a large amount of heat to be taken up and will correspondingly reduce the temperature of the earth surface.

NORTH ATLANTIC STORMS DURING 1885.

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It is intended to herein show the characteristics of the storms that appeared over the north Atlantic Ocean during 1885, with particular reference to their direction of movement, *rate of progress*, and the extent of territory they traversed, as shown by the storm-track charts and accompanying text published with the MONTHLY SUMMARY AND REVIEW OF INTERNATIONAL METEOROLOGY. The causes which contributed to abnormal movements of storm-areas over the ocean will also be considered, as determined by daily charts containing the data of simultaneous, international observations furnished by shipmasters. Before entering upon a discussion of this subject it is pertinent to state that it is a common belief that a large percentage of the storms which leave the American coast travel across the Atlantic and affect the weather conditions of western Europe. In this connection the storm-track charts show that of the sixty storms which advanced over the ocean from the American continent during the year, twenty-eight, or nearly 47 per cent. were traced to European waters. During the same period fifty-nine storms developed, or first appeared, over the ocean, of which about 65 per cent. were traced to the west coast of Europe.

The general direction assumed by storm-areas in the middle latitudes was east-northeast, and the average time occupied in crossing the ocean was four and six-tenth days; these averages holding good for each month of the year, except March, August, and October, when no storms traversed the ocean from coast to coast.

The direction of movement was due principally to the relative positions of the permanent area of high pressure which occupied the ocean south of the fortieth parallel, and the area of low pressure which appeared each month to the northward of the fiftieth parallel, the monthly positions of which, together with the mean barometric pressures as shown by the encircling isobars, being given in the following table:

Month.	Positions of centres of mean high barometer areas.			Positions of centres of mean low barometer areas.		
	Latitude.	Longitude.	Barometric pressure.	Latitude.	Longitude.	Barometric pressure.
1885.			*Inches.*			*Inches.*
January	N. 30	W. 55	30.20	N. 60	W. 30	29.50
February	25	38	30.10	60	10	29.40
March	40	30	30.30	70	E. 10	29.60
April	35	30	30.20	55	W. 20	29.70
May	30	35	30.10	60	0	29.80
June	35	30	30.20	65	20	29.80
July	38	28	30.30	65	30	29.80
August	30	40	30.10	65	20	30.00
September	35	30	30.20	65	20	29.60
October	40	25	30.20	60	E. 5	29.70
November	30	40	30.10	55	W. 30	29.60
December	45	0	30.20	70	E. 20	29.40
	30	40	30.10			

This table, in showing the relative positions of mean high and low barometer areas, verifies the fact that areas of low pressure, as a rule, take a north of east course along the west and north margins of high barometer areas, and advance to localites where the barometric pressure is least. It also shows that in March and October, when no storms traversed the ocean, the area of mean high pressure was located over mid-ocean in unusually high latitudes, and that during August the pressure was uniformly high over the entire ocean, and no area of relatively low mean pressure appeared in high latitudes, thus explaining why, in March and October, the storm-areas moved northward before reaching European waters, and in August why, in the absence of a mean low-area in high latitudes and the presence of unusually high average pressure along the middle latitudes, the storm-areas did not move eastward.

The flow of the Gulf Stream also seems to contribute to the normal direction of storms on the Atlantic, and it is found that here, as over other portions of the globe, cyclonic areas are inclined to follow the courses of warm ocean currents. These apparent causes, together with the earth's form and motion, seem to occasion the normal direction of storms over the Atlantic in the vicinity of the trans-Atlantic ship routes.

As regards the rate of progress of storms it may be generally stated that this feature, while depending largely upon the energy possessed by a storm upon leaving the coast seems to depend to a greater extent upon the barometric conditions which exist over the ocean to the eastward. Storm-areas do not pass through high barometer areas, and their forward movement is showed to be barred by areas of high pressure. During the annual movement of the Arctic ice fields over the Banks of Newfoundland the rates of progress as well as the direction of storms in that vicinity are greatly diversified, and while they acquire great energy in that region, a large proportion disperse over mid-ocean. These characteristics may be accounted for by the presence in that locality during the ice season of marked ranges in atmospheric temperature and humidity upon which a storm's strength is dependent, and a comparative absence of these conditions over the ocean to the eastward, whence the storm-areas are apparently forced by high barometer areas advancing from the westward. It would appear, therefore, that a storm's movement, both as regards speed and direction, depends upon its position relative to high barometer areas; its strength, and its position with reference to the warm ocean currents.

The extent of territory traversed by an ocean storm seems to depend not alone upon the conditions above mentioned, but also upon the region wherein it is first developed. It is shown that storms that originate in sections where the elements of their strength were well defined, exhibit a rapid loss of energy after leaving those regions. This fact may be illustrated by the cyclones peculiar to the West Indies during the summer season, which originate near the limits of the belt of equatorial rain and calm and move westward over the Carribbean Sea along the surface of the warm equatorial current and then circle slowly northward and eastward to colder latitudes, where they gradually lose energy and dissipate. It is noticeable that but an insignificant proportion of the storms which advance from southern latitudes cross the Atlantic in the vicinity, or to the northward, of the trans-Atlantic ship routes, and it is equally observable that, as a rule, the storms which do traverse the ocean leave the coast north of the fortieth parallel.

In summing up the above facts it would appear that a knowledge of the barometric conditions over mid-ocean would be necessary to foresee the probable course of a storm leaving the American coast, and that high pressure, north of the fortieth parallel, would prevent a storm from reaching European waters. The changes in position of the permanent area of high barometer which usually occupies the ocean in the vicinity of the Azores are exceedingly slow, and its change of location to more southern latitudes could not be safely calculated upon following its northward movement. It would also appear that the barometric gradient between the regions of high and low pressure constitutes an important factor in calculating the movement of ocean storms, and that storms move toward the region of permanent low pressure. It is also shown that storms of tropical or sub-tropical origin are not calculated to flourish in middle or northern latitudes, and finally that, with conditions over the ocean favorable to their passage, the storms of marked strength which leave the American continent, north of the fortieth parallel, are the ones most likely to affect the weather conditions of Europe. As only forty-seven per cent. of the storms traced during the year from the American coast crossed the ocean, it will be seen that the disturbances which occur in European waters are more generally due to storms which develop over the ocean, sixty-five per cent. of which were traced to Europe.

MEAN TEMPERATURE FROM MAXIMUM AND MINIMUM THERMOMETERS.

Observations of the temperature, taken at hourly intervals, will no doubt furnish a satisfactory basis upon which to construct a mean temperature for for any period. The want of satisfactory registering instruments for recording the temperature for each hour or moment of the day, and the time and expense of making personal hourly observations, makes it impracticable to obtain means at all points from hourly readings. A daily mean, computed from various intermediate observations, has been found satisfactory for purposes of climatology. Of these, a mean of observations made at 7 a. m., 2 p. m., and 9 p. m., or at 7 a. m., 8 p. m., and 11 p. m., have given good results. There are many amateur or voluntary observers who find it inconvenient to even take observations at these hours, and important temperature results from their localities are not available. If such observers can take a single daily reading of registering maximum and minimum thermometers their observation could be used to good advantage for constructing mean temperature. A mean of these two daily readings gives a satisfactory mean temperature for the day. The following table gives a comparison of monthly means obtained at a number of stations from observations taken during the year 1885, at 3 a. m., 7 a. m., 11 a. m., 3 p. m., 7 p. m., and 11 p. m., and means of the daily maximum and minimum temperature. An examination of the table will show that the difference between the two means is scarcely appreciable, with a few exceptions. The discrepancy in annual means for three of the five stations given, viz.: Boston, Buffalo, and Washington is only .°3; for Cincinnati it is .°4; and Chicago, .°5; the mean of the maximum and minimum temperatures being higher at all stations.

Month.	Boston.		Buffalo.		Chicago.		Cincinnati.		Washington.	
	Mean of six observations.	Mean of daily maxima and minima.	Mean of six observations.	Mean of daily maxima and minima.	Mean of six observations.	Mean of daily maxima and minima.	Mean of six observations.	Mean of daily maxima and minima.	Mean of six observations.	Mean of daily maxima and minima.
	°	°	°	°	°	°	°	°	°	°
January	27.2	27.4	20.5	21.0	18.2	18.6	25.9	26.0	33.1	33.7
February	20.5	20.6	13.6	14.6	16.8	17.8	23.2	23.4	26.7	27.0
March	27.9	27.6	19.9	20.4	30.1	31.3	33.4	34.8	34.6	34.8
April	46.7	47.4	39.6	40.7	45.5	46.3	53.0	53.6	53.5	53.6
May	52.4	53.2	53.1	53.8	53.2	53.4	62.2	62.0	62.4	62.4
June	66.6	66.7	61.5	60.8	65.6	65.4	70.2	70.4	71.3	71.3
July	71.4	71.8	70.5	70.0	73.1	73.2	78.0	78.0	78.0	78.4
August	67.4	67.8	65.5	65.0	68.4	68.4	72.7	73.0	73.5	73.9
September	59.9	60.2	61.0	60.2	64.2	64.4	66.0	66.4	66.4	66.6
October	51.4	51.6	49.9	50.0	51.3	51.6	52.6	53.0	55.0	55.4
November	43.7	44.0	40.7	41.1	42.0	42.7	43.7	44.2	45.5	45.4
December	32.8	32.6	30.1	31.1	31.1	31.8	34.9	35.3	37.4	38.1
Annual mean	47.3	47.6	43.8	44.1	46.6	47.1	51.3	51.7	53.1	53.4