been reproduced in Prof. Wm. M. Davis' Elementary Meteorology, p. 33.

From these observations we learn that while the average annual temperature at Munich for the period 1861–1885 was 6.9° C., the average annual ground temperatures at different depths were as follows.

Depth.	Temperature of ground.
Meters.	° C.
1.29	9.18
2.46	9.16
3.63	9.12
4.80	9.12
5.97	9 06

This indicates a ground temperature nearly 2.3° C. in excess of the air temperature at a depth of 1.3 meters, which is greater than has usually been observed. Thus, Wild[2] concluded after a study of observations at many different places that the annual mean temperature of the ground at a depth of 1 meter exceeds the annual mean of the air temperature by only 1° C., but that this value is by no means constant, but rather has a probable error of 1° C.

In the American Meteorological Journal, Vol. VII, p. 267, Prof. Mark W. Harrington, says: "The temperature of the soil usually increases slowly, and on a simple law as we descend to lower depths." He then gives the following table[3] summarizing the observations made near Edinburgh, and taken from Transactions Royal Society Edinburgh, Vol. VII, p. 204.

Station.	Average annual temperature (from five years' observations).			
	Depth of 3.2 feet.	Depth of 6.4 feet.	Depth of 12.8 feet.	Depth of 25.6 feet.
	°	°	°	°
Observatory	45.49	45.86	46.36	46.87
Experimental Gardens	46.13	46.42	46.76	47.07
Craighleith	45.88	45.92	45.22	46.07

It is therefore safe to say that in general the average annual temperature of the ground a few feet below the surface is slightly warmer than the average annual temperature of the air at the same place, and that it varies but little with distance from the surface. After a certain depth is reached, however, the earth maintains a constant temperature throughout the year, and from this point on there is a marked increase in temperature as we descend. The depth of the upper surface of invariable ground temperatures varies with the geologic formation, as also does the rate of increase of temperature below this level.

In a paper on the Geothermal data from deep Artesian Wells in the Dakotas,[4] N. H. Darton of the United States Geological Survey says:

> In many parts of the world it has been found that the rate of increase of temperature averages about 1° for each 50 feet, below the first 40 feet, in which the temperature is usually regarded as that of the mean annual temperature of the region. In the greater part of the artesian basin of the Dakotas the rate of increase is found to be greatly more than this, attaining at Fort Randall a rate of 1° for each 17½ feet. At this well the temperature of the water is 80° F., or possibly slightly more, but the depth from which it is derived is only 576 feet, which indicates the abnormally high rate of increase.

Since the water collected in wells usually percolates very slowly through strata at about the same level as the bottom of the wells, it follows that in general the average annual temperature of the water thus collected is apt to be a little higher than the average annual temperature of the place, and it may be several degrees higher in wells of great depth.

At 30 and 40 feet below the surface the maximum temperature does not occur until January; and conversely the minimum temperature occurs in July. In consequence the maximum and minimum temperature of water in wells of this depth should occur during these same months, as has been noted by Mr. Redding, provided the well is tightly closed at the top, so as to prevent the cold surface air of winter from gravitating into it. This latter source of cooling is really very important, and to it must often be attributed the many notable exceptions to our rule; we have already called attention to one, in the frozen well at Brandon, Vt.[5]—*H. H. K.*

PERIODICITY IN CLIMATE.

We have often had occasion to maintain that no appreciable permanent change in climate has taken place during the past two hundred years, or since records of temperature and of the flora and fauna, the freezing of rivers, the depth of snow and other climatic phenomena have been kept with sufficient accuracy to justify any rational conclusions. On the other hand, there can be no doubt that large fluctuations take place in the character of the seasons and years, and some of these fluctuations have been called "periodic," although they are not confined to periods of any well-defined length, and ought therefore to be designated as systematic rather than periodic. Thus, Brückner found that the fluctuations of a variety of phenomena grouped themselves roughly about an ideal 35-year period, although no one of them was confined strictly to that. The Editor's idea has always been that the presence of continents, oceans, plateaus, and especially the ice and snow of the polar regions, by contrast with the great oceans of the globe, must introduce systematic irregularities into the general circulation of the atmosphere, which reacting on each other, must produce frequent repetitions of warm or cold, wet or dry seasons in specific regions of the earth. Such repetitions will, for a while, recur at nearly the same interval but by and by at another interval, so that no uniform constant period could possibly represent them all. An article in the Boston Transcript, as quoted in the monthly report of the Iowa Climate and Crop Section for February, 1901, states that during the past year the streams of New England, the Middle States, the Northwestern States, and the Pacific coast have been at their lowest ebb in a century, but the streams of Arizona and Texas, which five years ago were apparently about to disappear entirely, have taken on new life and more water is flowing from them at the present time than for many years past. Of course, sometimes streams may be high in the winter and low in the summer, or vice versa, and the outflow of water or the "run off" does not depend altogether on the rainfall, but largely on the topography of the watershed and on the character of the rainfall, whether it comes in many small showers or a few heavy rains; it also depends upon evaporation, which is a function of the sunshine, the wind, the vegetation, and the soil. With regard to the rainfall, the Transcript says that in New England from 1830 to 1850 there was an abnormal deficiency; from 1850 to 1865 it was normal, and since then it has been far above the average. The Ohio and Mississippi valleys have also had their years of dryness and excessive rain. Now, the years of drought or rain are not the same in New England, the Mississippi Valley, New York, Texas, Arizona, California, and Oregon. The regions of excess and deficit move around from place to place over the

[2] H. Wild. Ueber die Bodentemperaturen in St. Petersburg u. Nukuss Rep. of Meteorologie. Band VII. No. 4. St. Petersburg. 1878. P. 88.

[3] Professor Harrington's table is slightly in error in that he failed to reduce the French feet, in which the depths were indicated, to English feet.

[4] Am. Jour. Sci., 1898, vol. 5, p. 162.

[5] See Monthly Weather Review, August, 1901, p. 370.

country, and in fact, over the whole globe, for, as we have long since had occasion to show, the droughts of India gradually extend eastward, and in the course of three or four years make themselves felt in the United States and Europe, while in the meantime a period of average or abundant rain has come to India. Those who are suffering from drought may rest assured that plenty of water will come in a few years, and those who now have a plenty should husband it for the drought that is sure to come.

These climatic oscillations from one extreme to another, whether it be sunshine, temperature, wind, or rain are essentially a part of the necessary regimen of the earth's atmosphere. The formation of rain undoubtedly depends essentially upon uprising currents of air, cooled by expansion so that they can no longer retain the moisture carried up from the ocean and the ground. Changes in the seasonal rainfall imply changes in the seasonal winds; these changes may be systematic, that is to say, the direct result of the system of forces that acts upon the earth's atmosphere, but by no means necessarily strictly periodic.

The general study of periodicity in the earth's atmosphere must be pursued by following up the logical dynamic reasoning indicated in a general way in the memoir "On long range forecasts" lately read before the American Association for the Advancement of Science, at Denver, and which will be published in the MONTHLY WEATHER REVIEW.—*C. A.*

AURORAL LIGHT.

The following extracts are from the Climate and Crop Section reports, November, 1901:

Laporte, Ind.—About 5:30 p. m. on the 28th, the observer noticed a peculiar light in the western heavens. The sky was covered with broken clouds, through which the light shone.

Huntington, Ind.—A peculiar streak of light was observed in the northwest about 6 p. m. on the 28th.

Stiffenville, Lewis County, Mo.—An aurora observed on the 28th.

The aurora borealis appears in every form, from the most magnificent display to the most insignificant patches of light that appear for a few moments and fade away forever. The above phenomena may well have been of the latter auroral character. Laporte, Ind., is from 50 to 75 miles northwest of Huntington. A northeast wind had been blowing from out an area of high pressure; the sky was covered with cumulostratus clouds at Laporte, but was probably clear at Huntington. These are the conditions that generally accompany auroras and we may assume that there was a faint one on the present occasion, although it was not observed elsewhere in the United States or in Canada.—*C. A.*

ESTABLISHMENT OF THE MARTINIQUE WEATHER SERVICE.

In a letter dated November 11, 1901, M. Merlin, Governor of Martinique, announces the establishment of a "Service of weather warnings which will be located at the military hospital of Fort de France under the direction of the Chief of the Health Service."

The Governor kindly volunteers to transmit monthly copies of observations to the Weather Bureau at Washington, and arrangements have been made for a reciprocal interchange of weather cablegrams between Martinique and the United States during the hurricane season.—*H. H. K.*

SECOND MEXICAN METEOROLOGICAL CONGRESS.

The following interesting program has been announced for the second National Meteorological Congress of Mexico, at the City of Mexico, December 17–20, 1901, in the hall of the Scientific Society "Antonio Alzate."

INAUGURAL SESSION, ENGINEER D. LEANDRO FERNÁNDEZ, MINISTER OF THE INTERIOR, PRESIDING.

December 17, 10 *a. m.*

1. Address of welcome by the vice president of the Society "Alzate."
2. The minister declares the Second National Meteorological Congress open.
3. Report of Prof. D. Mariano Leal, President of the Permanent Committee.
4. Report of the Treasurer of the Permanent Committee.
5. Designation of the presidents for the subsequent sessions and appointment of the committees.

On the evening of the 16th and the morning of the 18th the committees will meet in order to formulate the questions on which the congress will principally report.

December 18, 3:30 *p. m.*

1. Presbyter Severo Diaz, The predictions of Engineer Juan N. Contreras; Examination of meteorological criticism.
2. José Guzman, Principles of forecasting at short intervals.
3. Prof. Luis G. Léon, The Leyden jar as an apparatus for weather predictions.
4. Engineer José M. Romero, Application of the movement of the great aerial currents to weather prediction.

December 19, 9:30 *a. m.*

1. Presbyter Aniceto Castellanos, The volcano Colima and the weather conditions in that region.
2. Prof. Luis G. Léon, Measurement of insolation.
3. Mr. Elpidio López, Climatology of Chignahuapan.
4. Report of the committee on weather prediction.

December 19, 3:30 *p. m.*

1. Dr. Luis E. Ruiz, Hygienic value of local meteorological data.
2. Mrs. Professor María Luisa Dominguez, Study of storms and thunderstorms.
3. Prof. Manuel Moreno y Anda, Reduction of the curves of self-registering instruments.
4. Report of the committee on climatology and its application to agriculture.

December 20, 9 *a. m.*

1. Prof. Mariano Leal, A seismographic clock conforming to the decisions of the first Meteorological Congress.
2. Engineer Guillermo B. y Puga, Study of electrical storms.
3. Prof. Raquel Sánchez Suárez, The teaching of meteorology in primary schools.
4. Dr. José Ramirez, Study of the effects of the thunderbolt.
5. Dr. Joaquin Urrutia, (*a*) Improvements effected in the observatory of the State College (Colegio del Estado) at Puebla; (*b*) Comparison of the extreme values given by the instruments of direct observation and those by self-registering instruments.
6. Report of the committee on storms.

December 20, 3:30 *p. m.*

1. Prof. Rafael Aguilar Santillán, Bibliography of Mexican meteorology.
2. Results of the study of instruments shelters, by Mr. Leal and Mr. Moreno y Anda.
3. Prof. Enrique E. Schulz, Memoir on the improvement of the meteorological service in the state of Mexico.
4. Report of the committee on self-registering apparatus.
5. Report of the committee on the popularization of meteorological knowledge and the establishment of new stations.
6. Miscellaneous questions and the nomination of the permanent committee for 1902.
7. The under Secretary of the Interior, Engineer D. Gilberto Montiel y Estrada, will declare the second National Meteorological Congress closed.—*H. H. K.*

CORRIGENDA.

MONTHLY WEATHER REVIEW for September, 1901, page 419, column 2, line 30, after the word "velocity" insert "of the upper current from the resultant velocity."

MONTHLY WEATHER REVIEW for February, 1901, page 56, column 1, line 36, in place of "and St. Kitts, Antigua, and Barbadoes. On the other hand," read "and St. Kitts. Antigua, and Barbados, on the other hand."

Column 2, line 26, after "slopes" insert period (.) in place of comma (,).

Line 38, insert "elevation" before "only;" line 39, for "visitor" read "visitors."

Page 56, column 1, line 2, dele "which."