

## THE TORNADO.

THE exceptionally disastrous and destructive tornado which occurred at St. Louis, in the State of Missouri, shortly after five in the afternoon of May 27, draws more than ordinary attention to this class of disturbance, and excites, for a time at least, an interest in such phenomena. These disturbances are by no means of uncommon occurrence in the United States, but it is happily not often that a densely populated city falls directly in the track of the full fury of the storm.

Such well-known authorities as Ferrel, Finley, and Hazen have devoted much attention to tornadoes, and it is chiefly to the writings of these that we look for information. Several years ago the United States Signal Service published a report of the character of 600 tornadoes, and this clearly shows that no season of the year is exempt from their occurrence, but their greatest frequency is in the spring and summer, whilst in winter they are seldom experienced. Their occurrence is more common in April, May, June and July, than in any other months of the year. They almost always occur after the hottest part of the day, the hour of greatest frequency being between three and four in the afternoon, and they seldom begin after six in the evening. The centre of the disturbance is almost always formed in the southern or south-eastern segment of an ordinary area of low pressure, and a study of the weather charts, embracing a large area of the United States, shows that they are often several hundred miles from the centre of the parent disturbance. Those familiar with the formation and behaviour of our thunderstorm disturbances in England, will recognise an analogy to the tornado in their origin and motion with respect to the primary disturbance, of which they are mere secondaries. According to Finley, of the 600 tornadoes upon which he reported, the rotary movement of the whirling cloud was invariably from right to left, or the opposite movement of the hands of a watch. Ferrel remarks that this indicates either that the earth's rotation on its axis, as in cyclones, must determine the direction, or that the atmosphere has numerous whirls in this direction. The progressive motion of a tornado is almost always in a north-easterly direction, and here again there is a resemblance to the ordinary track followed by low-pressure areas in middle latitudes. The velocity of progression of the tornado cloud is said to vary from 7 to 100 miles an hour, the average rate being 44 miles. According to Finley the vortex wind velocities of the tornado cloud vary from 100 to 500 miles an hour, as deduced from actual measurements, and velocities of 800 to 1000 miles an hour have been reported. A wind velocity of 500 miles an hour is equal to about 750 lb. on every square foot. The width of the path of destruction, supposed to measure the distance of sensible winds on the sides of the storm's centre, varies from 40 to 10,000 feet, the average being 1085 feet, as deduced by Finley from a discussion of a large number of instances. The length of the tornado's track varies from 300 yards to about 200 miles, the average being 25 miles. The tornado has many features in common with the cyclone, but as experienced in the United States it is essentially different in many points, and in the interests of science it should be kept distinct. The tornado cloud assumes the form of a funnel, the small end drawing near or resting upon the earth, whilst the cloud and the air below it revolve about a central axis with inconceivable rapidity. Tornadoes differ from cyclones mostly in their extent, but both have vertical and gyrotory circulations. A cyclone may extend over a circular area of one or two thousand miles in diameter, while a tornado rarely affects sensibly at any one time so great an area as a mile in diameter. In a cyclone the base is so great in comparison with the height, that the whole mass of gyrating air may be regarded as a thin disc, and consequently a large

amount of the force is spent in overcoming the frictional resistances at the earth's surface. In a tornado the height is so great in comparison with the base that the gyrotory velocity is almost wholly free from friction. The late Prof. Ferrel, who ranks probably higher than any other authority on winds and storms, was of opinion that a cyclone "requires, in addition to the state of unstable equilibrium for saturated air, such a disturbance in the general equality of temperature over a considerable area that there is a central and somewhat circular area of higher or lower temperature, from which arises a vertical, and consequently a gyrotory, circulation"; while the tornado "simply depends upon conditions which give rise to very local disturbances merely." Without doubt the conditions which characterise the tornado are also common to such phenomena as waterspouts, cloudbursts, whirlwinds, wind-blasts, and others of a like nature.

An excellent descriptive report of the St. Louis catastrophe appeared in the *Daily Telegraph*, and is abridged below. The report shows that the tornado had many features common to such disturbances. The occurrence of "three separate and distinct storms," which subsequently became one, is especially alluded to by Ferrel in his general description of tornadoes. He says: "As the tornado originates in air in the unstable state, it often happens that there is about an equal tendency in the air of the lower stratum to burst up through those above at several places in the same vicinity at the same time. Each of these gives rise to a separate and independent gyration in the atmosphere, and a small funnel where they are of sufficient violence; but generally, as they increase in dimensions and violence, they interfere with one another and finally become united into one." The reported wind velocity of eighty miles an hour appears to be an estimate formed outside of the central area of the storm. In England the wind has attained a velocity of 107 miles for a whole hour, registered at Fleetwood in the gale of December 22, 1894, and at Holyhead on February 20, 1877, the anemometer registered an hourly rate of 200 miles for a short time in the gusts.

The weather at St. Louis nearly the whole of Wednesday, May 27, was unusually warm and oppressive. There was not a breath of wind, and the people suffered greatly from the heat. About four o'clock in the afternoon the western horizon became banked with clouds piled one on top of the other, with curling edges tinged with yellow. The sight was beautiful, but somewhat terrifying. Then a light wind sprang up, followed by sudden and ominous darkness.

The gloom deepened, and when the storm actually burst upon the city pitch darkness prevailed. These strange atmospheric disturbances had created anxiety among the people abroad in the streets, but not alarm.

There seemed to be three separate and distinct storms. They came from the north-west, from the west, and from the south-west, but when these reached the river they had become one.

Before the great mass of menacing clouds which were hanging over the villages of Clayton, Fernridge, Eden, and Central gave forth their contents funnel-shaped formations shot out of them. Some of these funnels seemed to be projected into the air; others leaped to the earth, twisting and turning like some wounded monsters. Lightning played about them. There was, in fact, a marvellous electrical display. Then came the stupendous outburst.

From the great black clouds came a strange, weird, crackling sound, at times stronger than the incessant peals of thunder, which had from the first been a terrifying feature of the storm. The funnels enveloped the western side of the city, and within thirty minutes of their first appearance on the horizon they were dealing out destruction.

So irresistible was the storm in its power, and so much greater in its magnitude than any other previously recorded in America, that some of the staunchest business blocks in St. Louis, considered absolutely tornado-proof, went down before it as though they were mere barns. Iron girders were torn from their massive fastenings and carried blocks distant. Roofs that were braced

and held by every device known to architects and engineers were wrenched off and hurled into the streets. The destruction of telegraph material was phenomenal. The poles were blown down in long rows, not singly, but in groups of a dozen or more at a time.

The western end of the Eads Bridge—admittedly one of the finest in the world—was destroyed. The same fate overtook other splendid bridges spanning the Mississippi.

The scene on the river at the moment the cyclone passed over it was awe-inspiring. The river tossed and boiled as though it was a whirlpool. Great waves struck the vessels and swamped them. Some steamers were blown bodily high up upon the banks, and others were twisted right round. Others, again, after being torn from their moorings disappeared in the torrent and were never more seen. As a rule the smaller craft did not live in the terrible sea for a minute, but just capsized and sank.

In the smaller places through which the tornado passed the terrible funnels rose and fell as they swiftly moved, and thus the line of destruction was not continuous. But whatever stood in their path was either destroyed or badly damaged, and all this destruction was done within the space of one hour.

About five hundred persons are reported to have been killed during the passage of the tornado, and more than seven hundred injured. The path followed is now shown to be a well-defined track about half a mile wide and four miles long.

NOTES.

THE second of the two annual conversaciones of the Royal Society, to which ladies as well as gentlemen are invited, will take place on Wednesday, June 10.

THE University of Paris will be represented at the forthcoming jubilee of Lord Kelvin, by MM. Moissan, Lippmann and Picard. The Royal Astronomical Society has appointed the President, Dr. A. A. Common, F.R.S., as its representative upon that occasion; and the Senate of the University of Sydney have appointed the Chancellor, Sir William Windeyer, and Prof. Liversidge, F.R.S., the Dean of the Faculty of Science, to represent them.

WE have referred from time to time to the approaching eclipse of the sun. During the last week some members of the expedition to Japan have sailed. From information received from the Japanese Minister, the reports of the bad weather chances at the station chosen are more than confirmed. The mean of the last five years gives for August—

	Days
Clear ... ..	0
Cloudy ... ..	22
Rain or snow ... ..	22

With regard to the Norwegian parties, Dr. Common will occupy a station at Vadsö, and in his neighbourhood will be Dr. Copeland. Mr. Norman Lockyer intends, if possible, to observe on the south side of Varanger fjord, if a suitable anchorage and observing station can be found sufficiently near the totality line. This point will be inquired into by Captain King Hall, of H.M.S. *Volage*, which will be detached from the Training Squadron for this purpose.

LIEUTENANT PEARY is making arrangements for another trip to Greenland, one of the objects being to bring back for the Philadelphia Academy of Sciences the forty-ton meteorite discovered by him last year, being the largest in the world. He will shortly give an account of his important explorations in Northern Greenland to the Royal Geographical Society.

THE Council of the British Medical Association desire to remind members of the profession engaged in researches for the advancement of medicine and the allied sciences, that they are prepared to receive applications for grants in aid of such

research. Applications for sums to be granted at the next annual meeting must be made on or before June 15, in writing, addressed to the General Secretary, at the office of the Association, 429 Strand, W.C.

THE Commissioners of the proposed zoological park of New York City have selected as the site that portion of Bronx Park lying south of Pelham Avenue, comprising two hundred and sixty-one acres. It is expected that their selection will be approved. The site is near the new botanical garden, and New York City will thus acquire in this year ample zoological and botanical gardens and an aquarium.

PROF. N. L. BRITTON has been appointed superintendent of the new botanical garden of New York City.

THE death is announced of M. Raulin, Professor of Industrial and Agricultural Chemistry in the University of Lyons.

THE Paris correspondent of the *Times* announces the death, at the age of eighty-two, of M. Daubrée, the eminent geologist. Born at Metz, and educated at the Polytechnic School, Paris, he was sent on a geological mission to Algeria, and from 1839 to 1855 was a Professor at Strasburg University. He was then promoted to a chair at the School of Mines and the Natural History Museum, Paris. His experimental researches, on the action of rapidly moving and high-pressure gases on rock masses, and the application of the results to peculiar rock formations, are still fresh in the minds of every one interested in geological problems.

WE regret to notice the death of Sir J. Russell Reynolds, F.R.S., on Friday last, at the age of sixty-eight. He was educated at University College, London, where he became Professor of the Principles and Practice of Medicine in 1865. Four years later he was elected a Fellow of the Royal Society. He was President of the British Medical Association in 1895, in which year he also received the honorary LL.D. degree at Aberdeen, and recently a similar honour was conferred upon him by the Edinburgh University. On the death of Sir Andrew Clark, in 1893, he was elected President of the Royal College of Physicians, which post feeble health compelled him reluctantly to relinquish at the recent annual election. Sir Russell Reynolds' works on diseases of the brain and spinal cord are valuable contributions to medical literature, and the "System of Medicine," of which he was the editor, stands as a proof of his sound sense and good judgment.

THE forty-first annual exhibition of the Royal Photographic Society will be held from September 28 to November 12, in the gallery of the Royal Society of Painters in Water Colours. Negatives, transparencies, photo-mechanical prints, stereoscopic work, photographs of purely scientific interest, photographs coloured by scientific or mechanical means, and photographic apparatus will be admitted. Foreign exhibitors are invited to contribute photographs or apparatus. Exhibits must be received by the Secretary of the Royal Photographic Society, on or before September 9.

THE President of the Board of Trade has appointed a Committee, consisting of the following gentlemen, viz.:—Lord Blythwood (chairman), Sir Benjamin Baker, K.C.M.G., F.R.S., Sir J. Lowthian Bell, Bart., F.R.S., Prof. Wyndham Dunstan, F.R.S., Prof. A. B. W. Kennedy, F.R.S., Major F. A. Marindin, R.E., C.M.G., Mr. E. P. Martin, Prof. W. C. Roberts-Austen, C.B., F.R.S., Dr. T. E. Thorpe, F.R.S., Prof. W. C. Unwin, F.R.S., and Mr. E. Windsor Richards—to inquire as to the extent of loss of strength in steel rails produced by their prolonged use on railways under varying conditions, and what steps can be taken to prevent the risk of accidents arising through such loss of strength. Mr. W. F. Marwood, of the Board of Trade, has been appointed to act as Secretary to the Committee.