ART. LIII.—*The Ischian Earthquake of July 28, 1883*; by
C. G. ROCKWOOD, JR., Princeton, N. J.

THE island of Ischia is situated at the western extremity of the bay of Naples, about twenty miles in a direct line from Vesuvius. It forms a part of the Vesuvian volcanic district, being an extension of the Phlegrean Fields with which it corresponds in geological character, as does also the smaller island of Procida lying between Ischia and the mainland. Ischia contains about twenty-six square miles, being eight kilometers or about five miles long east and west, by 4·8 kilometers or about three miles broad. In the center of the island rises Mount Epomeo, 792 meters (2,782 feet) high, an old volcano which during historic times has given no lava from its crater, and for over five hundred years has been nearly silent. The last emission of lava from its flanks occurred in 1302, since which time the volcanic activity has been shown only by hot springs and steam jets, and not infrequent earthquakes, the last notable one having occurred March 4, 1881.

Ischia is noted for its thermal springs, which with the pleasant climate make it a favorite summer resort, and during the season the town of Casamicciola is usually crowded with strangers. Other towns are Ischia on the east coast, Forio on the west and Lacco Ameno on the north.

Before the earthquake, which wrought so much damage in this beautiful island on July 23, 1883, there had been some indications of unusual subterranean activity; some of the hot springs had shown abnormal variations of temperature, but it is doubtful whether to an extent greater than at other times when no earthquake followed;—there had been a number of slight earthquake shocks in different parts of the island,—and the instruments in the seismological observatories at Naples and Rome were in increased motion. It is said also that unmistakable indications of an approaching earthquake were observed in Casamicciola, but were concealed from the public so far as possible, for fear of alarming the summer visitors and so diminishing the gains of the hotel keepers. These indications, beginning from a fortnight before the great earthquake shock, gradually increased in intensity and frequency, and Professor di Rossi of Rome said afterward that if there had been in Ischia any system of observation, by which at the time he could have been informed of all these phenomena, “he would not have hesitated an instant in pointing out the imminent danger of an impending seismic disturbance” menacing Casamicciola. But in the absence of observations in Ischia,

the indications of the instruments on the mainland were interpreted as being fulfilled by the earthquake of July 25th in Calabria. On July 27, however, the unusual noises before noticed at the Solfatara of Albano had increased to an alarming extent, and numerous slight shocks were felt at Vesuvius and vicinity, indicating that the seismic disturbance was not yet over. The violent shock came about 9.25 P. M. on Saturday, July 28, and the greatest damage was done at Casamicciola and vicinity. This town, built on two small hills on the north slope of Epomeo, was entirely destroyed, only one or two houses being left standing. A performance was in progress at the theatre, and when the building collapsed at the shock many were buried in its ruins. Lacco Ameno, on the coast about three miles northwest from Casamicciola, was also mostly destroyed and Forio was greatly damaged. The town of Ischia, on the east coast, was severely shaken, but without suffering very much damage. But the villages of Fontana and Serrara, situated in the interior of the island, and indeed within the old crater, were great sufferers, as was also Barano more to the south. Two large land-slips were caused on the north slope of Epomeo, but no true fissures were found anywhere, and no apparent changes of level.

The first accounts of the killed and wounded were largely exaggerated, the number of killed being stated as 4000, 5000, 8000 and even 13,000. The numbers given by the official commission (Sept. 26) were 1990 killed and 374 wounded. Many perished beneath the ruins of fallen walls, and some were rescued from such a death after having been thus entombed for longer or shorter periods; in one case several persons were taken out of the ruins alive nearly a week after the catastrophe.

The shocks were at first vertical, then undulatory, and lasted about fifteen seconds. The direction of the vibration is variously stated by different observers.

In endeavoring to trace this earthquake to its cause, we must not overlook the connection of this locality with the Vesuvian volcanic district. It will be desirable also to state briefly the location of the hot springs and stufas or steam jets, for which the island is noted. As we follow then the northern coast from east to west, we find thermal springs at Pontano, Fornello and Fontana near Ischia, stufas and thermal springs at Castiglione, stufas at Cacciuto, all near the northern coast, then the abundant hot springs of Gurgitello near Casamicciola, fumaroles at Monte Cito west of Casamicciola, and finally the springs of Paolone on the slopes of Monte Nuovo near Forio. All these lie on a line slightly convex toward the north, and crossing the island from east to west along the northern slopes of Epomeo. They are considered by L. Baldacci to mark an old

line of cleavage, from whence come these manifestations of subterranean activity. He also traces another line similarly marked from north to south; from the hot springs of San Res- tituta near Lacco Ameno crossing the first line at Monte Cito, almost under Casamicciola, cutting through the old crater of Epomeo, along the precipitous valley of the Scarrupato, where are found the inland villages of Fontana, Serrara, Meropane and Barano, and meeting the southern coast at the place where are the hot springs of Fondolillo and the stufas of Testaccio. The east-west line above indicated might find its prolongation in the volcanic islet of Procida, and in the elevated point which projects from the mainland opposite it and connects it geologically with the Phlegrean Fields. Now these two lines coincide nearly with the localities, where this earthquake shock was felt, and at their intersection stood Casamicciola which was so completely destroyed.

In view of these facts L. Baldacci states his conclusions thus: "That the residual volcanic activity of the island is manifested along two principal fissures, one a curve with its convexity to the north, from the baths of Ischia to Forio, the other directed approximately north-northwest and south-southeast between Lacco Ameno and the stufas of Testaccio; and that the place where Casamicciola stood is upon the intersection of these two lines and, therefore, at the very focus of seismic activity and that it always has been and always will be the locality most liable to be devastated by earthquakes."

But other facts also point in the same direction. H. J. Johnston-Lavis has drawn the isoseismal lines about the focus and finds them to be elongated ellipses having their major axes east and west, the lines lying much closer together in their northern portion than in the southern. The minor axes of these isoseismal ellipses is *nearly in the line* of Baldacci's north and south fissure. Johnston-Lavis states his conclusion thus: "From a careful examination of observed azimuths and angles of emergence, all point to a plate-shaped focus whose strike extends in a line from Fontana just west of Menella to near the beach at Lacco. The plane of this fissure is probably roughly perpendicular to the surface, but may dip slightly toward the east, as the isoseismals are slightly nearer on the eastern side of the seismic vertical, which, as a necessity, is not represented by a point, but by a line on the surface. The rupturing of this plate-like fissure was apparently greatest at a point nearly mid-way between its extremities."

To conclude, then, it seems to be pretty clearly made out as probable, that this earthquake shock had its origin and cause in a rupture taking place along an old volcanic fissure, directed roughly north and south, and extending radially in or under

the northern slope of Epomeo; and that the cause of the increased tension resulting in this rupture is to be referred to the residual volcanic activity which this island shares with the adjacent mainland rather than to any merely local subsidence.

Palmieri has advanced the opinion that the local violence of the shocks might be due to the collapse of subterranean cavities not very far below the surface. But it would seem likely that any subsidence of sufficient magnitude to cause the surface destruction, seen at Casamicciola, and to give rise to vibrations felt by instruments so far away as Rome, must have been attended also by surface fissures and changes of level, none of which were observed.

After the disastrous earthquake of July 28, slight shocks continued to occur, at first daily, and afterward at longer intervals, even as late as September 23d.

In preparing this notice free use has been made of the correspondence published in various journals and newspapers both of America and Europe, but the writer is especially indebted to articles contributed by Ch. Vélain to *La Nature* (August 18, 1883); by H. J. Johnston-Lavis to *Nature* (Sept. 6, 1883), and by L. Baldacci to the Boll. R. Com. Geol. (translated in *Science*, Sept. 21, 1883.)