

plain that these two spines, though not belonging to the same fish, form in other respects a *pair*, right and left.

A third specimen represents the distal portion of a spine broken off after the closure of the sulcus, but fortunately with the point entire. It is $2\frac{1}{2}$ inches in length, and $1\frac{1}{2}$ inch in circumference proximally, whence it tapers to a pretty sharp point. The unsymmetrically trigonal form of the transverse section, the nature of the striation of the surface, and the appearance, internally, of the tissue of which it is composed, show clearly that this fragment is the terminal portion of a spine of the same species as the two already noticed, and it may also be observed that, as regards the direction in which it is unsymmetrical, it belongs to the same category as No. 2. But the point of special importance in this specimen is that, extending from the apex for a distance of $\frac{1}{10}$ inch along the posterior aspect, are two rows of small recurved denticles, each row being placed slightly within the rounded margin separating the posterior from the corresponding lateral surface. The denticles on the broader side of the spine are nearly all perfect, and are nine in number, those on the narrow side are only eight, and are mostly broken off, though still indicated by the fractured bases,—I may add that they were perfect before the specimen was removed from its matrix. The distance between the denticles in each row increases from about $\frac{1}{12}$ inch at the apex to $\frac{1}{8}$ between the last two, but the increase is not regular, so that the denticles of the two series are not always opposite. The surface of the denticles is smooth, nevertheless there is no appearance of a covering of enamel.

This new spine is of great interest from the analogies with *Gyracanthus* which it presents in many important points of its configuration. As in *Gyracanthus*, we have here a spine which is not bilaterally symmetrical, the posterior area being turned awry, which occurs in pairs, and which accordingly may safely be looked upon as a lateral appendage. One of the specimens presents appearances at the apex which I am inclined to interpret as “wearing,” though, if so, the wearing is on the posterior aspect. But though the wearing in *Gyracanthus* spines is usually anterior, I have certainly seen it also on the posterior aspect in specimens from Borough Lee. Here, however, the resemblances cease, as the present spine is proportionally short and stout, is devoid of distinctive sculpture, and its mode of denticulation is very different.

From the want of shining enamel or ganoine on the surface, which want is certainly not due to abrasion or erosion in any specimen I have seen, I propose to call the present new genus and species of Selachian spine *Aganacanthus striatulus*.

III.—THE LONG MEAD-END BED. FURTHER REMARKS.

By S. V. Wood, F.G.S.

BY the kindness of Dr. Henry Woodward, Keeper of the Geological Department of the British Museum, I have been furnished with a list of shells which have the locality “Mead End” attached to them in the Edwards Collection in that Museum.

To these I have been able to add from other sources¹ some others which are given in italics in the subjoined list, those in the Edwards collection appearing in Roman letters; and together they represent the whole molluscan fauna which up to this time has, so far as I can ascertain, been obtained from this bed.

It is not unlikely that collectors from the Hampshire beds may be able to add to the list, and if so I should feel obliged to them if they would favour me with particulars of such. The columns to show the presence of the shells in the Upper Eocene of Belgium are based on the Bruxellian and Laekenian lists of Nyst, in Prof. Dewalque's "Prodrome d'une description géologique de Belgique," pp. 401 to 407, and those showing this in the Upper Eocene of France are based on Deshayes' "Animaux sans vertèbres dans le bassin de Paris, 1866." The negative occurrence of them in the column for the Lower Tertiary is based on the lists of Bosquet in the same "Prodrome," pp. 410 to 416.

Names of Species. (Those marked + are, though given in Messrs. Keeping and Tawney's list of Middle Headon Shells in Q.J.G.S., vol. xxxvii. p. 115, omitted from the "Meadend" column of that list.)	Upper Eocene, France.		Upper Eocene, Belgium.		Lower Oligocene, Belgium
	Calcaire Grossier.	Sables Moyens.	Bruxellian	Laekenian	Lower Tertiary.
<i>Marginella simplex</i> , Edw., Eo. Moll.
<i>Pisania</i> (<i>Buccinum</i>) <i>lavata</i> , Sow.
<i>Oliva</i> <i>Branderi</i> , Sow.	*
+ <i>Ancillaria buccinoides</i> , Lam.	*	*	*	*	...
<i>Natica Studeri</i> , Bron. (depressa of Sow., but Deshayes doubts its identity with either <i>intermedia</i> , Desh., or <i>depressa</i> , Desh.)	?
„ <i>grossiuscula</i> , Edw. MS. (a var. of <i>Studer</i> according to Keeping & T.)	?
<i>Planorbis hemistoma</i> , Sow. (a Lower Eocene species).
„ <i>biangulatus</i> , Edw. Eo. Moll.
+ <i>Odostomia hordeola</i> , Lam.	*	*
<i>Cerithium</i> (<i>Potamides</i>) <i>pyrgotum</i> , Edw. MS.
„ „ <i>speculatum</i> , Edw. MS.
„ „ <i>pleurotomoides</i> , Edw. MS. ? (authority of K. & T.)
„ „ <i>variabile</i> , Desh. (<i>funatum</i> of Mantell sec Desh., a Lower Eocene species.)
„ „ <i>submarginatum</i> , D'Orb.	*
„ (<i>Pirena</i>) <i>concovum</i> , Sow.	*	*
„ „ <i>cavatum</i> , Edw. MS. (a var. of <i>concovum</i> according to K. & T.)	?	?
<i>Melania fasciata</i> , Sow. (M. Nysti, Duch.?)

¹ These sources are, as to *Lucina concava*, a note in my father's handwriting, and as to *Melanopsis sodalis*, *Cardita oblonga*, *Lucina divaricata*, *Psammobia appendiculata*, *Mactra depressa*, and *Corbula oblonga*, similar notes, and also specimens in my possession with their names and localities affixed to them in my father's handwriting. The authority for the introduction of the rest in italics is mentioned in the list.

Names of Species (continued).	Upper Eocene, France.		Upper Eocene, Belgium.		Lower Oligo- cene, Belgium
	Calcaire Grossier.	Sables Moyens.	Bruxellian	Laetianian	Lower Tongrian.
† <i>Melania muricata</i> (Sow. ? given in K. & T.'s sect. Q.J.G.S., vol. xxxix. p. 574).
<i>Melanopsis fusiformis</i> , Sow. (M. buccinoides, Fer. ? and thought by Desh. to be only derivative in the Sab. Moyens).	...	*
„ <i>subfusiformis</i> , Morris.....
„ <i>brevis</i> , Sow.
„ <i>sodalis</i> , Desh. (a Low. Eocene, sp.)
<i>Rissoa carinata</i> , Edw. MS.
<i>Hydrobia subangulata</i> , Edw. MS.
„ <i>anceps</i> , (? author)
<i>Nematura (Valvata) parvula</i> , Desh.
<i>Neritina concava</i> , Sow.....
<i>Ringicula ringens</i> , Lam.	*	*
<i>Bulla Lamarckii</i> , Desh.	*	*
<i>Dreissena Brardii</i> , Fauj.
<i>Mytilus affinis</i> , Sow.
<i>Modiola elegans</i> , Sow.
„ „ <i>var. elegantior</i> , S. Wood..
<i>Trigonocella (Leda and Nucula) deltoidea</i> , Lam.	*
<i>Nucula tumescens</i> , Edw. (S. Wood)
„ <i>ampla</i> , Edw. (S. Wood)
<i>Cardita (Venericardia) oblonga</i> , Sow.
<i>Lucina inflata</i> , Edw. MS.
„ <i>pratensis</i> , Edw. MS.
† „ <i>concava</i> , De Fr.....
„ <i>gibbosula</i> , Lam.	*	*	*
„ <i>divaricata</i> , Lam. (<i>L. pulchella</i> , Ag.)	*	...	*	*	...
„ (<i>Strigilla</i>) <i>colvellensis</i> , Edw. MS.
<i>Cyrena cycladiformis</i> , Desh.	*
„ <i>pisum</i> , Desh.	*
„ <i>gibbosula</i> , Morris
„ <i>arenarea</i> , Forbes
„ <i>altirupetris</i> , Edw. MS.
<i>Psammobia rudis</i> , Lam. (<i>solida</i> , of Sow.) ...	*	*	...	*	...
„ (<i>Solen</i>) <i>appendiculata</i> , Desh. (upper Calc. Gros. only)	*	*	...
<i>Tellina reflexa</i> , Edw. in Lon. Geol. Journ...
„ <i>elongata</i> , Edw. MS.
<i>Macra fastigiata</i> , Edw. MS.
„ <i>filosa</i> , Edw. MS. (a var. of <i>fastigi-</i> <i>ata</i> , according to Keeping and T.)
„ <i>depressa</i> , Desh (<i>compressa</i> also of Desh.)	*	*
<i>Mya angustata</i> , Sow.
<i>Potamomya plana</i> , Sow.
<i>Corbula nitida</i> , Sow. (non Bron. non D'Orb. non <i>Sphenia nitida</i> , Desh.)
„ <i>cuspidata</i> , Sow.
„ <i>fortisulcata</i> , Edw. MS. (a var. of <i>pisum</i> , according to Keeping & T.)	...	?	...	?	...
„ <i>oblonga</i> , Desh. (upper Calc. Gros. only)	*

To what extent the species marked "Edwards MS." may be represented in French or Belgian beds I am unable to say; but taking the published species as the basis of remark, the statement I made in the December Number of the *GEOL. MAG.*, that not many of the Meadend species occurred in the Laekenian, but more in the Sables Moyens, is borne out. All the Upper Eocene of England, however, so far as the molluscan remains in it afford an indication, appears to have a greater connection with the beds regarded as the Upper Eocene of France, than with those similarly regarded of Belgium; a fact for which no sufficient explanation has yet been suggested.

Four of the published species, viz. *Marginella simplex*, *Psammobia rudis*, *Corbula nitida*, and *Mya angustata* (all Middle Headon shells), do not seem to have occurred lower in the Tertiary series of England than this bed, though *Psammobia rudis* occurs as low as the *Calcaire grossier* in France. Whether any of the species marked "Edw. MS." appear at a lower horizon than this bed I am unable to say.

When (in the December Number) I spoke of this bed showing the transition from the Upper Eocene to the Lower Oligocene, it was on the assumption that Prof. Judd's suggested correlation (p. 167 of vol. xxxvi. of the *Quart. Journ. Geol. Soc.*) was, so far as regarded the parallelism of the Lower Headon with the Lower Oligocene,¹ sufficiently founded, whatever questions existed as to other points of contention; but as not one of the Meadend species seems to have occurred in the Lower Oligocene of Belgium, and the Meadend bed is but the fluvio-marine base of the Lower Headon, the correspondence of any part of the Lower Headon to the Lower Oligocene appears questionable.²

As the paper of my father, in which the Meadend bed was first made known, appeared in a periodical which stopped 37 years ago, after only the first few numbers of it had been published (so that his paper was not even concluded), and may be unknown to many younger geologists, I here reproduce so much of it as specially relates to the marine beds of Hordwell Cliff, viz. the Meadend bed and the Middle Headon, and the positions they respectively occupy in relation to the freshwater beds with which they are associated.

"On the Discovery of an Alligator and of several new Mammalia in the Hordwell Cliff; with Observations upon the Geological Phenomena of that Locality. By Searles Wood, F.G.S. (page 3 of the London Geological Journal for September, 1846).

"So far back as 1822, Mr. Webster visited this coast for the purpose of tracing the connexion between the cliff at Hordwell and that on the opposite side of the

¹ As Prof. Judd in his vertical "New Forest" section, (*loc. cit.* p. 170) places the "Sands" (numbered 1 in the section of Hordwell Cliff accompanying this paper) which intervene between the base of the Lower Freshwater and the Barton Clay, in his "Headon Group," and places all this group on the horizon of the Lower Oligocene, it follows that this horizon begins in his view even some way below the Meadend bed, although he does not show this bed in his section.

² One of the shells, *Neritina concava*, is given from the Klein Spawen bed; but as my father (see *Eo. Moll.* p. 346) found it at Muddiford, which is far below the Meadend horizon, this would be no exception to the remark in the text. Bosquet, however, regards the Belgian shell as different from Sowerby's *concava*.

Solent. He discovered on that occasion the existence of this freshwater deposit [that of Hordwell Cliff], and its geological identity with that portion of Headon Hill, in the Isle of Wight, which is in juxtaposition with the London Clay,¹ and known as the *Lower Freshwater formation*. But he was unable to find anything at all analogous to the so-called *Upper Marine*, that estuary deposit immediately resting on the *Lower Freshwater* at Headon Hill, though he suggested that it very probably might exist in some portion of the cliff then inaccessible to his examination. Mr. Lyell subsequently explored this part of the coast, and the account which he has given in the Geological Transactions for 1827 is the latest memoir that I know of in which any information respecting the Hordwell Cliff is to be found. Mr. Lyell's investigation led him to the four following conclusions:—

"First. 'That no portion of the Upper Marine formation exists anywhere in this part of the Hampshire coast: the uppermost beds in the series at Hordwell Cliff, so far from indicating a passage into the Upper Marine, contain organic remains, both animal and vegetable, exclusively belonging to freshwater genera. The shells referred to by Mr. Webster as *Cerithia*, occurring in fallen blocks along the shore, belong to the genus *Potamides*, and the stratum in which they abound occupies a middle place in the series. *Cerithium* is a marine genus, but the *Potamides*, of which some species still exist in a recent state, inhabits rivers, or at least the mouths of rivers.'—Geol. Trans. New Series, vol. 2.

"As Mr. Lyell's visit was probably a short one, I am not surprised at his not having observed any portion of the Upper Marine formation in Hordwell Cliff, but the existence of that deposit may be seen at a spot one mile to the east of Beacon-Bunny, and a few paces westward of a ravine that is situated half a mile from the village of Milford.² The bed occurs at an elevation of ten or twelve feet above high-water mark, but with a thickness of only nine or ten inches, and only traceable for about forty yards. Mr. Frederic Edwards, of Hampstead, so well known for his unrivalled cabinet of Hampshire fossils, was the first to notice this deposit, three years previous to my visit. At that time, he informs me, the bed could be followed for three hundred yards, but owing to the debris which has since fallen from the upper portion of the cliff, I could not trace it for a third of this distance.

The following list of Testacea from this stratum of the Upper Marine formation at Hordwell, is the joint result of Mr. Edwards' researches and my own.

Acteon.
Ancillaria subulata [buccinoides], Lam.
Arca elegans.
Balanus unguiformis.
Bulla (two species).
Cæcum.
Cancellaria muricata.
 " *elongata*.
Cerithium cinctum, Sow.
 " *margaritaceum*, Sow.
 " *terebrale*.
 " *ventricosum*, Sow.
Chemnitzia [Turbonilla], two species.
Corbula cuspidata, Sow.
Cyrena cycladiformis, Desh.
 " *obovata*, Sow.
 " *pulchra*, Sow.
Cytherea incrassata, Desh.
 " *obliqua*, Desh.
Fusus labiatus, Sow.

Hydrobius.
Kellia [*Scintilla* and *Lepton*], two species.
Limnæus.
Lucina divaricata, Lam.
 " *pulvinata*.
Melania angulata.
 " *fasciata*, Sow.
Melania muricata.
Melanopsis ancillaroides, Desh.
 " *carinata*, Sow.
 " *fusiformis*, Sow.
 " *minuta*.
Murex sexdentatus, Sow.
Mya angustata, Sow.
Mytilus ? *affinis*, Sow.
Natica depressa, Sow.
 " *epiglottina*, Lam.
 " *labellata*, Lam.
Nematura.
Nerita aperta, Sow.

¹ At this time, and until after the first part of this paper had been published, the Barton Clay was regarded by geologists as the same formation as the London Clay.

² In the Ordnance one inch to the mile map this ravine is called Paddy's Gap, but in the six inch to the mile map no name is given to it. Its distance from Milford is given correctly in my father's paper, but its distance from Beacon-Bunny is according to the six inch map upwards of a mile and a half.

Neritina concava, Sow.

Nucula [*Trigonocælia*] *delloidea*, Lam.

„ new species.

Odosstomia subulata.

Ostrea.

Planorbis (two species).

Pleurotoma (two species).

Psammobia compressa, Sow.

Scalaria.

Serpula corrugata, Sow.

„ *tenuis*, Sow.

„ new species.

Turbo?

Voluta spinosa? Lam.

“In addition to these are also found a species of *Cytherina*, and one of *Cristellaria*.

“Many of the above species must have inhabited the sea, or at least that estuary portion of a river to which salt water must have had access, and these are not met with in that more purely *freshwater stratum* both above and beneath the *marine stratum* I have described. They are identical also with those *Testacea* which have been collected and regarded as marine from the so-called ‘Upper Marine’ in Headon Hill. The remaining portion of the cliff to the eastward, I consider more from position than its organic contents as the Upper Freshwater. Indeed, I am not acquainted with any species peculiar to this stratum; for I have found all hitherto published as such, in the *Lower Freshwater* at Hordwell.

“Secondly, Mr. Lyell says, ‘The extent of the Freshwater formation is somewhat greater than had been supposed, as it is continued in Barton Cliff to nearly opposite the village of Barton, the lower beds of the series there exposed contain in parts *Gyrogonites* and freshwater shells.’

“I am not disposed to admit the extent of this freshwater deposit to be so great as is here represented, but would limit its western extremity to that gorge or ravine known by the name of ‘Beacon-Bunny,’ the upper portion of which [gorge] is a bed of lignite beneath the gravel, and overlying a bed of greyish-white or light-coloured sand, containing the following molluscous genera, some species being extremely abundant: *Oliva*, *Potamides*, *Ancilla* [*Ancillaria*], *Natica*, *Melania*, *Melanopsis*, *Pleurotoma*, *Bulla*, *Maetra*, *Cyrena*, *Corbula*, *Sanguinolaria*, *Venericardia* [*Cardita*], *Cytherea*, *Lucina*, and *Potamomya*.¹

“This bed appears to be intermediate between the London Clay² and the Lower Freshwater, and must be referred to an estuary formation, for the largest portion of its *Testacea* are referable to marine genera; and for the sake of distinction it might be convenient to designate this estuary deposit by the term ‘Lower Marine.’ It may be traced to the eastward beneath the freshwater marls to about 300 yards from Mead-end, where it is lost beneath the shingle of the beach. It cannot be considered as a true freshwater deposit, having from its organic contents as much claim to be regarded of marine origin as the so-called ‘Upper Marine’ of the Isle of Wight.”

In the remaining portion of this paper, my father proceeded to combat Sir Charles Lyell’s third conclusion, that the white sand of Beacon and Barton Cliffs must be referred to the Freshwater formation; and also his fourth conclusion, that although the shells of Hordwell Cliff belonged exclusively to the Lower Freshwater formation, yet it might be a question whether the organic remains were not of a mixed nature—conclusions not entertained now by geologists;—and to describe the vertebrate and molluscan remains collected by him from the Lower Freshwater of Hordwell Cliff.

I now subjoin so much of the letter of Mr. Keeping to this MAGAZINE, of September last, as impugns my father’s description; having placed in italics the statements in that letter, and those in my father’s paper, that conflict. The statements in Mr. Keeping’s letter (no locality being named) could be reconciled with my father’s statements in no other way than by supposing Mr. Keeping to refer to the Mead-end bed.

¹ I have not been able to find *Pleurotoma*, *Sanguinolaria*, or *Cytherea* among the shells of this (Mead-end) bed.—S.V.W.

² By this is meant the Barton Clay, as explained in note *ante*.—S.V.W.

"In the discussion upon the paper 'On the Section at Hordwell Cliff from the top of the Lower Headon to the base of the Upper Bagshot Sands,' by the late Mr. E. B. Tawney and myself, which was read before the Geological Society, June 28, 1883, Prof. Judd is reported to have said: That the paper seemed to be a critical one, and the criticism was rather of the nature of a statement that the authors had not seen what several distinguished observers such as Mr. F. E. Edwards, Mr. Searles Wood, Dr. Wright, and others, stated they had distinctly seen. . . . Now I wish to assure Prof. Judd that my memory does not fail me, and that I have seen the fossiliferous patch of stuff in question many hundreds of times *just in the same position as Mr. S. Wood, Mr. Edwards, Dr. Wright, and the Marchioness of Hastings* had seen it, and I always believed it to be *nothing more than a slipped mass*, which I subsequently obtained complete proof that it was.

"The patch in question when described by Mr. S. Wood was only to be found close to the beach just above high-water mark, and only extending some 20 yards in length, and 9 inches in thickness. . . . I succeeded in finding the bed from which the fossils had come, *in situ*, just in the sequence as I had always expected to find it, namely, close under the gravel with all the Lower Headon Freshwater beds below it, showing clearly that *all* the previous authors were wrong in putting *these* freshwater beds above it. . . . The bed in dispute I wish to be distinctly understood to maintain is the Marine Middle Headon of the Geological Survey, and equivalent to the *Middle Headon* of Colwell Bay, *Headon Hill*, Whitecliff Bay, and Brockenhurst in the New Forest."

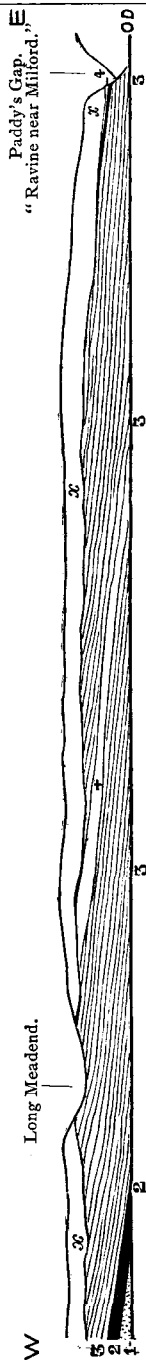
Mr. Elwes writes in the November Number of this MAGAZINE by the request of Mr. Keeping to say, that he and a party under Mr. Keeping's direction, had opened the bed on the west side of Paddy's Gap (the ravine near Milford referred to by my father), and found it *in situ* 13 feet above the shore, consisting of from 1 foot to 1½ of sand and comminuted shells, estuarine and marine, immediately overlain by whitish sand of similar thickness, beneath 26½ feet of gravel and soil, and resting on light green clayey sand in which specimens of *Paludina* and *Unio* were found; adding that about a third of a mile to the east, near Westover Lane-end, there is a slight upthrow showing the *Unio* bed, and about 10 feet of the underlying green clays; and that it was under this that the previous writers had placed the Middle Headon marine bed, instead of above it.

Mr. Elwes was good enough to send me the rough section which is given in *fac simile* in cut No. 2, in explanation of this; and I have added cut No. 1 to show the section of the entire cliff, from this point westwards to beyond Meadend, prepared from sections made by myself nearly 40 years ago, and connected by description with the vertical section given by Messrs. Keeping and Tawney in their paper giving rise to the discussion¹ (but which was not published till after both my article in the November, and letter in the December Number, of this MAGAZINE were in print); and I think that I need not add anything to the above to make the whole case intelligible, and show how utterly my father's statements have been misrepresented, and how the excavation made has confirmed his description in every particular, but carried the subject no further. The party have found the marine bed overlying the Lower Freshwater, *as he did, in situ* (and not as a slipped mass close to the beach, as Mr. Keeping made out), and at a height above the shore, which they estimate at 13 feet, instead of the 10 to 12 at which he estimated it; but as regards the Freshwater beds to the east of it, which

¹ Quart. Journ. Geol. Soc. vol. xxxix. p. 574.

FIG. 1.—HORDWELL CLIFF.

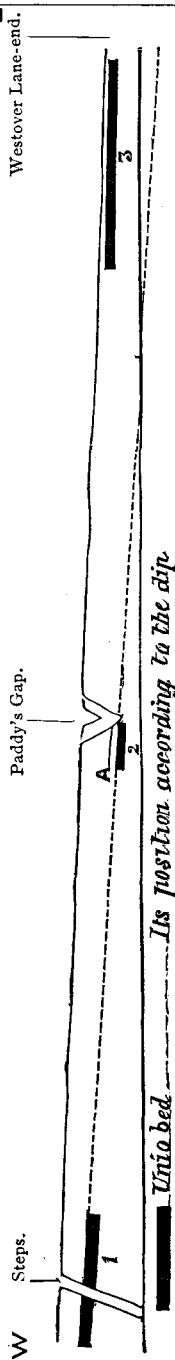
LENGTH OF SECTION, 12 FURLONGS, VERTICAL SCALE 8 TIMES THE HORIZONTAL.



1. White untossiliferous sand intervening between the Barton Clay and bed No. 2 (This is *g* of Messrs. Keeping and Tawney's vertical section in Q. J. G. S., vol. 39, p. 575; and "Sands" of Prof. Judd's vertical "New Forest" Sect. in vol. 36, p. 170.)
2. The Long Meadend bed (This is *a*, *b*, *c*, *d*, *e* & *f* of K. and T.'s section, but not shown in Prof. Judd's) "Lower Marine" of my father—fluvio-marine.
3. The Lower Headon (1 to 33 of K. and T.'s section and "Lower Freshwater" of my father)—Freshwater.

4. The "Upper Marine" of my father; "Middle Headon" of Mr. Keeping "Marine band" of Prof. Judd—Marine with some freshwater shells. *x* Newer Pliocene gravel. The Cross denotes the place and position from which were obtained the Mammalian, Avian, Reptilian, and Fish remains referred to in my footnote at p. 496 of Vol. X. of this MAGAZINE, the bed yielding them being No. 15 of K. and T.'s section.
- O.D. Ordnance datum line.

FIG. 2.—SECTION FURNISHED BY MR. J. W. ELVES.



1. Same as seen by the steps. 2, as in our pit. 3, opposite Westover.

my father considered might be Upper Freshwater only from their eastward position (pointing out that the shells in them were the same as in those beneath the marine bed), they have shown nothing beyond, or contrary to, what he stated; and it is obvious that it will require further excavations between the two points to determine whether the Freshwater beds a third of a mile to the east are, or are not, beneath the marine bed which this party opened. If such be done, and Mr. Keeping's view that they are beneath it is confirmed, this, so far from showing my father to have been wrong, will show him to have been right in so cautiously guarding himself against any more positive assertion as to the geological position of these freshwater beds to the east of the ravine, than appears from the extracts which I have given from his paper.

IV.—ON THE CAUSES OF CHANGE OF CLIMATE FROM WARM TO COLD, AND COLD TO WARM, DURING LONG PERIODS, AND ALSO OF COINCIDENT CHANGES OF THE FAUNA AND FLORA.¹

By JOHN GUNN, M.A., F.G.S.

IT is a trite observation that truths which lie at our feet may be overlooked by the wise, and discovered by mere accident, or the chance step of some casual passer-by.

This appears to be the case with the phenomena of the so-called Glacial epoch, and the causes of the change of temperature on the earth's surface. The depth and the height of science have been searched through heaven and earth, while the grand and simple agency of nature, which has been operating alike through all time, may have been overlooked, or not duly consulted.

To enter upon the subject at once: it may be asked, if the elevation of mountain ranges be productive of cold, why may not the converse be true, and the wearing down and levelling of those heights be the cause of a warm temperature?

This is not a matter of conjecture, but from its very nature it ought to be a subject of observation, and to admit of actual verification.

In pursuing this inquiry, it is not necessary to enter into the question, how the inequalities of the earth's surface may have originated, nor to refer to astronomical agencies, such as the Precession of the Equinoxes, which are perpetually and uniformly at work alike under all conditions of elevation or depression; but I will claim in support of my proposition, the effect produced by the alterations of the course of the Gulf Stream, through changes in the level of the land, and also by the transport and melting of icebergs and glaciers.

With these provisos, I will commence my observations with the Carboniferous epoch. There is evidence of a quiescent state during which coal was deposited. Not a single instance, that I am aware, can be adduced of the occurrence of bouldered rocks, certainly not of

¹ A Paper read before the Geological Section of the Meeting of the British Association at Southport, 1883.