disappear. Again a short funnel was projected downward and began to move slowly at first, in a northeasterly direction, and an ominous roar could be heard for miles. The funnel gradually lengthened, and when about 4 miles from Kirksville the point seemed to be within 200 feet of the ground. Suddenly it dropped like a plummet and started its work of destruction. Just before it struck our house there was an awful roaring noise, and it was dark as a dungeon while the storm was passing over.

Others state that two clouds came together in the southwest; that on either side of the funnel there was an arc glowing like a halo around the moon; above the arcs there was intense blackness and below them lighter clouds; the funnel extending downward between these arcs alternately approached and receded from the earth, and when it approached the earth a dark mass rose to meet it. The arcs disappeared as the tornado drew near; the funnel-shaped cloud seemed to a distant observer to take a zigzag course, sweeping a path much wider than its own diameter. One house was carried high in the air, where it exploded with a loud report. There was a light fall of rain before the storm and a heavy fall a short time after its passage. Very little lightning was seen.

As in many other descriptions, so here, the light rains, the descending spouts, the dark clouds, the ascending whirl of débris, the heavier rain that occurs sometime later, all harmonize so closely with the phenomena of the waterspout at sea that there must be a very close analogy between these and the tornadoes in the interior of our continent.

MARIANO BÁRCENA.

All who are interested in the progress of meteorology will regret to learn of the death of Don Mariano Bárcena, the illustrious engineer, senator of the Mexican Republic, founder and director of the Central Meteorological Observatory, and member of many scientific societies. In his death, on the 10th of April, in the City of Mexico, meteorology loses one of its most active friends. As a student of engineering, he early showed a special interest in the natural sciences, particularly geology, on which subject he is a well-known author. He was appointed a director of the Central Meteorological Observatory on the 7th of March, 1877, the date of the foundation of the establishment. During his connection with this institution, he published many important works, among which may be especially mentioned his Carpologia.

NO INCREASE IN TORNADOES.

Although the Weather Bureau has for many years repeated the statement that our data do not justify us in believing that there has been any material change in the number of tornadoes, nor, indeed, in any other feature of the climate, during the present geological epoch, yet the belief in such changes still lingers, and we are much pleased whenever the daily press comes to the relief of the meteorologist in the attempt to disseminate more correct views as to the permanency of our climate.

We copy the following from the Iowa State Register and the Iowa Weather and Crop Service, as it undoubtedly gives the true explanation of a popular mistake:

Many think that the railroad tracks banding the nation, and the continually increasing and large aggregate of metal on the surface throughout the country, aid in creating electrical disturbances in the atmosphere, and they call attention to the manner in which the needle is affected by the pole to sustain their theory; but the contrary opinion is presented by others, who assert that the railroad tracks and telegraph lines are useful as lightning rods for the earth. The scientists have many theories in regard to this subject, but the fact remains that all countries had windstorms of all degrees before there was a railroad track or telegraph line on the face of the earth, and it is probable that the number has not been increased by the added years. All of the civilized world's disasters are now published within twenty-four hours after occurrence, and that is the reason why there is an apparent large proportional increase in comparison with the days when telegraph and cable lines and daily newspapers were unknown—only one hundred years ago.

NO CHANGE IN THE CLIMATE OF APRIL.

The remarkable storms that we experienced during the spring of 1899, promptly started the query as to whether the climate has changed—that perennial theme about which the "oldest inhabitant" always freely expresses his ideas, though he knows little or nothing of it. It was soon shown that 2, 3, or 4 feet of snow had occurred in the Middle Atlantic States in a single storm several times during the past two hundred years; but, of course, each time over only a small district somewhere between Cape Hatteras and Cape Cod.

Now comes an interesting item with reference to Missouri, contributed by Prof. C. W. Prichett, of Glasgow, Mo., who says:

On April 7, 1837, it snowed all day in St. Charles and Warren counties, and on the morning of April 8 the snow was 2½ feet deep on the level. In April, 1857, the snow lay on the ground near Fayette from the 17th to the 20th to the depth of several inches. On April 15, 1842, the ground was so frozen in Warren County that we could not set stakes in the woods as guides for a worm fence.

RAINS OF SAND, DUST, AND MUD.

In the REVIEW for January, 1895, is given a full description of the general character of the dust that falls on our western plains, with snow or rain, and sometimes as perfectly dry dust; a recent occurrence of this kind is chronicled for April 30. At that time an area of low pressure moved from Colorado northeastward into Iowa. During the prevalence of the southerly winds on the southeast side of the storm center, the dust was carried in great quantities northward, but when the clouds coming from the west began to drop a little rain, preliminary to the heavy northwest winds that were to follow, then the dust became mud and the rain became a very dirty rain. This succession of dust followed by muddy rain moved eastward over the greater partof Nebraska, between 1 and 5 p. m., and during most of this time the sunlight was so obscured that lamps were lighted. The muddy rains occurred in Iowa as late as 9 p. m., but preceding that, viz, about 3:30 p. m., there were one or more tornadoes. A muddy rain began at Yankton, S. Dak., at 8 p. m. On the same day the severest northerly storm of the season occurred in Montana.

Both the dust storms and the tornadoes and northers indicate that there must have been ascending and descending currents of air of great violence, such as characterize what is called the unstable condition of the atmosphere in which air that has once started to ascend or descend, continues on its way with accelerated velocity. This condition of instability is sometimes spoken of as a condition in which colder air exists above and warmer air below, so that the colder air by virtue of its greater density, presses downward with sufficient force to displace the warmer air near the ground; but this is not a correct statement of the case, as the air is always colder overhead than it is below, and the mere deficit of temperature does not constitute instability. If the temperature diminishes with altitude at the rate of 1° F. in 185 feet, the atmosphere is said to be in neutral convective equilibrium, that is to say, if a cubic yard of this air is raised upward 1,000 feet, thereby cooling about 6° F., because of the internal work done by its own expansion, it will find itself surrounded by air of the same temperature, and will have no tendency to fall back or rise further. On the other hand, if the actual temperature of the air diminishes with altitude at

a greater rate than 1° in 185 feet, then our ascending mass will, at its new altitude, find itself warmer than the surrounding air, and its buoyancy will cause it to rise still farther, and in fact, indefinitely, unless the temperature of the quiescent layers of air diminishes slowly enough to bring them back to the temperature of the ascending mass.

The rate at which an ascending mass will cool, viz, 1° in 185 feet, is called the adiabatic rate, which means that it cools, not by virtue of any abstraction or loss of heat, but by the conversion of its heat into some other form of energy.

THE PREDICTION OF TORNADOES AND THUNDERSTORMS.

In connection with the destructive tornadoes that passed over Missouri and Iowa on April 27, the Chicago Tribune says:

> Nothing could have saved Kirksville, for the cloud evidently gathered near it, and was upon it before any one was aware; but might it not have been possible to warn Newtown, the next place in its course, so that its inhabitants could have taken every precaution to save themselves. Nothing would be of any avail in the immediate locality where the tornado has its beginning, but is it not possible, in these days of telephones and telegraphs, to send a warning to others in its course?

It is certain that if any such arrangement were possible, the Weather Bureau would have done this many years ago, but the time has not yet come. Already, in 1871, we began making general predictions in the well-known phrase "severe local storms are probable for the region," etc. We knew just as well then as now, that tornadoes occur on the south and east sides, and within the neighborhood of cyclonic vortices. General experience, as summed up in Finley's researches, has shown that tornadoes always whirl in the same direction, and generally advance at the rate of about 20 or 30 miles per hour for many miles toward the southeast, east, or northeast; that furthermore, if an observer sees one approaching him, his best method to escape its violence is to go into some cellar, cave, or trench, or failing in this, to go rapidly southward, as the chances are usually in favor of the storm going toward the northeast. Keep out in an open region and get down as low as possible. These are the only local precautions that can be taken to save one's life.

The great difficulties in the way of sending a warning forward to the next town are three:

First. You do not know exactly which way the tornado will move as a whole, and you may warn the wrong town; the present storm is said to have moved at first toward the northwest and then to the southeast.

Second. The tornado frequently retires to the clouds and is no longer felt on the earth.

Third. Every one, even the telegraph operator, is busy looking after his own safety, and when the word comes, "look out for the tornado," scarcely any one has the self-sacrifice or the self-possession requisite to call up "central," and spend several minutes in sending off the necessary dispatch to the next town. Once or twice it has happened that the telegraph operator has sent the word "tornado" on to the next station, but this can not be expected to happen, as a rule, in ordinary small country telegraph and telephone offices. We grant that it might be possible for the telegraph and telephone companies to organize a valuable system among their operators, by dint of a great deal of drill and a penalty for every failure. Such a system would be equally valuable when applied to severe thunderstorms, cold waves, prairie fires, earthquakes, meteors, and other phenomena that move over the surface of the earth. Some years ago, Prof. S. F. Baird attempted some arrangement of this kind with regard to the appearance of shoals of fishes, for the benefit of our fisheries. It is said that when the Morse telegraph was first built between Washington and Baltimore, it was quite common for the operators along the line to herald the approach of thunderstorms; subsequently, the progress of the floods down the Ohio, and of the breaking up of ice in the Mississippi were also similarly telegraphed by operators to river men.

But river floods and cold waves are simple matters compared with the instruction drill, watchfulness, and skill that would be requisite if the telegraph and telephone companies were to undertake anything like a satisfactory plan of tornado prediction from town to town.

Fourth. The principal difficulty consists in the fact that the telegraph and telephone stations are so far apart that three-fourths of the thunderstorms, to say nothing of the tornadoes, that are liable to pass over the central station, slip in between the outlying stations and, therefore, strike a town without being announced. It seems almost incredible, until we actually study the map, that there are so many gaps in the network of stations surrounding our principal cities, as to prevent our undertaking a satisfactory system of local thunderstorm predictions. We may illustrate this by our own experience in thunderstorm predictions for Washington. An elaborate map was prepared by the Editor in 1897 as a preliminary step toward the collection of thunderstorm data, and the organization of a system of daily thunderstorm predictions for the Capital. Every telegraph and telephone station within a hundred miles north, south, and west, was plotted down, and it was quickly found that thunderstorms whose average diameter is 5 miles would, inevitably slip through when approaching from the northwest, and could rarely be detected when approaching from the west or the north, the southwest or the south, in time to allow of any satisfactory prediction. Stations must be within a mile of each other in all directions in order to catch every tornado and determine the direction of its path in time to frame a warning that could be of any use to a central city. We have no right to issue numerous erroneous alarms. The stoppage of business and the unnecessary fright would in its summation during a year be worse than the storms themselves, so few and so small are they. However, as stated before in the MONTHLY WEATHER REVIEW, serious efforts in this direction should be made, and the local studies should be at once begun for the larger cities, such as St. Louis, Chicago, Cincinnati, Detroit, Buffalo, New York, Boston, Philadelphia, Baltimore, Washington, and New Orleans, since all these cities are surrounded by lines that are kept in good condition, and have so much at stake. At the outset, our efforts must be imperfect, but they will improve with experience. In general, we must remember that the destructive areas of tornadoes, and even of thunderstorms, are so small that the chance of being injured is exceedingly slight. For a tornado it is scarcely 1 per cent per century, that is to say, there is a certainty of being injured once in ten thousand years. This small chance renders it difficult to say how much could profitably be expended in order to avert disaster. If we grant that the chance of occurrence is exceedingly small, and the certainty of destruction is absolute when the tornado comes, then it follows inevitably that there is no material advantage to be derived from any, even the most perfect, system of forewarnings and attempts at protection. In ordinary life, we do not attempt to prevent that which is inevitable, but by a system of mutual insurance, divide up among many the loss experienced by one individual. Just so in the case of the tornado, so long as we can not possibly avoid it when it comes, the most perfect system of prediction will be of no avail, and the only method of alleviation is to be found in some method of insurance.

Inasmuch as we know that droughts and floods, storms and frosts, always have occurred in any given locality, therefore,