*Physical Review. Lancaster. Vol. 15.*

**Knipp, Charles T.** Method of Maintaining Intermediate Temperatures. P. 125-126.

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## GROUND TEMPERATURE OBSERVATIONS AT ST. IGNATIUS COLLEGE, CLEVELAND, OHIO.

By DR. LYMAN J. BRIGGS, Bureau of Soils.

In the report of the Meteorological Observatory of St. Ignatius College, Cleveland, Ohio, 1900-1901, Rev. F. L. Odenbach, S. J., publishes a series of observations on ground temperatures made at a depth of 4 feet. The observations cover a period from 1897 to 1901. The monthly and yearly mean for each year during this period is given, and the daily temperatures during the months of February, May, and August, 1900, are also published. The following excerpt from the report of the observatory gives the method of making the determinations:

The data subjoined were gathered from a thermometer placed 4 feet below the surface of the ground. Great care was taken to insulate it from solar radiation and atmospheric temperature. For this purpose a 2-inch steel pipe was sunk into the ground, the lower end reaching 4 feet below the surface. The top end projects through the bottom of, and 4 inches into, an earthenware jar. This projecting part within the jar is capped with a movable cover made of 2.5-inch steel pipe. The jar, in turn, is covered with a lid of earthenware and the whole, which stands even with the ground surface, is covered with a wooden drum. The thermometer, which rests at the bottom of the 4-foot shaft, may be pulled up by a chain after the three covers have been removed. It is encased in a wooden tube, exposing only the grading of the mercury column; while its bulb has been insulated by a mixture of asbestos and carbonate of magnesium, held around it by a perforated brass cup. With all these precautional appliances, we are certain of getting a real ground temperature. The circulation within the tube might seem to create some difficulty, but it was supposed that the warmer air toward the surface would not descend, but that it would lose its temperature where it was, by the conductivity of the steel pipe which extended downward into colder regions. The insulation of the bulb is so perfect that it may be exposed to the direct rays of the sun for almost half a minute before it shows signs of rising; it may therefore be read with leisure and without fear of its having been influenced by the temperature existing above ground. Because it is not subject to diurnal variations, it has been read at 8 a. m., seventy-fifth meridian time, daily; this being the time at which all other observations are taken.

We regret that we can not agree with Odenbach in his conclusion that his observations represent the true ground temperature at a depth of 4 feet. It will be noted that a 2-inch steel pipe extends from near the surface of the ground to a depth of 4 feet, and that the thermometer with which the observations were made was placed inside of this pipe. The bulb of the thermometer was not embeded in the soil, but was simply suspended at the base of the shaft, or with its asbestos insolation resting upon the bottom of the shaft. The temperature recorded therefore was not the temperature of the soil, but rather that of the air in the bottom of the shaft. No provision whatever was apparently made to prevent air-convection currents in the steel tube, so that the thermometer really records the temperature of the convection currents at the bottom of the shaft. During the summer months when the temperature at a depth of 4 feet is lower than the temperature nearer the surface, the error introduced from this source would probably not be great, but during the winter months when the surface stratum of soil is cooler, the cooler air in the upper portion of the tube would continually settle towards the bottom of the shaft, and the thermometer would record temperatures lower than the actual temperature of the soil at a depth of 4 feet.

Another feature leading to erroneous results is the steel tube extending from the bottom to the top of the shaft. Steel being so much better a conductor than the soil, would, during the warmer months, readily conduct the heat down from the surface stratum and so raise the temperature of the lower portion of the shaft. In winter also, the temperature of the lower part of the shaft would by this means be reduced below the true temperature of the soil at that depth.

In the opinion of the reviewer a far more satisfactory and reliable method of investigating ground temperatures at a considerable depth below the surface is to be found in some form of electrical thermometer. An insulated coil can be buried at the desired depth and allowed to remain undisturbed throughout the whole period of investigation of temperature; the presence of all heat-conducting material other than the soil is limited to the two small wires forming the terminals of the resistance coil. This method is employed in the temperature observations now being carried on at the Radcliffe Observatory,[1] Oxford, where platinum resistance thermometers of the well known Callendar and Griffiths pattern are used. Attention should also be called to the method of reducing the observations at Oxford, first employed by Thomson,[2] which gives not only the temperature but important data regarding the thermal conductivity of the soil as well. The observations are first grouped into monthly means, and harmonic expressions are then deduced which will represent the readings of each thermometer throughout the year. From each wave as observed at any pair of thermometers two determinations of the thermal conductivity of the gravel may be obtained, one from the diminution of the amplitude of the wave and the other from the retardation of phase.

## UNSEASONABLE WEATHER IN THE UNITED STATES.

By Prof. E. B. GARRIOTT, Weather Bureau, dated July 31, 1902.

The cause of unseasonable weather is not demonstrable. Neither is it possible in all cases to determine which of the general atmospheric conditions that are associated with unseasonable weather partake of the nature of cause and which of effect.

It has been observed that summer periods of low temperature are associated with barometric pressure below the normal and abundant rainfall, and that summer periods of excessive heat are associated with barometric pressure about or above the normal and a marked deficiency in rainfall. It has also been observed that winter periods of excessive cold are associated with barometric pressure above the normal and little or no precipitation, and that periods of high temperature in winter are associated with barometric pressure below the normal and rain or snow. It has been observed further that the general atmospheric conditions referred to are associated with areas of high and low barometric pressure that traverse the United States. In summer the atmosphere over regions subjected to unusual cold and abnormally heavy rainfall is dominated by areas of low barometric pressure, or general storms, that follow unusual tracks for the season, and the atmosphere over regions subjected to unusual heat is undisturbed by the passage of general storms, and is dominated by an extensive and almost stationary area of high barometric pressure. In winter periods of excessive cold are experienced in connection with areas of high barometric pressure of great magnitude that advance from the British Northwest Territory, and also in connection with general storms that follow abnormal southerly paths, and periods of unusually warm weather occur in connection with a succession of general storms that pursue abnormal northerly paths.

A study of the daily meteorological charts of the Northern Hemisphere shows that the general atmospheric conditions over the United States that are associated with unseasonable weather in any part of the country are, in turn, associated with atmospheric conditions that obtain over at least a great part of the Northern Hemisphere. The international charts

[1] Proceedings Royal Society, 67, p. 218, 1900.

[2] Transactions Royal Society, Edinburg, 22, p. 409, 1861.

show that when a period of abnormal weather prevails over a considerable area of the United States, there is a disarrangement of the normal distribution of atmospheric pressure over a great part of the Northern Hemisphere. They show that in the presence of unseasonable weather in any part of the Northern Hemisphere the so-called permanent continental and oceanic areas of high and low barometric pressure present abnormal aspects, and there is an interruption in the normal succession and progression of the areas of high and low barometric pressure of the middle latitudes.

Admitting the possibility of a primary cause of unseasonable weather that first affects the earth's atmosphere as a whole, by disarranging the normal distribution of atmospheric pressure and finally interrupts the usual succession over the continents and oceans of areas of high barometer and general storms, there is presented a fascinating field for speculation and study. Speculation regarding the nature of the cause would naturally be directed toward supposed evidence of solar disturbances as indicated by sun spots, to manifestations of the electro-magnetic influence of the sun's radiant energy, or perhaps to planetary or other equally obscure and possibly imaginary influences. Study should begin with facts presented at the surface of the earth. In the outline of these facts the association of periods of unseasonable weather with local, continental, and hemispherical barometric pressure has been shown.

A study of international meteorological reports conducted with a due regard for the facts referred to would be calculated to lead to a determination of the relation between changes and movements in the smaller and the greater barometric areas, and to an association of changes in the greater barometric areas with some cause that is external to the earth's atmosphere. It is possible also that study carried along these lines would lead to the discovery that periods of unseasonable weather in any part of the Northern Hemisphere are preceded days and perhaps weeks by certain changes in the hemispherical system of barometric pressure, and that all changes and conditions that are observed in our atmosphere, and that all kinds and types of weather that we experience are subject to definable laws of causation.

## CLIMATOLOGY OF COSTA RICA.

Communicated by H. PITTIER, Director, Physical Geographic Institute.

[For tables see page 340.]

*Notes on the weather.*—On the Pacific slope the rainfall was abundant and of daily occurrence until the 22d, after which there was a marked interruption, corresponding to the so-called veranills de San Juan. On the whole, the total amount at most stations was below the normal. At San Jose the pressure was generally below the normal, the lowest observed (660.6 mm. at 4 p. m. on the 1st and 2d) being the absolute minimum since 1888. The temperature was slightly above normal. On the Atlantic slope the rainfall was about normal, but there was a general complaint about the heat. Electric storms, with abundant showers, have been reported from several stations.

*Notes on earthquakes.*—June 12, $11^h 04^m$ p. m., slight shock, NNW-SSE, duration 12 seconds, intensity II. June 14, $5^h 40^m$ p. m., slight shock, E-W, duration 3 seconds, intensity II. June 20, $5^h 45^m$ p. m., slight shock, E-W, duration 7 seconds, intensity II. June 26, $0^h 29^m$ a. m., sensible tremors, E-W, generally felt, duration 12 seconds, intensity III.

## A WATERSPOUT AT CLOSE RANGE.[1]

By Dr. O. L. FASSIG, Section Director.

Although the mechanism and mode of occurrence of waterspouts are now fairly well understood, descriptions of these erratic phenomena are always interesting and instructive when coming from an eye witness. It is still a rare occurrence to meet with an intelligent observer who has seen a waterspout at close range. Capt. Fergus Ferguson, of the British steamship *Hestia*, in a recent interview gave a most interesting account of facts that came under his observation while on his way from Baltimore to the Cuban port of Daiquiri. On April 4, toward sunset, while passing off Hatteras, the captain observed several waterspouts in process of formation at a distance of 300 to 400 yards to windward. The largest of these, and the only one completely formed, seemed to be headed directly toward the ship. The captain at first attempted to change his course enough to avoid a collision, but soon discovered that this could not be done. Giving orders for all on deck to go below, he remained until the spout was close upon his ship and then hastily sought a place of safety. A deafening roar was quickly followed by strong wind gusts and a sudden shock as the spout struck amidships and passed over the deck in the direction of the storm. Captain Ferguson reappeared upon deck in time to see two tarpaulins which had covered the hatches, and a plank 8 feet long by 10 inches wide, high up in the air, while his log line with log attached extended straight up into the air to a distance of 40 feet. Beyond the loss of the lighter movable objects on deck and a temporary feeling of apprehension, no harm was done.

When first seen, the waterspout was incomplete. A portion of cloud dipped down from the general cloud level of about 2,000 feet, while at the same time a column of water was apparently rising from the ocean surface just below. At an elevation of between 200 and 300 feet the ascending water column and the descending cloud column met. The diameter of the spout was between 40 and 50 feet, or approximately the width of the *Hestia*. Within the column there was a dark core, almost black, with a diameter of about 2 feet. The captain did not clearly recall evidences of a whirling motion, but a strong upward suction is clearly indicated by the facts noted above. No reference was made to any considerable quantity of water being shipped as the waterspout passed over the vessel, a fact which would indicate that the lower portion of the column was composed mostly of spray formed by the friction of the winds with the surface of the water and carried up by the ascending currents of air.

The weather map for April 4 shows the *Hestia* to have been near the center of a barometric depression which had been moving eastward until the evening of the 4th, when the course was abruptly changed to nearly due north. The local weather conditions are described by third officer W. E. Jenkins in the following report published in the Hydrographic Bulletin for April 23, 1902:

> On the voyage from Baltimore toward Daiquiri, on April 4, 1902, one hour's run south of latitude 35° north, longitude 75° west, observed several waterspouts close at hand, one of which passed over the after end of the ship at 5 p. m. A fresh southwesterly, but unsteady breeze had been blowing; heavy masses of dark thunder clouds hung in the southwest, and the barometer was falling rapidly. The waterspout tore the tarpaulins off the hatches, took everything movable off the deck, and lifted the patent log right up in the air. At 5 p. m., barometer still falling, wind increasing to a fierce gale, with terrific squalls and much vivid lightning and deafening peals of thunder. At 11 p. m., latitude 34° 28′ north, longitude 74° 56′ west, the barometer reached its lowest reading, and the wind suddenly shifted in a fierce squall from southwest, 10, through west to northwest, 8, slightly moderating.

## HAWAIIAN CLIMATOLOGICAL DATA.

By CURTIS J. LYONS, Territorial Meteorologist.

### GENERAL SUMMARY FOR JUNE, 1902.

*Honolulu.*—The water in the artesian well fell during the month from 33.85 to 33.50 feet above mean sea level. June 30, 1901, it stood at 32.85. The average daily mean sea level

[1] Prepared for the April number of Maryland and Delaware Climate and Crop Report.