THE STUDY OF EARTHQUAKES IN SWITZERLAND

ALTHOUGH much has already been done for the investigation of earthquakes, it must be admitted that yet more remains to be done, and that we are very far from what might be considered as a scientifically organised system of observations of earthquakes. Therefore all lovers of science will be much pleased to see that the sixty-first meeting of Swiss Naturalists, which was held in 1878 at Bern, appointed a special commission for the study of this important subject. The Commission, which consisted of Prof. Forster, of Bern, as president, Prof. Albert Heim, of Zurich, as secretary, Professors Amsler, of Schaffhausen, Forel, of Morges, Hagenbach, of Basel, Soret, of Geneva, and M. Billwiller, Director of the Statistical Board of Zurich, chose the telluric Observatory at Bern as its central board, and, after having put itself into communication with foreign observers, it began with the elaboration of a scheme for the organisation of a wide system of observations on earthquakes in Switzerland.

The scheme elaborated by the Commission is to provide two or three chief stations (Bern, Basel, and, if possible, Geneva) with first-class seismometers, and then to organise a wide net of second-class stations provided with simpler instruments. As to the latter three different apparatus were proposed, and will be submitted to experiment. Prof. Amsler's seismometer is a pendulum, provided at its extremity with a pencil which draws a line on a blackened paper when it is set in motion by a shock of earthquake; the time of the shock is determined by connecting the pendulum with a clock which is stopped by means of an electrical current as soon as the pendulum is set into motion. The apparatus of Prof. Forster is the common mercury seismometer, but the usual cup with mercury is replaced by two Y-like glass tubes, the upper branches of which are directed to the four chief points of the horizon. Finally, the seismometer of Prof. Hagenbach is the simplest one; it consists of three hollow metallic cylinders with heavy tops, which are placed vertically like skittles; on a simple plank, when the plank is brought into motion by a shock, the cylinders fall down, and show the direction of the shock (rolling being prevented by a layer of sand which is strewn on the plank), and as they are of different sizes, it is only the smaller one which falls when the shock is feeble, and all three when the shock is a strong one. We do not know what results might be attained by means of the cylinders, but we fear that the pendulum and the mercury seismometers will prove far more difficult to manage, and that they will give less satisfactory results than might be expected. In every case these seismometers will be submitted to a thorough trial before being introduced into practice, and Prof. Forster has already constructed a special apparatus for trying them. A thick plank, 150 lbs. weight, is suspended in a room on three strings, and, the seismometer being placed on it, shocks of various intensity are communicated to the plank by means of a heavy lead-pendulum; moreover, we daresay that an earthquake will not be long in coming to tell what is the practical value of the new instruments.

Besides, the Commission has taken steps to interest the public in this class of observations, and Prof. Heim has just published a pamphlet on the nature and causes of earthquakes, and on the means of observing them without instruments. This pamphlet, which will be translated into French by Prof. Forel, will be sent to all members of the Swiss Society of Naturalists and of the Alpine Club, as well as to the meteorological and telegraphic stations and to the editors of all Swiss newspapers. Further, special leaves, containing each a series of questions on the chief features of an earthquake, are printed, and they will be sent in great quantities throughout Switzerland. The whole country is divided into seven regions, each member of the Commission being intrusted with one of them; and as soon as the newspapers announce an earthquake, the member of the Commission in whose region it has occurred immediately sends the printed leaflets with questions to all persons who might give any information about it. All information is represented on a map and inscribed in a special book, another book being used for collecting all information about former earthquakes.

Such are the important steps taken up to the present by the Commission, and we hope that soon a widely-spread organisation will afford us detailed and accurate information on all earthquakes in Switzerland.

THE HISTORY OF VESUVIUS DURING THE YEAR 1879

PROF. JOHN PHILLIPS, in his admirable monograph on Vesuvius, has given a history of the mountain from the earliest times to the end of the year 1868. Palmieri, in his detailed description of the eruption of 1871-72, continued the history to the end of the latter year; and in NATURE, vol. xix. p. 343, the present writer has described the comparatively uneventful life of the volcano from 1873 to the end of 1878. The past year, although unmarked by any special and paroxysmal disturbance, has furnished facts not unworthy of record.

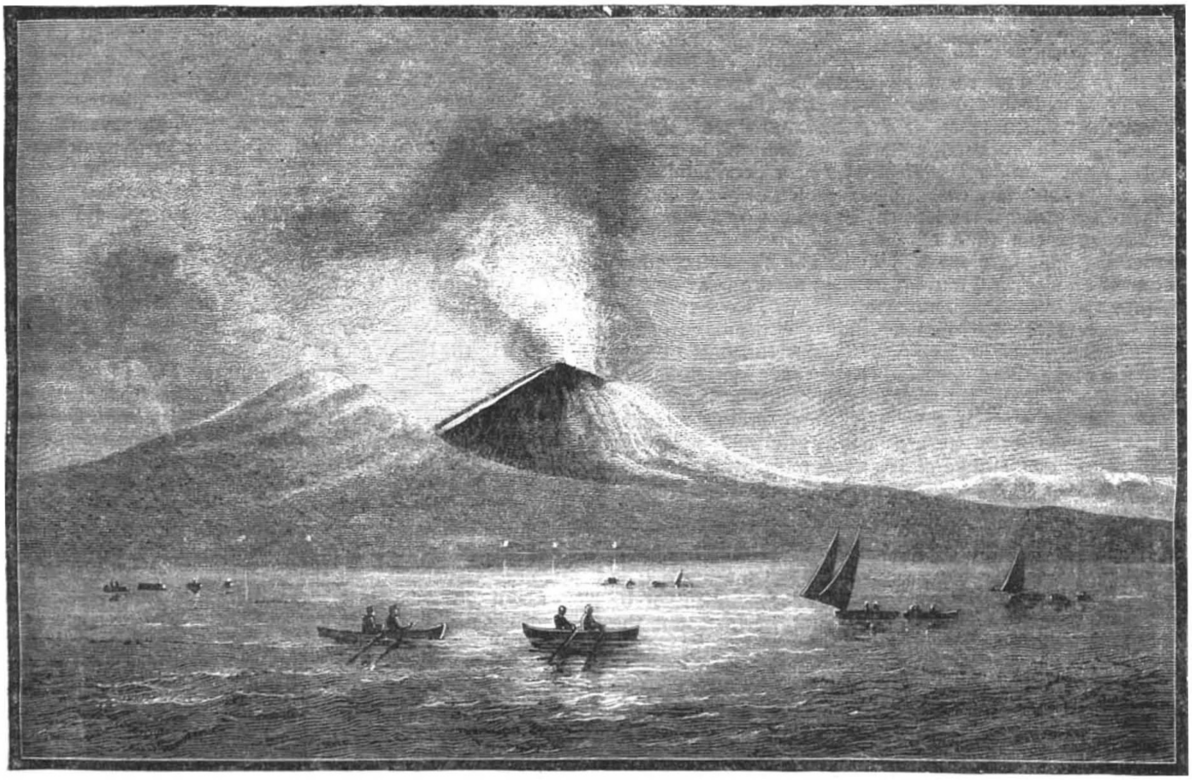
It will be remembered by readers of the former article on the subject, that at the conclusion of the great eruption of 1872, a vast abyssmal crater, 250 metres deep, and nearly as many in diameter, was left in the great cone of Vesuvius. After three years of comparative rest, during which carbonic acid, sulphurous acid, and ultimately hydrochloric acid, were evolved from fumeroles in the bottom and sides of the crater, a deep chasm opened on December 18, 1875, from which dense volumes of smoke issued. At night the smoke could be seen to be illuminated by the reflection of the light emitted by the molten lava within. A small eruptive cone was soon formed over a portion of this chasm, which increased in energy, and emitted small quantities of lava. On the night of November 1, 1878, the lava which had spread itself over the floor of the crater of 1872, rose to the lowest portion of the edge of the crater, and commenced to flow down the great cone in a north-westerly direction, towards the Atrio del Cavallo. The secondary cone rose to a height of about 20 metres, and exhibited a fair amount of dynamic activity when I visited it on December 29, 1878 (*v.* p. 344, *loc. cit.*).

During 1879 small lava streams appeared from time to time on the sides of the great cone, sometimes flowing a little distance downwards in a north-westerly direction, and occasionally towards the north-east. Prof. Palmieri, in a MS. account of "Il Vesuvio nel 1879," with which he has been so good as to furnish me, asserts that the energy is markedly greater at the time of the new and full moon. On December 17 the energy increased considerably, and a small stream of lava flowed down into the Atrio del Cavallo. When I saw the mountain during the last days of the year it emitted great volumes of smoke, but there was no lava flowing, and but slight illumination of the smoke at night. Towards the 11th of this month, however (new moon), the energy increased, and on the 13th I ascended the mountain, and witnessed a considerable augmentation of activity.

We reached the observatory at 11 a.m., when we found that a tramontana, which was blowing strongly at the foot of the mountain, was here so violent that it was questionable whether it would be advisable to attempt the ascent. Moreover, the temperature of the wind was $-3°$ C. (26·4° F.), and it blew with intermittent gusts of great violence. However, the guide determined to make the attempt, but he asserted that it would be impossible to ascend the cone by the usual path which proceeds nearly due west from the observatory, as the wind was blowing from the north-west, and we should be more or less in the teeth of it. Accordingly we bore to the south-west, so as to get the mountain between us and the wind. Even thus the ascent was very trying; violent gusts of wind sometimes caught us, and volcanic sand and small stones were blown across our path. On arriving at the summit I saw that the small cone, which, when I had seen it a year before, was no larger than an iron furnace, had in the course of the year increased both in bulk and height. It now reaches to a height of more than fifty feet above the rim of the great crater, and very large masses of cinders have accumulated around it. Moreover, it has almost filled up the great crater of 1872 by masses of lava and scoriæ. When the crater gets quite filled up, and the throat of the small cone choked with lava, we may look for a grand paroxysmal outburst like that of 1631 or 1872.

The cone of November, 1878, was giving off dense volumes of white steam and reddish smoke. Its dynamic activity was considerably greater than it had been the year before, and large masses of scoriæ were ejected to a considerable height at frequent intervals. The lava surged up within the throat of the cone very frequently, from the sudden disengagement of vapours within the seething mass. Near the base of this cone a small hole, apparently about five feet in diameter, had opened to give vent to lava, the great pressure of which had prevented it from rising high in the cone, and had caused the latter to give way at the point of least resistance. Two streams had recently flowed from this; a small one towards the south-west had not reached the rim of the crater; it was red-hot, not more than two inches beneath the surface, but we ran over it with no worse result than scorching our boots. The other stream—the main stream of December 17, 1879—(*vide* the accompanying woodcut) had flowed towards the north-west, and had found its way into the Atrio del Cavallo.

As we watched the lateral *bocca*, the lava within it



became furiously agitated; it was thrown up three or four feet above the opening, *exactly in every respect resembling small geysers which I have seen at Reykir, and at Haukadalr in Iceland;* and presently the liquid mass filled completely the *bocca*, and flowed over as a very fluid stream along the course of the lava of December 17. By the time we reached the Observatory again, the stream, which was about twenty-five feet wide, was seen to have flowed over the rim of the crater; by ten o'clock the same evening it had flowed half way down the great cone, and by 1 A.M. the next morning it had reached the Atrio del Cavallo, presenting an appearance almost precisely similar to that of the stream of December 17. Dense clouds of vapours marked the course of the stream; a good deal of hydrochloric acid was disengaged; and the icy tramontana in blowing over the liquid mass was converted into an unbearably hot furnace-breath. The next day (January 14) the energy of the mountain appeared to have slackened; and on the morning of the 15th a good deal of snow fell, and the course of the lava stream was well shown by a jet black line through the snow.

The lava is very leucitic, and is somewhat similar to that of 1871. The fumeroles have afforded copious sublimations of chlorides and sulphates, in which the spectroscope has revealed the presence of lithium and thallium. The gases evoked nearest to the centre of activity are sulphurous acid and hydrochloric acid. Carbonic acid still appears in some of the remoter sources of emanations.

Prof. Palmieri, in the MS. to which I have alluded above, writes as follows:—"This long and mild eruptive period, in which Vesuvius has become a mere imitator of Stromboli, will not in our opinion come to an end without displaying more decided activity. The whole history of Vesuvius, though its greater eruptions only have been chronicled by ancient writers, may be divided into periods of activity, with occasional phases of violence, and short intervals of rest. And the greatest eruptions have generally indicated the last phase of long periods of moderate activity, periods that escaped the notice of the early writers. The true history of Vesuvius could not have been written until after the establishment of the present observatory. The seismograph of the observatory gives the most accurate indications of the eruptive attempts (*dei conati eruttivi*) of the mountain and of the degree of its dynamic activity."

Two other facts require to be alluded to before we close the history of Vesuvius in 1879. The one is the alleged discovery by Prof. Scacchi of a new element in the yellow and green incrustations found on the lava of 1631. The former of these he believes to be vesbiate of aluminium, the latter vesbiate of copper. The element is named *Vesbium*, from an old name of Vesuvius mentioned by Galen. The subject requires further investigation before we can assert with any confidence that a new element has been discovered.

The second fact is that the Vesuvius railway, from the base to the summit of the cone, more than 1,coo feet, with an average slope of 32°, has been commenced, and is progressing thus far favourably. The work is slow, but labour is cheap; we saw fifteen men dragging a single beam of wood up the cone. We are inclined to regard the whole thing as a very hazardous commercial undertaking. For to begin with, if the company charges 20 lire for each ascent, it will be ong before a fair interest can be paid on the original one and the working expenses. Moreover, the prorty is itsccre, a stream of lava on the south-west side of the cone would destroy the line at once, and a violent earthquake would throw all the machinery out of gear.

G. F. RODWELL

THE CRAYFISH[1]

"COMMON and lowly as most may think the crayfish, it is yet so full of wonders that the greatest naturalist may be puzzled to give a clear account of it." These words from von Rosenhof, who in 1755 contributed his share to our knowledge of the animal in question, are cited by Prof. Huxley in the preface to the careful account of the English crayfish and its immediate congeners, which forms the latest volume of the International Scientific Series. The book is not designed for "general readers," those somewhat luxurious but presumably intelligent persons for whom so much scientific knowledge is chopped and spiced at the present day. It is, as we gather from the author's statement, intended as an introduction to serious zoological study, for those who will turn over its pages, crayfish in hand, and carefully verify its statements as to details of structure with scalpel and microscope. To these and also to those who are already well versed in crustacean anatomy, the book will have great value and interest; to the latter more especially, as showing how in the careful study of one organism we are "brought face to face with all the great zoological questions which excite so lively an interest at the present day," and as an exhibition of that "method by which alone we can hope to attain to satisfactory answers of these questions."

A crayfish is treated in this volume from the point of view of "science," and in the first pages we have some excellent observations (recalling earlier remarks of the author's in the same sense) directed to clearing up that mystery which good people will insist on throwing around that ever-more-widely-heard term. "Common sense," says Prof. Huxley, "is science exactly in so far as it fulfils the ideal of common sense; that is, sees facts as they are, or, at any rate, without the distortion of prejudice, and reasons from them in accordance with the dictates of sound judgment. And science is simply common sense at its best, that is, rigidly accurate in observation, and merciless to fallacy in logic." In the preceding quotation Prof. Huxley is (in a legitimate and intelligible way) using the word "science" in place of "that quality of mental activity by which science is produced." Immediately afterwards he speaks of science as the product of certain mental operations, in a passage which possesses great beauty whilst setting forth fundamental but neglected truths as to the source and scope of human knowledge. "In its earliest development knowledge is self-sown. Impressions force themselves upon men's senses, whether they will or not, and often against their will. The amount of interest which these impressions awaken is determined by the coarser pains and pleasures which they carry in their train or by mere curiosity; and reason deals with the materials supplied to it as far as that interest carries it, and no farther. Such common knowledge is rather brought than sought; and such ratiocination is little more than the working of a blind intellectual instinct. It is only when the mind passes beyond this condition that it begins to evolve science.

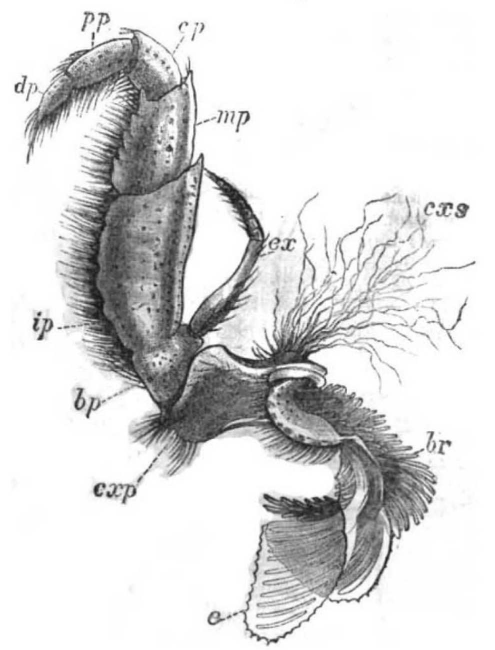


FIG 1.—*Astacus fluviatilis.*—The third or external maxillipede of the left side (× 3). *e*, lamina, and *br*, branchial filaments of the podobranchia; *cxp*, coxopodite; *cxs*, coxopoditic setæ; *bp*, basipodite; *ex*, exopodite; *ip*, ischiopodite; *mp*, meropodite; *cp*, carpopodite; *pp*, propodite; *dp*, dactylopodite.

When simple curiosity passes into the love of knowledge as such, and the gratification of the æsthetic sense of the beauty of completeness and accuracy seems more desirable than the easy indolence of ignorance; when the finding out of the causes of things becomes a source of joy, and he is accounted happy who is successful in the search, common knowledge passes into what our forefathers called natural history, from whence there is but a step to that which used to be termed natural philosophy, and now passes by the name of physical science.

"In this final state of knowledge the phenomena of nature are regarded as one continuous series of causes and affects, and the ultimate object of science is to trace out that series, from the term which is nearest to that that which is at the farthest limit accessibel to our that to of investigation.

"The course of nature as it is, as it has been, and as it will be, is the object of scientific inquiry; whatever lies beyond, above, or below this, is outside science. But the philosopher need not despair at the limitation of his

[1] "The Crayfish: an Introduction to the Study of Zoology." By T. H. Huxley, F.R.S. (London: Kegan Paul, 1880.)