March 28, they show a deep northerly or northwesterly wind, sometimes backing to westerly at still higher altitudes. On the other hand, flights in the rear of LOWS that seem more common to the winter season frequently show a strong, cold, more or less shallow northerly wind, surmounted by a wind from some southerly direction.

Thunderstorms occurred in the vicinity of Drexel on the night of the 27th–28th. The LOW had evidently been insufficiently developed to cause tornadoes in this section on the 27th, while by the 28th the conditions of temperature conducive to strong vertical circulation had passed by.

It is possible that when tornadoes occur near the center of a deep depression their cause is often largely mechanical and arises from a wind shift line much more abrupt than that apparent in the LOW of March 28.

REFERENCES.

(1) MONTHLY WEATHER REVIEW, SUPPLEMENT No. 11, Aerology No. 6, pages 63–66 and 76–80. See also MONTHLY WEATHER REVIEW, June, 1919, 47: fig. 5, p. 371.

(2) **W. R. Gregg.** Average free-air conditions as observed by means of kites at Drexel Aerological Station, Nebr., during the period November, 1915, to December, 1918, inclusive. MONTHLY WEATHER REVIEW, January, 1920, 48: 1–11.

DISCUSSION.

While there is no direct proof that there was a cold wind above the line where the tornadoes formed, it is reasonable to surmise its presence to account for the shift in surface wind. One other bit of evidence as to the presence of the cold wind above the warm is found in the occurrence of the tornado near Lincoln, Ill., late in the afternoon, about six hours after the passage of the wind-shift line that carried the other tornadoes. At Springfield, Ill., there was at this time a gradual change of wind to west, but it would not appear to have been sudden enough to account for a tornado without the aid of a strong vertical movement induced by a considerable contrast between the temperature of the wind near the surface, and that at a moderate elevation. In any event, the presence of a cold wind aloft may not be indispensable to the formation of tornadoes, where winds converge violently.—*Charles F. Brooks.*

TABLE 2.—*Free-air data from kite flights at Royal Center, Ind., Mar. 27, 1920.*

Time.	Surface temperature.	At different heights above sea.				
		Altitude.	Temperature.	$\frac{\Delta t}{100\ m.}$	Wind.	
					Direction.	Velocity.
A. M.	°C.	m.	°C.			m. p. s.
10:36	11.4	225	11.4		se.	6.3
		250	11.1		se.	6.2
		500	8.6		se.	5.3
11:03	12.3	636	7.2	1.04	se.	5.0
		750	7.6		se.	5.8
		1,000	8.6		s.	7.4
		1,250	9.5		ssw.	9.1
11:53	14.8	1,314	9.8	−0.38	ssw.	9.5
		1,500	8.7		ssw.	10.8
		2,000	5.8		sw.	14.5
P. M.						
12:09	14.9	2,419	3.3	0.59	wsw.	17.5
		2,500	2.6		wsw.	17.4
		3,000	−1.5		wsw.	16.6
		3,500	−5.7		sw.	15.8
12:40	16.0	3,708	−7.4	0.73	sw.	15.5
		3,500	−6.1		sw.	15.3
		3,000	−3.0		sw.	14.7
1:05	16.5	2,537	−0.1	0.92	sw.	14.2
		2,500	0.3		sw.	14.3
		2,000	4.9		sw.	15.4
		1,500	9.5		ssw.	16.4
1:34	17.4	1,383	10.6	0.15	ssw.	16.7
		1,250	10.8		ssw.	15.8
		1,000	11.2		s.	14.0
		750	11.6		sse.	12.2
1:54	17.5	605	11.8	1.53	se.	11.2
		500	13.4		se.	10.7
		250	17.2		se.	9.5
2:00	17.6	225	17.6		se.	9.4

THE TORNADOES OF MARCH 28, 1920, IN EAST-CENTRAL ALABAMA.

By P. H. SMYTH, Meteorologist.

[Weather Bureau, Montgomery, Ala., Apr. 24, 1920.]

The principal tornado first appeared at Deatesville, 18 miles north of Montgomery, and another at Cedar Springs, farther north. Unseasonably high temperatures prevailed during all the morning and afternoon of the 28th; at Montgomery the maximum was 77° F. at 11:45 a. m.; and at Wetumpka and Auburn the highest were 77° and 76°, respectively. The absolute humidity, as shown by the records at Montgomery, was likewise unseasonably high; the relative humidity at 7 a. m. was 91 per cent, at noon 74 per cent, and at 7 p. m. 79 per cent. Thunderstorms were reported from 10 stations in Alabama, most of these being in the east-central portion of the State. At Montgomery the average hourly wind velocity during the day was 14 miles, the directions varying from southeast to southwest.

THE DEATESVILLE-AGRICOLA-WEST POINT TORNADO.

This, the principal tornado in Alabama on the 28th, first appeared about 1 mile north of Deatesville, western Elmore County, near the Autauga-Elmore County line, at about 2:30 p. m. From Deatesville it moved east-northeastward over northern Elmore County, through south-central Tallapoosa County, wiping out the little village of Agricola, thence across southern Chambers County, crossing the Georgia-Alabama line at West Point, Ga., at about 3:37 p. m. The length of the track in Alabama, from Deatesville, Ala., to West Point, Ga., is about 65 miles on a straight line. Assuming the times as given above as correct, the speed of translation was about 60 miles per hour. As shown by a number of reports received, the tornado was well defined, from 100 yards to a quarter of a mile in diameter, marked by the usual funnel-shaped cloud, and accompanied by winds of very destructive violence.

Evidence of rotation was slight, amounting to the directions of felled trees at West Point, Ga., as reported by Conductor Hal Cline, of the Atlanta & West Point Railroad. He states that trees on the north side of the storm's path lay to the left; in the center, straight ahead; on the south side, to the right. Mr. Cline, while he did not see the funnel-shaped cloud, describes the clouds at West Point, Ga., just before the tornado struck, as follows:

> Coming to West Point about 3:30 p. m., I noticed awfully black, greenish-looking clouds; stood there about five minutes loading passengers. As we pulled out it began to rain a little; in about two minutes the storm hit us. We had to stop the train until it passed; came very near moving the train from the track. Of course, we were not directly in the path of the tornado, but on its edge. Being inside the cars and the rain so terrific, we did not look to notice the clouds.

Seventeen persons were killed in Alabama by the tornado; between 40 and 50 persons were injured, some of them seriously; and property, variously estimated at from $100,000 to $200,000 was destroyed. The greatest destruction was in Tallapoosa County in the vicinity of Susanna, Agricola, and the Red Ridge settlement. There is one reference to hail at Deatesville contained in newspaper reports. No reference to thunder is made in any of the reports received, but it is very likely that the tornado was accompanied by thunder and lightning, since thunderstorms were reported the same afternoon at Montgomery, Wetumpka, and Dadeville, points in close proximity to the storm's path. Numerous references are made in press reports to torrential rains in Tallapoosa County attending the tornado's passage. At Alexander City an estimated rainfall of 5 inches in one hour was reported. These reports are in part corroborated by the record of the rainfall station at Dadeville of 3.45 inches of rainfall from 11 a. m. to 10 p. m. Detailed reports from the section visited by the tornado follow:

Deatesville, western Elmore County.—Postmaster Ira C. Chapman reported as follows: The storm occurred about 1 mile north of Deatesville, thence eastward, about 2.30 p. m.; it came from the west and went toward the east; the funnel-shaped cloud was observed; trees in all sections of the path pointed eastward; width of path of greatest destruction about 100 yards; property loss closely estimated, $8,000; none killed; five injured.

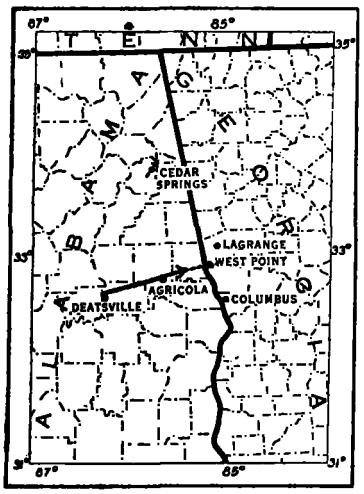


FIG. 10.—Tornadoes in Alabama and Georgia, March 28, 1920.

Eclectic, Elmore County.—Postmaster's report: The storm occurred about 3 p. m., coming from the northwest and going toward the southeast; the funnel-shaped cloud was observed; no appreciable damage was done at Eclectic, but it was heavier out 2 miles south and 4½ east of this place. The postmaster remarks: "The storm here was pretty heavy, but I could hardly tell you how it was. Came close to damaging some houses here. About 2 miles south of here several outhouse tops were blown off and trees were blown down, and east of here it blew down part of the Providence School building, some outhouses and trees."

Agricola, Susanna, and the Red Ridge settlement; Tallapoosa County.—Report of Dr. W. B. Fulton, rainfall observer at Dadeville: The storm occurred at Agricola, Susanna, and the Red Ridge settlement at 3:30 p. m.; it came from the southwest and went toward the northeast; the funnel-shaped cloud was observed; trees in all sections of the path pointed north; the path of greatest destruction was one-fourth mile wide; unable to estimate the amount of damage—one mule, two automobiles, in fact, everything in the path of the storm; 11 killed, 40 odd injured. According to the Montgomery Advertiser, property damage in the county will exceed $100,000, with from 50 to 60 large and small dwelling houses in the path of the great blast wrecked.

Extract from a letter to the editor of the Montgomery Advertiser on April 4, 1920, from Dr. Lyman Ward, cooperative observer, at Camp Hill: "* * * East of Camp Hill the damage was not so bad and there were no fatalities. Several tenant houses were blown down and many barns unroofed. * * * It is not known definitely the exact number of fatalities, but it will reach 14 or 15. Several children were badly injured and a number of adults are suffering from broken bones or wounds. Fifty families are homeless, food, clothing and rations all gone. * * * The loss will be over $200,000.

Alexander City, Tallapoosa County.—Press reports: Extract from the Birmingham Ledger for March 29, 1920: "The storm struck about 2 o'clock Sunday afternoon and did not let up until nearly 4. Five inches of rain fell at Alexander City in less than an hour. Little damage from the wind was felt here."

Waverly, extreme northwestern Lee County.—Postmaster W. O. Watson's report: "The storm was 4½ miles distant from this place. No damage to buildings or timber here."

Opelika, Lee County.—Postmaster R. D. Williamson's report: "The storm did not occur in this immediate vicinity, although there was a severe wind which blew down a number of trees and the roof off one house."

Between Waverly and West Point, Ga., no reports of damage were received.

It may be noted that the tornado must have crossed the Coosa, Tallapoosa and Chattahoochee Rivers in its path across nearly half of Alabama.

THE CEDAR SPRINGS OR WELLINGTON CREEK TORNADO.

Comparatively nothing can be learned of this tornado except what is contained in the following quotation from an article in the *Anniston Star* for March 29:

> Bennie Bowman, an 8-year old boy, was instantly killed Sunday afternoon near Cedar Springs, Calhoun County, when a cyclone dipped into a mile section of that part of the county; the residence and outbuildings of Jim McFall, at whose home the dead boy was visiting, was blown to pieces and scattered over a territory of half a mile * * * The cyclone of Sunday afternoon followed the course of a similar visitation along Wellington Creek about 10 years ago. The storm struck the ground a short distance southwest of Cedar Springs, blowing down timber, fences, telephone lines, houses, barns and outbuildings for a mile's space, and left the ground at a point near the West Point schoolhouse. * * * The barn of Mr Holmesley was carried a distance of several hundred yards, and the feed stuff it contained was practically ruined, a fine cow being reported killed and other stock injured in the same wind that carried destruction into several of the farms of that neighborhood.

The probable paths of the two tornadoes, together with the location of places mentioned in this report, are shown by the accompanying map (fig. 10).

NOTE.—The time used in this report is 90th meridian Standard, except the noon humidity values are for noon local mean time.

IN GEORGIA.

The following is an estimate of the loss of life and damage to property, taken from reports or newspaper accounts, viz:

West Point.—Ten people killed; property damage, $250,000.

La Grange.—Twenty-seven people killed; property damage, $1,000,000, including chiefly the plants of the Swift Fertilizer works and the United Mills Co. (cotton), and the settlements around them.

Macon.—One person killed; property damage, $500,000.

Washington.—No one killed: property damage, $100,000.

Milner.—No one killed; property damage, $10,000.

In every case the property damage corresponds to newspaper estimates, and in my opinion, are all ten times too large.

The storm which struck West Point at about 3:30 p. m., and La Grange half an hour later, was probably a tornado, but the disturbances reported at other widely separated places, Macon, Washington, and Milner were only severe squalls. Even at Atlanta, which experienced no storm, the day was remarkably dark. The newspapers contained the usual accounts of the damage wrought by the storm and the distressing features connected with it. Thirty-four people were killed, mostly in the cotton mill settlement at La Grange, and a considerable number were injured but nearly all only slightly. The pontoon bridge at West Point was swept away, but the Chattahoochie River did not quite reach the flood stage, and the assurance, given by this office, that the river would not exceed the flood stage of 20 feet was of some value.—*C. F. von Herrmann, Atlanta.*

Macon.—The forenoon was sultry, but with moderate breeze from south and southwest, shifting to southeast at 3:05 p. m. During the afternoon the sky looked ominous to the north and northwest and muttering thunder was first heard at 4:45 p. m. The storm was apparently moving slowly from the southwest to the northeast. At 6:35 p. m. a gentle rain began, that gradually increased in intensity about 6:47 p. m., the wind shifting to the northwest. At 6:50 it was blowing hard from the northwest, and then suddenly the storm burst in all its fury, accompanied by heavy hail from about 6:50 to 7 p. m. The wind increased in force, and a maximum velocity of 59 miles from the northwest was recorded with an extreme velocity of 78 miles. The storm was very severe for about 10 minutes with deafening crashes of thunder, mingled with the pelting of hailstones and the howling of the wind, the velocity exceeding anything previously experienced at this station in 21 years. The darkness was intense and nothing could be seen except during the flashes of lightning. The roof of the instrument shelter was carried away and hurled about 50 feet, almost demolishing one of the large ventilators on the roof. The instruments, strange to say, were uninjured and this is rather remarkable since the sunshine recorder was fastened to the shelter immediately below the roof. The temperature did not fall as much as might have been expected, and only reached 61° from 79°. The rain gradually moderated and the temperature rose rather rapidly, reaching about 72° at midnight. The pressure rose about 0.14 inch and then receded about 0.06 inch. Hardly a house in Macon escaped damage of some kind, and the loss is estimated at about $500,000. A colored woman is reported killed by lightning.

The hail partially melted as it fell, and by 8 p. m. none was seen on the ground or roof.—*R. M. Geddings, Macon.*

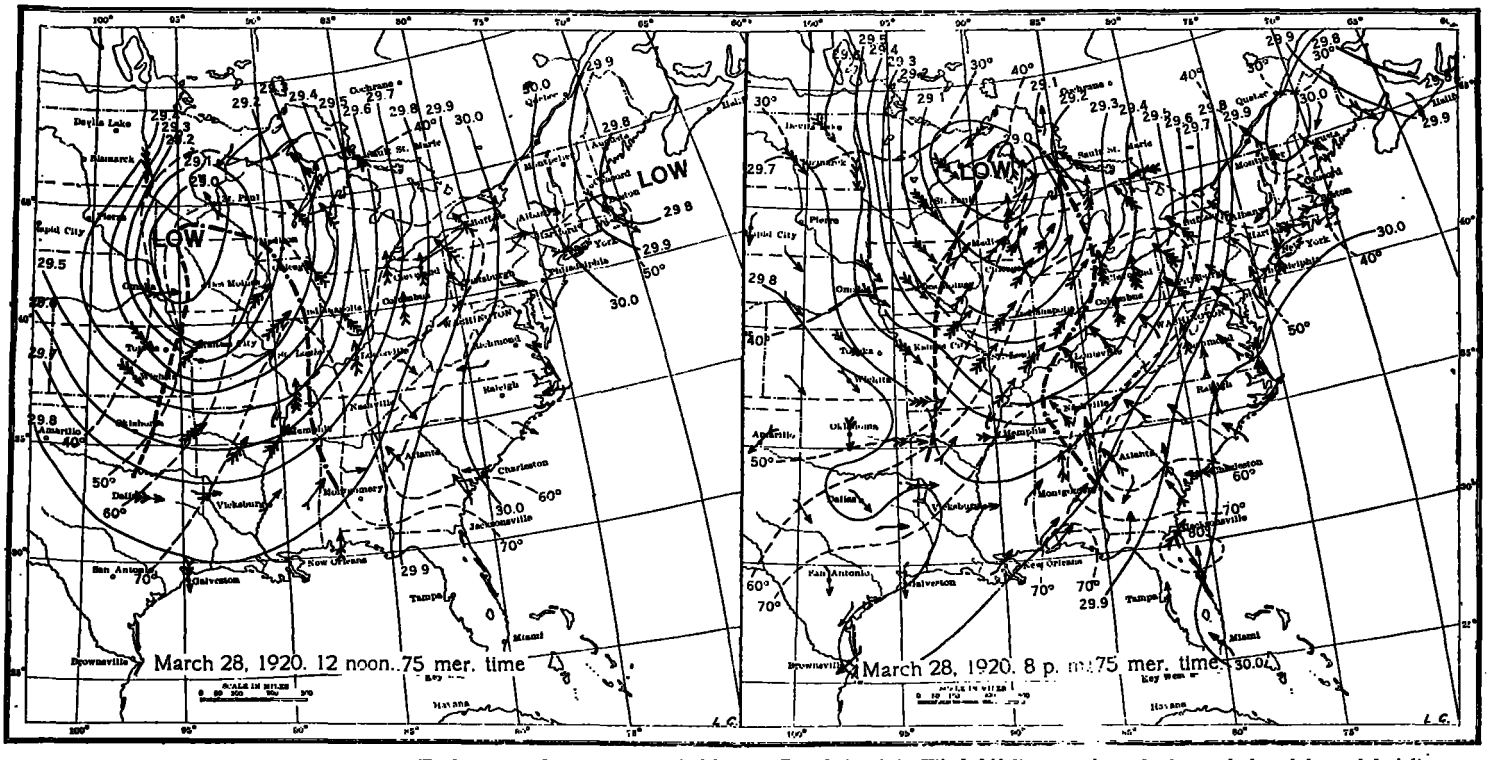
CONCLUSION.

Why did these 13 tornadoes occur on the afternoon of March 28? Let us review the facts as brought out by the weather observations:

1. There were strong, unusually warm winds from the southeast and south-southeast over a large area from the Gulf of Mexico to the Great Lakes.

2. A well-marked line (see dot-and-dash lines, figs. 8 and 9) separated these winds from still stronger, but slightly cooler, southwest or south-southwest winds in a belt immediately to the west.

3. Heavy thunderstorms, some with tornadoes and hail, occurred along this line of converging winds.



FIGS. 8-9.—Weather maps, March 28, 1920. (Barbs on wind arrows show wind force in Beaufort scale.) Wind-shift lines are shown by heavy dash and dot and dash line.