FARTHER NOTES ON THE EARTHQUAKES OF ISCHIA

BY

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In the Bolletino del R. Comitato Geologico d'Italia for 1883 appears an article on the Ischian earthquake of that year by the engineer L. Baldacci. The present paper is an epitome and review of the same.

The oldest geological soil of the island is the light green *tufa* of Epomeo this being an agglomerated and agglutinated mass of ashes in which are often found materials of non volcanic origin, mineral, animal and vegetable.

On this tufa there are very extensive deposits of a peculiar product due to the decomposition under the sea of the tufa itself, which product occasionally passes into plastic clay adapted to the manufacture of tiles.

Casamicciolo rested on this product of decomposition while Lacco is situated partly on the trachyte (*trachyte lava*) and partly on the original tufa of Epomeo. Forio, Fontana, Serrara &c. are built exclusively on the tufa.

Noting the position of the mineral springs and other volcanic manifestations of the island it is concluded that there exists on the north of the island a great curved fissure through which all these springs and other manifestations find their way to the surface—this curved fissure extending from the baths of Ischia to Forio passing exactly through Casamicciola, its convexity turned to the north.

Now if we examine the other principal manifestation going from N—S we find a series of thermal springs indicating a fracture running from N.N.W—S.S.E crossing the first exactly at Monte Cito almost under the town of Casamicciola.

He believes that there are two fractures and not the meeting of a fracture and the lip of the old submarine crater

as Rossi would have it, because the manifestations along both are the same and also because it is better to attribute them to the same cause than to seek out a hypothesis which can not be demonstrated.

The result of his observations has been that houses built on the trachyte at Lacco Ameno and at Monte Zale suffered infinitely less than those built on the tufa of Epomeo or on the clay, which was the result of the decomposition of the tufa. Casamiciola was almost exclusively built on this clay and it can be said without exaggeration that not one stone rested upon another. Forio was built on the tufa and even of this town very little remains standing. At Lacco the houses and walls which were built on the trachyte offered a much greater resistance to the shock while those built on the tufa were destroyed. This agrees completely with the theory of Mallet who says "A seismical wave passing suddenly from an unelastic to an elastic soil as for instance from tufa into trachyte will not only change its velocity but also its direction, one part being reflected and another refracted." The seismical wave being thus sent backwards produces a shock in the opposite directions causing great dammage to the buildings. At the same time shocks are attenuated when they reach the more elastic soil such as granite or trachyte. This might explain why the town of Ischia felt the shock so little, being separated from the main fissure by the masses of trachyte lava from Mt. Rotaro, Mt. Montagnone and that of Arso which absorbed most of the energy of the seismical wave.

He attributes all these seismical manifestations in Ischia at the present moment, to a wakening up of the residual volcanic activity of Epomeo. He says "the opinion of Palmieri does not seem to me demonstrable that the intensity of the shock should be attributed to the existence of large caverns precisely under Casamiciola and to the falling in of the columns which sustain the vaults—the falling in being caused by an earthquake and facilitated by the subterranean circulation of thermal waters." There are it is true in the neighbourhood of Casamiciola excavations of plastic clay but I am not sure it is of these the illustrious professor is speaking. Such a cause

indeed would be too small to produce such portentous effects and a seismical commotion propagated to so great a distance.

During his first visit he could not visit the interior of these excavations there being no one to serve him as guide, but in the latter part of August he paid a second visit to the island in order to make an examination of the excavations of plastic clay both in Casamicciola and in its neighbourhood.

In the very town of Casamicciola in the street La Faunina existed very important clay excavations which have been worked up to within three or four years. These works had a certain importance if we may judge from the numerous traces remaining of the mouths of shafts and tunnels which are to be seen. Unfortunately there apertures have been obstructed a long time back and its is absolutely impossible to gain access into the interior but *it is certain* that they must already be filled up considering on the one hand the nature of the ground which is clay with a natural tendency to swell and on the other the nature of the tunnelling which was in small sections.

The clay is extracted through little wells 20 to 30 feet in depth, these pits being dug through the overlying tufa until they meet the clay and in this clay galleries of different shapes and sizes are preforated in various directions, the clay thus extracted being drawn out by hand machines.

Besides it is undeniable that neither in the neighbourhood of these apertures nor within the perimeter of the excavations is there any trace of a falling in of the ground.

At the time of the earthquake they were working the clay in several other places, south of Casamicciola between the village and Epomeo, eastward on the lower slopes of Mt. Tabor. Unforunately the excavations south of Casamicciola could not be entered as their openings had been completely covered by landslides. The only excavations he could see were those lying to the east of Casamicciola. Owing to the nature of the ground, trachyte lava lying upon trachyte tufa, the openings into the excavation have sustained but little dammage and the works are accesible.

Accompanied by workmen he visited the most important

of these excavations. The workmen had not been there since the catastrophy as could be seen from the tools lying around. The openings which have been worked through the trachyte tufa in order to arrive at the clay are narrow low and tortuous. Some are more than 60 meters in length and descend into the mountains some 20—30 meters below the opening. The clay is excavated in small sections because that part of the bank of clay which can be utilized is not very extensive. It was evident that everything had remained intact in the interior and had not received the least dammage from the earthquake

This is not the first instance in which seismical shocks having produced great dammage at the surface have passed absolutely unperceived at a certain distance underneath.

One can therefore reasonably conclude so far as regards the old excavations which stood in the very town itself, that they could not have constituted a danger since having been abandoned for several years they must necessarily from the nature of the material have filled themselves up again under the influence of water and pressure. Any one who is conversant with mining and working galleries knows the disastrous effects of swelling clay. But even allowing that they were not filled up there could have been no falling in as is proved from the fact of there being no evidence of this on the surface. The excavation to the south of Casamiciola and those on Mt. Tabor are too distant to have been the cause of any dammage. Besides so far as the first are concerned although the mouths are covered and we can not enter them, we may reasonably conclude that they are in the same condition as those on Mt. Tabor, the only difference being in the nature of the overlying ground, the loose tufa in the one case having slid down and obstructed the openings, the trachyte on the other hand having remained in place.

He draws the following conclusions.

I—No other cause need be sought than the volcanic activity which still remains in the island and which wakes up at intervals.

II—That this volcanic activity manifests itself along two principal fissures. One with its convexity to the north

and extending from the Baths of Ischia to Forid, and the other in a line directed approximately from N. N. W.—S. S. E. between Lacco and the stupe of Testaicio.

III—That Casamiciola stood precisely at the intersection of these two fissures and hence at the center of the seismical focus and that it always has been and always will be the spot most devastated by earthquakes.

IV.—Finally that houses built on the trachyte lava present a much superior resistance to the shocks than those built upon tufa or upon clay and that this circumstances should be taken account of when time for rebuilding comes.

Like every one else who has written about Ischia this delegate from the corps of mining engineers has his theory. The paper however is a very unsatisfactory one. The observations are not searching, but such as they are he uses them to jump at conclusions, forgetting that he is not infallible. Whether he is right or wrong I do not know, but his facts do not warrant his inferences.

It is worthy of remark however that in the excavations where he did enter he found no evidence of the least shock and notices the fact that seismical shocks have often produced great dammage at the surface while they have passed absolutely unperceived at a certain distance underneath. This aspect of the case opens a wide field for inquiry, and I believe that Prof. Milne had already instituted experiments in this direction with very remarkable results which he will soon publish.