
21350 Chesapeake III, 36.44, 74.44; V/6, 1h:—D95: 0, 12.2, 33.93; 20, 10.8, 34.10; 50, 12.4, 35.06; 80, 11.6, 35.21.
21351 Chesapeake II, 36.49, 75.14; V/6, 4h:—D26: 0, 12.4, 33.23; 10, 12.2, 33.25; 20, 10.3, 33.75.
21352 Chesapeake I, 36.53, 75.41; V/6, 7h:—D22: 0, 13.7, 29.65; 8, 13.2, 30.43; 18, 10.6, 32.49.

Cruise of May 9 to 16, 1932, Stations 21353 to 21381, Albatross II Series

21353 Chesapeake I, 36.53, 75.41; V/9, 15h:—D20: 0, 13.0, 32.24; 10, 12.9, 32.25.
21354 Chesapeake II, 36.47, 75.15; V/9, 18h:—D29: 0, 12.8, 32.73; 10, 12.7, 32.74; 20, no temp.; 32.74.
21355 Chesapeake III, 36.46, 74.44; V/9, 23h:—D95: 0, 13.6, 34.26; 20, 13.0, 34.41; 50, 11.0, 34.83; 80, 10.7, 34.74.
21356 Winterquarter III, 37.31, 74.26; V/10, 5h:—D97: 0, 11.7, 33.64; 20, 11.6, 33.72; 50, 9.7, 34.27; 80, 10.8, 34.78.
21357 Winterquarter II, 37.40, 74.48; V/10, 8h:—D42: 0, 11.7, 33.38; 10, 11.7, 33.38; 30, 8.9, 33.56.
21358 Winterquarter I, 37.47, 75.04; V/10, 10h:—D27: 0, 10.6, 31.98; 10, 10.6, 31.98; 20, 10.8, 32.03.
21359 Cape May I, 38.44, 74.54; V/13, 9h:—D20: 0, 11.0, 31.50; 15, 11.0, 31.51.
21360 Cape May II, 38.40, 74.44; V/13, 11h:—D19: 0, 10.4, 31.86; 13, 10.3, 31.74.
21361 Cape May III, 38.31, 74.21; V/13, 13h:—D38: 0, 9.7, 32.63; 15, 9.7, 32.66; 30, 9.7, 32.77.
21362 Cape May IV, 38.23, 74.10; V/13, 16h:—D55: 0, 9.8, 33.44; 20, 9.5, 33.58; 40, 7.8, 33.48.
21363 Cape May V, 38.14, 73.51; V/13, 19h:—D90: 0, 11.2, 34.00; 20, 11.1, 34.04; 50, 7.8, 33.78; 80, 8.1, 34.00.
21364 Atlantic City IV, 38.52, 73.10; V/14, 2h:—D79: 0, 10.4, 33.70; 20, 11.7, 33.75; 40, 9.8, 33.78; 60, 7.9, 33.78.
21365 Atlantic City III, 39.00, 73.29; V/14, 4h:—D53: 0, 8.5, 33.07; 20, 8.4, 33.08; 40, 7.0, 33.25.
21366 Atlantic City II, 39.11, 73.50; V/14, 6h:—D33: 0, 9.0, 33.05; 10, 9.1, 33.08; 25, 8.9, 33.04.
21367 Atlantic City I, 39.21, 74.09; V/14, 9h:—D20: 0, 9.1, 32.46; 15, 9.1, 32.55.
21368 Barnegat I, 39.44, 73.49; V/14, 12h:—D24: 0, 10.4, 32.05; 15, 9.0, 32.14.
21369 New York I, 40.18, 73.44; V/14, 16h:—D29: 0, 10.0, 32.23; 20, 8.8, 32.31.
21370 New York II, 40.06, 73.23, V/14, 19h:—D38: 0, 9.5, 32.71; 10, 8.6, 32.74; 30, 6.8, 32.80.
21371 New York III, 39.50, 72.58; V/14, 22h:—D68: 0, 8.5, 32.79; 20, 7.8, 32.83; 40, 5.7, 32.90; 60, 7.0, 33.56.
21372 New York IV, 39.36, 72.37; V/15, 1h:—D80: 0, 8.2, 32.92; 20, 7.7, 32.98; 40, 7.7, 33.32; 70, 7.0, 33.59.
21373 Shinnecock II, 40.16, 72.23; V/15, 6h:—D55: 0, 8.5, 32.39; 15, 7.7, 32.62; 45, 5.3, 32.86.
21374 Shinnecock I, 40.41, 72.28; V/15, 9h:—D38: 0, 9.8, 31.22; 15, 8.5, 32.04; 30, 6.8, 32.39.
21375 Montauk I, 40.57, 71.50; V/15, 14h:—D33: 0, 9.0, 30.99; 10, 8.6, 31.20; 25, 8.5, 32.07.
21376 Montauk II, 40.34, 71.42; V/15, 17h:—D73: 0, 9.3, 32.65; 20, 8.1, 32.67; 40, 5.1, 32.75; 60, 5.3, 32.89.
21377 Montauk III, 40.14, 71.37; V/15, 20h:—D82: 0, 8.5, 32.72; 20, 7.8, 32.77; 40, 5.3, 32.90; 70, 5.5, 33.22.
21378 Montauk IV, 40.02, 71.33; V/15, 21h:—D92: 0, 8.3, 32.75; 20, 7.2, 32.79; 50, 4.8, 32.74; 80, 5.9, 33.39.
21379 Martha's Vineyard III, 40.22, 70.43; V/16, 2h:—D92: 0, 8.0, 32.66; 20, 6.8, 32.57; 50, 4.9, 32.82; 80, 5.2, 33.12.
21380 Martha's Vineyard II, 40.43, 70.46; V/16, 5h:—D64: 0, 7.9, 32.65; 20, 7.0, 32.69; 50, 4.8, 32.68.
21381 Martha's Vineyard I, 41.03, 70.49; V/16, 7h:—D42: 0, 9.1, 32.40; 15, 8.7, 32.49; 35, 6.2, 32.53.

Cruise of May 19 to 23, 1932, Stations 21382 to 21409, Albatross II Series

21382 Martha's Vineyard I, 41.02, 70.50; V/19, 16h:—D48: 0, 12.4, 32.29; 20, 7.9, 32.48; 40, 7.4, 32.21.
21383 Martha's Vineyard II, 40.41, 70.45; V/19, 18h:—D62: 0, 11.5, 32.56; 20, 6.9, 32.65; 50, 4.9, 32.63.
21384 Martha's Vineyard III, 40.22, 70.42; V/19, 21h:—D88: 0, 10.1, 32.66; 10, 8.8, 32.59; 20, 7.6, 32.83; 40, 5.6, 32.70; 70, 5.0, 32.97.
21385 Montauk III, 40.14, 71.36; V/20, 3h:—D82: 0, 9.1, 32.79; 10, 8.2, 32.56; 20, 7.0, 32.92; 40, 5.9, 32.75; 70, 5.1, 32.30.
21386 Montauk II, 40.35, 71.42; V/20, 6h:—D71: 0, 10.3, 32.21; 10, 10.5, 32.20; 20, 8.0, 32.43; 40, 5.6, 32.72; 60, 5.9, 33.15.
21387 Montauk I, 40.57, 71.50; V/20, 8h:—D42: 0, 10.8, 31.58; 10, 8.3, 32.30; 20, 8.1, 32.45; 35, 6.2, 32.70.
21388 Shinnecock I, 40.38, 72.29; V/20, 13h:—D42: 0, 11.7, 31.31; 10, 10.5, 31.27; 20, 8.7, 32.00; 35, 6.3, 32.48.
21389 Shinnecock II, 40.14, 72.21; V/20, 16h:—D58: 0, 11.5, 32.66; 10, 10.1, 32.68; 20, 8.5, 32.61; 50, 6.1, 33.10.
21390 New York IV, 39.36, 72.36; V/20, 21h:—D79: 0, 11.4, 32.88; 10, 9.8, 33.12; 20, 8.5, 33.03; 40, 5.8, 33.37; 70, 7.7, 33.87.
21391 New York III, 39.49, 72.58; V/21, 0h:—D64: 0, 10.9, 32.90; 10, 9.8, 32.88; 20, 8.2, 32.88; 50, 6.6, 33.49.
21392 New York II, 40.05, 73.23; V/21, 3h:—D40: 0, 11.1, 32.48; 10, 10.6, 32.77; 20, 9.4, 32.63; 35, 6.7, 32.79.
21393 New York I, 40.22, 73.47; V/21, 7h:—D44: 0, 12.0, 30.43; 10, 9.8, 32.09; 20, 8.6, 32.41; 35, 7.0, 32.99.
21394 Barnegat I, 39.44, 73.48; V/21, 12h:—D24: 0, 13.0, 31.82; 10, 11.2, 32.41; 20, 9.2, 32.57.
21395 Atlantic City I, 39.20, 74.09; V/21, 15h:—D22: 0, 13.4, 31.35; 15, 9.4, 32.52.
21396 Atlantic City II, 39.11, 73.47; V/21, 18h:—D42: 0, 12.8, 32.23; 10, 12.0, 32.34; 20, 10.4, 32.84; 35, 8.9, 33.10.
21397 Atlantic City III, 39.00, 73.26; V/21, 21h:—D58: 0, 11.4, 32.84; 10, 11.3, 32.92; 20, 9.1, 32.92; 50, 6.9, 33.21.
21398 Atlantic City IV, 38.51, 73.07; V/21, 23h:—D84: 0, 11.2, 32.88; 10, 10.9, 33.24; 20, 9.3, 33.37; 40, 7.5, 33.64; 70, 8.1, 33.89.
21399 Cape May V, 38.14, 73.53; V/22, 6h:—D88: 0, 12.5, 33.31; 10, 12.2, 33.46; 20, 10.7, 33.98; 40, 8.5, 33.86; 75, 10.1, 34.76.
21400 Cape May IV, 38.23, 74.08; V/22, 8h:—D60: 0, 11.8, 33.31; 10, 11.7, 33.33; 20, 11.0, 33.51; 50, 7.6, 33.60.
21401 Cape May III, 38.32, 74.26; V/22, 10h:—D44: 0, 11.7, 32.45; 10, 11.5, 32.48; 20, 10.0, 33.28; 35, 9.5, 33.28.
21402 Cape May II, 38.39, 74.44; V/22, 12h:—D18: 0, 13.4, 31.40; 10, 13.2, 31.36.
21403 Fenwick, I, 38.10, 74.50; V/22, 15h:—D26: 0, 13.1, 32.05; 10, 13.0, 31.94; 20, 12.6, 32.16.
21404 Winterquarter I, 37.46, 75.05; V/22, 19h:—D26: 0, 12.6, 32.59; 10, 12.6, 32.56; 20, 11.8, 32.61.
21405 Winterquarter II, 37.39, 74.47; V/22, 21h:—D37: 0, 11.4, 32.99; 5, 11.3, 32.88; 15, 11.5, 32.95; 25, 9.5, 33.22.
21406 Winterquarter III, 37.31, 74.30; V/22, 23h:—D60: 0, 10.9, 33.28; 10, 10.8, 33.26; 20, 10.7, 33.35; 45, 8.5, 33.68.
21407 Chesapeake III, 36.45, 74.51; V/23, 5h:—D48: 0, 12.2, 33.53; 5, 12.2, 33.35; 15, 12.2, 33.37; 35, 10.1, 33.89.
21408 Chesapeake II, 36.49, 75.14; V/23, 8h:—D26: 0, 12.8, 32.59; 10, 12.8, 32.70; 20, 12.4, 32.92.
21409 Chesapeake I, 36.53, 75.41; V/23, 11h:—D20: 0, 14.6, 31.08; 15, 14.1, 31.40.

Cruise of May 24 to 28, 1932, Stations 21410 to 21431, Albatross II Series

21410 Chesapeake II, 36.50, 75.16; V/24, 19h:—D29: 0, 13.8, 32.63; 10, 12.8, 32.88; 20, 12.6, 32.81.
21411 Cape May II, 38.38, 74.42; V/25, 7h:—D24: 0, 13.4, 31.38; 15, 12.3, 32.14.
21412 Cape May III, 38.31, 74.26; V/25, 9h:—D42: 0, 13.0, 32.25; 10, 12.9, 32.12; 20, 11.1, 33.10; 35, 9.0, 33.35.
21413 Cape May IV, 38.23, 74.09; V/25, 11h:—D55: 0, 12.0, 33.22; 10, 12.0, 33.21; 20, 11.0, 33.42; 45, 7.7, 33.57.
21414 Cape May V, 38.17, 73.51; V/25, 14h:—D104: 0, 12.7, 33.49; 10, 12.6, 33.60; 20, 12.3, 33.98; 40, 9.2, 34.25; 80, 10.3, 34.74.
21415 Atlantic City IV, 38.51, 73.07; V/25, 19h:—D79: 0, 11.6, 33.17; 10, 11.6, 33.13; 20, 9.4, 33.30; 40, 10.7, 34.43; 70, 8.3, 34.05.
21416 Atlantic City III, 39.00, 73.26; V/25, 22h:—D55: 0, 11.2, 32.90; 10, 11.1, 32.99; 20, 10.8, 32.95; 50, 7.0, 33.46.
21417 Atlantic City II, 39.11, 73.48; V/26, 1h:—D37: 0, 12.5, 32.54; 10, 12.4, 32.59; 20, 12.4, 32.54; 30, 8.9, 33.28.
21418 Atlantic City I, 39.21, 74.08; V/26, 4h:—D24: 0, 13.1, 31.74; 10, 13.1, 31.71; 20, 10.0, 32.95.
21419 Barnegat I, 39.48, 73.49; V/26, 7h:—D24: 0, 12.5, 31.87; 10, 12.4, 31.73; 20, 9.2, 32.97.
21420 New York I, 40.22, 73.48; V/26, 11h:—D46: 0, 11.9, 31.92; 10, 11.8, 31.98; 20, 8.5, 32.63; 40, 6.7, 33.28.
21421 New York II, 40.06, 73.24; V/26, 14h:—D37: 0, 13.1, 32.01; 10, 13.0, 31.92; 20, 11.0, 32.72; 30, 6.8, 32.99.
21422 New York III, 39.48, 73.01; V/26, 17h:—D48: 0, 11.7, 32.72; 10, 11.7, 32.66; 20, 11.5, 32.66; 40, 6.5, 33.04.
21423 New York IV, 39.36, 72.36; V/26, 20h:—D74: 0, 11.4, 32.66; 10, 11.4, 32.88; 20, 11.2, 32.99; 40, 6.7, 33.55; 65, 8.6, 34.13.
21424 Shinnecock II, 40.16, 72.31; V/27, 2h:—D53: 0, 12.2, 31.94; 20, 8.2, 32.75; 45, 6.2, 32.52.
21425 Shinnecock I, 40.41, 72.27; V/27, 6h:—D36: 0, 11.2, 32.63; 4, 11.2, 32.01, 14, 11.3, 31.74; 24, 8.4, 32.47.
21426 Montauk I, 40.56, 71.51; V/27, 9h:—D33: 0, 11.0, 31.96; 10, 10.9, 31.91; 20, 8.7, 31.98; 30, 6.6, 32.74.

21427 Montauk II, 40.34, 71.44; V/27, 13h:—D64: 0, 12.1, 31.98; 10, 12.0, 32.05; 20, 11.1, 32.14; 40, 6.0, 32.86; 60, 5.7, 33.08.

21428 Montauk III, 40.13, 71.36; V/27, 16h:—D84: 0, 12.4, 32.47; 20, 12.3, 32.54; 40, 7.6, 32.74; 75, 4.9, 33.04.

21429 Martha's Vineyard III, 40.22, 70.42; V/27, 21h:—D90: 0, 11.5, 32.50; 20, 10.4, 32.72; 40, 4.9, 32.86; 80, 8.4, 34.18.

21430 Martha's Vineyard II, 40.42, 70.46; V/28, 0h:—D63: 0, 11.6, 32.45; 10, 11.6, 32.47; 20, 10.8, 32.54; 50, 4.8, 32.79.

21431 Martha's Vineyard I, 41.02, 70.48; V/28, 3h:—D45: 0, 11.5, 32.12; 10, 11.5, 32.03; 20, 11.2, 32.20; 40, 6.4, 32.56.

CRUISE OF JUNE 1 TO 5, 1932, STATIONS 21432 TO 21453, ALBATROSS II SERIES

21432 Montauk I, 40.56, 71.50; VI/1, 20h:—D36: 0, 11.6, 31.08; 10, 11.1, 31.47; 20, 8.9, 32.48; 30, 6.5, 32.74.

21433 Montauk II, 40.34, 71.43; VI/1, 23h:—D68: 0, 13.4, 31.87; 20, 8.5, 32.57; 40, 5.9, 32.77; 60, 5.8, 33.04.

21434 Shinnecock III, 40.06, 72.10; VI/2, 3h:—D65: 0, 14.1, 32.34; 20, 11.0, 32.77; 40, 6.0, 33.10; 60, 6.0, 33.33.

21435 New York IV, 39.33, 72.32; VI/2, 8h:—D96: 0, 13.6, 32.61; 10, 13.4, 32.79; 20, 11.3, 32.74; 30, 6.4, 32.92; 40, 5.6, 32.45; 60, 6.1, 33.17; 80, 7.9, 33.95.

21436 New York III, 39.48, 72.58; VI/2, 12h:—D72: 0, 14.5, 32.54; 20, 11.7, 32.70; 30, 7.4, 32.84; 40, 6.2, 33.06; 60, 7.3, 33.55.

21437 New York II, 40.05, 73.25; VI/2, 15h:—D51: 0, 15.0, 31.83; 10, 14.3, 32.18; 20, 8.7, 32.66; 30, 7.7, 32.83; 45, 7.0, 33.60.

21438 New York I, 40.22, 73.49; VI/2, 19h:—D25: 0, 14.0, 31.78; 10, 12.2, 32.05; 20, 7.5, 33.06.

21439 Barnegat I, 39.44, 73.50; VI/3, 0h:—D24: 0, 15.2, 32.00; 10, 14.3, 31.96; 20, 9.2, no sal.

21440 Atlantic City I, 39.20, 74.09; VI/3, 4h:—D25: 0, 15.3, 31.96; 10, 14.8, 31.96; 20, 9.9, 33.06.

21441 Atlantic City II, 39.12, 73.48; VI/3, 7h:—D42: 0, 16.0, 31.91; 10, 15.1, 32.12; 20, 11.4, 32.95; 35, 8.7, 33.57.

21442 Atlantic City III, 39.00, 73.27; VI/3, 10h:—D56: 0, 15.8, 32.21; 10, 13.6, 33.01; 20, 10.6, 33.10; 30, 8.3, 33.24; 50, 7.0, 33.48.

21443 Atlantic City IV, 38.52, 73.09; VI/3, 13h:—D83: 0, 15.9, 33.28; 10, 13.1, 33.08; 20, 10.3, 33.37; 30, 7.6, 33.73; 40, 8.0, 33.89; 75, 9.4, 34.38.

21444 Cape May V, 38.14, 73.51; VI/3, 19h:—D111: 0, 15.6, 33.49; 10, 13.8, 33.55; 20, 10.6, 33.49; 50, 9.8, 34.29.

21445 Cape May IV, 38.23, 74.08; VI/3, 22h:—D59: 0, 17.2, 32.61; 10, 14.1, 33.10; 20, 11.0, 33.33; 30, 7.4, 33.49; 50, 7.8, 33.82.

21446 Cape May III, 38.30, 74.26; VI/4, 1h:—D38: 0, 16.9, 32.09; 10, 15.8, 32.09; 20, 11.0, 33.28; 35, 8.3, 33.73.

21447 Cape May II, 38.38, 74.40; VI/4, 4h:—D26: 0, 16.9, 31.92; 10, 15.7, 32.36; 20, 10.6, 33.01.

21448 Winterquarter I, 37.47, 75.04; VI/4, 10h:—D22: 0, 17.9, 32.39; 10, 15.1, 32.54; 20, 11.1, 33.28.

21449 Winterquarter II, 37.39, 74.48; VI/4, 14h:—D46: 0, 16.4, 32.75; 10, 14.5, 33.01; 20, 11.5, 33.73; 30, 10.8; 33.89; 40, 8.8, 33.75.

21450 Winterquarter III, 37.30, 74.30; VI/4, 17h:—D93: 0, 16.3, 32.99; 10, 15.2, 34.27; 20, 13.4, 34.65; 40, 8.8, 34.23; 80, 11.0, 35.01.

21451 Chesapeake III, 36.46, 74.49; VI/4, 23h:—D55: 0, 17.2, 33.03; 10, 14.7, 33.57; 20, 12.7, 34.07; 30, 10.3, 34.16; 50, 9.3, 34.22.

21452 Chesapeake II, 36.50, 75.13; VI/5, 2h:—D33: 0, 18.9, 31.15; 10, 16.0, 33.24; 20, 13.9, 33.39; 30, 10.4, 33.78.

21453 Chesapeake I, 36.55, 75.39; VI/5, 6h:—D23: 0, 19.2, 30.72; 10, 15.9, 31.33; 20, 15.3, 32.20.

CRUISE OF JUNE 5 TO 8, 1932, STATIONS 21454 TO 21468, ALBATROSS II SERIES

21454 Cape May II, 38.39, 74.44; VI/5, 20h:—D25: 0, 17.8, 32.20; 10, 16.7, 32.23; 20, 10.9, 32.97.

21455 Cape May III, 38.32, 74.26; VI/5, 23h:—D40: 0, 17.3, 31.06; 10, 16.8, 31.20; 20, 11.3, 33.80; 35, 8.2, 33.64.

21456 Cape May IV, 38.23, 74.09; VI/6, 2h:—D58: 0, 18.0, 31.13; 10, 16.9, 31.18; 20, 11.4, 33.19; 30, 8.3, 33.46; 50, 7.6, 33.78.

21457 Atlantic City III, 39.00, 73.27; VI/6, 9h:—D59: 0, 16.9, 32.21; 10, 13.5, 33.06; 20, 9.3, 33.06; 30, 7.5, 33.28; 50, 7.1, 32.16.

21458 Atlantic City II, 39.11, 73.47; VI/6, 11h:—D46: 0, 16.9, 32.23; 10, 16.4, 33.51; 20, 12.4, 32.05; 30, 9.5, 33.64; 40, 7.9, 33.24.

21459 Atlantic City I, 39.19, 74.07; VI/6, 14h:—D29: 0, 17.6, 31.73; 10, 16.5, 31.80; 25, 9.1, 33.13.

21460 New York II, 40.06, 73.23; VI/6, 21h:—D41: 0, 16.7, 31.83; 10, 15.4, 33.03; 20, 11.2, 32.05; 35, 7.4, 32.61.

21461 New York III, 39.49, 73.01; VI/7, 0h:—D52: 0, 16.3, 32.01; 9, 16.2, 33.01; 19, 11.9, 33.03; 29, 8.0, 31.85; 49, 6.6, 32.45.

21462 New York IV, 39.35, 72.36; VI/7, 3h:—D75: 0, 15.9, 32.72; 20, 9.1, 33.46; 30, 6.9, 32.79; 50, 5.2, 32.95; 70, 5.9, 33.24.

21463 Shinnecock II, 40.17, 72.20; VI/7, 9h:—D59: 0, 15.4, 31.74; 10, 12.6, 32.30; 20, 8.0, 32.77; 30, 7.6, 32.96; 50, 5.7, 33.03.

21464 Montauk I, 40.57, 71.50; VI/7, 15h:—D35: 0, 12.0, 32.65; 10, 12.0, 31.49; 20, 10.6, 31.96; 30, 7.2, 32.56.

21465 Montauk II, 40.34, 71.43; VI/7, 18h:—D64: 0, 14.6, 31.62; 10, 14.4, 31.73; 20, 10.0, 32.63; 40, 6.5, 32.81; 60, 5.8, 32.59.

21466 Martha's Vineyard III, 40.24, 70.44; VI/8, 0h:—D81: 0, 13.8, 32.61; 10, 13.8, 32.63; 20, 9.8, 32.75; 40, 5.3, 32.92; 75; 6.1, 33.35.

21467 Martha's Vineyard II, 40.42, 70.47; VI/8, 3h:—D57: 0, 14.1, 32.32; 10, 11.4, 32.21; 20, 10.9, 32.84; 30, 6.3, 32.77; 50, 5.4, 32.63.

21468 Martha's Vineyard I, 41.04, 70.50; VI/8, 7h:—D38: 0, 13.5, 32.32; 10, 13.5, 32.38; 20, 12.0, 32.27; 30, 7.6, 32.65.

Cruise of June 15 to 21, 1932, Stations 21469 to 21499, Albatross II Series

21469 Atlantic City I, 39.20, 74.09; VI/15, 14h:—D23: 0, 18.3, 31.96; 10, 18.2, 31.83; 20, no temp., 32.83.

21470 Cape May II, 38.40, 74.44; VI/15, 22h:—D44: 0, 19.2, 32.30; 10, no temp., 32.59; 20, 10.7, 33.06.

21471 Winterquarter I, 37.47, 75.04; VI/16, 5h:—D23: 0, 19.3, 32.14; 10, 18.8, 32.18; 20, 11.4, 33.04.

21472 Winterquarter II, 37.39, 74.47; VI/16, 8h:—D45: 0, 19.6, 32.57; 10, 19.3, 32.36; 20, 11.2, 33.22; 40, 8.8, 33.58.

21473 Winterquarter III, 37.31, 74.30; VI/16, 11h:—D91: 0, 19.0, 32.66; 10, 18.9, 32.92; 20, 15.6, 34.72; 40, 9.1, 34.16; 80, 10.2, 34.43.

21474 Cape May V, 38.14, 73.51; VI/16, 17h:—D113: 0, 19.9, 33.35; 9c, 19.7, 34.11; 18c, 17.1, 35.16; 47c, 9.9, 34.63; 94c, 11.7, 35.17.

21475 Cape May IV, 38.23, 74.08; VI/16, 20h:—D60: 0, 19.9, 32.43; 10, 17.5, 32.84; 20, 10.9, 32.99; 30, 7.9, 33.28; 50, 8.0, 33.66.

21476 Cape May III, 38.31, 74.26; VI/16, 23h:—D43: 0, 20.0, 31.94; 10, 18.7, 31.87; 20, 11.2, 33.04; 35, 7.8, 33.62.

21477 Atlantic City II, 39.13, 73.44; VI/17, 6h:—D46: 0, 19.0, 32.27; 10, 18.7, 32.00; 20, 10.5, 32.84; 35, 7.7, 33.13.

21478 Atlantic City III, 39.00, 73.26; VI/17, 9h:—D72: 0, 18.2, 32.36; 10, 18.1, 32.30; 20, 12.0, 32.79; 40, 6.1, 32.88; 60, 7.9, 33.84.

21479 Atlantic City IV, 38.52, 73.10; VI/17, 12h:—D74: 0, 19.7, no sal.; 10, 16.1, 32.61; 20, 10.6, 33.10; 40, 6.1, 32.97; 60, 8.4, 33.95.

21480 New York V, 39.26, 72.26; VI/17, 17h:—D119: 0, 17.4, 31.98; 10, 14.8, 32.61; 20, 13.2, 32.81; 50, 5.0, 35.19; 100, 12.1, 32.92.

21481 New York IV, 39.35, 72.36; VI/17, 20h:—D76: 0, 18.1, 32.09; 10, 18.1, 32.21; 20, 11.4, 32.83; 40, 5.9, 32.95; 70, 5.9, 33.24.

21482 New York III, 39.50, 72.58; VI/17, 23h:—D65: 0, 17.3, 31.98; 10, 16.9, 31.83; 20, 13.6, 32.30; 40, 6.3, 33.01; 60, 6.5, no sal.

21483 New York II, 40.05, 73.23; VI/18, 3h:—D43: 0, 17.2, 31.85; 10, 17.2, 31.80; 20, 14.8, 31.76; 35, 7.6, 32.92.

21484 New York I, 40.22, 73.50; VI/18, 7h:—D26: 0, 17.6, 31.69; 10, 17.6, 31.69; 20, 11.4, 32.30.

21485 Shinnecock I, 40.37, 72.47; VI/18, 15h:—D34: 0, 15.0, 31.47; 10, 14.9, 31.44; 20, 14.8, 31.47; 30, 9.6, 32.05.

21486 Shinnecock II, 40.17, 72.20; VI/18, 20h:—D55: 0, 16.5, 31.80; 10, 16.6, 31.87; 20, 8.8, 32.47; 30, 6.0, 32.72; 50, 6.0, 33.01.

21487 Montauk III, 40.14, 71.36; VI/19, 2h:—D82: 0, 14.6, 32.56; 10, 14.7, 32.41; 20, 14.0, 32.48; 40, 5.8, 32.75; 75, 5.1, 32.84.

21488 Montauk II, 40.35, 71.43; VI/19, 6h:—D69: 0, 15.6, 31.89; 10, 15.7, 31.94; 20, 11.7, 32.32; 30, 7.9, 32.56; 60, 5.6, 32.84.

21489 Montauk I, 40.56, 71.50; VI/19, 10h:—D33: 0, 15.4, 31.76; 10, 15.4, 31.73; 20, 13.9, 32.01; 30, 11.9, 32.12.

21490 Martha's Vineyard I, 41.05, 70.49; VI/19, 16h:—D32: 0, 13.3, 32.23; 10, 12.6, 32.23; 25, 10.7, 32.34.

21491 Martha's Vineyard II, 40.44, 70.41; VI/19, 20h:—D57: 0, 14.0, 32.48; 10, 14.1, 32.25; 20, 9.9, 32.65; 30, 7.1, 32.72; 50, 6.3, 32.77.

21492 Martha's Vineyard III, 40.24, 70.36; VI/19, 23h:—D85: 0, 12.3, 33.21; 10, 13.4, 33.12; 20, 8.2, 32.75; 40, 5.8, 32.88; 80, 8.0, 33.84.

21493 Martha's Vineyard IV, 40.01, 70.31; VI/20, 5h:—D185: 0, 14.2, 32.77; 10, 14.3, 32.70; 20, 11.0, 32.66; 32c, 8.2, 33.03; 50, 10.1, 32.81; 100, 10.8, 34.79; 162c, 11.0, 35.26.

21494 Nantucket Shoals III, 40.10, 69.32; VI/20, 11h:—D84: 0, 14.1, 32.95; 20, 9.7, 32.77; 50, 6.7, 33.10; 80, 7.0, 33.33.

21499 South Channel II, 41.07, 69.13; VI/21, 7h:—D66: 0, 12.6, 31.76; 20, 6.0, 32.52; 40, 4.5, 32.77; 60, 4.5, 32.52.

Cruise of October 19 to 28, 1931, Stations 1060 to 1105, Atlantis Series

1060 Martha's Vineyard I, 41.04, 70.50; X/19, 5h:—D48: 0, 14.7, 32.01; 10, 14.9, 31.98; 20, 15.0, 31.99; 29c, 14.9, 32.18; 39c, 14.4, 32.33.

1061 Martha's Vineyard II, 40.42, 70.54; X/19, 8h:—D93: 0, 14.2, 32.26; 10, 14.4, 32.25; 20, 14.3, 32.23; 30, 14.8, 32.57; 40, 13.4, 32.57; 50, 12.5, 32.63; 60, 11.3, 32.79; 80, 10.7, 32.86.

1062 Martha's Vineyard III, 40.20, 70.57; X/19, 12h:—D90: 0, 14.1, 32.37; 10, 14.1, 32.30; 20, 14.0, 32.30; 30, 14.0, 32.30; 40, 13.8, 32.32; 50, 11.6, 32.65; 60, 10.7, 32.96; 80, 10.3, 33.45.

1063 Martha's Vineyard IV, 40.10, 71.00; X/19, 15h:—D140: 0, 14.3, 32.49; 10, 14.3, 32.48; 20, 14.2, 32.53; 30, 14.5, 32.68; 40, 12.9, 32.84; 50, 12.7, 33.81; 60, 13.0, 34.35; 80, 11.8, 34.51; 100, no temp., 35.00; 130, 11.6, 35.35.

1064 Martha's Vineyard V, 40.02, 71.00; X/19, 17h:—D330: 0, 16.6, 33.93; 10, 16.6, 33.89; 20, 17.0, 34.08; 30, 15.5, 34.09; 40, 13.0, 34.27; 50, 11.4, 34.37; 60, 11.2, 34.60; 75c, 11.1, 34.70; 94c, 11.8, 35.18; 131c, 11.5, 35.35; 169c, 11.1, 35.35; 235c, 9.5, 35.21; 280c, 7.9, 35.08.

1065 Martha's Vineyard VI, 39.54, 71.00; X/19, 19h:—D500: 0, 16.0, 33.58; 10, 16.2, 33.65; 20, 16.5, 33.81; 30, 17.4, 34.26; 40, 14.0, 34.29; 50, 11.9, 34.54; 60, 12.7, 35.09; 80, 13.4, 35.48; 95c, 13.2, 35.34; 126c, 12.8, 35.50; 155c, 12.4, 35.45; 202c, 11.4, 35.42; 231c, 11.2, 35.28; 281c, 7.9, 35.05; 302c, 6.9, 34.99.

1066 Montauk VI, 39.36, 71.22; X/20, 6h:—D1000+: 0, 17.7, 33.87; 10, 17.7, 33.86; 20, 17.7, 33.86; 30, 17.4, 33.87; 40, 16.4, 33.86; 50, 8.9, 33.60; 60, 10.7, 33.70; 80, 10.8, 34.38; 100, 10.8, 34.63; 135c, 11.6, 35.14; 174c, 10.1, 35.25; 242c, 7.5, 35.03; 289c, 6.7, 35.00; 385c, 5.6, 34.96; 482c, 1.4, 34.96; 575c, 4.8, 34.96; 756c, 4.4, 34.96; 933c, 4.0, 34.96; 1104c, 3.8, 34.94; 1432c, 3.6, 34.94.

1067 Montauk V, 39.46, 71.27; X/20, 11h:—D700+: 0, 15.8, 33.36; 10, 16.4, 33.64; 20, 16.9, 33.88; 30, 17.0, 33.96; 40, 16.1, 33.96; 50, 12.0, 33.72; 60, 10.6, 34.14; 80, 12.1, 35.08; 100, 12.0, 35.28; 135c, 11.9, 35.34; 174c, 11.6, 35.41; 242c, 9.7, 35.21; 289c, 1.1, 35.08; 385c, 6.5, 35.01; 482c, 5.1, 34.95; 578c, 4.6, 34.95.

1068 Montauk IV, 40.00, 71.32; X/20, 14h:—D128: 0, 14.6, 32.45; 10, 14.3, 32.39; 20, 14.4, 32.65; 30, 14.4, 32.63; 40, 14.7, 33.18; 50, 9.7, 34.00; 60, 11.3, 34.12; 80, 12.3, 35.06; 100, 11.8, 35.24; 120, 11.5, 35.36.

1069 Montauk III, 40.19, 71.34; X/20, 16h:—D85: 0, 14.8, 32.57; 10, 14.8, 32.55; 20, 14.7, 32.58; 30, 14.3, 32.52; 40, 13.6, 32.55; 50, 6.1, 32.66; 60, 10.6, 32.81; 80, 11.3, 33.82.

1070 Montauk II, 40.32, 71.38; X/20, 20h:—D78: 0, 15.1, 32.70; 10, 15.1, 32.64; 20, 14.9, 32.65; 30, 14.6, 32.66; 40, 12.5, 33.12; 50, no temp., 33.10; 60, 10.0, 33.22; 70, 10.0, 33.37.

1071 Fire Island I, 40.23, 73.43; X/21, 11h:—D28: 0, 16.8, 31.91; 10, 16.8, 31.90; 20, 16.8, 31.91.

1072 New York I, 40.13, 73.28; X/21, 13h:—D38: 0, 16.7, 31.65; 10, 16.7, 31.64; 20, 16.7, 31.64; 30, 14.5, 31.82.

1073 New York II, 39.58, 73.04; X/21, 16h:—D53: 0, 16.6, 32.20; 10, 16.6, 32.15; 20, 16.4, 32.20; 30, 16.4, 32.20; 40, 10.5 32.47; 50, 9.4, 32.51.

1074 New York III, 39.46, 72.50; X/21, 19h:—D72: 0, 16.2, 32.50; 10, 16.1, 32.47; 20, 15.7, 32.62; 30, 15.7, 32.66; 40 14.2, 32.68; 50, 9.3, 32.66; 60, 9.3, 32.66; 70, 9.6, 33.06.

1075 New York IV, 39.31, 72.32; X/21, 22h:—D110: 0, 15.4, 32.75; 10, 15.4, 32.79; 20, 15.8, 33.07; 30, 16.3, 33.50; 40, 16.3, 33.53; 49c, no temp., 33.75; 59c, 12.6, 34.19; 79c, 11.7, 34.44; 98c, 8.1, 34.75.

1076 New York V, 39.20, 72.18; X/22, 0h:—D390: 0, 16.6, 33.69; 10, 16.6, 33.65; 20, 16.6, 33.66; 30, 16.6, 33.66; 39c, 16.4, 33.66; 49c, no temp., 33.86; 59c, 11.6, 33.99; 79c, 11.4, 34.45; 87c, 11.6, 34.64; 121c, 12.7, 35.44; 156c, 11.7, 35.38; 190c, 11.6, 34.50; 240c, 9.5, 35.24; 315c, 6.8, 35.02.

1077 Atlantic City VI, 38.40, 72.50; X/22, 6h:—D1000+: 0, 18.4, 35.21; 10, 18.4, 34.32; 20, 18.4, 34.28; 30, 18.4, 34.28; 40, 13.8, 34.00; 50, 12.4, 34.29; 60, 12.2, 34.53; 79c, 13.1, 35.22; 98c, no temp., 35.71; 131c, 13.6, 35.67; 163c, 12.5, 35.49; 215c, 11.3, 35.42; 248c, 10.4, 35.30; 304c, 8.1, 35.08; 347c, 6.5, 35.03; 369c, 7.0, 35.04; 509c, 5.2, 35.01 657c, 4.5, 34.94; 814c, no temp., 34.96; 1152c, 4.7, 34.91; 1525c, 3.5, 34.91.

1078 Atlantic City V, 38.46, 73.02; X/22, 12h:—D93: 0, 16.1, 32.93; 10, 16.0, 32.91; 20, 16.0, 32.90; 29c, 16.0, 32.90; 39c, 16.0, 32.88; 48c, 12.8, 33.03; 58c, 10.1, 33.28; 77c, 9,8, 33.70; 87c, 10.1, 33.85.

1079 Atlantic City IV, 38.56, 73.18; X/22, 15h:—D63: 0, 15.9, 32.79; 10, 15.9, 32.75; 20, 15.9, 32.73; 30, 15.8, 32.74; 40, 9.8, 32.57; 50, 9.5, 32.57; 60, 9.5, 32.92.

1080 Atlantic City III, 39.07, 73.35; X/22, 17h:—D49: 0, 16.4, 32.49; 10, 16.4, 32.48; 20, 16.3, 32.57; 30, 10.7, 32.48; 40, 9.8, 32.48.

1081 Atlantic City II, 39.13, 73.49; X/22, 19h:—D39: 0, 16.6, 32.09; 10, 16.6, 32.08; 20, 16.6, 32.05; 30, 16.6, 32.08.

1082 Atlantic City I, 39.21, 74.03; X/22, 21h:—D28: 0, 16.6, 31.97; 10, 16.6, 31.96; 20, 16.6, 31.97.

1083 Cape May I, 38.40, 74.40; X/23, 5h:—D22: 0, 16.8, 31.74; 10, 16.9, 31.86; 20, 16.3, 31.88.

1084 Cape May II, 38.30, 74.21; X/23, 7h:—D49: 0, 17.0, 32.34; 10, 17.0, 32.31; 20, 17.0, 32.34; 15.6, 32.51; 40, 10.0, 32.57.

1085 Cape May III, 38.22, 74.06; X/23, 10h:—D63: 0, 16.5, 32.50; 10, 16.3, 32.62; 20, 16.1, 32.77; 30, 15.9, 32.83; 40, 15.4, 32.83; 50, 9.2, 32.66; 60, 9.2, 32.66.

1086 Cape May IV, 38.17, 73.56; X/23, 13h:—D88: 0, 16.4, 32.72; 10, 15.9, 32.84; 20, 15.8, 32.87; 30, 15.7, 32.87; 40, 15.7, 32.88; 50, 14.6, 32.94; 60, 12.7, 32.93; 80, 9.8, 33.51.

1087 Cape May V, 38.13, 73.46; X/23, 14h:—D160: 0, 16.6, 33.05; 10, 16.4, 33.10; 20, 16.2, 33.04; 30, 13.6, 33.03; 40, 11.0, 32.96; 50, 9.7, 32.95; 60, 11.1, 33.75; 80, 10.8, 34.31; 100, 12.5, 35.26; 139c, 12.0, 35.36.

1088 Cape May VI, 38.04, 73.22, X/23, 18h:—D1800: 0, 18.8, 34.43; 10, 20.0, 35.13; 20, 20.3, 35.32; 30, 20.3, 35.30; 40, 20.2, 35.31; 50, 16.5, 35.48; 60, 15.1, 35.62; 80, no temp., 35.89; 99c, 15.1, 35.90; 137c, 13.3, 35.65; 175c, 13.5, 35.56; 240c, 10.0, 35.29; 286c, 8.9, 35.16; 375c, 6.9, 35.02; 461c, 5.4, 34.96; 480c, 5.3, 34.95; 620c, 4.5, 34.93; 751c, 4.8, 34.96; 901c, 4.0, 34.96.

1089 Winterquarter III, 37.32, 74.19; X/24, 7h:—D135: 0, 16.7, 32.75; 10, 16.6, 32.74; 20, 16.8, 32.86; 30, 18.7, 34.14; 40, 19.3, 34.42; 50, 15.9, 34.02; 60, 11.1, 33.87; 80, 12.3, 34.84; 100, 13.3, 35.39; 120, 12.8, 35.35.

1090 Winterquarter II, 37.37, 74.44; X/24, 11h:—D50: 0, 16.8, 32.76; 10, 16.6, 32.80; 20, 16.6, 32.80; 30, 14.4, 32.70; 40, 12.0, 32.61.

1091 Winterquarter I, 37.43, 75.10; X/24, 13h:—D28: 0, 17.7, 32.01; 10, 17.8, 31.98; 20, 17.6, 32.01.

1092 Chesapeake I, 36.58, 75.38; X/24, 20h:—D25: 0, 18.7, 31.68; 10, 18.7, 31.67; 20, 18.7, 31.77.

1093 Chesapeake II, 36.51, 75.10; X/25, 0h:—D36: 0, 18.2, 32.28; 10, 18.1, 32.24; 20, 17.9, 32.46; 30, 16.8, 32.54.

1094 Chesapeake III, 36.45, 74.39; X/25, 3h:—D500: 0, 19.5, 34.50; 10, 19.5, 34.42; 20, 20.4, 34.77; 30, 21.2, 35.35; 40, 15.4, 34.39; 50, 15.1, 34.96; 60, 15.6, 35.61; 80, no temp., 35.73; 91c, 14.5, 35.79; 127c, 13.4, 35.71; 163c, 12.3, 35.55; 228c, 10.4, 35.31; 270c, 9.2, 35.17; 358c, 7.7, 35.08.

1095 Chesapeake IV, 36.41, 74.21; X/25, 6h:—D1500+: 0, 20.6, 35.11; 10, 20.6, 35.08; 20, 20.6, 35.08; 30, 20.6, 35.08; 40, 20.3, 35.17; 50, 18.2, 35.32; 60, 16.6, 35.65; 80, 15.7, 35.71; 100, 15.0, 35.75; 140, 13.6, 35.68; 179c, 11.9, 35.53; 249c, 10.2, 35.28; 298c, 8.9, 35.14; 395c, 7.4, 35.05; 491c, 5.8, 35.01; 589c, 4.8, 34.96; 782c, 4.3, 34.96; 825c, 4.0, 34.96; 1018c, 3.8, 34.96; 1203c, 4.0, 34.92; 1566c, 3.4, 34.93.

1096 Chesapeake V, 36.38, 74.03; X/25, 11h:—D1000+: 0, 23.0, 35.01; 10, 21.5, 34.97; 20, 21.5, 34.97; 30, 21.6, 35.01; 40, 21.2, 35.07; 50, 14.5, 34.79; 60, 13.2, 34.95; 80, 14.3, 35.69; 100, 13.6, 35.66; 135c, 12.3, 35.54; 174c, 11.1, 35.41; 242c, 9.6, 35.25; 289c, 8.3, 35.08; 386c, 6.4, 35.00; 482c, 5.1, 34.98; 582c, 4.8, 34.99; 776c, 4.2, 34.98; 970c, 3.9, 34.96; 1164c, no temp., 34.96; 1552c, 3.4, 34.94; 1948c, 3.2, 34.93.

1097 Currituck IV, 36.13, 74.43; X/25, 20h:—D520: 0, 20.6, 34.95; 10, 20.6, 35.01; 20, 20.7, 35.02; 30, 20.9, 35.14; 40, 21.0, 35.19; 50, 20.8, 35.25; 60, 15.7, 35.06; 80, no temp., 35.72; 100, 14.9, 35.85; 138c, 12.7, 35.62; 177c, 11.2,, 35.44; 246c, 9.6, 35.23; 295c, 8.8, 35.13; 393c, 6.2, 34.98; 492c, 5.0, 34.95.

1098 Bodie Island III—North, 36.04, 74.59; X/25, 23h:—D98: 0, 18.6, 33.54; 10, 18.8, 33.68; 20, 20.2, 34.65; 30, 17.1, 34.01; 40, 11.2, 33.08; 50, 10.5, 33.56; 70, 10.3, 33.73; 90, 11.3, 34.13.

1099 Cape Hatteras, 36.06, 75.15; X/26, 0h:—D39: 0, 17.8, 33.22; 10, 18.0, 33.13; 20, 15.4, 33.18; 30, 14.8, 33.17.

1101 New York III, 39.46, 72.51; X/28, 8h:—D80: 0, 14.2, 32.60; 10, 14.2, 32.55; 20, 14.2, 32.55; 30, 14.2, 32.55; 40, 14.2, 32.56; 50, 13.5, 32.87; 60, 12.5, 33.05; 70, 10.7, 33.30.

1102 Fire Island II, 40.00, 72.26; X/28, 11h:—D82: 0, 14.2, 32.56; 10, 14.2, 32.56; 20, 14.1, 32.56; 30, 14.1, 32.60; 40, 13.4, 32.85; 50, 11.6, 33.13; 60, 10.8, 33.32; 80, 10.6, 33.77.

1103 Shinnecock II, 40.17, 72.00; X/28, 15h:—D85: 0, 13.7, 32.99; 10, 13.7, 32.97; 20, 13.7, 32.98; 30, 13.8, 33.03; 40, 13.8, 33.03; 50, 13.2, 33.21; 60, 10.2, 33.41; 80, 10.3, 33.83.

1104 Montauk II, 40.31, 71.38; X/28, 19h:—D83: 0, 13.2, 32.43; 10, 13.1, 32.40; 20, 13.1, 32.41; 30, 13.0, 32.54; 40, 12.9, 32.61; 50, 12.0, 32.92; 60, 10.0; 33.99, 70, 10.5, 33.51.

1105 Montauk I, 40.46, 71.42; X/28, 21h:—D67: 0, 13.7, 32.24; 10, 13.7, 32.19; 20, 13.7; 32.20; 30, 13.6, 32.20; 40, 13.1, 32.33; 50, 10.8, 32.80; 60, 10.5, 32.83.

Cruise of February 11 to April 28, 1932, Stations 1131 to 1258, Atlantis Series

1131 Chesapeake II, 37.00, 75.20; II/11, 22h:—D30: 0, 10.0, 33.21; 10, 9.9, 33.19; 25, 9.0, 33.18.

1132 Chesapeake III, 36.52, 74.59; II/12, 1h:—D38: 0, 10.6, 33.57; 10, 10.6, 33.87; 20, 10.6, 33.86; 30, 10.7, 33.57.

1133 Chesapeake IV, 36.41, 74.29; II/12, 5h:—D470: 0, 12.1, 34.63; 20, 12.1, 34.60; 41c, 12.1, 34.62; 61c, 12.4, 34.82; 82c, 13.2, 35.11; 164c, 13.4, 35.61; 246c, 11.3, 35.45; 370c, 7.7, 35.07.

1231 Chesapeake IV, 36.36, 74.37; IV/23, 3h:—D1020+: 0, 11.4, 34.62; 24c, 10.0, 34.45; 49c, 11.0, 34.84; 98c, 11.9, 35.31; 195c, 11.1, 35.37; 293c, 9.0, 35.17; 387c, 7.6, 35.07; 570c, 5.0, 34.99; 774c, 4.3, 34.98; 986c, 3.9, 34.97.

1232 Chesapeake III, 36.45, 74.58; IV/23, 8h:—D35: 0, 10.7, 33.84; 10, 10.2, 33.84; 20, 10.1, 33.96; 30, 9.5, 33.93.

1233 Chesapeake II, 36.52, 75.19; IV/23, 13h:—D30: 0, 11.6, 33.71; 10, 10.7, 33.49; 25, 9.5, 33.53.

1234 Chesapeake I, 36.58, 75.42; IV/23, 16h:—D20: 0, 11.7, 32.47; 9c, 9.9, 32.38; 18c, 9.8, 32.39.

1235 Chesapeake IA, 36.59, 75.50; IV/23, 17h:—D13: 0, 12.2, 28.24; 10, 11.1, 32.02.

1236 Winterquarter I—North, 38.13, 75.02; IV/24, 11h:—D22: 0, 9.8, 31.34; 10, 9.2, 31.25; 20, no temp., 31.64.

1237 Winterquarter II—North, 38.09, 74.51; IV/24, 13h:—D24: 0, 9.2, 30.97; 10, no temp., 30.97; 20, 8.2, 31.80.

1238 Winterquarter III—North, 38.02, 74.37; IV/24, 16h:—D37: 0, 9.9, 33.68; 10, 9.1, 33.61; 20, 8.7, 33.66; 35, 8.5, 33.69.

1239 Winterquarter IV—North, 37.55, 74.20; IV/24, 19h:—D68: 0, 9.6, 34.29; 10, 9.6, 34.20; 20, 9.4, 34.22; 30, 9.2, 34.26; 40, 9.1, 34.51; 60, 9.6, 34.20.

1240 Winterquarter V—North, 37.49, 74.07; IV/24, 23h:—D386: 0, 11.6, 34.42; 23c, 11.8, 35.06; 47c, 12.0, 35.26; 70c, 12.1, 35.34; 93c, 11.7, 35.32; 140c, 11.6, 35.41; 191c, no temp., 35.33; 243c, no temp., 35.22; 345c, 7.2, 35.06.

1241 Atlantic City V, 38.45, 72.57; IV/25, 9h:—D1000+: 0, 8.8, 33.76; 25, 10.3, 34.54; 50, 12.0, 35.19; 100, 12.1, 35.32; 201c, 12.2, 35.53; 301c, 8.8, 35.16; 388c, 6.9, 35.04; 605c, 4.6, 34.98; 740c, 4.2, 34.98; 875c, 4.1, 34.98; 1009c, 3.8, 34.97.

1242 Atlantic City IV, 38.47, 73.06; IV/25, 12h:— 0, 9.2, 33.82; 25, 9.2, 34.16; 49c, 8.8, 34.33; 74c, 9.5, 34.62; 98c, 9.7, 34.73; 122c, 10.1, 34.87.

1243 Atlantic City III, 38.58, 73.23; IV/25, 15h:—D63: 0, 8.7, 33.75; 10, 8.7, 33.73; 20, 8.3, 33.73; 40, 7.8, 33.76; 60. 7.7, 33.79.

1244 Atlantic City II, 39.07, 73.43; IV/25, 19h:—D43: 0, 8.2, 32.70; 10, 8.2, 32.70; 20, 7.8, 33.24; 40, 7.4, 33.54.

1245 Atlantic City I, 39.15, 73.56; IV/25, 22h:—D46: 0, 7.9, 32.29; 10, 7.9, 32.18; 20, 7.3, 32.35; 39c, 6.9, 33.08.

1246 New York I, 40.26, 73.49; IV/26, 8h:—D26: 0, 8.1, 31.01; 10, 7.1, 31.55; 20, 6.4, 32.43.

1247 New York II, 40.12, 73.27; IV/26, 12h:—D39: 0, 8.0, 32.54; 10, 7.9, 32.66; 20, 7.6, 32.89; 35, 6.7, 33.36.
1248 New York III, 39.59, 73.06; IV/26, 15h:—D49; 0, 7.8, 33.20; 10, 7.9, 33.21; 20, 7.7, 33.24; 45, 6.9, 33.61.
1249 New York IV, 39.46, 72.43; IV/26, 18h:—D61: 0, 7.4, 33.02; 10, 7.4, 33.01; 30, 6.7, 33.10; 55, 6.9, 33.57.
1250 New York V, 39.34, 72.25; IV/26, 21h:—D103: 0, 7.2, 33.11; 18c, 6.7, 33.13; 36c, 6.0, 33.17; 54c, 7.8, 33.92; 72c, 9.4, 34.53; 90c, 9.8, 34.76.
1251 New York VI, 39.30, 72.14; IV/26, 23h:—D680: 0, 7.2, 33.15; 18c, 6.9, 33.44; 36c, 8.7, 34.22; 54c, 9.4, 34.55; 72c, 10.0, 34.78; 144c, 11.4, 35.38; 219c, no temp., 35.24; 296c, 7.2, 35.10; 376c, 5.9, 35.01; 499c, 4.8, 34.98.
1252 Martha's Vineyard VII, 39.40, 70.58; IV/27, 8h:—D1000+: 0, 8.1, no sal.; 19c, 8.2, no sal.; 37c, 8.6, 33.86; 74c, 9.6, 34.61; 148c, 11.5, 35.37; 230c, no temp., 35.24; 318c, 7.2, 35.06; 498c, 4.9, 34.96; 510c, 4.9, 34.97; 701c, 5.6, 34.96; 932c, 4.0, 34.96; 1145c, 3.8, 34.96; 1601c, 3.5, 34.95; 2001c, 3.2, 34.96.
1253 Martha's Vineyard VI, 39.54, 70.58; IV/27, 13h:—D640: 0, 6.8, 33.10; 25, 6.8, 33.49; 55c, 10.5, 34.83; 101c, 11.3, 35.16; 202c, 10.8, 35.36; 293c, 8.3, 35.10; 417c, 6.1, 35.01; 626c, 4.3, 34.97.
1254 Martha's Vineyard V, 40.04, 70.59; IV/27, 15h:—D179: 0, 5.8, 32.88; 23c, 5.8, 32.84; 45c, 5.0, 33.02; 90c, 10.3, 34.73; 135c, 11.2, 35.18.
1255 Martha's Vineyard IV, 40.27, 71.00; IV/27, 18h:—D94: 0, 6.2, 32.82; 18c, 6.2, 32.77; 45c, 5.1, 32.92; 63c, 5.0, 32.93; 82c, 4.6, 33.03.
1256 Martha's Vineyard III, 40.43, 71.00; IV/27, 21h:—D69: 0, 6.7, 32.81; 19c, 6.7, 32.56; 38c, 5.9, 32.71; 61c, 4.9, 32.90.
1257 Martha's Vineyard II, 40.59, 71.00; IV/27, 24h:—D58: 0, 6.5, 32.70; 20, 6.5, 32.38; 39c, 5.6, 32.69; 54c, 5.6, 32.82.
1258 Martha's Vineyard I, 41.14, 71.00; IV/ 28, 9h:—D34: 0, 6.2, 32.41; 10, 6.2, 32.36; 30, 6.0, 32.53.

CRUISE OF JUNE 25 TO JULY 1, 1932, STATIONS 1259 TO 1283, ATLANTIS SERIES

1259 Montauk IV, 40.10, 71.28; VI/25, 9h:—D90: 0, 14.0, 32.81; 9c, 14.0, 32.70; 18c, 10.4, 32.79; 27c, 6.9, 32.84; 45c, 5.9, 32.90; 63c, 5.5, 33.03.
1260 New York V, 39.26, 72.20; VI/26, 0h:—D146: 0, 15.1, 32.81; 9c, 15.0, 32.72; 17c, 15.0, 32.63; 52c, 5.2, 33.04; 104c, 10.8, 35.01.
1261 New York VI, 39.19, 72.11; VI/26, 3h:—D250+: 0, 15.6, 32.90; 8c, 15.6, 32.94; 16c, 15.4, no sal.; 41c, 10.8, 34.25; 80c, 11.6, 35.05; 160c, 9.6, 35.26.
1262 Atlantic City I, 39.19, 74.13; VI/26, 19h:—D20: 0, 19.5, 31.98; 15, 18.4, 32.14.
1263 Atlantic City II, 39.11, 73.48; VI/26, 22h:—D38: 0, 19.0, 32.30; 10, 19.0, 32.23; 20, 15.2, 32.65; 30, 9.4, 33.19.
1264 Atlantic City III, 39.00, 73.24; VI/27, 2h:—D61: 0, 18.7, 32.39; 9c, 18.7, 32.47; 19c, 18.5, 33.36; 28c, 11.4, 33.19; 47c, 6.9, 33.24.
1265 Atlantic City IV, 38.52, 73.06; VI/27, 5h:—D165: 0, 17.9, 32.81; 9c, 17.9, 32.75; 18c, 17.8, 32.84; 36c, 15.2, 34.87; 73c, 13.1, 35.35; 147c, 12.2, 35.48.
1266 Cape May II, 38.41, 74.42; VI/27, 17h:—D26: 0, 19.8, 31.90; 10, 19.6, 31.91; 20, 11.3, 32.99.
1267 Cape May III, 38.32, 74.26; VI/27, 20h:—D45: 0, 20.3, 32.23; 9c, 20.1, 32.29; 19c, 15.6, 32.84; 37c, 8.9, 33.22.
1268 Cape May IV, 38.23, 74.08; VI/27, 23h:—D64: 0, 19.1, 32.94; 9c, 19.5, 32.90; 18c, 17.4, 33.01; 44c, 7.8, 33.51.
1269 Barnegat I, 39.44, 73.46; VI/28, 14h:—D25: 0, 19.6, 31.62; 10, 19.1, 32.01; 20, 12.8, 32.65.
1270 New York I, 40.22, 73.48; VI/28, 20h:—D32: 0, 19.4, 31.22; 10, 17.2, 31.74; 25, 7.8, 32.79.
1271 New York II, 40.06, 73.22; VI/29, 0h:—D45: 0, 18.8, 31.53; 10, 17.9, 31.83; 20, 10.2, 32.18; 40, 7.0, 32.81.
1272 New York III, 39.49, 73.00; VI/29, 5h:—D76: 0, 18.5, 32.87; 10, 18.3, 31.87; 20, 10.6, 32.70; 40, 6.7, 33.06; 70, 6.5, no sal.
1273 New York IV, 39.31, 72.37; VI/29, 9h:—D87: 0, 17.7, 32.48; 10, 16.6, 32.43; 19c, 10.2, 32.84; 39c, 6.8, 32.97; 77c, 6.0, 33.31.
1274 Shinnecock II, 40.08, 72.26; VI/29, 16h:—D67: 0, 19.4, 31.60; 10, 16.8, 31.56; 20, 9.8, 32.75; 40, 6.0, 33.08; 60, 6.0, 33.08.
1275 Shinnecock I, 40.45, 72.21; VI/29, 23h:—D41: 0, 17.3, 31.65; 10, 16.6, 31.74; 20, 7.7, 32.66; 35, 6.3, 32.90.
1276 Montauk I, 40.56, 71.50; VI/30, 5h:—D35: 0, 15.0, 31.08; 10, 14.8, 31.27; 20, 11.2, 32.05; 30, 7.9, 32.39.
1277 Montauk II, 40.35, 71.43; VI/30, 11h:—D68: 0, 18.3, 32.03; 10, 16.7, 32.12; 20, 8.3, 32.75; 40, 5.6, 32.88; 60, 5.5, 33.13.
1278 Montauk III, 40.14, 71.36; VI/30, 16h:—D80: 0, 18.3, 32.31: 10, 18.0, 32.14; 19c, 14.3, 32.48; 38c, 6.3, 32.79; 77c, 6.2, 33.40.
1279 Montauk IV, 40.02, 71.33; VI/30, 19h:—D99: 0, 18.1, 32.36; 10. 16.4, 32.39; 19c, 12.5, 32.97; 38c, 6.3, 32.94; 87c, 9.3, 34.43.
1280 Martha's Vineyard IV, 40.02, 70.41; VII/1, 3h:—D195: 0, 15.7, 33.05; 10, 13.9, 33.18; 20, 12.2, 33.12; 50, 8.5, 34.05; 100, 11.2, 35.14; 175, 10.5, 35.32.
1281 Martha's Vineyard III, 40.22, 70.40; VII/1, 8h:—D100: 0, 15.3, no sal.; 10, 13.9, no sal.; 20, 10.3, no sal.; 30, 7.8, no sal.; 50, 7.2, no sal.; 90, 8.0, no sal.
1282 Martha's Vineyard II, 40.41, 70.42; VII/1, 14h:—D61: 0, 16.8, no sal.; 10, 15.5, no sal.; 20, 11.0, no sal.; 30, 7.3, no sal.; 55, 6.2, no sal.
1283 Martha's Vineyard I, 41.00, 70.52; VII/1, 18h:—D51: 0, 17.3, 32.48; 10, 16.5, 32.48; 20, 11.1, 32.66; 30, 8.8, no sal.; 45, 7.3, 33.01.

Cruise of July 16 to 24, 1932, Stations 1288 to 1328, Atlantis Series

1288 Montauk I, 40.56, 71.50; VII/16, 23h:—D37: 0, 17.3, 32.16; 9c, 14.2, 31.78; 19c, 10.2, 32.34; 28c, 8.4, no sal.

1289 Montauk II, 40.34, 71.42; VII/17, 3h:—D66: 0, 19.8, 31.60; 9c, 18.6, 31.58; 19c, 9.4, 32.56; 28c, 6.2, 32.74; 56c, 5.3, 32.72.

1290 Montauk III, 40.14, 71.36; VII/17, 8h:—D83: 0, 21.2, 31.91; 9c, 20.9, 31.85; 19c, 18.6, 31.92; 28c, 8.1, 32.68; 47c, 6.1, 32.86; 71c, 6.2, 33.22.

1291 Montauk IV, 40.02, 71.33; VII/17, 12h:—D87: 0, 20.7, 32.34; 10, 20.4, 32.23; 20, 13.7, 32.63; 30, 9.3, 32.74; 50, 5.5, 32.86; 80, 7.1, 33.44.

1292 Shinnecock III, 40.05, 72.10; VII/17, 17h:—D71: 0, 21.5, 31.71; 10, 20.6, 31.55; 20, 11.4, 32.43; 30, 7.4, 32.64; 65, 5.2, 32.86.

1293 Shinnecock II, 40.22, 72.27; VII/17, 21h:—D49: 0, 20.5, 31.71; 10, 20.4, 31.85; 20, 8.2, 32.65; 30, 6.5, 32.74; 40, 5.8, 32.84.

1294 Shinnecock I, 40.38, 72.43; VII/18, 1h:—D35: 0, 18.9, 31.55; 10, 17.5, 32.10; 20, 12.4, 31.55; 30, 7.6, 32.56.

1295 New York I, 40.22, 73.48; VII/18, 10h:—D45: 0, 21.5, 32.20; 10, 21.3, 32.09; 20, 8.4, 32.45; 30, 8.2, 32.59; 40, 7.6, 32.68.

1296 New York II, 40.06, 73.22; VII/18, 14h:—D40: 0, 22.1, 31.74; 10, 21.5, 31.82; 20, 17.9, 31.87; 30, 7.2, 32.83.

1297 New York III, 39.46, 73.00; VII/18, 19h:—D69: 0, 22.4, 31.80; 10, 21.8, 31.85; 20, 13.7, 32.21; 30, 7.6, 32.18; 60, 6.3, 33.03.

1298 New York IV, 39.33, 72.38; VII/18, 22h:—D73: 0, 22.2, 32.10; 9c, 21.9, 32.00; 18c, 17.3, 32.14; 26c, 9.1, 32.66; 44c, 5.6, 32.90; 62c, 6.2, 33.21.

1299 New York V, 39.20, 72.25; VII/19, 2h:—D200: 0, 21.0, 32.29; 9c, 21.2, 32.14; 19c, 18.0, 32.57; 28c, 15.3, 32.99; 56c, 8.8, 33.74; 112c, 11.1, 35.05; 169c, 8.2, 34.97.

1300 Martha's Vineyard IV, 40.02, 70.33; VII/19, 15h:—D123: 0, 18.1, 32.57; 9c, 18.6, 32.52; 19c, 15.8, 32.63; 28c, 13.5, 32.63; 56c, 9.6, 33.77; 112c, 11.0, 34.02.

1301 Martha's Vineyard III, 40.22, 70.51; VII/19, 20h:—D82: 0, 19.9, 32.38; 9c, 19.9, 32.32; 18c, 15.0, 32.61; 28c, 12.4, 32.97; 45c, 9.1, 33.40; 68c, 8.4, 33.73.

1302 Martha's Vineyard II, 40.44, 70.46; VII/20, 0h:—D57: 0, 20.2, 32.23; 10, 18.3, 32.23; 20, 9.0, 32.61; 30, 7.5, 32.66; 50, 6.8, 32.81.

1303 Martha's Vineyard I, 41.01, 70.52; VII/20, 4h:—D48: 0, 18.1, 32.48; 10, 13.6, 32.45; 20, 9.1, 32.57; 30, 7.9, 32.92; 40, 7.7, 32.61.

1304 Nantucket Shoals I, 40.50, 70.07; VII/20, 12h:—D34: 0, 15.1, 32.61; 10, 12.2, 32.57; 25, 11.6, 32.57.

1305 Nantucket Shoals II, 40.38, 69.36; VII/20, 16h:—D55: 0, 16.2, 32.70; 10, 14.1, 32.68; 20, 9.9, 32.84; 30, 9.3, 32.83; 45, 8.7, 32.95.

1306 Nantucket Shoals III, 40.11, 69.32; VII/20, 21h:—D91: 0, 18.2, 33.04; 10, 17.6, 32.90; 20, 12.2, 33.06; 30, 11.5, 33.10; 50, 7.8, 33.30; 80, 8.9, 34.16.

1307 South Channel IV, 40.22, 68.54; VII/21, 2h:—D91: 0, 17.1, 32.95; 10, 16.3, 32.92; 20, 11.1, 32.79; 30, 8.6, 32.65; 50, 7.3, 33.19; 80, 7.5, 33.28.

1308 Western Georges III, 40.34, 68.26; VII/21, 7h:—D88: 0, 16.8, 32.68; 10, 15.2, 32.63; 20, 12.4, 32.63; 30, 9.2, 32.75; 50, 7.6, 32.86; 80, 7.2, 33.28.

1309 Western Georges II, 40.57, 68.24; VII/21, 12h:—D35: 0, 13.0, 32.95; 10, 12.9, 32.72; 20, 12.9, 32.97.

1310 Western Georges I, 41.23, 68.42; VII/21, 16h:—D94: 0, 13.4, 32.66; 10, 10.4, 32.92; 19c, 9.6, 32.52; 29c, 8.8, 32.99; 48c, 6.7, 32.65; 77c, 4.5, 32.81.

1311 South Channel II, 41.10, 69.13; VII/21, 21h:—D58: 0, 18.0, 32.32; 10, 6.3, 32.52; 20, 5.6, 32.57; 30, 5.6, 32.62; 45, 5.6, 32.59.

1312 South Channel I, 41.24, 69.26; VII/22, 0h:—D41: 0, 14.7, 32.12; 10, 10.4, 32.29; 20, 8.5, 32.36; 35, 6.9, 32.43.

1313 Chatham, 41.36, 69.44; VII/22, 3h:—D39: 0, 17.4, 31.82; 10, 14.1, 32.08; 20, 6.0, 32.32; 30, 5.3, 32.36.

1314 Nauset, 41.54, 69.52; VII/22, 7h:—D43: 0, 16.7, 31.92; 10, 8.6, 32.14; 20, 6.4, 32.25; 35, 6.1, 32.20.

1315 Stellwagen, 42.08, 70.18; VII/22, 11h:—D59: 0, 19.1, 31.78; 10, 16.4, 31.87; 19c, 11.4, 32.15; 29c, 6.2, 32.09; 48c, 4.4, 31.47.

1316 Cape Cod Bay, 41.56, 70.20; VII/22, 15h:—D38: 0, 20.6, 31.74; 9c, 19.1, 31.69; 18c, 6.7, 32.20; 26c, 4.9, 32.20.

1317 Boston Light, 42.20, 70.36; VII/22, 20h:—D61: 0, 16.1, 31.89; 10, 15.7, 31.83; 19c, 8.2, 32.05; 29c, 5.7, 32.32; 39c, 5.0, 32.31; 53c, 4.4, 32.32.

1318 Stellwagen, 42.22, 70.18; VII/22, 23h:—D26: 0, 16.2, 31.91; 10, 16.3, 31.69; 20, 7.9, 32.20.

1319 Cape Ann II, 42.38, 70.12; VII/23, 3h:—D70: 0, 16.0, 31.83; 10, 16.1, 31.69; 20, 14.0, 31.87; 30, 6.4, 32.29; 60, 4.4, 32.54.

1320 Cape Ann I, 42.38, 70.28; VII/23, 6h:—D109: 0, 14.7, 31.73; 10, 14.3, 31.82; 20, 6.6, 32.21; 30, 4.8, 32.34; 60, 4.5, 32.29; 90, 4.3, 32.32.

1321 Newburyport, 42.48, 70.42; VII/23, 10h:—D38: 0, 13.7, 31.33; 10, 10.0, 31.94; 20, 6.5, 32.12; 30, 5.8, 32.21.

1322 Boon Island I, 43.06, 70.24; VII/23, 14h:—D68: 0, 13.0, 31.74; 10, 12.8, 31.76; 19c, 6.8, 32.21; 29c, 5.9, 32.25; 48c, 5.1, 32.25.

1323 Cape Elizabeth I, 43.30, 70.07; VII/23, 19h:—D75: 0, 14.0, 31.51; 10, 12.6, 31.82; 20, 8.1, 32.25; 30, 6.1, 32.25; 40, 6.0, 32.23; 60, 5.6, no sal.

1324 Cape Elizabeth II, 43.20, 69.53; VII/23, 23h:—D178: 0, 16.1, 31.31; 9c, 15.9, 31.36; 19c, 9.0, 32.29; 28c, 7.5, 32.52; 76c, 4.6, 32.77; 152c, 5.5, 33.57.

1325 Boon Island II, 43.00, 70.04; VII/24, 4h:—D55: 0, 16.4, 32.01; 10, 11.0, 32.07; 20, 7.9, 32.41; 30, 6.2, 32.39; 45, 4.6, 32.52.

1326 Cape Ann III, 42.38, 69.38; VII/24, 9h:—D244: 0, 18.1, 31.73; 10, 17.9, 31.82; 19c, 11.9, 32.38; 29c, 8.4, 32.65; 48c, 5.0, 32.74; 97c, 4.5, 33.03.

1327 Highland Lt. II, 42.11, 69.27; VII/24, 15h:—D163: 0, 19.7, 31.96; 9c, 18.3, 32.01; 18c, 11.4, 32.29; 27c, 7.1, 32.59; 45c, 5.0, 32.83; 91c, 4.7, 33.06.

1328 Chatham II, 41.38, 69.00; VII/24, 21h:—D141: 0, 18.7, 31.94; 9c, 18.8, 32.07; 19c, 10.4, 32.41; 28c, 6.5, 32.75; 47c, 4.5, 32.81; 94c, 4.8, 33.21.

Cruise of September 3 to 10, 1932, Stations 1373 to 1399, Atlantis Series

1373 Chesapeake V, 36.25, 74.28; IX/3, 6h:—D1898: 0, 26.7, 33.62; 25, 26.3, 35.80; 49c, 16.9, 35.58; 99c, 12.4, 35.44; 198c, 10.2, 35.27; 294c, 8.1, 35.08; 387c, 6.4, 35.01; 577c, 4.6, 34.96; 761c, 4.2, 34.96; 839c, 4.0, 34.94; 1052c, 3.8, 34.95; 1177c, 3.6, 34.95; 1471c, 3.4, 34.94.

1374 Chesapeake IV, 36.35, 74.42; IX/3, 10h:—D275: 0, 26.6, 33.37; 25, 20.2, 34.82; 50, 10.0, 34.03; 100, 12.5, 35.36; 249c, 9.9, 35.26.

1375 Chesapeake III, 36.41, 75.03; IX/3, 13h:—D32: 0, 26.8, 33.11; 10, 25.3, 33.29; 25, 17.4, 33.80.

1376 Chesapeake II, 36.51, 75.21; IX/3, 16h:—D25: 0, 26.9, 33.07; 10, 26.8, 33.10; 23c, 14.0, 33.54.

1377 Chesapeake I, 36.58, 75.40; IX/3, 18h:—D18: 0, 27.0, 33.10; 15, 24.8, 33.40.

1378 Winterquarter I, 37.45, 75.06; IX/4, 4h:—D31: 0, 26.0, 33.07; 10, 25.9, 32.94; 25, 15.1, 33.53.

1379 Winterquarter II, 37.40, 74.48; IX/4, 8h:—D48: 0, 25.9, 32.48; 10, 25.9, 32.44; 20, 24.2, 32.96; 45, 9.0, 33.15.

1380 Winterquarter III, 37.30, 74.18; IX/4, 12h:—D454: 0, 26.0, 32.93; 25, 23.4, 34.62; 49c, 8.2, 33.30; 97c, 11.1, 34.77; 196c, 11.0, 35.38; 295c, 9.2, 35.18; 418c, 7.9, 35.08.

1381 Cape May V, 38.05, 73.24; IX/4, 22h:—D2100; 0, 25.6, 34.04; 25, 24.2, 34.87; 50, 15.5, 35.27; 100, 12.7, 35.48; 200, 10.1, 35.30; 300, 8.0, 35.10; 400, 6.2, 35.03; 600, 4.6, 34.99; 800, 4.1, 34.96; 1000, 3.8, 34.96; 1200, 3.6, 34.95; 1600, 3.4, 34.94; 2000, 3.3, 34.94.

1382 Cape May IV, 38.13, 73.41; IX/5, 3h:—D164: 0, 25.1, 32.22; 25, 22.6, 34.82; 50, 6.5, 33.12; 100, 12.2, 35.00; 150, 11.8, 35.36.

1383 Cape May III, 38.23, 74.02; IX/5, 7h:—D70: 0, 25.2, 32.23; 20, 24.5, 32.20; 40, 9.1, 33.07; 65, 7.0, 33.15.

1384 Cape May II, 38.28, 74.30; IX/5, 10h:—D43: 0, 25.3, 32.38; 20, 16.5, 32.75; 40, 9.4, 33.05.

1385 Cape May I, 38.40, 74.40; IX/5, 14h:—D24: 0, 23.0, 32.38; 20, 12.6, 32.94.

1386 Atlantic City I, 39.23, 74.07; IX/5, 21h:—D22: 0, 24.4, 32.18; 20, 10.6, 32.55.

1387 Atlantic City II, 39.14, 73.52; IX/5, 24h:—D35: 0, 24.6, 32.48; 12c, 24.5, no sal.; 32c, 9.8, 32.78.

1388 Atlantic Ciy III, 39.01, 73.26; IX/6, 4h:—D68: 0, 24.6, 32.31; 20, 18.2, no sal.; 40, 6.2, 32.95; 60, 6.2, no sal.

1389 Atlantic City IV, 38.45, 72.56; IX/6, 10h:—D675: 0, 25.3, 33.30; 25, 24.7, 34.78; 49c, 17.2, 35.17; 98c, 12.4, 35.32; 197c, 10.9, 35.38; 295c, 7.8, no sal.; 393c, 5.7, no sal.; 616c, 4.5, no sal.

1390 New York V, 39.08, 72.00; IX/6, 18h:—D1640: 0, 25.4, 33.37; 24c, 25.2, 35.02; 47c, 17.3, 34.96; 95c, 12.8, 35.45; 190c, 10.7, 35.35; 283c, 8.1, 35.10; 391c, 6.2, 35.02; 579c, 4.6, 34.96; 791c, 4.1, 34.96; 1006c, 3.9, 34.95.

1391 New York IV, 39.24, 72.18; IX/6, 22h:—D164: 0, 24.4, no sal.; 24c, 20.8, 32.57; 47c, 14.1, no sal.; 93c, 12.8, 35.48; 140c, 12.0, 35.49.

1392 New York III, 39.37, 72.44; IX/7, 3h:—D73: 0, 24.4, 32.61; 20, 22.3, 34.20; 39c, 6.7, no sal.; 64c, 6.0, 32.90.

1393 New York II, 39.53, 73.22; IX/7, 8h:—D45: 0, 22.0, 31.75; 20, 8.5, 32.70; 40, 6.4, 32.80.

1394 New York I, 40.14, 73.42; IX/7, 13h:—D32: 0, 22.8, 32.10; 25, 10.5, 32.56.

1395 Shinnecock I, 40.43, 72.23; IX/7, 23h:—D37: 0, 21.4, 32.31; 15, 21.4, 32.03; 35, 9.2, 32.68.

1396 Shinnecock II, 40.29, 72.06; IX/8, 2h:—D61: 0, 22.9, 32.05; 17c, 22.9, 31.89; 37c, 7.6, 32.83; 56c, 6.4, 32.84.

1397 New York IV, 39.27, 72.27; IX/9, 16h:—D130: 0, 19.2, 33.87; 15, 19.1, 33.60; 30, 19.0, 33.73; 45, 9.5, 33.16; 60, 8.2, 33.10; 75, 8.7, 33.58; 90, 9.7, 34.15; 105, 10.4, 34.49; 120, 10.3, 34.46.

1398 Martha's Vineyard VI, 39.42, 70.52; IX/10, 8h:—D2225: 0, 20.7, 35.44; 23c, 20.8, 35.23; 45c, 20.8, 35.22; 60c, 12.9, no sal.; 70c, 11.8, 34.74; 85c, 11.8, 34.99; 91c, 11.4, 34.98; 180c, 10.6, 35.36; 275c, 8.0, 35.10; 373c, no temp., 34.99; 562c, 4.6, no sal.; 750c, 4.3, 34.96; 958c, 3.9, 34.97; 1153c, 3.7, 34.94; 1546c, 3.4, 34.94; 1565c, 3.5, no sal.; 1585c, 3.4, no sal.; 1942c, 3.3, 34.96.

1399 Montauk IV, 40.00, 71.27; IX/10, 19h:—D105: 0, 17.6, 34.14; 25, 17.4, 34.01; 50, 15.7, 33.85; 75, 9.6, 34.26; 100 no temp., 34.36.

Cruise of November 30 to December 22, 1932, Stations 1417 to 1450, Atlantis Series

1417 Bodie Island III, 36.01, 74.48; XI/30, 16h:—D132: 0, 17.4, 35.24; 25, 17.3, 35.26; 50, 17.4, 35.34; 75, 17.6, 35.57; 100, 16.9, 36.09.

1418 Bodie Island IV, 35.57, 74.32; XI/30, 19h:—D1820: 0, 18.6, 35.52; 24c, 18.2, 35.39; 48c, 18.5, 35.45; 72c, 18.4, 35.49; 96c, 15.6, 35.91; 144c, 13.5, 35.70; 192c, 11.9, 35.48; 288c, 9.5, 35.24; 385c, 7.6, 35.12; 472c, 6.7, 35.05; 566c, 6.0, 35.01; 661c, 4.7, 34.98; 755c, 4.2, 35.12; 866c, 4.1, 34.97; 967c, 3.9, 34.97; 1068c, 3.8, 34.99; 1171c, 3.8, 35.15; 1379c, 3.7, 34.96; 1590c, 3.6, 35.01.

1419 Bodie Island V, 35.55, 74.07; XII/1, 0h:—D2494: 0, 18.5, 35.41; 25, 19.2, 35.34; 50, 19.1, 35.42; 75, 19.1, 35.34; 124c, 18.7, 36.45; 174c, 16.2, 36.15; 223c, 12.5, 35.59; 323c, 9.9, 35.26; 422c, 7.7, 35.09; 522c, 6.0, 35.04; 647c, 4.9, 34.99; 732c, 4.5, 34.98; 837c, 4.2, 34.99; 942c, 4.0, 34.98; 1047c, 3.9, 34.97; 1152c, 3.8, 34.97; 1257c, 3.7, 34.96; 1395c, 3.6, 34.96; 1596c, 3.5, 34.96; 1996c, 3.3, 34.97.

1436 Cape May V, 38.00, 73.24; XII/19, 9h:—D2141: 0, 14.9, 35.41; 25, 14.9, 35.39; 50, 14.9, 35.37; 75, 14.8, 35.37; 100, 14.8, 35.40; 150, 13.0, 35.61; 200, 11.9, 35.50; 300, 9.4, 35.20; 400, 7.1, 35.05; 489c, 5.6, 34.99; 588c, 4.7, 34.97; 687c, 4.4, 34.97; 787c, 4.2, 34.97; 887c, 4.1, 34.97; 987c, 4.0, 34.97; 1088c, 3.8, 34.96; 1189c, 3.7, 34.94; 1388c, 3.6, 34.95.

1437 Cape May IV, 38.12, 73.42; XII/19, 13h:—D183: 0, 13.4, 34.91; 25, 13.3, 34.91; 50, 13.4, 34.94; 75, 13.6, 35.06; 100, 13.8, 35.13; 150, 13.4, 35.21.

1438 Cape May III, 38.19, 74.00; XII/19, 16h:—D65: 0, 11.9, 35.17; 25, 12.0, 35.23; 50, 12.1, 35.24.

1439 Cape May II, 38.34, 74.18; XII/19, 19h:—D45: 0, 9.6, 32.96; 17c, 9.6, 32.93; 37c, 9.7, 33.01.

1440 Cape May I, 38.45, 74.41; XII/19, 22h:—D26: 0, 7.1, 32.28; 10, 7.3, 32.29; 20, 7.5, 32.37.

1441 New York I, 40.21, 73.35; XII/20, 13h:—D25: 0, 7.2, 32.38; 10, 7.3, 32.39; 20, 7.3, 32.45.

1442 New York II, 40.08, 73.17; XII/20, 16h:—D40: 0, 8.5, 32.90; 10, 8.4, 33.01; 25, 8.8, 33.09.

1443 New York III, 39.47, 72.51; XII/20, 20h:—D70: 0, 10.8, 33.91; 25, 10.8, 33.91; 50, 10.8, 33.91.

1444 New York IV, 39.36, 72.34; XII/20, 23h:—D82: 0, 12.4, 34.52; 25, 12.5, 34.56; 50, 12.6, 34.57; 75, 13.4, 34.87.

1445 New York V, 39.21, 72.13; XII/21, 2h:—D470: 0, 13.9, 35.28; 25, 13.9, 35.26; 50, 13.9, 35.23; 75, 13.9, 35.24; 100, 14.1, 35.38; 150, 12.8, 35.52; 200, 11.8, 35.44; 300, no temp., 35.16; 400, 7.6, 35.06.

1446 Martha's Vineyard V, 39.41, 70.37; XII/21, 13h:—D1930: 0, 15.0, 35.67; 20, 16.0, 35.67; 41c, 16.0, 35.68; 61c, 15.9, 35.68; 81c, 15.9, 35.68; 122c, 12.8, 35.56; 162c, 12.3, 35.50; 243c, 11.6, 35.44; 324c, 9.6, 35.26; 441c, 6.5, 35.03; 538c, 5.3, 34.98; 637c, 4.6, 34.96; 740c, 4.3, 34.95; 845c, 4.1, 34.95; 953c, 3.9, 34.96; 1063c, 3.8, 34.95; 1177c, 3.8, 34.96; 1413c, 3.6, 34.94.

1447 Martha's Vineyard IV, 40.00, 70.36; XII/21, 17h:—D220: 0, 14.9, 35.38; 24c, 15.0, 35.28; 49c, 15.3, 35.45; 73c, 15.2, 35.54; 97c, 15.1, 35.52; 136c, 14.4, 35.63, 175c, 12.0, 35.49.

1448 Martha's Vineyard III, 40.14, 70.44; XII/21, 17h:—D116: 0, 14.9, 35.34; 25, 14.7, 35.22; 50, 14.7, 35.24; 75, 14.8, 35.26; 100, 14.8, 35.22.

1449 Martha's Vineyard II, 40.40, 70.57; XII/21, 23h:—D66: 0, 8.0, 32.98; 25, 8.7, 32.97; 50, 10.3, 33.50.

1450 Martha's Vineyard I, 40.56, 70.57; XII/22, 0h:—D54: 0, 8.4, 32.78; 20, 8.3, 32.76; 40, 8.4, 32.79.

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