of the Thames be explained by any "meander system" such as that which Professor Davis expounds, or by any "curve-law" of "volume in relation to velocity" of which we often read? To me it is, throughout, a struggle between the influence of the affluents on the one and those on the other side, each, in turn, prevailing as their size or favourable circumstances may determine. If the great curve at Abingdon be not due to the influence of the river Ock and of other streams lower down, to what is it due? Can it be that the Isle of Dogs was formed "entirely independently of the action of tributaries," while we see that the Thames, in forming it, suddenly strikes southwards and takes in the Ravensbourne; then, as suddenly, striking northwards and taking in the Lea? I have not been able to examine the circumstances of every bend in the Thames, but those that I cannot understand, as seen on the map, are so few as to justify my belief that every one, from Oxford to Woolwich, admits of explanation.

My observations have mostly been made on the Severn, but I have never seen any reason to doubt the general application of the laws first suggested to me by these facts:—Above Gloucester is the "Long Reach," no affluents and a straight river; opposite the town, affluents on both sides and multiple channels, now only two enclosing the island of Alney; below the town, affluents on either side and a river with large or small curves according to the position of the affluents; in the estuary, affluents on both sides, and an ever-continuing struggle as to the extent to which either will prevail in having the principal channel on one or on the other side.

NOTICES OF MEMOIRS, ETC.

I.—On Reptilian Remains from the Trias of Elgin. By G. A. Boulenger, F.R.S.[1]

DESCRIPTIONS are given of various reptilian remains obtained by Mr. William Taylor, J.P., of Lhanbryde, in the Triassic sandstone quarries at Lossiemouth, near Elgin. Thanks to the kind permission of Dr. A. S. Woodward, the fossils were further developed in the Geological Department of the British Museum by Mr. Hall.

The remains described belong to three different reptiles.

1. *Hyperodapedon Gordoni*, Huxley.

A skull is contained in a block of sandstone, split horizontally in the plane of the palate, which is for the first time clearly exposed. The structure of the palate is seen to have been very different from what Huxley had surmised, and shows a much nearer approximation to that of *Sphenodon*. The choanæ were elongate, oval, and situated between the palatines and the vomers at some distance behind the

[1] Abstract of a paper (published by permission) read before the Royal Society of London, June 11th, 1903 (Proc. Roy. Soc., vol. lxxii, pp. 55–58).

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premaxillaries. Doubts have been thrown on Huxley's interpretation of the outer toothed bone of the skull, and it is important to settle the question of its identification. The new material has convinced the author that the teeth in the upper jaw are borne by both the maxillary and the palatine as stated by Huxley. The fossil shows well the elongate rhomboidal vacuity between the pterygoid, ending at the point where they converge before diverging again towards the quadrate, to the massive anterior branch of which they are suturally united.

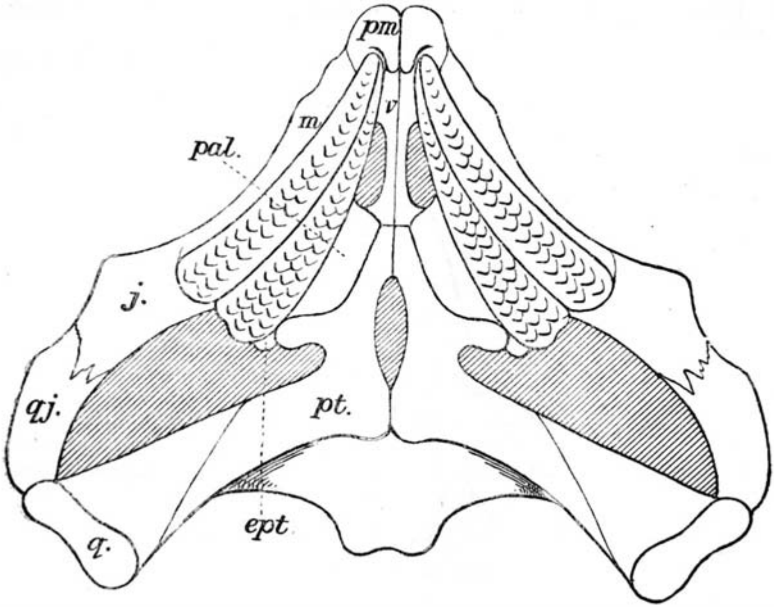

FIG. 1.—Palatal view of skull of *Hyperodapedon Gordoni*, Huxley.
ept. ectopterygoid; *j.* jugal; *m.* maxilla; *pal.* palatine; *pm.* premaxilla; *pt.* pterygoid; *q.* quadrate; *qj.* quadrato-jugal; *v.* vomer.

As may be seen from the annexed restoration, the palate of *Hyperodapedon* bears great resemblance, in its general structure, to that of the living *Sphenodon*, the principal differences, apart from the dentition, residing in the smaller bony roof of the mouth and the narrower vomers.

2. *Stenometopon Taylori*, gen. et sp. nov.

This name is proposed for a considerable portion of a skull of a Rhynchocephalian, closely related to *Hyperodapedon*, and belonging to the same family, Rhynchosauridæ. Its length is 177 mm. and its greatest width 160. One of the most striking features of *Hyperodapedon* as compared with its New Zealand ally, *Sphenodon*, is its much broader and more massive skull. The skull of the new Rhynchocephalian, although agreeing in its general structure with

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that of *Hyperodapedon*, is not broader and hardly more massive than that of *Sphenodon*, from which it differs, however, very much in shape. The rostrum has quite a different direction from either of these skulls; the tusk-like premaxillaries, instead of being bent downwards into recurved processes, are directed forwards in a gradual slope from the frontal region to their extremities, which project beyond the turned-up extremities of the mandibular rami. This is practically the reverse of the condition in *Hyperodapedon*, where the strongly curved premaxillary 'tusks' are received between the outwardly directed rostral processes of the mandible. Nasal bones are absent.

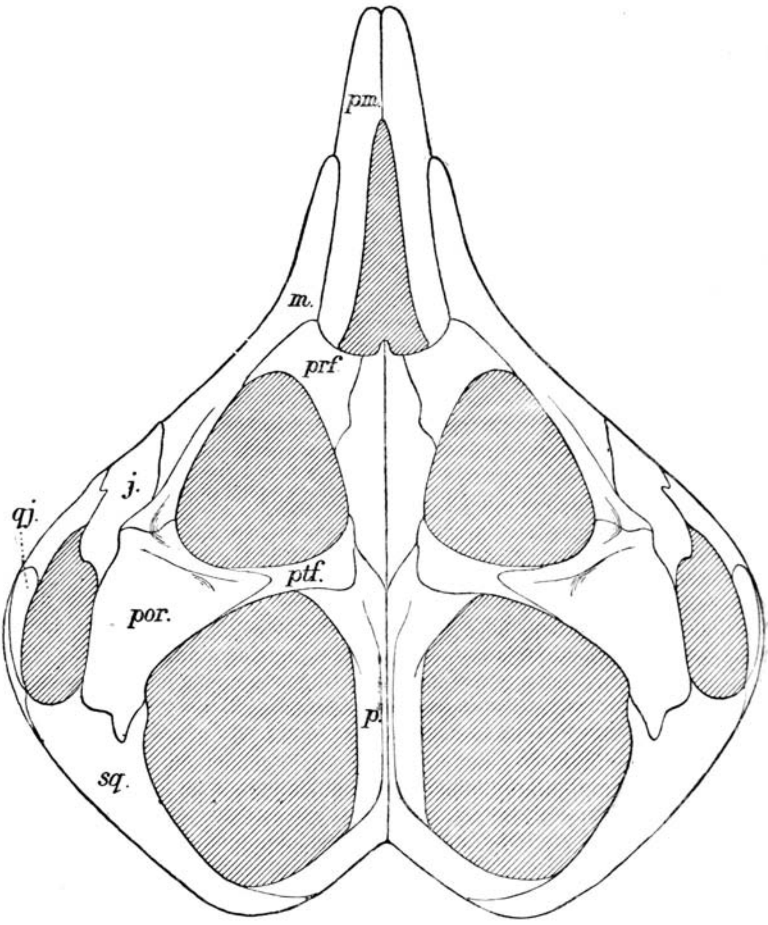

FIG. 2.—Dorsal aspect of skull of *Stenometopon Taylori*, gen. et sp. nov. *j.* jugal; *m.* maxilla; *p.* parietal; *pm.* premaxilla; *por.* post-orbital; *prf.* prefrontal; *pm.* premaxilla; *ptf.* post-frontal; *qj.* quadrato-jugal; *sq.* squamosal.

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As in *Hyperodapedon*, the nasal aperture is single, but, in accordance with the shape of the premaxillaries, it is more elongate, its length being to its width as $2\frac{1}{3}:1$; its posterior border extends to the level of the orbits, which are entirely directed upwards. The inter-orbital region is narrow, especially behind. The supra-temporal fossæ are very large, separated from the orbits by the narrow post-orbital arch and from each other by the sharp median crest of the parietals. The latero-temporal fossa is kidney-shaped, and proportionately larger than in *Hyperodapedon*, but smaller than the supra-temporal fossa. The maxillary bone is deep and nearly vertical, with an oblique ridge extending downward and backward to the jugal; the maxillary teeth, so far as they are preserved, appear very similar to those of *Hyperodapedon*, and form a single series in front and two behind. The palate is imperfectly preserved, but what is left of it agrees in essential points with *Hyperodapedon*; the palatine teeth are disposed in three series behind.

3. *Ornithosuchus Woodwardi*, E. T. Newton.

The specimen on which this species was founded by Mr. Newton in 1894 indicated a reptile about $2\frac{2}{3}$ feet long. Specimens more than twice as large are now described, and afford much information on points which remained obscure. Clavicles were present, large and widely expanded at their inner extremity, where they over-lapped the inter-clavicle. A plastron, or system of abdominal ribs, was also present, resembling very closely that of *Sphenodon*, each segment being formed of a median angulate piece, to which a lateral limb is attached, the segments, however, being much more numerous and closer together than in the New Zealand reptile.

The presence of clavicles and of a plastron show that *Ornithosuchus* cannot be included among the Dinosaurs, as originally suggested, but must be placed in the order Thecodontia of Owen, which contains *Belodon* and *Aëtosaurus*. The Thecodontia should be kept distinct from the Crocodilia or Emydosauria; they agree with the latter, the Dinosauria, and the Pelycosauria, to which they are very closely related, and differ from the Rhynchocephalia, in the truly thecodont dentition; they agree with the Rhynchocephalia and Pelycosauria, and differ from the Emydosauria and Dinosauria, in the presence of clavicles, whilst they show close resemblance to the Rhynchocephalia proper in the structure of the plastron. The presence of clavicles and the condition of the pelvis, in which the pubis enters the acetabulum, together with other characters showing greater generalisation, afford ample justification for the separation of the Thecodontia or Parasuchia, as a group of ordinal rank, from the Emydosauria. The author also expresses the opinion that precision in the definition of the higher group of reptiles would gain much by the order Dinosauria being restricted to the carnivorous, truly thecodont forms, the others deserving to form an equivalent order under the name of Orthopoda, Cope (Predentata, Marsh; Ornithischia, Seeley).

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II.—Description of a new species of *Matheria* (*M. brevis*), from the Trenton Limestone at Ottawa.[1] By Dr. J. F. Whiteaves, F.G.S.

THE genus *Matheria* was described by E. Billings in 1858, in the third volume of the Canadian Naturalist and Geologist. It was based upon a single species, the *M. tener* of Billings, a small lamellibranchiate or pelecypodous bivalve, from the Trenton Limestone at Lake St. John, P.Q. *Matheria* appears to be most nearly related to *Cyrtodonta* and *Vanuxemia*, and is now included in the family Cyrtodontidæ, Ulrich, of the order Prionodesmacea, Dall. The types of *M. tener*, which were collected by Mr. J. Richardson and Dr. R. Bell in 1857 at Blue Point, on Lake St. John, are still in the Museum of the Geological Survey.

A second species of this genus, from the Trenton shales of Minnesota, was described by Mr. Ulrich in 1892, under the name *M. rugosa*, in the Nineteenth Annual Report of the Geological and Natural History Survey of Minnesota. And, in his Report on the Lower Silurian Lamellibranchiata of Minnesota, published in 1897, in vol. iii, pt. 2, of the Final Report on the Geology of Minnesota, Mr. Ulrich expresses the opinion that the *Modiolopsis recta* of Hall, from the Niagara Limestone of Wisconsin and Illinois, is also a *Matheria*.

In the Museum of the Geological Survey there are a few specimens of a fourth and previously undescribed as well as unfigured species of this genus, from the Trenton Limestone of Ottawa, collected many years ago by E. Billings, and labelled by him with the manuscript name *Matheria brevis*. This species may now be defined and characterized as follows.

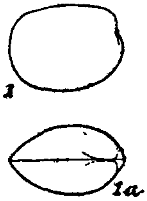

Fig. 1.—*Matheria brevis*. Side view of the most perfect specimen collected, in outline, and showing the marginal contour of the right valve.
Fig. 1*a*.—The same specimen, as seen from above, to show the amount of convexity of the closed valves.
Both of these figures are of the natural size.

Shell small, inflated, and regularly convex, but not quite as wide as high, suboval or oblong subquadrate, about one-third longer than high, and very inequilateral. Anterior side very short, narrow, and consisting of a small rounded lobe below the beaks on each side; posterior side longer, and a little wider in the direction of its height;

[1] Reprinted from the "Ottawa Naturalist," Journal of the Ottawa Naturalists' Club, vol. xvii (1903), pp. 33–34, May Number, Ottawa, Canada.

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posterior end vertically subtruncate at its mid-height, rounding abruptly into the cardinal margin above and into the ventral margin below. Ventral margin gently convex, but curving upward more abruptly and rapidly at the posterior than at the anterior end; superior border almost straight and nearly horizontal; umbones depressed, anterior, very nearly but not quite terminal; beaks incurved.

Surface-markings not at all well preserved in either of the specimens collected, but apparently consisting of fine concentric lines of growth. Hinge dentition and muscular impressions unknown.

Approximate dimensions of the specimen figured: maximum length, 15 mm.; greatest height, 11 mm.; maximum width, or thickness through the closed valves, nearly 9 mm.

Trenton Limestone, Ottawa, E. Billings: four nearly perfect but badly preserved specimens.

M. brevis can be distinguished at a glance from *M. tener*, *M. rugosa*, and *M. recta*, by its comparatively short, tumid, and regular convex valves.

III.—The use of Carboniferous Plants as Zonal Indices. By E. A. Newell Arber, M.A., F.L.S., F.G.S.[1]

THE student of Carboniferous plants has long ago realized that the kind of evidence which is drawn successfully from the distribution of marine invertebrata is inapplicable and inaccurate in the case of fossil plants. For instance, as is well known, the Jurassic rocks are divided into a number of zones on the occurrence of a species of Ammonite, confined or almost wholly confined to a particular zone. Apparently in regard to the Carboniferous mollusca, the same principle is being applied. Efforts are being made[2] to obtain one or two definite but common mollusca which occur in one subdivision of the Coal-measures, but which are absent or almost entirely absent from others, and to use such species as zonal indices. How far this will prove possible in the case of a fauna which has for the most part a wide vertical range, and which is not truly marine but largely littoral, estuarine, or even fresh-water, remains to be seen. The discovery of restricted species of plants is not, however, the primary object of the palæobotanist. Some geologists, realizing that fossil plants do not commonly afford this type of evidence, have rather hastily concluded that such remains are therefore useless as zonal indices. I hope, however, to show that this is not the case. It is true that in British rocks a number of plants are, so far as our knowledge extends, confined to one of the minor divisions of the Carboniferous, such as the Middle Coal-measures. This is the case with *Zeilleria delicatula* (Sternb.) and

[1] Abstracted from a paper read before the North of England Institute of Mining and Mechanical Engineers in June, 1903, and published in the Transactions of the Institute for the current year.

[2] "Life-Zones in the British Carboniferous Rocks: Report of the Committee": Report British Association, Bradford, 1900, pp. 340–342.

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Sigillaria ovata Sauveur, plants which have recently been found in the Cumberland Coalfield. The evidence of such restricted species is not, however, the foundation of any method of zoning by means of fossil plants, although it is often important as affording confirmatory support to conclusions gained on entirely different grounds.

In order to establish the position of any bed in the Coal-measures, it is necessary to collect and to study a number of different species from it or from the associated rocks; in other words, we must know not one or two species, but a flora. The number of species need not, however, be very large. Usually twenty species or even less will suffice if they belong to diversified types of plants, but the larger the number the better. It is the relative abundance of certain types of plants at any one horizon, and the absence of other types, rather than the occurrence of particular species, which gives the solution to the problem of the horizon of the bed in question. By taking into account the aggregate or assemblage of plant types, the common occurrence of certain classes, genera, subgenera, or species, and the absence or rare occurrence of others, species which have a wide range in time in Carboniferous rocks can be made to yield evidence. Such species, despite their range, are found to be much more abundant in some of the subdivisions of the Carboniferous than in others.

Thus the common occurrence of *Lepidodendron aculeatum*, Sternb. in coal-bearing strata in itself points to such beds being of Middle or Lower Coal-measure age, rather than Upper, as this species has been found to occur most abundantly on these horizons, and less abundantly in the Upper Coal-measures. From a number of separate small conclusions of this nature a general conclusion can be arrived at, for which support can often be found from other lines of evidence, such as the occurrence of restricted species. Again, an abundance of such types of plants as *Calamites* and *Sigillaria*, in association with *Sphenopteris*, and an absence of particular types of *Pecopteris*, *Alethopteris*, and *Cordaites*, will help to distinguish a Middle from an Upper Coal-measure flora.

Occasionally small points of disagreement with a general result are found. *Alethopteris Serli*, Brongt., a characteristic Upper Coal-measure fern-like plant, is sometimes found in the Middle Coal-measures, as for instance in Cumberland. The disagreement of a single character does not, however, invalidate the conclusion drawn from an aggregate of characters. Such disagreements occur among recent plants which are classified on very similar principles to those applied here. In the recent family Scrophulariaceæ, the presence of five stamens in the flower is a single character contributing towards an aggregate of characters which distinguishes this family or natural order from others. But many, perhaps the majority of genera belonging to this family possess only four or two stamens, whereas their other characters, as a whole, clearly point to close affinity with other members of the Scrophulariaceæ possessing five stamens. It need hardly be pointed out that if all

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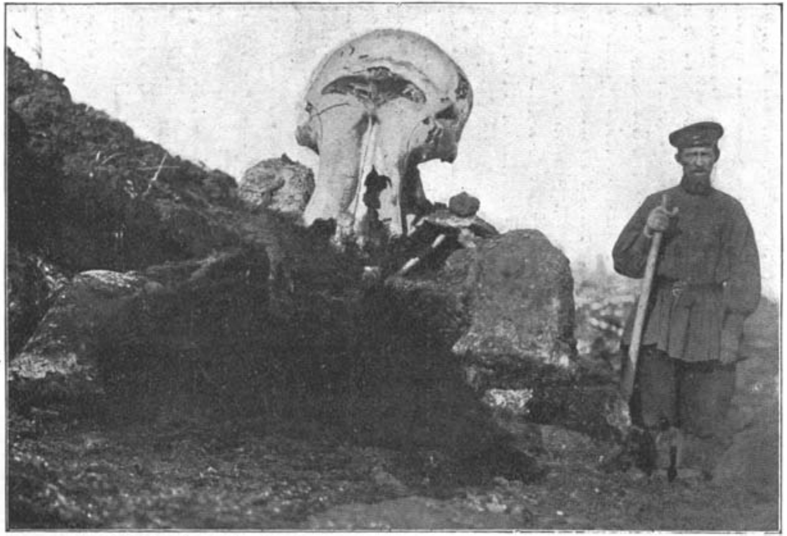

f

Photograph of the newly discovered Mammoth (*Elephas primigenius*), taken *in situ*.

Exposed by a landslip on the banks of the Beresowka, a tributary of the Kolyma, in the province of Jakutsk.

The skull was quite bare (the soft parts having been destroyed by foxes, etc.), but the body and the feet and limbs (*f*, *f*) were found still covered with the integument.

The skeleton and the skin are now both preserved and exhibited in the St. Petersburg Academy.

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the plants which possess five stamens were thrown into a group founded on this one character, that group would not be a natural one, since it would include a large number of genera in no way related to one another.

IV.—A Method for the Investigation of Fossils by Serial Sections. By W. J. Sollas, D.Sc., LL.D., F.R.S., Professor of Geology and Palæontology in the University of Oxford.[1]

MECHANICAL difficulties preclude the study of fossils by serial thin slices, but serial polished surfaces may be obtained at any desired degree of proximity, and these, when the fossil and its matrix offer sufficient optical contrast, serve most of the purposes of thin slices. They may be photographed under the microscope, so as to furnish a trustworthy and permanent record. The sections may be used to obtain reconstructions of the fossil in wax. Several fossils have been successfully studied in this way, such as *Palæospondylus Gunni, Ophiura Egertoni, Lapworthura Miltoni, Monograptus priodon,* and *Palæodiscus ferox.* The sections are obtained at regular intervals, usually of 0·025 mm., by means of an apparatus designed for the purpose by the Rev. Jervis Smith, M.A., Reader of Mechanics in the University.

REVIEWS.

I.—The Mammoth.

(PLATE XVIII.)

1. Berichte des Leiters der von der kaiserlichen Akademie der Wissenschaften zur Ausgrabung eines Mammuth-cadavers an die Kolyma-Beresowka ausgesandten Expedition. By Otto Herz. pp. 38, pls. x. Imperial Academy of Sciences, St. Petersburg, 1902.
2. Bodeneis vom Fluss Beresowka (Nord-ost Sibiriens). By I. P. Tolmatschow. Verhandl. k. russ. mineral. Ges., vol. xl, pp. 415–451, pls. v–viii (1903).
3. Osteological and Odontographical Comparison of the Mammoth (*Elephas primigenius*, Blum.) with the living Elephants (*E. indicus*, Linn., and *E. africanus*, Blum.) [in Russian]. By W. Salensky. pp. 124, pls. xxv. Imperial Academy of Sciences, St. Petersburg, 1903.

WHEN it was announced two years ago that the St. Petersburg Academy of Sciences had despatched an expedition to Siberia to obtain a newly discovered Mammoth, great interest was aroused. Previous attempts to recover a complete carcase had always ended in failure, owing to the difficulty of reaching any reported specimen in good time. On this occasion, however, it was hoped that the facilities afforded by the new trans-Siberian railway and the modern appliances of science would result in success, and at any

[1] Abstract of a paper read before the Royal Society of London, June 11th, 1903.

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