about six times the diameter of one of them, while in the latter the interval is only equal in width to one of the orbits. (4) The roofing bones of the skull, at least in the posterior region, differ considerably in form and arrangement in the two species. This is particularly noticeable in the case of the parietals, which in *K. crassum* form together a rectangle about twice as long from side to side as from before backwards. (5) In *K. crassum* the sculpture of the cranial bones consists merely of a few widely separated pits.

The differences between these two forms appear, therefore, to be so great as to render it impossible to refer them both to the same genus, and *K. crassum* should, therefore, be referred to as *Scincosaurus crassus*, the name originally applied to it by Fritsch in 1875.[1]

Concerning the resemblance of this skull to that of *Urocordylus* it is difficult to speak with certainty, since the skull of the specimen on which Huxley founded that genus is unfortunately very badly preserved (see *loc. cit.* pl. xx. fig. 1). In it no epiotic cornua are to be seen, and these structures are also wanting in *U. scalaris*, Fritsch, the skull of which also differs widely in other respects from that of *K. Galvani*. In *U. reticulatus*, Hancock and Atthey,[2] these cornua are well developed, but the specimen resembles *K. Galvani* in so many respects that it is not improbably a young individual of that species.

The remainder of the skeleton is not well preserved. The serration of the upper border of the neural spine, characteristic of the family Nectridea, is clearly visible in some of the dorsal vertebræ. The whole of the tail is missing, so that comparison in that respect with *Urocordylus* is out of the question. A large part of one of the lateral plates of the thoracic buckler is preserved, and in form exactly resembles the bone figured as *scapula* (?) by Huxley (*loc. cit.* pl. i. fig. 1). In this specimen the surface of the bone shows a sculpture of pits in rows radiating from its posterior spine-like prolongation. Scattered about the skeleton there are several scutes with a sculpture like that of the cranial bones, of which, indeed, some may be fragments; the others are probably the larger scutes figured by Huxley, pl. xix. fig. 3. Of the limbs only obscure traces of the femur and humerus remain.

NOTICES OF MEMOIRS.

Abstract of the Fourteenth Report to the British Association on the Earthquake and Volcanic Phenomena of Japan.

(Drawn up by the Secretary, Prof. J. Milne, F.R.S., F.G.S.)

THE first part of the Report gives a list of the earthquakes recorded in Tokio during the last year. The second portion gives an account of observations made with horizontal pendulums. These pendulums consist of a horizontal boom about five feet in length held up by a fine brass wire. At the extremity of the boom

[1] Sitzungb. der k. bohm. Ges. der Wissensch. 19 März, 1875.

[2] Nat. Hist. Trans. Northumberland and Durham, vol. iii. p. 310.

there is a light metal plate with a slit in it parallel to the length of the boom. Underneath this floating slit, but at right angles to it, there is a narrow slit in the top of a box. Light passing through the two slits goes into the box as a point, which is received on a drum carrying a photographic film. These instruments, which are usually arranged in pairs, are placed to point N.W. and N.E. or parallel and at right angles to the strike of a distant range of hill. Two have been used at Kamakura on the solid rock, and two at Yokohama and one at Kanagawa on the soft tuff rock. These instruments were in caves. Also I have had two underground on the alluvium and one at my house on a solid stone column in Tokio.

The movements recorded have been as follows :—

1. *The Wandering of Pendulums.*—All the horizontal pendulums, wherever situated, have slowly wandered from their normal position. Those situated on the rock have often gradually moved to one side and then returned, the double excursion usually taking from two days to a week. These wanderings might be due to a local warping of the supporting column; but inasmuch as it has generally happened that the periods of great movement and of comparative rest have coincided in time, it would seem that the movements are in all probability due to a more general cause. Because certain movements have usually been marked (but by no means always) at or after a rainfall, it seems possible that they may be connected with fluctuations in the volume and flow of underground water,—the pendulums nearest to this water moving the most.

2. *Daily Waves.*—In no instance have I observed a diurnal movement of the pendulums at stations situated on the rock. In Tokio the movements occur underground and on the surface; they happen at the same time and they are proportional in magnitude. At my house, for example, at about 10 a.m. a tilting commences on the N.E. side, and it reaches a maximum of one or two seconds of arc about midnight, when a sinking takes place until about 6 a.m., when the pendulums remain fairly steady for some hours, after which they again commence to rise. Because it was observed that the movements underground were greater than those recorded on the surface, it seemed possible that they might find an explanation in the fact that the underground instruments were nearer to pervious strata in which water fluctuated than the instruments installed in my house. By quickly emptying a well in my garden of about two tons of water which was run off down a hill, the pendulum on a column (104 feet distant) behaved as if the ground had been relieved of a load and therefore had risen on the well side. Because the direction of movement of the pendulums underground and on the surface is away from the side from which during the day the greatest load is being removed by evaporation, it is not unlikely that the main features of the diurnal wave may be due to this cause.

3. *Earth Pulsations* (*Tremors*).—In Italy I understand that earth tremors are as marked underground on the rock as they are on the surface. In Japan, on three underground rock foundations, I have not observed a single case of earth tremors. Both underground and

on the surface in Tokio they are marked, lasting many hours. As I have previously spent so much time in analysing tremor records, the present records remain untouched. Tremors occur with a low barometer, but more generally when there is a steep barometric gradient. It seems possible that these conditions may result in giving the surface of the ground an ocean swell-like motion through the agency of subterranean water.

4. *Earthquakes.*—At Kamakura, on the hard rock, the greatest earthquake motion has been given by the pendulum which records tilting parallel to the dip, suggesting the idea that in this direction there is an easier yielding (like the opening and shutting of a concertina) than there is in a direction parallel to the strike. On March 22, I and my colleague, Mr. C. D. West, watched an earthquake for 1 h. 47 m., during which time the pendulum did not *swing*, but was *forced* backwards and forwards intermittently and with extreme irregularity. These earthquakes are in the form of earth waves and usually come from a great distance. A sharp shock which may be felt throughout Tokio, and at many places in the country, does not disturb the pendulums, and it is difficult to find a blurr on the photographic trace.

REVIEWS.

I.—Geographical Morphology.

Morphologie der Erdoberfläche. By Dr. Albert Penck, Professor of Geography in the University of Vienna.
Ratzel's Bibliothek Geographischer Handbücher. J. Engelmann. Stuttgart, 1894. 8vo. 2 Vols. Vol. I. pp. xiv.+471, 29 Figures. Vol. II. pp. x.+696, 38 Figures.

As the study of geography must have commenced unconsciously in the very earliest days of man's existence on the earth, it is not surprising that this science long ago acquired a rigid conservatism, and lack of scientific method, and a burden of imperfectly defined popular terms. In England descriptive topographical geography is still hampered by this inheritance. Abroad, however, more scientific methods have been rapidly gaining ground, especially in Germany and Austria, and in the United States. In the two first geography reached its highest level in Richthofen's admirable "Führer für Forschungsreisende" and Suess's "Antlitz der Erde." In America the writings of Gilbert and W. M. Davis have founded a school which has advanced the subject with great energy. The works of these authors are, however, bulky and scattered, and a systematic text-book of orography has been a desideratum for some time past. Dr. Ratzel, the editor of the well-known "Bibliothek Geographischer Handbücher," persuaded Prof. Penck to undertake the preparation of one. The task has, however, taken more than ten years to fulfil, for the literature of geodesy, geography, and geology have had to be carefully worked through.

The book consists of three parts. The first deals with general morphology. This will probably be of most interest to geologists, for the subject is barely noticed in geological text-books, and there