TORNADOES AND WATER SPOUTS.

Professor Whitfield gives in the *American Journal of Science* the following statements relative to tornadoes and water spouts:

One of the most remarkable accompaniments of the tornado is the black column or spout, extending from the cloud down to the surface. It precisely resembles a column of black smoke, such as pours from the pipes of a steamer burning pine wood; it is, in fact, condensed vapor or cloud, intensified in blackness by the dust and rubbish carried up from the ground.

The tornado is a shell or hollow cylinder of air, and all its energy lies in its rotating rim, which is powerfully compressed by two antagonistic forces, centrifugal and centrepetal. The rapid whirl draws the air from the center towards the circumference, where it is met and opposed by the inrushing winds. There is, consequently, a rarefaction, a great reduction of temperature by expansion, and condensation of vapor within the shell.

The spout does not hug the earth continuously, but rebounds or *ricochets* along the uneven surface, often skipping the valleys, but generally desolating the hills. It is disposed, however, at every recurrence to strike at the same points. It is not an established fact, but it is commonly believed, and with some reason, that the tornado does, in the course of years, return along its beaten path, and that it is unsafe to build where one has ever passed. A house in Pickens county stood on a hill from which a log cabin had been blown away some thirty years before. I witnessed the last of three which have passed along the same track. Near Hernando, Miss., three have followed an unvarying line. It is probable that there are some localities more favorable than others to the generation of these storms, and if this be true, then the law of direction, hereafter explained, accounts for their progress along the indicated path.

Such an opportunity, as fell to my lot, of witnessing the formation and course of a tornado is rarely enjoyed, and the phenomena observed on that occasion are of great value in illustrating the origin of these whirlwinds. On the 29th of April 1867, at ten o'clock, A.M., I was approaching Tuscaloosa, on the Elyton road, the general direction being east and west. The weather was hot and oppressive, while a perfect calm prevailed both at the surface and in the upper regions, for the leaves were not stirred upon the trees, and the heavens were covered with fragmentary clouds, perfectly at rest. Occasional large drops of rain fell, and there was, now and then, lightning. The atmosphere was evidently surcharged with vapor, and in a condition of great electrical excitement. At the distance of three and a half miles from town, an elevated ridge, over which the road passed, afforded an extended view, and I saw a mass of black cloud detached and hanging over the western horizon. It appeared nearly circular in shape, with the exception of a slight angular projection, like an inverted cone, at its lower edge. I afterwards ascertained that it was at this time about five miles distant from me, and a calculation, based upon the estimated angles, fixed the elevation of its base above the surface at about fifteen hundred yards, and its diameter, considering it a sphere, at about six hundred. It was entirely at rest.

The first view of this cloud suggested to me the possibility of a tornado, and I watched it closely as I drove along in my buggy. While I was driving, leisurely, more than a quarter of a mile, it maintained its position and outline unchanged. At length a farm house with its shade trees intercepted the view for about a minute, and when I came again in sight of it, the projection beneath the ground appeared in violent commotion. There was now no longer any doubt of the character of the phenomenon about to be exhibited, and satisfied, from a knowledge of the general direction of tornadoes, that it must come near me, I leaped from the buggy and released the horse as quickly as possible, in order to give him a chance for his life. This did not occupy more than half a minute, and when I turned to look again, the black column was formed, reaching from the cloud to the ground. A few moments showed that it was rapidly approaching. I remember noticing small fragments of cloud moving toward it from the north, but there was no perceptible breeze where I stood. When about a mile distant I saw that it would go south of me, and at this time I first observed the surface drift, which appeared like an innumerable flock of birds, flying around the summit of the column, and here, too, the pine tree spoken of emerged from the vortex, and settled slowly to the earth. The column was now much shorter than when first formed; the cloud had descended much nearer the surface. It passed about three hundred yards south of my position, and at this point the first electric discharge took place. The lightning zigzagged down the column, shedding through it a lurid glare. The roar was deep toned and powerful. The gyratory motion was distinctly visible. When a little further on, it became so enveloped in clouds as to be no longer distinguishable, but I knew, by the now frequent peals of thunder, that it was increasing in violence and levelling all things in its path.

This tornado was formed about a mile and a half southwest of Tuscaloosa, over an extensive marshy flat, where an observer characterized it as a "big whirlwind." It was not destructive at first, but grew in energy as it progressed, and two miles from its starting point threw down a dilapidated building. About six miles from Tuscaloosa it struck a log cabin in which were sitting a woman and several children. Every log above the floor was carried away, while the occupants were left uninjured. Twelve miles further on it performed a similar feat, taking off every log of a house without the slightest hurt to any of the family, all of them having taken refuge within on its approach. This is remarkable, but there are other like instances well authenticated, and it is commonly believed that a log house is the safest retreat. The direction of this tornado was east by 20° north. After its passage the air was cool and pleasant, and at four o'clock in the afternoon heavy rain came from the north, followed, for the next few days, by clear weather with northwest winds.

The most remarkable fact disclosed by the phenomena of this storm is the inherent power of progression which it unquestionably possessed. After the gyration was established it began at once to travel eastward, not driven by any wind, but plowing its own way through the tranquil atmosphere with tremendous speed. Here is presented a problem, which, so far as I know, has not heretofore been propounded. Its solution is important to the science of meteorology. The fact that tornadoes invariably move from the southwest to the northeast is well established, as also the fact that, by an impulse acquired from the earth's rotation on its axis, they gyrate from north to west by south. This backward gyration is thus explained: all parallels of latitude decrease in diameter, and therefore in circumference, as we go toward the poles of the earth. As they all revolve in twenty-four hours, it follows that every one, approaching the pole on either side of the equator, moves around more slowly than the one preceding it. Therefore, a current moving southward, to the vortex of a tornado in the northern hemisphere, finds that vortex rotating eastward with a superior velocity, and is left behind, or projected to the west, while for the same reason, a current blowing northward to the vortex, finds it rotating with inferior velocity, and, preserving its own easterly momentum, is hurled forward or projected to the east. Thus the south half of the rim being impelled eastward, and the north half westward, the backward or left handed gyration is fixed and maintained. Just the reverse is true in the southern hemisphere of the earth, while on the equator the gyration would be free to take either direction.

Curious Meteorological Facts.

In the fourth meteorological Report by Professor J. P. Espy, of Washington, D. C., we find the following instructive generalizations:

1. The rain and snow storms, and even the moderate rains and snows, travel from the west toward the east in the United States, during the months of November, December, January, February, and March, which are the only months to which these generalizations apply.

2. The storms are accompanied with a depression of the barometer near the central line of the storm, and a rise of the barometer in the front and rear.

3. This central line of minimum pressure is generally of great length from north to south, and moves side foremost toward the east.

4. This line is sometimes nearly straight, but generally curved, and most frequently with its convex side toward the east.

5. The velocity of this line is such that it travels from the Mississippi to the Connecticut river in twenty-four hours, and from the Connecticut to St. John, Newfoundland, in nearly the same, or about thirty-six miles an hour.

6. When the barometer falls suddenly in the western part of New England, it rises at the same time in the valley of the Mississippi, and also at St. John, Newfoundland.

7. In great storms the wind for several hundred miles on both sides of the line of minimum pressure blows toward that line directly or obliquely.

8. The force of the wind is in proportion to the suddenness and greatness of the depression of the barometer.

9. In all great and sudden depressions of the barometer there is much rain or snow; and in all sudden great rains or snows there is a great depression of the barometer near the center of the storm, and rise beyond its borders.

10. Many storms are of great and unknown length from north to south, reaching beyond our observers on the Gulf of Mexico and on the northern lakes, while their east and west diameter is comparatively small. The storms therefore move side foremost.

11. Most storms commence in the "far west" beyond our most western observers, but some commence in the United States.

12. When a storm commences in the United States, the line of minimum pressure does not come from the "far west," but commences with the storm, and travels with it toward the eastward.

13. There is generally a lull of wind at the line of minimum pressure, and sometimes a calm.

14. When this line of minimum pressure passes an observer toward the east, the wind generally soon changes to the west, and the barometer begins to rise.

15. There is generally but little wind near the line of maximum pressure, and on each side of that line the winds are irregular, but tend outward from that line.

16. The fluctuations of the barometer are generally greater in the northern than in the southern parts of the United States.

17. The fluctuations of the barometer are generally greater in the eastern than in the western part of the United States.

18. In the northern parts of the United States, the wind, generally in great storms, sets in from the north of east and terminates from the north of west.

19. In the southern parts of the United States, the wind generally sets in from the south of east and terminates from the south of west.

20. During the passage of storms the wind generally changes from the eastward to the westward by the south, especially in the southern parts of the United States.

21. The northern part of the storm generally travels more rapidly toward the east than the southern part.

22. During the high barometer on the day preceding the storm it is generally clear and mild in temperature, especially if very cold weather preceded.

23. The temperature generally falls suddenly on the passage of the center of great storms, so that sometimes, when a storm is in the middle of the United States, the lowest temperature of the month will be in the west on the same day that the highest temperature is in the east.

Some of the storms, it is true, are contained entirely, for a time, within the bounds of my observers, and in that case the minimum barometer does not exhibit itself in a line of great length, extending from north to south, but it is confined to a region near the center of the storm, and travels with that center toward the eastward.

From these experiments it may safely be inferred, contrary to the general belief of scientific men, that vapor permeates the air from a high to a low dew point with extreme slowness, if, indeed, it permeates it at all; and in meteorology, it will hereafter be known that vapor rises into the regions where clouds are formed only by being carried up by ascending currents of air containing it.

The Coke Trade.

The western portion of Pennsylvania, says the *Protectionist*, is becoming quite celebrated for its extensive coke trade. The Pittsburg and Connellsville Railroad Company derives an enormous tunnage from the manufacture of coke, and every month it is increased by the addition of new ovens. Indeed the trade has assumed such vast proportions that the Pennsylvania Railroad Company is taking the preliminary steps to secure a portion of this important traffic. Surveys are making for a branch road from Greensburg to Connellsville—less than twenty-five miles—which, when completed, will be a paying institution from the commencement of business, for the reason that it will extend every facility to the coke men for their freights, and for the additional reason that the distance to Pittsburgh will be shorter than by the Pittsburgh and Connellsville road.

There are upwards of 900 coke ovens along the Pittsburgh and Connellsville road, and the Uniontown Branch and Bradford and Mount Pleasant Branch roads, and nearly 400 additional ones are being constructed. Some idea of the tunnage can be formed when it is known that the production largely exceeds 100,000 bushels, or about 5,000 tuns of coke per day, and falls far short of the demand.

The extension of the Hempfield railroad, east from Washington, Pa., to connect with the Pittsburgh and Connellsville railroad, is partially with a view to secure a portion of this tunnage. When built, the distance to Wheeling will be reduced some forty miles from Baltimore, and place that city within thirteen miles of the same distance from Baltimore that Pittsburgh is.

The enormous piles of "slack" or waste coal lying contiguous to the Westmoreland Coal Company's mines is to be utilized at last and turned into coke. The Messrs. Carregie, of Pittsburgh, and others, are constructing coke ovens along the Pennsylvania railroad for this purpose, and it is said they will be successful, having a process for desulphurizing the fine coal. The sulphur has heretofore prevented coke being made from the Westmoreland coal.

Lightning versus Gas Pipes.

Last summer the steeple of the Congregational church at Terre Haute, Ind., was struck by a bolt. From the description of it as given by an intelligent citizen of that place, the following facts are gathered: The bolt hurled the lightning rod into the street, then extending its force down and over the brick wall of the church, it seized upon the gas pipe in the wall, hurling the bricks outside at the point and the plastering inside; then passing down this pipe to the meter, it collapsed it and its lead connection pipes, and crumbled its dial plates; then it punched a hole an inch in diameter into the iron pipe that connects with the street main; passing along this connection to the street it ran along an iron main, of an inch bore, 650 feet, and along an iron main of four inches bore 350 feet, bursting the hubs of these mains along a distance of 1,600 feet before its projectile energy was dissipated.

The lead packing of these pipes partially insulated the iron at each joint, in consequence of the lead being a poorer conductor than iron by two and a half times, obstructing the moving force of the bolt, forcing the hubs of the pipes asunder for the distance above mentioned, causing a leakage of the gas and the discovery of the facts here detailed. Here, then, we find approximately the correlative amount of metal necessary to dissipate the energy of an ordinary bolt. Taking the outside of the pipes, we shall have about 1,400 square feet of metal surface; include the inside, and we have 2,800 feet, and this would be equivalent to about 300 ordinary lightning rods.

Now if it took 1,000 feet of six and four inch bore of iron pipe laid in the moist earth to dissipate a thunderbolt, and only dissipated it after an extraordinary amount of energy was neutralized in the breaking of the iron hubs, how much of a similar bolt would be dissipated by five or six feet of a lightning rod of three quarters of an inch in diameter, projecting into the ground, which is the case with most rods? I will leave electricians to answer the question.—*From a paper read to the Franklin Institute, by Professor J. Wise.*

IF we would establish the habit of drinking water freely in the morning, soon after arising, commencing with small quantities, increasing gradually as we learn to relish it, until the chief portion taken during the day is before breakfast, it will promote the health to a much greater extent than it ordinarily does, eradicate disease from the system, and become a most decided luxury in time.