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ALFRED J. HENRY, Editor

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CLOSED SEPTEMBER 3, 1924
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PUBLICATION OF SEISMOLOGICAL DATA IN THE REVIEW TO BE DISCONTINUED

Announcement is made that a bill (H. R. 8303), quoted hereunder, authorizing the Coast and Geodetic Survey to make seismological investigations and for other purposes, was introduced in the last Congress, passed by the House of Representatives on June 5, 1924, but failed of passage in the Senate because of the legislative congestion in the closing days of the session:

Be it enacted, etc., That the Coast and Geodetic Survey is hereby authorized to make investigations and reports in seismology, including such investigations as have been heretofore performed by the Weather Bureau.

The transfer as above proposed was fully discussed by the two departments concerned, both of which were agreeable to its enactment.

In view of the necessity of effecting economies in the conduct of the work of the Weather Bureau, it has been decided to discontinue, with the close of the fiscal year ending June 30, 1924, the publication of the table of Seismological Reports. Late June reports appear on pages 375–379.—*Editor.*

THE DISTRIBUTION OF THUNDERSTORMS IN THE UNITED STATES

551.515 (73)

By WILLIAM H. ALEXANDER, Meteorologist

[Weather Bureau, Columbus, Ohio, May 14, 1924]

The following paper is essentially a revision of that published in the MONTHLY WEATHER REVIEW for July, 1915, 43:322–340, bringing down to date especially the statistical portion, together with a complete revision of the 13 charts based on a 20-year instead of a 10-year period. Through the courtesy of certain Weather Bureau officials, some interesting notes on the characters of thunderstorms in various parts of the country also are added. For a statement of the "Methods of thunderstorm recording used by the United States Signal Service and the Weather Bureau," prepared by the Weather Bureau Library, Prof. C. F. Talman in charge, the reader is referred to the original paper in the July, 1915, REVIEW.

The original paper contains a summary of thunderstorm data obtained at the regular Weather Bureau stations prior to 1904; a detailed statement of the data for the 10-year period, 1904–1913, inclusive; twelve monthly charts and one annual chart based on the 10-year period; and some interesting historic notes on the character of storms in general or on individual storms of unusual interest in various parts of the country. It seems unnecessary to reproduce much of the original paper or to present the statistical data for the individual stations in detail, even for the 20-year period; a summary only is sufficient. Table 1 gives, for each of the regular Weather Bureau stations for which data are available, a summary, first, of the total number of days with thunderstorms for each month for the 20-year period 1904–1923 and, second, of the average annual number computed for that period.

Thunderstorm records prior to 1904 were not made with the same uniformity and accuracy as were those subsequent to that year. For that reason it has been considered advisable to begin the record with 1904. Moreover, by so doing the great majority of Weather Bureau stations can be used. Out of the 185 stations included in Table 1, all but 7 have the full 20-year record; those having less than 20 years are indicated by proper footnotes.

Explanation of the charts.—In charting the data the total number of thunderstorm days in the 20-year period for each month have been used to obviate the necessity of using fractional values when the total number fell below 20, as they very frequently do for the northern and extreme western portions of the country. The annual chart, however, presents the average annual number rather than the total number of thunderstorm days. The term isoceraunics used on the chart is explained below.[1]

As one would expect, the two sets of charts—the one based on the 10-year period and the one based on the 20-year period—are in very close agreement in all important details; but a close comparison of the charts, month by month, will reveal a number of minor differences. The charts are self-explanatory but perhaps a few general and very brief comments may not be amiss.

During the winter months, December, January and February, the center of thunderstorm activity for the United States is in the vicinity of Vicksburg, Miss. In February however the general thunderstorm area tends to drift southeastward; note the marked secondary over Pensacola, Fla., for example. In March, the center of activity is still over the lower Mississippi Valley with the general storm area spreading rapidly northeast over the Tennessee and Ohio valleys. In April, the center appears to be in the vicinity of Shreveport, La., with the general area spreading not only northeast over a large part of the eastern States, but also north and west.

The interesting thing about the May chart is the definite appearance of the primary center over Tampa, Fla., and a strong secondary over the lower Plains States. Great thunderstorm activity now prevails over the entire eastern half of the country, except in the Canadian bor-

[1] *Terminological note by C. F. Talman.*—In 1879 W. von Bezold and C. Lang applied the name "isobront" to a line drawn on a chart connecting places at which the first thunder in a thunderstorm was heard simultaneously. The word has since become fully established in meteorological literature with a somewhat broadened meaning, being applied generically to thunderstorm isochromes, including those of first thunder, loudest thunder, beginning of rain in a thunderstorm, etc. A chart of isobronts shows the progress of a particular thunderstorm across the country.

To avoid confusion, some different name should be applied to lines of equal thunderstorm frequency, such as appear on Mr. Alexander's charts and on charts of similar character that have been drawn for other countries and for the world at large. It is suggested that the isogram of thunderstorm frequency be called an "isoceraunic line," or, briefly, an "isoceraunic."

"Isobront" and "isoceraunic" are formed from familiar Greek words, the former meaning literally "equal thunder" and the latter "equal thunder and lightning."

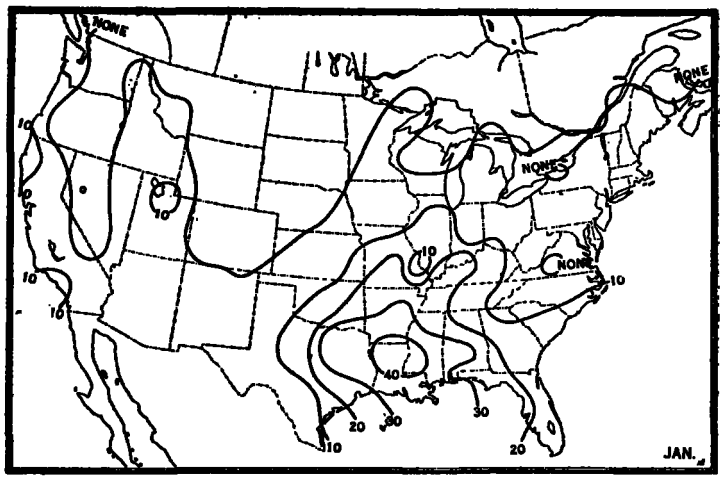

FIG. 1.—Isoceraunics, January, based upon total number of thunderstorm days, 20 years, 1904–1923

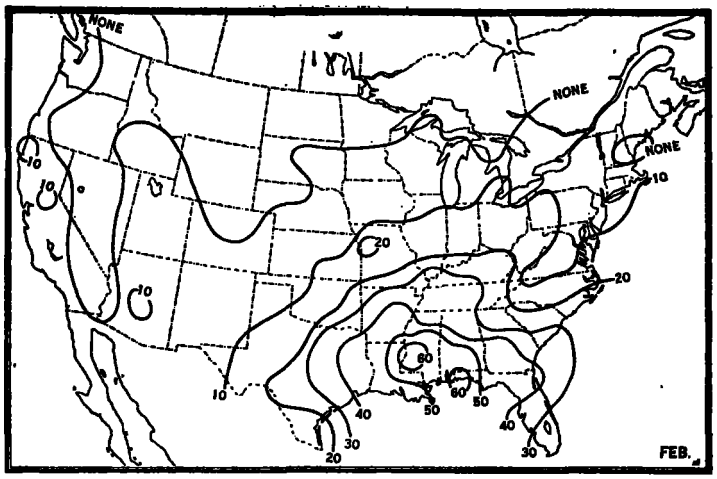

FIG. 2.—Isoceraunics, February, based upon total number of thunderstorm days, 20 years, 1904–1923

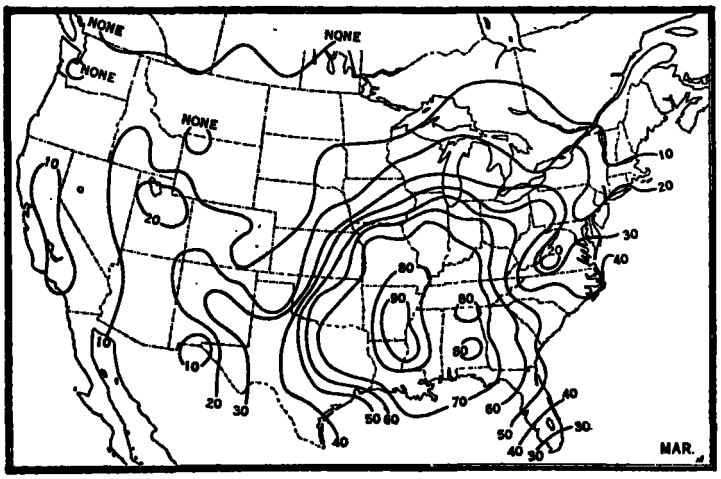

FIG. 3.—Isoceraunics, March, based upon total number of thunderstorm days, 20 years, 1904–1923

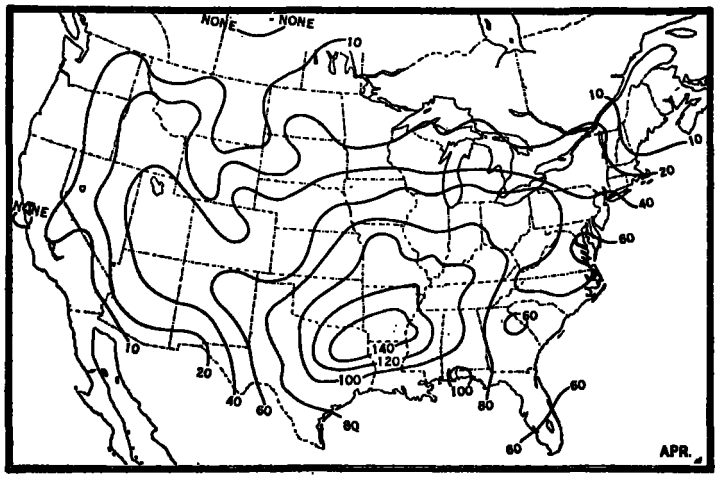

FIG. 4.—Isoceraunics, April, based upon total number of thunderstorm days, 20 years, 1904–1923

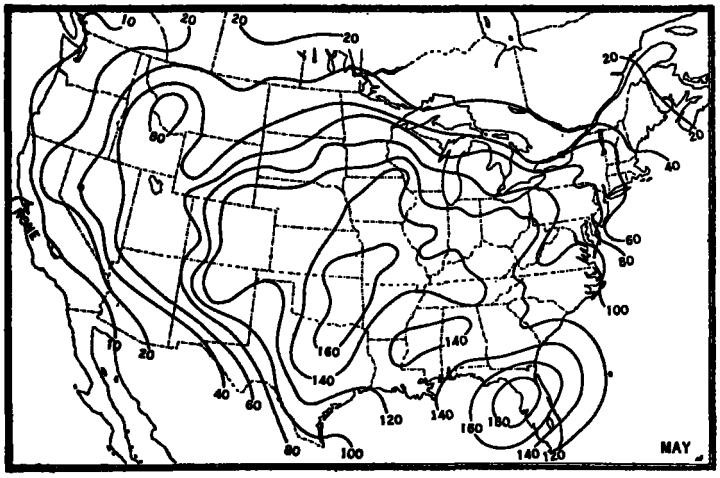

FIG. 5.—Isoceraunics, May, based upon total number of thunderstorm days, 20 years, 1904–1923

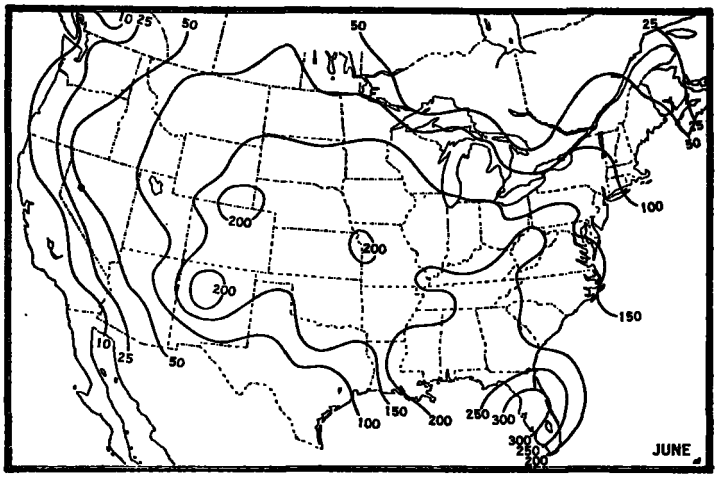

FIG. 6.—Isoceraunics, June, based upon total number of thunderstorm days, 20 years, 1904–1923

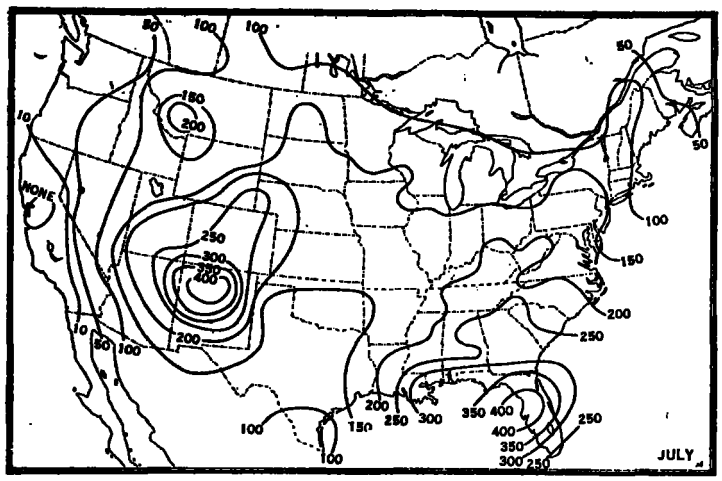

FIG. 7.—Isoceraunics, July, based upon total number of thunderstorm days, 20 years, 1904-1923

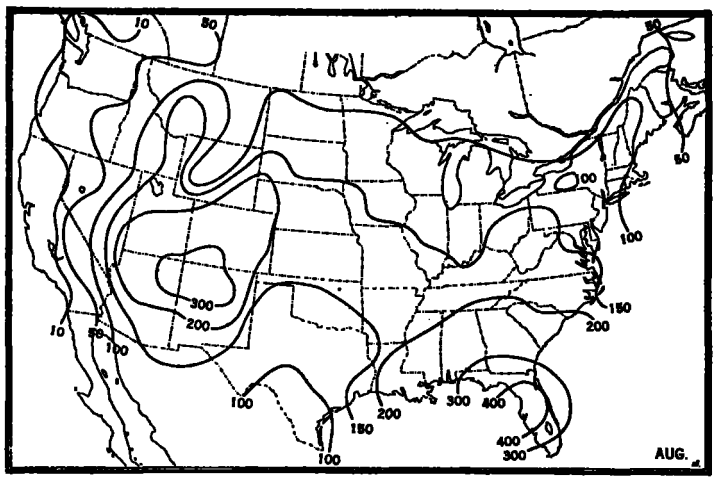

FIG. 8.—Isoceraunics, August, based upon total number of thunderstorm days, 20 years, 1904-1923

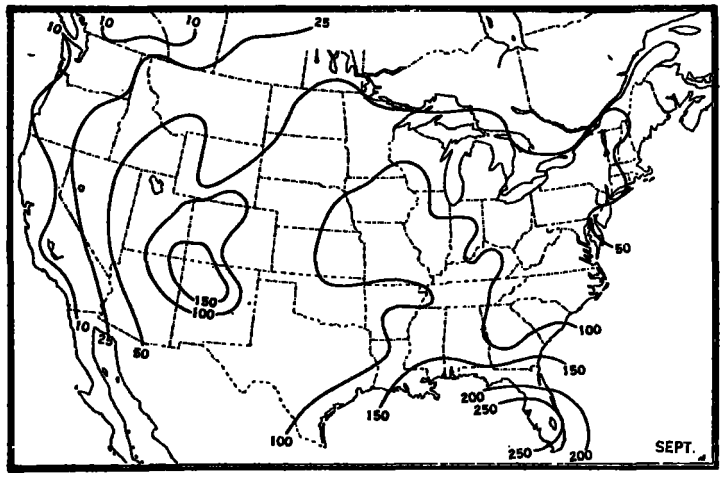

FIG. 9.—Isoceraunics, September, based upon total number of thunderstorm days, 20 years, 1904-1923

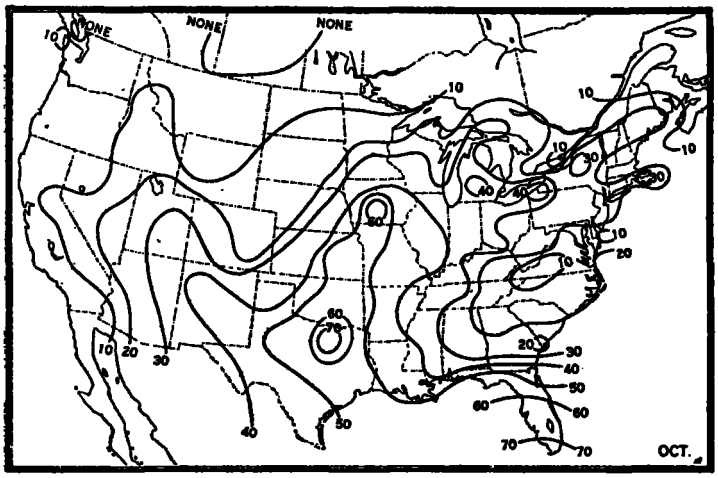

FIG. 10.—Isoceraunics, October, based upon total number of thunderstorm days, 20 years, 1904-1923

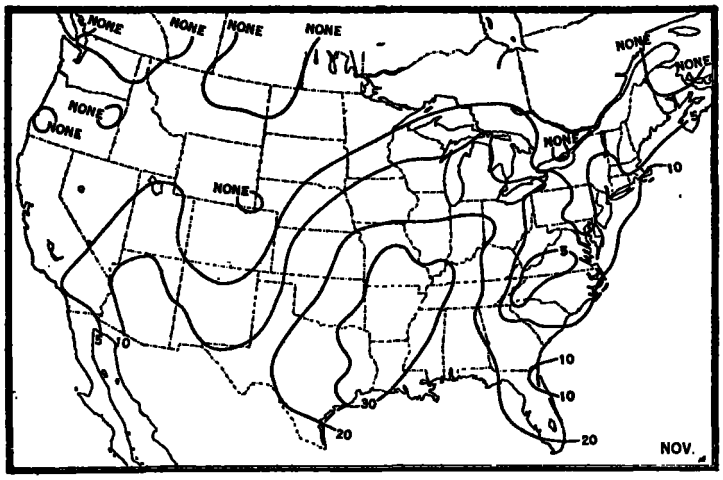

FIG. 11.—Isoceraunics, November, based upon total number of thunderstorm days, 20 years, 1904-1923

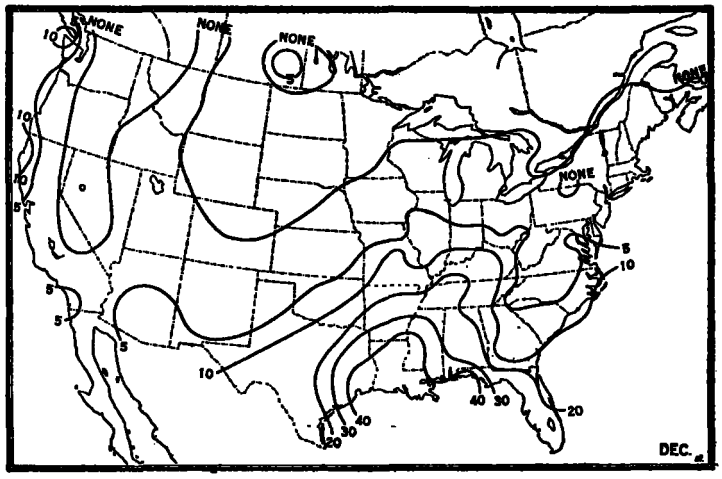

FIG. 12.—Isoceraunics, December, based upon total number of thunderstorm days, 20 years, 1904-1923

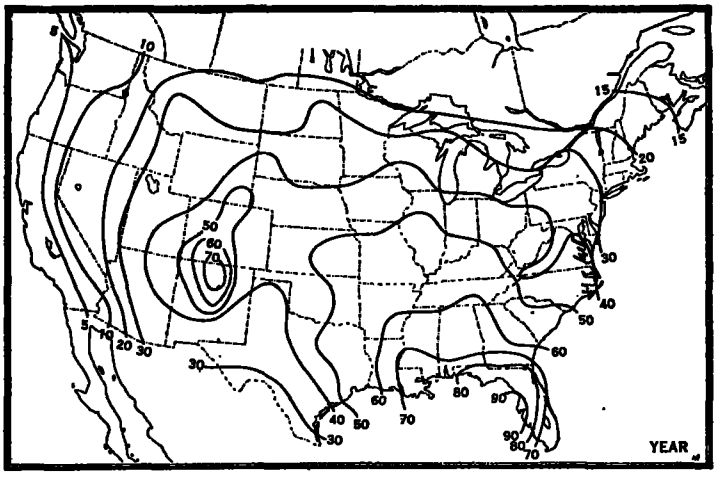

FIG. 13.—Isoceraunics, year based on average number of thunderstorm days, 20 years; 1904–1923

der states including the whole of New England. Note also the increased activity in western Montana.

During June the thunderstorm area continues to spread northward and covers the entire country east of the Rocky Mountains except possibly the extreme northeast. The center of greatest activity is in the vicinity of Tampa. There also are definite indications of the development of a secondary center over the southern Rocky Mountain States. One of the most surprising things revealed by the July chart is the increased activity over the Rocky Mountain States with a secondary over Sante Fe, N. Mex., almost as strong as the primary over Tampa. Marked activity also continues in southwestern Montana and in the vicinity of Yellowstone Park. The distribution during August is very much the same as in July, but with a notable decrease in intensity along the Canadian border and a marked weakening of the secondary over Santa Fe. The two centers, Tampa and Santa Fe, persist though weakening through September. In October the southeastern (Tampa) center seems to have dropped a little south and is now over Key West, while the Santa Fe center has disappeared or shifted to eastern Texas and the southern Plains States and the general storm area is rapidly diminishing. In November, as during the winter months, the active area is over the lower Mississippi Valley and the general area is limited largely to the Mississippi and Ohio Valleys.

Chart 13, which shows the average annual number of days with thunderstorms during the 20-year period at a large number of stations in the United States and Canada, has a number of rather interesting features and is worthy of considerable study. Note that no part of the country is entirely free from thunderstorms, and that they are comparatively rare along the Pacific coast; that there are two centers of maximum activity, one over Tampa, with an average of 94 days with thunderstorms in the 20 years, and the other over Santa Fe, with an average of 73 during the same period. The average number at both Tampa and Santa Fe is very nearly the same for the two 10-year periods.

An interesting comparative study which does not appear at all on the charts may be found in noting the records for Honolulu, Hawaii, and San Juan, P. R., two insular tropical stations. Honolulu is in latitude 21° 19′ N. and San Juan is in 18° 29′ N. The record at the former covers a period of 19 years and shows that most thunderstorms occur during the cool months of the year, with a total for the 19 years of only 102 days with storm, whereas at San Juan the storms occur mostly in the summer or warm months of the year, with a total for the 20 years of 942, almost the same as at Columbus, Ohio.

Perhaps the most important new data are for Alaska, given in Table 2. The record covers a period of seven years and in general shows that thunderstorms are quite rare and of a very mild type along the Alaskan coast, but are rather frequent and occasionally quite violent in the interior, notably in the Yukon and Tanana Valleys. Note that during these seven years, thunderstorms, one or more, have been recorded at all stations for which records are available and have been reported in all months except March. Quite a number of the interior thunderstorms were accompanied by hail, in one or two instances of a destructive character. Even damage from lightning stroke was noted.

Concerning thunderstorms in Alaska Mr. M. B. Summers, meteorologist, for a number of years in charge of the Alaska Section says:

> Yes, thunderstorms are rare in some parts of Alaska, particularly the coast region, where convection seldom takes place. In the interior valleys, however, particularly the Tanana and the middle Yukon, they are by no means rare, but occur a number of times during the summer months, some stations having five or six occurrences in a single month. They are usually mild in character, of short duration, and are seldom attended by hail. There have been several instances of the latter form of summer precipitation, however, and I have in mind now one that occurred at Allakaket, on the Arctic Circle, a few years ago, that inflicted damage to garden crops.
>
> Apparently, no part of Alaska can be said to be entirely immune from thunderstorms, for they have been recorded at Barrow, on the extreme northern Arctic Coast, on the Pribilof Islands, and in the island portion of the Panhandle. They are of course most frequent in the summer months, but have been observed at Sitka in December, and there have been cases of mild thunderstorms on the coast of the Gulf of Alaska in the fall months. One of these that I recall was at Seward in November, I believe. It attended a blinding snowstorm and was so unusual that I questioned the observer specially concerning it. Having experienced such a unique type of thunderstorm on the Pittsburg station some years ago, it afforded me considerable interest to know it may occur in Alaska, also.
>
> The dates and stations of all thunderstorms of which we have record are given in the monthly issues of Climatological Data, Alaska Section. It should be borne in mind, however, that most of the information comes from cooperative observers, some of whom are known to be careless or indifferent in the matter of recording miscellaneous phenomena. Consideration should also be given to the fact that there are wide stretches of territory for which no data of any kind are available, this being particularly true of the Koyukuk, Upper Kuskokwim, and Upper Tanana valleys. It is believed that the seemingly greater number of thunderstorms reported from Eagle and Nulato may be attributed in part at least to the fact that these observers have been more watchful in their work along such lines than many of the others have. All, or practically all, thunderstorms at those places have been recorded, while it is quite probable that many other stations have omitted at least some occurrences.

We desire to conclude this statement with an expression of our very real and sincere appreciation of the prompt, cheerful response on the part of practically all officials in charge of Weather Bureau stations to requests for data, thus making the bringing-down-to-date of this paper possible. Quite a number evidently put themselves to considerable trouble and labor to supply even more data than the "form" called for.

TABLE 1.—*Days with thunderstorms at Weather Bureau stations in the United States for the 20-year period 1904–1923, inclusive*

Stations	January	February	March	April	May	June	July	August	September	October	November	December	Average annual
Abilene, Tex	14	14	44	95	144	119	110	114	62	52	24	13	40
Albany, N. Y	2	2	17	30	71	113	143	105	52	18	8	3	28
Alpena, Mich	1	0	24	38	80	113	125	103	69	21	10	3	29
Amarillo, Tex	5	4	17	67	114	130	143	143	88	38	8	2	38
Anniston, Ala. (a)	19	45	75	92	144	237	277	235	120	27	17	22	73
Asheville, N. C	4	16	44	75	139	258	265	221	95	15	4	3	57
Atlanta, Ga	11	29	68	78	137	207	292	237	98	16	15	12	60
Atlantic City	2	9	25	51	63	121	123	111	45	23	8	4	29
Augusta, Ga	14	27	55	58	106	179	253	208	84	25	13	7	51
Baker, Oreg	0	0	2	12	36	71	81	67	31	6	0	0	15
Baltimore, Md	3	9	29	54	89	131	177	126	55	12	1	4	34
Bentonville, Ark. (b)	25	31	79	113	167	195	144	142	99	61	38	20	66
Binghamton, N. Y	2	7	24	31	78	124	168	120	65	23	5	1	32
Birmingham, Ala	26	38	74	101	146	240	290	239	138	27	21	24	68
Bismarck, N. Dak	0	0	1	21	77	142	159	130	63	16	1	0	30
Block Island, R. I	1	7	22	32	41	63	68	73	33	17	8	2	18
Boise, Idaho	3	4	16	26	66	81	74	59	39	13	2	4	19
Boston, Mass	2	2	19	18	43	67	93	76	41	11	2	3	19
Buffalo, N. Y	2	9	29	38	93	121	140	121	70	31	10	2	33
Burlington, Vt. (a)	2	1	12	23	61	107	136	110	59	23	1	1	30
Cairo, Ill	29	36	80	117	157	212	198	175	115	34	38	18	60
Canton, N. Y. (b)	2	4	16	25	51	69	107	93	50	21	2	0	26
Cape Henry, Va	3	14	40	67	129	173	191	156	70	22	6	8	44
Cape May, N. J	4	12	24	50	56	113	130	101	43	10	8	1	28
Charleston, S. C	13	38	48	73	127	175	274	243	132	27	14	10	59
Charlotte, N. C	6	19	44	69	112	186	238	187	73	17	9	4	48
Chattanooga, Tenn	16	29	84	90	141	245	247	242	118	19	20	11	63
Cheyenne, Wyo	0	0	2	51	148	229	273	250	100	13	0	0	53
Chicago, Ill	10	10	54	63	111	152	133	135	96	34	14	1	41
Cincinnati, Ohio	13	13	62	80	141	180	212	158	91	37	15	8	50
Cleveland, Ohio	5	10	35	64	107	126	156	120	88	34	10	2	38
Columbia, Mo	23	13	70	114	176	193	174	193	135	42	35	11	59
Columbia, S. C	11	25	51	78	120	197	243	212	96	19	7	10	53
Columbus, Ohio	9	17	59	77	123	187	198	152	86	25	19	4	48
Concord, N. H	2	0	9	14	46	71	119	108	40	11	4	2	21
Concordia, Kans	1	7	30	64	121	175	162	152	104	31	12	2	43
Corpus Christi, Tex	10	19	35	64	108	64	88	82	111	44	20	18	33
Davenport, Iowa	5	7	45	66	135	162	151	146	117	32	15	5	44
Dallas, Tex. (c)	26	26	44	78	77	80	55	70	40	32	19	17	56
Del Rio, Tex. (a)	8	6	22	47	46	47	41	40	28	20	11	4	18
Denver, Colo	0	0	12	35	124	199	251	238	100	15	1	0	49
Des Moines, Iowa	2	7	39	78	157	185	166	147	118	60	14	2	49
Detroit, Mich	6	13	35	68	98	148	144	129	78	35	11	2	38
Devils Lake, N. Dak. (d)	0	0	2	16	61	142	155	134	61	10	2	0	31
Dodge City, Kans	3	1	17	55	122	184	172	154	84	31	12	2	42
Dubuque, Iowa	2	5	36	70	128	157	136	133	100	40	14	2	41
Duluth, Minn	2	0	8	18	80	127	148	117	67	17	5	0	29
Eastport, Me	3	2	6	8	31	60	92	64	25	20	4	1	16
Elkins, W. Va	1	15	39	70	123	203	215	146	83	23	8	4	46
El Paso, Tex	4	6	9	18	32	100	177	188	74	35	10	5	33
Erie, Pa	5	10	36	64	101	142	128	123	83	47	9	5	38
Escanaba, Mich	0	2	21	32	67	122	158	123	81	29	9	1	32
Eureka, Calif	13	10	8	2	2	2	2	3	4	7	8	16	4
Evansville, Ind	22	24	77	98	147	189	198	172	106	40	30	18	56
Fort Smith, Ark	27	31	77	123	175	186	139	154	92	53	30	18	55
Fort Worth, Tex	33	39	75	137	174	154	130	136	94	71	30	19	55
Fresno, Calif	1	7	10	16	17	6	5	4	10	8	2	4	4
Galveston, Tex	22	40	47	85	112	102	160	172	135	58	31	44	50
Grand Haven, Mich	4	7	35	50	99	113	117	113	75	29	16	3	33
Grand Junction, Colo	0	3	19	48	76	112	240	221	113	30	3	2	43
Grand Rapids, Mich	3	8	39	61	103	131	131	117	90	40	17	4	37
Green Bay, Wis	0	3	21	37	94	123	142	120	84	29	10	1	33
Hannibal, Mo	14	11	70	92	151	175	146	157	117	41	25	8	50
Harrisburg, Pa	2	8	16	50	89	153	185	142	59	27	3	2	37
Hartford, Conn. (d)	5	6	24	29	59	82	140	113	52	27	6	3	29
Hatteras, N. C	15	26	44	62	94	113	152	133	75	20	15	12	38
Havre, Mont	0	0	2	13	41	158	141	105	33	1	0	0	25
Helena, Mont	2	0	4	23	86	185	201	163	48	8	2	1	36
Houghton, Mich	0	2	17	22	57	93	100	84	70	21	7	0	24
Houston, Tex. (c)	14	27	43	59	86	93	142	155	80	44	25	38	58
Huron, S. Dak	0	2	12	32	107	171	170	148	83	19	5	0	37
Independence, Calif	0	0	1	8	19	24	84	69	19	12	1	0	12
Indianapolis, Ind	8	10	65	93	123	178	183	147	105	35	28	6	49
Iola, Kans. (a)	13	13	51	89	150	157	139	130	113	43	18	6	51
Ithaca, N. Y	2	3	15	33	79	121	155	100	64	29	5	0	30
Jacksonville, Fla	17	44	57	77	172	259	385	340	171	46	9	20	80
Jupiter, Fla. (g)	3	13	29	35	77	118	150	142	81	::	8	8	65
Kalispell, Mont	0	0	1	9	41	89	113	81	26	8	1	0	18
Kansas City, Mo	13	21	77	109	158	206	190	177	142	59	23	5	59
Keokuk, Iowa	9	13	62	81	157	175	160	167	115	49	21	4	51
Key West, Fla	18	23	25	48	101	175	227	243	227	74	24	29	61
Knoxville, Tenn	9	25	57	93	136	203	214	185	90	12	15	11	52
La Crosse, Wis	1	2	21	54	149	176	155	148	113	35	11	1	43
Lander, Wyo	0	0	1	13	51	103	105	94	40	3	1	0	21
Lansing, Mich. (f)	0	6	25	43	73	96	97	100	71	19	8	1	41
Lewiston, Idaho	1	0	7	17	40	67	76	52	30	11	1	0	15
Lexington, Ky	17	25	59	89	133	197	221	169	105	20	17	11	53
Lincoln, Nebr	2	7	22	75	132	196	182	172	123	42	11	2	48
Little Rock, Ark	31	46	95	143	126	195	179	170	102	40	34	25	59
Los Angeles, Calif	10	7	16	7	4	4	4	6	9	6	5	2	4
Louisville, Ky	24	24	78	95	123	186	198	145	95	28	29	12	52
Lynchburg, Va	0	4	19	46	82	167	173	131	55	9	4	2	35
Macon, Ga	16	41	67	76	137	204	276	235	90	26	11	9	59
Madison, Wis. (d)	2	4	32	68	137	155	158	141	97	25	11	1	44
Marquette, Mich	0	0	17	17	59	110	121	97	53	15	6	0	25

TABLE 1.—*Days with thunderstorms at Weather Bureau stations in the United States for the 20-year period 1904–1923, inclusive*—Continued

Stations	January	February	March	April	May	June	July	August	September	October	November	December	Average annual
Memphis, Tenn	26	38	78	109	118	165	185	159	86	33	31	26	53
Meridian, Miss	34	53	76	119	140	213	247	218	104	31	23	39	65
Miles City, Mont	0	0	1	8	57	149	122	87	21	6	1	0	23
Milwaukee, Wis	5	3	34	57	114	144	109	133	100	30	11	1	37
Minneapolis, Minn	1	2	14	32	114	163	146	142	90	33	8	0	37
Mobile, Ala	24	54	74	96	139	228	323	282	155	37	23	35	74
Modena, Utah	3	1	11	41	71	59	234	233	78	24	8	2	38
Montgomery, Ala	32	56	87	90	139	207	231	220	107	26	28	23	62
Moorehead, Minn	0	0	6	19	87	136	143	117	66	16	2	0	30
Mount Tamalpais, Calif. (b)	6	3	4	1	0	1	1	1	7	1	2	5	2
Nantucket, Mass	6	10	19	32	46	73	75	65	34	30	15	8	21
Narragansett Pier, R. I. (e)	2	6	7	17	29	39	56	54	20	9	7	1	18
Nashville, Tenn	18	33	77	105	148	200	219	176	104	31	22	22	58
New Haven, Conn	4	4	22	29	62	111	133	109	51	23	7	3	28
New Orleans, La	38	46	76	93	134	227	302	298	163	46	22	44	74
New York, N. Y	4	4	19	46	79	116	150	113	51	23	4	3	31
Norfolk, Va	3	17	28	51	115	153	187	152	55	18	7	6	40
Northfield, Vt	1	1	6	16	57	97	143	107	66	22	2	2	28
North Head, Wash	2	4	3	0	1	2	5	6	4	7	8	8	2
North Platte, Nebr	0	1	9	46	132	187	204	181	66	14	5	0	42
Oklahoma, Okla	13	19	69	103	148	178	121	132	95	58	25	6	48
Omaha, Nebr	1	6	27	77	150	189	170	174	121	48	13	2	49
Oswego, N. Y	3	9	26	26	78	110	119	105	58	31	5	3	29
Palestine, Tex	33	42	75	144	152	139	150	130	95	56	28	37	54
Parkersburg, W. Va	4	18	46	76	129	201	193	155	80	25	11	5	47
Pensacola, Fla	32	64	71	100	157	233	329	320	192	55	23	43	81
Peoria, Ill. (d)	10	9	64	95	156	185	152	149	108	35	18	6	52
Philadelphia, Pa	2	11	23	45	83	125	167	125	47	22	5	2	33
Phoenix, Ariz	5	11	19	22	22	27	189	196	63	23	17	6	30
Pierre, S. Dak	0	1	3	20	98	154	166	136	58	14	2	0	33
Pittsburgh, Pa	9	14	43	72	117	179	191	160	95	29	8	5	46
Pocatello, Idaho	5	2	9	40	78	105	147	146	81	17	3	1	32
Point Reyes, Calif	9	7	4	1	0	1	1	3	6	4	4	5	2
Port Huron, Mich	3	11	28	49	90	127	131	126	72	30	8	2	34
Portland, Me	1	0	8	8	27	56	87	71	30	16	3	4	16
Portland, Oreg	2	3	3	7	17	17	14	17	17	9	2	1	5
Providence, R. I. (d)	1	5	15	21	44	60	82	79	39	12	5	2	19
Pueblo, Colo	0	3	9	43	122	178	274	223	81	16	3	2	48
Raleigh, N. C	6	17	40	58	119	175	220	159	74	17	7	2	45
Rapid City, S. Dak	0	0	5	26	107	216	219	174	60	12	2	0	41
Red Bluff, Calif	4	5	12	8	20	14	5	3	7	8	1	4	5
Reno, Nev. (a)	0	1	1	6	36	49	82	51	31	7	0	0	15
Richmond, Va	3	8	36	67	114	170	193	157	70	11	5	2	42
Rochester, N. Y	0	5	25	38	78	113	155	122	64	20	3	2	31
Roseburg, Oreg	0	0	4	4	17	15	15	13	11	2	0	1	4
Roswell, N. Mex. (a)	1	6	19	54	82	132	152	155	82	39	7	0	38
Sacramento, Calif	6	11	13	7	5	3	0	3	9	11	3	2	4
St. Joseph, Mo. (e)	2	7	39	61	98	122	109	113	96	29	12	3	49
St. Louis, Mo	9	19	70	97	137	163	158	160	109	49	25	4	50
St. Paul, Minn	0	2	15	27	107	155	137	125	83	27	6	1	34
Salt Lake City, Utah	11	7	25	43	79	96	144	167	86	29	8	2	35
San Antonio, Tex	9	24	49	99	130	81	102	82	89	46	27	18	38
San Diego, Calif	7	2	4	2	5	5	9	10	6	7	4	6	3
Sand Key, Fla. (g)	19	17	22	44	60	85	122	137	121	50	15	25	65
Sandusky, Ohio	7	11	38	57	123	148	153	132	86	32	10	3	40
San Francisco, Calif	5	7	2	0	1	1	0	4	3	4	1	3	2
San Jose, Calif. (a)	2	3	0	2	0	1	0	3	4	2	1	4	1
San Luis Obispo, Calif	3	3	9	3	5	2	3	5	11	9	4	4	5
Santa Fe, N. Mex	5	8	30	61	137	223	417	355	162	49	8	1	73
Sault Ste. Marie, Mich	1	0	16	23	45	75	77	81	64	33	10	0	21
Savannah, Ga	13	32	41	73	132	200	297	253	120	20	11	7	60
Scranton, Pa	1	2	18	35	81	144	161	125	63	28	5	1	33
Seattle, Wash	1	2	7	6	14	25	19	17	11	9	3	1	6
Sheridan, Wyo. (f)	0	0	0	13	82	176	169	115	39	3	0	0	35
Shreveport, La	40	46	77	147	133	144	162	145	75	31	32	36	53
Sioux City, Iowa	1	2	10	54	129	189	172	162	100	32	11	2	43
Spokane, Wash	2	0	1	13	22	47	45	47	18	5	0	0	10
Springfield, Ill	13	13	77	93	150	176	164	145	105	41	27	7	51
Springfield, Mo	23	20	70	106	159	198	175	149	103	45	35	10	55
Syracuse, N. Y	3	5	20	36	89	133	152	130	70	32	4	1	34
Tacoma, Wash	2	3	0	7	11	17	20	19	10	4	5	0	5
Tampa, Fla	21	31	43	64	184	317	440	430	256	65	11	21	94
Tatoosh Island, Wash	11	3	2	4	1	4	13	6	10	15	14	10	5
Taylor, Tex	24	33	67	114	145	95	112	114	94	55	29	29	46
Thomasville, Ga. (a)	22	47	58	86	143	246	330	279	150	34	16	16	79
Toledo, Ohio	7	12	35	75	111	161	165	137	85	37	16	2	42
Tonopah, Nev. (f)	0	2	1	10	23	29	66	57	28	5	0	0	13
Topeka, Kans	8	8	54	90	143	174	175	164	143	51	29	4	52
Valentine, Nebr	0	0	8	33	114	173	184	168	75	14	5	0	39
Vicksburg, Miss	47	68	98	135	147	216	233	217	122	48	33	46	70
Wagon Wheel Gap, Colo. (f)	0	1	4	26	64	160	255	254	102	27	5	1	69
Walla Walla, Wash	0	0	4	15	28	49	50	38	22	5	1	0	11
Washington, D. C	5	10	32	65	94	153	187	136	78	17	9	6	40
Wichita, Kans	8	14	50	95	161	184	170	154	124	50	20	4	52
Williston, N. Dak	0	0	1	11	48	146	129	111	39	5	0	0	24
Wilmington, N. C	11	26	43	75	105	169	235	212	97	20	7	7	50
Winnemucca, Nev	0	0	8	11	44	56	57	48	32	8	1	0	13
Wytheville, Va	3	5	31	49	102	171	161	135	65	9	2	2	37
Yankton, S. Dak	0	1	14	49	132	175	189	159	84	24	8	0	42
Yellowstone Park, Wyo	0	0	0	11	68	145	199	178	71	9	2	0	34
Yuma, Ariz	2	0	6	2	2	4	37	50	25	6	5	2	7
Honolulu, Hawaii (a)	24	11	12	3	7	1	0	1	4	11	6	22	5
San Juan, P. R	3	4	7	23	86	134	130	130	195	162	54	14	47

NOTE.—(a) = 18 years' record; (b) = 17 years' record; (c) = 10 years' record; (d) = 19 years' record; (e) = 14 years' record; (f) = 13 years' record; (g) = 11 years' record.

TABLE 2.—*Total number of days with thunderstorms in each month for the seven-year period, 1917–1923, inclusive, at the following stations in Alaska*

Stations	January	February	March	April	May	June	July	August	September	October	November	December	Annual
Akiak						4		1					5
Akulurak						1	3		1				5
Allakaket						[a]5	2	5					12
Anchorage						2	1						3
Annex Creek								2					2
Aniak								1					1
Attu	[b]												
Barrow							[a]1	1					2
Calder											1		1
Camp No. 6									1				1
Candle						3		1					4
Chickaloon							1						1
Chicken						1	3						4
Chitina				1		1	1						3
Claim No. 2						1	1	1					3
Copper Center							1						1
Cordova									4				4
Council								1					1
Crooked Creek						1	3	1					5
Dawson						4	3						7
Dillingham							2						2
Eagle						[a]15	9	2	1				27
Fairbanks					2	2	2	4					10
Fortman Hatchery						1		1					2
Fort Yukon						4							4
Goodnews Bay							1						1
Healy						2	3						5
Holy cross						3	2	1					6
Hydaburg				1									1
Indian River							1	1					2
Igloo								1					1
Juneau								1	1				2
Kake						1							1
Katalla										5	1		6
Kennecott							2						2
Matanuska						1							1
McKinley Park					1								1
Nakat					1								1
Naknek							1						1
Nenana						2	2	3					7
Nome						1		1					2
Noorvek					1	6	2	2					11
Nulato					3	3	5	4					15
Paxson							1						1
Peril Strait									1				1
Rampart					[a]1	5	5	2					13
Richardson					2	1							3
Ruby							[a c]1						1
Salcha						1							1
Salmon River					2	2	[a]1	1					6
Seldovia							1						1
Seward		1						1	1	1	[d]2		6
Sitka	1								3			1	5
St. Paul Island								1	1				2
Talkeetna						2	1	4	3				10
Tanana					1	7	3	3	2				16
Valdez							1	1	1				3
Total	1	1	0	2	14	82	66	48	20	6	4	1	245

[a] One or more storms accompanied by hail.
[b] Lightning observed on Jan. 28, 1921.
[c] Buildings were struck by lightning on July 3, 1920.
[d] One of these storms (that of Nov. 7, 1918) was accompanied by "a blindingstorm."

551.515 (771)

THUNDERSTORMS IN OHIO DURING 1917[1]

By W. H. ALEXANDER, C. F. BROOKS, and G. H. BURNHAM

INTRODUCTION

The purposes of this study are—

to determine as far as possible the origin, the distribution, the number, the frequency, the extent, the attending phenomena, etc., of these storms, and, if possible, to trace the history of each individual thunderstorm that enters or originates in the State of Ohio during the year 1917.[2]

About 830 well-scattered observers were enlisted. The network, however, was too open in the rougher plateau of the southeastern half of Ohio. Each observer was instructed to report each occasion thunder was heard or distant lightning seen and to give, so far as possible, the times, occurrences, or other information desired, as follows:

Thunder—first, loudest, last, and frequency; movement of storm—direction from which it appeared to come, how it passed (whether overhead, or to either side), and the direction to which it went; rain or snow—beginning, ending, and amount; hail—beginning, ending, amount, size, and form; wind—direction before and after, direction and time of highest wind; heat lightning—direction, and time. Remarks were also asked for.

Most of the observers made careful returns, but irregularity in reporting, omissions of place names or the sort of time used, and failure to discriminate between neighboring storms greatly reduced the potential value of many. The times of first and last thunder, occurrences of hail and lightning strokes, were mapped first, then small maps were made for thunderstorm areas each day or half day. Later, all the data on the cards were transferred to large post office maps.

Only on 7 days were the storms general over the State, and on 11 over almost the whole State; on 23, half the State, or slightly more, was covered; and on 17, almost half. Thunderstorms occurred with considerable frequency in a winter of much zero weather, even at times when the surface temperature was near freezing. There were tornadoes in winter as well as in summer.

Quick, decided changes in the weather proved favorable for the genesis and growth of thunderstorms, while equable conditions and gradual changes were unfavor-

[1] A joint study by the United States Weather Bureau and Clark University, in which Alexander, with the aid of H. H. Martin, collected and partially mapped the data, and both Alexander and Brooks studied them. Detailed discussions with maps are on file at the United States Weather Bureau Library, Washington, D. C., and the Columbus, Ohio, office of the Weather Bureau. The original reports and maps are at Columbus. The following summary was prepared by Brooks, of Clark University.

[2] Alexander, W. H., Climat'l. Data, Ohio Sec., Dec., 1916, 21: 91.