The general conclusion is that geometry is largely based on the results of experience. M. de Freycinet's book should prove of great interest to all who devote attention to the teaching of geometry.

Étude des Phénomènes volcaniques: Tremblements de Terre—Eruptions volcaniques—Le Cataclysme de la Martinique, 1902. Par François Miron. Pp. viii + 320. (Paris: Ch. Béranger, 1903.)

THE ground which this little work is intended to cover is so vast that it is impossible for the author to deal with any part of the subject in an adequate manner. Seismology is dismissed in twenty-seven pages, which serve only to give a most misleading impression of the present state of our knowledge of that science. The ninety-nine pages devoted to volcanic eruptions furnish only a short sketch of the subject, such as may be found in any treatise on geology, though here and there matters not ordinarily treated of in text-books may be met with, such as Fouqué's method of collecting gas at fumaroles. The thirty-eight pages devoted to the causes of vulcanism contain summary statements of the views of de Lapparent, Fouqué, Stanislas Meunier, Gautier and others, the author giving greatest weight to astronomical causes as possibly determining volcanic outbursts! To the phenomena following volcanic eruptions sixteen pages are devoted, while an account of the principal volcanoes of the globe occupies forty-two pages. The description of the Martinique and St. Vincent eruptions has, however, seventy pages devoted to it, and the work concludes with chapters in which vulcanism and the riches of the globe are discussed, such matters as mineral veins, thermal springs, and the occurrence of petroleum being hastily passed in review.

It is difficult to understand what useful purpose a compilation of this kind can serve, but, as the author says in his preface, general attention has been attracted by the catastrophe of St. Pierre, and there seems to be a demand for some kind of popular information on the subject. The supply possibly meets the demand, but both are probably ephemeral.

Experiments with Vacuum Tubes. By Sir D. L. Salomons, Bart. Pp. vii+49. (London: Whittaker and Co., 1903.) Price 2s.

GIVEN a well-equipped physical laboratory and an expert glass blower as assistant, one could pass many a pleasant hour in repeating the experiments described in this little book. The phenomena exhibited by vacuum tubes are perhaps the most fascinating that electrical science can show; they possess a rare and peculiar beauty which, like that of the rainbow or the Aurora, appeals to both the æsthetic and the scientific senses. Sir David Salomons describes how tubes may be constructed to produce certain definite results in the arrangement of striæ and so forth, and many of the designs give evidence of painstaking ingenuity. A number of experiments with tubes and magnets are also described, some of which serve to illustrate well the mutual action of electric currents and magnetic fields. The author does not deal with those phenomena which, in the hands of Sir W. Crookes, J. J. Thomson and others, have led in recent years to results of such importance; indeed, the theoretical explanations which are given as a running commentary on the experiments seem rather to show a lack of appreciation of the essential facts which have added such interest to the behaviour of the electric discharge in high vacua, and have raised the vacuum tube from the position of a scientific toy to that of a powerful instrument of research.

M. S.

LETTERS TO THE EDITOR.

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Energy Emitted by Radio-active Bodies.

PROF. J. J. THOMSON'S interesting article in last week's NATURE raises the question of how long the emission of energy by radium may be expected to continue. I think in this connection that it would be of great importance to determine, if possible, whether radium, as contained in pitchblende, emits as much energy as the same amount of the material in the form of an artificially concentrated product. The mineral must be supposed to have been in existence, in its present condition, for a period of time comparable with the age of the earth—perhaps 50 million years. It is certainly more likely to have lost than gained activity during that time. We may therefore reasonably assume that it has been liberating energy at not less than its present rate for 50 million years. A determination of the amount of energy thus emitted would carry us much further than the most careful and protracted observations on powerful radium preparations.

Such a measurement would, no doubt, be difficult, but not, I think, altogether impracticable. A very large block of pitchblende might be used, and a thermocouple inserted in the centre of it. Something might be gained by careful heat insulation of the block.

A rough calculation will show the rise of temperature to be expected.

Consider an infinite slab of pitchblende bounded by two plane faces, the axis of x being perpendicular to these faces. Take an elementary slice, of thickness δx, at distance x from the face, and bounded by planes parallel to it. The outflow of heat per square cm. from this slice is $-k\frac{d^2\theta}{dx^2}\delta x$, where k is the thermal conductivity, and θ the temperature.

When a steady state has been reached, this must equal the rate of generation of heat in the slice per square cm. $= q\delta x$ suppose.

Thus $$-k\frac{d^2\theta}{dx^2}\delta x = q\delta x,$$

or $$\frac{d^2\theta}{dx^2} = -\frac{q}{k},$$

and by integration $\theta = \frac{-q}{2k}(x^2 + ax + b)$.

If the faces of the slab are maintained at 0° C., and if the slab is 1 metre thick, we have

$$\begin{cases}\theta = 0 \text{ when } x = 0,\\ \theta = 0 \text{ when } x = 100.\end{cases}$$

Thus $$a = -100,\ b = 0,$$

and $$\theta = \frac{-qx}{2k}(x - 100).$$

We may take for k the value 0·005, which is a rough general average for the conductivity of rocks.

It was found by Curie that 1 gram of radium emitted 100 calories per hour. If we suppose that the density of the radium is 3, and that pitchblende contains one part of it in 100,000 by volume, then, if the pitchblende is as active as one would expect from the proportion of radium contained, we should have

$$q = \frac{1}{1200000}.$$

We can now calculate the temperature to be expected at any point of the slab. In the middle, where $x = 50$, we find

$$\theta = \tfrac{1}{8} \text{ nearly}.$$

So that the middle of the slab would be $\frac{1}{8}$° hotter than the faces.

In practice the difference of temperature available would be less, since the block used would not take the form of an infinite slab. But still, the effect would probably be measurable.

R. J. STRUTT.