station changes during the night it is the result of radiation and conduction, or transportation, or both. If the wind is blowing, then warmer air from high altitudes (an inversion of temperature is here assumed) or other localities, or colder air from some other locality, may be mixed with or even replace the air at some particular station. If the wind is not blowing, there would still be the natural drainage of colder, and thus denser air into the valleys from places of greater elevation. Thus, not only elevation, but also the openness of a valley, its direction, the roughness of the surface, and the direction from which the wind comes, would play a part in determining the minimum temperature. When we turn to the observations it will be seen that in fact elevation does play an important part. The valley on the west side of the village is well marked and the steady increase of coldness from station 4, past stations 5 and 6, westward to station 7 is very pronounced in the table of observations. The same thing is well marked between stations 7 and 8 and also between stations 1 and 2. On the other hand stations 8 and 9 and also stations 1 and 10 are practically of the same coldness although there is a marked difference in elevation. It will be seen from the elevations given in the table of observations that the highest station is not the warmest and the lowest station is not the coldest. The conclusion which must be drawn is this: Elevation plays an important part, but it must by no means be stated that stations can be arranged in order of coldness depending upon their elevation alone.

IV. THE EFFECT OF A THERMOMETER SHELTER.

The observations recorded in the column "A" were the readings of the registering, minimum thermometer in the thermometer shelter. They average 3.2° warmer than station 8, while station 1 averages 0.7° colder. This makes the readings at station A average 3.9° warmer than station 1. A direct comparison of the observations made at stations A and 1 for the nights when both were recorded makes A 3.7° warmer than station 1, with 1.8° and 7.8° as the limits in the variation. This means that during the still, clear winter nights a registering minimum thermometer exposed in the standard thermometer shelter reads on the average between 3° and 4° higher than the same instrument exposed in the open.

V. EFFECT OF A PIAZZA.

The column headed "B" contains the observations made on the piazza of a house twenty feet southeast of station 8. The readings average 3.9° warmer than station 8, with 1.5° and 5.0° as the limits of the variation. It will thus be seen that even on the post of a north piazza, a thermometer may read nearly 4° too high on still, clear winter nights.

This investigation might be extended in two directions. The given observations were all made while the ground was covered with snow. A similar series made during the summer when the ground is covered with vegetation would give an interesting comparison.

Station 8 has been found to be the warmest while station 7 is the coldest. By placing a number of thermometers between these two stations and taking readings every hour or every two hours during certain nights in winter interesting results might be obtained as to the relative importance of conduction and radiation and transportation of air in determining the temperature.

EARTHQUAKES RECENTLY RECORDED AT THE WEATHER BUREAU.

By C. F. MARVIN, Professor of Meteorology. Dated August 7, 1905.

Several distant earthquakes have recently been registered at the Weather Bureau, one of which was by far the most important lately experienced. No motion was felt on this occasion by any individuals so far as known; in fact the curious thing is that no accounts of any great earthquake or other disturbance that could produce the records we find have been reported in the public press anywhere. Reports from distant observatories at which seismographs are maintained are not available at the present time, but there is no doubt that the disturbance was registered all over the world.

The displacements shown by the Bosch-Omori seismographs at Washington were several times greater and many times more numerous than in the case of the great Indian earthquake of April 4. Other cases have likewise occurred in which great unfelt disturbances have been registered seemingly unaccompanied at any known or inhabited portion of the globe with such surface disasters as we are led to look for or as seem to be required to explain the occurrence of our records. Even where earthquakes occur deep under the sea, at great distances from land, we expect them to be accompanied by tidal waves of greater or less magnitude as tangible evidence of their occurrence. When, therefore, we find large disturbances recorded without being able to trace them to any obvious cause the question may be asked: Can the origin of these great effects possibly be so deep seated within the earth that the waves reaching the surface are not only feeble, but are not even of the same character as those we feel and that destroy buildings, etc. The suspicion may be awakened in the minds of some not familiar with the maintenance of modern seismographs that the records are not genuine, or may be due to some accidental local causes. This can not possibly be the case. No human, nor accidental, nor artificial agency can possibly produce one of these records *de novo* in all its minute perfection. It may be copied and duplicated, or possibly imitated if an elaborate machine were constructed for the purpose, but nothing but real motions in the crust of the earth can cause the instrument itself to produce such original records as these.

This last great disturbance began at Washington at 10^h 10^m 13^s p. m., of July 22, seventy-fifth meridian time, and from that time on for more than two hours and a half perceptible movements of the earth crust were being registered. For a period of nearly twenty-three minutes, from 10:30 to 10:53 p. m., the motions, especially in the east and west directions, were unusually great, the maximum wave to the west measuring 5.4 millimeters, while the pen went off the sheet three times in the east direction, which required a movement of more than 5 millimeters.

The entire records for this earthquake are shown on Plate I.

Tables 1, 2, 3, and 4 present the principal characteristics of the several earthquakes registered on the seismograph at the Weather Bureau, Washington, D. C., on seventy-fifth meridian time.

TABLE 1.—*Earthquake of May 9, 1905, N-S. component.*

		h.	m.	s.
First preliminary tremors began		2	53	42 a. m.
Principal portion began		2	57	32 a. m.
Principal portion ended		2	58	48 a. m.
End of earthquake		3	15	52 a. m.
Duration of first preliminary tremors	3 min. 50 sec.			
Duration of principal portion	1 " 16 "			
Total duration of earthquake	22 " 10 "			
Period of pendulum				28 sec.
Maximum double amplitude of actual displacement of the earth at the seismograph				0.1 mm.
Magnification of record				10 times.

This earthquake was too small and feeble to fully develop all the usual characteristics of such records.

TABLE 2.—*Earthquake of July 9, 1905, N-S. component.*

	h.	m.	s.
First preliminary tremors began	5	4	35 a. m.
Second preliminary tremors began	5	22	7 a. m.
Principal portion began	5	33	42 a. m.
Principal portion ended (not well defined)	5	46	27 a. m.
End of earthquake	6	34	25 a. m.
Large waves in second preliminary tremors	5	30	7 a. m.

TABLE 2.—*Earthquake of July 9, 1905, N-S.*—Continued.

Duration of first preliminary tremors	17 min. 32 sec.
Duration of second preliminary tremors	11 " 35 "
Duration of principal portion	12 " 45 "
Total duration of earthquake	1 hr. 29 " 50 "
Average complete period of seven waves in second preliminary tremors	30 sec.
Average complete period of large waves of principal portion	20 to 30 "
Period of pendulum	27 sec.
Maximum double amplitude of actual displacement of the earth at the seismograph	0.81 mm.
Magnification of record	10 times.

The waves are very complex in the principal portion and die away very gradually so that the beginning of the "end portion" is not sharply defined.

TABLE 3.—*Earthquake of July 22–23, 1905, N-S. component.*

	h.	*m.*	*s.*
First preliminary tremors began	10	10	13 p. m.
Second preliminary tremors began	10	25	33 p. m.
Principal portion began	10	39	00 p. m.
Principal portion ended	10	59	00 p. m.
End of earthquake, a. m. July 23	0	21	30 p. m.
Duration of first preliminary tremors	15 min. 20 sec.		
Duration of second preliminary tremors	13 " 27 "		
Duration of principal portion	20 " 00 "		
Total duration of earthquake	2 hr. 11 " 17 "		
Period of pendulum	26 sec.		
Maximum double amplitude of actual displacement of the earth at the seismograph	5.40 mm.		
Magnification of record	10 times.		

Largest earthquake yet recorded.

TABLE 4.—*Earthquake of July 22–23, 1905, E-W. component.*

	h.	*m.*	*s.*
First preliminary tremors began	10	11	00 p. m.
Second preliminary tremors began	10	24	00 p. m.
Principal portion began	10	30	40 p. m.
Principal portion ended	10	53	00 p. m.
End of earthquake, a. m., July 23	0	46	15 p, m.
Duration of first preliminary tremors	13 min. 00 sec.		
Duration of second preliminary tremors	6 " 40 "		
Duration of principal portion	22 " 20 "		
Total duration of earthquake	2 hr. 35 " 15 "		
Period of pendulum	30 sec.		
Maximum semiamplitude of actual displacement of the earth at the seismograph (to the west)	5.4 mm.		
Magnification of record	13.2 times.		

The pen went off the sheet to the east three times, viz, more than five millimeters, hence actual displacement exceeded eleven millimeters.

A critical examination of the wave motions as they are found recorded in the various records thus far obtained has led us to the opinion that the so-called steady mass of the seismograph fails to remain at rest as completely as it is generally supposed to do. In other words the motion of the earth soon sets the "steady mass" itself to swinging more or less, so that the trace finally resulting from the two movements is not a faithful record of the motions of the earth. The problem of completely separating the one motion from the other is very complex and difficult, and a full analysis has not thus far been brought out. Some notes presenting an approximate method of analysis have recently been employed and the results obtained will be given in a future communication to the REVIEW.

TIDES AND THUNDERSTORMS.

By JOHN C. BEANS, Cooperative Observer, Moorestown, N. J.

A recent circular requesting observations on the course of thunderstorms reminds me of certain articles and communications in the MONTHLY WEATHER REVIEW during the past year and the strong inclination I felt at those times to send in a communication disparaging the idea of perceptible inductive influence of tidal currents on atmospheric vapors, nay, on air currents too and whole thunderstorms as suggested.

Some years ago my father was a considerable grower of strawberries, employing some forty pickers daily. Many of these came from the village of Bridgeboro, then a considerable sailing packet port on the Rancocas two or three miles from the Delaware, but doing business several miles farther up, chiefly to Philadelphia. Navigating these sloops and schooners against wind and tide on rather narrow and crooked streams and between showers, if possible, developed in the captains and hands of these craft an alertness and shrewdness in observing the ways of the weather, probably not yet excelled, except by the educated part of the weather service. They would look at a possible coming shower, observe the state of the tide, and remark that if the tide was running up, the shower would go up the Delaware River, but if the tide was running down the shower might be expected to go up the Rancocas Creek, and we would get some. Ever since then showers have continued going sometimes in line with the Delaware, sometimes with the Rancocas, sometimes elsewhere. Those pickers generally knew the state of the tide, for two or three of the packets usually sailed past them daily. I can now see approximately the stage of the tide from my home, but I do not keep in mind its course and have not always a Public Ledger Almanac. However, with a farmer's need of rain lore, I have been watching showers (and for showers) these 35 years, but have not seen any four-times-a-day changeableness in the course of showers, nor any other changeableness that the tidal theory might lead to. The course of showers has often been with that of middle clouds when such appear. Did these old navigators of Delaware Bay get their theory from their fellow craftsmen, the farmers of Cape May County, and expect it to apply to all streams?

HAS THE RAINFALL OF SOUTHERN CALIFORNIA BEEN AFFECTED BY ANY SO-CALLED RAINMAKER?

During the discussion in southern California in April, 1905, over the merits of an individual calling himself a rainmaker, there was sent out by the Associated Press a general news despatch that seems to show there are a few believers in the supernatural still left over to this enlightened age. It behooves the press, as the leader of public opinion, to do what it can to enable the public to appreciate the influence of man on the weather.

From Los Angeles to San Bernardino is an eastward stretch of 75 miles; the railroad runs from the Pacific coast eastward along the southern slope of the San Gabriel, Cucamonga, and San Bernardino ranges of mountains. Los Angeles is about twenty miles east and also twenty miles north of the curved coast line. Pasadena is ten miles northeast of that and Altadena five miles north of that. The new Solar Observatory of the Carnegie Institution is on Mount Wilson near Pasadena. This whole region is a garden under the latitude of 34° north receiving moderate winter rains and an abundance of sunshine and needing only a wise supervision of the irrigation ditches to produce the most beautiful and profitable tropical plantations. The photographs reproduced in the MONTHLY WEATHER REVIEW for November, 1903, give a fair idea of the character of this garden spot. The general details as to orography may be seen in the relief map published in Bulletin L, Climate of California, by Prof. A. G. McAdie. It is easily understood by the meteorologist that northerly winds coming over the mountain ranges will bring dry and dusty weather, clear sky, hot days, and cool nights. Southerly winds, especially southwest winds, will push moist ocean air up the mountain slopes and give cloud and local rains to the southern slopes. Further details and tables of rainfall are given by Professor McAdie in the above-mentioned bulletin. In such a climate all vegetation depends on the rainfall of the winter season and the monthly

Plate I. Bosch-Omori Seismograph Record of Earthquake of July 22, 1905.
(Clock correction +3 seconds.)

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(Clock correction +3 seconds.)