TABLE 29.—*The manner of presenting the character of the precipitation of a locality; illustrated by the character of the precipitation at Borkum (6° 45′ E., 53° 35′ N.) during 1876–1885.*

Month.	Reduced depth.		Departures.				Extremes.		Extreme range.	Probability of a day with—		Rain-density.	Maximum in 24 hours.
			Number of.		Mean relative.		Maximum.	Minimum.		>0.0 mm.	>1.0 mm.		
	1	2	3	4	5	6	7	8	9	10	11	12	13
	mm.	*Per cent.*	Δ +	Δ −	+	−	*mm.*	*mm.*	*mm.*			*mm.*	*mm.*
January	44	5.8	5	5	0.40	0.40	94	16	78	52	32	2.8	22.1
February	56	7.4	4	6	0.46	0.31	96	25	71	63	42	2.9	21.9
March	49	6.5	5	5	0.42	0.42	112	10	102	52	37	3.2	20.5
April	42	5.5	5	5	0.36	0.36	74	9	65	43	24	3.2	25.4
May	39	5.2	4	6	0.67	0.40	97	6	91	45	28	3.8	16.0
June	51	6.9	4	6	0.63	0.42	128	11	117	47	31	3.7	30.0
July	68	9.0	5	5	0.42	0.42	130	3	127	57	39	3.9	32.2
August	87	11.9	4	6	0.59	0.39	156	30	126	57	40	5.1	31.2
September	79	10.4	4	6	0.39	0.26	172	41	131	57	42	4.6	31.5
October	91	12.1	4	6	0.39	0.26	170	42	128	67	49	4.5	25.6
November	83	11.0	4	6	0.38	0.25	157	38	119	68	51	4.1	22.9
December	63	8.4	4	6	0.40	0.27	95	22	74	64	46	3.3	15.2
Year	764	100	5	5	0.12	0.12	942	589	352	56	38	3.7	32.2

The rainfall of any locality is, however, by no means adequately presented by the mere monthly mean falls. One must also determine the precipitation falling within shorter intervals of time, and compute the frequency with which precipitation occurs.

And here the first question is: How define a "*day with precipitation*"?

[Various definitions have been adopted and proposed; the author decides to adopt as a rain-day "a day on which more than 0.0 mm. of precipitation was measured" and urges Hann's proposal universally to supplement this with a statement of the number of the days on which "at least 1 mm. (0.04 inch) precipitation was measured" (columns 10 and 11 in Table 29)].

On account of the various lengths of the month, *the probability of rain*, i. e., the number of rain-days in the month divided by the total number of days is the preferred form of publication. The good agreement between the values in columns 10 and 11 of Table 29, based on different definitions of a rain-day at Borkum, is by no means a general occurrence.

It is more or less common practice to compute and publish the *mean density of precipitation* or *mean rain intensity*, obtained by dividing the mean amount of precipitation by the mean number of rain-days (>0.0 mm.); but the significance of this factor is often overestimated. It is here expressly pointed out that the rain-intensity is only approximately the amount which is most likely to occur on a rain-day; the latter amount is quite considerably smaller. It is a rule, for all values relating to rainfalls, that the "scheitelwerth" is smaller than the arithmetical mean.

The greatest amount of precipitation during a day is of distinctly greater interest than the rain-density. The maximum fall in one day, accompanied by the year of occurrence, should never be omitted from a table of precipitation. If it is practicable to give more precise information as to the duration of considerable falls, this would be very welcome; because in many respects, e. g., in the problems of Hydrotechnics, it is of prime importance to know the volume of water which falls in intense downpours of shorter duration than 24 hours.

The values here discussed have been collected in Table 29 for the island of Borkum (lat. 53° 35′ N., long. 6° 45′ E.) off the mouth of the Ems. They must be regarded as the necessary elements for describing the periodic changes in the precipitation of a locality. However, it is urgently recommended that, whenever it is in any way possible to do so, the rainfall be treated in yet more detail and that first of all one determine *the frequency with which certain threshold values* (Schwellenwerthe) *are crossed* in the precipitation of a day. Among other advantages, such a computation also brings one to a correct estimation of the rain-intensity. For a long time very little work has been done along this line, but the little we have already is rich in interest. Only in this way may one secure a sharp picture of the rainfall conditions and relationships.

551.515 (759)

TORNADO OF APRIL 5, 1917, AT TAMPA, FLA.

By WALTER J. BENNETT, Meteorologist.

[Dated: Weather Bureau Office, Tampa, Fla. MS. received Apr. 14, 1917.]

At 7 a. m. (90th meridian time) on April 5, 1917, a low-pressure area of considerable intensity was central over Illinois, with its longer axis extending north-northwest to south-southeast. Strong winds had occurred on the coast of northwestern Florida during the night. At Tampa the weather was cloudy and warm, the temperature being about 7 degrees above normal at the 7 a. m. observation. The barometer was falling slowly, and the southwesterly winds were increasing. At 9:50 a. m. small-craft warnings for the Tampa district were issued as follows:

Hoist small-craft warnings. Fresh to strong west and northwest winds, probably thunder squalls.

An order for small-craft warnings was later received from the central office.

The maximum wind at the station was 26 miles per hour from the southwest at 11:05 a. m. and the wind continued above 20 miles per hour until about 1:50 p. m. The first thunder was heard at 12:45 p. m.; rain fell from 1:12 to 1:44 p. m. yielding the amount of 0.46 inch for that interval. The barometer continued to fall slowly until after 1 p. m. and then it suddenly rose about 0.02 inch.

A violent thunder squall, coming from the southwest, struck Seddon Island (*A* of fig. 1) about 1:40 p. m. and passed across Hookers Point (*B* in figure). At Seddon Island the wind velocity was estimated at about 90 miles an hour. An outbuilding and a smokestack were wrecked and the blow lasted less than a minute. At Hookers Point small houses were overturned and the pump house of the Mexican Petroleum Co. was wrecked. No funnel-shaped cloud has been reported seen over the bay, Seddon Island, or Hookers Point, but this squall seems to mark the incipient stage of the tornado.

After crossing Hookers Point, *B*, the storm apparently lifted, as no reports were received of damage on the bay shore southeast of Tampa, nor could I find any trace of its path along the road near *C*. Its full force was felt at *D*, and its track could be traced back only a few hundred yards west-southwest of *D*. At *D* the Flatwoods Baptist Church was wrecked. The east end of the building collapsed, possibly from explosive force of imprisoned air, but the wreckage had more the appearance of being pushed forward in the direction in which the storm was advancing.

At *E* the house of J. A. Rayborn was turned over on its side, apparently it also was pushed forward with the storm's advance and showed no evidence of explosion. Harley Rayborn, the 5-year-old son of Mr. Rayborn, was instantly killed; Mr. Rayborn who was also in the house at the time, had a rib broken and his back sprained; while Mrs. Rayborn was bruised and an infant son had his arm broken.

The Rayborn buildings were about two miles southeast of the village of Mango. The storm passed south of Mango a little after 2 p. m. From *D* to *F* the track of the storm could be readily followed. Apparently it lifted and settled several times. In some places trees were uprooted or broken off, in others only the upper branches were broken off and in still other places no damage at all could be seen for a short distance.

The storm crossed the railroad and the brick road at a very small angle, between the villages of Mango and Seffner. Somewhere along here an automobile was overturned and its top carried off.

At *F*, the house of M. B. Gray was lifted off its piers and carried forward about 7 feet, but was not badly wrecked. An immense tree just north of Mr. Gray's house was torn up by the roots. The spread of the roots torn up exceeded 20 feet.

The Methodist church at *G* was completely demolished, apparently pushed forward with the advance of the storm. The porch of the parsonage just north of the church was torn off. Damage was also done to the houses of Dr. J. L. Douglas, W. B. Pemberton, J. H. Spencer, Mr. Reynolds and the Hill House, all at Seffner. The storm passed over Seffner about 2:20 p. m.

At *H* many magnificent oaks of the Seffner picnic grounds were uprooted and broken. Beyond *H* the damage was less marked but the track could be followed as far as *I*. Later reports indicate that the house of R. L. Moore, on the Dr. A. M. Barns old place, 2 miles north of Plant City, was moved from its pillars and considerably damaged. Buildings on the old Covington place (McNeill estate) were moved or damaged, and other minor damage resulted in the same vicinity. At this point the storm was moving northeastward. It evidently came down again with destructive force at a point somewhere near *J* on the map, thus making the extreme length of the path about 24 miles.

The appearance of the cloud as reported at Mango and Seffner was funnel shaped, black or very dark gray, with no glow. No meeting of clouds was reported. No lightning was seen to issue from the funnel cloud, although it was preceded by a thunderstorm.

The precipitation was not very great, probably not much more than half an inch at any place, and lasting a short time. The precipitation ended abruptly with the passing of the storm, and the sky cleared rapidly. There was no hail. The general direction of motion of the tornado was from west-southwest to east-northeast.

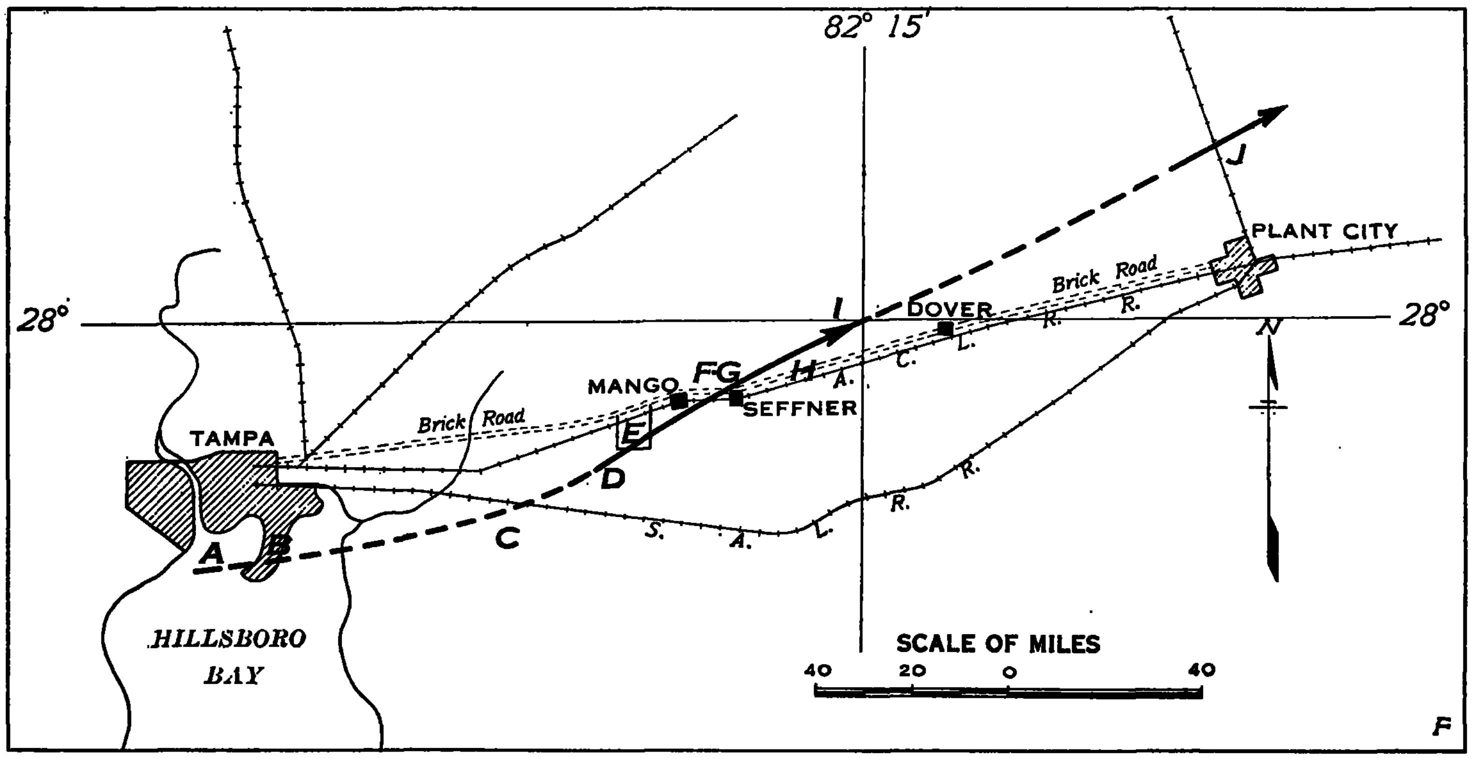

Fig. 1.—Path of the Tampa, Fla., tornado of April 5, 1917.

The whirl in the funnel cloud was plainly seen by a number of observers, and was counter-clockwise. It was not plainly evident in the distribution of the débris. A number of trees were twisted, some twisted off, and the twisting was mostly in a counter-clockwise direction. By far the larger number of trees felled, however, fell forward as though blown down by a straight wind. Some made different angles with the path of the storm, but no regularity could be detected, either in the center line of the path or on either side. The path was nowhere clear cut, many trees being left standing here and there even where the storm apparently had most force.

The length of path from *A* to *I* was about 14 miles; the path over which the funnel cloud was actually observed, *D* to *I*, was about 7 miles. The apparent speed of advance of the storm—reckoned from time observations at Seddon Island, Mango, and Seffner—was about 20 miles per hour and this agrees closely with the estimate of several observers. The width of the path was about a hundred yards at the point of greatest destruction.

The only person killed was the Rayborn child.

Tornadoes are uncommon in central Florida and the occurence of this one is for that reason more noteworthy. None has been recorded in this vicinity since the opening of the Tampa office of the Weather Bureau in 1890; but according to newspaper accounts one of considerable intensity crossed the northern part of the city on March 17, 1887.

551.515 (772)

TORNADO OF MARCH 23, 1917, AT NEW ALBANY, IND.

By FERDINAND J. WALZ, Professor of Meteorology.

[Weather Bureau Office, Louisville, Ky., Apr. 7, 1917.]

New Albany, Ind., is situated on the north shore of the Ohio River, opposite the west end of Louisville, Ky. Its population is about 26,000. A short distance back of the city proper there is a range of high hills popularly known as "The Knobs," but which in reality might be called bluffs of the Ohio River. The city is built on the flood plain at the base of these "Knobs," which were previously supposed to offer complete protection from tornadic and similar destructive storms. The tornado of March 23, 1917, however, came from beyond these "Knobs," passing over a portion known as "Silver Hills," whence it descended into the valley or basin lying between these hills and the Ohio River. It showed strength and great destruction occurred from the base of Silver Hills eastward.

The storm moved along a nearly straight path in an east-northeast direction, cutting a wide swath through the entire north side of the city. The width of the path of practically total destruction varied between 1,000 and 1,500 feet, with an area along each side varying between 600 and 1,000 feet in which there was a great deal of damage, mostly in spots. The length of the path of the storm, as shown by the destruction in New Albany and vicinity, was about 3½ miles. The storm continued on, however, in the same east-northeast direction and crossed the Ohio River into Kentucky about 10 miles above New Albany. It caused considerable damage at Harrods Creek, Ky., which lies in a direct east-northeast line from New Albany (see fig. 1 on p. 170).

Many articles of furniture and clothing, and other débris carried away by the storm, were found on farms and fields in Kentucky 25 to 40 miles from New Albany, whence they came. A family picture, which was in a house occupied in part by the James Franconia Grocery, Vincennes Street and Charlestown Road, New Albany, was found at Skylight, Ky., having been carried a distance of 25 miles. Also a jar of sweet pickles from the same grocery was found in a ditch on the same farm, the jar being uninjured. In the same vicinity were found articles of clothing, shingles, roofing material, flooring, weatherboarding, a kitchen safe door, letters, and papers.

In New Albany 45 persons, men, women, and children, were killed outright, or have died since from their injuries; several hundred others were injured, a number of whom will probably succumb to their injuries. Between two and three hundred houses were destroyed, including several manufacturing plants, one large greenhouse, two schoolhouses, and one fire-engine house and tower, while several hundred more houses were damaged. Practically 2,500 people, including between 350 and 400 families, were made homeless.

The district which suffered most severely consisted of cottages occupied and mostly owned by working people, and with their cottages went not only their homes but their household goods, clothing, and in fact, their all. The most costly residence caught in the destructive path of the storm was the De Pauw homestead, an old and substantial structure built of brick on a stone foundation, two stories and an attic in height. This structure was largely demolished, one inmate killed and several others injured. Mr. VanVreedenburg, one of the occupants of this residence, states that he and his mother were in a room on the second floor when they heard the approach of the storm, the sound of which he describes as resembling a sawmill buzzing in a low key. Almost immediately the storm struck the house and the next thing he realized was that he and his mother were in the midst of a mass of débris. The windows of the house were all gone, and a partition wall pushed in. Both suffered injury, but neither was seriously hurt. The room in which they were was located on the windward side of the building, and the instant the storm struck, the windows were all blown away. The stairway leading to the first floor was torn down. Many large and beautiful old shade trees and other trees at the De Pauw homestead were destroyed, a number being uprooted and others snapped off at the trunk.

The storm began at 3:08 p. m. and lasted only about five minutes. New Albany, Ind., and surroundings are plainly visible from the windows of the Weather Bureau office in Louisville, Ky., the scene of the storm being about 4½ miles in a northwest line from the office. The approach of the storm was viewed from the office windows, but the scene was soon cut off by heavy sheets of rain. The storm from this distance had the appearance only of an ordinary thunderstorm, with a dark-green background and attended by dark-green clouds. The storm was also attended by heavy downpours of rain, but there were comparatively little thunder and lightning. No tornado or funnel-shaped cloud was observed; but this could readily have been hidden by the blanket of rain which soon blotted out the view. There is plenty of evidence, however, both in the enormous force exerted by the storm, and in the deposit of the débris in its path, that the storm was tornadic. Also the manner in which some houses not entirely destroyed were twisted off their foundations, together with the twisting of trees, shows tornadic force. The center line of the destructive forces of the storm was plainly traced; also destruction seems to have been wrought more from a south direction than from a north; that is, it appears in many instances that the wind force from the south side was greater than from the north side,