PERCENTAGE FREQUENCY OF THUNDERSTORMS IN THE UNITED STATES, 1904-1913.

In the REVIEW for July, 1915, Mr. William H. Alexander presented a set of tables showing the total numbers of thunderstorms observed and recorded at the Weather Bureau stations from the beginning of observations to 1913, inclusive. Absolute numbers do not show as clearly as do relative numbers the seasonal distribution of such phenomena; therefore Mr. Herbert Lyman has prepared the following table of percentages showing thunderstorm frequencies for the different months on the basis of the fairly uniform series of observations between 1904 and 1913, both inclusive.

The average character of the seasonal distribution of thunderstorms in the United States appears from the following figures showing the number of stations whose maximum monthly percentage of thunderstorms falls in the respective months.

Month.	Number of stations.
January	1
February	0
March	3
April	0
May	6
June	33
July	78
August	15
September	2
October	0
November	0
December	2

From these figures it appears that practically all the Weather Bureau stations have their maximum number of thunderstorms during the summer months June to August. Such stations may be called the *regular type*, for purposes of classification. This table also shows that there are a number of stations where the maximum percentages fall in the winter months. Table 1 will show that most of these nonregular stations have two maxima, but a minimum in July or August. Among them may be mentioned Fresno, Los Angeles, and Sacramento. Port Crescent is peculiar in having its prime maximum in July with a secondary maximum in December, while Red Bluff departs from the other Pacific coast localities in having its prime maximum in May and its secondary maximum in October.

There are three of our stations, however, which show a well-defined simple curve of frequency which is just the opposite of the regular type curve. It may be called the *inverted type* curve, and the stations are Eureka and San Francisco in California and Honolulu, Territory of Hawaii. Eureka has a tendency to depart from the type slightly, and San Francisco has so few thunderstorms—eight in 10 years—that it does not give a very strong curve. Honolulu seems to be the best-established representative of this inverted type in the United States' possessions. Its minimum sinks to zero in July and August and rises to 21 per cent for both December and January.

We might make a more detailed analysis of the distribution of thunderstorms, but prefer to wait for another 10 years of homogeneous records. Enough is brought out here to show that over most of the United States the thunderstorm frequency is closely related to the temperature march.

TABLE 1.—*Percentage of thunderstorm frequency for the 10-year period 1904–1913.*

[Computed to nearest whole number.]

Stations.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Storms in 10 years.
	%	%	%	%	%	%	%	%	%	%	%	%	
Abilene, Tex.	2	2	5	11	19	12	17	15	9	6	3	1	339
Amarillo, Tex.	0	1	3	9	17	18	19	19	9	3	2	0	356
Atlanta, Ga.	1	2	6	6	12	17	24	21	9	1	1	0	626
Atlantic City, N. J.	0	2	5	11	12	18	21	18	8	5	1	1	286
Augusta, Ga.	1	3	6	6	11	18	24	20	9	2	2	1	532
Baker, Oreg.	0	0	0	4	12	28	28	16	12	2	0	0	171
Baltimore, Md.	1	2	6	9	14	17	26	16	8	2	0	0	325
Bismarck, N. Dak.	0	0	0	4	15	24	23	23	9	4	0	0	285
Block Island, R. I.	1	3	7	11	12	14	21	16	10	4	3	0	193
Boston, Mass.	2	1	4	4	14	17	23	22	11	2	2	1	180
Buffalo, N. Y.	1	1	5	5	16	17	22	18	10	4	2	0	315
Charleston, S. C.	1	4	4	7	10	16	22	20	12	2	2	1	634
Charlotte, N. C.	1	2	4	7	12	21	25	19	7	2	1	0	518
Chattanooga, Tenn.	1	3	6	7	11	20	20	19	11	1	2	1	681
Cheyenne, Wyo.	0	0	0	5	14	23	27	21	9	1	0	0	528
Chicago, Ill.	2	1	6	8	15	16	17	16	12	4	2	0	400
Cincinnati, Ohio	1	1	5	8	15	19	22	14	10	3	2	0	456
Cleveland, Ohio	1	1	4	8	16	17	22	16	11	5	1	0	384
Columbia, Mo.	2	2	6	9	14	17	16	16	10	4	4	1	575
Columbia, S. C.	2	2	5	7	12	19	22	21	8	2	1	1	544
Columbus, Ohio	2	1	6	8	14	18	22	15	10	2	2	0	456
Concordia, Kans.	0	1	3	7	15	21	19	17	13	4	1	0	455
Corpus Christi, Tex.	0	3	6	11	18	10	13	13	17	4	3	3	304
Davenport, Iowa	1	1	5	7	15	17	17	19	13	4	2	0	462
Denver, Colo.	0	0	2	3	14	21	26	23	11	1	0	0	467
Des Moines, Iowa	0	1	4	8	16	18	18	16	12	7	1	0	509
Detroit, Mich.	2	2	4	9	14	17	21	16	10	5	2	0	365
Dodge City, Kans.	0	0	2	6	14	22	22	18	10	4	2	1	399
Dubuque, Iowa	0	0	4	8	14	18	18	18	13	5	2	0	416
Duluth, Minn.	0	0	1	3	14	21	28	18	12	3	0	0	282
El Paso, Tex.	1	2	1	3	4	14	27	32	10	6	1	0	328
Erie, Pa.	1	1	5	6	14	19	18	16	12	6	1	1	368
Eureka, Cal.	12	12	22	4	0	0	6	0	6	12	4	24	33
Fort Smith, Ark.	3	3	6	11	16	18	13	15	9	4	3	0	559
Fresno, Cal.	3	14	16	14	16	5	3	0	11	8	5	5	37
Galveston, Tex.	2	4	4	8	11	9	17	18	16	5	4	4	481
Grand Haven, Mich.	1	0	4	8	17	15	19	17	9	5	4	0	324
Green Bay, Wis.	0	0	3	5	15	16	21	20	15	5	1	0	338
Hannibal, Mo.	1	2	7	9	15	18	15	15	11	5	3	1	526
Harrisburg, Pa.	1	1	3	8	12	19	27	18	8	4	0	1	355
Hatteras, N. C.	2	2	6	10	13	17	18	16	10	3	3	1	353
Havre, Mont.	0	0	0	2	7	34	25	24	8	0	0	0	236
Honolulu, T. H.	22	17	3	3	3	3	0	0	8	11	8	22	36
Huron, S. Dak.	0	0	1	4	13	24	24	21	11	2	0	0	343
Indianapolis, Ind.	1	1	7	9	13	19	18	14	11	3	3	1	467
Jacksonville, Fla.	1	2	4	5	11	16	25	20	11	3	0	1	795
Kansas City, Kans.	1	2	6	9	14	13	18	12	12	5	3	1	575
Keokuk, Iowa	1	2	6	8	16	17	17	15	11	6	3	1	516
Key West, Fla.	1	2	2	4	8	17	19	22	17	5	1	2	539
Knoxville, Tenn.	0	3	6	8	13	18	21	18	9	1	2	1	581
La Crosse, Wis.	0	0	2	6	18	17	18	20	15	4	2	0	424
Lander, Wyo.	0	0	0	3	13	26	26	23	11	0	0	0	251
Lexington, Ky.	1	2	5	9	12	18	22	16	10	1	2	0	587
Little Rock, Ark.	2	5	7	12	10	16	16	14	10	3	3	1	601
Los Angeles, Cal.	14	14	20	14	2	2	2	10	10	8	2	0	44
Louisville, Ky.	2	3	7	10	12	18	20	12	10	3	3	0	532
Lynchburg, Va.	0	1	3	8	12	26	24	18	7	1	0	0	343
Marquette, Mich.	0	0	4	3	14	24	25	18	10	3	1	0	242
Memphis, Tenn.	3	4	7	11	12	18	18	13	8	3	3	2	509
Milwaukee, Wis.	1	0	5	9	15	17	16	19	12	4	2	0	374
Minneapolis, Minn.	0	0	1	4	15	21	18	22	14	4	1	0	366
Mobile, Ala.	2	4	5	6	9	16	22	18	13	2	1	1	757
Montgomery, Ala.	3	4	6	7	12	18	18	16	10	2	2	1	624

TABLE 1.—*Percentage of thunderstorm frequency for the 10-year period 1904–1913*—Continued.

Stations.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Storms in 10 years.
Nantucket, Mass	2	3	5	9	13	15	21	14	9	5	5	0	223
Narragansett Pier, R. I.	2	3	5	8	12	16	23	19	9	2	2	0	169
Nashville, Tenn	1	3	7	11	12	18	19	15	9	2	3	1	566
New Haven, Conn	1	2	5	5	14	19	25	18	10	3	1	0	261
New Orleans, La	3	4	5	7	10	15	20	18	14	2	1	3	744
New York, N. Y	1	1	3	9	14	18	25	19	9	3	0	0	284
Norfolk, Va	0	2	4	8	15	21	22	19	7	2	1	0	406
Northfield, Vt	0	0	2	3	14	18	31	21	10	3	0	0	242
North Platte, Nebr	0	0	2	5	16	23	25	20	8	2	0	0	449
Oklahoma, Okla	0	3	5	12	17	19	14	13	10	5	2	0	448
Omaha, Nebr	0	1	3	8	16	20	18	17	12	6	2	0	499
Oswego, N. Y	1	2	4	4	14	19	22	18	11	6	1	0	296
Palestine, Tex	2	4	7	14	14	14	15	11	10	5	2	3	523
Pensacola, Fla	2	4	5	6	9	14	20	19	14	3	1	2	814
Philadelphia, Pa	0	3	5	7	15	18	23	19	7	4	1	0	319
Phoenix, Ariz	0	2	3	3	4	4	29	36	11	3	3	1	332
Pierre, S. Dak	0	0	1	4	14	23	26	22	8	3	0	0	359
Pittsburgh, Pa	2	1	6	8	13	20	22	16	11	3	0	0	431
Port Crescent, Wash	0	0	0	0	8	21	25	21	4	0	4	17	24
Port Huron, Mich	1	2	3	8	14	18	19	19	9	5	2	0	325
Portland, Me	1	0	4	3	12	19	29	18	11	4	0	0	153
Portland, Oreg	2	6	4	7	24	9	17	15	7	6	4	0	54
Pueblo, Colo	0	0	1	5	14	20	29	22	9	1	0	0	484
Raleigh, N. C	1	1	4	6	13	19	25	19	9	2	1	0	469
Rapid City, S. Dak	0	0	1	3	13	26	28	22	6	2	0	0	359
Red Bluff, Cal	8	4	10	8	25	17	8	2	8	10	0	2	52
Richmond, Va	0	0	4	9	13	20	23	21	8	2	1	0	415
Roseburg, Oreg	0	0	9	6	14	17	20	11	17	3	0	3	35
Sacramento, Cal	6	9	26	0	6	9	0	6	21	12	0	3	34
St. Louis, Mo	1	2	7	10	13	17	16	17	11	4	3	0	526
St. Paul, Minn	0	0	1	4	15	22	19	21	14	3	0	0	328
Salt Lake City, Utah	3	1	5	7	8	16	20	25	12	4	0	0	356
San Antonio, Tex	0	2	6	13	16	10	13	13	15	5	3	3	386
San Diego, Cal	6	3	11	3	6	6	11	17	9	14	6	9	35
San Juan, P. R	0	0	1	3	9	13	14	16	20	16	6	2	472
Sandusky, Ohio	2	1	4	6	15	18	21	17	10	4	1	0	400
San Francisco, Cal	12	50	12	0	0	0	0	0	0	13	0	13	8
Santa Fe, N. Mex	0	1	3	4	9	15	29	24	12	3	0	0	732
Sault Ste. Marie, Mich	0	0	4	4	9	17	19	19	15	11	3	0	209
Savannah, Ga	1	3	3	6	11	17	25	20	11	2	0	1	606
Seattle, Wash	0	3	10	3	10	25	15	14	12	3	2	2	59
Sioux City, Iowa	0	0	1	6	15	21	21	21	11	4	2	0	436
Spokane, Wash	0	0	0	8	14	25	24	18	10	3	0	0	108
Springfield, Ill	2	1	8	11	16	17	17	13	9	4	3	0	509
Springfield, Mo	2	2	5	10	14	19	18	12	10	4	3	1	572
Tampa, Fla	1	2	3	3	10	17	24	22	14	3	0	1	944
Tatoosh Island, Wash	8	6	2	2	2	4	9	6	19	12	14	14	53
Toledo, Ohio	2	1	3	8	13	18	23	16	9	4	2	0	405
Topeka, Kans	1	1	5	7	15	17	18	15	12	6	4	0	512
Vicksburg, Miss	3	5	6	11	11	16	17	15	10	2	2	2	668
Walla Walla, Wash	0	0	1	4	16	28	21	20	11	1	0	0	88
Washington, D. C	1	2	4	8	12	18	25	17	9	2	1	0	392
Wichita, Kans	0	2	4	9	17	18	18	14	12	5	2	0	531
Williston, N. Dak	0	0	0	2	11	29	23	25	9	1	0	0	211
Wilmington, N. C	1	3	5	6	11	18	23	21	9	3	1	0	511
Winnemucca, Nev	0	0	4	4	12	23	23	21	11	3	1	0	142

STORMS AND HURRICANES IN JAMAICA, 1655–1915.

By MAXWELL HALL.

[Dated: Montego Bay P. O., Jamaica, W. I., Dec. 12, 1915.]

The Government Meteorologist for Jamaica, publishes in his Weather Report No. 449, for November, 1915, a *corrected* list of severe storms and hurricanes that have passed over Jamaica and done more or less damage there between the years 1655 and 1915. In correcting his list he has omitted those which, though represented on some charts as crossing Jamaica, were not felt as severe storms on the island or really missed it completely. The lower limit of wind velocity adopted for qualifying in this list is one of 60 miles an hour, and the storm of June 13, 1904, barely secured a place in the table on this basis; it had unusual interest because of two cyclones visiting the west end of the island. The corrected table is printed below.—C. A., jr.

Table of storms and hurricanes in Jamaica, 1655 to 1915.

Year.	Month.	Description.	Authority; notes.
1670	Oct. 7	Storm; the fleet at Jamaica driven ashore	[Poey: K. Johnstone Phys. Atl., 1856.
1689		Storm mentioned in early vols. Jamaica Almanac.	Gardner calls it a hurricane, ed. 1909, p. 73.
1712	Aug. 28	First hurricane experienced by English in Jamaica.	[Poey: Gardner, p. 112.
1714	Aug. 29	Some men-of-war driven ashore in a storm.	[Poey: K. Johnstone Phys. Atl.
1722	**Aug. 28**	Great hurricane damaged the whole island; center passed over Port Royal.	Atkins "Voyage to Guinea, Brazil, and the W. I.," 1737, p. 238; Long, v. 2, p. 145.
1726	Oct. 22	Hurricane swept east end of island	Long, v. 2, p. 146; Gardner, p. 115.
1744	**Oct. 20**	Great hurricane damaged whole island; 104 ships wrecked in harbor.	Clowes, 3, p. 275; Long, v. 2, p. 146; Gardner, p. 125.
1751	Sept. 2	Storm	Jamaica Almanac.
1780	**Oct. 3**	Great hurricane destroyed Savannah-la-Mar and damaged whole island.	Wm. Beckford "Descriptive account of the island of Jamaica," 1790. Bryan Edwards, ed. 1819, v. 1, p. 236. Reid, "Law of storms," etc.
1781	Aug. 1	Hurricane; 120 vessels wrecked in Kingston Harbor and at Port Royal.	Bryan Edwards, v. 1, p. 234, brief mention.
1784	July 30	Hurricane; wrecked all but 4 of vessels at Kingston and Port Royal.	Do.
1785	Aug. 27	Storm	Do.
1786	Oct. 20	Storm followed by great scarcity of food	Do.
1812	**Oct. 12–14**	Great hurricane damaged the whole island.	Jamaica mag.; Jam. phys. jour., 1835.
1813	Aug. 1	Storm damaged shipping and buildings in Kingston.	Jam. Courant, Aug. 2–9, 181, 1813; Bryan Edwards, v. 5, p. 77.
1813	Aug. 28	Storm at Savannah-la-Mar wrecked vessels.	
1815	Oct. 18, 19	Hurricane over eastern part of island, and great floods.	Jam. phys. jour., 1835; Bryan Edwards, v. 5, p. 78.
		Great destruction of houses in St. George, St. David, etc.	Jam. wthr. rpt., No. 352, Apr., 1908.
1818	Nov. 18, 20	Hurricane swept western part of island	
1832	Aug. 7	Violent storm that lasted but 3½ hours	Keith Johnstone, Phys. Atlas.
1837	Sept. 26, 27	Storm, probably felt all over the island	Jamaica Despatch; Reid: "Law of storms."
1844	Oct. 5	Storm over the western end of the island, Falmouth, Montego Bay, and Black River.	
1874	Oct. 31	Hurricane over the eastern half of the island.	
	Nov. 2	Center passed over St. Anns Bay	
1880	**Aug. 18**	Great hurricane; two cyclones damaged the eastern half of the island.	Jam. wthr. rep., v. 1, Introduction.
1886	June 27	Storm, whose center passed rapidly from the east end to Montego Bay.	Jam. wthr. rep., No. 67.
1886	Aug. 19, 20	Hurricane, whose center took nearly the same course.	Jam. wthr. rep., No. 69.
1903	**Aug. 11**	Great hurricane, whose center took nearly the same course.	U. S. Mo. wthr. rev., Sept., 1905; Jam. wthr. rep., v. 4, Introduction.
1904	June 13	Storm and heavy rains over west end of island. Montego Bay bridge destroyed.	U. S. Mo. wthr. rev., Aug., 1904; Jam. wthr. rep., v. 4, Introduction.
1912	**Nov. 18**	Great hurricane; two cyclones devastated the west end of the island.	Jam. wthr. rep., No. 411.
1915	Aug. 12, 13	Hurricane destroyed banana fields throughout the island, and damaged all the towns on the northern coast.	Jam. wthr. rep., No. 445.
1915	Sept. 25, 26	Storm	Jam. wthr. rep., No. 447.

Dates of great hurricanes are in **bold-face type.**

THE APPLICATION OF PHYSICAL PRINCIPLES TO PROBLEMS SUGGESTED BY OCEANIC CIRCULATION AND TEMPERATURES.[1]

By GEORGE F. MCEWEN.

[Dated: La Jolla, Cal.]

Most of our quantitative knowledge of the great ocean currents depends upon the difference between the true position of a ship and that determined from "dead-reckoning"; and upon observations of floating objects. This work has been supplemented by current meter observations in a few limited regions. Also the distri-

[1] Abstract of a paper presented at the San Francisco joint meeting of the Physical Society and Section B of the A. A. A. S., Aug. 2–7, 1915.
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