occasion before long to communicate to you the general results of all observations made during past years.

An equally interesting set of observations carried out by the Meteorological Bureau was the determination of areas shaken in every earthquake, together with the reductions of results during the years 1885–86—the works of which I was directed to superintend. The method followed out was almost exactly the same as that originated by Prof. J. Milne in studying "387 earthquakes in North Japan," an epitome of which appeared some time ago in your columns. This method is briefly as follows. Observation-books furnished with directions for reporting earthquake phenomena with or without instruments were distributed, authorised by Government, among over 600 local offices throughout the empire ; in fact, the earthquake observations were made a part of the duty of local officers, and the reports were transmitted free of postage. From the reports sent in by different observers thus closely stationed, maps have been made showing the disturbed area in every shock, and a summary of observations has been compiled.

The results worked out from a large number of these maps and their notes have revealed many interesting facts, and entirely confirmed the previous works of the eminent seismologist above mentioned.

The total number of earthquakes in Japan in 1885 was 482, equivalent to 1·3 shakings a day. In Tokio alone 68 shocks were registered. Earthquakes are most prevalent in Yezo, and the north and central portions of the main island along the eastern or the Pacific coast, but in provinces bordering the Japan Sea they are few, and in some places none at all ; if they occur, they are generally limited to small tracts of land. Speaking of the main island in general, the range of mountains traversing through and forming the backbone of Central Nippon appears to divide it into two zones of different seismatic activities. In Kiushū, Shikoku, and other islands, disturbances are comparatively small.

Most larger earthquakes originate beneath the ocean. The majority of shocks are only local. Of the whole number, 235 local disturbances were recorded, which have not extended more than 100 square miles of land area. The maximum area of *one* earthquake was 34,700 square miles. The aggregate area of disturbance during the year was 796,000 square miles, and taking the total area of the empire to be 147,000 square miles, it is equivalent to saying that the whole of Japan has been shaken 5·4 times in one year. In summer shocks are less prevalent than in winter. The earthquakes occur in groups, that is to say, when disturbances occur, they are limited within certain portions of country, not generally extending beyond these limits. Propagations of seismic waves are often stopped by mountain-chains.

Finally, I may state that we shall continue these observations in future, and I hope the results to be obtained from more years' work of this nature will be some help in throwing light on the physics of the earth's crust.   SEIKEI SEKIYA
The Imperial University of Tokio, Japan, February 28

"The Krakatão Dust-Glows of 1883–84"

IN your issue of March 25 (p. 483) the writer of the critical notice of Dr. Riggenbach's pamphlet on the above propounds a statement which, if true, is of vast importance in accounting for the subsequent optical phenomena which are supposed to have been connected with the eruption. He says : "Thus the hurling into the air of 150 cubic kilometres of volcanic dust in August 1883," &c. Whence does he deduce this enormous quantity ? M. Verbeek, in his "Krakatão," part 1, which I have carefully perused, estimates the entire volume of ejecta (chiefly based on what fell near the spot) at only 18 cubic kilometres, and as his work is the only reliable source of information regarding the eruption with which I am acquainted, I am entirely at a loss to conceive how the 18 has been suddenly magnified into 150.

As one of the Krakatão Committee of the Royal Society, I have naturally examined the theoretical possibility of the amount of dust ejected having been sufficient to account for the optical phenomena witnessed, and have been obliged to content myself with the very modest quantity of 4 cubic kilometres out of the total 18, but if your writer's statement is correct, I am evidently at liberty to considerably augment the quantity at my disposal, and it is needless to say that this would seriously change the aspect of the question.   E. DOUGLAS ARCHIBALD
April 15

Pumice on the Cornish Coast

Is Mr. Guppy sure that the "pumice" he records in NATURE for April 15 (p. 559), as found on Maenporth Beach, is the natural article ? I ask because of having been accustomed to find pieces of a pumice-like stone, many light enough to float on the sea, along the Suffolk coast. This, however, is an artificial product, a sort of cinder from steamers, though it has deluded many people. It puzzled me for some time.   W. WHITAKER

33, East Park Terrace, Southampton

Ferocity of Animals

IF your correspondent in last week's NATURE (p. 583) will treat a wild rat in the way which I described, the animal will answer his question much more effectually than I can. For while I have only words at my disposal whereby to convey any "ejective" information upon the subject, the rat will display the fact of his understanding your correspondent's intention by a thousand co-ordinated movements of a much more eloquent kind.

The paper by Mr. Lloyd Morgan in the current issue of *Mind* is merely a republication of his views as already presented in this periodical. Having replied to these views as fully as seemed to me desirable when they were first expressed, it is needless that I should now go over the same ground a second time. It will, therefore, be sufficient to refer your correspondent to the discussion between Mr. Morgan and myself, which he will find in consecutive issues of NATURE for February and March 1884.   GEORGE J. ROMANES

The Climbing Powers of the Hedgehog

I REMEMBER many years ago we kept a hedgehog on the Continent in an upper garden well walled in. There she remained for some time, until she littered four or five young in a rubbish heap in a corner. The young having grown, and being able to move about, she and her whole brood disappeared. Her only way was over a wall four or five feet high, on which she left traces, but the young could not have been able to climb this, and she must have carried them.   HYDE CLARKE
32, St. George's Square, S.W.

ON THE LAW OF THE RESISTANCE OF THE AIR TO THE MOTION OF PROJECTILES

IN my experiments made to determine the resistance of the air to the motion of projectiles, it was assumed that this resistance followed *some law* producing a gradual change in the velocity, and consequently that the times occupied by the shot in passing over a succession of equal spaces would admit of being differenced. This method of proceeding gave the required result in the form of a coefficient K_v of v^3, in terms of the second and higher differences of time above referred to, when the time was expressed in seconds to five places of decimals. So long as this value of K remains constant, the resistance of the air varies as the *cube* of the velocity. The first results obtained were published in a note in the *Phil. Trans.* for 1868, p. 441. The experiments were afterwards more carefully calculated, and given in detail in the Reports published by Government in 1870. In using these results to calculate general tables for space and time, for cases where the projectile could be supposed to move approximately in a straight line, and free from the action of gravity, the corrected mean values of K_v were used, and made to vary with the corresponding velocity v. And in my "Treatise on the Motion of Projectiles" (1873), the *cubic* law of resistance was used for the purposes of calculation, so that for those velocities where K varied it was necessary to divide the trajectory into such small arcs that, throughout each arc, the average value of K could be used without sensible error. This treatment of the question rendered it unnecessary for me to attempt to express the law of resistance according to powers of v for all practical velocities. But from the results of my experiments for velocities between 900 and 1700 f.s., I remarked