THE CLIMATOLOGY OF ANTIGUA, W. I.

By WILLIAM H. ALEXANDER, dated April 16, 1901.

The island of Antigua lies to the eastward of St. Kitts in latitude 17° 5′ north, longitude 61° 50′ west. It contains an area of 108 square miles and is circular in form, being some 70 miles in circumference. The coasts are indented by numerous bays and, being high and rocky, are quite dangerous to navigation. The surface of the island is level, in the main; the highest point, McNish Mountain, is only 2,200 feet above sea level. The hills are probably less than 1,500 feet in elevation. Owing to a light rainfall the elevated portions of the island are not clothed with that luxuriant tropical vegetation to be seen in other of the Leeward Islands such as St. Kitts, Montserrat, and Dominica, but present to the eye a rather desolate, uninviting appearance. The valleys, however, stand in marked contrast to the hills, being arrayed in all the beauty and vernal richness of a tropical climate. There are no rivers and but few springs, and these are brackish. The people are dependent upon rainfall for a water supply, and have in former times suffered great loss and inconvenience from droughts. About one-third of the land is suitable for agricultural purposes.

As regards its geological structure, and in accordance with the character of its surface, it may be divided into three portions. In these three divisions marked contrasts are exhibited in their geological relations. On one side, the western, the rocks are of an igneous character, denoting violent action, akin to volcanic, but without actual eruption; on the other side, the eastern, the character of the rocks is totally different, being chiefly calcareous freestone and limestone; in the middle space, which is a plain, bordered on both sides by hills, both kinds of action may be said to be exhibited, the former in the indurated clays and silicious cherts, the latter in the numerous petrifactions (wood and coral) imbedded in its soil.

The soils of the island are not less varied than its rocks: stiff clays may be considered as predominating in the western division, lighter ones and calcareous marls in the eastern and middle. These are generally productive, especially the marls, of extraordinary fertility.—*C. A. Harris.*

The climate of Antigua for a tropical one is decidedly healthful, and excepting for the hot months is most agreeable. The remarkable dryness of the atmosphere renders it highly favorable for people subject to chest diseases, which are almost unknown among Antiguans. The prevailing diseases of the island are confined almost entirely to the blacks and may be attributed to uncleanly habits, bad diet, and neglect.

St. Johns, the principal town of the island, has a population of about 9,500, and is situated upon the northwest coast. The town covers an area of 150 acres of land and is built upon a slight declivity toward the sea. It is not only the seat of the island government but of the general government of the Leeward Islands as well. The population of the island in 1881 was 34,964, and the probabilities are that the present population differs very little from that figure.

The agriculturist is mainly engaged in the cultivation of the sugar cane from which he obtains sugar, molasses, and rum. The average sugar crop is about 12,000 hogsheads. The soil is very suitable for the growing of cane, which lives and thrives even under the most adverse circumstances. The laborers, when they can get the ground, cultivate for their own use small crops of yams, potatoes, guinea corn, etc. The wages of a field laborer vary to some extent, but generally are between 16 and 20 cents per day for a man; for a woman 12 to 16 cents per day is the usual pay. Domestic servants are paid $4 to $8 per month for a man, and $2.40 to $4.80 for a woman. Mechanics get from 36 to 48 cents per day. On account of the low wages and the limited demand for laborers, especially field laborers, there has been a steady emigration from the island of late years.

For more than ten years Mr. Francis Watts, chemist and government analyst for the Leeward Islands, has kept at Antigua, in connection with his other work, a complete series of meteorological records and has now kindly placed the same at my disposal. Mr. Watts being not only a scientific man but a close student of meteorology as well, has furnished the climatologist with material of more than ordinary value. The data were compiled by Mr. Watts himself or under his immediate supervision. I have worked the records into the accompanying tables, 1–6, each of which is self-explanatory and, it is confidently believed, worthy of careful study.

Relative to the instruments used and their exposure, a few words ought to be said. Referring to Table 1, it should be noted that the record for 1889 and for January, February, and March of 1890, forms no part of Mr. Watts's record. These data are from a record kept at the Public Library, St. Johns. The barometer readings are those of an ordinary Fitzroy barometer and the temperatures are the readings of the attached thermometer and are, therefore, not true atmospheric temperatures. The barometer readings are uncorrected except for the three months in 1890 when a correction for elevation only was applied.

When Mr. Watts began the work on April 1, 1890, he exposed his instruments at the old laboratory, the barometer being 37 feet above sea level. A Fitzroy barometer was used until April 14, 1891, all readings being corrected for elevation but not for temperature. On April 15, 1891, a mercurial barometer with Fortin cistern was installed at the same elevation, and the readings were corrected for temperature and elevation but not for instrumental error. The corrections used were taken from an article on Barometers in Henry Watts's Dictionary of Chemistry, Vol. I. and were approved by the Meteorological Office, London.

The thermometers were all standard instruments and were exposed in a Stevenson's screen, the double bottom and top of which each contains an air space. The screen was placed about four feet above the ground, but it appears that the surroundings were not favorable for the best results and the temperatures were a little high. The wet thermometer was of the cup-and-wick pattern, and the dew-point was found according to the rule and the data given in Henry Watts's Dictionary of Chemistry, Vol. III. p. 227 (old edition).[1]

This arrangement obtained until November 30, 1895, when all the instruments were moved to the new laboratory. The cistern of the barometer was now 24 feet instead of 37 feet above the sea. The thermometer screen was now exposed some 20 feet above the ground on a south gallery, where doubtless radiation had an important effect upon the instruments within, thus still giving too high temperatures. This, I understand, is also Mr. Francis Watts's opinion on this point. On June 1, 1900, the screen was again moved, this time to the botanic station about one-fourth of a mile eastward of the town, and was placed in a level, open space, about 4 feet above a grass-covered lawn. The screen is now 70 or 80 feet above the sea and very favorably surrounded.

On December 23, 1893, a Robinson anemometer was set up at Skerretts, about 1 mile to the eastward of St. Johns. The cups have a diameter of 3 inches, and the arms from outside to outside of cups measure 15¼ inches. The anemometer is exposed 17 feet above the ground in a broad, open, and level space. The exposure of this instrument is, apparently, all that could be desired.

A 9-inch rain gage was used, being so placed that the rim was 4 feet above the ground. Unfortunately the gage was not only moved a number of times, but at no time was the exposure free from surrounding influences, and therefore not the best. The gage at the Public Library, so far as known, was never moved, but was also probably not free from local influences. On June 1, 1900, Mr. Watts had his gage moved to a good location outside of the town.

[1] That is to say, the observer used the revised Glaisher's factors. See Hygrometrical Tables, James Glaisher, London, 1869. p. iv.—ED.

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Fortunately, however, we are not limited to this one record for our knowledge of the rainfall on the Island of Antigua. Table 5, for instance, gives the monthly and yearly means for a number of years, based upon quite a large number of stations well distributed over the island. At many of these stations the gages are not only well exposed, but have never been moved. In this connection, it may be interesting to compare the monthly means of Table 2 with those of Table 5, or, in other words, to compare the rainfall at St. Johns with that of the entire island. It will be noted that the fall at St. Johns for all months in the year, except September and November, is greater than that of the mean for the island and the mean annual fall at St. Johns exceeds the mean for the island by nearly 5 inches.

TABLE 1.—*Monthly mean pressure and temperature data for St. Johns, Antigua.*[2]

Date.	Air pressure.		Attached thermometer.	
	9 a. m.	3 p. m.	9 a. m.	3 p. m.
1889.	*Inches.*	*Inches.*	°*F.*	°*F.*
January	30.110	30.110	79.0	82.0
February	30.140	30.110	77.0	80.0
March	30.130	30.150	80.0	82.0
April	30.130	30.120	82.0	82.5
May	30.120	30.110	81.5	82.5
June	30.130	30.150	81.5	79.0
July	30.130	30.140	86.0	87.5
August	30.110	30.120	86.0	87.0
September	30.100	30.120	81.0	82.1
October	30.090	30.100	83.0	83.0
November	30.120	30.080	80.0	84.0
December	30.070	29.930	77.0	79.0
Annual means	30.115	30.109	81 2	82.5
1890.				
January	30.060	30.060	77 0	77.0
February	30.150	30.130	74.0	71.0
March	30.110	30.110	83.0	90.0

NOTE.—The observations were made on local time.—ED.

The data bearing upon the rainfall of Antigua are very complete and, to me, at least, very interesting. A careful study of the accompanying tables will reveal to the thoughtful many interesting points. Slight discrepancies in the means of the various tables may appear, but these were unavoidable, being the result of the various combinations and methods employed in obtaining the means, some of which were computed by Mr. Watts and some by myself. These differences, however, are immaterial in this connection. The means of Table 5 are, perhaps, slightly too great, for the reason that the period is not only short (twelve years), but contains the phenomenally wet year of 1889, when the mean for the island was about 60 per cent above the normal.

[2] The original Table 1 in Mr. Alexander's paper contained the monthly means and extremes of pressure, temperature, rainfall, wind, etc., arranged in chronological order from January, 1889, to December, 1900, inclusive, as copied from the record of Mr. Watts at St. John's, Antigua. As this arrangement was not conducive to the taking of monthly means and other climatological studies, the Editor has submitted this extensive table to Mr. H. H. Kimball for further elaboration, and all of Mr. Alexander's figures will be found rearranged in Mr. Kimball's article on the seasonal variations of the island of Antigua, except the data given in the preceding columns, which represent observations made by some unknown observer with the instruments kept at the Public Library in St. Johns, and the rainfall data, which Mr. Alexander had himself rearranged in his Tables 2 and 3.—ED.

Referring to Table 6, we find that of the twenty-six years there represented thirteen were below the normal and thirteen were above. The maximum deficiency, 17.22 inches, occurred in 1875, and the maximum excess, 27.59 inches, in 1889. Then, too, I can not refrain from inviting attention to the secular means in Table 5, which show a peculiar variation in the monthly averages beginning with May and concluding with December, while the departures in Table 6 reveal in a conspicuous manner the periods of large and small departures. They seem to indicate that for each period of seven or eight years, five or six years in succession will have a very nearly normal rainfall, followed by two years of comparatively large departures. For instance, the six years from 1876 to 1881 show very slight departures from the normal, but for the two following years, 1882 and 1883, the departures are very large, one above and one below the normal. Then comes another period of five years of nearly normal rainfall, followed again by two years of abnormally large departures, one above and one below the normal, and so on.

Taking 12,000 hogsheads of sugar as an average crop, and 46.00 inches of rain as the average fall, it would appear that for each inch of rain that falls the island produces 261 hogsheads of sugar.

TABLE 2.—*Monthly rainfall at St. Johns, Antigua, from April, 1866, to December, 1900, inclusive.*

Year.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Annual.
1866	.....	.....	.....	2.03	1.21	3.30	2.12	2.25	3.14	6.71	2.19	1.87	24.32
1867	2.15	3.56	0.63	6.11	11.02	10.36	4.74	2.95	7.52	3.30	6.46	5.22	63.92
1868	2.08	1.50	1.63	1.50	2.24	2.12	3.99	3.08	9.85	8.64	3.54	2.34	42.51
1869	2.33	2.69	2.00	0.68	1.80	5.70	2.04	3.77	6.83	2.50	5.22	2.21	38.37
1870	4.60	0.84	2.85	0.79	1.64	2.13	5.83	6.82	2.55	4.35	3.04	2.93	37.73
1871	3.47	1.49	3.05	4.20	3.30	1.81	2.93	2.52	4.01	3.40	1.97	2.82	34.97
1872	1.64	0.68	1.68	1.04	1.52	2.32	5.77	2.16	11.86	5.87	4.60	5.19	44.23
1873	4.05	1.17	4.22	1.11	1.83	1.89	1.75	4.63	5.84	6.62	1.92	2.52	37.05
1874	1.95	1.79	1.50	2.46	3.10	1.85	3.33	5.98	7.87	4.49	3.68	2.48	40.43
1875	2.50	2.83	3.52	1.24	1.48	2.99	3.06	4.71	3.16	6.11	1.08	7.49	40.17
1876	4.01	1.58	4.64	4.39	9.44	5.88	4.53	3.36	4.32	2.76	2.11	1.96	48.99
1877	2.06	4.06	0.44	8.45	2.64	6.58	3.69	2.34	3.99	6.90	6.35	4.16	51.58
1878	3.57	1.51	3.99	2.53	11.39	2.29	7.95	6.65	9.82	5.90	5.39	1.88	62.68
1879	3.63	5.75	1.81	5.47	11.89	6.90	5.96	12.15	2.78	8.66	7.71	4.22	76.43
1880	11.09	2.83	2.13	6 94	9.46	4.46	10.28	3.96	3.74	3.72	4.84	3.36	66.81
1881	2.77	2.71	0.66	4.13	8.01	10.65	5.23	8.70	4.79	12.65	6.25	1.30	68.85
1882	2.52	1.91	0.57	1.37	1.44	2.60	4.46	5.45	5.52	7.45	3.22	6.15	42.66
1883	3.75	4.18	2.27	4.64	6.76	5.08	3.63	6.19	3.13	10.70	10.12	8.69	69.14
1884	2.83	2.69	3.39	2.39	4.72	3.75	7.32	2.44	7.37	5.08	6.05	4.71	53.59
1885	2 59	1.59	1.47	2.25	1.57	2.04	3.31	9.85	2.63	9.87	9.28	4.70	51.15
1886	2.69	2.50	1.67	4.45	2 25	3.83	4.57	5.58	9.18	4.33	4.30	2.79	48.14
1887	3.16	2.76	1.82	0.54	3.84	7.90	4.48	6.11	7.32	6.31	4.55	1.65	49.89
1888	3.01	2.14	2.02	4.15	1.84	5.57	7.19	7.46	4.72	6.09	4.31	1.62	50.12
1889	2.83	5.36	4.03	8.27	12.29	17.51	4.18	7.08	13.71	6.01	4.56	3.23	89.06
1890	5.21	1.00	2.51	9.72*	3.06	1.30	3.79	5.53	5.26	3.32	1.56	1.96	44.32
1891	5.38	2.03	0.57	4.85	2.29	4.47	7.78	5.73	5.31	7.98	7.90	3.11	57.40
1892	5.64	0.91	1.02	1.59	1.99	3.77	3.87	2.58	4.68	5.22	10.03	1.99	43.29
1893	2.78	1.98	8.28	2.61	1.85	2.66	4.12	2.82	4.89	7.98	1.63	3.84	40.49
1894	2.89	1.69	1.18	6.36	3.60	1.30	2.50	1.09	7.41	5.18	8.05	6.70	48.00
1895	2.92	0.78	1.60	2.98	10.47	2.58	5.08	7.48	7.67	5.57	5.25	10.90	63.23
1896	3.84	2.71	2.55	2.21	6.30	7.22	6.61	4.85	3.18	4.95	15.54	5 21	64.57
1897	3.02	3.24	6.24	1.87	6.88	2.68	7.19	2.42	4.56	2.85	2.82	4.10	47.87
1898	2.94	1.82	2.78	0.98	3.17	2.99	9.64	6.45	14.85	4.80	9.72	3.89	68.18
1899	3.97	1.83	1.11	0.84	1.08	3.80	8.40	9.23†	10.48†	9.72	2.64	5.93	58.23
1900	1.72	1.84	1.18	2.18	3.89	2.83	4.91	6.48	2.27	10.28	3.10	3.26	43.39
Means 34 y'rs‡	3.39	2.27	2 22	3.40	4.69	4.42	5.12	5.25	6.27	5.96	5.38	3.83	52.21

* Beginning with April, 1890, the record was kept at the Government Laboratory; before this date at the Public Library.
† Partly estimated, gage blown over.
‡ The means are for the 34 years from 1867 to 1900, inclusive.

TABLE 3.—*Days on which one inch or more of rain fell at St. Johns, Antigua, during the eleven years from* 1890 *to* 1900, *inclusive.*

Year.	January.		February		March		April.		May.		June.		July.		August.		September.		October.		November		December.	
	Am't.	Date.	Am't.	Date.	Am't	Date.	Am't.	Date.	Am't.	Date	Am't.	Date.	Am't.	Date.	Am't.	Date	Am't.	Date.	Am't.	Date	Am't.	Date.	Am't.	Date.
1890							6.06	16							1.26	18	1.05	15						
1890																	1.50	25						
1891							2.10	20			1.03	7	1.60	14	1.70	25	1.32	3	1.07	7	1.06	15		
1891							1.75	22			1.15	21	1.48	19			1.50	7	1.95	14	2.10	21		
1891													1.17	30					1.34	15				
1891																			1.12	18				
1892	3.33	5									1.41	20					1.60	6	1.50	23	1.22	5		
1892																					1.31	6		
1892																					1.28	10		
1893															1.50	15	1.43	23	1.50	15				
1893																			2.20	18				
1894							4.33	19									1.26	4	1.12	13	1.90	24	1.14	12
1894																	1.02	29			1.71	26	2.87	18
1895							2.15	21	3.71	23			1.55	23	2.81	22	1.61	1	1.21	19	1.10	16	3.95	1
1895									3.49	28					1.50	31	1.05	20			1.17	27	1.90	10
1895																							2.38	12
1896	1.16	7							1.20	1	1.20	1	1.07	12	1.00	8			1.00	5	1.12	6	2.58	18
1896									1.10	2	1.02	4	1.01	18					1.00	30	1.47	16		
1896									1.00	3											2.03	27		
1896																					4.78	28		
1896																					2.00	29		
1897	1.50	5	1.68	5	2.36	9			3.19	17			1.24	25			1.09	24						
1897													1.20	28										
1898					1.30	10			1.66	5	1.08	3	2.10	6	1.08	12	1.66	4	1.82	27	1.75	5	1.08	20
1898													1.80	9	1.75	16	3.50	11			5.98	6		
1898													1.18	25			5.25	12						
1898																	3.30	20						
1899													3.30	14	5.00*	2	6.00*	8			1.22	21		
1899													1.50*	27	1.52	28	1.23	28			2.08	23		
1899															1.53	30								
1900					1.00	12			2.03	18					1.04	27			1.53	23				
1900															2.50	30			5.09	25				

* Estimated, gage blown over.

TABLE 4.—*Summary of meteorological records at St. Johns, Antigua, for the ten years* 1891–1900.

Years.	Mean air pressure.		Mean temperature. Dry.		Mean temperature. Wet		Mean dew-point.		Wind. Prevailing direction.		Wind. Average daily movement.	Precipitation. Total amount.	Precipitation. Number days with .01 inch or more.	Number of— Thunderstorms	Number of— Earthquakes
	9 a. m.	3 p. m.	9 a. m.	3 p. m.	9 a. m.	3 p. m.	9 a. m.	3 p. m.	9 a. m.	3 p. m.					
	Inches.	*Inches.*	°	°	°		°	°			*Miles.*	*Inches.*			
1891	30.075	30.023	80.9	82.9	74.4	74.7	70.0	70.0	e.	e.	.....	57.40	287	21	9
1892	30.097	30.085	81.4	83.2	73.8	74.3	69.0	69.0	e.	e.	.....	43.29	231	11	5
1893	30.046	29.979	81.0	83.1	74.3	74.9	70.0	69.0	e.	e.	.....	40.49	256	22	3
1894	30.077	30.007	80.8	83.1	73.9	74.7	70.0	69.0	e.	e	309.8	48.00	247	13	10
1895	30.070	30.004	80.1	83.4	74.7	75.6	70.0	70.0	e.	e.	307.0	63.23	252	18	8
1896	30.089	30.019	81.4	84.2	74.6	75.5	70.0	70.0	e.	ene.	196.4	64.57	239	17	5
1897	30.100	30.031	81.8	84.5	74.9	75.7	70.0	70.0	e.	e.	180.6	47.87	226	11	8
1898	30.068	29.998	81.6	84.4	74.3	75.0	69.0	69.0	e.	e	186.4	63.18	229	14	7
1899	30.065	29.994	81.6	84.6	74.3	75.3	70.0	69.0	e.	e.	195.6	53.23	221	17	8
1900	30.065	30.002	82.2	84.3	74.6	74.9	70.0	70.0	e.	e.	170.3	48.39	194	8	11
Secular means	30.075	30.009	81.3	83.8	74.4	75.0	69.8	69.5	e.	e.	190.9	52.46	240.2	15.3	7.4

NOTE.—The observations were made on local time.—ED.

TABLE 5.—*Monthly and annual average rainfall (in inches and hundredths) on the island of Antigua for a period of twelve years,* 1888 *to* 1899, *inclusive.*

Year.	Number of stations.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Annual.
1888	47	2.09	1.83	1.44	3.54	2.44	3.48	6.06	7.24	5.30	5.40	3.83	1.52	44.02
1889	51	1.70	5.07	4.05	6.96	9.86	14.36	3.10	5.25	11.15	5.17	3.33	3.69	73.61
1890	46	3.60	1.18	1.84	7.53	2.31	1.04	2.52	3.72	5.23	2.82	1.33	2.57	35.79
1891	45	3.67	2.34	0.84	2.71	1.87	4.02	2.95	5.63	8.63	7.07	6.70	1.86	50.01
1892	53	5.77	0.88	0.86	1.18	3.35	3.37	3.15	2.16	4.88	4.85	8.09	1.31	38.53
1893	54	1.76	1.50	2.66	2.10	2.04	2.09	4.60	2.99	6.58	8.42	1.16	2.88	38.69
1894	68	1.89	1.09	1.29	2.78	2.75	1.81	1.57	1.88	5.81	5.66	5.38	8.58	38.87
1895	69	2.30	0.51	1.45	2.80	7.94	1.57	3.65	6.46	7.41	5.18	5.08	8.88	52.91
1896	56	3.10	1.71	2.08	1.54	6.93	7.83	5.89	4.88	2.88	7.11	13.66	3.53	59.85
1897	54	2.28	2.24	6.18	1.15	5.91	2.25	6.01	1.70	3.78	1.96	2.68	5.69	39.67
1898	66	2.06	1.19	2.39	0.95	2.00	1.95	6.69	6.09	12.80	3.29	8.39	2.68	48.85
1899	68	3.17	1.20	0.86	0.46	1.17	2.67	7.50	7.14	10.54	4.98	5.60	1.54	47.50
Secular means	.....	2.79	1.71	2.12	2.76	3.91	3.78	5.06	4.47	6.58	5.10	5.49	3.55	47.35

The average rainfall for twenty-six years, from 1874 to 1899, inclusive, was 46.00 inches.

TABLE 6.—*Average annual rainfall on the island of Antigua for a period of twenty-six years,* 1874 *to* 1899, *inclusive.*

Year.	Number of stations.	Rainfall.	Departure from the normal.
		Inches.	*Inches.*
1874	41	31.16	−14.84
1875	40	28.78	−17.22
1876	36	41.98	− 4.02
1877	38	49.05	+ 3.05
1878	53	47.11	+ 1.11
1879	52	61.54	+15.54
1880	46	49.69	+ 3.69
1881	44	53.75	+ 7.75
1882	45	33.04	−12.96
1883	56	55.51	+ 9.51
1884	56	43.98	− 2.02
1885	53	43.39	− 2.61
1886	55	47.78	+ 1.78
1887	50	43.68	− 2.32
1888	47	44.23	− 1.77
1889	50	73.59	+27.59
1890	45	33.00	−18.00
1891	45	50.01	+ 4.01
1892	53	38.53	− 7.47
1893	54	38.69	− 7.31
1894	68	38.87	− 7.13
1895	69	52.91	+ 6.91
1896	56	59.85	+13.85
1897	54	39.67	− 6.33
1898	66	48.85	+ 2.85
1899	68	47.50	+ 1.50

see W H Alexander p165

THE SEASONAL VARIATIONS IN THE CLIMATE OF ANTIGUA, W. I.

By H. H KIMBALL, Weather Bureau.

The very interesting meteorological data for St. Johns, Antigua, W. I., embracing the observations of Mr. Francis Watts, chemist and government analyst for the Leeward Islands, and communicated by Mr. W. H. Alexander in Table 1 of his article entitled "Climatology of Antigua, W. I.," have been rearranged in the following 21 smaller tables so as to show in addition to the annual means, which in most cases were worked out by Mr. Alexander, the monthly and annual averages which have been computed by myself. In the case of a tropical oceanic climate like that of Antigua, where the variations from year to year, unlike those of the higher latitudes, are extremely small, excepting perhaps the variations in the rainfall, the changes from month to month, or from season to season, are of the greater interest.

For a description of instruments and exposures see Mr. Alexander's article above referred to. Apparently the correction to be applied to the readings of the barometer to reduce them to the readings of a standard instrument is unknown, but a comparison of the mean readings for 1899 and 1900 with those for Basseterre, St. Kitts, for the same years, after reducing the St. Johns readings to standard gravity, indicates that this correction is within the probable error[2] of the data for Basseterre, and is quite likely to be between ± 0.00 and $+0.01$ inch.

The observations appear to have been taken at 9 a. m. and 3 p. m., local time, corresponding to 8:07 a. m. and 2:07 p. m. seventy-fifth meridian time, or just previous to the principal maximum and minimum in the diurnal pressure curve. The mean of these two observations is only .002 or .003 higher than the mean of the hourly readings[3]. The barometric data were given by Mr. Alexander to thousandths of inches, and the means were computed from the data as so given, but only inches and hundredths have been retained in the printed tables.

The monthly averages of pressure show a maximum in February and again in June and July, with a decided minimum in October and November; the summer maximum is much more pronounced than at other West Indian stations. The winter maximum is easily explained by the southward movement at this season of the belt of high pressure encircling the globe north of the equator; the summer maximum may be attributed to the building up of the area of high pressure over the Atlantic which reaches a maximum in July.[4] The principal minimum of the year occurs a month later than in Havana, and is attributable to the combined effect of the northward movement of the high pressure belt, and the contraction of the Atlantic high pressure area.

It is interesting to notice that the average daily wind movement follows much the same law as the average monthly pressure, showing a decided maximum in June and July and a decided minimum in October. The wind direction data is not of a character that enables us to study changes of direction from season to season, since the prevailing direction only is given, that is, the direction observed the greatest number of times during the month, and this is almost always from the east. We notice, however, that northeasterly winds prevail less frequently in summer than in winter, and therefore infer that the prevailing easterlies, in a latitude where we would naturally expect northeasterlies, are due to the anticyclonic circulation about the Atlantic high to the east of Antigua. While the full observations of wind direction for Antigua would no doubt show the same strong northeasterly component that is observed at other West Indian stations, it must be admitted that the influence of the Atlantic high pressure area on both the atmospheric pressure and the winds of Antigua is very marked.

The table of lowest temperatures shows very clearly the effect upon the minimum thermometer of the change in the exposure of the instruments in November, 1895, referred to by Mr. Alexander, and the annual mean of the minimum temperatures after this date averages nearly 3° higher than before. The annual mean of the maximum temperatures is slightly lower after the removal than before, so that on the whole we may say that since November, 1895, the temperatures recorded have averaged too high, and the diurnal range of temperature has been too small.

The monthly averages of temperature vary less than 3° from the annual average. February is the coldest month and August the warmest, but the highest temperatures do not occur until September and October. Similarly, the minimum monthly rainfall for the whole island occurs in February, and the maximum in September.

The convectional origin of much of the rainfall is apparent, since besides the coincidence in the time of the occurrence of the maximums of temperature and rainfall already noted, there is also a marked decrease in the wind movement during September as compared with the summer months; moreover thunderstorms, which are unknown in February, average 2.5 per month during the summer, 2.6 in September, and reach a maximum of 3.2 per month in October. In this connection, however, Mr. Alexander has referred to an interesting relation between the rainfall at St. Johns and the average rainfall for the whole island, as shown by his tables 2 and 5. In general, the rainfall at St. Johns, on the leeward side of the island, is greater than the average for the whole island, the only exceptions to this rule occurring in September and November, or at a season of the year when, as we have seen, the winds are comparatively light and the convectional action comparatively strong. It therefore appears that in the case of Antigua either the crest of the atmospheric wave,[5] caused by the air being blown against the sides of the mountains on the island, occurs at some little distance after the tops of the mountains are passed, or else the forward drift of the clouds formed on the upward slope of this wave is very appreciable. Under the average conditions of pressure, temperature, and humidity that prevail during the summer at 3 p. m., the air at sea level would have to rise to a height of about 2,600 feet, or 400 feet above the tops of the highest mountains on the island, before it would be cooled adiabatically to the saturation point. It is, therefore, not impossible that in this case the heaviest rain may occur on the leeward side of the island, but it is very much to be desired that the rainfall data may be rearranged so as to leave no doubt as to this point. As is well known, but little rain falls in the trade wind belts except where the winds are deflected upward by mountains.

Mr. Alexander has referred to the dryness of the climate of Antigua, and I have, therefore, computed the relative humidity from the monthly means of the dry and wet bulb thermometer readings, using Marvin's Psychrometric Tables (W. B. No. 235, 1900), which are based on readings of the whirled psychrometer, and therefore would not apply to the readings of a stationary hygrometer unless the wind was sufficient to thoroughly ventilate the shelter at all times. While this seems to have generally been the case at Antigua, we suspect the relative humidities here given are a little too high, although the average of the two observations, 69.5, is considerably less than the average given by Prof. M. W. Davis for the mean relative humidity of the trade winds over the oceans, namely, 77 per cent.[6] Ravenstein's charts, British Associa-

[1] See page 165.
[2] See page 24, Report of the Chief of the Weather Bureau, 1899–1900.
[3] See hourly readings for Basseterre, Report of the Chief of Weather Bureau, 1899–1900, pp. 314–315.
[4] See Bartholomew's atlas of meteorology, London, 1899, plate 12.
[5] See the memoir by Dr. F. Pockels, p. 152 of this REVIEW.
[6] Elementary Meteorology, Davis, Boston, 1894, p. 152.

tion for the Advancement of Sciences, 1870, p. 812, would seem to make the humidity less than 80 per cent.

The mean dew-point computed by the use of Glaisher's factors gives an average annual vapor tension of 0.732, and an average relative humidity of 68.4 at 9 a. m., and 63.7 at 3 p. m., which is considerably less than the humidity given by the psychrometric formula. It may therefore be that Glaisher's factors are the more accurate for determining dew-points and humidities from readings of a stationary hygrometer, under conditions such as prevail at Antigua.

These tables emphasize the importance of proper exposure of instruments, if records of value in the study of the climatology of a place are to be obtained. The increase of nearly 3° in the annual mean minimum thermometer reading, due to a change of exposure in November, 1895, is as great as the differences in the average annual mean minimum temperatures for the different islands of the Windward group. Any error in recording the temperature also enters into the relative humidity data, and a comparison between the climates of the different islands is thus made difficult.

Meteorological data for St. Johns, Antigua, W. I.

TABLE 1.—BAROMETRIC PRESSURE, 9 A. M.

Year.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Annual.
	Inches.	*Inches.*	*Inches.*	*Inches.*	*Inches.*	*Inches.*	*Inches.*	*Inches.*	*Inches.*	*Inches.*	*Inches.*	*Inches.*	*Inches.*
1890	.....	.....	.....	30.16	30.17	30.20	30.06	29.99	30.01	30.02	30.00	30.06	.....
1891	30.10	30.14	30.07	30.08	30.06	30.09	30.11	30.09	30.04	30.00	30.03	30.08	30.08
1892	30.11	30.10	30.12	30.13	30.12	30.16	30.15	30.01	30.09	30.05	30.02	30.10	30.10
1893	30.07	30.11	30.10	30.09	30.05	30.08	30.04	30.01	30.00	29.94	30.02	30.05	30.05
1894	30.10	30.16	30.12	30.08	30.02	30.11	30.12	30.07	30.04	30.03	30.04	30.04	30.08
1895	30.10	30.10	30.11	30.10	30.08	30.14	30.12	30.03	30.02	29.99	30.03	30.03	30.07
1896	30.10	30.14	30.10	30.08	30.06	30.12	30.14	30.10	30.03	30.04	30.03	30.11	30.09
1897	30.11	30.17	30.11	30.11	30.07	30.14	30.12	30.10	30.06	30.06	30.04	30.08	30.10
1898	30.13	30.09	30.05	30.10	30.06	30.08	30.07	30.05	30.00	30.02	30.00	30.10	30.06
1899	30.13	30.15	30.12	30.08	30.10	30.09	30.06	30.02	30.03	29.98	30.00	30.02	30.06
1900	30.08	30.13	30.11	30.07	30.07	30.06	30.06	30.06	30.04	30.02	30.00	30.09	30.06
Means	30.10	30.13	30.10	30.09	30.07	30.11	30.10	30.05	30.04	30.01	30.02	30.07	30.08

TABLE 2.—BAROMETRIC PRESSURE, 3 P. M.

1890	.....	.....	.....	30.13	30.15	30.18	30.06	30.00	29.97	29.95	29.94	29.99	.....
1891	30.04	30.05	30.03	30.04	30.04	30.05	30.07	30.05	30.00	29.93	29.93	30.02	[illegible]
1892	30.03	30.02	30.03	30.06	30.06	30.11	30.12	30.08	30.02	29.97	29.95	30.03	[illegible]
1893	30.00	30.02	30.02	30.01	30.00	30.03	30.00	29.93	29.96	29.96	29.94	29.96	[illegible]
1894	30.03	30.05	30.05	30.01	29.97	30.02	30.08	30.02	29.96	29.92	29.96	29.95	[illegible]
1895	30.02	30.02	30.04	30.02	30.03	30.09	30.08	29.98	29.96	29.92	29.94	29.94	[illegible]
1896	30.02	30.06	29.98	30.01	30.01	30.06	30.11	30.05	29.97	29.95	29.95	30.02	[illegible]
1897	30.04	30.10	30.03	30.04	30.01	30.09	30.07	30.04	30.03	29.98	29.96	30.00	[illegible]
1898	30.05	30.01	29.99	30.03	30.00	30.04	30.03	30.00	29.91	29.95	29.93	30.02	30.00
1899	30.05	30.05	30.04	30.01	30.03	30.01	30.02	29.96	29.96	29.91	29.88	29.94	29.99
1900	30.00	30.05	30.04	29.99	30.01	30.04	30.07	30.01	29.99	29.94	29.92	30.01	30.00
Means	30.03	30.06	30.02	30.02	30.02	30.06	30.06	30.01	29.98	29.93	29.94	29.99	30.01
Means of the 9 a. m. and 3 p. m. pressure.	30.06	30.09	30.06	30.06	30.04	30.08	30.08	30.01	30.01	29.97	29.98	30.03	30.04

NOTE.—Data for 1890 not included in the means. The instrumental error of the barometer is unknown. The readings have been reduced to sea level, but not to standard gravity.

TABLE 3.—DRY THERMOMETER, 9 A. M.

	°	°	°	°	°	°	°	°	°	°	°	°	°
1890	.....	.....	.....	79.0	83.0	84.0	83.0	82.0	82.0	83.0	82.0	80.0	80.9
1891	77.5	77.0	79.0	81.0	83.0	84.0	82.0	83.0	84.0	84.0	79.0	78.0	80.9
1892	78.0	77.0	80.5	80.5	81.0	83.0	83.0	84.0	83.8	83.8	80.6	79.0	81.4
1893	77.8	78.0	78.0	79.8	82.3	82.5	82.7	84.0	83.0	82.5	82.3	79.9	81.0
1894	77.7	76.8	77.4	79.8	82.1	83.4	83.4	84.1	83.9	81.4	80.8	78.4	80.8
1895	76.7	77.0	79.0	81.2	80.7	82.7	82.8	83.3	83.1	82.8	81.3	80.8	80.1
1896	78.8	78.1	79.0	79.8	81.7	84.3	83.3	83.5	84.6	83.9	80.5	80.4	81.4
1897	78.8	78.5	78.7	80.8	82.3	82.6	83.3	84.2	84.3	84.4	82.8	81.8	81.8
1898	79.8	78.7	79.2	80.8	83.0	83.4	83.3	84.0	83.5	83.6	81.0	80.5	81.6
1899	78.6	78.1	78.3	80.8	82.8	83.4	83.4	84.0	83.5	83.6	82.8	80.8	81.6
1900	79.8	78.3	79.2	81.4	83.0	83.6	83.4	86.3	84.7	83.7	82.5	80.2	82.2
Means	78.3	77.8	79.1	80.4	82.3	83.1	83.1	83.9	83.7	83.3	81.4	79.8	81.3

TABLE 4.—DRY THERMOMETER, 3 P. M.

1890	.....	.....	.....	80.0	81.0	84.0	82.8	84.0	84.0	83.5	82.5	82.0	82.4
1891	80.0	79.0	82.0	83.0	84.0	84.0	84.0	85.0	85.0	84.0	82.0	82.0	82.4
1892	80.8	81.0	82.8	82.0	82.0	84.5	85.5	86.0	85.0	85.0	82.5	81.0	83.5
1893	80.7	80.8	81.5	81.5	83.6	85.0	85.0	86.8	85.8	83.7	83.7	80.0	83.1
1894	79.7	80.2	80.6	81.5	83.6	85.4	85.8	86.0	85.9	83.6	82.4	81.2	83.1
1895	81.3	82.0	82.6	83.8	83.0	84.8	85.2	85.2	84.8	84.8	82.3	83.2	83.4
1896	82.0	81.7	82.5	82.7	84.2	84.6	85.2	86.2	86.0	86.2	83.4	83.8	84.5
1897	82.8	82.5	82.2	84.0	83.6	84.3	85.4	86.9	86.7	86.7	84.9	83.6	84.7
1898	83.6	82.8	82.5	83.5	84.9	86.4	84.5	85.8	85.2	85.7	83.8	83.9	84.4
1899	82.4	82.0	81.9	83.5	85.2	85.6	86.1	85.1	85.9	86.8	85.9	85.1	84.8
1900	84.8	82.6	82.8	83.2	85.0	84.1	87.6	85.2	85.8	84.2	83.8	81.8	84.3
Means	81.8	81.5	82.1	82.6	83.6	84.8	85.2	85.7	85.5	84.7	83.3	82.6	83.6

TABLE 5.—MEAN MAXIMUM TEMPERATURE

Year.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Annual.
	°	°	°	°	°	°	°	°	°	°	°	°	°
1890	.....	.....	.....	84.0	85.0	87.0	87.0	87.0	88.0	87.5	86.0	85.5	85.7
1891	82.5	82.5	84.0	86.0	87.0	87.5	87.0	87.8	89.0	88.5	86.5	84.0	86.0
1892	84.0	84.8	86.5	86.0	85.5	87.0	88.0	89.0	88.8	88.8	85.0	84.5	86.5
1893	83.3	83.0	84.0	85.0	86.5	87.6	88.6	89.8	88.6	87.7	87.0	83.3	86.2
1894	82.5	82.9	83.4	85.0	87.0	87.9	88.6	90.2	88.9	86.5	85.2	84.2	86.0
1895	83.6	84.5	85.8	86.9	85.9	87.5	88.2	88.9	88.0	86.7	85.6	85.9*	86.4
1896	.....	82.7	83.3	83.7	84.6	86.0	86.0	87.3	88.8	88.1	85.0	84.8	85.3
1897	84.6	83.5	82.9	85.0	85.2	85.5	86.4	87.7	87.7	88.2	86.8	85.6	85.8
1898	84.7	83.9	83.6	84.4	85.7	87.0	86.2	87.0	86.9	87.4	85.4	85.1	85.6
1899	83.4	82.6	82.5	84.3	86.2	86.5	86.9	87.0	87.6	87.8	87.1	86.7	85.7
1900	85.1	83.9	83.6	85.2	86.1	86.6	86.7	87.4	88.0	87.1	85.1	84.9	85.8
Means	83.7	83.4	84.0	85.0	85.9	86.9	87.2	88.1	88.2	87.7	85.9	85.0	85.9

*Mean for the first seventeen days of the month.

TABLE 6.—MEAN MINIMUM TEMPERATURE.

1890	.....	.....	.....	68.0	71.0	73.0	73.0	74.0	72.0	72.0	73.0	70.0	71.4
1891	68.5	69.5	67.0	72.0	73.0	74.5	75.0	74.5	73.5	73.0	72.0	69.2	71.8
1892	68.5	67.0	69.5	71.0	74.0	74.5	74.8	74.8	73.0	73.0	71.0	70.0	71.8
1893	67.7	68.7	71.0	70.0	72.7	74.0	74.0	74.7	72.8	72.4	70.6	70.3	71.6
1894	68.2	68.0	67.4	70.6	71.8	74.5	74.3	75.7	73.8	72.8	72.2	69.6	71.6
1895	68.4	69.5	70.3	71.8	72.7	74.3	74.7	75.6	74.7	73.5	73.0	72.2	72.5
1896	70.8	71.8	72.2	73.8	72.2	76.8	77.1	77.5	77.2	76.0	74.1	74.1	74.5
1897	72.0	71.7	71.5	73.7	75.6	76.4	77.0	78.1	77.1	76.8	75.2	73.8	74.9
1898	72.3	71.2	71.5	73.5	76.0	77.3	76.2	77.1	76.7	76.2	73.3	73.2	74.5
1899	72.2	71.7	71.4	73.3	75.3	76.5	77.5	77.8	76.8	76.1	75.7	71.9	74.7
1900	73.0	72.0	73.2	74.0	76.0	75.0	75.4	75.6	75.5	74.3	72.6	72.2	74.1
Means	70.2	70.1	70.5	72.0	73.7	75.2	75.4	75.9	74.8	74.2	73.0	71.5	73.0

TABLE 7.—MEAN TEMPERATURE (MAX. + MIN.) ÷ 2.

1890	.....	.....	.....	76.0	78.0	80.0	80.0	80.5	80.0	79.8	79.5	77.8	78.6
1891	75.5	76.0	75.5	79.0	80.0	81.0	81.0	81.2	81.2	80.8	79.2	76.6	78.9
1892	76.2	75.9	78.0	78.5	79.8	80.8	81.4	81.9	80.9	80.9	78.0	77.2	79.1
1893	75.5	75.8	77.5	77.5	79.6	80.8	81.3	82.2	80.7	80.0	78.8	76.8	78.9
1894	75.4	75.4	75.4	77.8	79.4	81.2	81.4	83.0	81.4	79.6	78.7	76.9	78.8
1895	76.0	77.0	78.0	79.4	79.3	80.9	81.4	82.2	81.4	80.1	79.3	79.0	79.5
1896	.....	77.2	77.8	78.8	78.4	81.4	81.6	82.4	83.0	82.0	79.6	79.4	79.9
1897	78.3	77.6	77.2	79.4	80.4	81.0	81.7	82.9	82.4	82.5	81.0	79.7	80.3
1898	78.5	77.6	77.6	78.0	80.8	82.2	81.2	82.0	81.8	81.8	79.4	79.2	80.0
1899	77.8	77.2	77.0	78.8	80.8	81.5	82.2	82.4	82.2	82.0	81.4	79.8	80.2
1900	79.0	78.0	78.4	79.6	81.0	80.8	81.0	81.5	81.8	80.7	78.9	78.6	79.9
Means	76.9	76.8	77.2	78.4	79.8	81.1	81.3	82.0	81.5	80.9	79.4	78.2	79.5

TABLE 8.—HIGHEST TEMPERATURE.

1890	.....	.....	.....	88	90	91	90	90	90	90	88	88	91
1891	85	84	89	89	90	90	90	91	92	93	92	86	93
1892	86	89	90	89	89	89	90	91	91	92	88	88	92
1893	86	85	87	88	89	90	91	92	92	92	90	86	92
1894	85	84	85	88	90	90	90	92	93	89	87	87	93
1895	86	87	88	92	89	90	92	92	90	89	89	90[n]	92
1896	.....	85	86	86	87	88	88	89	92	92	89	87	92
1897	88	86	86	87	88	88	88	90	90	91	89	90	91
1898	88	86	86	86[a]	89	89	88	88	90	90	89	87	90
1899	86	86	85	85	87	88	89	90	90	92	90	90	92
1900	88	86	88	88	88	89	89	90	91	91	90	89	91
Absolute maximum	88	89	90	92	90	91	92	92	93	93	92	90	93

TABLE 9.—LOWEST TEMPERATURE.

1890	.....	.....	.....	62	68	69	69	72	70	67	65	63	.....
1891	61	67	60	68	66	72	72	71	70[a]	69	65	63	60
1892	61	61	63	60	72	71	71	70	71	68	68	66	60
1893	63	60	61	62	68	72	73	71	70	67	65	65	60
1894	61	67	60	67	67	72	71	73	69	70	68	63	60
1895	61	63	68	68	70	71	71	72	72	69	67	67	61
1896	65	69	67	72	73	73	74	75	75	71	69	71	65
1897	68	66[b]	67	71	72	74	73	74	72	75	71	70	66
1898	68	67	68	71[a]	73	75	72	74	73	72	68	69	67
1899	70	70	69	70	72	74	73	72	73	73	73	65	65
1900	69	70	71	72	75	72	72	73	73	71	70	70	69
Absolute minimum	61	60	60	60	66	69	69	70	69	67	65	63	60

TABLE 10.—WET THERMOMETER, 9 A. M.

Year	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Annual.
	°	°	°	°	°	°	°	°	°	°	°	°	°
1890	.....	.....	.....	72.5	74.2	75.1	76.0	76.6	77.2	76.7	75.0	73.3	74.1
1891	71.0	69.0	70.5	73.8	74.0	76.0	76.8	77.0	77.8	77.5	76.0	72.8	74.4
1892	72.5	70.0	71.8	71.0	74.5	75.5	72.5	77.0	76.6	76.5	75.5	72.5	73.8
1893	71.5	71.0	70.5	72.4	74.7	76.6	77.0	77.3	76.4	77.0	74.7	72.0	74.3
1894	70.8	69.6	70.5	73.1	75.7	75.7	75.6	76.0	76.8	75.8	74.8	72.6	73.9
1895	70.7	70.1	71.2	73.5	74.5	77.2	77.3	77.2	77.3	77.0	75.2	74.8	74.7
1896	72.3	71.3	71.4	71.9	74.8	76.6	76.8	77.2	77.6	77.0	74.1	74.4	74.6
1897	72.6	71.5[b]	72.3	73.5	75.5	75.5[a]	76.5	76.9	77.1	76.8	75.9	75.0	74.9
1898	72.2	70.8	70.0	71.8[a]	75.1	75.9	76.6	77.2	77.2	76.6	74.3	73.9	74.3
1899	71.3	70.7	70.2	72.0	74.5	75.7	76.5	77.2	77.3	77.0	76.8	72.5	74.3
1900	72.5	71.2	70.7	73.6	75.3	76.2	76.4	76.7	77.1	76.7	75.1	74.2	74.6
Means	71.7	70.5	70.9	72.6	74.8	76.0	76.2	76.9	77.2	76.8	75.2	73.5	74.4

TABLE 11.—WET THERMOMETER, 3 P. M.

1890	.....	.....	.....	73.5[b]	74.7[b]	75.8[b]	78.7[b]	77.6[b]	77.0[b]	76.5[b]	75.0[b]	73.5[b]	74.7
1891	72.0[b]	69.5[b]	71.5[b]	74.5[b]	75.5[b]	76.0[b]	77.0[b]	78.0[b]	78.5[b]	74.0[b]	76.0[b]	74.0[b]	74.7
1892	73.0[b]	71.2[b]	72.8[b]	72.0[b]	75.0[b]	72.0[b]	77.0[b]	76.8[b]	76.0[b]	77.0	76.0[b]	73.0[b]	74.3
1893	72.4[b]	71.8[b]	71.4[b]	73.0[b]	75.0[b]	77.3[b]	77.7[b]	78.2[b]	77.7[b]	76.7[b]	75.0[b]	72.5[b]	74.9
1894	71.6[b]	70.6[b]	71.4[b]	74.0[b]	76.4[b]	76.5[b]	76.3[b]	76.8[b]	77.3[b]	75.8[b]	75.4[b]	73.8[b]	74.7
1895	72.7[b]	72.0[b]	72.4[b]	74.8[b]	75.1[b]	78.2[b]	77.7[b]	77.9[b]	78.0[b]	77.2[b]	75.9[b]	73.4[b]	75.6
1896	73.9[b]	72.4[b]	72.7[b]	72.7[b]	75.5[b]	76.6[b]	77.4[b]	77.9[b]	78.5[b]	77.5[b]	76.2[b]	75.9[b]	75.5
1897	73.9[b]	72.4[b]	73.3[b]	74.2[b]	75.7[b]	76.1[b]	77.3[b]	77.9[b]	77.6[b]	77.5[b]	76.5[b]	75.8[b]	75.7
1898	73.2[b]	71.3[b]	71.4[b]	72.9[b]	75.3[b]	76.6[b]	76.9[b]	77.7[b]	77.3	77.5[b]	75.3	75.0[b]	75.0
1899	72.6[b]	71.6[b]	71.4[b]	72.8[b]	74.8[b]	76.1[b]	77.6[b]	77.8[b]	77.8[b]	78.2[b]	77.6[b]	74.8[b]	75.2
1900	70.9[b]	72.6[b]	72.1[b]	74.2[b]	76.0[b]	75.8[b]	76.7[b]	77.9[b]	77.4[b]	75.7[b]	75.8[b]	75.0[b]	74.9
Means	72.6	71.5	72.0	73.5	75.4	76.1	77.1	77.6	77.6	76.7	75.6	74.4	75.0

TABLE 12.—DEW-POINT, 9 A. M.

1890	.....	.....	.....	67[a]	69	70	70	72	72	74	70	69	69
1891	67	64	65	70	69	72	73	74	74	74	73	70	70
1892	68	64	66	65	70	70	71	72	70	72	72	68	69
1893	67	66	65	67	70	72	74	73	74	73	70	67	69
1894	66	65	66	69	72	71	70	71	72	72	71	69	69
1895	66	65	66	68	70	74	72	73	74	73	71	71	70
1896	67	67	66	66	70	72	72	73	73	72	70	72	70
1897	68	67[a]	68	69	71	71[a]	72	72	72	72	71	70	70
1898	67	64	64	66[a]	70	70	72	73	73	72	70	69	69
1899	66	66	65	66	69	71	72	72	73	73	73	67	69
1900	67	66	65	69	71	72	72	72	73	72	71	70	70
Means	67	65	66	67	70	71	72	73	73	73	71	69	70

TABLE 13.—DEW-POINT, 3 P. M.

1890	.....	.....	.....	64[a]	69[a]	70[a]	71[a]	72[a]	72[a]	71[a]	70[a]	68[a]	70
1891	68[a]	65[a]	65[a]	69[a]	69[a]	72[a]	73[a]	74[a]	74[a]	73[a]	72[a]	69[a]	70
1892	67[a]	65[a]	65[a]	64[a]	70[a]	70[a]	71[a]	70[a]	72[a]	72[a]	72[a]	68[a]	69
1893	66[a]	66[a]	65[a]	67[a]	69[a]	72[a]	73[a]	73[a]	73[a]	71[a]	69[a]	68[a]	69
1894	66[a]	64[a]	65[a]	69[a]	72[a]	71[a]	70[a]	71[a]	72[a]	72[a]	71[a]	69[a]	69
1895	67[a]	65[a]	66[a]	68[a]	70[a]	74[a]	73[a]	73[a]	74[a]	74[a]	72[a]	70[a]	70
1896	68[a]	66[a]	66[a]	66[a]	70[a]	72[a]	73[a]	73[a]	73[a]	72[a]	70[a]	71[a]	70
1897	68[a]	66[a]	68[a]	68[a]	70[a]	71[a]	72[a]	72[a]	72[a]	72[a]	71	70[a]	70
1898	66[a]	64[a]	64[a]	66[a]	70[a]	70[a]	72[a]	72[a]	72[a]	72[a]	70	69[a]	69
1899	66[a]	65[a]	64[a]	66[a]	68[a]	70[a]	72[a]	72[a]	73[a]	73[a]	72[a]	67[a]	69
1900	67[a]	66[a]	65[a]	68[a]	70[a]	70[a]	72[a]	72[a]	72[a]	73[a]	72[a]	70[a]	70
Means	67	65	65	67	70	71	72	72	73	72	71	69	70

TABLE 14.—RELATIVE HUMIDITY, 9 A. M.

	%	%	%	%	%	%	%	%	%	%	%	%	%
1890	.....	.....	.....	73	66	72	72	78	81	75	72	73	73
1891	72	67	66	71	66	72	79	76	75	74	67	73	74
1892	77	71	87	64	74	71	69	73	70	72	79	73	72
1893	74	71	69	70	70	76	74	74	73	78	70	71	73
1894	71	69	71	73	74	70	70	69	73	78	75	76	72
1895	74	71	69	70	74	78	78	78	78	77	76	75	75
1896	73	71	69	68	72	74	74	76	73	73	73	73	73
1897	74	71	73	71	73	72	74	72	72	71	72	73	72
1898	71	66	63	64	69	68	74	74	74	73	73	73	70
1899	70	69	67	65	68	70	73	74	73	74	76	69	71
1900	71	71	66	70	70	71	73	64	71	73	70	75	70
Means	73	70	67	69	71	72	73	73	75	74	75	74	72

TABLE 15.—RELATIVE HUMIDITY, 8 P. M.

Year.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Annual.
	%	%	%	%	%	%	%	%	%	%	%	%	%
1890	.....	.....	.....	74	74	68	76	75	73	73	71	67	70
1891	68	62	60	67	68	69	73	73	75	62	76	69	68
1892	69	62	61	61	72	54	68	65	66	70	74	68	66
1893	67	64	61	67	67	71	72	68	71	73	67	70	68
1894	68	62	63	70	72	66	64	63	68	70	72	69	67
1895	67	61	61	64	69	74	71	71	75	78	74	68	69
1896	69	64	62	61	67	69	71	69	66	68	68	69	67
1897	65	61	65	70	69	68	69	66	66	65	68	70	67
1898	61	57	58	60	64	64	71	70	70	69	67	66	65
1899	62	60	60	57	61	65	68	72	70	68	69	61	64
1900	51	61	60	66	66	68	61	70	70	68	71	75	66
Means	65	61	61	65	68	67	69	69	70	69	71	68	67

TABLE 16.—PREVAILING WIND DIRECTION, 9 A. M.

1890	.....	.....	.....	e.	e.	e.	e.	e.	e.	e.	e.	e.	e.
1891	e	e.	e.	e.	e.	e.	e.	e.	e.	e.[a]	e.	e.	e.
1892	e.	ne.	e.	e.	e.	e.	e.	e.	e.	e.	e.	ene.	e
1893	e.	ene.	e.	e.	e.	e.	e.	e.	e.	e.	e.	e.	e.
1894	e.	e.	e.	e.	e.	e.	e.	e.	e.	e.	e.	ne., e.	e.
1895	e.	e.	e.	e	e.	e.	e.	e.	e.	e.	e.	ene., e.	e.
1896	e.	e.	e.	ene., e.	e.	ene.	e.	e.	e.	e.	ene.	e.	e.
1897	e.	ene.	ene.	e.	ese.	e.[a]	ene.	e.	e.	e.	e.	e.	e.
1898	ne.	e.	ene.	e.	e.	e.	e.	e.	ene.	e.	e.	e.	e.
1899	e.	e.	e.	e.	e.	e.	e.	e.	e.	e.	e.	ne	e.
1900	e.	e.	e.	e.	e.	e.	e.	e.	e.	e.	e.	e.	e.
Prevailing direction	e.	e.	e.	e.	e.	e.	e.	e.	e.	e	e.	e.	e.

TABLE 17.—PREVAILING WIND DIRECTION, 3 P. M.

1890	.....	.....	.....	e.[f]	e.[a]	e.[a]	e.	e.	e.	e.	e.	e.[b]	e.
1891	e.[c]	e.[b]	e.[g]	e.[d]	e.[h]	e.[c]	e.[f]	e.[i]	e.[d]	e.[c]	e.[c]	e.[f]	e.
1892	e.[g]	ne.[d]	e.[d]	e.[f]	e.[c]	e.[c]	ene.[c]	e.[c]	e.[d]	e.[c]	e.[c]	ene.[c]	e.
1893	e.[f]	e.[d]	ene.[c]	e.[f]	e.[c]	e.[c]	e.[c]	e.[c]	e.[d]	ene.[c]	e.[c]	e.[g]	e.
1894	e.[f]	e.[d]	e.[c]	e.[c]	ese.[c]	e.[d]	e.[c]	e.[c]	e.[c]	se.[d]	ene.[c]	ene.[g]	e.
1895	e.[c]	e.[d]	e.[c]	e.[f]	e.[c]	e.[f]	e.[d]	e.[a]	e.[c]	e.[a]	e.[c]	e.[g]	e.
1896	e.[a]	ene.[d]	ene.[c]	ene.[f]	e.[g]	ene.[d]	e.[d]	ene.[f]	e.[d]	ene.[d]	ene.[f]	e.[f]	ene.
1897	ene.[f]	ene., e.[d]	ene.[d]	e.[f]	e.[f]	e.[g]	e.[d]	e.[f]	e.[d]	e., ese.[c]	ene.[c]	e.[f]	e.
1898	ne.[f]	ene.[d]	ene.[d]	e.[f]	e.[g]	e.[c]	e.[c]	e.[c]	e.[c]	ene.[c]	e.[c]	e.[c]	e.
1899	e.[f]	e.[d]	e.[c]	e.[f]	e.[f]	e.[d]	e.[c]	e.[d]	e.[d]	e.[c]	e.[c]	ne.[g]	e.
1900	e.[c]	e.[d]	e.[d]	e.[c]	e.[c]	e.[c]	e.[c]	one.[a]	ese.[c]	ene.[d]	e.[c]	e.[f]	e.
Prevailing direction	e.	e.	e.	e.	e.	e.	e.	e.	e.	e.	e.	e.	e.

TABLE 18.—AVERAGE DAILY WIND MOVEMENT.

	Miles.	*Miles.*	*Miles.*	*Miles.*	*Miles.*	*Miles.*	*Miles.*	*Miles.*	*Miles.*	*Miles.*	*Miles.*	*Miles.*	*Miles.*
1894	233.5	273.5	217.9	202.5	128.2	252.3	271.7	.....	.....	.....	169.8	138.7	198.4
1895	194.8	185.5	234.2	241.2	264.3	219.0	250.3	235.0	192.5	156.4	190.0	110.5	206.9
1896	166.1	194.0	229.5	212.6	222.7	248.8	238.5	187.0	138.2	111.8	239.3	167.9	196.4
1897	160.0	220.4	160.5	143.2	240.2[a]	266.7	222.1	230.4[d]	164.8	143.4	152.0	171.0	189.6
1898	195.0	167.0	197.0	245.0	186.0	258.5	209.0	199.5	146.0	117.0	186.0	169.0	186.4
1899	219.0	228.5	198.0	176.5	207.6	240.0	273.4	226.2[a]	184.3	93.6	106.2	92.0	188.0
1900	191.1	183.6	226.4	216.8	218.3	166.1	241.8	200.5	124.8	96.7	68.8	109.4	170.8
Means	194.2	207.5	209.1	205.4	209.6	237.3	243.8	214.8	158.4	119.8	153.2	136.9	190.9

*Anemometer out of order from August 7 to 21.

TABLE 19.—NUMBER OF DAYS WITH .01 INCH OR MORE RAINFALL.

1890	.....	.....	.....	19	18	21	25	25	23	21	29	26	263
1891	28	22	9	13	18	23	25	23	25	25	29	27	267
1892	29	20	18	13	22	25	21	21	19	24	27	28	261
1893	19	19	21	17	16	22	27	22	26	21	17	29	256
1894	19	22	18	17	17	17	21	19	25	24	27	20	247
1895	19	10	20	15	22	19	26	26	27	27	22	19	252
1896	25	17	17	13	14	25	26	24	15	20	21	22	239
1897	18	16	17	12	20	22	21	23	20	18	24	25	236
1898	23	13	18	12	14	16	26	23	20	18	21	25	229
1899	28	21	14	8	11	23	28	20	20	19	22	12	221
1900	20	15	9	15	15	14	20	21	10	20	16	19	194
Average	22.8	17.5	16.1	13.9	17.0	20.1	23.7	22.5	21.0	21.5	23.2	22.3	242

TABLE 20.—NUMBER OF THUNDERSTORMS.

Year.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November	December.	Annual.
1890						2	2	2	3	6	1	0	
1891	0	0	0	1	1	4	4	5	1	4	1	0	21
1892	0	0	0	0	0	3	0	1	3	2	2	0	11
1893	0	0	0	0	1	3	6	3	5	4	0	0	22
1894	0	0	0	0	2	3	0	0	3	4	0	1	13
1895	0	0	0	0	2	2	4	4	1	5	1	0	19
1896	0	0	0	0	2	2	3	3	4	2	1	0	17
1897	0	0	1	0	0	2	3	2	2	0	0	1	11
1898	0	0	0	0	0	1	2	5	5	1	0	0	14
1899	2	0	1	0	0	3	3	1	2	4	1	0	17
1900	0	0	0	1	0	1	2	1	0	3	0	0	8
Average	0.2	0	0.2	0.2	0.8	2.4	2.6	2.5	2.6	3.2	0.6	0.2	15.3

TABLE 21.—NUMBER OF EARTHQUAKES.

1890						0	0	0	2	1	2	2	
1891	0	0	2	0	0	0	2	2	0	1	1	1	9
1892	0	0	0	0	1	1	0	1	1	1	0	0	5
1893	0	0	0	0	0	0	1	0	1	1	0	0	3
1894	0	2	0	0	2	3	1	2	0	0	0	0	10
1895	0	0	1	0	2	0	1	1	1	1	0	1	8
1896	1	0	2	0	0	1	0	0	1	0	0	0	5
1897	0	1	2	1	0	0	1	1	2	0	0	0	8
1898	2	1	2	1	0	0	0	0	1	0	0	0	7
1899	0	0	3	0	0	1	0	0	0	2	0	2	8
1900	0	0	1	1	0	0	1	1	1	3	2	1	11
Average	0.3	0.4	1.3	0.3	0.5	0.5	0.6	0.7	0.9	0.9	0.5	0.6	7.4

NOTE.—When the data for any month is missing, the average for that month has been used in obtaining the annual mean. The letters in the figure columns indicate the number of days missing from the record: for instance, "e" under notes five days missing.

NOTES BY THE EDITOR.

MR. ALEXANDER ASHLEY.

When the Editor came to the weather service in January, 1871, as civilian assistant to the Chief Signal Officer of the Army, his first acquaintance was Mr. Alexander Ashley, who was usually spoken of as Chief Clerk, although, strictly speaking, he was Chief of the Division of Correspondence and Records; and now, after more than thirty years of public service together, the Editor regrets to have to announce the death of his colleague. Mr. Ashley's official record is as follows:

Born at Pittsburg, Pa., May 31, 1831. Served as an enlisted man in the United States Army from May 10, 1861, to March 31, 1863. (Private Company I, Tenth Regiment, Pennsylvania Reserve Corps, May 10, 1861; Corporal August 12, 1862; detailed from the Army for signal duty August, 1861; assigned to Office of Chief Signal Officer March 19, 1862; discharged from Army March 31, 1863.) Appointed civilian clerk April 1, 1863. Died April 11, 1901.

Mr. Ashley was graduated from Allegheny College, at Meadville, Pa., which conferred upon him the degrees of A. B. and A. M. He enlisted and was ordered to Washington, D. C., at the outbreak of the war; was detailed for duty under Gen. A. J. Myer, and later assisted him in the formation of the meteorological service of the Signal Corps. All scientific papers passed through his hands; for several years he prepared and had printed lists of the principal scientific documents preserved in his files, which lists were a great convenience for reference in the daily work of the office. He was also the recorder and historian of the Veteran Signal Corps Association. On June 30, 1887, on account of his advancing age, he vacated the position then regarded as that of chief clerk and was assigned to less exacting work. From July, 1897, until his death, he was on duty as examiner with the United States Civil Service Commission, by detail from the Weather Bureau.

Animated by the highest ideals of duty, Mr. Ashley's life was one of great official activity and personal influence. Both in official and private life he adhered to the right without a trace of compromise. Often a great amount of work was suddenly imposed upon him and his assistants, and he never failed to hold himself to duty as strictly as he held his subordinates; withal he was as kind and considerate of the rights and feelings of others as any comrade or brother could be. Although essentially a business man, a soldier, and a churchman, yet, he knew also how to further the scientific interests of the meteorological service in minor details and in many ways the Weather Bureau has been benefited by his long and faithful career.

MR. CHARLES DAVIS.

Mr. Charles Davis died at Charlotte, N. C., April 26, 1901, after a brief illness. He was born in Wilmington, N. C., on April 24, 1870, and educated in the graded schools of Chatham, Va., being graduated from the Chatham High School. He entered the meteorological service of the Government on August 21, 1889, and served as an assistant at Vicksburg and Meridian, Miss., Pensacola, Fla., Galveston, Tex., New Orleans, La., and Memphis, Tenn. In June, 1894, while but 24 years of age, he was promoted to the important position of observer in charge and assigned to duty at Shreveport, La. Four years later he was placed in charge of the Charlotte station, where he continued on duty until his death. His record in the Bureau is an enviable one. In his meteorological work he attained a high degree of accuracy, for which he was several times officially commended. A few months ago his station was rigidly inspected and found to be in splendid condition. In the death of Mr. Davis the Weather Bureau sustains a distinct loss. His good work as an observer and his excellent qualities as a man will be long remembered.

LORIN BLODGET.

This eminent statistician and author of several works on meteorology died in Philadelphia, March 24, 1901. He was born in Jamestown, N. Y., May 25, 1823, and was educated at the academy in that place and at Hobart College, Geneva, N. Y. His interest in meteorology was aroused during the years 1841–1844 when traversing Wisconsin, Illinois, and Iowa for the purpose of examining and purchasing land. As one of the voluntary observers and correspondents of the Smithsonian Institution he attracted the notice of Prof. Joseph Henry, who (1851–1854) employed him in the reduction of the meteorological records that were rapidly accumulating. After a few years, owing to a difference of opinion as to his right to use these official records for his own publications, this arrangement was terminated. He subsequently prepared some of the climatological charts published in the reports of the Surgeon General, and in 1857 published his "Climatology of the United States," a book that attracted much attention and is still often quoted, although its different sections are of very unequal value.

At the Cleveland meeting of the American Association for the Advancement of Science, in 1853, he presented several papers on meteorology. In 1854–1857 he was employed in barometric hypsometry by the army engineers surveying the Pacific Railroad. The subsequent portion of his life was devoted to general statistics, and for a long time he was general appraiser of customs for Philadelphia. However, about 1890, he found time to make several reports to the Secretary of State for Pennsylvania, on the climatological records of that State. He is the author of about 150 volumes on economical, financial, and industrial matters, and perhaps 400 pamphlets, besides thousands of editorial articles.

He labored unselfishly to promote the public interests in widely varied fields, and his life, work, and character, remind us very much of his distinguished neighbor, Franklin B. Hough, who was born in northern New York a few years earlier.

HAWAIIAN WEATHER FOR FEBRUARY, 1901.

Mr. Curtis J. Lyons, in a letter dated April 17, 1901, gives the following account of the general weather conditions during February in the Hawaiian Islands:

The main feature of the month here was the great low that persistently hung around these islands from the 4th to the 14th. In fact, after a very clear day on the 1st, it clouded up on the 2d, beginning with wisps of cirri. The cloud movement you will have seen in my February report. The storm evidently came up from the south-southwest, as the wind was southeast, an unusual storm wind here, and shifted afterwards to southwest and even north, backing into southwest again. I am inclined to think the storm described a loop in its course. The steamer *Mariposa* met it two days or 600 miles northeast of here on the 6th. I think it moved off to the north-northeast then east, making the Oregon coast on the 15th, but without reports from ships at sea between these islands and the coast, this is merely a conjecture. The open question here is whether our storms usually move toward the Oregon coast or toward San Diego. The storm which your weather maps show as crossing the entire continent from San Diego to Maine during the above-mentioned period was, of course, another low and not this one. It would seem that important storm movements do take place at the same time in widely separated sections of the same hemisphere.

It seems a noticeable fact that most of the storms of the past two months in the United States have, to an unusual degree, moved from the southwest instead of from northwest.

There was a good deal of thunder and lightning during several days of this storm. The barometer was the lowest for twenty years, both for the storm and for the month.

I may be pardoned for introducing a theory of mine, which seems rather in accordance with facts, that during the years of minimum sunspot frequency there is an increase of solar heat. This first takes effect in equatorial regions causing a preponderance of northerly currents of air in the semitropical belt, thus producing a dry season. The next season we have increased heat in the semitropical belt, followed by a movement of air from the southwest and heavy rains. This is precisely what has taken place here within the last two or three years. This state of things might show at some places and not at others. The summer of 1900 was unusually warm here, and the rainfall from October 1 to April 1, 1900, was 35 inches, 10 inches above the normal for that period. A wet winter had been predicted.

I give this only for what it is worth, as possibly bearing on the variation of the average track of storms during the different years. In speaking of northerly currents of air, upper currents are particularly included.

I shall be happy to continue, as far as possible, to notice what connection may be apparent between lows here and lows on the coast. Inclosed is a specimen of monthly local report, also the daily weather item.

In his regular monthly local report for February, as published in the Pacific Commercial Advertiser, Honolulu, March 1, Mr. Lyons gives the detailed records of the rainfall at all stations and a number of general items from which we copy the following:

Barometer average, 29.838; normal, 29.947 (corrected for gravity by —.06); highest, 30.11; lowest, 29.48; greatest 24-hour change, 0.22. The above is the lowest average, also the lowest single reading for twenty years. Lows passed this point on the 6th and 20th; highs on the 16th and 28th. * * *

The main feature of the month was the storm of February 4 to 14. This storm moved up from south-southwest, beginning here with a southeast gale, which is an unusual direction for storm winds around this group, this wind being called by the Hawaiians "makani kia." Veering southwest after two days it became a regular "Kona," accompanied by electric storms, the barometer sinking to 29.48. The storm seems to have formed a loop in its course, as after moving away it returned again before finally going to the northward. Turning to the eastward it appears to have reached the Oregon coast about the 19th. Great damage was done, especially on the Maui and on the Kona and Konala slopes of Hawaii. Snow fell on the Hawaii mountains well below the timber line, 7,000 feet.

WEATHER BUREAU OFFICIALS AS INSTRUCTORS.

Mr. J. P. Bolton, Observer Weather Bureau, Fresno, Cal., states that the class in physical geography from the Fresno High School visited the Weather Bureau office on April 23 for instruction in the use of meteorological instruments. On April 26, at the request of Superintendent McLane, Mr. Bolton lectured to this class in the high school on weather forecasting and the daily weather map.

Mr. W. E. Donaldson, Observer Weather Bureau, Binghamton, N. Y., reports that he gave the pupils of the Free School of Union, N. Y., a lesson on local and general weather conditions and the preparation of daily weather maps, illustrated by the map of March 20, 1901. It is his intention to give frequent talks on meteorology to all the schools in his vicinity along lines readily understood by pupils over fifteen years of age.

Mr. Alexander G. McAdie, Forecast Official, lectured upon the climatology of California, at the Students' Observatory, Berkley, Cal., on April 23.

Mr. F. L. McClintick, Observer, lectured before the Lewiston, Idaho, Commercial Club on April 3. His remarks were confined principally to temperature, and he exhibited and explained to his audience the various thermometers employed by the Bureau.

Mr. W. A. Shaw, Observer, states that he has recently completed a course of instruction in meteorology to the senior class in the Norwich University, Norwich, Vt. The course covers a period of eleven weeks, with two hours each week. Waldo's Elementary Meteorology is used as a text-book, but is supplemented by lectures on special subjects and by the study of Weather Bureau maps and charts. This course, which was established by Prof. Henry J. Cox, in 1887, is now a *required* study for the senior class. Mr. Shaw also lectured before the Norwich High School on Weather maps and weather forecasting, on April 19.