

the necessity, of establishing a governmental bureau for investigating and reporting upon the efficiency of the machines and tools that are used by the farmers. The need of such an institution is now felt all the more as a safeguard against imposition in connection with these proposed new motors and new methods of manufacturing power out of nothing.

DUST WHIRLS AND FAIRY DANCES.

Mr. O. C. Pepoon, of Medicine Lodge, Barber County, Kans., sends the following description of a dust whirl observed at that place in the summer of 1897:

In the summer of 1897, the exact date is forgotten, at about 3 p. m., I noticed a whirlwind moving from the northwest to the southeast. It was in every way similar to an ordinary whirlwind, including the straight wind which accompanied it, except that instead of one circular wind five small whirlwinds whirled around a common centre. Each whirlwind resembled an ordinary whirlwind in form and velocity. They whirled on their individual axes, also on their common axis to the right. The whirlwinds were about 15 feet high.

The day was clear, warm, and still, with occasional gusts, from different directions generally westerly. The whirlwind was first seen at the northwest corner of a field of last year's stubble, at the north end of an 8-foot osage orange hedge, running south.

The whirlwind ran a few rods and vanished.

The diagram accompanying this article by Mr. Pepoon shows that the system of little whirls revolving about a common center was formed on the leeward side of the hedge to which he refers. These whirls were undoubtedly due in part to the presence of the hedge, since similar whirls are encountered in the rear of every obstacle. But they were also due in part to the hot, dry surface of the ground, since every small mass of air that is heated hotter than its neighbor rises and carries the lightest dust with it. Pictures of similar and many other forms of dust whirls are given in the volume of plates accompanying the work on Whirlwinds and Duststorms of India by P. F. H. Baddeley, London, 1860. He gives diagrams showing several dust whirls rushing along one after the other until finally all combine into one large whirl; or again, a group of thirty or forty whirls forming a continuous series like the front of an advancing squad of soldiers, or even circling around a central region like the outside boundary of a tornado. His diagrams suggest that in some cases a circle of dust storms, representing ascending whirls, incloses an area in which the air is descending, but this may be a hypothesis of the author and not the result of actual observation. Baddeley was a very enthusiastic student of the subject, and followed these whirls on horseback or in a buggy, note book and pencil in hand, noting and sketching as he went along. He attributes to electrical action the phenomenon that we believe can easily be explained without electricity as being due simply to the wind and the heat. He says that:

Dust whirlwinds are common in all parts of India, especially during the dry season. Sometimes a slender lofty cylindrical pillar of dust is seen revolving on its axis, or several such pillars moving on together in the same direction, or revolving in a circle, or as a dense cloud of dust sweeping over the country like a tornado, the cloud of dust occasionally presenting to the view a distinctly columnar structure. In northern India the smaller whirlwinds appear in dry, windy weather. They occur with singular regularity during the middle of the day. Sometimes a slowly-moving whirlwind instead of appearing as a simple column is found to be composed of several distinct vortices, each one rotating on its axis as it revolves around in the whirling circle. Each separate vortex has attached to it a fan-shaped train of dust.

This remarkable sight gives the idea of a fairy dance round a ring, and the motions are, from all accounts, exactly imitated by the dancing Dervishes of Turkey, one of their holy exercises being to whirl round and round like a top, singly, or in company with several others, performing at the same time a gyration round in a circle, as if their dance originated in the very phenomenon now described. We may sometimes watch this motion for a length of time without changing our position more than a few yards.

Mr. Baddeley says that—

The essential portion of the whirlwind always appeared to him as a lofty cylindrical pillar preserving apparently the same diameter throughout its entire height for thousands of feet. A dust storm or tornado is occasioned by an accumulation of whirlwind columns moving en masse or in rapid succession over the earth's surface in a direct or wavy line. Thousands of these spiral columns pass by in one direction during six or seven hours of the hottest portion of the day, and on other days re-pass in another direction as if a host was mustering for battle.

Among the numerous details given by Baddeley, we quote the curious fact stated by him:

Birds, such as kites and vultures, are often seen soaring high up just above and around these dust whirlwinds, following them for some distance, soaring about and around them, diving at each other as if in sport, keeping pace with them, seemingly with no other purpose than that of enjoyment.

The reader will find a very interesting description of mechanical methods of forming whirling columns of air with the attending dust whirls and waterspouts in a French work on *Tourbillons*, by Weyher. The method adopted by him consists in placing a wheel or fan at some distance above a basin of water or table covered with dust. The rapid horizontal rotation of the fan sets all the air of the room in motion, producing a spiral ascending whirl over the table, having a crude resemblance to a dust whirl, waterspout, or tornado.

Much more natural imitations of the atmospheric dust whirls have been made and described by Vettin in the *Annalen für Physik und Chemie* for 1856 and 1857. Experiments of this kind have lately been carried out quite perfectly by one of America's most skillful experimentalists, Prof. R. W. Wood, of Madison, Wis. (See an article by him entitled *Some Experiments on Artificial Mirages and Tornadoes*, *L. E. D. Phil. Mag.*, April, 1899, Vol. XLVII, p. 349.) Professor Wood uses flat metal plates about a yard long and a foot wide covered with a little sand. By heating the plates the air above the sand becomes warmed and produces mirage effects; but when heated still hotter most beautiful little whirlwinds of rising hot air can be seen running about over the surface and carrying up the fine silica powder that is scattered upon the plate. When sal ammoniac is used instead of silica, dense clouds of white vapor immediately arise, and he has observed a most perfect miniature tornado of dense smoke about two yards high.

The preceding notes suffice to show how eddies and whirls of dust are formed on the hot plains of Kansas. It seems natural to infer that special combinations of winds and temperature may give rise to the large whirls or waterspouts and tornadoes, but we think it more likely that the latter have an analogous but slightly different origin. The solar rays that heat the ground on a clear day have an effect analogous to that of those rays that are stopped by the clouds in ordinary weather. In the formation of a waterspout, it is quite common to see its slender axis form at the base of a cloud and descend toward the sea level. This has been properly explained by Ferrel, who showed that the velocity of gyration can easily be very much greater high above the earth's surface than lower down, and that the cloud that is formed in the region of low pressure along the axis of the whirl must begin at the upper end of the waterspout and grow downward. The whirls in both waterspouts and tornadoes are, therefore, explained mechanically as originating in the clouds and extending downward, under favorable conditions, to the earth's surface. It is only the small dust whirls that originate at the earth's surface and only in rare cases do these extend upward to the clouds.

MONTHLY CHARTS FOR THE WEST INDIES.

We are pleased to be able to present in the accompanying charts, XII and XIII, a first attempt to draw monthly iso-