tered wind velocity at that place for 5 minutes was 50 miles per hour from southeast, with an extreme of 60 miles per hour, though the storm seems to have lost its tornado characteristics before reaching that place. The approximate value of property destroyed is as follows: Moundville, $80,000; Hull, $8000; Birmingham, $4000; total, $92,000.

The tornado at Moundville occurred on the southeast side of a decided barometric depression which swept rapidly northeastward over northern Mississippi, or northwestern Alabama, during the night of January 21–22, when the pressure was rather low, though not extremely so, at Birmingham, Meridian, Mobile, and Montgomery.

Fig. 1 shows the section of country through which the storm passed.

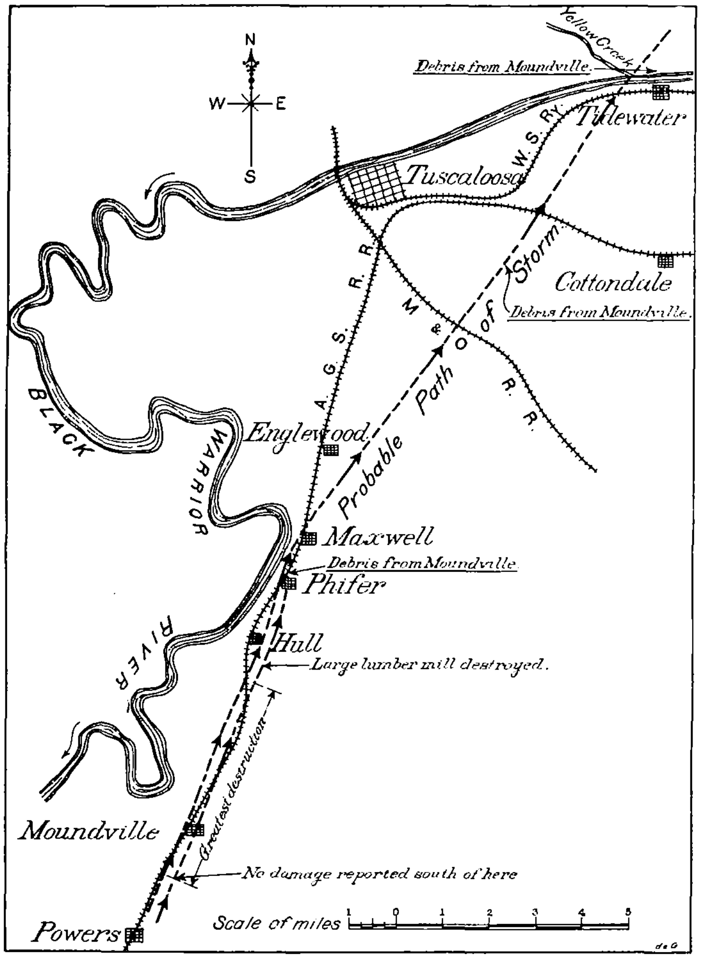

FIG. 1.—Path of tornado at Moundville, Ala., January 22, 1904.

ARRANGEMENT OF LIGHTNING RODS.[1]

By Prof. W. S. FRANKLIN, Lehigh University, South Bethlehem, Pa., dated February 10, 1904.

1. Good connection of a lightning rod to ground is a prime necessity in lightning rod construction.

2. The experimental and theoretical study of the transmission of rapid electrical oscillations and of abrupt electrical pulses along wires or rods has led to the recognition of the following facts:

(a) Straightness and directness of path to earth is the most important condition in so far as the arrangement of the rod is concerned.

(b) A given weight of metal is much more effective as a carrier of rapid electrical oscillations or abrupt electric pulses when it is in the form of a ribbon or thin-walled tube or wire cable than when it is in the form of a solid rod.

3. If the path along the rod to ground is roundabout, the more direct path through the protected (?) structure is apt to be chosen by the electrical discharge, notwithstanding its poor electrical conductivity and in spite of any ordinary degree of insulation of the rod.

4. The arrangement shown in fig. 1 affords very direct com-

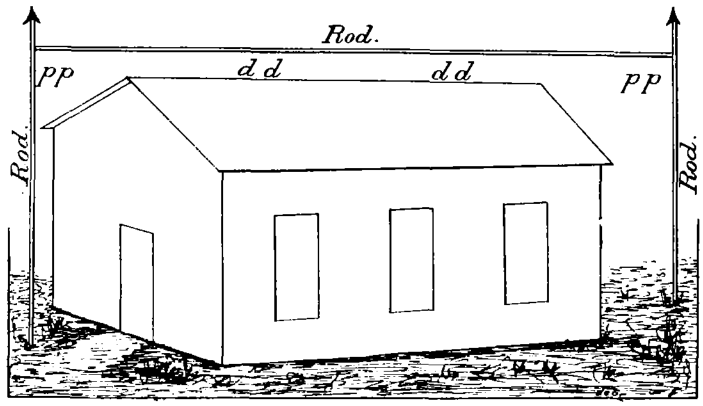

FIG. 1.—A well-protected structure.

munication to ground from the regions *pp pp*, which regions are, therefore, to be considered as well protected. On the other hand, the ground communication from the region *dd* is unnecessarily roundabout, and this region *dd* is, therefore, unnecessarily exposed to danger.

Given a good ground connection, then directness of path to ground from the region which is to be protected is so important that the matter of insulating the rod from the building, either by air spaces or by glass, is of no importance whatever in comparison. If the path is direct, there is no need of insulation; and if the path is roundabout, effective insulation is not practicably feasible.

[1] This article was written, at the request of the Editor, as an answer to a question by a correspondent of The Rural New-Yorker in regard to the arrangement of lightning rods.

A NEW NEPHOSCOPE.

By LOUIS BESSON.

[Translated from Annuaire de la Société Météorologique de France, February, 1903, p. 29.]

The vertical component of the movement of the clouds introduces into nephoscopic observations an error, the law for which I have recently studied,[1] at least as regards the direction. All along any great vertical circle, in whose plane a cloud moves, the error in direction is zero (or equal to 180°), but it is easy to see that the error in the relative velocity is at its maximum there. I have shown that by making two determinations at the same elevation, perpendicular to the movement of the clouds, the exact direction, and at the same time the inclination can easily be obtained; but this solution is only rigorous if the vertical component has the same value in the whole extent of the sky; moreover, the work of the observer is doubled.

If, neglecting the measurement of the inclination, it is proposed only to determine, under the best possible conditions, the direction and the relative velocity, it is best to observe at the zenith, because there the error in the direction is zero, and the error in the relative velocity is generally negligible. Now, it must be acknowledged that near the zenith the use of the nephoscopic herse[2] is very inconvenient on account of the fatiguing position that the observer must maintain. For such observations the dark nephoscopic room, such as is used at the observatory for dynamic meteorology at Trappes and at the municipal observatory of Montsouris[3] is certainly the most convenient arrangement, but the pictures of the clouds upon

[1] Annuaire de la Société Météorologique de France, 1902, p. 180.
[2] Annales de l'Observatoire Municipal de France, 1901, p. 50.
[3] Annales de l'Observatoire Municipal de France, 1901, p. 17.

the screen are necessarily much less bright than the clouds themselves, and when these latter are pale or nearly uniform, or again when the daylight is feeble, the images in the dark room have not the clearness necessary for making good observations.

The preceding considerations have led me to construct a new nephoscope, which will render observations in the neighborhood of the zenith easy, and obviate the inconveniences of the dark room. It consists essentially of a horizontal frame upon which are stretched two orthogonal systems of parallel and equi-distant threads, forming a lattice. By standing above this frame and looking at the clouds through it, their direction may be determined by turning the frame in such a manner that one of the systems of threads will be parallel with it; the other system of threads is then perpendicular to the motion of the clouds and enables us to determine their relative velocity. As a matter of fact the observation is not made directly, but with the aid of an inclined plane mirror placed below the frame. This arrangement has a twofold advantage; first it relieves the observer from an uncomfortable position; and in the second place, for the same elevation of frame, it increases the useful length of the instrument by the distance which separates the eye from the mirror. The position of the eye is fixed by means of an eye hole which may be furnished with a piece of smoked glass, if it is thought necessary.

In the model constructed according to our instructions by Richard, the frame is circular and has a diameter of 0.65 meter; it is supported by three rods resting upon an annular metallic plate. This is the movable part of the instrument. The fixed base is formed of a wooden disk, the upper side of which is divided into degrees; this disk is set and fixed immovably upon a pillar or some kind of a pedestal. The support of the mirror, fixed to this wooden disk, fits the central part of the annular metallic plate and serves it as an axis of rotation. Upon the edge of this bevelled plate are engraved four reference lines, traced parallel to the threads of the frame. The direction is read upon the graduated scale of the disk, opposite to the reference mark on the side from whence the clouds come. The height of the instrument above its socket is 1.10 meters, but on account of the reflection from the mirror it seems as though the eye was exactly 1.50 meters below the frame. The space from one thread to the other, upon this frame, is 0.075 meter or 1/20 the distance from the eye. Consequently, the relation of the height of the clouds, H, to their velocity V is given, as in the dark nephoscopic room, by the formula:

$$\frac{H}{V} = 20\frac{t}{n},$$

n being the number of spaces passed over by the observed point and t the time occupied in passing over. Two nephoscopes of this pattern have been in use for more than six months at stations of the municipal meteorological service, where they are used specially in the study of the influence of Paris upon the movement of the upper currents. For researches of this kind, it was indispensable that the observations at each station should be made in close proximity to the zenith; and it was, therefore, advisable to put into the hands of the observers an instrument the field of which was limited to this part of the sky. In ordinary meteorological observations it will be advantageous to make use of this nephoscope whenever the layer of clouds whose motion it is intended to determine is situated in the neighborhood of the zenith.

THE EARTHQUAKE OF JANUARY 20, 1904, AT WASHINGTON, D. C.

By Prof. C. F. MARVIN.

The fourth great earthquake of very distant origin to be recorded at the Weather Bureau occurred on January 20, 1904, at $9^h\ 58^m\ 38^s$ a. m., seventy-fifth meridian time. While the disturbance at Washington was wholly imperceptible to ordinary sensations, yet the horizontal movement of the ground was greater than in any of the earthquakes thus far recorded.

The apparatus by which this earthquake was recorded has already been described in the MONTHLY WEATHER REVIEW for June, 1903, page 271.

It is interesting to note, in connection with this earthquake, that for fully twenty-four hours preceding the disturbance the seismograph record showed minute waves of earth movement extending more or less continuously throughout the whole time. It is also to be remarked in this connection that a vast area of high barometer dominated the whole eastern area of the United States from January 18 to 20.

It is not to be inferred that the writer argues that there is any necessary connection between the earthquake and the high barometer. This is hardly probable, although the high barometer may in some way have contributed to produce the minute pulsations referred to.

The waves of displacement, as shown by the record, are unusually regular and of a simple sinusoidal type. The period is also, on the whole, relatively long.

The following table gives the times of the pricipal features of the disturbance. The north and south component of horizontal motion only is recorded:

January 20, 1904, a. m., seventy-fifth meridian time.

	h.	m.	s.	h.	m.	s.
First preliminary tremors	9	58	38 a. m.			
Second preliminary tremors	10	3	52 a. m.			
Principal portion began	10	8	50 a. m.			
Principal portion ended	10	11	50 a. m.			
Maximum waves at	10	11	16 a. m.			
End of earthquake	10	51	51 a. m.			
Duration of first preliminary tremor				0	5	14
Duration of second preliminary tremor				0	4	58
Average period of waves in principal portion (seven complete waves in $2^m\ 45^s$)						23.6
Period of slow waves of principal portion						25.8
Period of shorter and maximum waves of principal portion						19.0
Period of uniform waves in final portion						17.3
Period of pendulum						26.0
Maximum double amplitude of actual displacement of earth at seismograph				0.4 mm.		
Magnification of record				10		

LUNAR HALO OF JANUARY 30, 1904.

By Rev. F. L. ODENBACH, S. J.

A halo was observed on January 30, 1904, at Ignatius College Observatory, Cleveland, Ohio, 7:20 p. m., seventy-fifth meridian time.

The sky at the time was evenly covered with a thin pallium of stratus; stars of the first magnitude were visible through it.

I observed four of the so-called Newton's rings around the moon.

I Ring.—Blue, white, yellow, red, 2°.

II Ring.—Blue, green, yellow, red, 6°.

III Ring.—Blue, green, red, 10°.

IV Ring.—Red, 12° to 15°.

It was very brilliant, in fact the most perfect and elaborate I have ever seen. The measurements were taken with a theodolite, the tube of which is plain and without lenses, made for this kind of work. The angles were read in a hurry and to the nearest degree, since I followed the same method as in the observations of the Hevelian halo of 90° in 1901, and with the same luck, as the phenomenon lasted only for about five to eight minutes.

After that the pallium thickened and finally broke into denser cloud, strato-cumulus, the altitude of which I measured and found to be 4783 feet (method described in 8th Annual Report of the Ignatius College Observatory, 1902–03).

The most prominent part of the corona was the yellow and