EXCURSION TO THE SOUTH ITALIAN VOLCANOES.

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On Tuesday, September 17th, at Messina, the son of the late Prof. Seguenza and Messrs. Platania, of Acireale, met the party, and acted as directors. The steep escarpment of Taormina, composed of Triassic and Liassic strata, which have given rise to much controversy, was examined in the walk up to the town from the station.

Early the next morning the members of the excursion returned by train to Messina, to embark on the "Villa San Giovanni," a small private steamer hired for the week's trip to the Lipari islands. Just after mid-day we steamed out of the harbour and through the Straits, obtaining a splendid view of Scilla, with the lofty triple-stepped mountain of Aspromonte, which probably owes its configuration to as many planes of marine denudation. The port of Lipari was reached at sunset, when some of the less seaworthy members landed to pass the night. A portion of the party walked to the south end of the island to watch the explosions from Vulcano, and were repaid by seeing one dust-cloud give out many flashes of lightning. The next morning (September 19th), weather being favourable, we steamed out soon after sunrise and reached Stromboli early in the forenoon, where the ascent was made on the east side of the Sciarra. The summit was reached by a climb of about three hours, with short interruptions during which the party helped themselves to the splendid grapes from the vines through which much of the track lay. At the top I pointed out the sites of one or more ancient craters, as well as the peculiar position of the present vent, which occupies a situation similar to that of a parasitic cone, at a high elevation, but yet a considerable distance below the mountain summit. On account of the great depth of the sea at the north foot of the island, all the ejected materials that cannot remain at their maximum angle of repose roll down to the sea and continue their course onwards to the submarine foot of the cone. Five of the party photographed the crater from the overhanging summit. There were five active blow-holes, or small vents and cones, each of which from

time to time ejected with considerable violence showers of hot, pasty lava fragments, often accompanied by splendid vortex rings of smoke. The party then descended to the level of the vents on the west side of the Sciarra, from which also a fine view and many photographs were obtained. The westernmost vent showed a small quantity of pasty lava oozing from it for a metre or two, and then breaking off in pieces, which bounded down the steep slope of the Sciarra to the sea. Many augite crystals were collected, and the party then descended over a steep talus of sand and winding paths to the town, and embarked on the steamer. The ship steamed round opposite the Sciarra, where, two hours after dark, the monotony of the peculiarly hard bread (compared by some to trachyte) was relieved by the splendid display of Nature's fireworks.

At daybreak we steamed for the islets of Basiluzzo, Datolo, Lisca Bianca, Lisca Nera, and Bottaro, on some of which a landing was made, and a few of the members attempted to see the Caldaje, a well-known submarine fumarole, but owing to the roughness of the sea its exact position could not be made out. The party then landed on Panaria, where the typical liparite is seen to perfection. There I drew the attention of the members to the very large number of worked obsidian flakes which are met with in the surface soil, though no natural source of this rock occurs at the island. These, together with numerous little Greek statuettes of household gods, indicate the colonization of this island in very early times. On a visit to Lisca Bianca also, some years since, I found a small number of obsidian flakes on that island. At Panaria the party collected a considerable number of flakes and a few implements.* The same evening the port of Lipari was reached, and as the steamer coasted along

* From the house top on Panaria, where the party had breakfasted, a fine view of the neighbouring islets could be obtained. I drew attention to the fact that Panaria, Basiluzzo, and the other islets constituted a volcanic pile, chiefly submarine but which in many respects might be compared to Lipari itself. In fact, were the sea bottom raised a few fathoms, an island of very considerable extent would be formed, the higher eminences of which would be constituted by the few patches of dry land we saw before us. Panaria and Basiluzzo represented two enormous domes of a highly acid trachyte or rhyolite or liparite, as variously named, which had oozed forth in a highly pasty condition, without much explosive action. Some portions of the magma were less glassy than others, and as these had been drawn out just as the layers of butter and dough in a flaky pie-crust, they had produced a similar stratified structure at these two islands. If you compare the appearance of the natural section of Basiluzzo with the artificial experiment of Prof. Reyher ('Theoretische Geclogie,' Stuttgart, 1888, Fig. 153, p. 152, copied into Prof. Judd's 'Volcanoes,' Fig. 43, p. 126) you will notice the striking resem-

the east coast of that island those on board were able to examine the principal geological features as they were pointed out to them. From north to south these are the great white crater of explosion of Campo Bianco, and the enormous obsidian stream that afterwards welled out from it, breaching it to the north-east, and flowing down into the sea, now known as the Rocche Rosse and Punta della Castagna. The far greater height of the south wall of the crater, with its peculiar hump, now known as Monte Pelato, I pointed out as due to the explosion occurring on the side of an old dolerite cone, which, covered by the essential ejectamenta of the Campo Bianco crater, constitutes this Monte Pelato. This structure is revealed in the sea-cliff where the relations of the dolerite and white pumice are well seen. Farther to the south, the geologists were shown another obsidian stream which issued on the east side of Mte. St. Angelo, and flowed nearly down to Canneto. The next to attract attention were the twin cones of Monte Rosa and their peculiar imbricated slopes, due to the interstratifications of streams of dolerite with scoria and other fragmentary deposits, which were being undercut by the sea. Finally, the spherulitic rock upon which the Castle of Lipari was built, was also indicated.

A visit to the Island of Vulcano, which has been in a state of eruption since August 3rd, 1888, was the business of the next day. Landing at the Porto di Levante, the first thing that struck the attention of the party was Mr. Narlian's cutter with its side staved in by one of the projectiles at the beginning of the eruption, although the boat was more than a kilometre distant from the crater. The holes in the roof and walls of Mr. Narlian's villa, the desolation of the vine-plantation and broom scrubs, many of which had been kindled and burnt by the red-hot projectiles, and the deep layer of grey volcanic dust on everything, formed a striking picture of the desolation caused by a small eruption of a small volcano. As we approached the foot of the cone we were impressed by the projectiles scattered about in large numbers, many of which were of great size. One still hot, and therefore recently ejected, was about a cubic metre in size and

blance of the two. In fact, there is good reason to believe that important geographical changes have been brought about in historic times, and we have indisputable evidence of endogenous activity in the solfatara of *Lisca Bianca* and the fumarole of *Le Caldaje*.

nearly a kilometre in a straight line from the crater. Most of these bodies consist of a mass of very acid obsidian pumice, covered by a crust of obsidian, cracked and bent up in a very curious manner, which I have described elsewhere as *bread crust structure*.*

This I pointed out to be due to the obsidian reaching that intermediate stage between a liquid and a solid, or in other words a state of intense viscosity, like slightly warmed sealing-wax or hardened Canada balsam, which break when exposed to strong and violent mechanical stress, but bend under a slight and gradually applied one. The magma in the upper part of this volcanic chimney seems to be in this critical state, and, as the vapour collects and escapes from the more heated and fluid portion beneath the upper part, is broken in fragments and ejected, when it is relieved from the surrounding pressure and allowed to expand. The crust has cooled along the cracks before this, and continues to do so, as it is whirled through the air, and after its fall, whilst the interior expands at the same time, innumerable vesicles being formed from the water dissolved in the magma separating as steam. This expansion causes the cracking of the hardened crust, and in some cases protrusion through the crust. This expansion is proved not only by the cracking and protrusion, but also by the bending out in some cases of pieces of the crust and the drawing asunder of crystals, pieces of ancient dolerite and other rocks included in the magma, and attached to the walls of a vesicle.

The presence of these numerous projectiles, called "bombs" by some, was a warning; so the ascent to the crater was requested to be done in open order. After a tiring scramble, we reached its north-west edge. The old, deep crater is now replaced by a much shallower one, the sides and bottom of which are covered by obsidian dust, sand, lapillo, and projectiles of different kinds.

At the bottom we noticed a number of small, shallow, funnel-like pits in the sand, but no indication whatever of any activity, so much so that an unwary visitor might walk across it and probably notice nothing but a very high temperature. From time to time part or the whole of this crater-bottom is raised up by explosions of vapour and the essential eruptive material into

* H. J. J. L., 'The Recent Eruption of Vulcano,' 'Nature,' Vol. xxxix, p. 173, and "Further Notes on the Late Eruption at Vulcano Island," *ibid.*, Vol. xxxix, p. 109.

vast columns of dust, which rise to ten or more times the height of the volcano. Most of the coarser materials fall back into the crater, the distribution at a distance of the finer dust depending upon the force of the explosion and that of the wind.

During the greater of these explosions the bread-crust bombs are ejected to a considerable distance and electric discharges take place, which some of the party, who were fortunate enough to see one in the evening, described as having a peculiar green tint. We were able to remain at the crater's edge for two or more hours, during which upwards of a dozen explosions occurred, many of which five of us who were photographers have been able to register. We were at last driven away by a much more violent outburst, but on our way down did not fail to examine the fumaroles at the outer crater edge on the east side of the old obsidian stream. These were very active, giving out much vapour under pressure and depositing an abundance of realgar and sulphur and a little boracic acid.

The party then proceeded to the alum caves of the Faraglioni, whilst some bathed in the hot mineral streams gushing out on the shore close by, one well-known Professor of Mineralogy being very enthusiastic in collecting specimens of coquimbite, halotrichite, voltaite, and other rare alums in an exceedingly light Adamic costume, and fortunately for him no hand camera was in the vicinity. The triple-cratered doleritic cone of Vulcanello projecting from its plateau of lava, the formation of which has for the major part taken place in historic times, was next ascended and examined. As the different points were visited, the director explained the main features of interest, which will be reserved for a separate communication, they being too long to introduce here. After a very successful day the party embarked, with a rich collection of bombs, alums, and other specimens, on their return to Lipari, where the night was passed.

September 22nd was devoted to a trip on the Island of Lipari. Starting on mules and donkeys, we directed our steps to the east slope of Mte. St. Angelo, an old cone truncated by a crater of explosion. From the east side, at a very recent period, possibly historic, as the name would indicate, a stream of spherulitic obsidian oozed forth and flowed down the slope as a great, thick, viscous mass, known as the Forgia Vecchia, reaching nearly to the beach. Comparatively little explosive

action seems to have preceded its outpouring. Over the actual vent are a few small craterets with diminutive rings of fragmentary material, which were formed towards the end of the eruption, and in one crater are the remains of the old gas-fissure from which the last emanations occurred, depositing on its walls hæmatite and granular fluorite. Quitting this point, the deposits of white pumice derived from the Campo Bianco crater begin to form a thicker and thicker covering as we approach that old eruptive centre. Soon the sunlit glittering snow-white flanks of Mte. Chirica stood looming out against the background of the blue sea. Here I was able to point out that these mountains, like the original Mte. Pelato, are dolerite cones simply covered with a mantle of white pumice, which in some points has been denuded off. A peculiar yellow band, representing an old vegetable soil, is here met with, dividing the upper white pumice of the Campo Bianco eruption from an older one of the same material, the point of origin of which is not clear without long and careful study of the intricate overlappings of different eruptive deposits.

The grand crater of Campo Bianco with its wall of white pumice deeply interested all the party. This locality, which supplies all the first-class pumice of the world, is drilled by thousands of tunnels made in search of the larger morsels. The value depends on the practically total absence of any porphyritic crystals, which, from their greater hardness, would stand out and scratch the surface being polished. The view I offered of its formation was this:—Beneath this point there existed a fissure or canal filled by a completely fused acid glass in which separation of “formed material” in the shape of felspar or other crystals had not commenced. The glass in the upper part of the conduit had gradually dissolved or absorbed a considerable quantity of water from the more superficial and aquiferous strata until the increased tension was sufficient to overcome the superincumbent pressure. A gigantic explosion was the result, drilling out the side of the old dolerite cone of Mte. Pelato, the first essential eruptive material being nothing more than the scum or froth of the glass caused by the conversion of the water dissolved in it into the state of vapour on the relief of pressure, just as separation of carbon-dioxide blows out part of the champagne when the cork is removed. Behind there is, more and more gradually welled up, the less aquiferous glass which breached the crater to the north and poured forward into the

sea, forming a great promontory. The outer portion, which cooled more rapidly, remained a more or less pure obsidian, whilst the interior was able to undergo an imperfect crystallization, so that the whole mass has become an intricate spherulitic mass. As at the Forgia Vecchia, the last eruptive act is represented by the small unimportant crater-rings around the source and a few blow-hole craters. Some members made the ascent of Mte. Pelato along the crater edge, upon which a very large mass of black obsidian has been projected by one of the last explosions, which is interesting as showing the conversion of the fragments formed by its collision with the ground into bread-crust bombs.

A descent was made along the east side of the Rocche Rosse obsidian stream to the beach, where the deposits of commercial pumice-stone were examined, after which we embarked on our steamer, which had come to meet us, the mules returning by the paths.

The following day was devoted to the Island of Vulcano. Starting early from Lipari, we steamed along the east coast of Vulcano, landing just beyond the Pta. dell' Asino. The ascent to the great platform over the steep slopes was very tiring, as the track lay over the loose dust recently ejected, and nearly every broom, brush, or tree was dead or stripped of leaves, and the day a very hot and oppressive one. At the height of about 450m., we passed a notch in the crater rim near the Pta. della Trovatina, where ancient, very finely stratified, dust beds are seen to perfection, traversed by an old radial dyke. Just beyond this point we rested in the shade of a few still surviving broom trees, and obtained a number of photographs of the explosions from Vulcano. Thence we proceeded to a small farmhouse, where a few grapes that had been able to resist the destructive effect of the falling volcanic dust were very acceptable. Close by I drew the attention of the party to a group of small olivine-basalt cones, La Soumata, where a number of beautiful, fusiform bombs and pieces of finely corded lavas were collected. This was a good point to give a general outline of the structure of the island, so far as two short visits have permitted me to make it out, and as it differs from the very simple arrangement we read of in text-books, it is perhaps worth repeating.

At a distant period two great cones grew up, that to the north-west of a line from So. dell, Arpa to Mte. Luccio being composed of trachytic rocks, and that to the south-east of

doleritic rocks. Which of these came first it is difficult to determine without a very detailed study, and it is not unlikely that they were contemporaneous, as Vulcanello and the present active cone of Vulcano have been. One or more grand explosive eruptions then truncated somewhat eccentrically to the north-west the great dolerite cone of the south half of the island. At a later date, one or more explosive eruptions likewise truncated the trachytic cone of the north half of the island somewhat eccentrically to the north-north-east of the original axis. Much of the filling up and conversion of the south crater into a raised plateau may be attributed to the materials ejected from the north crater. On this crater-plane fresh eruptions took place at Mt. Saraceno, at the junction of the two ancient explosion crater rings. From this cone part of the lavas poured down on the great crater-plane, Il Piano. Other outpours of basalts, with the formation of the cones of La Sommata, all helped to raise the floor of the great explosion-crater of the south half of the island to a plane. From the bottom of the crater of explosion in the trachyte cone, a new and at present active cone grew up, the later products of which are acid rocks, chiefly varieties of obsidian and its allies. In historic times, some distance to the north of the island, in the straits separating it from Lipari, eruptions of dolerite lava, scoria, lapillo, and dust took place, forming the present triple-cratered cone of Vulcanello with its surrounding platform of lava.

After a rough scramble the party descended to the Porto di Levante, embarked on the steamer, and steered for Messina, in the port of which town we passed the night.

Early the next morning, September 24th, we steamed out of the Messina harbour, and, after quitting the whirlpools, were much troubled by an increasingly rough sea, so that our hope of reaching Acireale and landing there was given up before we reached Taormina. The effect of sea-sickness on the majority resulted in the captain being ordered to land us at the first sheltered point. The operation of disembarkation, the finding of an ox-cart, and the transport of our luggage over part beach and part road to the Giardini Station, and our collapsed selves, must have presented a serio-comic side to the few observers of this group of disciples of Vulcan retreating from the domination of Neptune. That evening we arrived in Acireale and found ourselves once more amidst comparatively civilized life. There we were met by Prof. O. Silvestri, of Catania, and his son, who seems

to be a worthy pupil of his father. Here I handed over the reins of direction to Prof. Silvestri, satisfied that they were in more competent hands, the more so that I was really very ill. Messrs. Gaetano and Giovanni Platania—the former a Member of our Association, and an old travelling companion of mine in the Aeolian Islands, who had been of so much assistance in directing the party there, not only still continued to do so here, but in their native place of Acireale—rendered us most valuable services.

The following day we took carriages to Zafferana, and then, some on foot, others on mules, we ascended into the Val di Bove, Prof. Silvestri lucidly indicating and describing the important geological points along the way, such as the lava cascades of Val Calanna, the configuration and limits of the Val di Bove, the parasitic cones and lavas occupying its floor. Beneath the escarpment under Mt. Pomiciaro we were able to examine some of the radial dykes, the lava streams, and numerous other points of lithological interest. This was followed by an “*al fresco*” lunch, which unfortunately was cut short by a storm. A number of us pushed through the driving rain to near Lyell’s axis of Trifoglietto, from which point the sight is imposing, especially with the addition of the drifting clouds.

The same evening the excursionists had been offered a banquet by the municipality of Acireale, and on their return from the Val di Bove were pleasantly astonished on their entry to the town to find it artistically illuminated in their honour. After dinner, during which the very fine town band had played a series of pieces, toasts were drunk by some of our members, and replied to by the Sub-Prefect, the Syndic, and Messrs. Platania. This small, but pretty and clean town owes much to the late well-known Baron Panisi, who founded here a meteorological and seismological station, and in many other ways has been active in making Acireale, with its grand hotels and thermomineral establishment, what it now is, a place from which many continental Italian cities might take an example.

On Thursday, September 26th, under the direction of Messrs. Platania, on the path down to the beach, the different superposed doleritic lavas of Etna were examined, and after refreshment at one of the directors’ houses, we embarked on boats, which first conducted us to the remains of the Grotto delle Palumbe, where a thick stream of dolerite exhibits, for such a coarse-grained rock, very fine columnar structure. The

energetic rowing of the fishermen took us rapidly along the coast, where very ancient Etnean basalts are intricately interwoven with Pliocene clays; where lava-stream succeeds lava-stream; where the fig-cactus and the vine monopolize every metre of loose scoria or lapillo; and where at some points fine ferruginous springs gush out from the cliff-face.

On our landing at Trezza, the largest of the Cyclopean islands, Prof. Silvestri pointed out that it was in part composed of clay metamorphosed by the contact of the basalt forming the other part of the island. The members were able to observe numerous minute dykes extending into the clay from the main mass, and to collect some very creditable crystals of analcime from the basalt. This mineral has been subsequently introduced into the basalt in such great quantities as in some cases to convert it into a rock which has been called analcimate. Landing at Acicastello, the celebrated globular basalts, with their associated palagonite tuffs, containing herschelite, phillipsite, and other zeolites in abundance, furnished ample scope for observation and discussion by the party. A comparatively recent but non-historic lava-stream is seen at one point covering some of these more ancient Etnean productions. Before taking the train to Catania, a fine fan-shaped group of basalt columns was examined close to the station.

On Friday, September 27th, invited and conducted by Prof. Silvestri, the fine museum of the University was visited by the party. This collection, probably the finest vulcanological collection that exists, and especially the beautiful models of recent eruptions of Etna, and the collection of their ejectamenta, were much admired. Not less valuable are the fine series of rough rock-specimens, with their polished equivalents and large very thin sections from the same. The Sicilian sulphurs, ambers, and other minerals add to the beauty of the collection. The museum also contains a fine series of seismological instruments. The whole represents many years of toil on the part of Prof. Silvestri.

In the afternoon we drove to Biancavilla, noticing the numerous large lava-streams cut by the road, chiefly outflows of 1669. At Paterno, the so-called mud-volcanoes, or "Salse," were examined, which, although now comparatively inactive, in 1879 showed great activity. Here Prof. Silvestri gave a discourse on the phenomena of mud-volcanoes in general, which he illustrated by those in the midst of which we were

standing. He then conducted us to the neighbouring *Acqua Grassa*, which is seen to be two rectangular basins, containing about two cubic metres each of a ferruginous water in a constant state of ebullition from the escape of carbon-dioxide, constituting a splendid drinking water, of which most of us availed ourselves with gusto.

It was nearly dark when we arrived at *Biancavilla*, having made another stop to collect specimens of the *angite-andesite* at the foot of the cone of *Mt. Calvario*. At *Biancavilla* we had been kindly offered hospitality in the country-house of the *Marquis di Favara*, a most valuable help to us, for which the party were most grateful, as there is nothing approaching an hotel in the place. Soon after our arrival the *Syndic*, some of the municipal councillors, and the town band came to greet us, the latter playing to us whilst dining.

At daybreak the following morning we were up, and the large quadrangular court-yard presented a picturesque scene—with over twenty mules, many recalcitrant, lethargic muleteers, excited geologists, odd-looking baggage, with the writer running here and there, directing, scolding, hurrying, urging, and otherwise stimulating the guides and mule-drivers.

Notwithstanding that the starting had been ordered for five a.m., it was nearly six before we were all fairly on our journey. A splendid morning, *Etna*, standing out in all its grandeur, was a picture that few who saw it will not have indelibly engraved on their memory. Not less impressive were the numerous wild, rugged lava-streams that were crossed, alternating with vines and woodland, with here and there a gigantic parasitic cone. Thus we continued till near midday, when we halted at the cones of *Grotta degli Archi* to eat our well-earned lunch, which was followed by a demonstration from *Prof. Silvestri* of the way in which these cones were formed along a lateral fissure, now known as the *Grotta degli Archi*, or *Grotto of Arches*, a tunnel the upper portion of which we entered, representing the upper extremity of the now empty dyke, and forming an arched communication from one parasitic crater to the other.

Another few hours of climbing on our mules brought us past the eruptive fissure of 1879 to the edge of the *Piano del Lago*, beyond which all is desert. At about 5 p.m. we reached the

Observatory, and, depositing our mules and baggage, I called upon those near by to follow me if they wished to see the crater that evening, as we did not know what weather we should have on the morrow. Six or seven besides myself started, and although I did not know the new path since the last eruption, fortune favoured us, and in spite of a strong and biting wind we were able to obtain a fine view of the crater and circle round more than half its circumference, which is probably more than a mile. It is now in a solfataric state, with nearly perpendicular walls and flat floor, probably some 100 to 200 metres beneath the rim. We descended opposite the Observatory, and had an amusing scramble over a very steep slope of hot, fuming, compacted dust.

Unfortunately, after a terrible night of piercing wind and driving cloud, the following morning rendered the ascent that was to be made under Prof. Silvestri's direction impossible, and some of the party had to descend disappointed. It is not the crater of Etna, however, that is the great centre of interest, but the innumerable things that one observes in the ascent and descent. After leaving the Piano del Lago on our way down, we quitted the clouds which were simply capping the mountain, and on our path to the Casa del Bosco, where we lunched, we often had bright sunshine. At the Observatory, thanks to the kindness of Prof. Silvestri, we had been most hospitably fed, and even at this point we had again to fall back on the abundant supply of provisions that he had provided for us.

Our next goal was the eruptive focus of 1886. We struck out of the main path for Mt. Gemellaro, a very large parasitic cone thrown up during that outburst. A considerable number of the bombs, containing partially fused quartz, thrown out on the flanks of the cone, were collected, and after photographing some peculiar lava formations, we continued our way down amidst a slight rain which rapidly increased, so that we had to hurry past the foot of Mte. Rossi without stopping to examine it. At Nicolosi we were met by carriages which conveyed us to Catania. The next day we took train to Messina, crossed to Reggio, and then went for twenty-four hours by train to Naples. The latter part of the journey, though undoubtedly fatiguing, was of great interest on account of the physiognomy of the country, from which many interesting lessons of

mountain and valley formation as well as of simple denudation could be learned.

On October 1st, the second group of the party, who had assembled in Naples, visited the National Museum, the churches of S. Chiara, Duomo, etc., Dr. A. Sambon, who especially occupies himself with mediæval art, acting as director, and in the evening they were joined at Parker's Hotel by the section from Sicily.

The following morning (Tuesday) a couple of hours were passed in examining the Zoological Station, its well-fitted laboratories and scientifically and artistically arranged aquaria, under the able guidance of the vice-director, Dr. Eisig, and MM. Linden and Megazini. We then proceeded in carriages to Camaldoli, where a magnificent view of the Campi Phlegræi is obtained. After lunch, the writer said he had brought them there to point out the general configuration of the country to be visited during the next fortnight. On the one hand was the Gulf of Naples, with its south-west side bounded by the Cretaceous and Jurassic Limestones of Capri and the Sorrentine peninsula, while at its deepest concavity rose in elegant, sweeping curves, broken by jagged precipices, the pile of Somma and Vesuvius. Then came the true Phlegræan Fields, including the amphitheatre of Naples, the ridge and Cape of Posilippo, Nisida, the hills of Mte. Dolce and Mte. Olibano, La Starza with Pozzuoli, Mte. Nuovo, the Lucrine lake, Baths of Nero, Baiæ, Bacoli, Mare Morte and Misenum on the mainland, but also the geological prolongations of the Islands of Procida, Vivara, and Ischia. The latter islands formed the south boundary of the Gulf of Gaëta, with Monte di Procida, Fusaro, Cuma, and then that long sweep of low ground of Castel Volturno, Mondragone broken only by the limestone bosses of Mte. Massico, until close to Gaëta, which is backed by the calcareous pile forming the north boundary of the gulf. The numerous cones and craters at our feet in all stages of ruin; the plains of Bagnoli, Soccava, Pianura, Quarto, in part due to old craters of explosion; later submarine bottoms when the waves lapped the foot of Mte. Barbaro and the base of the precipices we were then looking down from; the bright sun, the blue sea, and green foliage after the first autumn rains, combined, with the fantastic configuration of the country and its varicoloured rocks, to form a picture unique in itself and of

uncommon beauty. In fact, all the party admitted that they could hardly decide which impressed them most: the valuable geological lessons to be learnt from the district, or the beautiful outline and colouring of the landscape. Regaining our carriages we directed our course to the new quarter of Naples, now being constructed on the Vomero hill, where some good sections are exposed. The great mass of almost uniform yellow tuff cut into for some 25 metres is well seen overlaid by numerous comparatively recent, though pre-historic, trachytic pumice and dust beds, on which the writer expressed the opinion that they were derived from the craters of Astroni, Fondo di Ciglio, and the Fossa Lupara. He also pointed out nuclei of greener tuff passing into the characteristic yellow variety towards the surfaces of cracks and fissures, due to higher oxidation. The museum of San Martino was closed, but by the kindness of the Conservator, by order of the Minister of Public Instruction, a short round was permitted. From two of the balconies the topographical features of Naples, Somma-Vesuvius, and the Sorrentine peninsula were explained more fully than at Camaldoli.

That evening it had been intended that I should give a lecture on the geology of the Neapolitan district, and I had commenced to carry that determination into effect, but was prevented from continuing by an increase of ill-health that I had been battling with for a fortnight, and the following day I was compelled to remain in my bed. Fortunately, Prof. Bassani kindly replaced me, and under his care the party were conducted to the celebrated Grotta del Cane and the neighbouring thermomineral springs of the Lago d'Agnano, with the fumaroles of the Stufe di San Germano. From thence they proceeded to the Solfatara, where Prof. Bassani explained the phenomena of this semi-extinct volcano, how its emanations attack the trachytic tuffs, decomposing them into kaolin, free silica, alumina, and sulphates of the bases, which the party collected in the form of halotrichite, coquimbite, voltaïte, copiapite, gypsum, etc. Lastly, the party examined the renowned so-called Temple of Serapis, where the phenomena of oscillation of the land-level are fully demonstrated.

Sufficiently recovered from my indisposition, it again fell to my lot to grasp the guiding reins, so that on October 4th (Friday) the Campi Phlegreai was our goal.

Approaching Monte Barbaro from Pozzuoli, I drew the attention of the party to the irregular and ruined appearance of the south side of the mountain which extended round and had made so much progress as to leave a breach in the east side of the great crater, so separating, on this side, Monte Corvara, which constitutes the north side of the cone, and the crater of Campiglione, from Monte Barbaro which forms the south side. Towards the west the crater is also in part breached beneath S. Angelo, but not to such an extent; yet it is sufficient to mark the separation of Monte Corvara and of Monte Barbaro on the opposite side of the crater. It was by this former breach that we obtained admission to the great crater of Campiglione, the plain at the bottom of which is now covered by fields and gardens. This erosion of the front and sides of Monte Barbaro took place when the land-level was very much lower, so that the waves had in part destroyed this, the largest cone of the Campi Phlegreai. The deposits at the sea-bottom constitute the materials now forming the plains through which have risen, at a later date, the volcanoes visible from a point we had gained on the south-east limb of Mte. Corvara, namely: Astroni, Cigliano, Senga di Campania, Mte. Olibano, Solfatara, Mte. Nuovo, etc.

The old coast-line at the epoch when the waves lapped the base of Mte. Barbaro, and when the sea-level was some 60m. higher than at present, was as follows: Starting from the Island of Nisida it swept round the toe of the Posilippo ridge to Fuorigrotta, cutting back the cliffs behind Soccava, and beneath Camaldoli, thence to Pianura, and by a less distinct coast-line until we again meet a well-marked cliff which some distance to the west is traversed by a cutting for the road to Qualiano. The coast-line makes a sweeping loop to the south round three quarters of the Campiglione volcano, and probably including the upper rim of the Avernus and Lucrine Lakes. Monte di Procida, and a few other points of the Baja peninsula, were then islands, as well as such rocks as that on which Pozzuoli was built, Mte. Dolce, near Bagnoli, and probably Mte. Spina and some old trachyte and tuff bosses in part sheared by the eruption of Astroni on its east side. These latter eminences seem to have acted as breakwaters, and in consequence we find the old coast-line behind them more prominent and possessed of less abrupt declivities; that is that portion

from Pianura westward to a point just north of Segna di Campania.

After having examined the conformation of the Campiglione crater, we returned to the exit, near which was a quarry of the yellow tuff which composes the main mass of the cone. Numerous large fragments of grey pumice stone, quite fresh in the interior, but decomposed on the surface to a kind of palagonitic matter, illustrated how the whole of the smaller pieces and dust had undergone a similar change, blending the heap of incoherent fragments into one compact mass. This enormous collection of pumice indicated a gigantic explosive eruption which had not only built up the present cone, but probably had afforded much of the compact yellow tuff of the region, the position of which would indicate that the Campiglione volcano was later than the centre or centres from which was derived the grey piperoid tuff of the Campanias, the piperno and the museum breccia of Pianura, Soccava and Naples.

The party then proceeded to Mte. Nuovo and ascended to the summit of the mountain, which was built up in the course of some forty hours by the constant ejection of pumice and other materials from an eruptive axis passing through the streets of Tripergola, a village with thermomineral baths on the seashore. The geologists might perceive that the main mass of the mountain was composed of a trachytic pumice, over which was spread a mantle of great masses of a dark, very basic trachyte (sometimes considered a phonolite), occasionally compact, but more often scoriaceous. This, I said, I considered to prove that while the magma in the upper part of the chimney was saturated with dissolved water, that lower down, and farther from aquiferous rocks, was less so, and had the eruption become permanent, no doubt lava would have poured out continuously. Many of those present collected fossiliferous concretions, which are similar to those found in the submarine marly tuff of Ischia, and in the submarine tuffs of the Starza which underlie Mte. Nuovo, and which are the deposits of the epoch of the erosion of Mte. Barbaro. Descending to some pozzuolana quarries, I pointed out that when we cut into the mountain for a few yards, we could see that the pumice and pozzuolana had already been converted into a yellow tuff much like that of Mte. Barbaro, although only 250 years had passed since its ejection as new material.

The crater lake of Avernus and the Lucrine lake were next visited, and the return journey included an examination of the Starza cliff, where a large collection of fossils was bagged. The following explanation was given: The materials here seen in section were derived from different sources, and in part by marine erosion of Mte. Barbaro, and were deposited at the seabottom when that erosion was progressing as described above. Immediately previous to the historic period, and after the rising of the land some 60m., a marine terrace was cut in these deposits with a cliff face from 10 to 100m. nearer the beach than at present. The Romans built along near the edge of this cliff, and on the foreshore at its foot (Temples of Serapis, Nymphs, and Neptune), and during this period depression was going on, the temples of the Nymphs and Neptune were probably abandoned, and a new and higher floor was added to that of Serapis. Up to the middle ages this depression continued, until the sea once more had covered the foreshore and cut back the Starza cliff to its present position, exposing and undermining the foundations of the Roman villas above. Part of these fell, were broken and rounded by the sea, and converted into pebbles. The exposed beach, with black sand, shells and brick and marble pebbles, was shown to the party, opposite the main gate to the Armstrong Works, at a height of 3·75m. above present mean sea-level.

In the evening the party paid a visit to my house to examine my private collection of rocks and minerals from the South Italian volcanoes, the former being by far the most extensive and choice either public or private, and the latter the finest private collection, or second only to that at the University, and therefore likely to prove of considerable interest to geologists visiting the neighbourhood.

The following day (Saturday, October 5) the party proceeded in carriages to the Vesuvian Observatory, and thence on foot to the Atrio. During the ascent the lavas of 1631, 1767, 1858, and 1872 were examined. The scoriaceous lava surface, with its bombs and the pahoehoe or corded type, with but few bombs, were pointed out, and explanations of the reasons of this were given. In the Atrio the dykes, lava-streams, and conglomerates were examined, and the condensation and agglomeration of the latter into a solid rock towards the lower part and centre of the great escarpment were shown to result

from heat and pressure. The newly-discovered hollow dykes and those that had been drained out and refilled a second, and even a third time, excited much interest.

The barren, rugged, and jagged lava-fields of the Atrio, the stupendous precipice, the frowning cone of Vesuvius, with its jets of stones and volumes of vapour, the latter mingling with the storm-clouds scudding through the ravines and around the towering peaks, strongly impressed those present with their grandeur.

With a basket or two of lapillo, a model was improvised to illustrate the causes of the configuration of this volcano at different periods of its growth. Some of the party descended by the Cupa Pallarino (once called the Riva di Quaglia), where the pumice beds of Somma are well seen, and where a good selection of the various ejected blocks can be collected.

The Sunday (October 6th) was occupied amongst the beauties of the National Museum, Dr. A. Sambon's demonstrations being very interesting and valuable.

Attention was drawn by myself to the various stones used in the arts there represented, as well as to the different minerals formed by the decomposition of the bronze antiquities. In the afternoon about half the members accompanied me to the tunnel of the Mte. Santo-Vomero funicular Railway in Naples, where the newly-discovered sections of interest are to be seen. A rich collection was made of rocks from the "museum" breccia as well as of the grey pipernoïd tuff. The details of this section have been described in the 'British Association Reports' (Vesuvian Committee) during the last three years. In the evening, boxes at the Bellini Theatre had been offered the party by the municipality of Naples, and a pleasant distraction from vulcanological work was found by the excursionists in Gluck's charming opera of "Orfeo."

On Monday (October 7th) the triple crater ring of the Fossa Lupara or Senga di Campana was visited, but the height and denseness of the vegetation prevented a good general view being obtained. Subsequently the sections of Pianura and Soccavo were examined. The problem of the "piperno" was broached by me somewhat in these words. Those of the party who had seen the tunnel section on the previous day would recognize its similarity to that before us. The massive yellow tuff, beneath which comes, in both cases, the "museum"

breccia, reposes, in its turn, at Naples on pipernoid tuff, and at Pianura on piperno, and these respective materials on white pumice beds. This showed that the grey pipernoid tuff and the piperno were stratigraphical equivalents. The former had all the characters of a tuff, the latter those of a lava, as indicated by flow-structure around the numerous fragments of greenish-yellow tuff, etc., caught up, by the overlying fragments of a more vitreous variety of the same, and by the presence of two (especially at Soccavo) distinct flows separated by a breccia of trachytic rock-fragments. Some authorities had supposed the piperno to be a metamorphosed tuff, but an examination of the section disproved that view, since the underlying pumice was unaltered, as also the trachytic breccia between the two flows of piperno. These facts lead us to the conclusion that not far from here, and probably a little to the south of Soccavo, at one time stood the great piperno volcano, subsequently destroyed by explosive eruptions and marine erosion, and that this was the centre from which was dispersed the grey tuff of Naples and of the whole Campania, which is of the same age. As regards the origin of the pipernoid structure, it could be explained by supposing the vent opening at the top of a fissure filled by the original magma, at the junction of two portions which contained different proportions of dissolved water and had undergone different stages of crystallization from cooling. The pasty magma would then issue with a laminated structure, just as different coloured clays or soaps do through a narrow aperture, the greater cohesion of the black, more vitreous, and less cooled portion causing the separation of the laminæ into larger pieces, which, with their peculiar, crushed, and squeezed-out surface, have remained in the lighter coloured, more granular, crystalline, less cohesive, and cooler ground-mass, which from containing more water tended to its disintegration to dust.

On Tuesday (October 8th) the train was taken to Pompeii, where Dr. A. Sambon acted as archæological director, and the beauty of the buried city being duly admired, the attention of the party was turned to the materials in which the town was buried. The pumice, with the more vitreous lower part, contains, as porphyritic inclusions, crystals, chiefly of intratelluric minerals; whilst the upper part, darker in colour and more microcrystalline, has inclusions of crystals of post-eruptive

minerals, and above these pumices come the pisolitic dust-beds. These are followed by very thin lapilli beds of later eruptions. The leucitic lavas on which the town stands, and the different rocks used in the arts by the ancient inhabitants, also attracted attention.

Signor Dini had kindly placed his steam-tug at the disposal of the party to visit the quarries of 1631 lava owned by him, which are the largest and best worked on the mountain. The rough sea and unfavourable weather prevented our availing ourselves of that kindness, and also of refreshments it had been the intention of the proprietor to offer us. After visiting Pompeii, we drove over to one of the smaller quarries of the 1631 lava, where the irregular columnar structure, shearing-planes, steam-caverns, and scoriaceous surface with bombs, could be well seen in section.

Early the next morning, being joined by Professor Bassani, we drove to the quarries of Faiano, near Nocera, where the grey pipernoid tuff is seen and quarried to 20 metres in depth. I explained that these tuffs are found all over the Campanian plain and a great part of the Terra di Lavoro, almost uniform in structure. Where they are in close vicinity to high limestone mountains they contain fragments of that rock, which are more or less, according to size, converted into silicates and fluorides, which was supposed to be due to the action of hydro-fluosilicic acid, which probably formed one of the soluble constituents of the dust as it fell. What was of great interest was the fine crystals of biotite and nepheline, besides pyroxene and amphibole. Of not less important bearing on the temperature and pressure of metamorphism was a deer bone, which I lately found there, covered with amphibole and some nepheline crystals, but still retaining traces of animal matter. The age of this grey tuff is indicated by its stratigraphical position, which, taking distance into consideration, is similar to that of the grey pipernoid tuff of Naples and the piperno of Pianura. At Fiano and the neighbouring Fossa Lupara (not that north of Astroni) the grey tuff is overlaid by the Somma pumices representing the eruptions that excavated the Atrio del Cavallo crater (PHASE III TO VIII). In the great Atrio section, we have exposed the different mantles of volcanic ejectamenta, the lowest of which date back to the time when the entire cone of Somma could not have been as high as the present Vesuvius;

yet no traces of it are to be found, so that it must be more ancient.

Rejoining our carriages, we drove along the Sarno plain, at the foot of the limestone mountains to Castellamare, Professor Bassani pointing out the characters of the sedimentary rocks. After dinner, Professor Bassani gave a very able and interesting discourse on the orography of the Sorrentine peninsula and Capri, together with an account of the recent geological investigations of that district.

On the following morning (Thursday, October 10th), under the joint direction of Professor Bassani and myself, the sections exposed along the road from Castellamare to Sorrento were examined. We descended from the carriages at different points to visit the fine exposures of the Neocomian ichthyolitic limestones and the *Orbitulina*-marls (Aptien), ably guided by Professor Bassani.

Just before Vico Equense, we descended to the bathing establishment, where nearly at sea-level a very abundant spring of a very rich sulphur water issues, and the products of oxidation of its sulphur-compounds erode the limestone into fantastic caves, from the fissures of which abundant crusts and crystals of selenite, as well as some epsomite, can be collected. Close at hand I drew attention to a patch of the grey pipernoid tuff, with pieces of limestone partly converted into fluorides, etc. This tuff is seen reposing on some much older volcanic deposits, yellow earth and pumice collected in depressions in the limestone.

On our arrival at that point of the road which overlies the plain of Sorrento, I explained the structure as follows: the Sorrento peninsula represents an upthrow along a line of fault marked by its southern coast. Springing from this main fault, nearly at right angles, extend a number of transverse ones, and between two of these a depression is formed by a downthrow. This lower slope has been partly levelled by filling up with grey pipernoid tuff similar to that we saw at Nocera and Naples. This tuff is beautifully seen from our standpoint, forming a long line of cliff limiting the plateau seawards. These cliffs have a coarse columnar structure, which in other localities is often developed to great perfection, and the tuff near the contact with the limestone contains the usual inclusions.

The municipality of Naples had kindly placed a large steam-yacht, the "Sibilla," at our disposal, and on our arrival at Sorrento we were met by a deputation of representatives from the Naples municipality, consisting of Professors Majone and Roccatagliata, and Captain Vercilli, with whom we immediately embarked.

Within an hour we found ourselves at the Blue Grotto of Capri, which we were able to visit, owing to the calm sea.

On landing, our party, which was now over fifty in number, were divided amongst three hotels. After lunch, the prehistoric flint and obsidian implements, rocks, minerals, etc., of the island, carefully collected by Dr. Cerio, were exhibited by that gentleman, and the thanks of the party were offered to him with the expression of their admiration of his efforts to get together under many difficulties this valuable local collection. Later the party ascended to the Palace of Tiberius, and along the road Professor Bassani lucidly explained his own views, as well as those of Oppenheim and others, on the relationship of the Jurassic and Cretaceous rocks of Capri to those of the Sorrentine peninsula, and other parts of the mainland. From the ruins of the Palace of Tiberius the magnificent view at sundown, and the historic reminiscences called up by the locality, and ably recorded by the Rev. J. C. Fletcher, of Naples, deeply impressed everyone. After dinner, the party accepted coffee, etc., offered by the Mayor of Capri, and walked over to the Villa Tragara, the property of C. W. L. Ostermoor, Esq., of London, from which a magnificent moonlight view of the island was obtained, and where a pleasant hour was spent in admiring the scene, and consuming the liberal supply of refreshments provided by Mr. Ostermoor.

The next morning, October 11th, found us betimes on board the yacht, and a pleasant steam of two hours brought us to Casamicciola in the Island of Ischia. I had requested the captain to take the course outside Procida, so that those on board might admire the remarkably picturesque situation and surroundings of the town of Procida, and look into the partially submarine crater of Vivara Island. On landing at Casamicciola, the town authorities met us, and placed carriages at our disposal, with which we proceeded to visit some parts of the island. Monte Rotaro crater with the Monte Tabor lava-stream of mellilite trachyte, the craters of Montagnone, Porto d'Ischia,

the trachyte dome of Castello d'Ischia, and the bosses of ancient trachyte were pointed out. The road we followed lay for some distance over the olivine-trachyte lava-stream, the rough surface of which is still well seen, although at many parts small pine copses have been planted. Passing close to the irregular crater ring of Cremate, I pointed this out as the source from which this lava-stream, called the Arso, flowed in A.D. 1302 for a distance of two miles, when it entered the sea, forming a promontory. The Molara and another parasitic cone and crater were examined. At Testaccio, quitting our carriages, we descended to the beach of Maronti, but owing to the heat and the tiring walk on sand, the party did not reach the patch where the beach and sea-bottom attains a temperature of boiling water; nevertheless, some fine gorges in alluvial tuff, illustrating denudation, the formation of earth-pillars, etc., were examined. On the return of the party to Casamicciola, the remaining half-hour at our disposal was devoted to a drive round the earthquake ruins of the town. After a sumptuous dinner, at which over 50 people sat down, votes of thanks were offered to the municipalities of Naples, Capri, and Casamicciola, and their representatives. So high did the spirits of the company rise, that even ladies became eloquent and proposed toasts, which, though short, were no mean specimens of oratory.

A calm sea, a bright moon, and a soft evening, made our return trip to Naples such as is not to be forgotten. The deep indigo sea, and the trace of haze gave to the promontories, islands, and rocks a fantastic beauty, whilst the majestic, sweeping curves of Vesuvius, crowned by the jewel-like volcanic fires and vapour plume, reminded us that amidst all this beauty beneath and around us, the great igneous forces of nature were but in a recuperative slumber, a slumber the awakening from which will be earthquakes and eruptions.

The crater of Vesuvius, the principal focus of the volcanic activity of the Naples district, was the centre of the hopes and wishes of the party. I had placed it at the beginning of the programme, but for ten whole days either strong wind or cloud cap had prevented me from making the excursion. Over sixty visits to the Vesuvian crater had taught me to be cautious, but some members of the party, inexperienced of the locality and impatient to get there, openly rebelled and went on their own

account, of course failing to see anything more than mist. Saturday morning, 12th October, being more favourable, I gave the order for Vesuvius. Fortune favoured us in every way, and even a little cloud that had collected on the mountain top dispersed before our arrival. Four concentric crater-rings were visible, and at the bottom of the central one, two vents which all the party were able to approach within twenty yards, were giving issue to high-pressure vapour and pasty lava-fragments. Descending some 100 metres on the east side of the great cone, we were able to approach a small stream of lava, upon which various experiments were performed.

Sunday, October 13th, was a well-earned day of rest, and, although, owing to the loss of two days, the excursion to Monte Somma should have been undertaken, yet the majority of the party prayed for rest, and none desired it more than myself, still imperfectly recovered from my indisposition.

One or two of the youngest members of the party, however, had a successful trip to the locality. Neither on Monday could all the attractions of the Mineralogical Museum of the University, or the extensive knowledge of its contents of the venerable Professor, A. Scacchi, infuse sufficient stimulus in the flagging energy of the party. Packing the numerous spoils of the vulcanological chase required a considerable share of the morning.

Starting by the 3.25 express train, we arrived at Sparanise just before sundown, and were met by carriages placed at our disposal by the Province of Terra di Lavoro, to convey us to the town of Sessa Aurunca, where we arrived some time after dark. As the town possesses no hotel, the municipality had kindly allowed us to sleep in the Lyceum, the scholars being sent to their homes or friends' houses. The married couples were placed in different private houses. In the hall dedicated to the celebrated Nifo, a native of Sessa, a luxurious banquet was offered us by the town, most of the municipal authorities being present at the table.

The following morning (Tuesday, October 15th), after coffee offered by the municipality, we mounted in carriages, again provided by the province, personally represented by Prof. Spatuzzi. It was fortunately market day, and what the ordinary visitor, who follows the regular travellers' track, does not see, was a most interesting spectacle to our party. As we

wended our way up the vine and olive-clad slopes of the extinct volcanic pile of Roccamonfina, the yellow tuffs, then the leucotephrite and leucitite lavas and breccia beds, were of great interest. The peculiar decomposition of the former rock into a kind of concentric lamellar wacke, which often completely involved a stream, and made it look like a tuff, taught an important lesson to those who had studied ancient volcanic rocks. Near the entrance to the great crater-ring the explosive pumices and lapilli, near a great leucitite dyke composed of large leucite crystals in a fine-grained base, are well seen in the road-section. A little beyond, overlying all other deposits, we have the grey piperoid tuff in columns that we had studied at Naples, Faiano, Vico and Sorrento. The town of Roccamonfina is the birth-place of the Com. N. Amore, the Mayor of Naples, who had done so much for us during our stay there, and he had determined that we should be equally well received in the town of his boyhood. On nearing Roccamonfina, we were met by the Mayor, Town Council, and the other notabilities of the place, including Com. Amore's brother. We had to descend from our carriages and enter the town in state procession, preceded by a town band, and amidst the shouts of welcome from all the inhabitants, who had turned out to see "gli scienziati Inglesi."

While lunch was being prepared, we ascended to the Pietritroccoli, one of the central eminences of the mountain. From this favourable position I made the following observations:—"You will notice the striking similarity in size and configuration of this volcano to that of Somma-Vesuvius. This similarity even extends to the leucitic rocks forming the main mass of the mountain. Some years since I spent some weeks in studying this volcano, but have never published the observations then made. Doctor Bucca and Signor P. Moderni, both of the Italian Geological Survey, have since then published short memoirs on the mountain. The researches of the former are chiefly petrographical, and his views quite correspond with my own; and Signor Moderni has added much to our knowledge of the sequence of the different eruptive products, especially the lavas, and I propose to supplement those researches by alluding to the information to be derived from my own observations.

"So far as we know, the volcano originally consisted of a gigantic cone, built up by the constant outpouring of lavas and

the ejection of scoria, lapillo, and dust. These materials were both characterized by the presence of leucite, and, according to the researches of Bucca and Moderni, the earlier outpours are of leucitite and the second of leucotephrite. My own observations lead me rather to consider them as intermitting with one another, and also to conclude that during the leucitite phase explosive eruptions occurred with the production of much white and grey pumice, pumiceous scoria, etc. As the great mountain grew, parasitic cones burst forth from its flanks, from which flowed the leucitic lavas, and Signor Moderni enumerates no less than a dozen such, still recognizable. The main volcanic cone having attained an altitude of from 2,000 to 2,500 m., one or more violent explosive eruptions truncated this cone down to less than 1,000 m. in height, leaving a large crater-cavity from five to seven kilometres in diameter. This or these explosive eruptions were around an axis a short distance to the east of the old one, upon which had been built up the old cone during long periods of Vesuvian activity. The products of this or these explosive eruptions we see in the numerous and extensive beds of white pumice and yellow tuff derived therefrom on some of the upper parts of the mountain, and especially around its toe. Around this new axis of eruption, exudation rather than eruption of an augite-andesite lava took place, building up a great triple dome or mammelon, on a portion of which we are now standing, and partly filling up the great crater-cavity. The annular fossa between this central cone was subsequently filled up level with the lower part of the great crater rim by fragmentary eruptive materials from other centres, and by erosion of the central cone and the inner crater walls. The latter are known at present as Monte La Frascara and Serra Piccola, or sometimes as Monte Cortinelli. You will recognize the analogy of this crescentic enceinte with the similar escarpment of Monte Somma, the circular plain on which the town of Roccamonfina is situated, with that of the Atrio del Cavallo and the Pedimentina, and, lastly, the compound cone of Monte S. Croce, Lattani, and Pietri-troccoli, on which we now stand, with the great cone of Vesuvius. Trachytes were poured out from thirteen lateral cones at an uncertain date, which Signor Moderni places just previous to, during, or after the production of the great central andesite mass. Then followed a period during which nine other parasitic cones gave forth basaltic

lavas, scoria, etc. Two of these latter had formed on the crater plain, constituting the hills of *Tori Sichi* and *Garofali*.

"At a still later date enormous quantities of a fine dust were deposited on the volcano from some distant source, which, when washed down, choked the valley by the resulting tuff, which often exhibits beautiful columnar structure, and if not identical with, bears a very close relationship to, the grey pipernoid tuff of the *Campania*."

Descending to the Town Hall, we found a plentiful lunch awaiting us, provided at the expense of the Commune, to which we did full justice after our long walk and climb. After taking coffee at the house of *Cav. Amore*, we again resumed our carriages, and drove down to *Mignano*. Although rain was now falling, we stopped at various points along the road, and at one spot made a good bag of large leucite crystals. At *Mignano* station we took the Roman express, it having been stopped for us by order of the Minister of Post and Telegraphs. We descended at the station of *Cassino*, and had over an hour's drive in torrents of rain to the top of *Monte Cassino*, where we were most cordially received by the prior, *Dom Oderisio Piscicelli*. One carriage had broken down on the way, and the occupants had had to tramp the rest on foot, one gentleman being only shod in thin slippers. A luxurious dinner, served in the great hall of the monastery, soon restored our drooping spirits and exhausted energies, and after a pleasant chat with the prior and other monks we retired to our comfortable cells, and slept a blessed, and, I hope, a saintly, though certainly profound sleep. The ladies had been quartered at the *Foresteria*, outside the monastery, and were equally well treated.

The next morning they were allowed to join us, and visit this remarkable centre of culture, with its valuable works of art, archives, antiquities, natural-history specimens, etc. The reproduction in lithography of the designs of ancient ecclesiastical robes and the printing and publishing of the contents of the innumerable manuscripts were all duly appreciated.

Lunch was served in another apartment, where ladies could be admitted, and the honours of the table were taken by the *Rev. Prof. Laitine*, a French monk specially delegated to receive strangers. After expressing our gratitude to the prior

and all the fathers of Monte Cassino, we commenced our descent on foot. Prof. Bassani, of Naples, who was to have directed, being unable to be present, had kindly handed me the following notes, which I communicated to the members :—

Monte Cassino is entirely composed of Cretaceous rocks containing *Hippurites*. The rock is a compact limestone, sometimes arenaceous, of a dirty white, dark yellow, or carnation colour. It is always traversed by veins of crystalline calcite, and often resembles that of Castellamare. The stratification is rarely clearly defined, but may be well seen at the commencement of the road from the town to the monastery. Three quarries occur in the neighbourhood, one just north and to the right of the station; another north of the town, and at the base of Monte Silvestro, beneath and to the north of Castello Manfredo (Rocca Jovina). The strata dip in the former 30° towards north, 40° west; and in the second, 42° towards north, 40° west. The third quarry is the most interesting, because one can easily collect specimens of *Hippurites* from it. It also exhibits a calcareous breccia. It is situated a few paces from the carriage road to the monastery, about twenty minutes' walk up.

A considerable number of specimens were collected, amongst which were some crystals of sulphur, which I discovered in a geode, its first known occurrence, I believe, in these Cretaceous rocks. Again joining the express train to Rome, we arrived at that city late in the evening, and took up our quarters in the Via Sistina, in the pension of Mrs. Dawes.

The following day (Saturday, October 19th) being wet, we visited the Museum of Geology and Mineralogy of the University, under the valuable guidance of Professors Strüver, Portis, Clerici, Tellini, Bucca, etc. The interesting series of minerals from the ejected blocks of the Lazial and Sabatine volcanoes, and the collection of decorative marbles and porphyrites used by the ancient Romans, were much admired.

Later in the day we examined the Museum of Geology and Agronomy at the "Istituto Geologico," in Via Susanna, under the able guidance of Cav. Ing. Zezi, the secretary to the Comitato Geologico (Geological Survey). The great variety of Carrara and other Italian marbles, the collection of building-stones and rocks, were duly admired. The interesting models of the Lipari Islands, Ischia, etc., were of great interest, and I

took this opportunity to draw the attention of those members who had lately visited the Aeolian Islands to their subaërial and also to their submarine conformation, pointing out how Stromboli is a very large and high volcano, half of it being submarine, and the origin of its Sciarra del Fuoco. Similar to Stromboli, Filicuri and Alicuri are seen to be composed of one or more semi-submarine cones, whilst Lipari is an exceedingly complex association of basic and acid volcanoes. The structure and physiognomy of Vulcano could be well studied on the raised model.

The next day (October 20th) being Sunday, the forenoon was devoted to St. John-in-Lateran and St. Peter's, and after lunch a number of other churches were visited.

On Monday, in carriages, we proceeded to the Capo di Bove, Signori Zezi and De Marchi acting as directors. In the quarries opened in the great lava-stream nearest to Rome, which flowed from the great Lazial volcano, some very fair specimens of nepheline were secured. The pozzuolana quarries, newly opened, close to the tomb of Cecilia Metella, were entered, and numerous good leucite crystals were collected. The Via Appia, the Catacombs of St. Calixtus, and the Circus of Maxentius were visited, in which latter the inner man was refreshed by a picnic lunch. In the afternoon the so-called pozzuolana quarries of the Tre Fontane were examined and a visit paid to the monastery and Eucalyptus plantations of the Certosa. On the return journey a stoppage was made at the magnificent church of St. Paul without the walls.

On Tuesday, October 22nd, we took the early train to Frascati, observing the peculiar facies of the Campagna Romana on our way. At Frascati, having provided the weaker of our party with donkeys, we made the ascent of Monte Tuscolo, Signor Zezi and Prof. Portis acting as directors. The rock, supposed by the local geologists to be a lava, but undoubtedly in most cases, according to my own views, an altered and compacted scoria, which is locally known as "sperrone," was seen to perfection. This rock has been very much used both by ancient and modern Romans as a building-stone, especially for posts, lintels, traves, etc. The ruins of Tusculum were finally reached, and lunch taken in the small theatre. Chestnuts were ripe, and we had filled our pockets with them: before lunch we made a fire of brushwood over them; and at the end of the meal

we had them ready roasted. From the summit of Tusculum Signor Zezi explained the configuration of the Alban Hills, and how the point on which we stood formed part of the rim of the great outer crater. The descent was made by way of Camaldoli and Monte Porzio, which latter is built on a parasitic cone, the form and structure of which can be easily studied.

Wednesday (October 23rd) was devoted to studying the rocks upon which the Eternal city is built, under the direction of Prof. Portis and Signor Clerici. At the Valle dell'Inferno, the directors drew attention to the fine section, in which three distinct beds were visible. The lowest, of bluish-grey sandy and fossiliferous clay, was the Pliocene marine clay; superposed on this we have the second stratum of yellow colour, composed of beds of sand which are also fossiliferous and of Pliocene age; and, lastly, the third or uppermost cap was of a darker yellow tint and consisted of materials of volcanic origin derived from the neighbouring volcanoes. Being specially permitted to enter the Farnesina, we descended to a brickyard, near which was a very fine section, similar to the last, and from which a rich selection of fossils was made. Here Sig. Clerici, who has devoted much time to the study of this formation, gave many interesting details.

On Thursday (October 24th), under the direction of Prof. Meli, we proceeded in train to Frascati, and from thence in carriages to Rocca di Papa, which is situated on the edge of the inner great crater-ring, often stopping to examine and collect. After an "al fresco" lunch, we ascended on foot to Monte Cavo, much of the way being over the polygonally paved road, made by the Romans, still in splendid repair. The constant occurrence of V. N. (Via Numinis) referred to the temple to Jupiter Latium which once occupied the summit, the centre of the annual pilgrimages of the Latin races who camped in the subjacent crater-plain. Monte Cavo is a small cone thrown up on the edge of the inner crater-ring which encloses the crater-plain just mentioned, which is known as "Campo di Annibale," although Hannibal never encamped here. Prof. Meli referred to a passage in Livy, which mentioned the occurrence of a rain of stones on the Alban Hills, supposed to be due to some eruption close by. The descent was made by way of the Madonna del Tufo, to Albano, where we passed the night at the Hotel de l'Europe. At dinner Mr.

T. V. Holmes, F.G.S., the President of our Association, said that he regretted having to leave us on the following day, and took that opportunity, in the name of the Geologists' Association and Geological Society of London, to thank Dr. Johnston-Lavis, and also Mr. L. Sambon, who had done so much to make this scientific excursion a success. He had greatly enjoyed his visit to that beautiful country, of which he would carry away an indelible remembrance. He drank to the prosperity of Italy; and as her volcanic fires were not yet spent, so he hoped that neither were those gifts which once had rendered her the first nation of the world. Profs. Meli and Portis, as also Mr. L. Sambon and myself, replied.

Early the next morning (Friday, October 25th) we took carriages to Genzano, and thence on foot made the whole tour of the beautiful Lake of Nemi. The party had the valuable services of Profs. Meli and Portis, to whom were added Signori Zezi and Tellini. The character of this crater-lake was explained, as well as that of Valle Ariccia, of which we had obtained a fine view. The latter has been filled up to its lowest edge by alluvium brought down from the hills above. Many interesting specimens were collected, including many varieties of peperino. After lunch at Albano we mounted to the edge of the Albano crater-cavity, which contains a much larger crater-lake than Nemi. Numerous ejected blocks, with haüyne and other minerals of contact metamorphism were obtained. The edge of the crater was followed to beyond Castelgandolfo. Just beyond this town Prof. Meli pointed out the vegetable impressions on the under-surface of the peperino which indicated its mud-like character when ejected. Descending to Marino, the numerous and extensive peperino quarries were visited, and our bags having reached the limit of what they could contain, pockets, greatcoats, baskets, and even ladies' mantles were converted into receptacles for the numerous heavy but interesting examples of rocks and minerals, with which we returned to Rome by the evening train.

Saturday (October 26th) saw us, with Signor De Marchi at our head, taking the train to Montecelio, near which, at Collelargo, are the quarries of Messrs. Maggiorani, worked in the Liassic limestone. In one quarry we found the old Pliocene shore-line, in which the limestone is bored by *Lithodomus* and *Olionia*, and presents other similar indications. Here we lunched,

being supplied with refreshments by the proprietor, to whom a vote of thanks was accorded. Returning we examined the bathing establishment of the "Acqua Albule." This spring, which forms a small river, sufficient to be utilized for mechanical power, is very rich in carbon-dioxide and hydrogen-sulphide. The former and the oxidation-products of the latter produce very remarkable effects upon the solution and deposition of lime in the form of travertine. Next we were conducted in a special train, provided by Count Guiseppe Savorgnan di Brazza, to his quarries of travertine, where we were joined by Signor Lanciani, the Professor of Archæology in the University of Rome, who kindly gave us much valuable information of an antiquarian nature, from which we could glean the following: These were the ancient Roman quarries, from which the stone of the Colliseum, Basilica Julia, Castle of St. Angelo, and numerous other buildings was derived. They had but lately been reopened, and we were able to see a talus of travertine that had formed against the old quarry-face since Roman times. The area that had been denuded by the ancient workers was very great, as also were the mounds, or more properly hills, of *débris*. Even tombs of the ancient quarry masters had been met with. The method of cutting out and splitting off blocks of this rock, one of which was 40 c.m. in volume, was seen going on, and Mr. G. W. Butler, B.A., obtained some photographs of it. After Count S. di Brazza had liberally supplied us with tea, sandwiches and champagne to sustain us during our return journey, we entered our special carriages, which at Bagni were attached to the train to Rome.

After dinner the members of the excursion assembled in the salon of the hotel, where I gave the discourse which I had, on account of ill-health, been unable to do at Naples. The general arrangement of the Italian volcanoes and their geological age were referred to. The only rational theory that explains all the phenomena of eruption was in a few words described, and the different regions we had visited were recalled as illustrations of the theory.

Sunday, October 27th, was again given to the churches and antiquities of Rome.

On Monday, October 28th, in steam-tram, we took the road to Tivoli with Prof. Portis, Sig. Zezi and De Marchi as our leaders. We were met at Tivoli by Cav. Tomei, and taking

the ladies in his carriage he conducted us to the sights of the town. The beautiful Villa Gregoriana, the cascades, both natural and artificial, the Mesozoic limestones, and, above all, the formation, in some cases rapidly progressing, of calcareous tuff and travertine in and near the caves of Neptune and the Siren. After partaking of lunch, the different works that utilize the water-power were inspected, and on our return journey we drove through a new subterranean viaduct lit up by incandescent lamps, worked from the electric illumination station.

In the evening the members of the party issued an invitation to the directors of the different excursions, including Profs. Lanciani, Meli, Portis, Count G. Savorgnan di Brazza, Cavalieri De Marchi, Zezi, etc.

Dr. Drew, who had presided after Mr. Holmes's departure, said, in recalling the numerous and deeply interesting excursions that they had made, he could not forget the provinces and municipalities that had offered us hospitality, thus showing sympathy to us Englishmen and interest in science; still less could he forget the professors and friends who had directed and aided them in their excursion, and he wished especially to express his thanks to Dr. Johnston-Lavis and Mr. L. Sambon, who, with their wide information, their knowledge of the localities and their love for science, had known how to overcome the obstacles and carry into execution the programme that had been proposed. He was not only grateful to Dr. Johnston-Lavis for having promoted such an important series of excursions, but also for having added so much to the advancement of vulcanological science by so many years of disinterested study, with so much intelligence and so much enthusiasm.

Before finishing his speech, he felt it his duty to combat two false and preconceived ideas of English people regarding South Italy, viz., the laziness of the people and the insalubrity of the towns. Wherever he saw man, woman, or even children, they were working with great activity, and were working for little or nothing. Then at Naples and elsewhere, all had been to visit the magnificent Sanitation works, and he recalled the interesting discourses of Prof. Spatuzzi, Signor Sambon, and Dr. Johnston-Lavis, who had shown with statistical data how Naples was far healthier than many well-known European cities and that it had made an enormous stride in the last two or three years,

which brought it up to the level of sanitation which modern civilization requires. He, therefore, could not do better than wish Italy a future as glorious as her past.

Dr. Johnston-Lavis, in reply, said that he could only express his deepest thanks for the flattering remarks referring to himself and Mr. L. Sambon. He felt it an honour to have been useful to such a large body of scientific men and women.

Mr. L. Sambon said he was sure he should be interpreting the sentiments of all in expressing their gratitude to Comm. P. Boselli, the Minister of Public Instruction, who, patronizing this journey through Italy on the anniversary of the celebrated voyage of the great Spallanzani, had shown how much interest he took in science and the renown of the country.

Count G. T. di Brazza drank to the harmony of science, art, and industry, and to the friends of his country.

Prof. Lanciani drank to the health of Old England, calling her the modern Rome, for her greatness was in her colonies, as was that of ancient Rome.

Signor Ingre. Demarchi drank to the lady members of the party, who proved how strong the weak sex were in England.

Mr. G. Potter said that as one of the three founders of the Geologists' Association, he was glad to see that on its 30th anniversary he should have been able to take part in the greatest and most successful enterprise yet undertaken by it, and he, therefore, in the name of that Association drank to the health of Dr. Johnston-Lavis, to Mr. L. Sambon, and to the professors of Catania, Naples and Rome, who had directed the various excursions.

The following day the party broke up, but a considerable number remained to see the sights of Rome.

In bringing this report of our excursion to a termination, I must first ask your pardon for the imperfections in the style and details of the account, which have been due to the very limited spare time at my disposal. In a considerable number of places it has been necessary for me to speak of myself, but although I should have wished to do otherwise, it would have rendered the account so disjointed as to have made it unsatisfactory.

Altogether, it may be said that the journey was made without any serious hitches, and even where some discomfort and displeasure were caused there was ample justification for them. A journey in Italy is not the same as one in England,

nor is one that lasts nearly two months to be compared with one of a week. Such conditions as a different people, few and bad means of communication, absence of hotels, along a track where it is considered the duty to impose on the foreigner, besides the want of punctuality and absence of those business habits on which so much depends, renders the burden of responsibility a most heavy one. Had I not had the kindest co-operation of my valued and many-gifted friend, Mr. L. Sambon, I am sure that I could not have made the excursion approach to a success. I take this opportunity in offering my deep gratitude for his valuable aid, when suddenly I found myself not only holding the helm of responsibility in the vast ocean of science, but amidst the reefs and breakers of administration. Lastly, let me thank the Association for the confidence it placed in me in putting in my charge such an important undertaking, and also for the kind tolerance towards me, when troubled by ill-health, worry, want of sleep and repose and unfavourable weather, of those who took part in it. In conclusion, let me wish success to this Association, which may be looked upon as the pioneer of its kind, and hope that this may be the first of a series of excursions to localities where the grand geological processes and phenomena are easy of access. Amongst such may be mentioned the volcanic districts of Iceland, the Auvergne, the Eiffel, the Tyrol and Hungary, the glaciers, lakes, and mountain sculpture of the Alps and Norway. I am grateful for the many valuable lessons in geology I have learnt through this Association, and there is little doubt that hundreds of others are equally or still more indebted to it.