Zoom in North Brabant, exported in 1881 a[illegible] million oysters, valued at some three million francs.

In order that the building may be easily taken to pieces and put in position, it is made entirely of wood; and the parts are arranged with such care that its removal from one place to another requires only three days besides the transit.

The station was at Bergen-op-Zoom when we visited it, and we were received by Professor Hubrecht with the cordiality and kindness characteristic of the *savants* of Holland. It is composed of a principal building about eight metres long and five broad. One façade has four windows; the other, three. The walls are three metres high; the ridge of the roof, four and a half. The framing of the roof is of wood, covered with a double layer of rush-matting. Opposite each window there is a stationary table: tables are also arranged in the centre of the room. In the laboratory are a closet for the instruments, another for the reagents and bottles, and also a small library, containing periodicals and the principal works on marine faunas. Each investigator can, in addition, send for books which he needs, either from the library of the zoölogical society, or from one of the universities of Holland. A desk, foot-rests, and some folding iron chairs complete the furnishings. The work-room, properly so called, is entered through a room in which are the aquaria, the collecting-apparatus, and the smaller dredges. The cumbersome instruments are placed in a room connected with one of the side-façades. Another room, opposite the entrance, leads into the private office of the director of the station. A fence of galvanized zinc wire runs around the building, and, while it wards off the thoughtless, encloses a space which may be used either for experiments in the open air, or for the dissection of animals of large size.

The construction of the house, as it stands to-day, has cost fifty-five hundred francs. An additional sum of six thousand francs was expended in the purchase of furnishings, aquaria, collecting-apparatus, reagents, thermometers, lenses, etc.

The management of the station is regulated in a very simple manner. The members of the zoölogical society nominate each year a committee, which publishes at the end of the year a report of the work, and gives an account of the funds expended.

Although the resources of the zoölogical commission are very limited, nevertheless the members have undertaken important work. During the season at Helder, Mr. Hubrecht was engaged upon fishes; Mr. Hoek studied the crustaceans; Mr. Horst, annelids; while Messrs. Van Harem, Noman, and Sluiter studied the other invertebrates. Mr. Hoek undertook, at Bergen-op-Zoom, his interesting researches on the embryology of the edible oyster. H. E. SAUVAGE.

LETTERS TO THE EDITOR.

The formation of tornadoes.

IN the discussion of Mr. Hoy's paper before the American association for the advancement of science, at the recent meeting at Minneapolis, I notice a number of statements which seem to me erroneous. Professor Rowland, for instance, asserts that "the rotation of the tornado is a necessary consequence of the earth's rotation." Now, if this be true, why are not tornadoes more frequent? Why is it necessary to have brisk, southerly winds, with high temperature and low barometric pressure? Why do they not happen on clear days as well as on cloudy ones? Again: if the earth's rotation determines the direction of the gyratory motion of tornadoes, why does it not govern the motion of the little whirlwinds occurring in dry weather? Every observer knows that these revolve, sometimes in one direction, and sometimes in the other, but perhaps, in a majority of cases, in the same direction as tornadoes.

It is well known that tornadoes in our latitude occur on days when there is a strong breeze from a southerly direction. Now, the air on such days, in spring and early summer, is heavily charged with moisture; to which fact is due the oppressiveness of the heat. As the heat of the day increases, local showers are formed, which move, not with the surface-wind, but in a higher current from a westerly direction. There is usually a divergence of about ninety degrees in the angle formed by a line indicating the direction of the track of the tornado, and another marking the direction of the preceding surface-wind.

Now, the mingling of these currents, or even the passage of one beneath the other, must, on account of their unequal temperatures, condense more or less of the moisture of the warmer current. This condensation is nearly always noticed. A cloud, often of intense blackness, accumulates just under the southern edge of the storm-cloud, and is usually prolonged horizontally to the northward along its base. If the cloud is near enough, so you can see beneath it, the parts farther in the rear will be seen to move rapidly in an easterly direction, just as the air-current moves which bears them. How can it be otherwise than that a gyratory motion shall result from such conditions? People frequently say, in describing a tornado, that "two dark clouds rushed together from opposite directions, and produced the tornado." This statement, if we are expected to construe it literally, seems somewhat absurd, since a cloud is always a passive element, moving only as the air moves in which it floats. That fragments of clouds and often quite large masses move toward each other is true; but tornadoes are not produced because of this, but on account of the *mutual resistance of two currents of air*. If two liquids or gases are brought together from different directions, a whirling motion is produced, as may be seen where two small streams of water flow together, or where a rock or fallen tree interrupts the direct movement of the water. This is but a necessary result of the combination of properties inherent in such a medium.

A volume of air, under pressure, escapes in the direction of least resistance: and, as there is a considerable pressure of the air where the two currents meet, an escape-current must form somewhere; and it forms, in accordance with the above law, in the direction of minimum resistance, obliquely upward to the east or north-east. As soon as this escape-current is developed, its position is at once located by a slender stem of vapor rapidly ascending obliquely; though, if the observer is at some distance, it seems to be suspended from the cloud above it, and even at times to descend toward the earth. Some of the downward movements of this 'funnel' are apparent only, the constantly ascending vapors sometimes condensing near to the ground, and at other times high in air. The funnel-cloud is often absorbed into the cloud above, almost as soon as formed, the conditions necessary to its full development not existing.

In his excellent article on tornadoes, in the current number of the *Kansas City review of science*, Mr. John D. Parker speaks of the four characteristic motions of these meteors. These motions might be classified as horizontal and vertical. The horizontal motions are the linear, caused by the forward motion of the air-current governing the direction of the storm-cloud; second, the gyratory motion, caused, as above stated, by the mutual resistance of air-currents moving in different directions; third, the swaying motion, due partly to the varying pressure on different sides of the tunnel, and partly to the vertical or bounding motion of the tunnel. This latter motion would not have a very marked effect in producing the 'dentated edges' of the storm's path, if the tunnel-cloud were vertical instead of slanting. What causes the bounding motion it is difficult to say, but it certainly resembles electrical attraction and repulsion. This bounding movement was very marked in the tornado of April 18, 1869, which passed near this locality; but occurring, as it did, in the day-time, I could not distinguish the illumination of the lower part of the tunnel, which may sometimes be seen when these storms occur after dark, and which some think is due to electricity.

It is interesting to produce in miniature the horizontal motions of the tornado by the following simple experiment. When there is a good fire, let a small quantity of light, flaky ashes, or other light material, be sprinkled over the whole top of the cooking-stove. The heat forms quite a strong current, ascending mainly from the central parts toward the pipe. Cool currents flow in from all sides. Now, with the hand or a fan, produce local or opposing currents over the heated surface, and at once little tornadoes are developed, whirling the ashes several inches in the air. I have often produced them on both sides of the stove at the same time; those on the left moving as tornadoes in our latitude, and those on the right in the opposite direction. Now, are not the causes of the gyratory motion of the little whirlwinds on the stove, tiny as they are, the same in kind as those which produced the storms which devastated Marshfield, Grinnell, or Camanche? If this be answered in the affirmative, the rotation of the earth plays no direct part in causing the gyratory movement of this class of storms. Of course, the rotation of the earth causes the higher currents of air to move toward the north-east, instead of due north, as they pass from the equatorial to the arctic zone, and these currents determine the general linear movement of storms in our latitude; but this makes it proper to consider the gyratory motion an indirect result rather than a direct consequence.

S. A. MAXWELL.

Morrison, Ill., Oct. 9, 1883.

The chinch-bug in New York.

Why should Mr. Lintner conclude that the chinch-bug was brought to St. Lawrence county, N.Y., in a freight-car from the west? Harris corrects the erroneous idea that it is confined to the states south of 40° of latitude by demonstrating its occurrence in Illinois and Wisconsin, while Fitch's record of finding it in northern New York would justify us in assuming that it has always existed there, especially when we know that its range is much farther north. Packard found it on the top of the White Mountains; and it is to-day the most serious enemy that threatens the vast wheat-fields of Dakota. It seems to me more rational to consider this injurious manifestation in New York a result of undue increase of a species always there than to call it an invasion. Though we rarely hear of its injury in the Atlantic states, yet it is commonly met with where collecting is done near or in the ground, and in dry years is by far the most common Heteropter in grain and grass fields and dunes. This I know from personal experience, and have found it as far north as Boscawen, N.H.

Should it prove less susceptible to heavy and continued rains in New York than elsewhere, the fact will be remarkable. Such rains affect it most, however, in spring and early summer. My own interpretation of the interesting facts recorded by Mr. Lintner would be, that the species multiplied exceedingly during the very dry seasons of 1880 and 1881, and that the wet season, which it has so far braved (as it often does for a while in the west), will nevertheless tell on the hibernating bugs. In this view there is cause for encouragement rather than alarm. A careful survey would undoubtedly show, as Mr. Lintner suggests, that it exists in many places in the state where it has not yet been detected.

C. V. RILEY.

Washington, D.C., Oct. 24, 1883.

Unusual reversal of lines in the summit of a solar prominence.

On Oct. 17, between 3.45 and 4.30, local time (about 8.45 and 9.30 Greenwich time), a rather unusual phenomenon was observed at Princeton, in a prominence connected with the large and active group of spots which at that time was just passing off from the sun's disk.

The prominence had the very common form of a number of overlapping arches, with a sort of cap above them, or of a cloud connected by several curved stems to the chromosphere below. Its elevation was about 2′, and its extent along the sun's circumference a little less.

The peculiar features were the extreme brilliance of the cloud-cap at the summit of the prominence, and the perfect delineation of the form of this cloud in certain spectrum-lines, which ordinarily are reversed only at the base of the chromosphere; while, at the same time, certain other lines, which not unfrequently are reversed at considerable elevations, showed its form only very faintly, or not at all.

When I first came upon the prominence, in running around the sun's limb with the spectroscope, the brightness of the cloud-cap, as seen through the *C* line, was simply dazzling. I do not remember ever to have seen a prominence, or any part of one, quite so brilliant. At the same time, the line λ 6676.9 (which is in the same field of view with *C*, and is No. 2 of my catalogue of chromosphere-lines, — a line attributed to iron) also showed the top of the cloud quite as well and as brightly as is usual in *C* under ordinary circumstances. The chromosphere, also, was faintly visible in the same line; but the stems and lower portion of the cloud could not be seen at all in it. On turning to line λ 7055 (No. 1 of the catalogue), I was surprised and gratified to find the same appearances conspicuous in this line also. A careful search failed to show any other lines reversed below *C*.

Running up the spectrum from *C* to *D*, I could not find any lines showing the *top* of the prominence, though a considerable number were reversed in the chromosphere at its base. D_3, of course, showed the cloud-cap magnificently, but D_1 and D_2 only very faintly, though *distinctly* enough.

Between *D* and *b* the same remarks apply as between *C* and *D*. The corona-line, λ 5315.9, was reversed at the base of the prominence a little more brightly