weather. The "rainy season," from June to October, has hot-rainy days about one-third the time and hot-fair-quiet days the remainder.

The effect of altitude is clearly shown by the weather types of Mexico City (Table C). Although about the same latitude as Manzanillo and Vera Cruz, Mexico City is dominated almost entirely by the moderate temperature types. From October to April, inclusive, four-fifths of all the days are moderate-fair-quiet. A few hot-rainy days and about three times as many hot-fair-quiet days occur between the middle of April and the middle of June. At no other time does the average temperature of the day reach 68° F. Moderate-rainy days occupy about two-thirds of the time from May to September, inclusive. The increased cloudiness and evaporation are probably the largest factors in maintaining moderate temperatures during the summer season. Mexico City would appear to have almost ideal weather for a winter resort of the Northern Hemisphere.

TABLE D.—*The mean annual rainfall at the different stations and the average number of rainy days for each station during the five-year period 1917–1920*

Station	Inches rainfall	Number of rainy days
Colon	127.9	229.0
Balboa Heights (Panama)	69.4	154.4
Vera Cruz	68.0	90.0
Salina Cruz	39.4	46.0
Manzanillo	26.0	32.0
Progreso	17.2	37.4
Matamoros	36.6	58.6
Mexico City	23.1	136.8
Habana, Cuba	51.7	80.0

Habana serves to compare the weather types of an insular location with those of continental stations of similar latitude (Table C). The frequency of hot-fair-windy days, with a maximum in April or May, shows a resemblance to the west-coast stations. The distribution of hot-rainy days throughout the year, with a maximum in late summer, is like that of a modified eastern coast climate of low latitude. Unlike the sequences at most stations on the continent, no one type occurs on many successive days. Three or four successive hot-rainy days occur but about five times per year, and hot-fair-quiet days, which exceed all others in number, seldom occur on more than 10 successive days.

The average annual rainfall and the average number of rainy days is given in Table D, from which many interesting comparisons may be made. For example, Balboa Heights has about the same annual rainfall as Vera Cruz, yet has one and seven-tenths times as many hot-rainy days. Mexico City has about one-third as much rainfall as either Balboa Heights or Vera Cruz, yet has three-fifths as many rainy days as the former and one and four-tenths times as many as the latter. Progreso, with 75 per cent as much rainfall as Mexico City, has but 29 per cent as many rainy days.

From the above comparisons and many more that might be made, it seems evident that, for these stations, annual and seasonal rainfall, temperature, and wind velocity and direction data do not give an adequate conception of the weather conditions experienced. May not some combination of the weather elements into types of weather units be found that would more adequately depict the weather and climatic conditions under which the people live, work, and find their recreation?

TORNADOES IN ALABAMA

By WELBY R. STEVENS

[Weather Bureau Office, Montgomery, Ala., April 25, 1925]

A list has been made of tornadoes that have been reported in Alabama since 1794. All available records have been searched in an attempt to make this list as complete as possible, although completeness is not claimed, due to lack of information, especially in the early years. Prior to 1871 the list follows that of Finley, almost without exception, and while his work was evidently the result of much labor and as complete as possible at the time, in view of the sparsely settled nature of the State up to the first half of the last century, many tornadoes must have escaped notice. Advantage was also taken of the valuable Special Paper No. 1 of the Alabama Weather Service: Record of the Weather from 1701 to 1885, by Capt. W. H. Gardner, Mobile, Ala., which, however, contains little information about tornadoes. The following sources have been used in the tabulation: Report on the Character of Six Hundred Tornadoes, and Tornado Studies for 1884, by John P. Finley, U. S. Signal Service, Bulletins and Special Papers of the Alabama Weather Service, and the succeeding Climatological Data, Alabama Section, of the Weather Bureau, Annual Reports of the Chief Signal Officer, U. S. Army, and of the Chief U. S. Weather Bureau, THE MONTHLY WEATHER REVIEW since 1876, and correspondence and original records on file at the Montgomery, Ala., Weather Bureau Office. Many sections of the State are still thinly populated, and doubtless many tornadoes in recent years have occurred without coming to notice, but certainly the most severe ones since the establishment of the Signal Service in 1871 appear. The list, Table No. 1, shows the county in which the tornado occurred, the date and time of occurrence, direction in which the tornado moved, number killed, number injured, and amount of property damage, where these data could be obtained.

TABLE 1.—*Tornadoes reported in Alabama: Earliest record to April 1, 1925.*

Number on chart in figures	County	Date	Time	Direction of path	Number of persons—		Property loss
					Killed	Injured	
1		1794 Aug. —					
2	Morgan	1822 Apr. 16	5 p	NE			
3	Chilton	1823		E. 10° N.			
4	Morgan	Apr. 6	9 p	NE			
5	Pickens	1824					
6	Tuscaloosa	1829 Apr. 25					
7	Calhoun	1830 May 1					
8	Morgan	1834 June 16	4.30 p	NE			
9	Blount	1840		E. 20° N.			
10	Etowah			E. 20° N.			
11	Blount	Mar. 10	6 p	E.			
12	Jefferson	Mar. 16	do	NE			
13	Mobile	Mar. 24	7 p	S. 80° E.			

TABLE 1.—*Tornadoes reported in Alabama: Earliest record to April 1, 1925*—Continued

Number on chart in figures	County	Date	Time	Direction of path	Number of persons—		Property loss
					Killed	Injured	
		1842					
14	Tuscaloosa	Mar. 4	6 a	NE			
		1843					
15	Tuscaloosa			E. 45° N.			
		1854					
16	Lee	Mar. 7	1 p	NE			
		1855					
17	Pickens	Mar. 12		SE			
		1857					
18	Cherokee	May 24		NE			
		1858					
19	Lee			NE			
		1861					
20	Cleburne	Nov. 30	10 p	NE			
		1863					
21	Cleburne	Mar. 4	11 p	NE			
		1864					
22	Lee	Dec. 25	Midnight	NE			
		1866					
23	Cherokee			E. 40° N.			
24	Cleburne	Apr. 16	11 p	NE			
25	Talladega	May 6	8 p	E 10° N.			
		1867					
26	Calhoun	Feb. 15		E. 10° N.			
27	Tuscaloosa	Apr. 29	10 a	E. 20° N.			
28	Cleburne	May 4	Midnight	NE			
29	Cleburne	May 26	8 p	E. NE.			
		1868					
30	Cleburne	Feb. 12	3 p	NE			
31	Pickens and Tuscaloosa.	May 8					
		1869					
32	Clay	Jan. 29	8.30 a	E			
33	Talladega	Apr. —		NE			
34	Pickens	May 6	6 p	E			
		1870					
35	Calhoun	Jan. —	8 a				
36	Marshall	Apr. 23		NE			
37	Calhoun	Dec. 24					
		1871					
38	Coosa and Tallapoosa.	May 1	10 a	E			
		1873					
39	Cleburne	Nov. 16	Midnight	NE			
		1874					
40	Jackson and Calhoun.						
41	Hale	Nov. 22	Afternoon.	SE			
42	Colbert	do	6 p	NE	12	30	$100,000
43	Shelby	do	Midnight.	E 10° S.			
44	Dallas	Nov. 27					
		1875					
45	Cherokee			E 30° N.			
46	Lamar	Feb. 24	6.30 p	NE			
47	Lee and Chambers	Mar. 20	2 p	NE			
48	Pike	do					
		1876					
49	DeKalb	Apr. 23		NNE			
50	Etowah	Dec. 25		E. 20° N.			
		1878					
51	Hale	Mar. 27					
52	do	Apr. 23	5 p	NE			
		1879					
53	Chilton	Feb. —					
		1880					
54	do	Feb. 13		ENE			
55	Barbour	Mar. 15	Evening				
56	Pike	Mar. 18	do	NE			
57	Jackson	Apr. 25	Afternoon.	NE			
58	Blount	Dec. —		SE			
		1881					
59	Cherokee			ENE			
60	Tuscaloosa	Feb. 18	Afternoon.	NE			
61	Perry	Feb. 26	Midnight.	NE			
62	Randolph	Mar. 22	1 a	NE			
63	Sumter	Mar. 23	5 p	NE			
		1882					
64	Madison	Feb. 28	11.45 a	NE			
65	Washington	Mar. 27	2.30 p	E			

TABLE 1.—*Tornadoes reported in Alabama: Earliest record to April 1, 1925*—Continued

Number on chart in figures	County	Date	Time	Direction of path	Number of persons—		Property loss
					Killed	Injured	
		1882					
66	Dallas	Mar. 27	Night				
67	Lee	do	2.30 p				
68	Barbour	do	Night				
69	Henry	do	9.30 p	E			
70	Etowah	Apr. 2		NE			
71	Choctaw	Apr. 22	4 p	NE			
		1883					
72	Jefferson	Jan. 16		NE			
73	Blount	Apr. 2		SE			
74	Talladega	Apr. 22			1		
75	Jefferson			NE			
76	Cherokee	Apr. 22	10.30 p				
77	do	Apr. 23	4.30 p	NE			
		1884					
78	Fayette	Jan. 11	6 p	E			
79	Pickens	Feb. 19	11 a	NE			
80	do	do	Noon	NE			
81	Jefferson and St. Clair	do	1.20 p	NE	11	31	$80,000
82	Talladega and Calhoun.	do	2 p	NE	16	50	
83	Marshall	do	9 p				
84	Cherokee	Mar. 6	4 p				
85	Pickens	Mar. 11	7 p	NE			
86	Marshall	do	7.30 p				
87	Greene	do	8 p	NE			
88	Tuscaloosa	do	10.30 p	NE			
89	Barbour	Mar. 24	2 a	NE	1	(1)	
90	Jefferson	Mar. 25	2 p	NE			
91	Cherokee	do	8 p	NE		1	
92	Chambers	do	— p				
93	Lawrence and Jackson.	Apr. 1	6 p	NE			
94	St. Clair	do	Midnight.	NE	1		
95	Blount and DeKalb.	do		NE			
96	Blount	Apr. 2	Night	NE	7		
97	Madison	do	do		3	4	
98	Lawrence	Apr. 12	2.30 p				
99	Franklin and Colbert.	Apr. 14		NE			
100	Cullman	Apr. 15					
101	Henry	do	— a				
102	Lee	do	Midnight.	NE			
103	Morgan	do	Dusk			2	
104	Perry	do					
104a	Elmore	Apr. 19		NE			
104b	Cherokee	Apr. 25	9 p	NE			
105	Morgan	July 5	6 p	SE			
106	Lee	Dec. 12	Night	NE			
		1885					
107	Randolph	Jan. 11					
108	Macon	do	11 p	E. 20°N.	1		
109	Coosa and Clay	do	9 p	E. 10°N.			
110	Lamar, Fayette and Walker.	do	5 p	E. 15°N.	1	(1)	
111	Greene, Hale, Bibb and Chilton.	do	6.20 p	E. 30°N.			
112	Cullman, Blount, Marshall, and DeKalb.	do	7 p	E. 20°N.	1	(1)	
113	Coosa	Feb. 20	5.30 p	NE			
114	Marshall	Mar. 28	Afternoon.				
115	Dallas	Apr. 30	5.30 p	SE			
116	Madison	May 6	6.30 p	N. 45° E.			
117	Autauga, Chilton and Bibb.	do	4.30 p	N.			10,000
118	Morgan	Nov. 6	11 a	NE			10,000
119	Sumter	do	8 p	NE			
120	Lamar	do	10 p	NE			
121	Dallas	do	2 p	NE	5	41	
		1886					
122	Clarke	Mar. 27		E			
123	Lee	Mar. 29		NE		(1)	
124	Elmore	do	Morn.	NE			
125	Bullock	Mar. 30	11-12 a	NNE		7	
126	Hale	Apr. 25	Afternoon.	NE			
		1887					
127	Washington	Jan. 13	Morn.	NE			
128	Jefferson	Apr. 18	3 a	NE			
129	Lamar	Apr. 22	6 p	NE			
		1888					
130	Pike	June 26	Afternoon.	E			
131	Talladega	do	do	E			
		1889					
132	Bibb	Feb. 18	2 a	NE	(2)	(2)	
		1890					
133	Geneva	Feb. 7		N. 20° E.			

[1] Several. [2] Many.

TABLE 1.—*Tornadoes reported in Alabama: Earliest record to April 1, 1925*—Continued

Number on chart in figures	County	Date	Time	Direction of path	Number of persons— Killed	Number of persons— Injured	Property loss
		1890					
134	Pickens	Feb. 27	7.30 p	NE	1	3	
135	Pickens	do		NE			
136	Talladega	do	Night	NE		(1)	
		1891					
137	Tuscaloosa	Feb. 9	3 p			(2)	$2,000
138	Shelby	do	3.30 p	NE			5,000
		1892					
139	Chambers and Randolph.	Jan. 5		NE	(1)	(1)	
140	Monroe	Nov. 7	Morn	NE			
		1893					
141	Sumter	Mar. 3	6.30 p		1		
142	Choctaw	do	7.30 p	E. 10° S.			Slight.
143	Choctaw	Apr. 19	8 p	NE		(1)	2,000
144	Dale	do	11 p	NE		1	25,000
		1894					
145	Jefferson	Feb. 3		E	4	26	50,000
146	Wilcox	Feb. 12	4 a	NE	1		1,500
		1895					
147	Mobile	Jan. 15 or 16	8.30 p	NE			20,000
148	Escambia	Mar. 7		NE			
149	Pike	Mar. 13	10 a				100
150	Barbour	do	do	NE			13,000
151	Baldwin	July 21			(2)		
		1896					
152	Marshall	June 9	11 a	E		5	5,000
		1897					
153	Lowndes	Aug. 2		NE			2,500
		1898					
154	Jefferson	Jan. 19–20	Night				
		1899					
155	Walker	Mar. 15	1 a	NE			1,500
156	Jefferson	do	4.55 a	NE		1	25,000
157	Montgomery	Mar. 18	1.10 p	NE		(1)	10,000
158	Cleburne	do	5.30 p		11	14	2,500
159	Shelby	do	7.30 p		3		1,000
160	Montgomery	Mar. 28	10 a				
161	Jackson	May 29	11 a	NE			
		1900					
162	Greene	June 24	6.45 a	NE			5,000
163	Jefferson	do	11 a	NE			500
164	Cullman	do	3 p	N		1	1,500
165	Marion	Nov. 20	6–6.10 p	NE		1	550
166	Madison	Nov. 21	2.30 a	NE			4,500
167	Mobile	Dec. 23	2 a	NE			3,000
168	Butler	do	2.30 a	NE			
		1901					
169	Jefferson	Mar. 25	9.40 a	NE	11	40	170,000
170	Pickens	Apr. 17	9 p	NE			5,000
		1902					
171	Greene	Mar. 15–16	Night	NE	1	12	
172	Bibb	do	do	NE	1	(1)	3,000
		1903					
173	Cullman	Apr. 8	1.30 a	NE	12	10	45,000
174	Bibb	Apr. 13	6–8 a	NE			35,000
175	Conecuh	do	do	SE	3	(1)	3,000
176	Shelby	Nov. 11	4 p	NE			
		1904					
177	Hale and Tuscaloosa.	Jan. 22	12.20 a	NE	36	80	92,000
178	Mobile	May 30	4 p	NE			200
		1905					
179	Chambers and Randolph.	Mar. 20	3.20 p	NE	9	19	5,000
		1906					
180	Pike	Jan. 3	11.30 a	NE	2		1,000
		1908					
181	Walker, Jefferson, Blount, Marshall, and DeKalb.	Apr. 24	2.40–4.15 p	NE	35	188	650,000
182	Lowndes and Montgomery.	Apr. 24	9 p	NE	2	22	83,000
183	Pike	Apr. 30	1.30 a	NE		10	35,00

[1] Several.
[2] Many.
[3] A number.
[4] Very destructive to life and property.
[5] A waterspout went ashore.

TABLE 1.—*Tornadoes reported in Alabama: Earliest record to April 1, 1925*—Continued

Number on chart in figures	County	Date	Time	Direction of path	Number of persons— Killed	Number of persons— Injured	Property loss
		1909					
184	Cullman	Feb. 5	1.15 p	NE	1	12	$5,000
185	Lowndes and Montgomery.	do	4.40 p	NE	3	17	7,800
186	Colbert	Feb. 23	5.30 p	NE	1	1	5,000
187	Calhoun	Apr. 13	3 a	NE			1,000
188	Lawrence and Morgan.	Apr. 30	Noon	E	1	18	15,000
189	Calhoun	do	4.30–5 p	NE			4,000
190	Clay	do	8 p	NE		7	5,000
191	Escambia	May 5	3 a	NE			10,000
192	Madison and Morgan.	May 30	5 p	NE			(6)
		1910					
193	Monroe and Butler.	Apr. 16	9 a	NE		(1)	10,000
194	Macon	Apr. 26					
195	Macon	Apr. 27	4 p				
		1911					
196	Monroe	Mar. 26	4.45–5.30 p	NE	2	50	25,000
		1912					
197	Henry	Mar. 14	11.30 p				
198	Geneva, Houston, and Henry.	Mar. 15	3 a	NE	9	50	50,000
199	Butler	Apr. 17	3.45 a	E			
200	Pike	do	4 a	E		2	3,500
201	Jefferson	Apr. 22	4.30 a	E	1	18	30,000
202	Talladega	May 11	8 p				75,000
		1913					
203	Butler, Crenshaw, and Pike.	Feb. 27	—a			3 or 4	100,000
204	Macon	Mar. 13	12–1 a	NE		5	3,000
205	Talladega	do	3.20 p	NE			4,000
206	Calhoun	do	3.25 p			(1)	
207	Talladega	do	4 p	E		2	1,000
208	Etowah and Cherokee.	do	8 p	NE		1	2,000
209	Bullock	Mar. 14		NE			
210	Russell	do	3.30 a				
211	Lauderdale	Mar. 20	Night		3		25,000
212	Morgan	do	5 p		1		
213	Talladega	Mar. 21	a	NE			25,000
214	Talladega	do	a	NE			
215	Morgan	do	2 a		3		11,000
216	DeKalb	Mar. 26	2.30 p	NE		2	100
217	Macon	Mar. 29	10 p	NE		2	1,000
		1914					
218	DeKalb	Apr. 7					5,000
		1915					
219	Choctaw	Dec. 17					
220	Montgomery	do					
		1916					
221	Montgomery	Feb. 28	10.30 p			1	
222	Mobile	Apr. 20	4.40 p	NE	1		3,500
223	Jefferson	May. 22	12.47 a	NE	3	1	15,000
224	Jefferson	June 6	11 a	E		(3)	5,000
225	Tallapoosa	July. 6	4–5 p	N		1	
226	Montgomery	Oct. 18	2.30–3 p				2,000
		1917					
227	Hale	Feb. 23	1 p	NNE	6		
228	Coosa and Clay	do	3.30 p	NE	10		
229	Pike	Mar. 3	11.30 p				
230	Hale	Mar. 26	1 p		1		
231	Pike and Crenshaw.	Mar. 27	12.30 a	NE	9	(5)	2,600
232	Walker	May 27	8.45 p	NE	5	50	200,000
233	Jefferson	do	8.45 p	NE	26	35	65,000
234	Blount	do	9.15 p	E	1	15	40,000
235	Talladega	May 28	12.45 a	SE-E	1	4	125,000
236	Madison	May 27–28.	Night		6	6	
237	Tuscaloosa	do	Night	E	1		(7)
		1918					
238	Baldwin	Jan. 11	p	NE			
239	Pike	do	p		1		
240	Houston	do	1.40 p	NE	12	10	100,000
241	Elmore	Feb. 14	—p	ENE			10,000
		1919					
242	Escambia, Crenshaw, Pike, and Barbour.	Mar. 5	12.35 p	NE	5	16	200,000
243	Mobile	May 26	9 a			(1)	700
		1920					
244	Elmore, Tallapoosa, and Chambers.	Mar. 28	2.30 p	ENE	17	40–50	150,000

[6] Considerable.
[7] Several thousand.

TABLE 1.—*Tornadoes reported in Alabama: Earliest record to April 1, 1925*—Continued

Number on chart in figures	County	Date	Time	Direction of path	Number of persons— Killed	Injured	Property loss
		1920					
245	Pike	Mar. 17	Noon	NE			$5,000
246	Calhoun	Mar. 28			1		
248	Marion, Franklin, Colbert, and Lawrence.	Apr. 20	9 a.	NE	44	315	1,000,000
249	Walker, Cullman, Morgan, and Madison.	do	Noon	NE	46	215	1,000,000
		1921					
250	Pickens	Mar. 9	2 a.	NE		2	1,200
251	Baldwin	Mar. 31	9.15 a.	E		5	500
252	Lamar, Marion, Franklin, Colbert, and Lauderdale.	Apr. 15–16.	Midnight.	NE			
253	Choctaw	Apr. 16	6.30 a.	NE			10,000
254	Tuscaloosa and Jefferson.	do	6.30 a.	NE	5	12–15	200,000
255	Hale	do	10 a.	NW		2	
256	Dallas, Autauga, Elmore, Tallapoosa, and Chambers.	do	12.05 p.	ENE	2	9–10	1,000,000
		1922					
257	Coffee	Feb. 5	3 a.	NE	1	12	40,000
258	Mobile	Mar. 14	1.30 p.	NE			
259	Limestone	do	4 p.	NE			
260	Lee	Mar. 19	Dusk	ENE	2		1,000
261	Cullman	Mar. 14	8 p.	NE			
262	Colbert and Lawrence.	Mar. 31		NE			
263	Cullman	do	3 a.	NE		3	100,000
264	Pike	Apr. 5					
		1923					
265	Baldwin	Nov. 29	8 a.	NE	1	2	12,000
		1924					
266	Walker	Feb. 4	5 p.	NE		3	5,000
267	Jefferson	do	5.30 p.	NE	3	5	25,000
268	Autauga	Apr. 30	2.45 a.	E		8–10	30,000
269	Butler, Bullock, and Macon.	do	4.50 a.	NE	8	31	47,000
270	Chambers	do	4.30 a.		1	6	25,000
271	Lee	do	5 a.		4	13	10,000
272	Barbour	do	7 a.			12	40,000
273	Barbour and Pike.	do	6 a.		1	25	20,000
274	Limestone	May 26	11.45 p.		8		5,000
275	Pickens	May 27	Early a.		1	4	10,000
276	Walker	do	2.15 a.		11	7	19,000
277	Marion	do			1	2	
278	Dallas	do	3.40 a.			2	3,000
279	Etowah	do	Daybreak			8	
		1925					
280	Coffee	Jan. 10	8 a.			(1)	5,000
281	Coffee	do	Noon			1	
282	Pike	do	do				

During the period 1794 to March, 1925, at least 283 tornadoes have occurred in Alabama. Since 1871 only three years have passed without at least one, namely, 1872, 1877, and 1907. The year of greatest frequency was 1884, with 31 reported; 1885 and 1913, were next with 15 each, and 14 were reported in 1924. There can be no doubt that tornadoes are more frequent in some years than in others, but it is difficult to make comparisons, because of the incompleteness of the records, and the variation in vigilance of those who have recorded them in the past. For example, the large number recorded during 1884–85, is partly due to the special efforts of Finley to secure a record of all tornadoes; probably, however, these years were unusually stormy, particularly 1884. After unusually destructive tornadoes occur, newspapers are likely to print articles concerning them, and for this reason many minor storms are noted at such times that would otherwise remain unrecorded. Another source of difficulty is the fact that in some years several tornadoes occur on the same date and under about the same conditions, while in other years fewer tornadoes occur, but are scattered more throughout the season. The total for each year has been computed, however, and is given in Table No. 2.

The average yearly frequency for Alabama as figured by Finley for the period 1822–1888 is 1.6. The average yearly frequency figured for the 54-year period, 1871–1924, inclusive, during which time reports may be assumed to be fairly complete, is 4.5. It is not likely that there has been an actual increase in frequency; the apparent increase is probably due entirely to the increase in population and the consequent increased facilities for obtaining reports.

TABLE 2.—*Total number of tornadoes reported each year in Alabama, 1794 to March, 1925, inclusive*

Year	Number	Year	Number	Year	Number
1794	1	1868	2	1898	1
* * *		1869	3	1899	7
1822	1	1870	3	1900	7
1823	2	1871	1	1901	2
1824	1	1872	0	1902	2
* * *		1873	1	1903	4
1829	1	1874	5	1904	2
1830	1	1875	4	1905	1
* * *		1876	2	1906	1
1834	1	1877	0	1907	0
* * *		1878	2	1908	3
1840	5	1879	1	1909	9
* * *		1880	5	1910	3
1842	1	1881	5	1911	1
1843	1	1882	8	1912	6
* * *		1883	6	1913	15
1854	1	1884	31	1914	1
1855	1	1885	15	1915	2
1855	1	1886	5	1916	6
* * *		1887	3	1917	11
1857	1	1888	2	1918	4
1858	1	1889	1	1919	2
* * *		1890	4	1920	5
1861	1	1891	2	1921	7
* * *		1892	2	1922	8
1863	1	1893	4	1923	1
1864	1	1894	2	1924	14
* * *		1895	5	1925	3
1866	3	1896	1		
1867	4	1897	1		

The number of tornadoes that occurred in each month of the year and the corresponding percentage of the total number for the period have been determined, and appear in Table No. 3. It will be seen that tornadoes occur with greatest frequency in late winter and spring, but have occurred occasionally in every month of the year except September. The month of maximum frequency is March, with 80 reported, or 29.4 per cent of the total number. The next most frequent month of occurrence is April, with 69 reported, or 25.4 per cent of the total number, while February and May rank next in order of frequency with 12.5 and 10.7 per cent, respectively. From July to October, inclusive, tornadoes are rare, with only 2.2 per cent of the total number reported in this third of the year. There is a slight, but noticeable, rise in frequency in November and a falling off in December, the percentages in these months being 5.5 and 3.3, respectively. These facts have an important bearing on the question of the origin of tornadoes in this region. The scarcity of tornadoes during the summer months, when thunderstorms are most frequent, indicates that they seldom, if ever, develop in the heat thunderstorms so prevalent in the Gulf States during the summer. Some of those that occur in summer and autumn develop even in West India hurricanes. It is interesting to compare the monthly frequency of tornadoes in Alabama with the monthly frequency of thunderstorms at Montgomery. Table No. 4 shows the number of thunderstorms that have occurred in each month during the period 1872–1924, inclusive, with the

W. R. S. FIG. 3—Tornado tracks, Alabama, 1794 to March, 1925.

corresponding percentages of the total number in the period. Nearly two-thirds of all the thunderstorms occur during the four months May to August, inclusive, while less than 15 per cent of the tornadoes occur during the same period, and most of those in May. Figure 1, the graph of the percentage columns in Tables 3 and 4, brings out very clearly the wide difference in the seasonal distribution of thunderstorms and tornadoes in this section of the country.

TABLE 3.—*Total number and percentage of tornadoes recorded in Alabama, by months, 1794–March, 1925, inclusive*

Month	Number	Percentage	Month	Number	Percentage
January	22	8.1	September	0	0
February	34	12.5	October	1	0.4
March	80	29.4	November	15	5.5
April	69	25.4	December	9	3.3
May	29	10.7			
June	8	2.9	Total	272	100.0
July	3	1.1	Month unknown	11	
August	2	0.7			

TABLE 4.—*Total number and percentage of thunderstorms at Montgomery, Ala., by months, 1872–1924, inclusive*

Month	Number	Percentage	Month	Number	Percentage
January	73	2.7	July	508	19.0
February	121	4.5	August	466	17.5
March	193	7.2	September	175	6.6
April	211	7.9	October	47	1.8
May	292	11.0	November	56	2.1
June	472	17.7	December	54	2.0

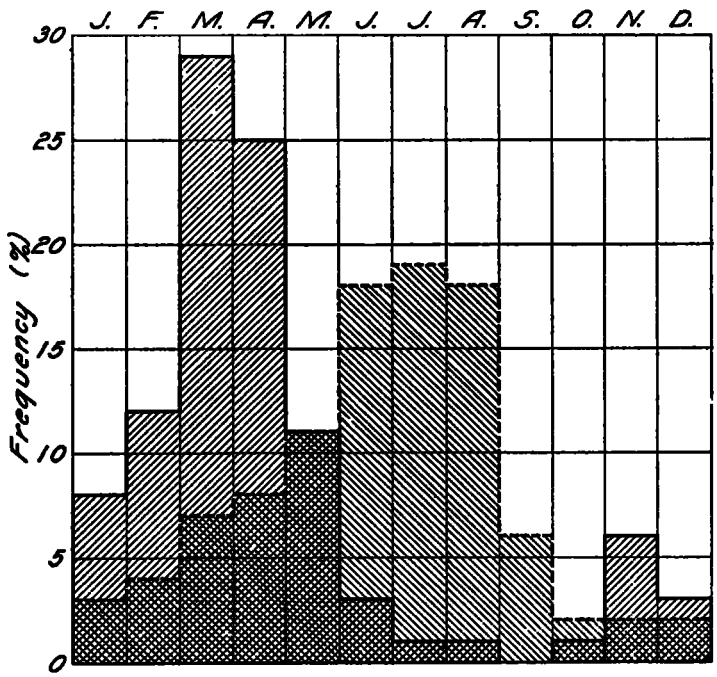

FIG. 1.—Occurrence of tornadoes and thunderstorms by months: Tornadoes, light shading; thunderstorms, dark shading

Table No. 5 and Figure 2 show the hourly frequency of tornadoes in Alabama. The time of occurrence which was available in 194 cases has been tabulated by hours and the percentages in each hour determined. It is an interesting fact that the tornadoes occurred at all hours of the day and night. The hours of greatest frequency are from 4 p. m. to 7 p. m., with 14 out of the 194, or 7.2 per cent, in each of the three hours. The hours of next greatest frequency are 8–9 p. m. and 12–1 a. m., with 6.7 per cent in each. The hour of least frequency is 7–8 a. m., with only one case out of the 194. Approximately three times more tornadoes occur during the four hours 4–8 p. m. than in the corresponding period in the morning. In general it may be stated that, roughly, there is a gradual hourly increase in frequency from about sunrise to sunset, and a gradual hourly decrease from about sunset to sunrise, with nearly an equal number in each period, though with a few more during the night.

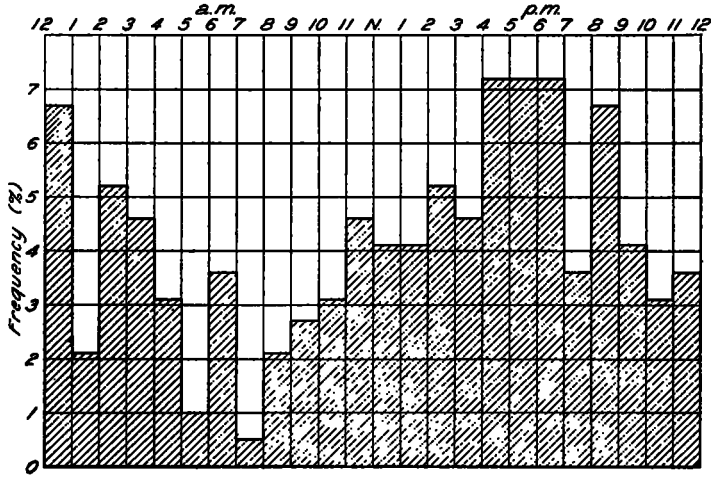

FIG. 2.—Hourly frequency of tornadoes in Alabama

TABLE 5.—*Hourly frequency of tornadoes in Alabama, 1794–March, 1925, inclusive*

A. M.			P. M.		
Hour	Total number	Per cent	Hour	Total number	Per cent
12–1	13	6.7	12–1	8	4.1
1–2	4	2.1	1–2	8	4.1
2–3	10	5.2	2–3	10	5.2
3–4	9	4.6	3–4	9	4.6
4–5	6	3.1	4–5	14	7.2
5–6	2	1.0	5–6	14	7.2
6–7	7	3.6	6–7	14	7.2
7–8	1	0.5	7–8	7	3.6
8–9	4	2.1	8–9	13	6.7
9–10	5	2.7	9–10	8	4.1
10–11	6	3.1	10–11	6	3.1
11–12	9	4.6	11–12	7	3.6
			Total, a. m. and p. m.	194	100.0

Hour uncertain: a. m., 7; p. m., 13; night, 12; total, 32. Hour unknown: 57.

The tornado tracks (shown in fig. 3) have been located as accurately as possible, and the lengths of the arrows made to indicate approximately the lengths of the paths. The tracks are numbered to correspond with the list in Table No. 1. When the location of the tornado was definitely known, and the direction in which it moved unknown, only the number has been entered at its proper place. In those cases where the exact location in the county was unknown, the number has been placed in the county, within a small circle, and the arrow drawn to show the direction, if known, and omitted if not known. Figure 4 and Table No. 6 show the number of tornadoes that have occurred in each county in the State. On account of the difference in size of the counties, many of which are more than twice as large as

others, it was thought advisable to reduce the number in each county to the number per 1,000 square miles; these numbers as thus computed appear in Figure 5.

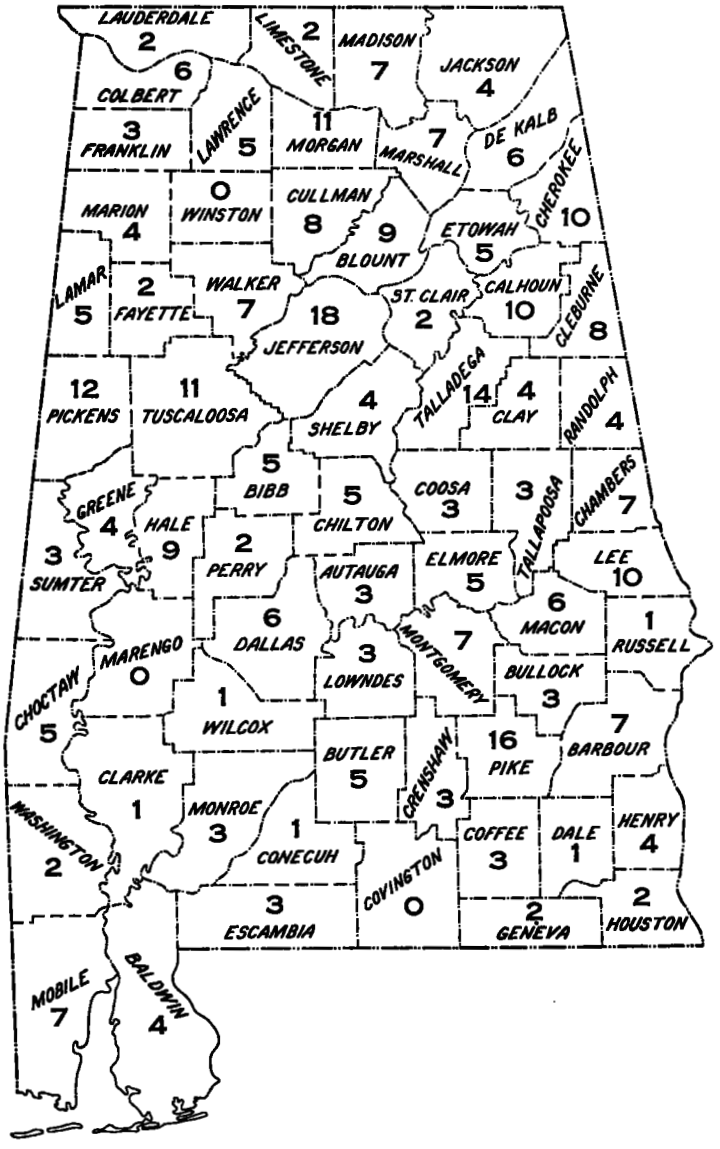

FIG. 4.—Number of tornadoes reported in each county, 1794–March, 1925, inclusive

Tornadoes have occurred in nearly all parts of the State. There is a tendency toward clustering of the tracks in the central and eastern portions of the northern half of the State, and in the central part of the southeastern portion. How much of this is due to incompleteness of reports is impossible to say, but it is believed that the tendency exists, though perhaps not so well marked as appears from the charts. The greatest number, 18, have been reported from Jefferson County; the next greatest number, 16, from Pike County. None have ever been reported from Covington, Marengo, and Winston Counties, although at least one appears to have crossed Covington and Winston. The absence of tornadoes in these three counties is believed to be due solely to lack of reports, as there seems to be no reason why they should be immune. There appears to be a tendency to more frequent occurrence on the northwestern slopes of the mountain ranges in northern Alabama than on the southeastern.

TABLE 6.—*Number of tornadoes in Alabama by counties 1794–March, 1925, inclusive*

County	Total number	County	Total number	County	Total number
Autauga	3	Dallas	6	Marion	4
Baldwin	4	DeKalb	6	Marshall	7
Barbour	7	Elmore	5	Mobile	7
Bibb	5	Escambia	3	Monroe	3
Blount	9	Etowah	5	Montgomery	7
Bullock	3	Fayette	2	Morgan	11
Butler	5	Franklin	3	Perry	2
Calhoun	10	Geneva	2	Pickens	12
Chambers	7	Greene	4	Pike	16
Cherokee	10	Hale	9	Randolph	4
Chilton	5	Henry	4	Russell	1
Choctaw	5	Houston	2	St. Clair	2
Clarke	1	Jackson	4	Shelby	4
Clay	4	Jefferson	18	Sumter	3
Cleburne	8	Lamar	5	Talladega	14
Coffee	3	Lauderdale	2	Tallapoosa	3
Colbert	6	Lawrence	5	Tuscaloosa	11
Conecuh	1	Lee	10	Walker	7
Coosa	3	Limestone	2	Washington	2
Covington	0	Lowndes	3	Wilcox	1
Crenshaw	3	Macon	6	Winston	0
Cullman	8	Madison	7	Unknown	1
Dale	1	Marengo	0		

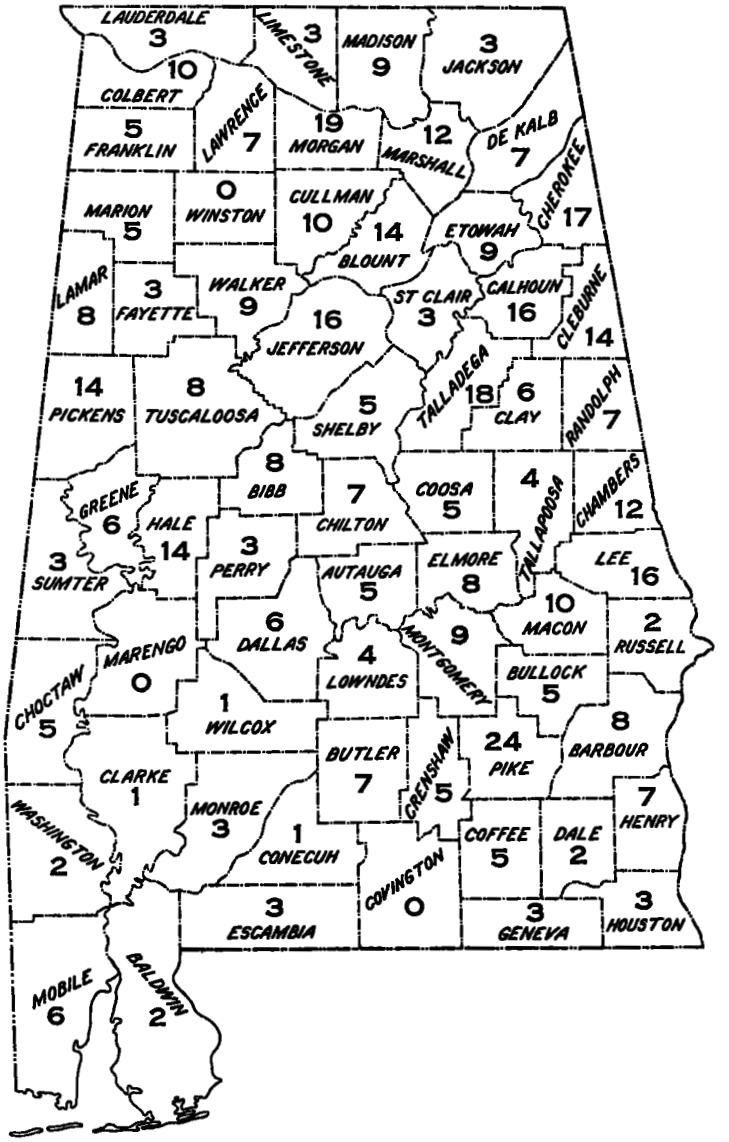

FIG. 5.—Number of tornadoes per 1,000 square miles, based on number reported in each county, 1794–March, 1925, inclusive

An analysis of Figure 3 shows that a far greater number of tornadoes move northeastward than in any other direction, which is the normal direction of movement in most

sections of the country where tornadoes occur. The conditions that give rise to a northeastward movement can then be said to be normal. These normal conditions are an east to northeast movement of the LOW and a north to northeast drift of the winds within the LOW at the point where the tornado occurs, and the velocity of translation is the resultant of the velocities of these two components. After a study of weather maps and storm tracks, it seems that abnormal movements can be explained in this way.

For example, two tornadoes that have developed in West India hurricanes had abnormal movements. A tornado in Tallapoosa County on July 6, 1916, occurred when the hurricane was centered about 275 miles slightly south of east, near Vicksburg, Miss., and when the larger storm was on the recurve and moving northward. The surface wind at Montgomery was southeast, but the lower clouds were from the south; the tornado moved almost exactly north over a path 25 to 30 miles long.

The tornado that occurred 20 miles southwest of Miami, Fla., in the hurricane of September 10, 1919, and, as pointed out by Gray,[1] moved west-northwest with the strong southeast wind that prevailed at the time on the southeast Florida coast; the hurricane at the time was also moving west-northwest.

There is a tendency toward a more easterly movement of tornadoes in the southern part of the State than in the northern; this tendency is frequently noticeable on those occasions when tornadoes occur in northern and southern sections in connection with the same storm, and is probably due to the more easterly winds near the southern end of the LOW or trough. The easterly movements in the northern part of the State could be explained in a similar manner if the LOW were centered far to the north; and, in the cases investigated, this is true, the LOW sometimes being as far north as the upper Lake region. Occasionally northeasterly movements have been followed several hours later by easterly and southeasterly movements in the same general region; in these cases the LOW is found to have altered its course and dropped southeasterly from the Lake region to the middle Atlantic coast. Easterly or southeasterly movements would result if the axis of the LOW extended east and west, provided the tornadoes originated, as they usually do, in the southeastern quadrant of the cyclone, for then the winds would be westerly. An interesting and unusual case is pointed out by Williamson;[2] the tornado occurred in the southwestern quadrant of a LOW with major axis east to west and moved east to southeast, while the LOW was moving slightly north of east. An instance where the tornado originated in the northeast quadrant of the LOW and moved a little west of north is noted by Loveland.[3] The surface wind was southeast and the LOW was moving rather slowly northeastward. Tornadoes originating in the northeast quadrant are comparatively rare, apparently due to the contrary direction of the progressive motion of the LOW and the drift of the winds in that part of the LOW; since it is possible for the vertical temperature gradient to be as steep in the northeast as the southeast quadrant.

To show the relation of tornadoes in Alabama to the parent LOWS, monthly charts and a yearly chart were prepared showing the approximate location of the centers of the LOWS at the time the tornadoes occurred. On the monthly charts lines were drawn connecting the cyclonic centers and the tornado tracks, but this was impracticable on the chart for the year. (Fig. 6.) Tracks of centers of cyclones in the MONTHLY WEATHER REVIEW since 1876 were used, the center, of the individual LOW being obtained from a consideration of its rate of movement. The charts show a wide divergence in the position of the centers, which is to be expected because of their varying size and shape. However, the most dangerous position for the center with respect to Alabama is 300 to 600 miles slightly west of north, more particularly in Illinois, Indiana, or western Kentucky and western Tennessee. Tornadoes occasionally occur when the center of the LOW is over the upper Lake region, but these are found to be greatly elongated, V-shaped LOWS.

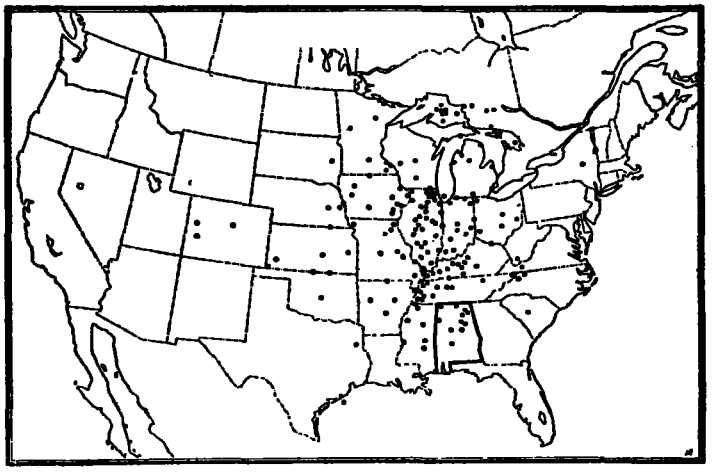

FIG. 6.—Location of the centers of LOWS which were accompanied by tornadoes in Alabama.

[1] Gray, R. W. A Tornado within a hurricane area, MONTHLY WEATHER REVIEW, Sept., 1919, 47: 639.

[2] Williamson, R. M., Tornado in Davidson County, Tenn., May 12, 1923, MONTHLY WEATHER REVIEW, May, 1923, 51: 262.

[3] Loveland, G. A., Tornadoes in eastern Nebraska, April 6, 1919, MONTHLY WEATHER REVIEW, April, 1919, 47: 284.

THE PREDICTION OF MINIMUM TEMPERATURES FOR THE RED RIVER VALLEY

By ALBERT W. COOK

[Madison, Wis., August 19, 1925]

Damaging minimum temperatures have always been a matter of grave concern to the shipper of perishable goods, to the grower of citrus fruits in southern California and deciduous fruits in Washington and Oregon, to growers of cranberries in Wisconsin and New Jersey—in fact to all businesses dealing with commodities which suffer damage when exposed to low temperatures. And now, with the development of the potato industry and the advent of sugar beets to the Red River Valley the farmers of that section are confronted with the same problem, the protection of their produce while still in the field and unharvested. Before they will be willing to invest in expensive frost-fighting equipment, methods already in use elsewhere for accurately foretelling the occurrence of damaging minimum temperatures during the critical spring and autumn periods of plant growth must be adapted to the local atmospheric and topographic conditions under which frost occurs.

The general prediction of light, heavy, and killing frosts for considerable areas are made from the morning weather maps and are issued at the time of the regular morning forecast. These forecasts are usually quite ac-