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"*To the solid ground*
Of Nature trusts the mind which builds for aye."—WORDSWORTH

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THE LAST ERUPTION OF VESUVIUS

THE scientific results of the late eruption of Vesuvius promise to be as important to science as the phenomena were grand and awe-inspiring to the spectator. Not only has Prof. Palmieri published an account of the observations from his dangerous standpoint, in Italian and German, which will shortly make its appearance here in the English translation by Mr. Mallet, but M. Henri Saussure has also published in the Geneva *Bibliothèque Universelle* an account of an excursion made by him to Vesuvius about the middle of last May, shortly after the violent eruption of April. This account, given by such a competent observer, is so interesting and valuable, from all points of view, that it must be regarded as a most valuable addition to the literature of one of the most popularly-known volcanoes on our planet. For the better understanding of the geographical features we may refer our readers to the article in NATURE, vol. vi. p. 2.

Vesuvius, as Prof. Phillips has taught us, was formerly a mountain forming a vast circle, whose central part, occupied partly by a crater—which, without doubt, has been often displaced within the limits of the circumference—was not less than three kilometres in diameter, and the projecting part of which, occupied at present by the cone, formed then only a kind of plateau. The famous eruption of A.D. 79, which happened unexpectedly after a very long period of repose, entirely changed the form of the mountain. Very little lava seems to have been given forth during that eruption, which was characterised by tremendous showers of stones and ashes, and by rivers of mud. This it was that buried Pompeii and Herculaneum, the former being covered by fifteen feet, the latter by thirty or forty feet of *débris*, and which, at the same time, appears to have formed, by accumulation, the present mountain of Vesuvius, placed in the centre of the ancient circle, the work having been completed by innumerable successive eruptions.

The Vesuvius group, then, is at present composed of two distinct mountains—namely, the cone of Vesuvius, and the rest of the ancient circle which form, to the north and west, a vast amphitheatre, named *La Somma*. Between the two mountains is an elevated horse-shoe shaped valley, the middle part of which bears the name of *Atrio del Cavallo*, and the upper extremity, towards the east, that of *Canale del Inferno*. This elevated valley is depressed and widened towards the west, where it takes the name of *Gli Atri*, and ends by being lost upon the slopes of the *Piano* which form the buttresses of the two mountains, and which emerge by various ravines into the plains which stretch from San Sebastiano to Torre del Greco.

This description would be incomplete if we did not mention a knoll or hillock, apparently insignificant, but in reality of great importance from the part it plays in giving direction to the lava. This little eminence, named Monte de Canteroni, has the form of an elongated saddleback; it runs east and west, parallel with the western extremity of the crest of La Somma, rising towards Vesuvius. It divides, as it were, in the direction of its length, the outlet of the elevated valley, and as it does not reach the foot of the cone of Vesuvius, it forms only an incomplete partition which divides the currents of lava flowing out of Atrio del Cavallo. At the lower or western extremity of this saddleback is situated the Observatory.

The greatest overflows are always those which make their way across the mass of the mountain; for when a volcano has acquired a certain height, the weight of the liquid column which issues from the vent becomes so considerable that the incandescent matter must rush from the fissures at a lower level. But, for a certain number of years, the centre of eruption of lava seems to have shifted towards Atrio del Cavallo, in the elevated valley situated between the two mountains.

In 1855 and the following years, eruptions made their way or had been thrown upon this point, and have transformed the elevated valley into a sort of sea of lava, which at present may be about 1,000 metres in breadth. The burning torrent makes its way to the west, but on leaving the valley of Atrio, it very soon encounters Monte de Canteroni, which divides the current into two unequal parts, giving to each a different direction, throwing back

the principal stream on the left into Fosso Vetrana, and the small part on the right, upon the slopes of the Piano. The lava does not scoop out but only rolls along the ground, the eroded ravines which furrow the sides of the mountain becoming necessarily their natural channels. Thus the successive currents have followed very nearly the same channel, being superimposed on each other through a great part of their course. When the lava streams are of considerable depth, they often pass over small inequalities of ground, and leap to right and left when they strike against any considerable obstacle.

A good carriage road leads from Resina as far as the Observatory, across the cultivated slopes which are covered with houses. At less than a kilometre from the Observatory, the road traverses the lava of 1858, which has covered up the old route, and through which it has become necessary to reopen the way. Almost immediately after having passed the lava, the Observatory is reached, where Prof. Palmieri sojourned during the terrible days of the last eruption. This building, situated at a height of 600 metres, is a substantial freestone structure of two stories, surrounded by beautiful terraces which overlook the lava field on all sides, and the edges of which are enclosed by a handsome railing not much in keeping with the desolate aspect of the place. M. Palmieri has been compelled, from the want of trained assistants, to set up registering apparatus, and can obtain certain connected observations only during the time of his occasional stay at the Observatory. But for this circumstance, the last eruption would probably have been foreseen for some time.*

From the Observatory, the summit of Mount Vesuvius can be reached in two hours. The road skirts the immense fields of black lava which stretch between Monte Canteroni and the foot of Vesuvius, and which have been formed by the recent eruptions as they escaped from Atrio del Cavallo. The lava of April 26 M. de Saussure found already quite cooled on the surface. There would not appear to be a greater amount of incandescence at the bottom of any crevasse, although the matter certainly preserves its heat under the superficial stratum, as was attested by the great number of fumaroles encountered almost everywhere. These emanations escaped for the most part from little kilns, or swollen crevasses, which communicate by clefts with the deeper lava. Around some of these fires there prevailed a strong odour of hydrochloric acid, while other vents did not emit anything but steam or warm air. These are, indeed, the successive phases which mark these emanations of lava until they reach complete coolness.

At first, the whole surface of the lava-streams seems to exhale steam and hydrochloric acid, and the atmosphere is filled with a disagreeable odour which makes breathing uncomfortable. But very quickly the exhalations are localised around the little centres of fire, whose activity continues for many months, and emanations from which are gradually modified. Thus, as seen from Naples at the time of the visit, the whole of the lava appeared to be smoking, and it was possible clearly to distinguish the tracks of the whitish vapours which appeared to wander over the surface; but close at hand there was nothing to be seen but the fumaroles, between each of which there is plenty of space. The gas and the hot vapours which the lava emits are charged with numerous substances, and become the source of mineral deposits which fill the tourist with wonder. One of the most curious phenomena observed is the power of burning lava to retain an enormous quantity of water and salt, which it does not allow to escape until it begins to cool. The formation of salt is shown generally over the whole stretch of lava emitted in 1872. Soon after the surface cools it is covered with a light crust of salt, which forms in similar flowery patterns on the beds of cinders that cover the plains, the cinders themselves emitting everywhere hydrochloric acid. The first showers caused this deposit rapidly to disappear, and there remained on the 12th of May only scanty traces, except on the lower surface of the blocks, where the rain had not the power to dissolve it. But the salt continued to be deposited in the vents, from which were detached beautiful crystals and graceful concretions; it continued also to be formed upon the great deposits of cinders on the cone of Vesuvius, and, even on May 19, the summit of the mountain, as seen from the Observatory, appeared from this cause as if sprinkled with snow.

Next to salt, the substance which is formed in greatest abundance upon the lava is chloride of iron, which assumes the most varied tints according to its surroundings, but is in general of a beautiful yellow, often orange, and is easily mistaken for sulphur. A multitude of other substances are deposited around the smoke-vents, besides those which have been named. These are for the most part metallic compounds, especially chlorides, and more rarely sulphur compounds. There are chlorides of copper and lead, hæmatite and magnetic iron ore, gypsum, &c. The peroxide of iron, in particular, plays an important part in the life of these fumaroles; it appears to be formed by the decomposition of chloride of iron; the protuberances of the scoriæ are often covered with the substance, which gives them the richest and most brilliant variegated appearance.

The origin of these many substances has considerably occupied the attention of chemists, and has not yet been satisfactorily explained; but the form of the concretions, as much as the accumulation of substance, apparently foreign to lava, indicate that they are formed by sublimation.

When the summit of the cone was approached, fine ashes were found scattered about the transverse rents that are apt to be taken for ruptures caused by the concussions accompanying the eruptions. But violent fissures would rather have formed radiating or longitudinal rents, while these are perhaps only the effect of the settlement of the cinders which naturally tend to act in the direction of the greatest slope, and to give rise to fissures analogous to those which are observed in the centre of the Alps. It is to this same phenomenon that must be attributed the step-like structure, traces of which are met with on the external face of the summit of the mountain, and which is probably owing to the fact that the lower edge of the rents must be elevated by the settlement, while the upper edge remains unaffected, or is itself lowered in supplying the matter which afterwards fills the rents. On the outside face of the cone, these steps are scarcely more than three or four inches in height, but on the margin of the internal face of the south-west side of the crater are

* See description of the Observatory, NATURE, vol. vi. p. 145.

four large sharp-edged steps of more than a metre high, arranged stair-wise, the formation of which can scarcely be explained otherwise than by a deposit or a flow of ashes accumulated at the end of the last eruption.

A vast transverse funnel, much larger than it is broad, occupies the south-west part of the summit of the cone, and this gulf is itself divided at the bottom by a partition of rocks which divides it into two compartments. A third crater occupies the north part, and is separated from the first by a considerable wall of rocks. This latter crater opens into the great north fissure which descends into Atrio del Cavallo; it was opened during the last eruption at the expense of an adventitious cone raised in 1855, and appears to have been the most active, since it is upon its side that the mountain is rent as far as the base of the cone; however, it has not ejected any lava, this having found its way out by the bottom of the fissure. During the eruption the lava was raised as far as the summit of the mountain—it has filled to the brim the double crater on the south-west—yet two days after this the lava had escaped by the south side; for on the 24th of April it overflowed the crater and formed three streams on the south, the west, and the north-east, which flowed down the slopes of the cone, and lost themselves among the fields of lava underneath. After this event the lava fell back to the bottom of the craters.

The depth of the crater may be estimated at about 130 metres. The bottom appears to be full of *débris* and ashes, but shows no sign of incandescence, nor of any adventitious cone; no smoke ascends, and the volcano, after its convulsion, has apparently fallen into a complete sleep. The only signs of activity are seen in the numerous unimportant jets of white vapour which escape either from the bottom or from various points in the walls, and which appear to dissolve in the atmosphere. Nevertheless, as seen from Naples, Vesuvius always appears with a light smoke hanging over it, which is invisible on the mountain itself. On the side next Pompeii only, to the east and north-east the slopes are macadamised by bomb-like blocks of the size of the head. The crater must have projected from all sides a shower of such blocks, but over all the other parts of the mountain this deposit must have been covered by a thick bed of ashes; and since these blocks are seen only on the east, it is evident that at the time of the last eruption of cinders a violent wind must have blown them to the opposite side. The large blocks, if they have been thrown up to the height of 1,500 metres, appear to have fallen back at a short distance from the crater. Shot vertically, they fell so, while the ashes, on account of their greater lightness, have been carried to a greater distance.

The crater on the south-west is divided through and through by a narrow rent, which is doubtless the prolongation of that which on the 24th emitted, half way up, the lava which went in the direction of Torre del Greco. This rent divides the south crest, and may be traced upon the walls of the crater, where it looks only like a simple fissure; it re-appears more distinctly on the opposite side. Another disappears among the cracks of the rocks. This rent exhaled at the summit of the crater burning gases, which formed upon the sides abundant deposits. The south crest was sufficiently filled up by sand to enable one to cross it, but such a quantity of sulphurous vapours was emitted, that to escape being asphyxiated it was necessary to make several rapid leaps. On the west side of the crater the rent still gapes, and has not been filled up, notwithstanding the heat which escaped.

The eruption of April 26 which followed the rending of Vesuvius, reopening the same vent, suddenly made its way to the same point, shattering the manifold bed of lava, and ejecting to the surface immense blocks, probably torn from their beds far below. Of this *débris*, mixed with incandescent lava, there is formed an elongated ridge of about 50 metres high, from the base of which there sprung an enormous mass of lava that swept over the little cone of Atrio. The lava burst forth at first in all directions, even a little behind in ascending the valley. It filled all Atrio, without, however, encrusting anywhere the sides of the rocks of the Amphitheatre of La Somma, and flowed along the valley in the form of a current of about 1,000 metres broad. Subsequently encountering the ridge of Canteroni, it was turned to the right, though a part of it was separated by the upper extremity of this knoll, and diverted to the left on to the slopes of Piano, where it contorted somewhat the foot of the mountain, thanks to the lava of 1858, which, having changed the slope of the ground, prevented it from continuing its route. The principal stream continued to follow the valley of the Fosso de la Ventrana, running at the rate of about one kilometre and a half in two hours, passing under the Observatory, where the lava was seen to boil up at places and shoot forth into little eruptions, projecting jets of steam and scoriæ; then it was precipitated in a cascade of fire over a wall of rock, and continued its course by the same ravine as the stream of 1855, and for the greater part of its course overrunning the lava of that year. It passed, exactly as its predecessor did, between the villages of Massa and San Sebastiano, sweeping away likewise a portion of the houses, part of it at last lodging itself on the south of Cercola, while a branch of the current continued in the direction of San Giorgio.

The imagination is unable to comprehend how such a mass of matter could escape in a single day from a single fire, and spread itself over an area of seven kilometres. The elongated ridge formed in the Atrio, at the time of the eruption, upon the site of the centre of the outbreak, appears at present only like a huge bubble on the sea of lava. It is composed of recent black lava, strewed with enormous blocks of old bleached lava encased in the new. These blocks are, without doubt, the *débris* of subjacent beds which have been broken and driven back by the lava at the time of its outbreak; the mass of them encrusted with the same lava having formed a whole so solid that it could not be swept away by the general current. This ridge does not now overtop the surface of the lava more than fifteen to twenty metres, from which we may conclude that the bed of lava at this point has an enormous depth.

The general effects of the eruption of 1872 have been somewhat as follows, according to M. de Saussure:—

1. The mountain of Vesuvius has been divided by a rent running nearly from north to south-south-west.

2. The lava, rising in the rent, has rushed along the two sides, on the north to the very foot of the cone, on the south half-way down in much less abundance.

3. The summit of the mountain has been lowered and flattened.

An examination of the lava of 1872 does not appear likely to lead to any new results. Its mineralogical nature is essentially the same as that of the other lavas of all ages that have been found both on Vesuvius and in La Somma. It is composed of a leucitic rock strewn with crystals of augite, and destitute of vitreous felspar; whence the names of leucitiferous or augitiferous, as one or other substance prevails. The most ancient lava which forms the body and crevices of La Somma, is in general very pale; it often contains an abundance of leucite crystals of the size of a foot; but its composition is, qualitatively, essentially analogous to that of the actual black lava. The lava of 1872 differs considerably in its physical appearance from that of 1858. The last is much less scoriated; it has a fleecy surface formed of round embossments, shining and comparatively little roughened. We might liken it to black whipped cream, which has flowed along, forming arches, fibrous stalactites twisted cords, which look at places as if vitrified. The lava of 1872, on the contrary, is extremely scoriaceous, and assumes a form almost like madrepore. On account of the great shrinking of the material, it has been broken up into blocks, entirely separated from each other, and roundish, because the mass was as yet vitreous; porous, in consequence of the quantity of gas it enclosed, and full of the most curious irregularities resembling coral and vegetation, which render progress infinitely difficult. The difference of appearance, combined with a thin layer of gray cinders which adheres to the lava of 1872, enables one to distinguish at once between it and those of preceding years. It will be noticed also to the north of the Observatory that the current has filled all the bottom of the valley of Ventrana, while on the south it has only run into the crevices of the old lava, surrounding the knolls, separating, re-uniting, leaving here and there inlets, as rivers without any determinate bed do at low water. This difference of structure of the two lavas seems to result from the very rapid cooling of that of 1872.

It is not easy to form a notion of the depth of this lava. In the lower parts the bed is about eight metres deep, with a breadth of about 800 metres; its borders form moraines of 45°, which indicate the small fluidity of the matter at the time it reached the place. In Atrio del Cavallo the moraine of the bed of lava which leans against the foot of the rocks of La Somma is less elevated, but the enormous waves in the middle of this surface argue in some places a considerable thickness.

The successive eruptions which have taken place in Atrio and which have piled up layer on layer, have enormously raised the level of the ground. A German geologist has conceived the idea of counting the layers which form the vertical dykes on the rocks of La Somma. At present the number would be hidden beneath more than a hundred feet of lava. The stream which debouches from Atrio has ended by considerably overtopping the Observatory; and that the latter has not been threatened this year results from the fact that the saddleback of Monte Canteroni, upon which it stands, rises in the direction of Vesuvius in such a manner that its eastern extremity (Croce del Salvatore) has hitherto performed the part of a buttress in dividing the burning stream and diverting the two currents into the ravines which slope rapidly to the right and left of the height. But a new outbreak will, without doubt, sweep away the eastern extremity of this crest, and a succeeding one would easily be able to send a stream of lava flowing as far as the Observatory. Foreseeing this danger, M. Palmieri has raised above the building a redan of a very sharp angle. This will form but a weak barrier, though it may be able to retard for a little the progress of the devastating element. Since several of the recent eruptions have happened on the Atrio side, it would seem as if the chief centre of volcanic action was tending towards that point, and there seems little doubt that one of the next eruptions will place the Observatory more or less in danger. Let us hope, however, that when that time arrives a worthy successor of Palmieri may safely chronicle what is going on, and that another De Saussure may be there to see.

WAGNER'S HANDBOOK OF CHEMICAL TECHNOLOGY

A Handbook of Chemical Technology. By Rudolph Wagner, Ph.D. Translated and edited from the eighth German edition, with extensive additions by William Crookes, F.R.S. (London: J. and A. Churchill, 1872.)

EVERY one who has studied chemistry from a scientific point of view must have been more or less struck with the fact that nearly all our manuals of chemistry have much of their space occupied with detailed descriptions of various manufacturing processes, and many must have asked why this is. It is not easy to see what utility there is in describing, in works professedly devoted to a scientific subject, such processes as those for the manufacture of chamois leather, wine, vinegar, china and earthenware, &c. &c.; and yet our largest and most ambitious manual, in common with its smaller companions, devotes scores of its pages to the consideration of such subjects. This fashion is much to be deprecated for many reasons: in the first place, these processes are utterly useless to the student, as, in the majority of cases, they illustrate no rule, elucidate no reaction. In the second, it is utterly impossible to do full justice to them in the space to which they must perforce be confined; and in the last, much valuable matter about the rarer elements and reactions is squeezed out of place altogether, or passed over with a mere mention.

This system has borne its natural fruit in the numberless questions bearing on manufactures which are to be found in all our chemical examination papers; and the result is, that many a man passes with credit on the marks gained by answering such questions, while others who, perhaps, have a much better knowledge of the science, fall behind in the race, because they have not devoted their time to Technology.

It is not difficult to see how this state of things arose. It is not so many years (we were almost going to say months), since chemistry was regarded by the public much in the same way that they now look upon the higher mathematics, as something very mysterious, very good for a learned man to know—but utterly useless and "unpractical" for all ordinary purposes. Such being the