specimens varied very greatly; on some of them parts yellow as brass, of troilite were discernible, and the polished surface of the metal itself appeared, when the light fell on it in a certain direction, divided into rounded parts of different brilliancy and shades of colour. Other pieces seemed to form a perfectly homogeneous aggregate of crystal needles of carburetted nickel iron. The Widmanstädt's figures were visible after etching on some, but not all, of the specimens. *These were particularly distinct on the iron from the above-mentioned basalt ridge.* In general the iron was so hard that they would not undertake at the ironworks to saw through any of the larger balls, in consequence of which I know no more of the internal character of the meteoric iron than what I could ascertain from the specimens which fell to pieces.

(*To be concluded in our next.*)

NOTICES OF MEMOIRS.

PAPERS, READ BEFORE THE BRITISH ASSOCIATION, BRIGHTON, 1872.

I.—ON THE OCCURRENCE OF TRUNKS OF *PSARONIUS* IN AN ERECT POSITION, RESTING ON THEIR ORIGINAL BED, IN ROCKS OF DEVONIAN AGE IN THE STATE OF NEW YORK; WITH SOME INFERENCES REGARDING THE CONDITION OF SEA-BOTTOM AND SHORE-LINE DURING THE DEPOSITION OF THE STRATA.

By Professor JAMES HALL, For. Memb. Geol. Soc., Lond.; of Albany, U.S.A.

AFTER a preliminary explanation of the general geological features and sequence of the formations in the State of New York, and a comparison of the thickness, condition, and nature of the sedimentary deposits along the Apallachian range, and in the plateaux of the west, Mr. Hall proceeded to the subject of the paper.

During the year 1870, some excavations made in Schoharie County, New York, in beds of fine sandstone referred at that time to the upper part of the Hamilton Group, but which probably belong to higher beds of the series, several trunks, which appeared to belong to Tree-ferns, were found in an upright position, with their bases resting in and upon a clay-bed, in which they appear to have originally grown. The clay-bed is filled with thin blackened bits of vegetable substance, which appear to belong to the large roots or bases, but no direct connexion has yet been shown. The strata above this, which enveloped the trunks to the height of two or three feet, were filled with fragments supposed to belong to these trunks and of other vegetation of the period. These trunks have been referred by Principal Dawson, of Montreal, to the genus *Psaronius;* and he has determined two or more species from the locality.

The points which I would call attention to are not those relating to the structure or relations of these plants, but to the fact that their presence indicates a point of comparatively dry land upon the eastern margin of the Devonian Sea. The position and relation of these trunks does not, I think, admit of a doubt that they have retained the position and locality in which they grew. No less than

twelve of these trunks were found on two sides of an area less than sixty feet square. They were of various sizes, from less than six inches diameter in their smallest part to more than one foot in diameter at the same height above the base. Several of them have a diameter of more than two feet at the spreading base, and I have seen one specimen of fully three feet in diameter at its base.

The strata in the immediate neighbourhood contain few organic remains except plants, but the strata both below and above as well as on this horizon contain numerous fossil shells, Crustacea, etc. Going in a westerly direction, the sandy beds lose their coarseness, and the shales become finer, until we find deposits of calcareous mud. Receding from what I suppose to have been the ancient shore-line, the fossil shells are principally *Lamellibranchiata;* the *Brachiopoda* do not come in at all, or but in small degree, till we have travelled a considerable distance to the westward. Moreover, when we have so far left the shore-line that we can take satisfactory cognizance of the condition of the sediments, we find them made up of alternations of harder and softer beds—that the *Lamellibranchiata* are confined to the harder and coarser beds, and the *Brachiopoda* to the finer sediments, as a rule. Not only so, but sometimes the coarser beds are charged with a few species of particular genera, as of the *Aviculopecten,* while others are crowded with Modiola-like forms, with few *Aviculopecten*; while *Grammysia,* a genus which may perhaps belong to the *Unionidæ* has sometimes flourished abundantly to the almost entire exclusion of everything else.

Were we to make vertical sections at some points along a line extending westerly from the first points indicated, we should have something like what I have shown in the diagram where I have indicated the harder layers as much thicker than the softer ones, which are wedging out to the eastward. At another point, fifty or one hundred miles westward, we should find many of the harder beds wedging out in that direction, and the softer shales predominating in thickness, as shown in the diagram.

It so happens that we have a direct line of outcrop of more than three hundred miles from east to west, and while at the eastern end the sediments are coarse, and the prevailing fossils are *Lamellibranchiata,* with a few large Cephalopods, we have, at the western extremity, fine calcareous shales, with abundance of *Brachiopoda* and Corals, while *Lamellibranchiata* are rare. These formations in their greatest thickness are quite four thousand feet, and in their greatest attenuation about two thousand feet. Every layer has, of course, at one time been the sea-bed on which the animals have lived, and the final result has been the slow depression of this sea-bed to accommodate the gradually accumulating sediment. The belt of sediment in which the fossil trunks stand has again been submerged, and hundreds of feet of marine strata of the same age have accumulated above them.

Now the question arises whether this depression has been gradual and constant, or whether there have been intervals of depression, and again of elevation, making the movement which resulted in the

great final depression one of oscillation. I have inferred the latter as the actual condition during all this period of the sedimentary accumulations. I am inclined to believe, moreover, that the alternation of coarser and finer beds may be due to such action, and that the pushing out of these coarser beds towards the westward, charged as they are by a littoral fauna, may be due to the elevation of the shore-line, and the consequent extension of such sediments. When again the shore-line recedes, from the gradual submergence and depression of this area below the sea-level, the finer sediments encroach upon the area before occupied by the coarser; the *Brachiopoda* succeed to the *Lamellibranchiata*, and we have the alternation of coarser and finer deposits, and the alternation of generations of essentially the same species, with now and then the coming in of new forms. Whether this view be tenable or not must depend on future continued and careful investigations. I had entertained this view from the alternation in the character of the sediments and the fossils. The discovery of this evidence of a shore-line, which afterwards became submerged, and again elevated, and extended westward at a later period, seems to offer some confirmation of the view.

II.—On the Tree-ferns of the Coal-measures, and their Affinities with Existing Forms.

By W. Carruthers, F.R.S.

Lindley and Hutton describe two species of Tree-ferns from the Coal-measures, both from the Bath Coal-field. I have been able to add eight species hitherto undescribed, chiefly through the assistance of J. M'Murtrie, Esq., of Radstock. These belong to three groups, which are remarkably distinguished by peculiarities in the structure of the stems. Two of the groups belong to living forms, while the third is extinct, being confined to Palæozoic formations. *Caulopteris* and *Tubicaulis* belong to the same type as the living Ferns which possess stems, including under this term the humble stems (falsely called rhizomes) of many of our British species, as well as the arborescent Ferns of warmer regions; and excluding the rhizomatous forms like *Pteris*, *Polypodium*, and *Hymenophyllum*. In all these stems we have a central medulla, surrounded by a continuous vascular cylinder penetrated regularly by meshes, from the margins of which the vascular bundle or bundles to the fronds are given off, and through which the parenchyma of the medulla is continuous with that of the stipes. In most Tree-ferns the medullary axis is larger, and the bases of the stipes decay down to the circumference of the stem; but in *Osmunda* the persistent bases of the stipes permanently clothe the small vascular cylinder which incloses a slender pith. To this latter form belongs the stipe with a dumb-bell-shaped vascular bundle, separate specimens of which I have obtained from the Coal-measures. These have been described, both on the Continent and in this country, under the name of *Zygopteris*, but they belong to Cotta's genus *Tubicaulis;* and they

are very closely allied to a group of Fern stems which I have already placed together under the name of *Chelepteris*. The stem structure of the common Tree-fern is represented by the genus *Caulopteris*, of which I have six species of Carboniferous age.

The third and extinct group is represented by Corda's genus *Stemmatopteris*, only now known to be British, and by *Psaronius*, which is, however, not a separate generic form; it is based on the internal structure of the stems of which Corda's genus is the external aspect. The chief characters of *Psaronius* have been drawn from the structure of the aerial roots which invest the stem, from which indeed the generic designation was derived; while the structure of the stem itself has been overlooked. But this is really of the first importance, as will appear from the following description which I have been able to make from a finely-preserved specimen of an undescribed species in the British Museum, and from the figures of Cotta and Corda. The circumference of the stem was composed of a continuous envelope of indurated tissue; within this there were perpendicular tracts of vascular tissue never penetrated by any mesh. Between these tracts the leaves were given off in perpendicular series, the large single leaf bundles coming right out from the central parenchyma, where they existed as well-formed bundles, filling up more or less completely the medullary cavity. In one form (*Zippea*) the leaves are opposite, and the great proportion of the circumference of the stem is made up of the persistent and common vascular tissue: in others (species of *Psaronius*) the permanent elements of the stem consist of three, four, six, or more perpendicular tracts.

The first two groups are analogous in the arrangement of the parts of their stems to that which exists in the first year's growth of a dicotyledon. In both there is a parenchymatous medulla surrounded by a continuous vascular cylinder, which is perforated in regular manner by meshes for the passage out of the vascular elements of the appendages. The stems of the third group have a structure analogous to that which is found in the stems of monocotyledons, for in both we have the vascular bundles of the appendages existing in the parenchymatous axis, and passing out independently of any closed cylinder. The permanent elements of the circumference of the stems of *Psaronius*, are, however, without any analogue in the monocotyledonous stems.

There seems then good reason for establishing two groups of Ferns, with differences characteristic of their stems, comparable to those which distinguish the stems of monocotyledons from those of dicotyledons. But the caution I have always insisted on in dealing only with vegetative organs is specially required here, for I have discovered, I believe, the fruiting fronds of one species of this group of plants. With the Bath specimens of *Stemmatopteris insignis*, Corda as well as with those found on the Continent, the fronds of *Pecopteris arborescens* are always associated. It is the only Fern found with some of the Bath specimens. It is also to be observed that the bases of the stipes correspond with the size of the leaf-scars on the stems. These facts are not absolutely sufficient for the correlation of the

fronds with the stem, but they are the best evidence for this that we can expect in Fossil Botany short of actual organic union. Now the fruit of *Pecopteris arborescens* is so near to that of *Cyathea* that I can find no characters whereby they can be separated. Our classification based on the stems must of course yield to that derived from the organs of fructification, and our group of Ferns, instead of being made into a new order, as would be the case by some who publish on Fossil Botany, must be grouped with a tribe of recent *Polypodiaceæ*.

It may seem that this is a forced and arbitrary grouping together of plants that in some important characters so remarkably differ; and so it is undoubtedly to those who with rash confidence generalize on the systematic position of plants from stem structure alone. But what can such objectors say to the practice of placing in close proximity plants that are beyond question nearly related to each other in all essential characters, though some have caudices while others possess rhizomes? Yet these two forms of stems are more widely separated from each other than the extinct Palæozoic group is from the recent forms.

III.—On the Occurrence of a Remarkable Group of Graptolites in the Arenig Rocks of St. David's, South Wales.

By John Hopkinson, F.G.S., F.R.M.S.

In a series of black, iron-stained shales, about 1000 feet in thickness, which form the lowest beds of the Silurian rocks in the immediate vicinity of St. David's, the author noticed the occurrence of about twenty species of Graptolites, which, he considered, furnished conclusive evidence of the equivalency of these beds with the Quebec group of Canada, the Skiddaw slates of Cumberland, and the Arenig group of Shelve. From their stratigraphical position, and from the evidence afforded by the fossils they had previously yielded, these rocks had already been inferred to be of Arenig age.

The Graptolites were collected in the lower beds of the series at Ramsey Island and Whitesand Bay, by Messrs. Hicks, Homfray, Lightbody, Kirshaw, and the author, in the course of a few days they spent together at St. David's in July.

Of the true Graptolites, or *Rhabdophora*, the only genera of undoubted occurrence are *Didymograptus*, *Tetragraptus*, and *Phyllograptus*. *Didymograptus* is represented by five species, three of which—*D. extensus*, Hall; *D. patulus*, Hall; and *D. pennatulus*, Hall—are characteristic of the Quebec group and the Skiddaw slates, *D. patulus* also occurring in the Arenig rocks at Shelve; the other species are new. Of *Tetragraptus* but one species, *T. serra*, Brong., a Quebec and Skiddaw form, has been found. *Phyllograptus* also is only represented by a single species, which is new. There is also another new species—a very peculiar branching form referred provisionally to *Loganograptus*. The absence of any specimens undoubtedly referable to *Dichograptus* is remarkable, as this is a common Quebec genus. *Diplograptus* and *Climacograptus*, genera of very rare occurrence in the Quebec group, have not as yet been found here.

Of the allied forms, all the genera of the so-called dendroid graptolites, so characteristic of the Quebec group, are present in the St. David's beds. *Ptilograptus* is represented by two new species, and *Dendrograptus* by five species, three of which—*D. divergens*, Hall, *D. flexuosus*, Hall, and *D. striatus*, Hall—are at present only known to occur elsewhere in the Quebec group, the other two being new. *Callograptus* is also represented by five species, three— *C. elegans*, Hall, *C.* (?) *diffusus*, Hall, and *C. Salteri*, Hall—being Quebec forms, and two being new; and lastly, of *Dictyonema* but one species, which is new, has been found. Many obscure impressions referred to the genus *Retiolites* also occur, one species seeming to agree perfectly as far as its state of preservation allows of comparison with Prof. Hall's figures, with his *R. ensiformis* of the Quebec group. Another appears to be distinct from any species yet figured.

The Graptolites and their allies are now thus known to be represented in the Arenig rocks of St. David's by nine genera and about twenty-two species. Of the true Graptolites three genera—namely, *Tetragraptus*, *Loganograptus*, and *Phyllograptus*—are exclusively confined to the horizon of the Quebec and Skiddaw groups. The remaining genus, *Didymograptus*, is represented in higher rocks by but two species, *D. Murchisoni* and *D. serratulus*. The former occurs in the Lower Llandeilo, at Abereiddy Bay, near St. David's, and at Builth; and the latter in the Hudson River group (Caradoc) of New York. It has also been recorded from the Skiddaw slates. With these exceptions *Didymograptus* is exclusively an Arenig genus occurring in rocks of this age in Canada, Cumberland, and Shropshire. The four genera of dendroid Graptolites have a more extensive range, *Dictyonema* lasting from the Cambrian to the Devonian period, but until now they were only known to occur together and in any abundance in the Quebec group of Canada.

During, however, a recent visit of the Geologists' Association to Ludlow and the Longmynds, the author had found, at Shelve, in the lower part of the Arenig rocks, underlying the great mass of the Llandeilo, a Graptolite zone, in which these four genera are represented by species, some of which are identical with, and others nearly allied to, those in the St. David's beds and in the Quebec group of Canada; these beds, and also the Skiddaw slates of Cumberland, the equivalency of which with the Quebec group has already been shown by Prof. Nicholson, being therefore of Lower Arenig age.

IV.—Proceedings of the Geological and Polytechnic Society of the West Riding of Yorkshire. New Series. Part I. 1871–72.

MR. L. C. MIALL read a paper on the Contortion of Rocks.[1] He exhibited photographs showing contorted Limestone Beds in Draughton Quarry, where solid layers of rock, a foot or two in thickness, have been bent into the figure of an inverted W.

[1] See Geol. Mag. for November, 1869; also Popular Science Review, January, 1872.

The angles are sharp, but unbroken. There were a few fossils in the Draughton Limestone, and these were distorted like the rest of the rock, which sufficiently disproves the notion that the rocks were in a soft state when the beds were disturbed.

Mr. Miall has made a series of experiments on Limestone Rocks, which prove that they are both elastic and plastic; and that sharp unbroken contortions indicate a molecular re-arrangement which has been produced by causes slow and long-continued in their action.

Mr. W. H. Dalton, of the Geological Survey of England, contributes an interesting paper on the Geology of Craven, referring more particularly to the rocks occurring within the basin of the Aire. He gives a general account of the Silurian Slates, Carboniferous Limestone, and Millstone Grit, pointing out the most instructive sections of each rock.

Mr. Miall read a short paper on the Formation of Anthracite, which is published in abstract; and another on the Structure of Ganoid Fishes, introductory to an account of the Ganoid Fishes of the Yorkshire Coal-field.

In the Minutes of proceedings there is an address by Mr. John Brigg, J.P., on the Geology of the neighbourhood of Keighley.

REVIEWS

I.—"Sur la division de l'etage de la Craie blanche du Hainaut en quatre assises." Par MM. F. L. Cornet et A. Briart, ingenieurs civils. Extracted from vol. xxxv. of the "Mémoires couronnés et mémoires des savants étrangers." (Published by the Royal Academy of Sciences, etc., of Belgium, 1870.)

WHEN, some years ago, the authors of this paper made the description of the Cretaceous Rocks of Hainault the subject of a detailed memoir, they were unable to assign any divisions to the fifth and most important formation of the series—the White Chalk. Since then, however, renewed investigations on their part, aided by new sections which had not before been available, have led Messrs. Cornet and Briart to consider the White Chalk of Hainault as being divisible into four distinct members, the local character of which at the same time the present paper seems to establish.

In this part of Belgium the White Chalk rests upon the denuded surface of what is known there as "gris" by the miners, the "*Craie glauconifère*". of foreign geologists. Its upper limit is marked by the appearance of the Brownish Chalk of Ciply, which is regarded as the representative of the lowest of the Maestricht beds.

Immediately below this comes the uppermost of our authors' divisions of the White Chalk, to which they have given the name of *Craie de Spiennes*. It consists of White Chalk tinged with grey, rough to the touch, and with an almost gritty fracture. It is irregularly stratified in thick and generally unbroken beds. It