III. The induction plate was lowered from 2 inches to $1\frac{1}{2}$ inch. Current −. (The current + was not observed for want of time.)

Ring	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Readings	276	217	200	187	174	159	144	130	116	104	90	76	62	48	35	22	0
Differences	59	17	13	13	15	15	14	14	12	14	14	14	14	13	13	22	

The observation III. illustrates that which has already been said concerning the fall of potential within the tube.

In case I. we have for the currents in webers—

$$C+ = \frac{\frac{47}{180} \times 2400 \times 1{\cdot}03}{1{,}000{,}000} = 0{\cdot}0007261, \text{ and}$$

$$C- = \frac{\frac{65}{194} \times 2400 \times 1{\cdot}03}{1{,}000{,}000} = 0{\cdot}0008281,$$

and for the difference of potential in volts (V) between the two ends of the tube—

$$(C+)\,V = \tfrac{112}{160} \times 2400 \times 1{\cdot}03 = 1730, \text{ and}$$
$$(C-)\,V = \tfrac{127}{194} \times 2400 \times 1{\cdot}03 = 1618.$$

These differences of potential would be reproduced if for the tube were substituted metallic resistances in ohms (R)—

$$(C+)\,R = \tfrac{112}{47} \times 1{,}000{,}000 = 2{,}383{,}000, \text{ and}$$
$$(C-)\,R = \tfrac{127}{65} \times 1{,}000{,}000 = 1{,}954{,}000.$$

In case II.—

$$C+ = \frac{\frac{19\cdot5}{164} \times 2400 \times 1{\cdot}03}{800{,}000} = 0{\cdot}0003674, \text{ and}$$

$$C- = \frac{\frac{25\cdot5}{188} \times 2400 \times 1{\cdot}03}{800{,}000} = 0{\cdot}0004190.$$

$$(C+)\,V = \tfrac{116\cdot5}{164} \times 2400 \times 1{\cdot}03 = 1756, \text{ and}$$
$$(C-)\,V = \tfrac{132}{188} \times 2400 \times 1{\cdot}03 = 1736.$$
$$(C+)\,R = \tfrac{116\cdot5}{19\cdot5} \times 800{,}000 = 4{,}780{,}000, \text{ and}$$
$$(C-)\,R = \tfrac{132}{25\cdot5} \times 800{,}000 = 4{,}142{,}000.$$

Selecting the observations with the current positive in each case and placing these in juxtaposition thus—

	C		V		R
Case I.	0·0007261	...	1730	...	2,383,000
,, II.	0·0003674	...	1756	...	4,780,000

we see that when C is varied in the ratio of 2 : 1, V remains sensibly constant, R varying as 1 : 2; that is to say, though the current is halved, the difference of potential between the ends of the tube remains constant—a condition which could only be brought about when metallic resistance is substituted for the tube, by doubling this resistance.

This points to the important conclusion that *other things being kept constant* and the current alone varied, we should find the value of V *strictly* constant for all values of C; but it may readily be imagined that in experiments with "vacuum tubes" it is not easy to ensure perfect constancy of the accompanying circumstances.

To test this conclusion we extended the range of our observations by varying the value of C as much as from 1 to 135.

In the paper are given the original measurements themselves, not the mean results, in order that the discrepancies in the readings obtained for V when C was kept as constant as our powers of control permitted, might be compared with the variations, such as they are, in the values of V when the circuit was purposely varied so as to produce currents of different strengths. Our observations show clearly that discharge through rarefied gases cannot be at all analogous to conduction through metals; for a wire having a given difference of potential between its ends can permit one—and only one—current to pass; whereas, from the measurements obtained it became evident that with a given difference of potential between the terminals of a given vacuum tube, currents of strengths varying from 1 to 135 can flow. We are therefore led to the conclusion that the discharge in a vacuum tube does not differ essentially from that in air and other gases at ordinary atmospheric pressures—that it is, in fact, a disruptive discharge.

By fixing small rings of tinfoil to the glass near the places where the metal terminals are fused into the tube and connecting these rings to earth, we were able to cut off the leakage over the surface (which, in spite of precautions, is considerable), and prevent it from interfering with our measurements of the potential of the gas *inside* the tube.

(To be continued.)

NORTHERN BORNEO

SOME time ago (NATURE, vol. xviii. p. 454) we were able to give a few particulars respecting the acquisition, by a British association, of a considerable portion of Northern Borneo, a region which has never yet been thoroughly explored. Under the title of "North Borneo," the promoters of this association have just printed for private circulation a 4to volume, containing a sketch of the territory of Sabah, lately ceded to them, and a report on various portions of the same by a Ceylon planter, which are accompanied by an analysis of soils and three appendices. The volume also contains two maps of Borneo, but the details given therein about the northern part are necessarily meagre.

The territory of Sabah comprises an area of some 18,000 square miles, possessing the great advantage of a coast-line of 500 miles from the Kimanis River on the north-west coast, to the Sibuco River on the east side of the island; it has the finest and almost only good harbours in Borneo, viz., Gaya Bay, Ambong, and Ousukan Bay on the west, and Sandakan Harbour on the east coast, the first and last named of which will, no doubt, become of great importance, especially if it be true that there is coal close at hand. The whole of Sabah is traversed by a mountain range of 5,000 to 8,000 feet in height, which culminates in the Kini Balu mountain, 13,700 feet high. To the east of this is the supposed position of the Kini Balu Lake, which no European has yet visited. On the shores of the lake, according to native reports, there are many villages of Ida'an, who cultivate cotton, tobacco, &c., and are said to be peaceful and industrious. There are numerous rivers on the north-west coast, but owing to the proximity of the high mountain ranges they are said to be only navigable by light craft; on the east coast, however, there are several splendid rivers, the Paitan, Sibuco, and Kinabatangan, the latter of which is believed to be navigable by large steamers for several hundred miles. As far as has been at present ascertained, the spurs and slopes of the Kini Balu range seem well fitted for the cultivation of coffee, tea, and cinchona, and the level country on the banks of Kinabatangan for sugar, indigo, tapioca, tobacco, cocoa, cotton, and rice. The Sabah territory is believed to be but sparsely peopled, the total population being estimated at 150,000 to 200,000; the interior is inhabited by descendants of the aborigines, called variously Muruts, Dusuns, or Ida'an, and corresponding in their external appearance in many respects to the Dyaks of Sarawak and the southern parts of the island, though they are of a lighter hue. The climate of the region is believed to be very favourable; in the plains and low-lying lands near the sea and rivers an invigorating breeze is generally felt during the day, the thermometer seldom ranging beyond 86°, while the nights are cool, with a temperature sometimes below 70°. No data are yet available in regard to the rainfall, but it is believed to be very similar to that of Ceylon. The soil is rich and fertile, and in many localities of superior quality. The chief vegetable productions indigenous to the soil and growing wild in the forests are india-rubber and gutta-percha, baroos camphor and gum damar, and many valuable kinds of hard-wood timber. Rice, millet, tapioca, Indian corn, sugar-cane, tobacco, cotton, pepper, and many kinds of tropical vegetables are cultivated by the natives. The sago palm is found in abundance, cassia lignea is met with in some localities, and cocoa-nuts, the areca palm, mangoes, limes, oranges, bananas, and pine-apples are plentiful. Under the head of animal productions the report mentions edible birds'-nests, beeswax, hides and horns of cattle and deer, mother-o'-pearl shell, seed pearls, bêche de mer or trepang, and tortoise-shell; elephants exist in the Kinabatangan province in large numbers; rhinoceros, numerous deer of large and small breeds, and wild pigs are met with in many parts, but beasts of prey of the feline species appear only to be represented by a small cheetah in the interior. Minerals will, doubtless, be found in abundance in Northern Borneo. Gold occurs in several localities. Borneo diamonds are famous for their purity and water, and it is believed that they exist in Sabah as well as in Dutch territory. Tin, antimony, coal, quicksilver, iron, copper, petroleum, and other valuable minerals and metals, there is reason to believe, will be found in the territory of the association, but there has not yet been time for even a partial exploration of it from a geological and mineralogical point of view. The labour question may cause some little trouble. The population near the coast consists of Malays, Lianuns, Bajous, Sulus, and others of a mixed breed who are lazy, indolent, and averse to manual labour of any kind. The aborigines in the interior, Dusuns and Ida'an, are peaceful and docile, and accustomed to a certain kind of labour. But the company will not have to rely upon either for the development of their territory, for, as the report puts it, "the enormous amount of labour waiting for employment in the Chinese Empire, not more than three or four days' distance by steam from North Borneo, is at the disposal of intending planters and others . . . on reasonable terms."

VULCANOLOGY IN ITALY IN 1878[1]

A FEW years ago Cav. Michele Rossi, brother and collaborateur of the well-known author of "Roma Sotterranea," determined to try the experiment of collecting together from all parts of Italy facts connected with Vulcanology, and publishing an account of them in the form of a monthly fasciculus. He hoped by this means to found a new school for the study of endogenous meteorology, to be affiliated with the study of meteorology proper. The experiment has succeeded admirably, and we have before us a volume of 140 pages, recording all the phenomena of internal telluric dynamics which have been observed in Italy and Sicily during the past year. The vulcanology of Sicily, notably of Etna and the eastern sea-board, is also recorded in the Acts of the Accademia Gioenia of Catania. In no other part of Europe, except Iceland, would it be possible to have a journal solely devoted to the volcanic phenomena of one country. The kingdom of Italy contains within it the two most famous volcanoes in the world; it contains solfataras, soffioni, and maccalube; it is subject to earthquakes, sometimes of great severity, and spread over large areas; the district between Naples and Cape Misenum embraces almost every phase of volcanic phenomenon, excepting only the geysirs, and the Stufe di Nerone belong to this class of effects. Hence, obviously, there is no country of equal accessibility in the world which is so well adapted for the study of vulcanology.

The *Bullettino* opens with a tribute to the memory of Padre Angelo Secchi, which is followed by a proposition to erect a monument to his honour. We were glad, a few weeks ago, to notice that a well-executed bust of the great Roman astronomer had already been placed among those of the many celebrities which adorn the Pincian Hill. The new monument will probably take the form of a *monumento meteorologico*, to be erected in Rome.

A list of twenty-six Italian observatories in which seismic observations are recorded is given in the *Bulletino*, with the names of the observers, who are in direct communication with Prof. de Rossi. Among the minor notices we find mention of the proposed railway to the observatory of Vesuvius; of various new seismological observatories, including that of the Solfatara at Puzzuoli; and of the earthquake which was simultaneously felt at Fiumalbo, Florence, and Rocca di Papa. Bibliographical notices and correspondence find a place at the conclusion of the fasciculus. In the next number we find letters on the application of the microphone to seismological studies, from Prof. Michele Rossi and Count Giovanni Mocenigo, and later in the volume a very interesting article by the former details his experiments on the subject. The Umbrian earthquake of September, 1878, receives full description at the hands of Prof. Arpago Ricci; Silvestri gives an account of the mud eruption which broke out on the sides of Etna near Paternò in December; and Palmieri continues his "Cronaca Vesuviana" to the end of September, 1878. An exact account of the time of occurrence of earthquake phenomena in any part of Italy is entered in a tabular form, and it is surprising to notice that not a day passes in Italy without some indication of endogenous dynamic action. This also proves to us the sensibility of the instruments. The date is given, then the hour, the place, and the nature of the observation, thus:—

"13.—0.08 a. Messina, forte.—Reggio di Calabria, due scosse.—Palmi, scosse.—Capo Spartivento, molto forte.—Tropea, leggera ondul.
1.15 a. Corleone, leggera E—O, rombo.
5.50 a. Tolmezzo, debole; altra poco dopo.
7.15 a. Narni, sensibile N O—S E.
Mattina Rocca di Papa, leggerissima.
11.15 a. Bologna, leggerissima."

At the conclusion of the volume there is a large table showing at a glance the daily distribution of earthquakes throughout Italy. Twelve vertical divisions correspond to the twelve months of the year, and these are further divided by small lines into days. The horizontal lines serve to indicate:—

1. In the uppermost portion of the diagram the height of the barometer in millimetres. Thus we have the barometric curve for each month.
2. Here also is shown the variations during each month of the level of the water in the wells of Leghorn and Porretta.
3. Earthquakes according to the latitude.
4. Earthquakes according to the longitude, east and west of the meridian of Rome.
5. Daily maxima of the force of the shocks.
6. Phases of the moon.
7. Daily maxima of the number of the shocks.

In Prof. Michele Rossi's seismological observatory in Rome we saw at work a set of instruments devised by himself for registering both vertical and horizontal shocks. These are not the same as Palmieri's instruments, and are said to be more sensitive. In both sets of instruments the general principle is the same. The shock, by its movement, communicates motion to some appliance, such as a pendulum, or a column of mercury in a bent tube, which establishes electrical communication with a recording instrument. In the latter a ribbon of paper is drawn at a definite rate over a drum, and whenever electrical contact is established a small electro-magnet becomes active and draws down an armature to which a pen is attached, and for every contact a mark is made upon the

[1] Bulletino del Vulcanismo Italiano. Periodico geologico ed archeologico per l'osservazione e la storia dei fenomeni endogeni nel suolo d'Italia. Redatto dal Cav. Prof. Michele Stefano de Rossi. Roma, 1878.