calibrated against the dry-bulb thermometer. Readings were taken from well forward in the "eyes" of the ship, the Assmann being held on the weather side and readings taken every half minute until two consecutive readings were identical.

The points as plotted in the accompanying graph indicate temperatures less than that of the sea surface and having a diurnal range of similar magnitude to that of the sea temperature, namely 3° F. The premaximum rate of increase appears to be less than that of the sea temperatures, while the slope of the line indicating its rate of decrease in temperature after the maximum is almost parallel to that of the sea temperature for a corresponding period.

As indicated by the values for the 15th–16th, the maximum air temperature is reached about one hour after the corresponding point for the sea temperature, while a similar interval occurs between the hours of minimum temperature. This is to be expected by reason of the temperature superiority displayed throughout by the sea surface and corresponds to what occurs over the land But since the temperature superiority of sea water over the air above it is less than for corresponding day times in the case of land, the lag of the air temperature would be expected to be of a lower order.

The fog off Ras el Tin on the night of the 14th–15th is clearly manifested by the record of the relative humidities. Apart from this phenomenon, the record indicated a distinct diurnal variation in the relative humidity of the air, with a maximum at sunrise on the 15th and a minimum in the afternoon of the same day.

As regards the temperature gradient between 13 feet and 71 feet above sea level. The apparatus used was identical with that described by N. K. Johnson in his article in the Quarterly Journal.[4]

In brief the apparatus consisted of a pair of platinum resistance thermometer elements, placed one over the bow of the ship, 13 feet above the water, and the other at the masthead at a height of 71 feet. Both elements were protected from incoming solar radiation and were aspirated at a constant rate by means of two fans and lengths of tubing. By adapting a Wheatstone bridge circuit, the *difference* between the resistance of the two elements could be ascertained, and hence the difference in temperature at the two heights. Although originally designed to measure only to the nearest 0.1° C., it was found that the instrument was surprisingly accurate to 0.01° C.

Although not clearly portrayed, there are indications in the results obtained during the voyage of the following:

(*a*) A decrease in the lapse rate as midnight, 14th–15th, is approached. This might be expected from the fact that at midnight fog conditions abounded and the temperature of the sea and that of the air at 20 feet were equal.

(*b*) There are indications of a decrease in the lapse rate at sunrise on the 15th, a steady lapse rate thence to midday, when the lapse rate gradually increased until sunset.

[4] Quarterly Journal Meteorological Society, vol. 53, No. 221.

Meteorological data for October 14, 15, and 16

Time	1400	1600	1700	1900	2200	Midnight	0300	0600	0800	1000	1200	1300	1400	1600	1700	1920	2100	2300	0100	0400	0600	0730	0845
Sea temperature	73.4	73.9	73.3	72.9	72.7	71.8	74.3	74.4	75.5	75.5	77.1	77.1	77.1	76.9	76.3	76.3	76.2	76.1	75.8	75.0	75.1	75.5	75.4
Air temperature	72.8	72.4	72.3	72.2	72.0	71.7	73.0	73.3	73.6	73.8	74.3	74.3	74.5	74.4	74.0	73.8	73.5	73.0	73.1	72.5	72.1	72.0	72.2
Temperature gradient	−.20	------	−.23	−.22	−.21	------	−.24	−.21	−.22	−.21	------	------	−.24	------	−.26	------	------	------	−.23	−.21	------	------	------
Wind (m./sec.)	3	------	3	4	4	8	6	7	------	------	------	------	4	3	------	3	------	0–1	------	3	2	------	4
Relative humidity	82	86	84	88	92	94	81	84	82	82	78	75	76	75	76	74	74	72	75	73	77	77	77

Sea and air temperatures are in degrees Fahrenheit. Temperature gradient is measured in degrees centigrade, negative values indicating a lapse rate between 13 and 71 feet above water level. Times are in zone times. (See text.)

ICE FORECASTING BY MEANS OF THE WEATHER

[Reprinted from U. S. Coast Guard Bulletin No. 15, "International ice observations and ice patrol service in the North Atlantic"]

One of the most important scientific problems that has confronted the ice patrol for some time is the desire to obtain advance information regarding the annual amount of ice to be expected south of Newfoundland. If the master of the *Titanic* had known, as we can clearly see to-day, that the year 1912 was one in which icebergs by the hundreds invaded the North Atlantic to low latitudes, he would probably have navigated his command farther south, and more cautiously, past the Arctic ice barrier. The amount of ice drifting out of the north into the open Atlantic is subject to great annual variations; for instance, in 1912 there were approximately 1,200 bergs counted south of Newfoundland while in 1924 there were only a total of 11. Several investigations have been made of the relation between the amounts of ice in the northeastern North Atlantic and logical contributary factors, but only a few similar papers have dealt with the ice stream past Newfoundland.

All of the investigators, Schott, Mecking, Brenneck, Weisse, and Meinardus found that the wind was the most important factor which governs the southward drift of polar ice. The ice patrol, with the assistance of the British Meteorological Office and more recently the United States Weather Bureau, has begun an investigation into the effect of the weather upon the distribution of icebergs. It is desired, therefore, under this section devoted to weather to give a brief account of the results so far of this research work. The period embraces 47 years, 1880–1926, a series of sufficient length to permit mathematical correlation, and in this respect it has an advantage over previous works.

The results differ somewhat from those previously obtained by Mecking in that the chief importance is assigned to the variations of the pressure difference between Belle Isle, in Newfoundland, and Ivigtut, in southern Greenland, during the period December to March. The pressure difference directly affects the amount of field ice, and it has been found that there is a very close relation between the amount of field ice and the number of bergs south of Newfoundland. The field ice tends to act as a fender along the shoreward side of the Labrador current, and thus more or less prevents the bergs from stranding as they are borne southward. The truth of this statement was curiously revealed during the 1924 patrol, when the unusual absence of field ice left the season's crop of bergs to strand in northern waters. When the sea ice recedes northward, due to melting in May, the coast line becomes more and more exposed. Stranding takes place on a great scale, and the consequent supply of bergs to the Grand Banks is cut off. The iceberg menace to steamships in the North Atlantic would be greatly diminished, or practically disappear, if sea ice did not hamper the North American coast line from February to March every year. The pressure difference between Bergen and Stykkisholm during the period October to January was also found to be of importance.

The use of pressure difference between various points furnishes the best data for forecasting purposes, because there is no room for the personal bias which may come in when charts are classified according to types. A classification of the charts of pressure anomaly over the North Atlantic during the period December to March has, however, been made, and this distinctly reveals two types of pressure distribution—a plus-type, in which an excess of pressure centered in the region of Iceland, more or less dominates the Atlantic north of the Azores (see fig. 8a, p. 46), and a minus type when reverse conditions

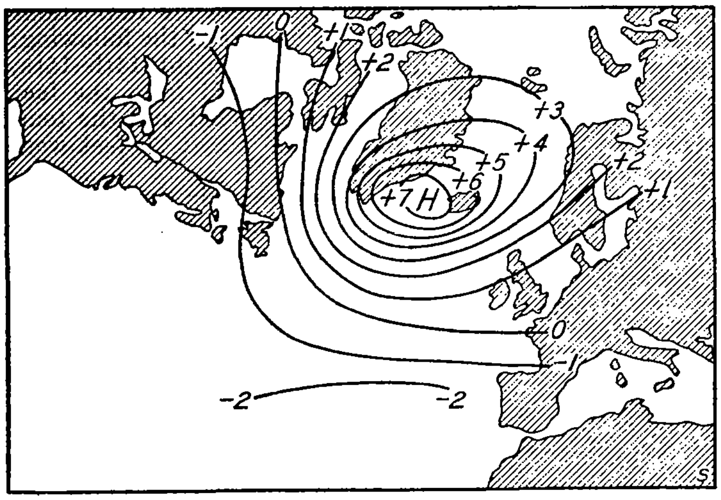

FIG. 1.—Pressure departure map-plus type. Made by averaging the December to March pressure departures for 1881, 1891, 1895, 1900, 1902, and 1917. These years were characterized by a smaller amount of Arctic ice drifting into the western Atlantic than usual

prevail (see fig. 8b, p. 47). (Reproduced as Figs. 1 and 2 respectively.) The plus type is subject to further classification into (1) and (2), depending upon a relatively great or moderate intensity of the excess pressure mass, both of which are reflected in a relatively very light, or light ice year, respectively, in the western North Atlantic. The minus type, although unmistakably showing a greater amount of ice than normal, does not permit subgrouping. In other words, the plus type of pressure conditions (fig. 1) exhibit a higher correlation with poor ice years than do the minus type (fig. 2) with correspondingly rich ice years. This indicates the presence of other factors such as variations in the air and water temperatures in the far north, or variations in precipitation, or perhaps an unnatural phenomenon such as an ice jam in the Arctic Archipelago.

Although the investigation is not yet completed at the present writing the results already indicate a high degree of success for such a method of ice forecasting. Correlation coefficients have been calculated between the following variables:

(*a*) Number of bergs (on a scale of 0 to 10).
(*b*) Amount of field ice (on a scale of 0 to 10).
(*c*) Pressure difference (in millibars) between Belle Isle and Ivigtut, combined with a deviation of pressure from normal at Stykkisholm during the period December to March. The mean pressure difference is calculated from the combination: $2\times$Dec.$+2\times$Jan.$+1\times$Feb.$+1\times$March and this mean is combined with the pressure deviation at Stykkisholm in the proportion of 6 to 1.
(*d*) The pressure difference between Stykkisholm and Bergen during the period October to January, inclusive, December being given double weight.

The correlation coefficients employed in the preparation of the forecast were as follows:

Between (*a*) and (*b*)	+0.85
Between (*a*) and (*c*)	−0.58
Between (*a*) and (*d*)	−0.63

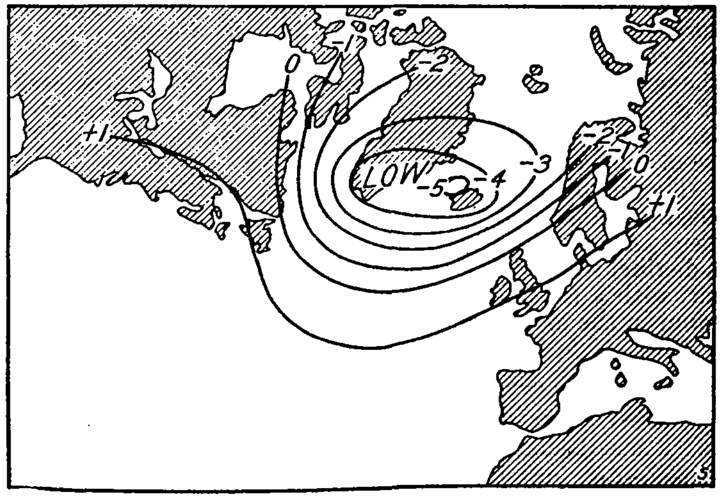

FIG. 2.—Pressure departure map-minus type. Made by averaging the pressure departures for the months December to March in the years 1885, 1890, 1903, 1912, and 1921. These years were characterized by a greater amount of Arctic ice drifting into the western Atlantic than usual

At the end of March a forecast of the number of bergs can be prepared by means of the regression equation:

$$\text{Bergs}=4.8-0.08\ (c)-0.12\ (d)$$

At the end of the field ice season, April 15, the number of bergs, May to July, can be predicted very closely by making use of the high correlation between field ice and bergs.

Arrangements have been made with the United States Weather Bureau whereby that organization furnishes the ice patrol with the pressure data for the months October to March, inclusive, and upon which is based the forecast of bergs for the following spring season. The forecast for the ice season of 1926 was "a light ice year" (3.4 on scale 0–10), while as a matter of record it developed that we experienced very closely to "a normal season 4.3." It is fair to add that we were handicapped in making a forecast due to the absence of pressure data from a very critical area, that of Greenland. This difficulty will probably not arise again, as Greenland meteorological stations are now connected with Europe by means of radio.

OUTLINE OF THE ARTICLE ON "THE CLIMATIC REGIONS OF EASTERN NORTH AMERICA"[1]

By W. VAN ROYAN

[Clark University, Worcester, Mass., 1927]

Aim of the study: Why the eastern part of America has been treated. Data used: Koeppen's Leading Principles. Criteria used in his classification: The A climates and C, D, and E climates. Comparisons with the vegetation map: The limit of the dry zone. The isotherm to be used for the distinction between hot and cold steppes and deserts. The mountains.

[1] Owing to the fact that the illustrations in the original article as published in the July REVIEW, pp. 315-319, did not have the proper legends, the two line cuts are reproduced here.—EDITOR.