

ledge, we should not know where to look for its analogue in rocks older than the Lower Jura or Upper Trias.

In the same limestone as contains these *Entomostraca* at Kotá, we are presented with an interesting assortment of Insect exuviae, including the wing-covers of *Blattidæ* and the elytra of Beetles, which forcibly remind me of the researches of the Rev. P. B. Brodie in the Lower Jura of England. The Fishes of this limestone and its associated bituminous shale have been pronounced by Sir P. G. Egerton to belong to a "true Oolitic form, and apparently of the date of the Lias*". Finally, an imperfect bivalve found in the shale with *Lepidotus Deccanensis* exhibits an appearance of corrugation at the umbo such as characterizes the genus *Unio*, a Mollusk of comparatively recent introduction on the stage of existence.

Combining these results, it would appear that of the rocks which we have been comparing, while one fossil (viz. the *Brachyops* of Mángali) points to the highest member of the Trias, and while the abundance of *Estheriæ* associated with it would indicate either that or a Lower Jurassic age, the latter organism is found at Kotá, with Fishes, Insects, *Cypris*, and *Unio* (?), which are all in favour of an epoch not lower than the Lias. And to this same side of the balance must be added the evidence of *Glossopteris*, *Tæniopteris*, a species of *Pecopteris*, the furcate-veined tripinnate frond, the *Cycadaceæ*, the *Phyllotheceæ*, disk-bearing *Equisetites*, the stems with obliquely striated bark, and some of our seeds or seed-vessels. It may be that these Indian strata constitute a sort of passage between the Lias and Trias, as has been suggested by Mr. Jones in a valuable note on *Estheria*†; and certainly the *Ceratodi* of Máledi cannot fail to call to mind the Bone-bed of Aust; but, upon the whole, I am still of opinion that the weight of testimony lies on the side of the Lower Jura, as I endeavoured to prove in a paper submitted to the Bombay branch of the Royal Asiatic Society in March 1853. And, on this view of the age of the contemporaneous fossiliferous strata of Western Bengal, Nágpur, Mángali, and Kotá, if we may assume the red clay at Máledi to be the same as the red clay in Dr. Bell's section, about 70 feet below the lowest of the ichthyolitic beds on the banks of the Pranhítá, we may understand how appropriately the *Ceratodus* teeth of the one locality are found beneath the *Lepidotus*, Insects, *Entomostraca*, *Unio* (?), and reticulated fronds of the other.

3. On the RELATIVE POSITIONS of certain PLANTS in the COAL-BEARING BEDS of AUSTRALIA.

By the Rev. W. B. CLARKE, M.A., F.G.S.

IN the "Observations on the Flora of the Oolite," by Baron de Zigno, published in the Quarterly Journal of the Society, No. 62,

* Quart. Journ. Geol. Soc., vol. vii. p. 272; vol. ix. p. 351.

† Quart. Journ. Geol. Soc., vol. xii. p. 376.

there is a paragraph* respecting the supposed non-verification of certain genera of plants in the Australian coal-fields, which were reported by me in 1847.

It is only right that I should offer a few words of comment on that paragraph.

By reference to the same number of the Quarterly Journal (p. 147), it will be seen that Mr. Selwyn has already recognized in Eastern Victoria "true Carboniferous plants;" and he further states that "in Tasmania the coal-bearing beds rest quite conformably on and pass downwards into calcareous beds, the fossils from which are, I believe, nearly all Carboniferous or Devonian forms."

Now this is precisely the case in New South Wales, in which colony the plants said to be Jurassic occur (coal-cliffs, Mulubimba, near Newcastle, mouth of Hunter River) in the same beds and blocks with heterocercal Fishes, one of which is figured by Dana† as *Urosthene australis*, and was acknowledged by Agassiz to be a palæozoic fish.

In other portions of New South Wales, and in the new colony of Queensland, in close connexion with calcareous beds holding abundance of "Carboniferous and Devonian" zoological forms, occur shales and fine calcareous grits charged with the plants which I reported in 1847, and which Baron de Zigno does not find verified by Messrs. Morris and McCoy.

The latter gentleman examined and reported on the collections which I forwarded to Professor Sedgwick, and which are now deposited in the Woodwardian Museum at Cambridge; but he did not mention the fossils alluded to by De Zigno, because I did not, at that time, include them in my collections for the university. Nor could Professor Morris mention such in his account of the fossil flora published in Strzelecki's work, because at that time none of the older forms had been found by Count Strzelecki, and no one besides myself had made any discovery of such plants in Australia. But Mr. Selwyn's paper referred to above is sufficient to verify the facts I communicated, so far as concerns the particular genera to which Mr. Selwyn alludes. Moreover, I placed years ago, in the Australian Museum at Sydney, specimens of these disputed plants; and in the present year I saw one of them in the University Museum at Melbourne, which had been found in Gipp's Land.

Some years since I forwarded specimens to England, and one was considered at the time, by Professor McCoy, to be a *Lepidodendron* of the English coal-fields, so much did it resemble a well-known

* "This would not be the case with those of Australia, if the observations made in 1847 by the Rev. Mr. Clarke were confirmed; for he mentions in these deposits the presence of the genera *Sigillaria*, *Lepidodendron*, and *Stigmaria*, which would settle the question. But I am not aware that the facts thus cited have been since verified. On the contrary, no mention is made of these genera in the works of Messrs. Morris and McCoy, in which we are presented with a series of forms among which, together with local types analogous to those of India, there are species which recall the Jurassic flora of Scarborough." (Vol. xvi. p. 111.)

† Geolog. U. S. Soc. Expl. Exp., pl. 1. fig. 1.

species. Afterwards another was noticed by the late E. Forbes*, who expressed his doubts whether that fossil was a *Lepidodendron* at all. The late Mr. Stutchbury mentions two from the coal-formation on the Storton River, in the vicinity of calcareous rocks which have their equivalents on the Hunter River, where the overlying coal-measures contain the Jurassic (?) forms. And he also figures one under the impression that it had not before been figured from Australia†.

In the course of my explorations in the northern districts of this colony, I found abundance of these *Lepidodendra*, with other allied genera, in a peculiar shale mentioned by the late Allan Cunningham as occurring on the Peel River‡. This rock occurs also not far from Goonooگونو; and from it I have made a considerable collection, of which I now propose to forward specimens for comparison§; as they resemble in some respects Göppert's *Pachyphlæus*|| rather than the usual forms of *Lepidodendra*, it may be well to ascertain whether they belong to that plant. Similar fossils exist in the neighbourhood of Wellington Valley, to the west of Bathurst; and lately I have found that abundance of them occur in the shale forming the surface in places, at Canoona (where a considerable gold-field exists), on the Fitzroy or Lower Mackenzie River in Queensland, nearly half a degree north of the tropic of capricorn, and a few miles east of the 150th meridian. They were considered by the persons who first saw them there as belonging to a "tesselated pavement," and excited great curiosity. In one of the grooves defining the leaf-scars, I detected a minute particle of gold, which had settled in it from the alluvium above.

M. Oderheimer also mentions similar *Lepidodendra* in his account of the Peel River district, published in our Proceedings¶; and from my own inquiries I know they occur abundantly along the Manilla River, and in that part of the Liverpool Plain country which skirts the western limits of the Peel and Bingera Gold-fields, the latter of which has on that border coal (near Warialda), and just such grits and sandstones as cover the coal along the coast from the Hunter to the Illawarra; the usual underlying calcareous beds, abounding in Carboniferous and Devonian zoological forms, also making their appearance, as they do to the west of Newcastle.

I consider, therefore, that there has been a sufficient verification of some of the genera I reported in 1847**, since they have thus been found in various parts of a region extending from 23° to 37° S. lat., at least one thousand miles of direct distance.

In the collection which I exhibited at Paris in the year 1855, were included two specimens marked in the catalogue as "*Lepidoden-*

* Lectures on Gold, 2nd edit. p. 53.

† Report to New South Wales Government July, 1853; Parliamentary Blue Book, Dec. 1854, p. 18—20.

‡ Proceedings Geol. Soc., vol. ii. p. 109.

§ The specimens have not yet arrived, July 15, 1861.—Edit.

|| Fossilen Farnkräuter, pl. 43.

¶ Quart. Journ. Geol. Soc., vol. xi. p. 401.

** See also Quart. Journ. Geol. Soc., vol. iv. p. 60.

dron" and one "Sigillaria*," and mention is made of the probable age of them in the introduction to the catalogue of my collection †.

It cannot, then, be said that publicity has not been given to at least some of the genera I reported; and if in any of the others I may have erred from want of means of comparison in this country, yet there is no doubt that plants apparently older than those called "Jurassic" occur in Australia under circumstances no way distinguished from those which mark the reputed younger forms, in relation to the overlying sandstones and underlying calcareous beds containing true "Carboniferous" animal remains.

When Mr. McCoy wrote his valuable account of my fossils at Cambridge, he concluded from what he saw that there must be two periods of wide interval—the plants marking an Oolitic and the animals a Lower Carboniferous epoch, equivalent to that of Ireland, and without any confusion of type ‡. But discovering plants of the genera I reported occurring under the circumstances described above, and not comprehending how this could be without assuming the whole series in which coal occurs to be one consecutively, he expressed the desire that geologists would withhold their judgment till the whole evidence had been adduced. To assist in this inquiry into the true age of our Australian coal-beds, I therefore divided the succession of beds, as in the Paris catalogue before mentioned, and have since briefly described my divisions in a little work recently published at Sydney §. These divisions conveniently group the strata, even if, eventually, they have no direct bearing on epochal succession, though there really appears to be a sort of grouping in the fossils equivalent to that in the strata themselves.

It must, however, be observed that the distinguishing feature of the strata in Australia is their variableness; and to so great a degree is that observable, that I, for one, would scarcely venture in any part of the coal-fields to trust any stratum further than I could see it.

Notwithstanding this, however, there are four main groups of strata, generally sufficiently distinct for such divisions as I have made, and which show that it is scarcely right to class them, as has been done, in two widely distinct formations.

The evidence now collecting as to the formations in other countries seems also to show that, so far as they are concerned, but little light is thrown on the age of the Australian coal-beds; for if, as Baron de Zigno maintains||, the Richmond plants, and, as Mr. Bunbury says ¶, the Indian plants do not prove what has been deduced from them, so it may come to pass that the evidence hitherto derived from the Australian flora may, on further examination, receive a modified form.

At present no notice has been taken as to the association of

* See British Catalogue Expos. Universelle 1855, p. 102.

† *Ibid.*, p. 100, and P. S. p. 103.

‡ Ann. Nat. Hist., vol. xx.

§ Researches in the Southern Gold-fields of New South Wales, chap. xiv.

|| Quart. Journ. Geol. Soc., No. 62, p. 112.

¶ *Ibid.* p. 115.

certain Fishes with the so-called Jurassic plants; for the fact that a palæozoic Fish was found in one of the pits at Newcastle in the same block with the Plants in question, which are called Oolitic, has not shaken faith in the latter assumption. Yet that fact must be explained away before the view in question ought to be adopted.

And if it should be found that certain genera, such as *Glossopteris* and *Sagenopteris*, are not always of so recent date as the Jurassic epochs; if it should also be found that the supposed palæozoic plants (*Lepidodendra*, &c.) ascend higher than the Lower or Upper "Carboniferous," then it may be that (which I have been inclined to believe may be the case) there is an epochal as well as stratigraphical succession in the Australian coal-bearing beds. The only way to settle the doubt unmistakably would be to have a complete and careful measurement made of all the beds supposed to be contemporaneous in all the Australian colonies, and to collocate them after due investigation.

But that is at present an "impossible quantity;" we must be content with such evidence as we have; and as a contribution to the general data, I will make a few further remarks.

In Victoria, the geological survey obtained in the early part of this year a *Tæniopteris* from the neighbourhood of Cape Paterson, and have recently obtained other plants of supposed like age from the neighbourhood of Geelong. These fresh discoveries have been taken to demonstrate the Oolitic age of that vicinity. Now, in my examination of the Barrabool Hills, near Geelong, in 1856, I saw enough to induce me to consider that the beds of that neighbourhood (especially about Ceres) belong to the first or upper division of the New South Wales series, and to my Wianamatta beds. But the other divisions must not be forgotten. The four divisions are—1. *Wianamatta Beds*; 2. *Hawkesbury Rocks*; 3. (*Workable Coal-beds*); 4. "*Lower Carboniferous Rocks*" of McCoy:—

"Jurassic" (McCoy).	{	1. Wianamatta Beds. Upper Carboniferous. 800 to 1000 feet thick.	{	Upper Carboniferous or Permian (Dana).
		2. Hawkesbury Rocks ("Sydney Sandstone" of Dana).		
		3. Coal-seams of Newcastle, &c. { Middle Carboniferous.		
"Palæozoic" (McCoy).	}	4. Lower Carboniferous Rocks.		

In New South Wales the Wianamatta beds contain Fishes, which are heterocercal and certainly not so near to *Pholidophorus* as to *Palæoniscus*, to which I consider some of them to belong. A species of *Phyllothea*, as well as *Sphenopteris*, is found in the same beds with the Fishes; and a Mytiloid shell accompanies them.

The following Plants from this division I sent to Cambridge, and they were determined by Mr. McCoy:—

Gleichenites odontopteroides.

Pecopteris tenuifolia.

Odontopteris microphylla.

[*Phyllothea Hookeri* is marked in the memoir from Clarke's Hill; but it is a mistake probably from accident, as that species belongs to much lower beds than these.]

I have recently procured a species, with Fish, from the same division, which in some respects resembles a *Tæniopteris*, but is probably not such. It will be forwarded to England. In Tasmania, both in 1856 and in 1860, I examined carefully the section from Launceston to Hobart Town, right through the island, and traced what I believe to be an equivalent of my Wianamatta beds of New South Wales, from the neighbourhood of Spring Hill nearly to the Derwent. They appear to be in great force about Green Ponds and up to Lovely Banks, near which I found beds before unnoticed as fossiliferous, in which are plants of a different character to any hitherto found in that or this country. I will also forward them.

The second division, or Hawkesbury Rocks, are in Strzelecki's book classed as *Pliocene**; but the Fishes contained in them are nearer to *Platysomus* and *Pygopterus* than to any Tertiary genera; and over them the Wianamatta beds attain a thickness of from 800 to 1000 feet. No Plants from these rocks were sent to Cambridge, because I had not then found any. But in the beds with the Fish were *Sphenopteris*, &c., and in the massive sandstones, along the Hawkesbury itself, I have found casts of large fronds like *Odontopteris*. Neither in Victoria nor in Tasmania have I seen any beds which I can consider the direct equivalents of these, either in mass or in distinct resemblance; but patches of sandstone underlying the supposed Wianamatta beds, about the descent to Bagdad and Brighton, occur in Tasmania, which might occupy their position. As Mr. McCoy considers these two divisions with the third, or the workable coal-beds, to belong to the Oolite, it becomes important that the new fossils should be examined. But Mr. Dana considers † that these same three divisions belong to the true "Upper Carboniferous or partly Permian." I have already alluded to the Fish *Urosthene australis*, on which in part, as well as on certain Plants, as *Næggerathia elongata*, Mr. Dana founded his opinion.

The Plants from the third division (which cannot be separated from the second, as the Hawkesbury Rocks cover and pass into the coal-measures, containing coal-seams in their lowest masses) are, as indicated by Professor McCoy's memoir, as follows:—

Sphenophyllum (Vertebraria) australe.	Glossopteris linearis.
Sphenopteris lobifolia, Morris.	Næggerathia (Zeugophyllites) elongata, Morris.
— alata, 1 var. exilis, Morris.	Phyllothea australis, Brongn.
— hastata.	— ramosa.
— Germana.	— Hookeri.
— plumosa.	Otopteris ovata.
— flexuosa.	Cyclopteris angustifolia.
Glossopteris Browniana, Brongn.	

The other plants described by Professors Morris and Dana belong to this division‡.

* p. 129.

† Geol. U. S. Explor. Exped., p. 495.

‡ The following are the plants enumerated by Morris:—

Sphenopteris lobifolia.	Pecopteris odontopteroides.
— alata, var. exilis.	Zeugophyllites elongatus.
Glossopteris Browniana, Brongn.	Phyllothea australis, Brongn.
Pecopteris australis.	

Thus far, it may be said the evidence went up to a certain period. But no place has been found for the plants whose verification was doubted. Where do they belong in Prof. McCoy's gap between the Oolite and the "Lower Carboniferous"?

It might be said truly they are "Upper Carboniferous." But in 1859 a discovery was made at Stone Creek near Maitland, which again complicates the question. Mr. Bourne Russell made two pits at the place mentioned, and passed through four or five workable seams, the beds between which and on the top, consisting of coarse grits and conglomerates full of *Pachydomi*, *Spiriferi*, *Orthoceratites*, large *Conulariæ*, *Asteridæ*, &c., prove that these coal-seams are not in beds supposed to be Oolitic, but in McCoy's Lower Carboniferous. And to complicate still further the whole, below the coal-seams a bed of shale was reached in which are impressions of *Neggerathia* (or *Zeugophyllites*), *Glossopteris* (or *Sagenopteris*), and other plants, such as *Cyclopteris*, that look as much like Jurassic as any that are so called.

Mr. Russell, at my request, placed at my disposal the whole series of excellent specimens, with memoranda of depth, &c. The locality is known to me, and I collected *Pachydomi*, &c., abundantly from the vicinity; so that these seams and Plants unquestionably occur in the midst of beds considered to be Lower Carboniferous.

I do not pretend to explain this anomaly, if it be one: but it is deserving of notice that the supposed *Lepidodendra*, &c., do not occur in the same beds with the *Glossopteris*, &c., described by Mr. McCoy, but they occur apparently in similar relation to the animal remains in other parts of the country. And they may, for anything known to the contrary, occupy a corresponding position in relation to the lower members of the "Lower Carboniferous" rocks as the supposed "Jurassic" plants do to the upper members of that formation. The whole affair is mysterious, and leads to an opinion that the hitherto received conclusion must be modified.

Within the last few years the search for coal has been greatly on the increase in New South Wales; and various deep shafts have been sunk between the back of the cliffs at Newcastle and the junction of the Hunter and Williams Rivers, near which at Muree (Raymond Terrace) many of the animal remains described by McCoy, Dana, and Morris were found. Some of these shafts show an uninterrupted series of coal-measures to a depth of 400 feet, without reaching the floor of the basin. Coupled with the facts already enumerated and divers others, such as the occurrence of coal and

By Dana:—

Coniferae.
Neggerathia spatulata.
— *media*.
— *elongata*, *Morris*.
Sphenopteris lobifolia, *Morris*.
Glossopteris Browniana, *Brongn.*
— *ampla*.
— *Reticulum*.
— *elongata*.

Glossopteris (?) *cordata*.
— *linearis*, *McCoy*.
Phyllothea australis, *Brongn.*
Clasteria australis.
Anarthrocanna australis.
Cystoseirites (?).
Austrella rigida.
Confervites (?) *tenella*.

fossilized wood in the midst of the Muree fossils,—the existence of coal in association with beds of fossils of Lower Carboniferous age on the Page River, as at Coyeo and at the back of Mount Wingen, where the coal-beds (on fire) contain plants equivalent to those of Mulubimba, and appear to be lower than the *Spirifer*-bearing beds on the ranges above them,—the occurrence of similar phenomena as to the presence of the fossilized wood both in the *Glossopteris*-beds of Mount Keera and in the *Spirifer*-beds of Black Head, and others elsewhere—it does clearly appear that, in the present state of our knowledge of the stratigraphical disposition in New South Wales, it is impossible, without a grave doubt, to admit that the whole of our coal-measures, if any, are of Oolitic age. A more likely solution of the difficulty would be the adoption of the conclusion that either the plants are not necessarily “Oolitic,” or, if some of them are, there is a descending order of an epochal, as well as successional kind, which may fill up the gap assumed in theory, by sufficient evidence to remove the difficulty there is to all in receiving it as satisfactory.

That the Carboniferous formation in Australia, whatever becomes of the disputed beds, is of very great thickness, may be conceived from the fact determined by me when I was in Tasmania last March, that the “siliceous breccia” of Strzelecki* is a member of this formation. Mr. Gould, the accomplished director of the Geological Survey of Tasmania, will, it is to be hoped, very shortly furnish us with certain data respecting some of the points discussed above.

As much of the coal of the southern part of Tasmania is chiefly anthracite, it would be interesting to show whether it is older than the seams of Jerusalem, Richmond, Jericho, Fingal, the Mersey, &c., and if any phytological evidence exists for connecting it with the age of the *Lepidodendra*, &c., of New South Wales; whether all the coal in Tasmania is younger than the whole of the “Carboniferous” beds with animal remains; whether the coal of the Mersey is connected with the latter in the same way as the coal is at Stony Creek near Maitland, or is rather related to the coal of the Tertiary deposits near Launceston.

If it is the case that in India genera of plants stereotyped as “Jurassic” are found in varying species in other formations besides; if the identity asserted for such plants in distant countries, such as India and Yorkshire, is disproved—if the Richmond plants are now acknowledged to be older—if the reputed age of certain plants in Africa is in the same category,—it may, perhaps, be yet proved that the assumption of the “Oolitic” era for that of the Australian coal is also too general a deduction conjointly from such facts as we have and from the want of more, especially such as the want of good unmistakeable deposits in which the animal remains will leave no further room for doubt. Beyond two specimens found in the superficial Tertiary gravel at Melbourne, no one has pretended to have discovered *in situ* any shell or other animal remains of Oolitic age.

in all Australia*. Loose on the surface in the neighbourhood of Grafton, on the Clarence River, a portion of an Ammonite was also picked up and brought to me; but it may have been dropped by an emigrant from Europe, and is of no value in so important a question.

Different, however, is the testimony of my late friend Leichhardt, who was both a good botanist and a good geologist, and who left with me his MS. journal, in German, of a geological excursion to the northward in the year 1842. He therein mentions that he obtained a plant (named by him, doubtfully at the time, "*Equisetum obtuse striatum*?" but which was afterwards found to be a *Phyllothea*) from one of the lowest beds in the section at Harper's Hill, so well known for its abundant "Lower Carboniferous" animal forms; and he further says that he considers that bed was equivalent to one of the beds in the cliff at Newcastle. There is no doubt that that plant was in the midst of, and far below, shells and other fossils respecting which there is no dispute. It is, in short, a fact well agreeing with the evidence from Stony Creek.

In venturing on this extended discussion of a difficulty, my chief object has been to show that the age of the Australian coal-beds is not sufficiently determined at present to justify their being used as a test of "Jurassic" age of coal-beds in other countries.

At the same time I may add how much I have been gratified in obtaining Baron de Zigno's work, and that, notwithstanding all I have written, I am open to the conviction of evidence.

4. Prof. HUXLEY, Sec.G.S., made the following observations on some Reptilian Remains from North-western Bengal:—Some bones, found by Mr. Blanford in the uppermost portion of the "Lower Damūda" group of strata in the Ranigunj coal-field, and forwarded to Prof. Huxley by Dr. Oldham, have proved to belong to Labyrinthodont Amphibia and Dicynodont Reptiles,—hereby affording new and interesting links with the fossil fauna of the Karoo Beds of South Africa, and largely increasing the probability that the rocks in which they were found are of Triassic age.

Notes on some further Discoveries of FLINT IMPLEMENTS in Beds of POST-PLIOCENE GRAVEL and CLAY; with a few Suggestions for Search elsewhere. By JOSEPH PRESTWICH, Esq., F.R.S., Treas.G.S.

[This paper, read on May 8th, is, by order of the Council, printed in the August No. of the Journal, that it may be as useful as possible to geologists during their autumn excursions.]

SINCE my communication to the Royal Society† on the discovery of Flint Implements in post-pliocene beds at Abbeville, Amiens, and Hoxne, similar implements have been found in a few new lo-

* Fossils of Upper Mesozoic age have been brought to England from Western Australia by Mr. F. T. Gregory, and noticed in his paper read before the Geological Society on May 22, 1861.—EDIT.

† Phil. Trans. for 1860, p. 277.