PROCEEDINGS

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CORRIGENDA.

Page 13, Table, last column, (No. 34.) *f. for* Marrington Dingle, *read* Mary Knoll Dingle
g. — Prescold *read* Prescoed
k. — Corton *read* Corston
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— 24, line 25 ..... *for* Bailey *read* Bayly
— 53, — 14 and note * ..... — Ovelipore *read* Oudeypore
— 146, — 7 from bottom ..... — 1784 *read* 1824
— 147, — 9 ..... — Hardy *read* Hardie
— 149, — 6 from bottom ..... — outline *read* outlier
— 161, — 19 ..... — medal *read* Proceeds
— 162, — 30 ..... — Wallickii *read* Wallichii
— 171, — 18 from bottom ..... — shisti *read* schisti
— 196, bottom line ..... — white *read* while
— 210, line 16 ..... — F. Darwin *read* C. Darwin
— 221, note ..... — No. 41, vol. ii. p. 191. *read* No. 36, vol. ii. p. 83.
— 416, line 21 }
— 417, — 10 & 22 } ..... — Hunter *read* Hunton
— 450, — 10 from bottom ..... — Plaistic *read* Plastic
— 530, — 21 ..... — Walton Naze *read* Harwich Barracks Cliff
— 535, — 3 ..... — breaches *read* beaches
— 537, — 8 from bottom ..... — rocks and *read* rocky

PROCEEDINGS

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THE GEOLOGICAL SOCIETY OF LONDON.

VOL. II. 1835. No. 41.

May 13th.—George Thomas Nicholson, Esq., of Waverley Abbey, near Farnham, was elected a Fellow of this Society.

A paper was first read, "On the Cretaceous and Tertiary Strata of the Danish Islands of Seeland and Möen;" by Charles Lyell, Esq., P.G.S.

The author commences with a short account of the succession of deposits formerly supposed by Dr. Forchhammer to exist in the Danish islands. In a memoir published in the "Edinburgh Philosophical Journal of Science" for July 1828, Dr. Forchhammer had described the white chalk of Seeland as covered by a coralline limestone, and had imagined the white chalk of Möen to be a formation higher in the series than this coralline limestone. He had also considered certain deposits of blue clay, sand, and gravel, seen in the cliffs of Möen, as alternating with the white chalk.

Mr. Lyell examined, in company with Dr. Forchhammer, the cliffs of Seeland and Möen, during the summer of 1834, and the following are the results at which he has arrived. The two formations of which Denmark and Danish Holstein chiefly consist, are, chalk, and an overlying tertiary deposit. Part of the latter resembles in composition the argillaceous and sandy beds of the English crag. Another part corresponds with deposits usually called diluvial, especially those associated with the English crag, in parts of Norfolk. Large erratic blocks are also strewed over the surface of Denmark, connected with, and sometimes buried in, the gravel or "diluvium". In some sections on the banks of the Elbe, the yellow tertiary sands are divided regularly into thin strata, and are exposed for a thickness of about 200 feet. Unstratified masses of blue clay, of great thickness, are also there seen, in which gravel, containing every kind of rock, from granite to chalk, occurs.

There is often an abrupt passage from the stratified to the unstratified parts of the formation, which the author compares to the Norfolk and Suffolk crag, from its general appearance, but without pretending to decide its relative age in the tertiary series. Fossils are rare, except those washed out of older strata. A few recent shells have been found near Segeberg, and at other points, and two of extinct species at Schulan on the Elbe.

The white chalk of Denmark is characterized by the same fossils as those of the upper chalk of France and England, and occurs at Stevensklint in Seeland, and in the cliffs of Möen. On the coast

at Stevensklint, and at several places in the interior of the same island, particularly at Faxoe, a newer limestone occurs, consisting, for the most part, of fragments of coral, cemented together by a chalky matrix. It is separated from the white chalk by a thin seam of bituminous clay, containing marine shells and impressions of plants. The limestone contains beds of flint, like those of the white chalk, but more cherty, and usually in continuous layers; and these are sometimes disposed diagonally to the general lines of stratification. The author presumes that this coral limestone, which he calls the Faxoe limestone, may be the equivalent of the Maestricht beds, as, like them, it contains some fossils identical with those of the chalk, intermixed with others which belong to genera more usually characteristic of tertiary formations.

The shells at Faxoe are chiefly in the state of casts, and among them are several species of Cypræa, Conus, Mitra, and Voluta, as also an Ammonite, a Patella, a Fusus, and a Cerithium. Upon the whole, there are in the collection of Prince Christian of Denmark 132 species of fossil shells from the Faxoe beds, of which 26 have been ascertained by Dr. Beck to be identical with chalk species, while the rest are distinct from them, but do not agree with known tertiary shells.

Lastly, the author considers the relations of the chalk of Möen with the tertiary strata of that island. The white cliffs of Möen are from 300 to 400 feet in height, consisting of chalk and parallel layers of nodular flint, the strata having been violently disturbed; so that instead of being nearly horizontal, as at Stevensklint, they are curved, and often vertical, and, upon the whole, more deranged than the chalk of Purbeck and the Isle of Wight.

The range of lofty cliffs in Möen is divided into separate masses by ravines, which often intersect them from top to bottom, but are in great part filled up with tertiary clay and sand, masses of which appear to have subsided bodily into large fissures and chasms of the fractured chalk. In consequence of these disturbances the chalk has been made to alternate on a great scale with interposed and unconformable strata of clay and sand. These alternations cannot be explained by supposing the detritus of the superincumbent strata to have been washed in by running water into clefts; but masses of the tertiary beds seem rather to have been engulfed. Several drawings illustrating these dislocations accompany the memoir, and the appearances are compared to those exhibited by the chalk, nearly enveloped by crag, near Trimmingham in Norfolk, although the entanglement of the two formations there, is on a smaller scale.

Dr. Forchhammer now agrees with the author in the principal conclusions above enumerated, and has discovered the disturbed chalk of Möen in the South of Seeland, as also the Faxoe beds overlying chalk in Mors, an island of the Lym Fiord.

A paper was afterwards read, "On a peculiarity of Structure in the Neck of Ichthyosauri, not hitherto noticed;" by Sir Philip Grey Egerton, Bart., M.P., V.P.G.S.

Miss Anning of Lyme Regis discovered, a short time since, in a thin bed of lias shale, near that town, a large portion of the skeleton of a new gigantic species of Ichthyosaurus. Among these interesting remains are the anterior cervical vertebræ, together with an occipital bone, and it is to the peculiarity of structure which they present that Sir Philip Egerton principally confines his observations. The occipital bone, he says, on the authority of Mr. Owen, proves very satisfactorily the permanent separation of the basilar element of the occiput in individuals of the fullest growth and largest size, evincing a very languid circulation in this family of reptiles. The atlas and axis of Ichthyosauri, the author states, are usually found adhering together, the connexion between them being so intimate that it is rarely possible to disunite them; and when this has been effected, the surfaces have borne the appearance of fracture more frequently than that of natural division. In one instance in which he succeeded in separating the two bones, the articulating surfaces were nearly even, and without cup. This union of the two vertebræ appears to have received additional strength from a small bone which articulated with the under circumference of the atlas and axis, showing, as the author observes, that in the anterior region of the spinal column strength and not latitude of motion was required. This bone is a nearly circular, solid, umbonated disc; the central projection being on the inferior or external surface, while the upper is depressed anteriorly and posteriorly for the purpose of articulating with the atlas and axis, the two surfaces being divided by a transverse elevation corresponding with the line of union of the vertebræ. The atlas and axis have their circumferences prolonged in the form of two tangents meeting at an obtuse angle on the under surface. These processes are truncated, and form, when the vertebræ are in apposition, a triangular depression for the reception of the two articulating surfaces of the interspinous bone. Sir Philip Egerton states that Mr. Owen has informed him, that a bone somewhat analogous in position, although not in form, occurs in some recent saurians. The apparently two succeeding vertebræ present, at the lower part of their articulating surfaces, an alternating elevation and depression, fitting into each other so exactly, as to limit, to a great extent, the motion between the bones. Some of the other cervical vertebræ are also remarkable for the flatness of their surfaces, the intervertebral cavities being nearly obliterated. In conclusion, the author says, that the conditions under which the atlas and axis are found; the existence of an auxiliary bone connecting the two; the form of the articulating surfaces of the cervical vertebræ, and the consequent contraction of the intervertebral cavities, all tend to prove that the extent of motion in the cervical region of Ichthyosauri was extremely limited, at the same time that its strength was proportionally increased.

May 27th.—A paper was first read, "On certain Lines of Elevation and Dislocation of the New Red Sandstone of North Salop and Staffordshire, with an account of Trap Dykes in that Formation;

at Acton Reynolds, near Shrewsbury;" by Roderick Impey Murchison, Esq., V.P.G.S.

The author refers to former memoirs, read before the Society, in which he pointed out the existence of certain bedded trap rocks, interstratified with transition deposits, and of other intrusive trap rocks which have been subsequently injected amid these stratified masses. The Breiddin Hills, west of Shrewsbury, afford examples of both these classes of trap rock, in ridges running from west-south-west to east-north-east, and also indicate, upon their flanks, that elevations have taken place along these lines, subsequently to the deposition of the adjoining coal measures. The author has lately discovered that still more recent movements of elevation have been propagated along the same line of fissure, posterior to the consolidation of the new red sandstone. He was led to this observation by the unexpected discovery of three small trap dykes beneath the house of Sir A. Corbet, Bart., at Acton Reynolds, which were accidentally laid open upon clearing out the foundations of that mansion.

These dykes cut like walls through the new red sandstone, and are made up of a peculiar greenstone and a mottled concretionary felspar rock, both of which rocks occur in the Breiddin Hills. Besides this similarity in structure, the principal dyke has precisely the same direction as the Breiddin Hills, and hence the author was induced to examine the intervening tract of fifteen miles by which these trap rocks are separated. The result has been the detection of an anticlinal line throughout that space, along which the strata of the new red sandstone are thrown off, both to the south-south-west and north-north-east, or at right angles to the line of eruption of the trap. The clearest and most unequivocal point in the course of this anticlinal line is seen in Pim Hill, six miles north of Shrewsbury, in the centre of which the sandstone is compact, white, and unstratified, with slickensides, coatings of earthy oxide of manganese, traces of copper ores, vertical fissures, &c., whilst strata of unaltered sandstone dip away from this common centre, both to the south-south-west and north-north-east. This point of altered rock lies exactly upon the line connecting the Moel y Golfa ridge of the Breiddins with the trap dyke of Acton Reynolds. The line of elevation is further traceable for about fifteen miles, to the east-north-east of Acton Reynolds, usually throwing the strata into only dome-shaped masses; but the Rev. T. Egerton has observed it passing the Liverpool and Birmingham canal thirty miles distant from the Breiddin Hills.

The author is of opinion that the hilly range of new red sandstone extending from the Ness Cliff Hills, by the south of Wem, into the Hawkstone and Hodnet Hills, and then prolonged by the south of Market Drayton into the high grounds of Ashley Heath (parallel to the line extending from Moel y Golfa through Acton Reynolds), has been affected by similar elevatory forces acting along a line proceeding from the focus of the principal ridge of the Breiddins, or that on which Rodney's Pillar stands; and in corroboration of this, he alludes to the veined and metalliferous character of the red sandstone along this line, in which copper ores, manganese, &c. are of partial

occurrence. Immense accumulations of coarse gravel and clay obscure the flanks, and sometimes hide, for vast spaces, the disturbed and denuded strata of red sandstone along the chief anticlinal line.

Attention is then directed to the position of the lower strata of the new red sandstone, around the coal-fields of Colebrook Dale and South Staffordshire; and in confirmation of opinions expressed in former communications, the author cites several examples near Wolverhampton and Dudley, particularly one at Sedgely, where the coal itself is thrown up at an angle of about 40°, the strike being north and south, with the lower new red sandstone conformable to it; and from these evidences he concludes that the principal lines of fracture along the margin of these coal-fields took place after the deposition of the new red sandstone series, and that, therefore, the break so prevalent in the South-west of England, between the upper part of the coal measures and the new red sandstone, can no longer be considered as of general application in English geology.

From the amount of dislocation which has taken place throughout all this region, accompanied by an enormous destruction of masses of new red sandstone, and from the protrusion of so many points of trap rock, some of which cut through that formation, the author is disposed to think that the recently described outlier of Lias at Cloverly and Prees, in Shropshire, *may* have been originally connected with the chief escarpment of lias in Warwickshire and Worcestershire, there being in the large accumulations of gravel in the intermediate country, many lias shells, which may have been derived from the destruction of once continuous strata of that formation.

In conclusion, he recapitulates what in former memoirs read to the Society he has endeavoured to show—

1st, That certain trap rocks have been evolved during the formation of the transition rocks:

2ndly, That others have burst forth subsequently to the consolidation of these older strata, throwing them into vertical and broken forms, and producing metalliferous veins in them:

3rdly, That this period of activity was anterior to the formation of the coal measures, as is proved by the strata of the latter resting unconformably upon the highly inclined edges of the transition rocks.

Carrying on the inquiry from this point, the present memoir demonstrates, 4thly, that igneous agency evolving precisely similar products has been renewed at a much later period upon one of these lines of ancient eruption; and, finally, that the great disruptions around the flanks of the central coal-fields of England took place after the accumulation of the new red sandstone.

A paper was afterwards read, "On the Crag of part of Essex and Suffolk;" by Edward Charlesworth, Esq.; communicated by Edward William Brayley, Esq., F.G.S.

After stating that the only direct information respecting the crag is to be found in the works of Mr. R. C. Taylor and Mr. Woodward, on Norfolk, and in Mr. Lyell's Principles of Geology, the author quotes an extract from Prof. Phillips's Guide to Geology, to show

the state of knowledge respecting the formation up to the period of preparing his memoir.

Mr. Charlesworth then proceeds to point out that the crag consists, in parts of Essex and Suffolk, of two well-defined beds; the upper characterized by its ferruginous colour, and the lower by the presence of corals; and he proposes for them the terms of "red crag" and "coralline crag".

The best localities for examining these beds are, Ramsholt, on the eastern bank of the Deben; Tattingstone, between the Orwell and Stour; Sudbourn Park, twenty miles to the east of Tattingstone; and Orford.

The "red crag" at these localities varies from four to nineteen feet in thickness, and the "coralline crag" from seven to twelve feet.

The most striking peculiarity of the coralline crag is stated to be its uniform character, presenting none of those variations in colour or stratification which are constant in the upper beds. It is composed of highly calcareous sand, containing numerous Testacea, none of which appear to have been rolled, and the species often occur in groups. The corals are most abundant at Orford and Sudbourn.

For his general information respecting the organic remains in the two beds, the author states that he is indebted to Mr. Wood, of Hasketon, near Woodbridge, who has formed a very large collection of crag shells, and has been, as well as the Rev. G. R. Leathes, for many years aware of the existence of the two beds. Mr. Wood's collection is stated to contain the following species:

Annulata.....	13	Conchifera.....	189
Cirripeda	11	Mollusca	257

in all 450, including 50 species of minute Cephalopods. Of these species, about 80 are said to be peculiar to the red crag, upwards of 200 to the coralline, and the remaining 150 to be common to the two. One of the most marked distinctions between the Testacea of the upper and lower deposit is the total absence in the latter of the *Fusus contrarius*, and the Buccina and Murices, so abundant in the former. In the coralline stratum the remains of Echinidæ are numerous, belonging to several genera. In the red crag, fish teeth are very common, but they are of rare occurrence in the coralline; and the remains of Mammalia appear to be confined to the upper bed. The author then enters into an inquiry respecting the relative age of the red and coralline crag; and from the difference in their zoological contents, he concludes that the two beds were deposited under different conditions, at different periods.

June 10.—John Cowley Fisher, Esq., of Woodhall, near Cockermouth, Cumberland, and Frederick Ayrton, Esq., Lieutenant in the Bombay Artillery, were elected Fellows of this Society.

A paper was first read, entitled "Note on the Trappean Rocks associated with the (New) Red Sandstone of Devonshire;" by Henry T. De la Beche, For. Sec. G.S.

The author remarks, that white trappean rocks are not found among

the (new) red sandstone series of Somersetshire and the more northern portions of Devonshire: the southern portions of the latter county afford many examples of the association of trappean rocks with the lower parts of this series, particularly near Tiverton, Thorverton, Silverton, Kellerton Park, Crediton, and Exeter.

When hastily viewed, the trappean rocks might be mistaken for masses of igneous matter which have been intruded, in a state of fusion, among the beds of red sandstone. A more detailed examination of the various facts connected with their mode of occurrence leads, however, in the opinion of the author, to the inference that they have been produced by volcanic action during the formation of the lower parts of the (new) red sandstone series; in fact, that the trappean rocks in question are the remains of melted rock, either ejected from, or retained within the pipes of, volcanos which were in a state of activity during the production of the lower part of the (new) red sandstone series of Devonshire.

The author endeavours, in the first place, to point out the relative geological age of the red sandstones and conglomerates with which these trappean rocks are associated in Southern Devon, by showing, that in their continuation to the northward, along the skirts of the grauwacke to the shores of the Bristol Channel, they pass into a series of beds which is crowned by magnesian limestone and conglomerate, equivalent to the magnesian limestone and conglomerate of the Mendip Hills and the vicinity of Bristol. The beds beneath the magnesian conglomerate, which very rarely passes into a magnesian limestone, from the absence of pebbles derived from older rocks, consist, for the most part, of red or claret-coloured sandstones, with an occasional seam or bed of conglomerate, the cementing matter of which is not calcareo-magnesian. Their thickness is necessarily variable, from the uneven surface of grauwacke, upon which the sandstones rest unconformably; but it amounts to about one hundred and fifty feet in the vicinity of Wiveliscombe. The author points out, by the aid of sections, that the magnesian conglomerate may readily rest upon the grauwacke, and conceal the lower red sandstone series by overlapping it, and that therefore it becomes exceedingly difficult to obtain an average thickness of these lower red sandstones, which, if we consider the magnesian conglomerates of the Mendip Hills as an equivalent of the zechstein of Germany, would be equivalent to the *rothe todte liegende* of the same part of Europe, and therefore be of the same geological age as the lower red sandstones of the North of England described by Prof. Sedgwick, and the beds noticed by Mr. Murchison.

Having thus obtained the relative geological age of the beds with which the trappean rocks are associated, the author proceeds to point out the occurrence of beds of sand among the more common red sandstone, which presents every appearance of having been volcanic sands ejected from a crater, and which became subsequently mixed with common detrital matter then depositing. It is stated that though the trappean rocks may sometimes be seen, as in the vicinity of Exeter, to rest as if they had overflowed the grauwacke which the

(new) red sandstone series skirts, they are generally separated from the grauwacke by conglomerates, or sandstones, which do not contain the detrital remains of trappean rocks. Hence the author considers that the (new) red sandstone series of the district generally was, to a certain extent, in the course of formation when the volcanos came into activity.

A description is given, accompanied by a section, of the manner in which the trappean rocks of Washfield, near Tiverton, are associated with the (new) red sandstone of the same locality, and it is inferred from the facts detailed, that events there succeeded each other in the following order: 1. An original subaqueous valley or depression in the grauwacke. 2. A deposit of detrital matter derived from the subjacent grauwacke. 3. An eruption of igneous substances, in the manner of modern volcanos, beneath very moderate pressure. 4. The deposit of detrital matter, in a great measure derived from the neighbouring grauwacke, mingled with fragments of trappean rocks, many of which may have been ejected, as fragments now frequently are, from volcanic craters. 5. Denudations at various geological epochs since the period of the (new) red sandstone, which have left the rocks as we now find them.

It is noticed as a fact, which the author conceives to be of difficult explanation without the aid of this volcanic hypothesis, that in the localities where the trappean rocks, associated with the red sandstone, occur, there are numerous angular fragments, some of considerable magnitude, even equal to one or two tons in weight, intermingled with the conglomerates, which do not resemble any trappean rocks discovered, in place, within the district. These fragments principally consist of reddish brown quartziferous porphyry, the base being felspathic, and the contained crystals being those of quartz and glassy felspar, the latter often attaining a large size. Though quartziferous porphyry is observable in place in some situations, as, for instance, to the northward of Dunchideock, near Exeter, it does not contain the large crystals observable in numerous fragments of porphyry included in the red conglomerates. The author, therefore, is inclined to consider, that these angular fragments have been ejected from volcanic vents, and that, falling upon the detrital matter then in the course of deposition around such vents, they became included among it. It is remarked that these fragments, as well as those of the more common, scoriaceous, and other trappean rocks, found in place, do not form component parts of the red conglomerates beyond somewhat moderate distances, measured from situations where the existence of volcanic vents, during the early part of the (new) red sandstone epoch, may be considered a probable inference, from the various, observed phænomena.

A memoir was next read "On the range of the Carboniferous Limestone flanking the primary Cumbrian Mountains; and on the Coalfields of the N.W. Coast of Cumberland, &c.;" by the Rev. Adam Sedgwick, F.G.S., Woodwardian Professor in the University of Cambridge, and Williamson Peile, Esq., F.G.S., of Whitehaven.

The authors first briefly describe the general relations of the zone of carboniferous limestone (surrounding the primary Cumbrian system) to the central carboniferous chain, and show that this zone has been separated from the central chain by a great *downcast fault*, described in a preceding memoir. In illustration of this, they give a transverse section from the carboniferous limestone ridge, south of the river Lowther, to the chain of Cross Fell, proving that this low limestone ridge is not connected with the elevated chain, but with some dislocated masses which appear at its base, and dip towards the valley of the Eden.

They then give a detailed account of the range of the carboniferous limestone from the neighbourhood of Kirkby Stephen to Egremont. Beyond the latter place, patches of limestone are also stated to occur at Mousehole, Kirksancton, and Hodbarrow-Point, giving indications of at least a partial extension of the carboniferous series along the S.W. coast of Cumberland. Lastly, they notice the prolongation of the limestone (chiefly in great detached tabular masses) through Low Furness and a part of Westmoreland, till the broken zone reaches the great *downcast fault* at the base of Ingleborough.

They afterwards describe, in considerable detail, the sections exhibited by the carboniferous zone between Kirkby Stephen and Egremont. It is stated that the lower part of the carboniferous limestone corresponds, on the whole, with the great scar limestone of Yorkshire; but it is, here and there, more subdivided by thin beds of shale and by coarse beds of sandstone. Near Hesket Newmarket two or three beds of coal (some of which have been considerably worked) appear in the lower part of the series, offering an analogy to the structure of the central carboniferous chain on its approaching the Scotch frontier. They are stated to thin off in the range towards the west, and the formation to resume its more ordinary characters. The authors then give a section from the rivulet below Cleator through Bigrigg-moor, by which they show, (1.) that the limestone series is there greatly diminished in its aggregate thickness; (2.) that it contains *subordinate* irregular *beds* of red hæmatite (now extensively worked); (3.) that it is separated from the new red sandstone by thin bands of magnesian conglomerate.

They afterwards describe several sections in an upper division of the series, intermediate between the great *scar limestone* and millstone grit. The principal details are derived from the Westmoreland range of the limestone, and from the works in the neighbourhood of Caldbeck Fells. In these localities thin beds of coal alternate with the shale and limestone, and have been worked to a considerable extent.

The millstone grit is ill exhibited along the line of range; but may in some places be concealed under the great accumulation of alluvial matter on the confines of the new red sandstone. The great upper coal formation commences near Rosley, and is greatly expanded in its extension towards the west, so as to occupy the whole coast from St. Bee's Head to Maryport. But all details respecting it are referred to a subsequent communication.

In the concluding portions of the paper the authors briefly notice

the unconformable position of the carboniferous series on the primary Cumbrian slates, and the occasional masses of old red sandstone and conglomerate by which, in the eastern part of the range, the two systems are separated from each other.

Considered in its greatest generality, the carboniferous series is divided into four groups: 1. The great scar limestone; 2. Alternations of limestone, shale, and coal; 3. Millstone grit; 4. Great upper coal formation. The 1st and 4th preserve their characters in a great measure unchanged in all the great carboniferous deposits of England and Wales; the 2nd and 3rd undergo modifications which are briefly enumerated. In Flintshire, Yorkshire, and Cumberland the richest metalliferous veins appear to be in the 2nd group.

A paper was afterwards read, "On the occurrence near Shrewsbury of Marine Shells of existing species in transported Gravel and Sand, resting upon a peat bog which contains imbedded Trees;" by Joshua Trimmer, Esq., F.G.S.

In November of last year Mr. Trimmer noticed, that in widening the road about five miles from Shrewsbury, towards Shiffnal, some very black timber was extracted from beneath a bed of loam and gravel; and having subsequently examined the spot, he has communicated his observations in this paper.

Two sections have been cut, to the depth of 15 feet, and are distant from each other about 600 yards. The eastern excavation is 360 yards long, and consists, proceeding from east to west, of 200 yards of sandy loam and gravel; 40 yards of sand resembling sea-sand, the laminæ crossing each other in various directions; 60 yards of reddish loam, with curved laminæ near its junction with the sand, and horizontal at the lower part, the upper portion not being laminated; and lastly, 60 yards of sandy loam and gravel. Fragments of shells occur in every part of the section, but are most abundant in the veins of fine gravel which pervade the sand: among them the author found *Turritella terebra*, *Cardium edule*, and *Tellina solidula*.

The western excavation contained fewer shells, and presented near the eastern termination of the southern side: cultivated soil, 1 foot; whitish and reddish finely laminated loam, 6 to 8 feet; peat, with prostrate trunks of oak trees, 6 inches to 2 feet; black clay, 4 inches; whitish sandy gravel, 12 to 18 inches, passing beneath the level of the road into reddish sandy gravel. Still nearer the eastern termination, the section presented thin beds of laminated loam and sand resting on peat. On the southern side this excavation consisted of fine cultivated soil, 1 to 2 feet; sandy loam, with occasionally boulders of several varieties of granite, some more than 2 feet long, and patches of peat, containing fragments of oak, beech, and fir, 6 feet; blackish loam, enveloping the upper part of a fir-tree, 6 inches; peat, enveloping the lower part of the fir-tree, 2 feet: the base of this tree was not visible, nor had any trees still rooted been noticed by the workmen. The patches of peat in the bed of loam the author conceives were derived from the tearing up of part of the peat bog.

From these details the following changes are inferred:

1st, A surface of dry land, consisting of gravel derived from the neighbouring rocks, either while the district was submarine, or during the rise of the strata, or by subsequent denudation, or by these causes united.

2ndly, The surface was covered with a forest of birch, oak, and fir.

3rdly, The forest was destroyed, or it decayed, and a peat bog was formed.

4thly, A rush of sea buried the bog beneath a mass of loam and gravel, containing fragments of existing marine shells and granite boulders.

In conclusion, the author draws attention to the natural sections on both sides of the Severn, west of Shrewsbury, about one mile above the Welsh Bridge, in one of which he obtained, after much search, a few fragments of shells; and he begs geologists in general, both in England and Ireland, to institute a patient examination of the superficial gravel of their neighbourhood for fragments of shells, however, comminuted.

A paper was also read, entitled, "Description of some Fossil Crustacea and Radiata;" by William John Broderip, Esq., F.G.S. F.R.S., &c.

Lord Cole and Sir Philip Egerton having placed in the author's hands some fossils which they had lately found in the lias at Lyme Regis, a detailed account is given, in the memoir, of those which he considers to be new.

CRUSTACEA.

The first specimen described consists of the anterior parts of a macrourous Decapod, between Palinurus and the Shrimp family, but of a comparatively gigantic race; and its organization being considered by the author to be *sui generis*, he has assigned to the fossil the name of *Coleia antiqua*, with the following generic characters:

"*Antennæ*. Base of mesial antennæ (*antennæ internæ*) not extending beyond the anterior spine of the thorax; each antenna terminated by two annular setæ. External antennæ provided with a large and rude scale, and having a spine on the exterior of the penultimate joint: the terminal setæ large, but the length undetermined.

"*Eyes* pedunculated, directed outwards, approaching in their situation and form to those of Palinurus.

"*Feet*. First pair long, slender; the cubit (*cubitus*) with small spines or serratures on the internal margin, and terminated externally by three strong spines.

"*Hand* (*manus*) elongated, slender; digits slightly incurved, filiform, unarmed, pointed.

"*Thorax* thin (divided transversely by furrows indicating the different regions), tuberculate, spinous at the sides, and with three deep emarginations anteriorly, the middle one the largest; each of the four anterior angles produced into a strong spine."

The collection contained the remains of other macrourous Decapods. One of these specimens consisted of a fragment of the post-abdomen,

approaching nearest in sculpture to Palinurus, and equaling in size the sea crawfish: and two others are peculiarly interesting from their exhibiting the tips of the four larger branchiæ, and of the four smaller ones below, pointing towards the situation of the heart, and proving, the author observes, that this Crustacean did not belong to the Amphipoda, but to the highest division of the Macroura, of the arctic forms of which it reminds the observer.

RADIATA.

OPHIURA EGERTONI. *Oph. radiis tereti-subulatis, disco subplano, rotundato.*

This species, Mr. Broderip states, approaches very nearly to the recent *Ophiura texturata*, and differs from *Ophiura Milleri* of Phillips, in as much as, among other differences, the disk of the latter is lobated according to the figure given in the "Geology of the Yorkshire Coast." There is no description, but there is authority for considering the figure to be correct, though it is stated to have been drawn from separate parts. The specimens were found about half a mile west of Bridport harbour, in masses of micaceous sandstone fallen from the cliffs.

CIDARIS BECHEI. *Cid. testâ subglobosâ, mamillis parvulis, spinis elongatis, aculeatis.*

This fossil the author considers may be identical with that figured in the Geological Transactions, Second Series, vol. ii. Pl. IV. as an Echinus.

A letter from Sir Philip de Malpas Grey Egerton, Bart., M.P., V.P.G.S., addressed to the President, "On the Discovery of Ichthyolites in the South-western Portion of the North Staffordshire Coalfield," was then read.

The part of the coal-field in which the ichthyolites occur is called Silverdale, and consists of the following beds:

Superficial covering.

1. Argillaceous shale, generally of a lightish colour and soft texture.
2. Ditto, of harder texture, and more calcareous.
3. Ditto, black, and highly fissile.
4. Ditto, more compact, containing nodules of ironstone.
5. Ironstone, extensively wrought.

Beds 1 and 2 abound in vegetable remains, and the upper portion may be distinguished by the frequent occurrence of *Stigmaria ficoides*. The ichthyolites are principally contained in No. 4, and consist of teeth, palatal bones, and scales, belonging to the Placoidian order, and to the Sauroid and Lepidoidian families of the Ganoidian order of M. Agassiz.

Some of the scales correspond precisely with those of the Megalichthys, described by Dr. Hibbert, from Burdiehouse near Edinburgh*: but the plants associated with the ichthyolites, the author states on

* Transactions of the Royal Society of Edinburgh, vol. xiii. pl. 8. fig. 3. and pl. 11. figs. 2, 7, 8.

the authority of Professor Lindley, are entirely dissimilar from those found at Burdiehouse.

In No. 3 nodules occur, which Dr. Turner has ascertained to agree chemically with coprolites, though they do not present the external characteristic markings.

A paper was next read, "On the Bones of Birds from the Strata of Tilgate Forest in Sussex;" by Gideon Mantell, Esq., F.G.S.

Mr. Mantell states that soon after his attention was first directed to the fossils of the Wealden, he discovered in the strata of Tilgate Forest several slender bones, which, from their close resemblance to the tarso-metatarsal bones of certain Grallæ or Waders, he was induced to refer to birds. The correctness of this opinion was afterwards doubted, in consequence of the thin fragile bones found at Stonesfield, and considered as belonging to birds, being ascertained to be those of Pterodactyles. Having subsequently discovered a few specimens of more decided character, Mr. Mantell submitted them to the inspection of Baron Cuvier, during his last visit to England, who pronounced them to belong to a Wader, probably to a species of Ardea. Still it was doubted whether these remains did really belong to those of birds; but the author's attention having recently been directed to the subject, he placed his specimens in the hands of Mr. Owen, of the College of Surgeons. This gentleman, after a careful examination, pointed out that one bone decidedly belonged to a Wader, being undoubtedly the distal extremity of a left tarso-metatarsal bone, presenting the articular surface or place of attachment of the posterior or opposable toe. Other specimens of long bones Mr. Owen conceives may have belonged to a more erpetoid form of bird than is now known. From this examination, Mr. Mantell's previous views of the existence of birds below the chalk have been fully established, and, as the author observes, these are the oldest remains of the class at present known. The memoir concludes with a description of the bones, consisting of a tarso-metatarsal of a Wader, a tibia (?), a metatarsal bone, a humerus, and an ulna.

The next paper read was entitled, "Remarks on the Coffin-bone (distal phalangeal) of a Horse, from the Shingle Bed of the Newer Pliocene Strata of the Cliffs near Brighton;" by Gideon Mantell, Esq., F.G.S., &c.

The deposits which partially fill up the valley of the chalk, and constitute the subsoil of the central part of Brighton, as well as the line of cliffs extending from Brunswick Terrace to Rottingdean, are divided by Mr. Mantell into the following beds:

Top, 1. Elephant bed; an obscurely stratified mass, formed chiefly of chalk detritus, with a large intermixture of ochreous clay, and containing remains of the elephant, horse, buffalo, and deer. This bed forms the greater portion of the cliff.

2. An ancient shingle beach, consisting principally of pebbles and boulders of chalk flints, interspersed with boulders of many varieties of primary, secondary, and tertiary rocks.

3. Sand resting upon chalk.

The coffin-bone described in the paper was obtained from a fallen mass of the upper part of the shingle bed (2.), and in addition to that specimen the author procured an *astragalus*, *os calcis*, two canon bones, and a phalangeal. On comparing the coffin-bone with that of a young horse which had never been shoed, no difference was perceptible, the outlines of each presenting the same beautiful form, and proving that no hereditary change has taken place in the feet of the domesticated race.

An extract was lastly read, of a letter from Dr. Daubeny.

In this letter Dr. Daubeny gives the analysis of the mineral spring lately discovered near Oxford, and announced to the Society by Dr. Buckland, at the Meeting held on the 29th of April.

Dr. Daubeny says the water at the time the analysis was made (March 26th) contained more sulphuric salts than any other spring in this country. The following were the saline contents of a pint of the water:

Chloride of sodium.....	70·82
——— calcium	7·25
——— magnesium	2·40
Sulphate of soda	52·40
	132·87

This being the last Meeting of the Session, the Society adjourned, at its close, to Wednesday, November 4th.