last winter they were south of the *Fram*, so that the general mean direction of the tracks for latitude 82° north and longitudes between 20° east and 140° east is nearly due east.

On page 586 Mohn has made an interesting computation, which he requests us to look upon as a mere experiment, in which he attempts to deduce a connection between the rate of movement of a barometric minimum as a whole and the wind velocity and barometric gradient. From this calculation he concludes that we should expect a rate of 12 or 15 meters per second, or 647 to 809 miles per day, for the centers of low areas in the Arctic Ocean. On page 588 Mohn gives an elaborate mathematical study of the peculiarities of the diurnal and annual periods of the meteorological elements in the arctic circumpolar sea. The main factor to be considered is the heat received by radiation from the sun, and the amount of this heat he computes in detail month by month, as also the sum total of the radiation from the sky and the loss of heat by radiation, utilizing the previous computations of Maurer and Angot. Mohn's effort to compute these quantities is ingenious and suggestive, and will undoubtedly stimulate others to publish analogous computations that have been made. He is quite right in saying that the diurnal variation of the total radiation effect is the chief factor that determines the periods of the various meteorological elements. The principal meteorological effect of the radiation from the sun and sky above us is the heating of the atmosphere and of the surface of the earth. The radiation of heat from the surface of the earth is always going on, but must vary with the cloudiness or clearness of the sky. With an overcast sky the radiation from above is screened off, and the radiation from below is radiated back to the surface of the earth. The radiation from the twilight sky has an appreciable heating power, and acts as a "heat twilight," as it is called by Dove.

During the long winter night, when the sun's rays do not strike the earth or the ice in the neighborhood of the *Fram*, they do, however, pass through the atmosphere at some distance above sea level, and even when they make a scarcely perceptible twilight they are still effective in warming up incipient precipitation at great altitudes and in maintaining a clear atmosphere with a blue black sky where there would otherwise be a slight haze. Radiation takes place more easily through such a clear sky. Consequently the local temperature has a tendency to fall during arctic winters when the sun is near the meridian, and this is clearly brought out by Mohn's computations. Therefore, we may say that the diurnal periodicity of temperature during clear days in midwinter is inverse to the diurnal period during such days in midsummer. This minimum of temperature during the winter twilight is entirely analogous to the minimum that occurs in temperate zones in the early morning twilight, and even sometimes after sunrise on the clearest days at high altitudes.

The diurnal period in the velocity of the wind is due to this diurnal period in the resulting radiation effect, and the observations of wind and radiation harmonize therewith, but the annual period of the velocity of the wind does not seem to depend on the annual period of the total radiation, as other factors become important, such as the extent of the areas of cloud and fog, the annual change of the general circulation of the atmosphere, the annual change in the distribution of vertical temperature gradients. Mohn especially calls attention to the need of careful anemometric observations in the polar regions at the topmast for comparison with those near sea level.

The diurnal variation of vapor tension is distinctly shown by the observations. There is one maximum after noon and one minimum late at night. "The diurnal ascending currents are too weak to carry the vapor upwards at a rate sufficient to produce a secondary minimum at the warmest time of the day." On the other hand the diurnal period of the amount of cloud is also distinct, there being a greater amount in the daytime than in the nighttime, so that the diurnal ascending currents must be strong enough to produce this diurnal period in the cloudiness. The probability of precipitation is greater in the daytime than during the nighttime.

METEOROLOGY IN SOUTH AMERICA.

CHILE.

Referring to an article under the title Meteorology in Chile, that will be found on page 326 of the MONTHLY WEATHER REVIEW for 1904, we are informed that meteorological work in Chile, after being for a long time divided between the national Astronomical Observatory at Santiago and the Central Meteorological Office connected with the Navy Department of the Republic of Chile, has now been subdivided and will hereafter be carried on by the following institutions:

1. "The Hydrographic Office of the Navy Department, at Valparaiso," which will have charge of ocean meteorology.
2. "The Section of Meteorology of the Administration of the Maritime District, Valparaiso," which controls the light-house stations of Chile and takes the place of the former Central Office at Santiago; it will have charge of coastal meteorology.
3. "The Section of Meteorology of the Astronomical Observatory of Santiago," which has charge of the meteorological stations established in the public schools in the provinces. The observatory will doubtless also have charge of higher scientific research in meteorology.
4. "The Weather Office connected with the Agricultural School of Santiago," which is under the Ministry of Industry. This weather office was established for the study of climate and meteorology in their relations to agricultural industries. This office issues a daily weather map based on observations taken at 4 p. m., Santiago time. It is expected that a special system of observations at 12 noon, Greenwich time, will soon be organized, and that a monthly bulletin will be published.

While this subdivision will give opportunity for the development of the scientific ability of many officials, yet it may also lead to a diversity of methods, and to a dissipation of energy and money that may not redound to the advantage of meteorology.

It would seem that while stimulating individual ability, the citizens of the Republic of Chile may lose the advantages that flow from the recognition of some central authority. Thus we find meteorological observers in that country writing to the Weather Bureau of the United States asking for the privilege of cooperating with it, whereas the true interests of meteorology would require the most hearty cooperation among themselves and with the excellent services in the adjoining countries, Peru, Brazil, and Argentine Republic.

Whatever may be the political, local, or commercial jealousies that prevade neighboring countries there can be no doubt that meteorology demands the most perfect scientific harmony; its field is the world. All in North and South America who would advance the study may well profit by the experience of meteorologists in Europe, where climatological observations and daily telegrams are neutral matters so far as they are affected by ordinary military conditions, and where international conventions labor to bring about perfect conformity with the present state of physical science.—*C. A.*

Mr. Lucio Alonso Villalobos, a wealthy merchant of Iquique, Chile, informs the Chief of the U. S. Weather Bureau that he has ordered meteorological apparatus from Europe and magnetic apparatus from Shanghai, China, and intends to establish "the best observatory in South America." He con-

templates ordering the captains of his sailing vessels, going to Hamburg and back by way of Cape Horn, to keep careful records that he will himself reduce and publish. The U. S. Weather Bureau will be pleased to cooperate with him.

PERU.

The American consul at Callao, Peru, under date of April 7, 1905, advises the U. S. Department of State that by decree dated March 31, 1905, the Government of Peru will at once establish meteorological stations at the following points:

Puira, Chiclayo, Ica, Moquegua, Cajamarca, Jauja, Huancavelica, Ayacucho, Cuzco, Puerto Barmudez.

The apparatus for these stations has already been purchased abroad and their work will be done under the direction of the Minister of Public Works. At some future date other stations will be established at Trujillo, Chachapoyas, Huánuco, Morocachas, and Abancay.

Next to Argentina, Chile, and Brazil, Peru seems to be most progressive in meteorological matters. Long before the establishment of a government service, as chronicled above, private parties were active in taking and recording meteorological observations.

The most important observatory in Peru seems to be the Harvard College Observatory at Arequipa. Observations at this station and its several secondary stations are published in the Annals of the Astronomical Observatory of Harvard College.

In 1892 the Academy of Medicine of Lima built a meteorological observatory, called Unanue and equipped it as a first order station. Its records, and the records of observations by correspondents of the Sociedad Geografica de Lima, are published in full in the Boletin of that society. Among the places for which such records have been published are San Ignacio, Department of Arequipa, and also the Instituto Agricola Salesiano at Arequipa.

ARGENTINE REPUBLIC.

The transfer of the Central Meteorological Office from Cordoba to Buenos Ayres, some account of which was given in the MONTHLY WEATHER REVIEW for 1902, page 315, has, as is well known, been followed by the publication of a very important daily weather map covering a region from latitude 22° south to 56° south, that is to say the whole of Terra del Fuego and Argentina as well as portions of Paraguay, Uruguay, and Brazil. The observations are made at 8 a. m. of the sixtieth meridian of Greenwich noon, except 6 a. m. in Paraguay. Unfortunately the extensive region on the chart covered by Chile is blank, and some of the observations from Brazil are a day late but so far as the Argentine Republic is concerned the tabular data and the chart give a more complete view of the atmospheric conditions than is usual. The data for upper clouds are especially appreciated. A small inserted map extends the main chart northeastward through Brazil to the equator. We see therefore on one map the low pressure belt of the equator, the low pressure area of the Antarctic region, the intermediate high pressure of the Tropic of Capricorn and the occasional passages of small areas of high pressure or low pressure across the meridians of 50°, 60°, and 70° west.

The charts are usually sent us in packages by months. For the month of May, 1905, we find a decided area of low pressure moving eastward from the 3d to the 9th, in latitude 45° on the west coast to 40° on the east coast, after which slow movement it then goes more rapidly to latitude 30° off the coast of Brazil, followed as in the United States by an area of high pressure whose pampero winds pour downward from the Andes over the plains of Argentina and Brazil generally from the southwest and corresponding to the dry, cool northwest winds of North America. On the 15th a second area of low pressure appears at latitude 42° S. on the west coast while a similar one is on the east coast, but a large area of high pressure comes in between with strong southerly winds shifting to northerly. To those accustomed to the maps of the Northern Hemisphere there would seem to be anomalies and confusion for a few days that can only be explained as due on the one hand to the continuous long narrow range of the Andes on the west, and the close proximity of the Atlantic coast on the east.

It would seem that at an elevation of 10,000 feet or more a rapidly moving layer of air from the west strikes the great mountains and plateaus and curls down most unexpectedly upon the lowlands of the east. Unfortunately, although the quantities of the upper and lower clouds are carefully given, yet the direction of their motion is not given by these charts so that our hypothesis remains to be tested by the observed movements of the clouds; it is, however, confirmed by the appearance of the isotherms and the gradual transition from clear weather to rain. By the 20th our low area had become a well-defined low in southern Brazil and another area of high pressure came pressing in from the south. On the 27th–31st a third area of low pressure seems to have passed northward at some distance from the coast and was then finally central in Uruguay.

As all these movements take place between latitudes 25° and 45° south (corresponding to our Florida and Maine, respectively) one would perhaps look for the same well-defined types of paths of high and low pressure, but large modifying conditions must be considered, viz, (1) our coast is much farther east of the Rocky Mountain region; (2) the trend of our coast is nearly parallel to the average path of the storm while the trend of the South American coast is nearly perpendicular to that path; (3) our storms at latitude 25° N. are practically over a broad ocean, while at 45° N. they are very largely under the influence of the broadest expanse of the northern part of the North American Continent and of the land regions far to the north, which are hot in summer and cold in winter—whereas on the other hand the South American storms when at latitude 25° S. come under the influence of the heated and broadest portion of the South American Continent, and at latitude 45° S. they are under purely oceanic influences and have naught but ocean between them and the Antarctic Circle. The outcome of this complete inversion of terrestrial conditions is a great change in the meteorology, and the development of a set of paths for the wandering highs and lows that contrast as greatly with those of North America as they do with those of Europe on the one hand and China and Japan on the other. They differ more than one would expect from the paths in the neighborhood of Australia and south Africa. Of course the winds blowing into, out, and around these areas harmonize approximately with the so-called laws of storms, but the movements of areas as a whole seem to be controlled by the surging to and fro of the areas of high pressure whose centers oscillate between latitudes 20° S. and 40° S. on the Pacific side and 20° S. or 30° S. on the Atlantic side.

The month of May, whose charts we have been considering, is the quiet month of the South Temperate Zone just as it is in the North Temperate, the sun has moved northward and the hot weather of February is about to change to the cold weather of June and July; the average temperature at Cape Horn is about 50° F. in February; 35° F. in May and for June, July, and August about 31° F. The rainfall on the west coast is rather more, but the winds are decidedly feebler in May than in February. The well marked areas of high pressure, central at 30° south in February over the Atlantic and Pacific have broken up into broad bands of small areas and will soon become broad bands of very high pressure in June, July, and August, while south of these to latitude 60° south the barometric gradients are very much gentler in May than in February. These gradients and the attendant winds

from the west appear to control the changes and motions in the special temporary areas of low pressure. Indeed the latter appear to owe their very existence to the flow of air over the chain of high mountains and the resulting formation of eddies. Eddies rotating around horizontal axes form cloud and rain on the east, but foehn winds and pamperos on the west of the axis. Eddies around vertical or inclined axes constitute low pressures whose perpetuity and development depend almost wholly upon the question whether the rising air with cloud and rain is on the east side or the west side of the circulation. The general tendency of the low areas is to move southeastward toward the coast of Chile and Argentina and then if they live, to pass northeastward over the east coast.

BRAZIL.

The Department of Marine of the United States of Brazil has for the past nine years published a monthly bulletin, giving in full the results of the daily observations at various hours, including Greenwich mean noon observations, taken at a number of stations along the eastern coast, and a few in the interior. In addition to the strictly meteorological features the bulletin gives the results of the magnetic observations made at the central station, Moro de San Antonio, Rio Janeiro. The work for each six months is summarized in semiannual volumes, the periods covered being October–March and April–September respectively. This work is under the immediate supervision of Captain Americo Silvado, of the Brazilian Navy.

The State of São Paulo has had an independent meteorological service since 1886, under the direction of the Commissão Geographica e Geologica de São Paulo, publishing the results of its observations in an annual volume of Dados Climatologicos. General observations are made at the hours of 7, 2, and 9, at about twenty stations, and rainfall observations at several others.

At Juiz de Fora, in the State of Minas Geraes, an independent observatory has been maintained by the municipality since 1893, and has published its observations.

BOLIVIA.

The Sociedad Geografica de La Paz regularly publishes observations made at La Paz. The bulletin of this society has also occasionally contained summaries of observations at other places in Bolivia, among which are Sucre, Oruro, and Trinidad. Private individuals have published observations at Potosi and Cochabamba.

GUIANA.

In British Guiana a fairly complete system of rainfall observations is maintained throughout the colony under the direction of the Government Botanic Garden at Georgetown. In Georgetown itself records of temperature, sunshine, and rainfall are kept up; the record of the latter element extends back to 1880. The observations are published in the Report on Botanic Gardens, Georgetown.

A first-class meteorological observatory is maintained at Cayenne, French Guiana, the data from which are published in the Annales of the Bureau Central Meteorologique de France.

For Dutch Guiana (Colony of Surinam) the Meteorological Jaarboek of the Netherlands has contained, since 1880, daily observations taken at Paramaribo. The French Annales gives an annual summary of monthly means of observations at Burnside-Coronie.

COLOMBIA.

Colombia has a Meteorological Office, but no reports have been received recently. Monthly totals of rainfall, number of rainy days, and greatest fall in 24-hours for Cartagena are published in the Annales of the Bureau Central Meteorologique de France.

ECUADOR.

The Observatorio Astronomico y Meteorologico de Quito seems to be the only meteorological observatory in Ecuador. It publishes an annual résumé of meteorological observations, of which the first volume, for September, 1895, to October, 1896, has been received.

URUGUAY.

In Uruguay the Jesuit Colegio Pio de Villa Colon has maintained a meteorological station of the first order near Montevideo since 1883. The Meteorological Society of Uruguay, established in 1890, maintains a number of second order and rain stations and publishes the results in its Resumen de las Observationes Pluviometricas.

E. D. ARCHIBALD AND THE MODERN KITE.

The Editor regrets that by a slip of the pen in the second column of page 257 of the MONTHLY WEATHER REVIEW for June, "Abercromby" was published instead of "Archibald." The great work done by E. D. Archibald in 1883 in the way of reviving the use of the kite for meteorological purposes was mentioned in the MONTHLY WEATHER REVIEW for 1895 and 1896, but lest modern readers should forget what we owe to him we may add that Archibald carried out a systematic series of observations with anemometers at different heights above the ground during 1883, 1884, and 1885. He used steel music wire as a kite line almost from the start in 1883, and attained heights up to 1500 feet above the ground. He also invented and patented in 1885 the kite balloon to which he gave that name. A combination of the kite and the balloon that we believe was the first ever made.

Mr. A. Lawrence Rotch was present at one of the first flights at Tunbridge Wells, and in 1887 Mr. Archibald took a photograph from a kite, which is also one of the first if not the very first occasion on which that was done. The great improvements that have been made in kite work by Mr. Rotch, the Weather Bureau, and various investigators all over the world have been the natural outcome of Mr. Archibald's demonstration of the general utility of the idea. He may fairly claim to have started the modern systematic kite flying with steel wire for scientific purposes. At the meeting of the British Association for the Advancement of Science in 1884 at Montreal, he brought the importance of the subject prominently to the attention of those present and ventured to predict an important future for this method of studying the atmosphere. His name should replace that of Abercromby on page 257.

THE MOUNT WEATHER OBSERVATORY.

In response to a correspondent inquiring about the Mount Weather Observatory, the Chief of Bureau has lately replied as follows:

The Mount Weather Observatory is not for solar physics alone, nor are the forecasts of the U. S. Weather Bureau likely to be founded upon solar observations only, but upon the data and study of the atmosphere itself.

The Weather Bureau makes forecasts of weather and of floods that are of general and sometimes of critical importance to agriculture, commerce, and many other human interests. These forecasts depend upon our knowledge of a branch of science whose field is the study of the earth's atmosphere as a whole.

Recent research has shown that there is a possibility of improving these forecasts by a more complete study of the changes going on in the radiation that we receive from the sun, but this is a minor matter compared with the study of the so-called waves of temperature, pressure, and moisture that pass over the earth's surface, and the mechanical laws that govern the movements of the air. As progress in our knowledge of the mechanics of the earth's atmosphere can only be made by means of daily weather charts, laboratory experiments, and mathematical study, therefore the U. S. Weather Bureau has established a meteorological institution of broad scope, designated as the Mount Weather Ob-