There are some small differences between the inclosed figures and those formerly sent, caused by errors in the report of rainfall first received from the Isthmus, but fortunately they are of no importance.

The Valley of the Chagres above Bohio may be divided into three subbasins, of which the general dimensions are given in the following table. The figures for the upper basin are only approximate, as toward the southern side the divide has not been accurately defined by surveys; but no material error is believed to exist. The two lower basins are well determined.

The upper basin includes the most mountainous district. About 7 miles above Alhajuela the principal stream takes the name of Pequini, and heads within about a dozen miles of the Atlantic coast, where the rainfall is greatest. It is from this region that the river receives its chief contributions, especially during the dry season; but during the eight months of rains the lower tributaries considerably increase the volume.

Geographical details of the basin of the Chagres.

Subbasins.	Area.		Length.	Width.	Length of channel.	Number of tributaries (about).
	Square miles.	Per cent.				
			Miles.	*Miles.*	*Miles.*	
Bohio-Camboa	250	37	11	23	19.5	17
Gamboa-Alhuela	130	19	7	18	11.0	15
Above Alhuela	290	44	18	16	31.0	?
Total	670	100	.....	.....	61.5	.....

The discharge of the river was accurately determined during the past year from the automatic registers of the three gages at Bohio, Gamboa, and Alhajuela, and rating tables based on many hundred careful measurements were compiled. The water heights were taken every two hours to correct for any small changes of level in the torrential stream.

The daily rainfall was observed at Bohio, Gamboa, Alhajuela, and Colon. There is reason to believe that the rainfall at the latter measures quite approximately the precipitation near the sources of the Chagres, as both are situated near the Atlantic coast and not remote from each other.

Considering the limited areas and compact form of the three subbasins, it is not a violent assumption that the average precipitation for the lower subbasin may be estimated by the mean between that measured at Bohio and Gamboa; for the intermediate, by the mean between that measured at Gamboa and Alhajuela; and for the upper, by the mean between that measured at Alhajuela and Colon. Admitting this assumption, the numerical value of the desired ratio between downfall and drainage for the entire basin above Bohio results from the following formula. Similar expressions for the entire basin above Gamboa and for each subbasin are readily deduced. In the formula, Q denotes the discharge at Bohio in cubic metres per second; D, the number of days considered; B, G, A, and C, the rainfall at Bohio, Gamboa, Alhajuela, and Colon in metres; and R, the desired ratio for the days considered.

$$R = \frac{Q \times 3600 \times 24 \times D}{1610^2 \times \left(\frac{250\,(B+G)}{2} + \frac{130\,(G+A)}{2} + \frac{290\,(A+C)}{2}\right)}$$

Although the variable nature of the ratio between downfall and drainage is well known, depending on the character of the storms, the condition of the soil as to moisture and geological formation, the forest growth, and many other local peculiarities, it is not too much to assume that for a single month the variation will be confined to narrow limits in a valley like that of the Chagres. Its numerical value may be found from the above formula by substituting the mean discharge per second at Bohio for Q; the number of days in the month for D; and the respective rainfall for B, G, A, C. The following table exhibits the results obtained from the observations of the past year, conducted with every care to secure accuracy, by the New Panama Canal Company:

Ratio between rainfall and drainage above Bohio.

Month.	Above—		Subbasin.			Former values (7 years) above—	
	Bohio.	Gamboa.	Upper.	Intermediate.	Lower.	Bohio	Gamboa.
1899.							
July	0.44	0.46	0.45	0.50	0.38	0.58	0.65
August	0.84	0.99	1.04	0.80	0.57	0.70	0.64
September	0.61	0.71	0.75	0.62	0.42	0.80	0.63
October	0.65	0.73	0.88	0.59	0.52	0.94	0.86
November	0.81	0.85	0.39	0.72	0.73	0.87	0.77
December	1.39	1.63	1.64	1.51	0.99	1.08	0.99
1900.							
January	1.04	1.47	1.60	0.66	0.48	2.07	2.41
February	7.41	12.00	15.50	*	3.27	1.89	1.97
March	2.63	3.36	3.56	*	1.71	1.15	1.48
April	0.41	0.54	0.90	*	0.21	0.46	0.54
May	0.30	0.36	0.48	*	0.18	0.50	0.58
June	.....	.....	.....	.....	.....	0.54	0.57

*No outflow.

The figures in the last two columns are added for comparison, although being based only on the discharges actually measured, and on the assumption that the rainfall at Colon measured that in the upper subbasin, where no rain measurements were then made, they are less trustworthy than those of the past year.

Without wishing to attach too much value to the exact figures in this table, it is to be remarked that they generally conform to known conditions in the several months, and accord well with each other. For example, in August and November some rather large freshets occurred, which should and did increase the ratios for those months; but in July, September, and October, when the discharge was less variable, the ratios fell, as they should have done. In leaving the hills and entering the more level district, the ratios become less, as is usually the case.

But the most important and most striking fact developed by these investigations is the exaggerated values of these ratios in the months of little or no rainfall, of which December, 1899, was one. This supplementary volume could only be ground water. For example, in February the rainfall at Bohio was only 0.47 inch; at Gamboa, 0.16; at Alhajuela, 0.04, and at Colon, 0.35. Nevertheless, after two months of previous drought, the average monthly discharge at Bohio was 1,060 cubic feet per second; at Gamboa, 812; and at Alhajuela, the same (812). This water could only have issued from the ground. It is a phenomenon common in the United States. The tributaries of the right bank of the Allegheny River drain a district of glacial drift, while those of the left bank issue from more impermeable soil. In times of severe drought the former often afford a fair discharge while the latter run nearly dry.

That the Chagres belongs to this class of streams is a matter of no small importance for the canal. It gives the explanation of the well-known fact that no fear of a lack of water in the dry season need be entertained with the reserves contemplated by the new company.

CLOUD-BURST AT ERWIN, TENN.

By S. G. WORTH.

The following communication from Mr. S. G. Worth, Superintendent of the United States Fish Commission station at Erwin, Tenn., dated October 13, 1898, relates to an unusual rainfall in that vicinity on August 12, 1898. The Weather Bureau did not have a gage very near this cloud-

burst, but heavy local rains were reported at surrounding stations.

In this connection I wish to advise you that the streams of this immediate vicinity are now in an abnormal state in consequence of the heavy rain which occurred here on August 12. From what I have seen of these streams I am confident that it will be two or three years before the normal (animal) forms become restored. The downpour of rain was greater than had been known here before in 20 or 30 years, and the beds of the streams were completely scoured of all loose material and now consists simply of round boulder rocks. Millions of forms, both large and small, must have been destroyed at that time. On the 26th of September, while taking a day's leave of absence, I went into the headwaters of one of the largest creeks near here for a day's outing and was completely astonished at the torn up condition of the mountain sides. I had never before witnessed the work of a so-called cloud-burst, but after that day's observation I came to the conclusion that if the Weather Bureau had an adequate conception of the destruction in this vicinity, in that rain, they would probably send a man out here to look over the ground and make a report upon it.

At the point where the cloud-burst occurred the ground was torn up a width of 15 to 30 feet and from 100 to 300 yards in length up and down the mountain side. At the bottom of the mountain slope there were evidences of a violent rush of water, mud, and hundreds of tons of loose rock, stumps, and fallen timber. On Rock Creek, and especially on Martins Creek, the disaster wrought by the storm was phenomenal and something beyond my imagination until I had witnessed it myself. The scars made on the mountain sides can be seen several miles distant.

THE SEISMOGRAPH AT THE OBSERVATORY AT CARSON CITY, NEV.

By C. W. FRIEND, Director of the Observatory.

The seismograph stands on a solid foundation that is about even with the surface of the ground. It is of the pattern known as the duplex-pendulum seismograph. A massive bob is hung by three parallel wires from the top of the three-cornered box, and is reduced to nearly neutral equilibrium by being coupled by a ball-and-tube joint to the bob of an inverted pendulum below it. The two form a system which can be made as nearly astatic as is desirable, and so furnish a suitable steady-point for showing the horizontal component of earthquake movement in any azimuth. The motion is magnified (in the observatory seismograph about four and a half times), and recorded by a vertical lever geared to the upper bob by a ball-and-tube joint, supported on gimballs from a bracket fixed to the box, and furnished with a jointed index, which writes on a fixed plate of smoked glass.

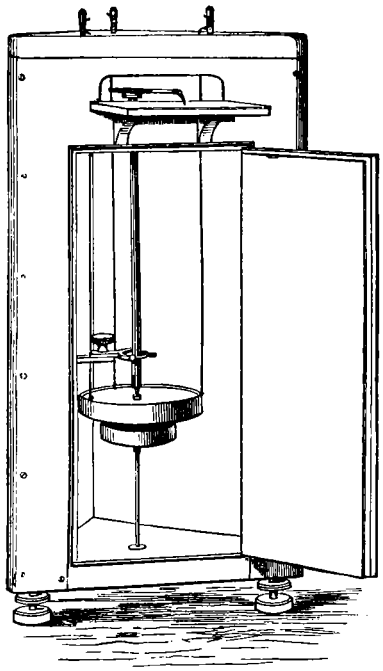

FIG. 1.—Duplex-pendulum seismograph for horizontal motion.

MEXICAN CLIMATOLOGICAL DATA.

Through the kind cooperation of Señor Manuel E. Pastrana, Director of the Central Meteorologic-Magnetic Observatory, the monthly summaries of Mexican data are now communicated in manuscript, in advance of their publication in the Boletin Mensual. An abstract, translated into English measures, is here given, in continuation of the similar tables published in the MONTHLY WEATHER REVIEW since 1896. The barometric means have not been reduced to standard gravity, but this correction will be given at some future date when the pressures are published on our Chart IV.

Mexican data for June, 1900.

Stations.	Altitude.	Mean barometer.	Temperature.			Relative humidity.	Precipitation.	Prevailing direction.	
			Max.	Min.	Mean.			Wind.	Cloud.
	Feet.	*Inch.*	°*F.*	°*F.*	°*F.*	%	*Inch.*		
Durango (Seminario)	6,243	24.03	99.5	48.2	74.5	43	0.67	wsw.	sw.
Leon (Guanajuato)...	5,934	24.27	92.5	56.5	74.5	47	1.51	ne.	ne.
Mexico (Obs. Cent.)..	7,472	23.05	84.2	51.8	66.6	50	1.20	n.	ne.
Morelia (Seminario)..	6,401	23.96	87.4	56.5	71.1	66	5.27	s.	ene.
Puebla (Col. Cat.)....	7,112	23.36	86.5	50.5	69.4	59	4.38	ene.	ne.
Puebla (Col d. E.)...	2,169	23.33	86.9	51.1	68.4	58	3.78	ene.	ne.
Real del Monte... ...	9,095	21.63	74.1	39.9	57.0	.....	4.31	n.	.....
Saltillo (Col. S. Juan).	5,399	24.75	91.6	60.6	76.1	53	0.48	n.	w.
San Isidro (Hac. de Guanajuato)	.....	.....	85.1	69.8	.....	.....	3.76	ne.	.....
San Jose del Cavo (B C.).....	.....	.....	90.0	77.0	83.8	.....	.....	s.	n.
Silao	6,063	24.22	90.1	62.6	75.4	50	3.28	se.	ese.
Queretaro.....	6,070	24.18	93.2	56.7	72.9	46	1.30	e.	.....

RECENT PAPERS BEARING ON METEOROLOGY.

W. F. R. PHILLIPS, in charge of Library, etc.

The subjoined list of titles has been selected from the contents of the periodicals and serials recently received in the library of the Weather Bureau. The titles selected are of papers or other communications bearing on meteorology or cognate branches of science. This is not a complete index of the meteorological contents of all the journals from which it has been compiled; it shows only the articles that appear to the compiler likely to be of particular interest in connection with the work of the Weather Bureau:

Comptes Rendus. Paris. Tome 130.
Violle, J. Observations actinométriques pendant l'éclipse du 28 mai, 1900. P. 1658.

La Nature. Paris. 28me Année.
Plumandon, J. R. La pluie à Nice. P. 75.

Technology Quarterly. Boston. V. 13.
Rotch, A. L. Use of Kites to obtain Meteorological Observations. P. 89.

Das Wetter. Berlin. 17 *Jahrg.*
Muttrich, ——. Ueber die Einrichtung von meteorologischen Stationen zur Erforschung der Einwirkung des Waldes auf das Klima. P. 121.
Pernter, J. M. Wetterschiessen. P. 134.

Scientific American Supplement. New York. Vol. 50.
McAdie, A. G. Frost Fighting. P. 20512.

Geographical Journal. London. Vol. 16.
Arctowski, H. Observations on the Aurora Australis. P. 92.

L'Aerophile. Paris. 8me Année.
Vincent, J. L'emploi des cerfs-volants en météorologie. P. 63.

Philosophical Magazine. London. Vol. 50.
Wood, R. W. Photography of Sound-Waves, and the Kinematographic Demonstration of the Evolutions of Reflected Wave-Fronts. P. 148.

Gaea. Leipzig. 36 *Jahrg.*
Kleln, H. J. Wetterprognosen auf mehrere Tage und die täglichen Wetterkarten. P. 475.

Comptes Rendus. Paris. Tome 131.
Gautier, A. Gaz combustibles de l'air; air des bois; air des hautes montagnes. P. 13.
Gautier, A. Gaz combustibles de l'air; air de la mer. Existence de l'hydrogène libre dans l'atmosphère terrestre. P. 86.
Poncare, A. Combinaison des effets des révolutions synodique et tropique; son action sur la marche des dépressions. P. 132.