TORNADOES OF MARCH 18, 1925.

F. H. Colyer, State Normal University, Carbondale.

Perhaps most people believe that within a considerable area not more then one tornado occurs in a period of one day. As a rule this is true; but to this rule there are decided exceptions. On March 18, 1925, in the six states of Missouri, Illinois, Indiana, Kentucky, Tennessee and Alabama occurred seven distinct tornadoes, between the hours of 1 p. m. and 7:30 p. m. One of this group of seven, now known as the Tri-State Tornado, was so much greater in extent, duration and total destructiveness, that the other six received but little notice, even in the Associated Press dispatches. In fact so overshadowing was the Tri-State Tornado that most people do not know there was more than one tornado on that date. Yet in the six smaller tornadoes, 50 people were killed, 262 were injured and there was a property loss of $1,340,000. If the most violent one of the six lesser tornadoes had occurred at some other time the newspapers would have given it extended notice for in it 38 people lost their lives and 98 were injured, which is more than double the loss in the average tornado.

TRI-STATE TORNADO MARCH 18, 1925. DATE, LOCATION, DIRECTION AND GENERAL CHARACTER OF THE TORNADO.

The Tri-State Tornado began about 1 P. M. March 18, 1925, in the western part of Reynolds County, Missouri. Its course was 21 degrees to the north of east and in the remainder of Missouri it passed through rough hill country of few towns and sparse rural population. It crossed from Missouri into Illinois in the western part of Jackson County, maintaining a remarkably straight northeastern course, entirely across the state. Its path in Illinois was largely through the "coal belt" where the towns were larger and the rural population was greater than in Missouri. The tornado then crossed from Illinois into Indiana. In this latter state it crossed the greater part of three counties, finally disappearing in Pike County, three miles southwest of Petersburg. Thus in the three states of Missouri, Illinois and Indiana the

tornadoes' path had the remarkable length of 219 miles. The significance of this long path can be better understood when we are reminded of the fact that the average length of a tornadoes track is somewhere near 25 miles.

WEATHER CONDITIONS DURING DAY OF TORNADO.

Perhaps without a single exception tornadoes occur within low pressure areas, and generally in the southeastern quadrant of a low of a particular type. It is equally significant that tornadoes occur in connection with thunderstorms and these thunderstorms in turn often have distinctive peculiarities. Thus any discussion of tornadoes must necessarily involve the consideration of low pressure areas and thunderstorms.

LOW PRESSURE AREA DURING DAY OF TORNADO.

At 7 A. M. the Low, in which the tornado was later to develop was centered near Forth Smith, Arkansas. The general area of low pressure was an elongated trough extending from the Gulf of Mexico well into Canada. Within this trough was the real nucleus of the low pressure, which, as already stated, had its center near Fort Smith, Arkansas. The longer axis of this nucleus had the same direction as the long trough-like depression, from northeast to southwest. Within the daylight hours of March 18th, the nucleus of the low moved rather rapidly northeastward in the trough and at the same time the whole elongated trough-like area changed to a low pressure area, with more or less oval isobars. By 1 P. M., the time the Tri-State-Tornado began, the longer axis of the low changed from a N. E.-S. W. direction to almost a due N-S. position and the innermost isobars having a N. W.-S. E. direction. It is not clearly known why this N.-S. direction of the longer axis of the low should cause unstable conditions of the atmosphere, yet many of the great tornadoes have this N.-S. direction of the longer axis. This N.-S. direction of the longer axis was maintained through the period of the Tri-State Tornado as is clearly shown by the charts at 1 P. M. and 4 P. M.

TEMERATURE GRADIENTS DURING TIME OF TORNADOES.

Whatever significance may be attached to the change in the shape of the low and direction of its longer axis, yet the temperature gradients are much more significant. At 7 A. M. of March 18th, the weather map shows a temperature of zero in the region just north of Minnesota, while in central Florida the temperature was 70 degrees. Near the center of the low, however, are the greatest temperature gradients. Even at 7 A. M. these gradients are marked; but at 1 P. M., when the great tornado began, the three isotherms of 50°, 60° and 70° are even closer together, as can be clearly seen from the Chart for 1 P. M. Just before the tornado reached Murphysboro a maximum of 75° was recorded at Anna. Anna is about 20 miles south of Murphysboro. Some 20 or 25 miles north of Murphysboro the temperatures were 50 degrees. Thus within a latitude range of 40 or 45 miles there was a difference of 25 degrees of temperature. As in the case of all low pressure areas the winds are from a southerly direction to the east of the low, while to the west of the low the winds are from the north or northwest. Near the line where the warm moist southerly winds met the cold northwest winds is the line along which the tornado traveled. Where cold winds come in contact with warm moist winds the moisture is rapidly condensed and thunderstorms of marked intensity will quickly develop.

The writer well remembers how hot, close and oppressive the air was just before the tornado and how cold and piercing the winds were soon after the tornado was over.

Within the last 15 years four tornadoes have passed within a range of six miles to the north and seven miles to the south of Carbondale, Illinois: and in each case the writer has noticed very distinctly these strong temperature contrasts near the line of the advance of the tornado. In one instance, as a tornado was passing within a few miles of where I stood, I could easily distinguish alternating winds first from the southwest, then from the northwest. The first was warm and oppressive, the

next cold enough to make me shiver. This alternation of the wind direction and change of temperature lasted several minutes.

GENERAL CONDITION JUST PRIOR TO TORNADO.

For several hours before the tornado not only was the temperature warm for the time of year, but there was a general oppressiveness the effect of which may be described as causing a feeling of dejection or "lethargy" due to "closeness", and "mugginess" of the atmosphere. Students in school were restless and inattentive.

For an hour or two before the tornado heavy banks of clouds could be seen to the north and west. The clouds seemed unusually black and with great domed shaped tops that had the appearance of boiling. The thunder peals were short, clear-cut and explosive-like in character.

THE TORNADO AS OBSERVERS IN ITS PATH SEE IT.

Almost without exception those who observed the tornado as it approached them, state they saw two clouds rush together, one from the northwest and the other from the south, or southwest. Those who attempted an explanation of any kind said, this rushing together of opposing cloud masses caused the destructiveness that followed. In a certain sense this is perhaps true: but it would be a better statement of the case to say that the rushing together of the clouds was but the movements of the clouds due to a vortex already formed.

The appearance of the clouds in the path of the tornado was noticed by many. They were impressed with their inklike blackness and lowness. On the sides of the inklike clouds, some people said they saw clouds that were white and steamlike. Very few saw a funnel cloud. This may in part be accounted for by the lowness of the general cloud mass, which prevented a long tapering funnel development; or it may have been due to the wideness of the funnel cloud preventing an observer near the tornado from seeing the two sides distinctly. Many people who were in buildings say they felt the building being lifted and carried. Some said "I saw the house to the east of mine carried north then west and then

placed in my back yard. These statements mean there was a rotary and upward movement which should be the case in a whirling vortex of a funnel cloud. There are abundant proofs that these two movements did exist. Trees in the south edge of the storm's track were thrown northward or to northwest. While in the north edge of the storm the trees were thrown south or southeast. The upward movement is likewise attested by the great quantities of debris that was taken up in the vortex to great heights, then carried forward to the northeast. Observers state they saw the air literally full of debris and at heights as far as they could see. Gradually these bits of paper, cloth and wood settled to the ground. Notes signed and filed at Murphysboro were picked up 160 miles to the northeast and some 20 miles north of the path of the tornado. In one case a legal document was carried from Murphysboro into Indiana, 600 miles to the northeast.

UNUSUAL FEATURES OF MARCH 18TH TORNADOES.

Perhaps the best conception of how the tornadoes of March 18th, differed from others can be gained from this statement; the phenomena did not differ so much in kind as in degree. Most of the phenomena were on a larger scale. The path of the larger tornado was much longer and wider than the average; the duration was likewise was much greater. This tornado did not skip objects in its central part like others have done; finally its total destructiveness was greater than any other, of which we have any record. It should also be added that the number of tornadoes in a little over six hours was also unusual.

SIX LESSER TORNADOES.

While seven tornadoes in 6½ hours is unusual; yet more than one tornado in one day can hardly be said to be a rare occurrence. On February 19, 1884, forty four tornadoes occurred in one day in the states of Mississippi, Alabama, Georgia and South Carolina. This however is a record breaking number. There have been quite a number of instances where two and three tornadoes have occurred in one day.

The seven tornadoes of March 18, 1925 were quite distinct. While they all moved in practically parallel paths, no two were in the same line. The larger, or Tri-State-Tornado, was quite distinct in time from the other six. It began at 1 P. M. and ended at 4:30 P. M., and the first of the others did not begin till 5 P. M. Of the six lesser tornadoes two began at 5 P. M., the third at 5:15 P. M., the fourth at 5:45 P. M. and the fifth and sixth at 6 P. M. It would perhaps not be far wrong to think of the Tri-State-Tornado as breaking up at 4:30 P. M. into six lesser tornado centers. This however may not be really true for it may be that the same causes that produced the larger one may have been operative in six other quite distinct areas. The six lesser tornadoes had quite a range in latitude; the southernmost was in northern Alabama, two in central Tennessee, two in central Kentucky and one partly in Indiana and partly in Kentucky.

DURATION, LENGTH AND WIDTH OF PATH OF TRI-STATE TORNADO.

The duration of the average tornado is somewhere between one half an hour and one hour, while the Tri-State-Tornado lasted three and one half hours. This fact must be taken into account when we consider the destruction it caused.

While the path of the Tri-State-Tornado had the remarkable length of 219 miles, it much be remembered the tornado that passed through Mattoon was 293 miles in length. Still it was not so destructive as the great tornado of March 18, 1925.

The width of path of the average tornado has been estimated from a few hundred feet to one quarter of a mile. The larger tornado of March 18, 1925, varied from one half to a mile in width, with an average width of something like three quarters of a mile or perhaps a little less.

In many tornadoes the funnel cloud rises and falls thus causing the curious spectacle of objects in its path being almost unmolested while on either side everything is blown down. In this respect, again the Tri-State-Tornado is unusual, for there is little or no evidence of ob-

jects in the center of the destructive path being skipped. The probable explanation of this is the lowness of the general cloud mass that prevented the full development of the funnel cloud. Even if the funnel cloud did rise and lower, its lower end never left the ground. In this connection it may be stated there is some evidence that seems to indicate that the funnel cloud was much longer than I have indicated; but that its lower end when it reached the ground simply stretched out horizontally on the earth's surface, and continued its rotary motion along a horizontal, rather than a vertical axis. The evidences of this is the settlement of several witnesses, who said they saw a dark cloud rolling long on the ground in which the movement was quite similar to the movement of hay in an old fashioned steel wire sulky hay rake. Whether the laws governing atmospheric movements can sustain this view, is an open question.

DESTRUCTIVENESS OF TORNADOES OF MARCH 18, 1925.

So far as available records show these tornadoes were the most destructive of any yet known. The total loss of life, as given by the Associated Press in 834. This number however includes those who died after the tornadoes, but due to injuries received in the storm. The nearest approach to this loss of life is 600. This is so far beyond the death loss of the average tornado as to make the average seem insignificant. While I have seen no average estimated loss of life, it perhaps does not exceed 30 or 40 and perhaps much less.

The total number injured is placed by the Red Cross and Associated Press as over 3,000. Here again the total list of injured is far in excess of the average; but since estimated averages are not available no definite statement is here attempted.

The total destruction of property has been variously estimated. The more conservative estimates vary from $16,500,000 to well over $20,000,000. Perhaps no accurate estimate will ever be made, yet these approximate estimates may be taken with a fair degree of accuracy since they are based upon estimates made by insurance

companies in adjusting losses. However much property was destroyed which was not covered by insurance.

There is no doubt that the total loss of life and property at Murphysboro was greater than at any other place in the entire tornado area; but it would be a mistake to think that the proportionate loss was greater in Murphysboro. Gorham, De Soto, Parrish and Griffin, Indiana, suffered a greater proportionate loss than Murphysboro. It is stated on good authority that there was not more than one building left in Gorham sufficiently uninjured to be used as a place where the injured could be taken for treatment till provision could be made elsewhere. Parrish and Griffin were as completely destroyed as Gorham and De Soto. In these towns from one-fifth to one-twelfth of the inhabitants were killed.

In Murphysboro 225 were killed and 1,500 injured out of a total population of 12,000 to 13,000. The property loss is estimated at $10,000,000; or stated in other words 120 city blocks were destroyed either by the wind or by fire resulting from the wind.

The rural districts suffered in proportion to population fully as much as the towns, and in some respects more, for aid to the injured could not reach them so readily as in the towns. In Illinois, alone, 380 farms were struck by the tornado, 136 deaths are reported and the loss of farm property is estimated at $1,434,000.

WHY THIS LARGE LOSS OF LIFE AND PROPERTY.

The chief explanation has already been given. The seven different tornadoes, the Tri-State-Tornado having a path 219 miles long, three quarters of a mile wide, the holding of the funnel cloud constantly to the ground, and finally the number and size of the towns in the path of the tornado.

The only other factor that could have much of a bearing on the tornadoes destructiveness is the strength of the wind in the vortex. There is no good evidence that the winds in this tornado blew with any greater force than in some other great tornadoes. It is perhaps true that the rate of winds was greater than in the average tornado. The rate of winds in the vortex has never

been accurately measured for the simple reason that any instrument in the path of the storm would itself have been destroyed. The best estimates of the wind velocity is based upon the amount of force it would take to drive straws, pieces of wood, dirt, etc. into steel, brick, trees, etc. In Murphysboro a piece of timber six inches by two inches was driven through a base of a tree eighteen inches in diameter. Small twigs were driven into vitrified brick in the Murphysboro high school building. Wheat straws were deeply driven into hard seasoned oak posts. Fine particles of mud were blown through the clothing and buried in the flesh of several persons. In still other instances pieces of timber were driven through steel plates. To accomplish such penetration some engineers have estimated it would take a wind velocity of 400 to 500 miles per hour. These, however, are mere estimates and are not pretended to be more than approximately accurate.

IN A TORNADO ARE THERE PLACES LESS DANGEROUS THAN OTHERS?

The question is often asked, are there places in a tornado less dangerous than others, so that the loss of life can in a measure be avoided? While there is no place in a tornado's path that is free from danger, yet there are certainly some places, that are frequently less dangerous than others.

As a rule a person is safer in some building than out in the open, for the air is literally full of violently whirling missiles of various kinds. Many of these are splintered timbers from destroyed buildings that may at any moment be thrust through the body. In other cases a person may be struck by the rapid movement of any kind of debris in the air.

In case the building has a basement, the southwest corner of this basement is generally a safer place to be than in rooms above ground. In this case, however, one should keep away from a stove or furnace with a fire in it. A number of persons were burned to death while pinned beneath fallen debris, which was near a furnace or stove.

If there is a room with some strong box, steel bed, or exceptionally strong table, it is well to lie flat on the floor near such an object, for it will often hold up a fallen ceiling or roof sufficiently to save a person from being crushed. Many people came out of completely wrecked buildings, because they had presence of mind enough to place themselves in such a position.

Sometimes hallways, where the walls are near together may be safer than in large rooms, where there is nothing to break the force of a falling ceiling or roof.

This question is sometimes asked, can a person seeing the storm approaching get out of its destructive path? Yes, if a person sees the funnel cloud at a considerable distance he may drive an auto, or a pedestrian may run fast enough to escape. In that case it is better to run, or drive northward, since from the center of destructive path northward is less than from the center to the south.