disturbance of the normal conditions that may have arisen; to compare the conditions of wind and weather prevailing simultaneously at points of the sea more or less remote from each other; to determine the constant relation, if any, which exists between these conditions; to make plain the manner in which a vessel, beset by foul winds, might have been navigated, with the result that these winds would have been avoided, or even been replaced by fair; and finally to instruct the navigator as to the conclusions to be drawn from his meteorological observations, in order that this result may be accomplished.

It was with a view of combining these two equally essential methods of meteorological investigations—the old, having for its aim the collection of a large number of reliable observations to serve as a basis for the study of the climatological changes as they occur from month to month,—and the new, having for its aim the collection of a large number of daily simultaneous observations to serve as a basis for the study of the weather changes as they actually occur from day to day—that the present form of weather report was adopted. It demands but a single observation per day, instead of the twelve demanded by the Meteorological Journal, this large reduction being made in the hope that the number of observers would increase in the same ratio as the services required of them would diminish, a hope which has proved more than justified. This single observation, however, is to be taken each day over the entire globe at the same instant of time, viz, Greenwich mean noon. The local or ship's time of the observation will thus vary with the longitude.

The daily synoptic weather charts.—The next step is the utilization of the observations in the construction of the daily synoptic weather charts.

A suitable series of outline charts of the various oceans having been prepared and dated, one for every day in the year, the observations contained in the report are plotted, one by one, each in its proper position upon the chart of corresponding date. For this purpose a system symbols is employed which shows at a glance the height of the barometer, the direction and force of the wind, the proportion of clouded sky, the nature of the precipitation, whether rain, snow, or hail, the presence of fog, the character of the weather, etc., all precisely as recorded by the observer, with the exception of the reading of the barometer, which is first corrected for initial error, and (if mercurial) for temperature. For the North Atlantic Ocean, the first reports to reach the office, and consequently the first observations to appear upon the chart, are those returned by the westward bound transatlantic liners. These are closely followed by the slower steamships from Europe and the West Indies, and these in turn by the homeward bound sailing vessels. The last reports to appear are those of eastern Asia. These are sometimes as much as a year late in reaching the Hydrographic Office, owing to the practise of holding them until the return of the vessel to the United States. Masters are therefore earnestly requested to avoid this delay by forwarding their observations on reaching their first port. The contingent furnished by the sailing vessels is of the highest value, as the observations taken aboard the latter are free from certain constant sources of error introduced by the speed of steamships.

As the reports from these various sources accumulate, the plotted observations become more and more densely distributed over the chart, each plotting representing the position of an observing vessel at the instant of Greenwich noon and the conditions prevailing in its vicinity at that instant, until in its final shape the chart for each day offers to view a complete picture of the pressure, wind, and weather covering the entire ocean at the hour and minute of Greenwich mean noon of the day in question.

A word as to the value of such a series of charts to the navigator. As is well known, the governing features of the weather in the extratropical regions of both hemispheres is the practically ceaseless procession of areas of alternately high and low barometer which move around the earth with varying velocity in a general easterly direction, each accompanied by its own system of winds circulating about the center, the direction of the circulation being cyclonic around the area of low barometer, anticyclonic around the area of high. The synoptic charts of the various oceans enable us to follow up the movement of these areas from day to day, to mark the changes which take place in them, and to study the effect of these changes in modifying the weather. It is from this source that the path followed by each of the several barometric depressions that occur during the month, as given on the Pilot Charts of the North Atlantic Ocean, is derived, the aim in thus displaying the daily movement of the storm centers being not only that mariners may have at hand the means of explaining in accordance with the law of storms the occurrence of any heavy weather encountered, but also that by studying this feature of the Pilot Chart, seeing track after track repeat itself with some slight modifications, they may come to know in what part of the ocean to expect disturbances, what will be their character, extent, and duration, and what the direction and velocity of motion of the vortex.

It is, however, in the light of the assistance with which careful study of these charts will ultimately furnish the mariner in properly interpreting his own isolated observations, that they have their main value. If we look through a series of such charts, the first impression gained is that they are of endless variety, each one being apparently a law unto itself. Close observation, however, will soon reveal certain points of similarity, especially in the position and extent of the areas of high barometer, and consequently in the outflowing winds which surround them, a given distribution of pressure often appearing to hold sway for several days in succession, only to be supplanted by some quite different but equally persistent arrangement. Careful study has thus shown that the daily synoptic weather charts of the North Atlantic Ocean may, with certain restrictions, all be referred to one or another of a limited number of types, each type possessing certain characteristic features, which vary from season to season, and each exhibiting a certain degree of persistency.

It is upon the study of these *types* of weather, their character, duration, and order of succession, that the hope of eventually predicting the weather over the ocean several days in advance rests. Such a study demands that the meteorologist have at hand a series of daily synoptic charts, accurate in every respect, and covering the ocean, especially in the higher latitudes, as widely and as completely as possible, and it is to the merchant marine that he must look for the material necessary for the construction of these charts. Once having attained a knowledge of these types, moreover, the ability of the mariner to forecast the weather from his own isolated observations would be vastly increased. Knowing the type of weather prevailing, his observations of pressure, temperature, winds, and clouds, would gain a new importance, showing whether the type was about to change, and in what direction.

The tabulation of the observations.—Having served their purpose in the construction of the daily synoptic charts, the observations are ready for tabulation. For this purpose the surface of the ocean is supposed to be divided into a number of fields or squares, bounded by the even 5° parallels of latitude and meridians of longitude, 0°, 5, 10°, 15°, etc. The observations are then separated according to months, and all of those within a given square and during a given month (irrespective of the year) are assembled. The next step is to obtain for each month and each square the average temperature of the surface of the sea, the ratio that the winds from each compass point bear to the total number of winds, the average force of the winds, the frequency of the various forms of clouds, varieties of weather and character of the sea, and the average velocity and set of the current. These final values are then carefully tabulated and mapped, and the results given to the seafaring community in the shape of the Monthly Pilot Charts published by the Hydrographic Office.

LUNAR INFLUENCES IN METEOROLOGY.

The admirable elementary treatise on meteorology by Prof. Alfred Angot of the Central Meteorological Bureau in Paris, published in 1899, concludes with a chapter on the prediction of the weather and the regular periodicities that have been sought for in meteorology. After showing that long-range predictions can not yet be made by utilizing any such periods, and that even the sun spots have not yet been shown to have any special influence. Angot adds a paragraphs with reference to the lunar periods, which we translate as follows:

The idea that the moon exerts any influence on meteorological phenomena goes back to the most ancient times; there is no belief that has left more traces in the popular traditions in regard to the weather, nor that has been the subject of more controversy.

Let us recall that the time occupied by a true or sideral revolution of the moon is 27d. 7h. 43m, or 27.322 days; the apparent or synodic period, after which the sun, earth, and moon return to their same respective positions, is a little longer, viz, 29d. 12h. 44m., or 29.531 days, it is after this latter interval that the *phases* of the moon again become the same. The *anomalous revolution* or mean value of the intervals of time separating two consecutive passages of the moon through its shortest distance from the earth, is 27d. 13h. 19m., or 27.555 days. Finally the orbit of the moon has a mean inclination to the ecliptic of 5° 8′ 48′′; the maximum declination of the moon. therefore, varies between 18° 10′ and 28° 45′, while the maximum declination of the sun is 28° 27′.

The moon imparts to us only a very small proportion of the light and heat that she receives from the sun; the heat that she sends toward the earth is so feeble that the most powerful instruments and the most delicate methods of measurement must be employed to discover it; there can, therefore, not be any question of a luminous action of the moon and much less of a caloric action, and we can scarcely think of anything else but an attraction analogous to that produced by the tides on the great masses of water of the oceans. It is, therefore, necessary to first seek to discover whether the action of the moon does produce atmospheric tides that show themselves by the periodic variations in the height of the barometer.

If we observe the pressure at the lunar hours, that is to say, when the moon passes the meridian, and she is distant from it 15°, 30°, 45°, etc., and if we take hourly means of the values observed during a very long period of time, in order to eliminate the disturbances, these means will certainly give an indication of a lunar tide, but extremely feeble; it will only be found at the equatorial stations and disappears entirely in the middle latitudes. At Batavia the maximum pressure occurs a half-hour or an hour after the upper and lower passages of the moon over the meridian; the minimum occurs from six to seven lunar hours after the maximum; the total extent of the variation is only 0.11 millimeter, which corresponds to a column of water of about 1.5 millimeter [or one seven-thousandth part of the standard average atmospheric pressure.—ED.]

The insignificance of the diurnal lunar variation of pressure indicates that this must also be true of the variation corresponding to the revolution of the moon around the earth, that is to say, to the phases of the moon. In Batavia the pressure is the feeblest at the time of new moon and most powerful shortly after the period of full moon; the total extent of this oscillation does not reach 0.2 millimeter. The diurnal rotation and the synodic revolution of the moon therefore cause tides in the atmosphere as well as in the oceans, but the atmospheric tides are so extremely feeble that they scarcely exceed the limit of accuracy of the barometric observations.

The study of the influence of the synodic revolution, or of the phases of the moon, upon other meteorological phenomena produces results which are absolutely contradictory, and which have been discussed in detail by Arago and, more recently, by Van Bebber. We shall, therefore, limit ourselves to summarizing briefly the conclusions arrived at by them.

The temperature, the cloudiness, and storms do not show any periodicity in relation to that of the phases of the moon. In Germany north and northeast winds seem most frequent in the period of the last quarter of the moon and most rare in the first quarter; the southwest winds show an inverse variation. But this law has not been verified in any other countries.

At Paris and in Germany the maximum number of rainy days occurs between the first quarter and the full moon; the minimum number between the last quarter and the new moon. The relation of the maximum to the minimum is 1.26 at Paris and 1.21 in Germany. It would, therefore, at first sight seem that there is here a true law and that the prospects for rain are greater by a fourth or a fifth after the first quarter than after the last. But even this would be too slight a difference to be made use of for a serious forecast. Besides, this law does not hold good for the south of France. At Orange, for example, the minimum of days with rain occurs between the full moon and the last quarter and at Montpellier in the first quarter. If there is any relation between the phases of the moon and the rainfall, this relation is, therefore, very complex and variable from one region to another.

The study of the changes of the weather has produced still less convincing results. In discussing the observations made at Padua in the last century, Toaldo found that, according to the popular belief, the weather is much more variable at the time of new moon than at the other lunar periods. But convinced in advance of the existence of the influence that he wished to demonstrate, Toaldo attributed to the action of the new moon the changes in the weather occurring one or two days either before or after; whereas for the rest of the lunar period each day was considered separately. If now rigorous computations be made, giving to each day the same value, there will no longer be found any trace of the influence of the phases of the moon on the changes of the weather. During the past few years the study of the influence of the moon has been again taken up in a manner apparently more scientific. In the first place, all idea has been abandoned of finding any relations between the meteorological phenomena and the phases of the moon; that is to say, the synodic revolution which represents only the relative positions of the earth, the moon, and the sun. Then the anomalistic revolution was studied, which corresponds better to the respective real positions of the earth and the moon. But, above all, the position of the moon in declination has been compared, not with any special local meteorological phenomenon, such as temperature, rainfall, changes of the weather, etc., but with the distribution of pressure over the surface of the globe as a whole. The fundamental idea of these researches is that the movements of the moon in declination may lead to general displacements of the air, or a balancing between the tropical regions and the higher latitudes, and thus cause periodical changes, such, for example, as in the boundary of the trade winds and in the law of change of pressure with latitude. We should then understand that a movement of a zone of high pressures, for example, might cause fine weather on one side of the zone and at the same time foul weather on the other side, and that these variations, which at first sight seem contradictory, might nevertheless be due to one and the same cause. These studies are, however, of too recent date and still too undeveloped to have already given results that may be considered as sufficiently conclusive and general. It is, however, interesting to mention them here, since by continuing to work in the same lines we may, perhaps, succeed in discovering the true relations between the moon and the phenomena of the weather, since the earlier researches have not brought about any positive conclusion. On the whole, in the present state of our knowledge, it can not be affirmed that the moon does exert any influence upon the weather, but at the same time it should not be denied that this influence may possibly exist. In any case, it would show itself by complex phenomena, such as the displacement of the zones of high and low pressure, and might cause very different results in different regions.

In concluding the examination of the various opinions in regard to the influence of the moon, it may be well to say a word on the opinions concerning the *lune roussee, or harvest moon.* This name has been given to the lunar period which, beginning in April, has its full moon either in the second half of that month or in the month of May; if there are two new moons in April it is with the second that the harvest moon begins. Agriculturists declare that often at that time, when the sky is clear and the moon shines brightly during the night, the tender buds are frozen and turn red even although the temperature of the air does not fall below freezing; nothing of this nature occurs if the moon remains hidden behind the clouds. The explanation of this phenomena is very simple and the moon has no part in it. When the sky is clear and the atmosphere dry and transparent (this is the time when the moon shines most brightly) the temperature of the bodies subjected to the nocturnal radiation falls far below the temperature of the air. If, during the day, the temperature has not been very high the nocturnal radiation may then chill the plants below freezing and they will freeze although the air remain at a higher temperature; on the other hand the plants will not be frozen if there are clouds to diminish the radiation. The conditions that lead to these freezings are therefore a clear sky and a relatively low temperature during the day. At the end of May or June the mean temperature is generally too high to allow us to fear these freezes although they do occur sometimes. Before the commencement of the harvest moon, that is to say, at the end of March or the beginning of April, the temperature is lower than during the harvest moon itself; the conditions are therefore much more favorable for freezing by radiation; but as the vegetation has not yet begun these freezes do not cause any damage and do not attract any attention. We have here to do with a very simple phenomenon in which the moon plays no other part than merely to indicate by its brilliancy when the sky is pure and transparent.

In the countries in the south of France, where the vegetation is more advanced than in the center and the north, the critical period of vegetation is no longer during the harvest moon but during the lunar period which precedes it.

THE RED DUST OF MARCH, 1901.

In connection with the remarkable dust storm that prevailed over a large part of Europe between the 10th and 13th of March, Monsieur M. Barac, director of the petroleum refinery at Fiume has made an examination of the dust and we quote the following from his report.

The chemical analysis of the dust gave the following results:

	Per cent.
Silicic acid ($Si\ O_2$)	49.49
Oxide of iron ($Fe_2\ O_3$)	9.96
Clay ($Al_2\ O_3$)	12.10
Oxide of manganese ($Mn_3\ O_4$)	1.99
Oxide of calcium ($Ca\ O$)	11.46
Oxide of magnesium ($Mg\ O$)	0.40
Carbonic acid ($C\ O_2$)	8.96
Organic substance	5.48
Traces of sodium, sulphuric acid, hydrochloric acid and loss	0.16
Total	100.00

The microscopic examination, under a power of 640, shows that the mass was composed principally of colorless, mixed with a small portion of colored, irregular fragments of crystals and particles of minerals together with the skeletons of micro-organisms and small particles of soot. Small quantities of well-formed, sharp-edged rhombohedric carbonate of lime, quartz prisms, and cubes of chloride of sodium, and the lime as well as the quartz crystals showed the phenomena of chromatic polarisation.

In regard to the diameters of the particles, the smallest were 0.001 millimeter, the average 0.017 millimeter, while the maximum size of the fragments of crystals was 0.051 millimeter, and that of the structureless mineral particles 0.113 millimeter.

If we compare these results with those published by A. E. Nordenskiold, Zeit. Oest. Gesell. für Meteorologie, relative to the dust that fell May 30, 1892, in Sweden, we are led to conclude that the dust of 1901 belongs to the same class as the