

admirably jointed and polished. It is, in fact, the finest external masonry work remaining upon any pyramid. This pyramid has hitherto been supposed to be unopened. Professor Maspero, however, by cutting a vertical trench down the north side of the hill, has laid bare the face of the pyramid, and proved that it rises direct from the plain. The "hill" is found to be an immense heap of accumulated sand and debris, which has probably been formed since the end of the period known as the New Empire. The height of the lower stage is therefore now seen to be about 134 feet. Exactly in the center of this northern face (*i. e.*, about twenty meters above the plain) was discovered an opening about 1 meter 60 c. square, from which a passage of the same dimensions descends at a rapid incline toward some point not yet reached. This passage has already been cleared to a distance of 40 meters. For the first 10 meters it is lined with superb masonry; beyond that point it reaches a central core of rock, and becomes an excavated sloping shaft of the same size, and descending at the same angle as before. The pyramid is, in fact, built around a natural rock, in the heart of which it is presumed the sepulchral chamber will shortly be discovered. At a short distance from the entrance there was formerly a "stopper" stone, the place of which is clearly indicated; but this stone has been destroyed and removed at some very remote period. It is evident that the pyramid had been violated and was open to the curious as early as the period of the Twentieth Dynasty; three graffiti, or scribbled inscriptions in the hieratic writing, written by visitors of that time, having been found on the ceiling at the very spot where the closing-stone had originally been placed.

The rapidity with which Professor Maspero has carried out this work is as remarkable as the success with which it has been crowned, the trench not having been begun till the last week in November, 1881. The labor is, however, very trying, owing to the want of air and light, and the overwhelming heat inside the Pyramid. The workmen cannot stay in for more than an hour at a time without fainting, and being carried out to recover.

It is hoped that hieroglyphed inscriptions of great archaeological importance may be found in the sepulchral chamber; though doubtless everything in the shape of movable treasure was rifled when the pyramid was first opened.

The date of Seneferoo is estimated by Mariette Pasha at B. C. 4235; and by Brugsch at B. C. 3766.—*London Graphic*.

THE RECENT ERUPTION OF MAUNA LOA.

THE flow of lava from this noted Hawaiian volcano, lately in eruption, is the greatest observed there within the last fifty years. It began on November 5, 1880, and continued without interruption till the middle of August, 1881. Probably no lava flow has been so largely photographed, and an artist, M. Furneaux, has represented various phases of it in thirty-eight oil paintings. A published letter from Mr. Green, of Honolulu, states that when the lava accumulates on a large surface a permanent cloud of condensed vapor, with smoke, forms above. When the cloud becomes too dense the cooled vapor descends through the hot and light air below, and when the waterspout reaches the incandescent lava it is anew converted into vapor. In such cases there is usually a surface of several square miles of lava at a red heat, and more or less in fusion. Photographs of the lava near Hilo show that after flowing thirty or forty miles it was still in a very liquid state. Further up it has formed the usual scoriaceous embankments, and a tunnel of its cooled crust. Wherever it could be seen through apertures in this crust it seemed as liquid as water, and at a red-white heat. It was apparently a case of pure igneous fusion; no vapor or gas was observable when the stream did not enter water or come on vegetation. Eight photographs were taken of a lake with vertical sides, two miles from Hilo, which was filled with lava in one hour and forty minutes. The pretty little town of Hilo was like to be engulfed, the lava forming a semicircle of fire about it, and the possibility of damming and diverting the current was being considered, but happily the flow ceased in time, and parts of the arched crust falling in afterward, blocked the passages, so that Hilo at the end of August seemed comparatively safe, at least for some months.—*London Times*.

DESTRUCTIVE FORCES ATTENDING TORNADOES.

MEMORANDUM No. 1.

Prepared for the *American Architect*, by GENERAL W. B. HAZEN, Chief Signal Officer, U. S. Army.

FROM the examination of the data contained in the works referred to in memorandum No. 2, it appears that during the passage of a tornado, buildings and other objects are subject to the following destructive forces, viz.:

I.—VELOCITY, OR FORCE OF THE WIND.

1. From the destruction of bridges, wind pressures of from 18 to 27 pounds per square foot have been demonstrated.

2. From the destruction of brick buildings, wind pressures of from 58 to 84 pounds per square foot have been demonstrated.

3. From the lifting up and transportation and destruction of loose objects, such as a barrel of tar, a locomotive, a stove, a heavy log, cattle, etc., wind pressures of 52, 93, 31, 112, and 58 to 83 pounds per square foot respectively have been demonstrated.

4. The upward pressures are occasionally shown to be as great, if not greater, than the horizontal pressures.

5. Downward pressures, or downward movements of the wind have not been clearly demonstrated.

6. Upward velocities of 60 meters per second (135 miles per hour), are not unusual, if we may judge from the effects produced.

7. From observations of the Robinson anemometer, horizontal wind velocities of 80 miles per hour (36 meters per second) have been recorded during tornadoes; subject to a reduction to about 65 miles per hour for possible instrumental errors. But as velocities of 180 miles per hour (reducing as before to 140) have been recorded in hurricanes, there is no apparent reason why the latter should not also be attained in tornadoes.

II.—AREA EXPOSED TO DESTRUCTIVE WINDS.

That the destructive wind velocities previously enumerated are confined to very small areas, such as 10, 20, or 100 feet square, is shown:

1. By the narrowness of the path of greatest destructiveness; the destruction of fences, trees, etc., is frequently visible over a path many miles long, but only a few hundred yards wide; but the path of greatest violence is very much

narrower than this. The excessive cases above enumerated are observed only in small, isolated spots, less than one hundred feet square, unequally distributed along the central portion of the track; hence in very large buildings, bridges, etc., only a small portion is liable to be subjected to destructive wind in the passage of a storm.

2. In the different portions of this area of maximum severity, the winds are simultaneously blowing from different—perhaps even opposite—directions, so that the total resultant of the winds at any moment is not so much to overturn or carry off or crush in, but rather to twist around a vertical axis—thus trees are found twisted off, and buildings are generally lifted up and turned around immediately before being torn to pieces—numerous instances of this last action are given in the tornadoes investigated by Sergeants Finley and Mackintosh.

3. As the central area of maximum intensity is comparatively narrow, and the chances are very small that a building will be exposed to the violent twisting action, it is evident that the average velocity of rectilinear winds within the general path of moderate destruction is the one most necessary to provide against in ordinary structures. These winds may attain a velocity of 80 miles per hour, over an area 1,000 feet broad, and generally blow from the southwest; those next in frequency blow from the northwest. Of course, the tendency of such a wind upon an object whose center of inertia does not coincide with the center of figure, will be, first of all, to turn it around through an arc sufficient to bring these two centers into the line of the direction of the wind, which partial rotation may occur anywhere within the path of the tornado, and is to be distinguished from the destructive twist that is experienced by bodies that lie in the path of maximum intensity. A similar problem occurs in the case of monuments, stones, etc., disturbed by earthquake shocks, as was first pointed out by Mallet.

III.—THE DURATION OF THE EXPOSURE.

1. The time during which an object is exposed to these destructive winds varies from six to sixty seconds—the general average of a large number of cases is sixteen seconds—it is therefore probable that the maximum winds at the tornado center rarely continue longer than the lower of these limits. A building exposed to these winds experiences but one stroke like the blow of a hammer, and the destruction is done. In the case, therefore, of a suspension bridge, a chimney, or other structure liable to be set into a system of rhythmic vibrations, destructive to its integrity, the effect of the maximum winds in inducing such vibrations is reduced to a minimum.

2. The duration of the heavy southwest and northwest winds prevailing over the area of moderate destruction rarely exceeds two minutes.

IV.—VERTICAL WIND CURRENTS.

At the point over which the center of a tornado stands at any moment, or immediately beneath the funnel or spout that is seen descending from the clouds, there is experienced a strong vertical current whose tendency to destroy and carry upward is greatly assisted by a local diminution in the barometric pressure within the funnel, by virtue of which the air previously confined within a dwelling exerts an outward pressure that is not counterbalanced by the exterior atmosphere. The amount of this unbalanced pressure is, as shown by Ferrel, frequently much more than one inch of mercury or a half pound to the square inch, and may easily amount to ten times this quantity. Of course the interval during which this expansive force is exerted is but a few seconds, corresponding to the time occupied by the central spout in passing along its path, which motion of translation is, on the average, at the rate of 30 miles per hour.

The relative frequency of tornadoes during the months of the year is as follows, beginning with the month of greatest frequency: July, May, June, August, April, March, September, February, October, November, January, and December.

The geographical distribution of 247 tornadoes, from 1794 to 1878, was as follows, viz.:

New York....	24	North Carolina..	7	Connecticut....	4
Indiana.....	20	Alabama.....	6	Michigan.....	4
Illinois.....	20	Minnesota.....	6	New Hampshire..	3
Ohio.....	16	Mississippi....	5	Arizona.....	2
Georgia.....	16	Maryland.....	5	Louisiana.....	2
Iowa.....	11	Virginia.....	5	Kentucky.....	2
Kansas.....	11	South Carolina..	5	Rhode Island....	1
Pennsylvania..	10	Massachusetts..	5	Colorado.....	1
Tennessee.....	9	New Jersey.....	5	Indian Territory	1
Missouri.....	9	Dakota.....	4	Wyoming do.	1
Nebraska.....	8	Wisconsin.....	4	Maine.....	1
Texas.....	8	Florida.....	4	Montana.....	1
				New Mexico....	1
	162		61		
Total.....					247

Doubtless the irregularity in this geographical distribution is largely due to the imperfection of our fragmentary records.

The distribution with reference to the time of day is about as follows:

Between 11 A. M. and noon.....	4
" noon and 1 P. M.....	2 ?
" 1 P. M. " 2 ".....	7
" 2 " " 3 ".....	7
" 3 " " 4 ".....	5
" 4 " " 5 ".....	24
" 5 " " 6 ".....	12
" 6 " " 7 ".....	7

The remainder are equally distributed at the rate of about two per hour throughout the other hours of the day.

A BIRD-CATCHING SEDGE.

ANOTHER example of the wonderful adaptation of seeds for the purpose of distribution is recorded by a writer in the *Gardener's Chronicle* as having been observed by him in those of the *Uncinia jamaicensis*, a Jamaica sedge. This is a plentifully distributed plant, growing in damp hollows and shaded woods on the Blue Mountains of the above-named island. The plant is about a foot or eighteen inches high, with narrow-pointed, grass-like leaves. The flower-head is a slender spike about three inches long, of a dark brown shining color. Its most remarkable feature, however, consists in the spikelets, which are furnished with a smooth, long-exserted awn of a peculiar hooked character, resembling a shepherd's crook, but with the hook pressing so closely against its base that it will hold the finest hair. By means of this delicate and wonderfully-contrived awn

the seeds of the sedge attach themselves with great tenacity to the coats of dogs, the legs of pedestrians, or, indeed, to anything that comes within their reach; and when once they are attached they are removed with the greatest difficulty. In fact, as showing their finely adjusted power and their tenacity, it may be stated that if a spike is drawn along the back of the hand the hooks will clasp and easily pull out single hairs by the roots.

The narrator states that on two occasions he has found small birds (grass-quits) securely caught by a couple of spikes of this sedge. The spikes were attached along the under side of the body of the bird, with the hooked arms buried among the feathers. From the secure manner in which the birds were caught he has no doubt that many birds, not large enough to drag out the spikes, or draw the spikelets from their receptacles, must die in this manner from exhaustion, or fall a prey to rats and other vermin.

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