over again. If these floods could be trapped a hundred miles above Cairo, and impounded in Lake Moeris, the question would be solved, and Mr. Whitehouse's zeal for the reputation of Herodotus would have wrought more good to the country than it has derived from the entire European Concert.—*Engineering*.

A VISIT TO THE VESUVIUS OBSERVATORY.

By P. MARCILLAC.*

"EVERYBODY knows the Vesuvius Observatory by name," said Mr. Faye recently in a note addressed to the Academy of Sciences. There is, in fact, no electrician who has not heard it spoken of; still, as there are few who know it *by sight*, I think, before passing in review the apparatus used there, that I ought to give some details as to the exact position and internal arrangement of this celebrated station.

As shown in Fig. 2, where the location of the station is indicated, Vesuvius rises straight from the sea, and reaches a height of about 4,300 feet above the level thereof. Taken isolatedly, the bulk of the volcano appears to be greater than that of certain well-known summits which are higher, but which are partially lost in rocky masses of the first rank. Up to about midway between base and apex, reddish or black ridges of lava, radiating from a center like the spokes of a wheel, alternate with long strips of earth that are planted with the celebrated vines that yield *Lacrymæ-Christi*. At about 700 yards begins the base of the great upper cone, which keeps increasing every day from the material thrown out by the crater. To the east spreads out in a circle Mount Somma, whose cone is active in the center. This was formerly the culminating point of Vesuvius, but is now exceeded in height by the cone of ashes. At this altitude, and looking toward Naples, stands the Observatory upon the summit of a prominence at whose base lie to the right and left two long lines of hardened lava that possess the form of enormous cables twisted into an inextricable mass.

A meteorologist might seek in vain for a finer view and a situation at once so perilous, so charming, and so strange. Apropos of this, two facts taken at random: at the time of the great eruption of 1872, the temperature reached 72° C outside of the Observatory, which was hemmed in by two sheets of fire several miles in length; on another hand, some time before my trip in the month of May last, a terrible squall of wind removed every trace whatever of the irons that held and strengthened the shaft of the anemometer, and buried the whole in ashes, so that it was impossible, the guardian told me, to again find the place where the thing had occurred. Under conditions such as these it is easy to observe phenomena that tend toward a maximum of energy, and that are consequently more clearly marked. The Observatory, as a whole (Fig. 1), constitutes a vast pavilion, whose different stories contain, along with special apparatus, rich collections of minerals. A beautiful flight of steps fronting an elegant little garden gives access to the first room, which is provided with glass cases containing a unique collection of ashes from the different eruptions of Vesuvius. These pulverulent debris, whose nature seems to exclude them from any other study than that of geology, are directly and immediately connected with the electric experiments. As well known, in fact, in the

collectors now in use, we employ a gas, a flame, or a liquid for collecting the traces of atmospheric electricity. Mr. Palmieri, the director of the Vesuvius Observatory, conceived the idea of using volcanic ashes for an analogous purpose. Some of this material is of the coarseness of fine starch, and some again is as fine

nevertheless one remark to be made on the subject of this apparatus and the role that it plays on Vesuvius, or is capable of playing in any other place of observation of similar location; Mr. Palmieri considers it as a valuable aid in observing temporary, local variations in terrestrial magnetism, but he rightly objects that

FIG. 1.—THE VESUVIUS OBSERVATORY.

as the ashes of a cigar. These ashes are used by Mr. Palmieri instead of a liquid for collecting atmospheric electricity according to processes that have been detailed by him in a recent memoir. Continuing our examination of the station, we find, alongside of small geological wonders, and geodes as large as a bomb-shell, an apparatus for observing the variations in terrestrial magnetism. As this instrument is not special to this station, and is moreover well known, I shall not stop to describe it, but shall merely say that it is an apparatus of Lamont of Munich. As well known, it consists of a collection of needles formed of small strips of steel properly suspended, the slightest movements of which can be observed without trouble, owing to a system of reflection identical with that which Sir William Thomson uses in his galvanometers. There is

the measurements furnished by it, as regards general variations in the different elements of the magnetism of the globe, have no significance at the Vesuvius station. In fact, says he, the peculiar magnetism of the rocks or lavas, which possess characteristic polarities, changes these values of general magnetism from one place to another, and sometimes even at the same point, if some rock or mass of lava of larger size be near. So the results obtained are considered by Mr. Palmieri only as local indications that vary with local causes. As for general variations, it is not on Vesuvius, but at some distance therefrom—at Naples—that they are studied, the magnetic secondary effects of the lavas being then considered as unworthy of being taken into consideration. It is useless to give in this place a description of numerous instruments that are

* In *La Lanterne Electrique*.

FIG. 2.—GENERAL VIEW OF NAPLES.

common to all meteorological stations, and I shall therefore confine myself to the statement that the Vesuvius Observatory possesses an ample collection of thermometers, barometers, pluviometers, hygrometers, etc., plus a certain collection of peculiar objects, such as two beautiful reductions in relief of Vesuvius and Etna. These very remarkable pieces, which are of galvanic copper, figured in the Italian Pavilion at the Paris Exposition of Electricity.

The first story of the station is almost wholly set apart for numerous seismographs, or apparatus for registering shocks, which are but little known and not much used except in Italian observatories. Without

FIG. 3.—VARIOUS SEISMOGRAPHS.

entering into considerations upon the origin or laws of earthquakes, it is difficult to keep from saying a few words concerning these phenomena, *apropos* of seismographs that serve not only for showing their presence, but also for measuring their intensity. The behavior of these movements is exceedingly variable. Sometimes the ground vibrates horizontally like a table that one has come into contact with. Sometimes the terrestrial crust vibrates after the manner of the sides of a boiler, and sometimes the trembling is analogous to that of a vibrating membrane whose surface has been raised or depressed by a smart blow given to it from below or above. From this it will be seen that it is indispensable to have very different styles of the apparatus, which, although designed for the same object—the registration of earth tremors—are adapted through their special arrangement for the observation of different kinds of movements.

Seismographs.—Of these apparatus, some are simple indicators, while others on the contrary comprise an indicator and a registering device. The apparatus are represented in Fig. 3, at which it is only necessary to

FIG. 4.

glance in order to understand how they work. A is formed of a steel wire fixed by one of its extremities, and provided with a spherical slide that can be held stationary at any desired point by means of a regulating screw. Its free extremity is provided with a light cone terminating in a needle. The whole is inclosed in a glass cylinder.

At the least lateral oscillation of the earth the affair vibrates or oscillates. It is only necessary to observe the needle's oscillations, the amplitude of which indicates the degree of intensity of the subterranean action. The apparatus, B, comprises a helix of brass wire provided with a metallic ball or a sharp cone, whose platinized point touches the convexity of a small quantity of mercury contained in an iron cup. At every oscillation of the earth the spiral successively elongates and contracts, and renders visible to an attentive eye motions that even the most experienced observer does not perceive at his feet, although standing upon the ground that is vibrating. It is rarely the case that the instrument is at rest. It follows, so to speak, all the pulsations of the volcano, and makes accurately known the variations in its energy. If a current be passed into the spiral, and the iron cup be connected with a registering device that we shall describe further along, we can evidently effect a registration of all the movements of the ground. At C is seen an apparatus for the registration of exceptional-

FIG. 5.—REGISTERING SEISMOGRAPHS.

ly strong shocks. A small strip of steel is here held horizontally by means of a vertical column, and its free extremity is provided with a platinized point separated by a fraction of an inch from a cup full of mercury. D represents a seismograph for indicating horizontal motions. In the interior of a glass cylinder is suspended a very fine wire that supports a small brass ball, which is provided beneath with a platinum point. Under this latter there is an iron cup whose bottom presents the form of a truncated cone. The annular cavity thus obtained is filled with mercury, which forms a ring into which the platinum point descends

when a shock moves the pendulum from its vertical position. This contact closes an electric circuit, and a signal is registered. The instrument is further provided with a series of small glass tubes arranged like the spokes of a wheel, and very movable. The brass ball strikes one or more of these tubes in its lateral motions, and thus allows the direction of the undulation to be seen. This part of the instrument is shown in Fig. 4.

These various earthquake recorders being now known to us, let us see how the shocks are registered at the Vesuvius Observatory.

FIG. 6.—APPARATUS FOR REGISTERING UNDULATORY MOVEMENTS.

Fig. 5 gives a view of the *stationary* registering seismograph, so called in contradistinction to another style called a *portable* one, designed for temporary use only in cases where peculiar phenomena are manifested that require but a transient observation, and where there is no meteorological station.

The stationary registering apparatus consists of two clocks, A and B, the former of which indicates the hours, minutes, and half-seconds, while the latter is at rest, and does not start till the occurrence of a shock, as we shall see further along. When this clock is running, it causes a band of paper, *k k*, on the wheel, *i*, to unwind at the rate of twelve inches per hour. Between the two clocks there are two electro-magnets, *m m*, *n n*, whose armatures are connected with two bent levers, one of which carries a black pencil and the other a red one. These levers are so jointed that when the armatures are attached, the pencils press against the paper band which is passing under their points. If a very

FIG. 7.

slight vertical shock occurs, the electric current influences the magnet, and this starts a simple mechanism that stops the clock, A, and the latter sets a bell ringing. The clock, B, then begins to run, and carries along the paper band, upon which the red pencil will trace lines whose length gives the measurement of the shock's duration. This done, a blank space is left upon the unwinding paper; but if, say an hour afterward, another shock occurs, we shall find twelve inches beyond, on this paper, the traces of a shock and its duration, and so on. If, instead of being vertical, the mo-

FIG. 8.—ELECTROMETER.

tion is horizontal or undulatory, the current will pass into the electro, *n n*, which will work as just explained, and the black pencil will register the shock and its duration. It is clear, then, that being notified by the bell, the observer will proceed to the apparatus, although, as may be seen, these latter, in case of his absence, will operate in such a way that the phenomena cannot pass unnoticed. From the description of the indicators above given, it will be seen that it suffices to connect with the first electro one of the vertical shock indicators, and with the second an indicator of horizontal shocks. It now remains for me to de-

scribe the model which best indicates these latter, and which, likewise, registers undulatory motions. This is shown in Fig. 6.

Here a sort of frame supports four communicating tubes and four uprights provided with channeled pulleys. One of the vertical branches of each tube is wide, while the other is narrower—about one-third the diameter of the former. The four tubes, which contain mercury, are placed in the direction of the cardinal points. Into the wide branch of each of them runs a platinum or iron rod, while in the narrow branches there are platinum points that nearly touch the mercury (Fig. 7). Under such circumstances, if a shock—even a slight one—occurs in the horizontal direction of one of the tubes, the mercury will touch the platinum point, the electric circuit will be closed, the black

FIG. 9.

pencil electro will operate, and the shock will be registered. In addition, there is in each narrow branch an ivory float suspended by a cocoon fiber which passes into the channel of one of the pulleys, *q, q, q, q*, and which is provided with a counterpoise. According to the motions of the float, the pulley revolves and displaces a needle fixed upon its axis, thus indicating the direction and amplitude of the movement. If an oscillation occurs in a direction intermediate between that of the tubes, two needles will be moved.

A final word upon these apparatus of Mr. Palmieri's, which have served as models for all those that have since been devised: It is not only at Vesuvius that they are employed, for the Society of Seismology of Japan possesses two beautiful models made by Messrs. Negretti & Zambra, a third is in use in Mexico, and a fourth, I believe, is to be found at San Francisco.

Evidently, the mountain masses of France are not overturned or agitated as often as are those of the countries above cited. There is a marked difference

FIG. 10.—APPARATUS FOR ASCERTAINING THE ELECTRICAL STATE OF THE ATMOSPHERE.

between southern Italy, with its three volcanic craters; Japan, with its 29 ignivomous cones; Mexico, with its 23 volcanoes; California, with its single outlet of Las Virgines, and our provinces of Auvergne, Provence, and Dauphiny, that have been dormant for several centuries. But it appears to me that it is to be regretted that our observatories, at least those in the three provinces that I mention, are not provided with seismographs. The effects are feeble, it is true, and certainly less frequent than in volcanic centers, but they are not to be left out of consideration.

The electrical apparatus, properly so called, and the piles that actuate the various registering apparatus, seismographic clocks, anemographs, etc., are placed on the last story of the observatory. Here are arranged, and attended to with particular care, the Calland elements that compose the batteries of the station. Here

FIG. 11.

also are found the constant piles as modified by Mr. Palmieri, and which the learned physicist makes use of in his open air experiments on the nature of the electricity shown by his portable registering apparatus. Here, finally, figure, in the guise of historic apparatus, the ascending or descending liquid vein collectors, the precursors of those so eminently practical instruments that are now used at all the Italian stations, and that consist of an electrometer, a movable collector, and a modified Bohnenberger electroscop.

Electrometer.—Let A A be a cylindrical glass box, the circumference of which is provided with a scale, and

which is supported by a metallic base, and is covered with a glass disk having quite a large aperture in the center (Fig. 8). In this aperture is fixed a glass cylinder, S, containing two cocoon fibers to which is attached a thin disk of aluminum, *i*, traversed diametrically by a very fine wire. The disk, *i*, revolves in the interior of a gilded metallic cup that carries two horizontal arms, *e e*, formed of tubes cut in the direction of a plane at right angles with that of the cup. The wire moves parallel with these arms, and approaches or recedes from them according as it is or is not electrified. These arms, *e e*, are supported, as is the cup, *r*, by a copper rod, *c*, which is insulated from the lower surface of the apparatus by a sleeve, *b b*, of a substance of peculiar nature (Fig. 8). Leaving aside the applications of the instrument itself, I desire to speak only of the composition of this substance, which is capable of rendering a genuine service to constructors or to electricians in general. It is a current formed of two-thirds Greek pitch and one third calcined plaster by weight. This plaster, called in Italian *scagliola*, is not the natural plaster, but plaster raised to a high temperature in order to divest it of half its water, and which afterward thrown quickly into water hardens in taking up the liquid lost. The cement thus obtained forms when warm a pasty mass that must be continuously stirred with a spatula until it becomes very homogeneous. The substance is then allowed to cool somewhat, and, according to requirements, is poured into moulds or applied while yet viscid to the piece to be insulated. It has not the consistency of ebonite, and it rather resembles Spanish wax; but it is possible, with some precaution, to turn it in a lathe and polish it. It then exhibits the appearance of amber, with a slight shade of bistre. Its insulating power is superior to that of ebonite, and its cost price is next to nothing. Finally, it possesses two properties of the first rank, from an electrical standpoint, and that is that its insulating qualities are not lost through a considerable degree of heat or moisture. It is to the perfect insulation obtained with this material that the director of the Observatory attributes the superiority of his excellent electrometer, which, as Mr. Mascart said at the Meteorological Congress at Rome, "might serve for controlling the results furnished by other apparatus of the same nature."

Apparatus with Movable Conductor, (Fig. 10).—A metallic rod provided at its upper extremity with a brass disk, and at its lower with a channeled pulley carefully insulated from it, such is in substance the collector of electricity used at the Vesuvius Observatory. A triangular guide (Fig. 11), provided with springs, serves to hold the rod vertically during its ascent, and to establish a communication between the collecting disk outside of the roof and the bifilar electrometer.

The entire maneuver consists in pulling a cord, *i i i*, which passes through the channel of the lower pulley, *h*, and then through that of a second one fixed to the ceiling of the room. This obliges the rod to rise above the roof, *H*, and permits of collecting whatever traces of electricity the atmosphere may show. The latter influences the electrometer, and it only remains for the observer to note the deflection obtained.

As may be seen, nothing could be simpler. Although this kind of a collector may at first sight seem to be rudimentary, it will quickly be seen how valuable an aid it is capable of proving in mountain stations. In these, much greater difficulties are encountered in the way of devising gas or water reservoirs for supplying liquid vein collectors than in the vicinity of large cities. On another hand, if it rain, blow, snow or hail, the regularity of the flow is much disturbed, if not absolutely stopped. It must be admitted that there is nothing to be dreaded with the Italian apparatus, the management of which is at once rapid, simple and sure. This, at least, is the impression that I formed of it after being present at a series of experiments at the Vesuvius station.

It is objected that this system does not permit of a continuous registration, and the objection is evidently a serious one. Mr. Palmieri answers this by demonstrating the irregularity of the flow of liquid or gaseous jets exposed to all the caprices of the weather. He dwells, moreover, upon one capital point, to wit, that, even in not taking into account the irregularities and losses that the at-present-known continuous registering apparatus undergo, the curves do not indicate much unless the indications they give are doubled by a personal observation of the meteorologist. In banishing all kinds of continuously registering apparatus from the station that he directs, the learned Italian has desired to command the attention of the operator, and oblige him to consider the motions of his instruments and the aspects of the heavens simultaneously. "Only in this way," says he, "have I been able to succeed in discovering and enunciating the laws that govern atmospheric electricity." This idea has been clearly summarized by Mr. Faye in his recent memoir upon the labors of Mr. Palmieri, and I can only cite his conclusion, which is as follows: "Mr. Palmieri thinks the observer should be alongside of his instrument, in order to note the unforeseen details that would be unable to inscribe themselves automatically upon a sheet of paper. His methods are applicable, moreover, with equal success to the study of ordinary electricity in calm weather, and, in case of a storm, to all the phases of the phenomenon, without causing the observer to run the risk of being struck by lightning."

The instruments that I had an opportunity of studying at the Vesuvius Observatory are just the opposite of certain physical apparatus, being simple, cheap, elegant even, and at the same time strong. The management of them is, as a general thing, so simple that the custodian of the station often makes the electrical tests, and that too with much accuracy. The results obtained with them are well known, and are of great value. It is natural, then, to wish that we may see them introduced into France, and come into extended use here, not to the exclusion of other apparatus (which they would serve, as required, to control or complete), but concurrently with them, at least at mountain stations, which might thus be confided to observers who have but a very limited knowledge. It would be especially interesting to see what results they would furnish elsewhere than at the Vesuvius Observatory. Volcanic action and the friction (of extremely variable intensity) of smoke or gases against the sides of the crater, or through the crust of the mountain, constitute almost an exceptional case for this observatory. When, for example, fissures open and permit the

escape of torrents of gas or bluish smoke, which the wind whirls over the blocks of hardened lava, there is necessarily some friction, without speaking of the multiple chemical effects that escape the observer, and that must give rise to electric manifestations of exceptional intensity. The Observatory is not then in a normal situation. It would consequently be necessary to examine, under ordinary circumstances, the results furnished by the ingenious but too little known instruments of the observatory under consideration. The cost, which is a matter never to be left out of consideration in questions of installation, appears to me very moderate and the construction very easy.

HYBRID PITCHER PLANTS.

ALTHOUGH Pitcher plants have long been known to cultivators, it is only comparatively recently that they have been much grown, a circumstance doubtless attributable to the indifferent success which attended the efforts of many who attempted their cultivation. Now, however, when their requirements are better understood, they are gradually finding their way into the collections of those who can appreciate beauty beyond that afforded by brightly colored flowers. With *Nepenthes* or Pitcher plants, as with everything else of an attractive character, hybridizers have been busy, and their labors have been rewarded by the production of a large number of varieties possessing great merit, and which, while combining as they do more or less of the general character of the species from which they originated, are yet so far distinct from the parent plants in both color and form as to render them most acceptable additions to the family. Apart from varieties resulting from cross-breeding, *Nepenthes* raised from seed, the produce of plants fertilized with pollen of the same species vary considerably in their marking; in some the spotting is much deeper and more intense than in others. A great difference in this respect may

be seen in such kinds as *N. Rafflesiana*, the color in the spotting of some forms of which is much more intense than in others. *Nepenthes* being dioecious, it is difficult to have a plant bearing female flowers open at a time when pollen can be had to fertilize them, and this has doubtless been the cause of comparatively little having been done in the way of getting improved forms of the most desirable species. There is, I think, good reason to suppose that, lurking in the islands of the Indian Archipelago, there are still species bearing much larger pitchers than any that have yet been introduced or described. Henschall, the late Messrs. Rollisson's collector in these regions, showed me at one time dried pitchers much larger than such as are borne by any kind that we yet have in cultivation.

A NEW HYBRID PITCHER PLANT (*NEPENTHES COMPACTA*), SHOWING HABIT OF GROWTH.

who has also been very successful in hybridizing *Nepenthes*, is a large sized, very distinct kind, with stout, flask-shaped pitchers, remarkable for their breadth in the lower part; the wings are also ample. While young the pitchers are mottled with bright red and light green, but when older they become nearly wholly deep red.

As regards culture, the general opinion that used to be entertained was that Pitcher plants not only required to be kept in all but a saturated condition at the roots, but that they also must have a reeking atmosphere and be heavily shaded. Under such conditions, with a high temperature, the plants with me grew apace—in fact; they grew too fast; but the shoots came long-jointed and weak, with comparatively little disposition to produce pitchers, without which, it is needless to say, they have little that is interesting or attractive about them. The leaves made in the late autumn, winter, and early part of spring never pitched at all; it was only from those produced in summer that pitchers were formed, and these not more than a fourth of the size they should have been, and with proportionately little color. Little satisfied with such results, I headed some of the plants down and made the shoots into cuttings, which when rooted I placed in quarters where they got more light, through being more elevated toward the roof, and also through using a thinner shading. The first season there was a marked improvement, which induced me to try some of the stock hung up, so that the extremities of the shoots were not more than a foot from the glass; here the growth made a season after was of a very different character, the shoots not being half the length between the joints, with leaves much shorter and of greater substance and pitchers double the size, with the color of those that were not naturally wholly green much deeper. Since then, whenever an opportunity has occurred of saying anything on the cultivation of *Nepenthes*, I have continually urged the necessity of a completely opposite course being followed to overshadowing with a confined, reeking atmosphere, as well as the plants being kept too far from the glass, conditions collectively the cause

The three hybrid varieties are, as will be seen, quite distinct both in form and marking from kinds which we already possess. In *N. Dormaniana* the peculiar flask formation is less decided than in many of the species; the pitchers from their widest part at some distance from the bottom almost gradually taper upward, while the deep red of the irregular markings stand out conspicuously, owing to the grounds color being much paler than that of most kinds. There is, too, an absence of deep color on the lid and rim surrounding the orifice. *N. Williamsi*, the smallest in the group, is a very handsome, highly colored variety, with the red coloring, paler or darker as the case may be, distributed over almost the entire pitcher, and as the pitchers get older the whole surface becomes as deeply colored as a well-grown example of *N. sanguinea*. *N. Henryana* has the green ground color deeper, while the marking is much the deepest in the upper portion of the pitcher; it is the largest sized one of the group, with the lower part more dilated than in the others. The wings of all are conspicuous and the teeth prominent. Among other hybrid *Nepenthes* in Mr. B. S. Williams' nursery, Holloway, may be named *N. atrosanguinea*, a variety in which the pitchers are medium sized; their ground color red slightly marked with pale yellowish green. In form they are somewhat cylin-

drical, the bottom being broadest, and the wings fully developed and fringed. *N. coccinea* has pitchers similar in size to the last; their ground color is crimson, spotted with yellow; they are flask-shaped above, cylindrical toward the top, and the ribbed rim round the mouth is of a dark blackish red. One of the best features connected with these Pitcher plants, which are of American origin, is their fine and vigorous growth; the shoots are short-jointed, and the plants profusely clothed with leaves that produce pitchers much more profusely than many species; they also appear to retain them in a fresh condition longer than most Pitcher plants. Even in spring, before much active growth has commenced, the plants are as fully furnished with highly colored pitcher as others are in autumn.

Mr. Dominy was, I believe, the first who attained success in hybridizing Pitcher plants. *N. Dominiana*, a cross between the well-known *N. Rafflesiana*, still one of the finest known kinds, and a green-leaved species, is a very handsome plant, in general character much resembling its female parent, *N. Rafflesiana*. The work begun by Mr. Dominy has been successfully continued by Mr. Seden and Mr. Court, and many handsome kinds have been the result. Among these may be mentioned *N. Courti*, obtained by crossing an unnamed Bornean species with the pollen of *N. Dominiana*. It is a handsome variety, with flask-shaped pitchers 7 inches or 8 inches long. The ground color is green, densely spotted and shaded with deep crimson. *N. Mastersiana*, a grand variety, was raised between the rare and beautiful *N. sanguinea* and one of the forms of *N. distillatoria*, the former being the seed-bearing parent. It is a robust grower, and bears pitchers about 8 inches long, somewhat distended in the lower part and cylindrical above; the whole surface of the mature pitchers, as well as the lid, is of a deep claret red, relieved by slightly lighter markings. This fine kind is the result of Mr. Court's handiwork. *N. Morganiae*, a variety raised in America by Mr. Taplin,