A Fossil Plant Formation in Central Queensland.

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I wish to bring under the notice of the Society a fossiliferous formation in Central Queensland, which has recently yielded plant remains which are new to Australia. It is situated on the central line of railway, which runs westward from Rockhampton to the Drummond Range, a distance of about 230 miles from the farthest navigable point of the Fitzroy River, and nearly 300 miles from the sea. It is intended to carry the line far into the plains of the western watershed, but as yet it has not crossed the divide. It is necessary to bear this in mind in considering the relations of the rocks exposed in the railway cuttings. There is no part of the continent where the Dividing Range makes so far a curve inland from the sea. Even when the Drummond Range is cut through, the railway will not be found upon western waters. The valley of the Belyando will be reached, which is a tributary of the Burdekin River. On the further side of this valley will be the real divide. I shall have occasion to refer to this more particularly in the latter part of this paper. In the Drummond Range occurs the fossiliferous formation whose plant remains I am about to describe. Its highest point where the railway crosses is 1,840 feet above the sea-level, at 235 miles from Rockhampton.

After crossing the basaltic plains west of Emerald, with their immense tracts of brigalow scrub, a remarkable change occurs in the geology of the country, at a place called Zamia Range, 1,180 feet above the sea, at the railway cutting 213 miles from Rockhampton. The soil is sandy, supporting an open forest of *Eucalyptus melanophloia*. The railway cuttings expose one or two igneous dykes, and some granite, or metamorphic rock of some kind, which is not exposed beyond the weathered portions, and therefore its true character is difficult to determine. It is mingled with a stratified rock, in which no fossils could be detected, but in appearance it was like some of the oldest mesozoic rocks in Victoria; it overlies, as it seemed to me, certain dark brown sandstones, which soon rise to the surface and occupy the whole extent of the country around. The rock forms low outliers from the Drummond Range, giving an undulating but not rugged outline to

the country. The dip is very regular to the eastward, but the inclination is slight, hardly more than 10 degrees. At about 10 miles from the range an anticlinal axis is crossed about 1,200 feet above the sea-level, and then the dip is regularly to the westward, with the same or a less inclination. As the chain of mountains is approached, it is seen to consist of a series of terraces or escarpments facing to the eastward. The lines of bedding are very visible on all the sides of the valleys, and give the scene a remarkable and characteristic aspect. The sandstone is now and then interrupted by beds of shale of a dark and earthy composition. It weathers into a fair soil in some places, but is generally poor and sandy.

A little beyond Bobuntungen, which is the last station on the railway, there is a heavy embankment, and the stones composing it are entirely derived from the sandstone range. At the first glance I was struck with the number of plant impressions they contained, none of them being sufficiently well preserved to admit of their identification. There were some long, linear, narrow, ligulate leaves which strongly resemble the *Cordaites australis* of McCoy, to which reference will be made presently. It was found afterwards that these leaf-like impressions were in reality stems of *Calamites*. The discovery of this much, however, encouraged me to a closer and more extended exploration of the rocks around, and soon an immense number of fragments of stems of *Lepidodendron* and *Stigmaria*, with *Calamites*, were obtained. I spent in all a week at Bobuntungen, yet being occupied in other ways I could not give to the formation all the attention I desired; but I found an active co-operator in Mr. Phillips, the Station-master, who, since my departure, has been indefatigable in seeking for well-preserved specimens from the abundance of fossils in the locality. I have lately received from him a small box of fossils which are of the highest interest, and which, together with my own collections, will form the subject of this evening's paper.

Before entering into a description of the species, it may be well to give a retrospect of what has been done hitherto by geologists in illustrating the paleozoic plant remains of Queensland. In 1861, the Rev. W. B. Clarke, F.R.S., in a paper read before the Geological Society of London (see vol. xvii, p. 354), speaks of the occurrence of shales and grits charged with plants in Queensland, associated with calcareous beds holding abundance of Carboniferous and Devonian zoological forms. These referred to the Bowen River and other coal-fields. In 1872 Mr. Daintree gave to the same Society a sketch of the geology of Queensland (see vol. xxiii, p. 271), in which were fuller details. He says, at p. 288:—"*Devonian.*—From the southern boundary of Queensland up to lat. 18 degrees south, a series of slates, sandstones, coral limestones, and conglomerates extend to a distance of 200 miles

inland. These are sometimes overlaid by coal measures, sometimes by volcanic rocks, and consequently do not crop out on the surface over such districts * * * In the higher members of this group, which from their general analogy to the English group of that name we will term Devonian, specimens of fossil plants are abundantly met with." Mr. Carruthers, F.R.S., has described and named those from three widely separated localities—Mount Wyatt, Canoona, and the Broken River—and refers them all to one form, *Lepidodendron nothum*, Unger (not Salter's species of that name). To the same paper Mr. Carruthers added an appendix in which the fullest details of the plant were given. He states that the collections of Mr. Daintree were so full and complete, and so much more perfect than any previously at the disposal of palæontologists, that he was able to give a description of the whole plant and clear up every doubtful point of its structure.

Before giving details of the species I have recognized, it may perhaps be as well to remind the members of the Society who may not have access to all the literature of the subject, of the progress that has been made in this portion of palæontology. The plants of the early geological periods differ so completely from anything existing at the present day that they presented very puzzling problems to palæontologists. This is not a matter of wonder when we remember how fragmentary were the specimens submitted to their examination, and how rare it was to find stem, leaves, roots, flowers, and fruits so associated together that they could be recognized as belonging to one plant. To add to the difficulty of the problem, it has been found that in these extinct forms of vegetation the various parts of the plant were more differentiated and specialized than they are now. Thus roots of plants in the present day are very uniform and simple organs; in fact, so uniform that only slight difference or no difference can be traced between those of shrubs or trees widely separated in every other respect. But the roots of coal plants seem to have been very different structures. *Stigmaria*, for instance, is now known to be the root of trees resembling our club mosses, called *Sigillaria*. But these roots were arranged in a regular spiral series. They were swollen fleshy tubers, articulating by a joint to the rhizome, having peculiar scars in the bark outside and in the woody tissue underneath. Furthermore, they are forked or divided, and terminate in an obtuse apex. No wonder that Sternberg, when he found these rootlets by themselves, compared them to arborescent euphorbiaceous plants. Von Martius referred them to a fleshy composite (*Cacalia*) or a fig-tree. Brongniart classed them with the Lycopods, but later as roots of such peculiar conifers as in his view *Stigmaria* were. Corda regarded them as plants uniting the characters of houseleek, euphorbias, *Cactus* and *Zamia*. Lindley and Hutton took them for the fleshy leaves of some horizontal

subterranean tree entirely different from anything at present known. In the course of time the discovery of true Lepidodendroid trees with upright stems and with roots (*Stigmaria*) in the ground has manifested the true character of these remains.

In like manner, different portions of the same plants have been subjects of doubt and controversy until their nature and office was known. The cones, or fruit spikes, of *Lepidodendron* were called *Lepidostrobus*; *Cyperites* was the name given to the leaves, *Sternbergia* to the pith, and *Knorria* to the internal casts of the trunk.* Other specific and generic distinctions were built upon the mode of preservation, which was subject to great variation, for the stems of these trees were soft and hollow, or at any rate filled with a soft yielding pith; then, when the entombing rock pressed upon them in the course of time, they became flattened, and the sections of round stems, or the cast of the interior, were thinned at each end, so that the section became like the section of a lentil.

All these remarks are necessary to understand the character of the fossils which I exhibit this evening. They have been subjected to great pressure, and there are fragments of all the different portions of the plant. I will begin by describing the species to which most of them must be referred.

Lepidodendron veltheimianum.

Sternberg—Flor. d. Vorw. I, part 12, pl. 52, fig. 2. See also Schimper, "Paléontologie Végétale," vol. ii, p. 29, atlas, pl. 59, figs. 6, 7, 8. Schimper gives a large list of references and synonyms, which I need not quote here. See also Feistmantel "Paleozoische and Mesozoische Flora des öestlichen Australiens"—Cassel, 1878 and 1879, p. 151, pl. 5, figs 2 and 3 (though doubtfully referred to this species); pl. 7, fig. 2; pl. 23, figs. 2 and 3.

Apparently a moderate-sized tree, with dichotomous branches, covered with a network of very narrow leaf-scars; leaves narrowly lanceolate, spreading, slightly incurved; scars of the branches erect, rhomboid, close, with an obovate cushion accuminate at the base, keeled, furnished with a transverse rhomboid cicatrix; scars of the trunk oblong-rhomboid, apex and base long and acuminate, subinflexed, and after the disappearance of the little cushion, fusiform.

This plant is characteristic in Europe of the lower coal formations, corresponding to the carboniferous limestone. It has been found in many places in Silesia, in the *Posidonomya* schists at Magdeburg, in the Hartz Mountains, at Nassau, in the valleys of Thann and Niedurburdach; in France, in the Upper Vosges, and in the coal-seams of the Black Forest. This fossil is also, according to M. Geinitz, the same as *Ulodendron ornatissimum*.

* But the name *Knorria* is now generally applied to a genus of plants like *Lepidodendron*, but with peculiar fleshy leaves.

In the 3rd edition of the late Rev. W. B. Clarke's "Sedimentary Formations of New South Wales" (1875), at p. 17, mention is made of a species named *Lepidodendron rimosum*, of which in 1878 Feistmantel gave a fig. (*loc. cit.*), remarking that it seemed more to resemble *L. veltheimianum*. Before this, in 1876, as I shall state subsequently, Professor de Koninck had submitted about twenty plant specimens sent to him by the Rev. W. B. Clarke to the eminent Belgian palæontologist, M. Crepin, of the Brussels Museum. Though the specimens were in a very bad state of preservation, he was able to recognize *L. veltheimianum*, besides *Calamites radiatus* and *C. varians*, all of which we shall see are found in the Drummond Range. Dr. Feistmantel was not aware of Mons. Crepin's determinations at the time he pronounced upon his specimens, so that the independent testimony of two such eminent and experienced authorities gives additional weight to the identification. Mr. Clarke's fossils are quoted by De Koninck as from the quarries of Murree, Russell's Shaft, Glen William, Burragood, and the Ichthyodorulite Range. Dr. Feistmantel's examples came from the strata of Smith's Creek, near Stroud, and the Rouchel River.

Amongst the numerous examples found in the Drummond Range, there are many compressed branches which have formerly been cylindrical, and instead of having the lozenge-shaped depressed leaf-scars with a raised margin, are marked with impressions of distant narrow-pointed leaf-like scales. They exactly correspond with the figure given by Feismantel in the above work, at plate 23, figs. 2 and 3, and which are lettered *Knorriastadium* (?) of *Lepidodendron veltheimianum* (?), the doubtful note in both cases being that of Dr. F. They came from Smith's Creek, New South Wales. I think there can be but little doubt, from the mode in which they are associated, that they belong to the same plant. There are also smaller stems, of which I figure one example, which seems to me like the internal casts of the smaller branchlets. The surface is covered with raised cushions, which are closely quincuncial. The cushions rise gradually towards the apex, and have an imbricated appearance. In the larger examples the cushions are longer and very much narrowed. I think we have in these, internal casts of the branches. If we suppose the external scars to be raised in such a way as to give rise to a corresponding depression in the internal cylinder, then the casts would present the appearance noticed above. Moreover, they are ill-defined, and without any leaf impressions, just as internal depressions would be. The stone is quite fine enough to retain the most delicate marks where they exist. The shape of these casts also confirms this explanation, for they are always more or less cylindrical, or the casts of cylinders which have been compressed. Whenever the exterior of the branches is exhibited, it is on the surface of concave casts.

Cyclostigma. Haughton.

The plants thus distinguished were first brought to the notice of science by Dr. Haughton, in a paper published in the Annals of Nat. History for 1860 (3rd ser., vol v., p. 444), entitled "On Cyclostigma : a new genus of fossil plants from the old red sandstone of Kiltorkan." *

Cyclostigma australe.

Feistmantel, *loc. cit.* p. 76. A tree trunk with slender terete branches, cushions or raised scars subglobose, pitted, approximate, spirally disposed, impressions oblong oval, rather deep, situate in the upper portion of the oblong ovate tubercle. The species was found in two places in New South Wales, according to Dr. Feistmantel, namely Goonoo Goonoo Creek, near Tamworth, and at Smith's Creek. Dr. Feistmantel was of opinion that the species was so near *C. kiltorkense* that he could see little difference, but lest he should make a false identification in a plant where the details are so few and simple, he preferred to give it another name. He gives figures of a few specimens at pl. i, fig. 6, a doubtful identification, pl. iv., fig. 3, pl. v, fig. 1, pl. xxii, fig. 1. Amongst the Drummond Range specimens I have only one which can be referred with any probability to this species, and in this case the impressions are so faint and worn that I describe it as a *Stigmaria (Cyclostigma ?)*. I quote from the Rev. Dr. Haughton's paper somewhat fully, because his description corresponds so well with the strata of the Drummond Range that lithologically they may certainly be said to belong to one formation. The rose pink sandstone in which some of the fossils are embedded, and the golden yellow colour of others, is especially remarkable.

"The fossil plants of the yellow sandstone of the county Kilkenny occur, as they do in other parts of Ireland, in the sandstone lying immediately under the great mass of the carboniferous limestone, which constitutes the most important member of our Irish fossiliferous rocks. They are found at Jerpoint, about a mile and a half south of the Abbey, on the roadside near the corn-mill, on the road to Ballyhale, about 90 feet below the lowest bed of limestone, in rocks composed of red, whit , and blue limestone, with triboliths formed of pink quartz, rounded pebbles grooving the hone stone ; and above the plant beds a remarkable white grit conglomerate is found. The plant-beds, on the same geological horizon, are also found in the railway cuttings at Ballyhale. They are found, however, in the greatest abundance, and in

* Other species have since been described by Heer. Fossil Flora de Burren-Insel, p. 43, pl. xi ; by Lesquereux, Geol. Survey of Arkansas, p. 311, pl. iii, fig. 3 ; and Dawson, Fossil Plants, Geol. Survey of Canada, p. 43, pl. xiii, figs. 92 to 96.

the best state of preservation, on the top of the Kiltorkan Hill, near the railway station of Ballyhale. I believe the plant-beds on the summit of this to form an 'outlier,' and to occupy the same geological position with respect to the limestone as the beds at Jerpoint and those of the railway cutting. The fossil plants here found have never been described except casually. They consist of remains of a large fern, called *Cyclopteris hibernica*, by Professor Forbes, associated with a large bivalve, named by him *Anodon jukesii;* of undescribed dermal plates of a cartilaginous fish, probably a species of *Coccosteus;* and of numerous unknown plants closely allied to *Lepidodendron*, and so named by Professor Forbes and M. Brongniart, the latter of whom has named a remarkable species, preserved in the Museum of the Royal Dublin Society, *Lepidodendron griffithsii*. Others of these fossil plants have been named *Knorria;* and a large undescribed group remains, to which I propose to give the name *Cyclostigma*."

Cyclostigmacæ.

A natural order of fossil plants found in the lowest beds of the carboniferous system, part of the oldest flora known to have existed on the globe, probably closely allied to the orders described as *Knorria*, *Lepidodendron*, and *Sigillaria*, known only by their leaf-scars and leaves, which were arranged in alternate whorls, plants not jointed at the whorls, the leaf-scars perfectly circular, showing in many cases a minute and well-marked dot in the centre, probably coinciding with a central bundle of woody tissue. Many of the larger plants show traces of a thick central woody axis, like that found in *Stigmaria;* stems much crushed and flattened, as if they were not woody throughout. They approach nearest to *Stigmariaceæ*, from which they differ in the leaf-whorls being further apart and more distinct. There are many varieties of this remarkable fossil, showing the alternate whorled arrangement of leaf-scars. None of them are perfect stems, but appear to be torn portions of the rind of large plants which have been macerated by floating for a long time in water. In the quarry of Kiltorkan the *Cyclostigma* is found in layers different from those in which the *Cyclopteris hibernica* occurs. In some specimens of *Cyclostigma* the leaf-scars are closer together than in the last, and are somewhat oblique to the transverse line of the stem—this obliquity being due to distortion caused by lateral pressure of the mudstone in which the fossils occur. The whorled arrangement of the leaves, each whorl being alternate to that above and below it, is frequently well shown.

Mr. Carruthers, in his appendix on the fossil plants (see Daintree on the Geology of Queensland, *loc. cit.*), says:—"Among the Devonian fossils presented by the Rev. W. B. Clarke to the Society's museum there is a fragment of a lepidodendroid plant

which I cannot separate from that found at Kiltorkan, to which Dr. Haughton gave the name of *Sigillaria dichotoma*, and afterwards of *Cyclostigma kiltorkense*, and which, after receiving many other aliases, should be named, I believe, *Syringodendron dichotomum*, as being a species of that genus as amended by Brongniart in his 'Histoire,' and again in his 'Tableau.'"

Order Calamiteæ. Brongniart.

(See Schimper, *op, cit.* vol. i, p. 291.) For the convenience of students in Australia, where the works of Schimper, Brongniart, Ettingshausen, &c., are so difficult of access, I give an abridged notice of the literature of the order, and fuller descriptions of its character. This order is distinguished from the *Equisetaceæ* or horse-tails, to which also belongs our fossil *Phyllotheca*, by the verticillate leaves, which are entirely free or confluent at their base, and by the sporangiferous spikes being axillary like those of Lycopods. Some of the genera of this order have been named and classified in the early history of palæontology from fragmentary fossils, and, as investigation has gone on, and better and more numerous specimens were discovered, just as in the case of the different portions of the *Lepidodendron* family, they have proved to be different portions of the same plants. Thus Ettingshausen has proved that *Asterophyllites* are the branches and branchlets of Calamites, and the spikes known under the name of *Volkmanniæ* are the fruit-bearing portions of the same genus. It is to Mr. Binney, of Manchester, that we owe the knowledge that the capsules enclosed in the spikes are not anthers but sporangia.

Calamites. Suckow.

Including *Calamites*, *Equisetites* (in part), *Asterophyllites*, *Volkmannia*, *Bechera*, *Bruckmannia*, *Bornia*, of Sternberg and Goeppart, and the *Calamites*, *Equisetites* (part), *Calamodendron*, *Asterophyllites*, of Brongniart, Bunbury, Binney, Dawson, and others. Tree-like plants, rising from subterranean rhizomæ, stem simple, somewhat conical, jointed and gradually narrowed, branches in whorls, with forked branchlets. Bark smooth, or more or less distinctly sulcate, internodes of varying length, but generally shorter as they descend. Inner lining always sulcate and constricted at the joints. Internal structure similar to *Equisetum*. Cauline leaves extremely fugacious, wholly unknown but in their place, usually represented by minute, convex, ovate scars on the inner wood. Branch leaves longer and more numerous than the cauline, of equal length, free or confluent at the base, linear or narrowed or slightly dilated above, acuminate, ribbed, entire, suberect or reflexed. Sporangiferous spikes verticillate from the axils of the leaves, disposed in corymbs along the branches or at

their extremities, oblong or elongately cylindrical, small for the size of the plant. Bracts, alternating with the sporangia, verticillate, lanceolate, erect above, below uniting into a disc. Sporangia bearing stalks, peltate, and arranged in whorls of six; sporangia, four to each stalk, borne on the under side of the peltate leaves; spore cases, with cellular walls; spores spherical, with thread-like elaters. The fruit-spike or cone bears a very strong resemblance to *Equisetum*, but in the latter all the leaves of the cone are fruit-bearing, while in *Calamites* some are fruitful and others are like the ordinary leaves of the plant.

Calamites abound in the carboniferous rocks, and no doubt the great mass of the coal was formed by them. They may be said to have died out at the close of the palæozoic period; though some are still found amongst the lower members of the mesozoic strata. We have only two quoted from Australia, and those are from the lowest group of our coal strata. Smith's Creek, near Stroud.

Calamites (Bornia) radiatus.

Brongniart, Histoire des Végétaux Fossiles, i, p. 122 (quoted by Schimper as *Bornia*, vol. i, p. 335). Paris, 1828. This species belongs to the subdivision *Bornia*, distinguished amongst *Calamites* by its interrupted, non-alternating ribs, its free leaves, which on the branches are once or twice-forked, divided above, ovoid elliptic spikes, scutellæ with a scar on the centre of the external face. It is thus characterized :—Leaves of branches very long, linear free, often forked. Cauline leaves much shorter. The fossil is very wide-spread, being found in the lower coal and Devonian rocks of Europe and those of America. (See Dawson's Devonian Plants, Quart. Jour. Geol. Soc., vol. xviii, p. 309 ; also Schimper, atlas, pl. xxiv, where many figures are given of stem, leaves, and fruit.) In Feistmantel's Nachtrag zur Fossilien Flora Australien, already quoted (Paleontographia, *loc. cit.*, plates vi, vii, xxiv, xxv) there are three figures given of this fossil, representing some leaves and certain portions of the stem. It should be mentioned that, except to an experienced eye, or without some fruit-cones, these fossils might easily be mistaken for *Phyllotheca australis*. It belongs, however, to a much lower horizon, and the leaves will be found to be dichotomous, which is never the case in *Phyllotheca*. *Calamites varians* is quoted by Feistmantel (*loc. cit.*, p. 145) on the authority of De Koninck. The passage referred to is as follows :—*

"Before commencing the study of the numerous animal forms belonging to the carboniferous period, I will glance on some contemporary plant remains received at the same time and also often

*(Recherches sur les Foss. Paléoz. Nouv. Galles de Sud. Australie, part 3, p. 142).

in the same rocks from the Rev. W. B. Clarke. I should state, previously, that the specimens sent to me (not above twenty in number) were in such a bad state of preservation that, notwithstanding the immense experience of M. Crepin, who was kind enough to examine them, or the abundant materials for comparison which he had at his disposal in the Brussels Museum, he was unable to determine any specimens with certainty. According to him, nevertheless, some specimens came very near to *Lepidodendron veltheimianum*, Sternberg; others to *Bornia radiata*, A. Brog; and others to *Calamites varians*, Germar, and constitute the dominant forms. All these plants are contained either in a hard and compact greyish yellow or greenish limestone, the other in friable, easily powdered, grey or brownish sandstone. Many are associated with marine animal remains such as stems of *Crinoids*, *Productus*, *Cornularia*, &c. By their characteristics they cannot be said to belong to the carboniferous formation properly speaking, but to the period which preceded it, being preserved in the rocks on which the carboniferous rocks rest. The principal localities in which these different fragments have been collected are the Murree quarries (Loder's Creek), Russell's Shaft, Glen William, and Burragood."

CALAMITES VARIANS.

Schloth, Petrefac, p. 399, pl. xx, fig. 2. Artis, Antedeluv. Phytology, pl. 4.

This species is distinguished by the very short intervals in the basal part of the trunk becoming suddenly elongated in the upper part. The shoots of the basilar portion were rather stout, and disposed quincunically. The scars are large and round, and the ribs near them converge towards them with their upper and lower extremities. The same thing is seen in the leaf-scars, but then the converging ribs are less numerous, and there are never more than three. From the Drummond Range I have a very fine series of these plants, as will be seen from the accompanying specimens and figures, which place the nature of the fossils beyond any doubt. It is the first time that we have any record from Australia of the roots and stems of this characteristic palæozoic coal fossil. They abound in the strata, and there are some portions of the stone which seem to be made up entirely from the stems. Nevertheless, leaves are rarely found associated with them; in fact, none of the more tender plants—such as ferns, or organs of plants—are found in these strata where *Lepidodendron* abounds. In the neighbourhood of the shales, leaf impressions and those of ferns may be found; but these I have not as yet been able to examine.

It remains to say a word as to the age of these beds. There can be but little doubt that they agree in the fossils with the

Smith's Creek beds and those of Goonoo Goonoo. These, again, are identical with the plant remains of the lower coal formation of Europe. These Australian formations, for which I propose the name of Bobuntungen beds, because they are best represented at that place, are distinctly separated in their fossils from the Devonian beds of Gippsland and Queensland, with *Lepidodendron nothum*, *L. australe* (M'Coy), *Sphenopteris iguanensis* (M'Coy), and *Archæopteris howitti* (M'Coy). They are equally distinguished from the Newcastle beds with *Glossopteris*, *Phyllotheca australis* (M'Coy), and the well-known flora of our New South Wales coal measures. I think we may also safely say that the Bobuntungen beds should be intercalated between them, which will give one more link in the series which gradually unfolds itself of our Australian coal-bearing strata.

Without venturing to decide finally as to the horizons or periods which I here give only provisionally to the formations cited, I think the time has come when we may very safely rely upon the following order in which they are placed, as marking the relative age of their distinct and well-marked flora:—

1. Devonian rocks, with *Lepidodendron australe*, *L. nothum*, *Cordaites australis*, *Sigillaria*, *Stigmaria*, *Archæopteris howitti*, *Sphenopteris iguanensis*. Victoria: Iguana Creek, Gippsland. New South Wales: Capertee? Mt. Lambie, Nyrang Creek (near Canowindra). Queensland: Mt. Wyatt, Canoona, Broken River, and Gympie.

2. Lower carboniferous, with *Lepidodendron veltheimianum*, *Calamites radiatus*, *Rhacopteris inæquilatera*, *Cyclostigma australis*. Victoria: Not known. New South Wales: Smith's Creek, Goonoo Goonoo Creek, Liverpool Plains, Rouchel River, County Durham. Queensland: Bobuntungen.

3. Upper Palæozoic (according to most authors), with *Glossopteris* (several species), *Phyllotheca australis*, *Vertebraria australis*, *Gangamopteris angustifolia*, *Noggerathiopsis spathulata*. Victoria: Bacchus Marsh. New South Wales: Newcastle, Greta, Raymond Terrace, Blackman's Swamp, Bowenfels, Mudgee, Illawarra, &c. Queensland: Mackenzie and Dawson Rivers, Bowen River, Pelican Creek (all within the tropics). Tasmania: Don River, Mersey River.

4. Mesozoic Beds. *Zamites*, *Alethopteris australis*, *Equisetum*, *Thinnfeldia odontopteroides*, *Tæniopteris daintreeii*. *Palissya* species, and probably *Thinnfeldia indica*, with a *Brachyphyllum* closely resembling *B. mamillare*, which would all indicate an oolitic flora, as Professor M'Coy has long since pointed out. The discovery of so well-marked an oolitic form as this *Brachyphyllum* has been quite recently made by me. *Thinnfeldia indica* (Feistm.), or a closely allied form to what is a characteristic Indian fossil, has been recognized amongst some plant remains

sent to me by the Rev. J. Milne Curran, from Dubbo, where it was found associated with *T. odontopteroides*. Victoria: Bellerine, Cape Paterson, Wannon River. New South Wales: Mount Victoria, Dubbo. Queensland: Ipswich, Tivoli, Burrum River (near Maryborough), Burnett River (near Bundaberg), Clifton (?) on the Darling Downs. Tasmania: Jerusalem Basin. I must add that I do not think that the identification of the Victorian with the Queensland beds has been satisfactorily worked out.

5. Plant beds of uncertain position but probably mesozoic. (1.) Rosewood, 24 miles west of Rockhampton, with large *Equisetum*, *Ptilophyllum oligoneurum* (n. s. nobis. MS.), a coniferous plant like *Sequoia* (*Voltzia?*) (2.) Ballinore, near Dubbo, with *Arucarites australe* (nobis MS.), *Thinnfeldia*? *Sphenopteris*. (3.) Cooktown, North Australia. Plants not identified.

I may further state that no coal has been found in connection with No. 2, at Smith's Creek. There are beds of impure earthy shale, which will not burn. The same kind of shale I noticed at some of the outcrops at Bobuntungen, but no further examination has been made.

It will be necessary to make some alterations with reference to these beds in the geological sketch map of Mr. Daintree and my own, as published by Messrs. Gordon & Gotch, in "The Australian Handbook." In Daintree's map, the portion of Drummond's Range here referred to is coloured as metamorphic, bordering on the edge of carbonaceous rocks to the eastward. In my map it appears as a granitic axis flanked by earlier palæozoic rocks, such as Cambrian and Silurian. It must now be coloured as a granite axis, and in this locality flanked by carboniferous rocks.

It is stated in the earlier part of this paper that the dividing range here makes a curve to the westward, leaving a larger area between it and the eastern sea than is found at any other portion of its course. The distance of the divide from the sea is at this point nearly 300 miles. From Rockhampton the railway passes along a gently sloping open forest, with occasional scrub to Westwood, 30 miles, where it cuts through the Goganjo Range at 600 feet. The cuttings display much older hornblendic trap rock, with palæozoic (Cambrian?) slates, folded and highly inclined, also quartz reefs and a little gold. This range and its spurs being crossed, there is a fall for about 10 miles to the basin of the Dawson River, which is not quite 280 feet above the sea; from this point there is a gradual rise to the foot of Expedition Range, which at 110 miles from Rockhampton is 800 feet above the sea-level. Then succeeds a table-land, undulating between 650 and 800 feet, falling to 520 feet in the basin of the Comet River at 140 miles. Another table-land, of about 700 feet elevation, succeeds with the basin of the Nogoa at Emerald at 620 feet, distance 164 miles. All the table-lands are clothed

with brigalow scrub; but where they are basaltic, which they are in most cases, the soil is very rich. Beyond Emerald a basaltic terrace raises the table-land to 800 feet, and at 175 miles St. Helen's Range is crossed, at 900 feet elevation. This height is kept on an undulating plateau to 195 miles, where a sandstone or quartzite terrace raises it to 1,000 feet. The terrace bears the name of Anakie Range. Basaltic rocks of a modern aspect succeed. At Blackfellows Creek, 205 miles, the basin is below 900 feet, but 8 miles further the elevation of Woodbine Creek is 950 feet. Zamia Range is crossed at 217 miles (1,180 feet). The Medway Creek, 228 miles, is 1,220 feet above the sea-level, and then the rise is abrupt by escarpments of carboniferous rocks to the Drummond Range, which probably average 2,000 feet above the sea.

In more than one place in all this distance lower carboniferous marine fossils are found, many of the species being identical with those found in the equivalent beds of Europe. At about 10 miles from Rockhampton, in what is called the agricultural area, careful collections were made by Mr. Charles de Vis, B.A., Curator of the Brisbane Museum. The locality is extremely rich in fossils, and the zeal and industry of the gentleman named were such that a complete series were obtained in excellent preservation. Many of these were kindly submitted to me for examination, and I propose, as soon as my other engagements will permit, to publish the results. I am not as yet able to state the relative positions of these marine fossils and plant-bearing beds. Between them there occurs the Boomer Range, with palæozoic rocks, highly inclined, and of probably Cambrian age. West of this is the basin of the upper tributaries of the Fitzroy, in which newer coal deposits occur. These are the equivalents of the Newcastle beds. They are so overlaid by recent volcanic rocks that it is hopeless to expect to find the relations between them and the strata of the Drummond Range.

Discussion.

Mr. Wilkinson, the Government Geologist, remarked that the fossils were exactly like those found at the Lachlan, in the Forbes district, and the occurrence of this formation in the locality described by Mr. Tenison-Woods was of especial interest, as showing the wide-spread extent of the lower carboniferous formation. It was found in Smith's Creek and in the Upper Hunter, also west of the dividing range and elsewhere; and the beds were associated with purple, pink, and yellow-coloured sandstone, as described by Mr. Tenison-Woods. It was important when these rocks were met with, because they were an indication of the formation referred to, in which coal exists in other parts of the world.

Some of these were to be seen near Narranderra and Moun Brown. They all, as it were, represented islets of the same formation, the intermediate country being filled up by a newer formation. At Smith's Creek, in the locality of these rocks, coal-beds had been seen, but they had proved to be of very little value; still in some of these localities workable and valuable coal might be found, and therefore this subject became one of great importance as the railways extended into the interior of the country.

EXPLANATION OF PLATES.

Plate XI.

Fig. 1. Portions of branches of *Lepidodendron veltheimianum*, half natural size. These exhibit the impressions of peculiar scale-like leaves tapering sharply to a point.

Fig. 2. Cast of exterior of same enlarged, showing the leaf-scars.

Fig. 3. Branch of same internal cast. The reniform tubercles are succeeded by an elongated leaf impression; still this may not belong to the same plant.

Fig. 4. This was seen to be (from the lower portion which has been destroyed in getting out the fossil) a large Calamite root.

Fig. 5. Better preserved portion of root end of *Calamites radiatus*. In this specimen the scars of rootlets are well seen at the septa.

Fig. 6. Internal cast of trunk of *Lepidodendron veltheimianum*, half natural size. This was seen to belong to the same species, as it formed part of a tree-stem which had well defined leaf-scars.

Plate XII.

Fig. 7. *Calamites radiatus*. Stem natural size, showing septa and continuity of the ribs.

Fig. 8. Cast of small trunk of *Lepidodendron veltheimianum*. I am inclined to regard this as an internal cast, nevertheless it may be an external surface with faint impressions of leaf-scars.

Stigmaria. Two-thirds natural size. This fragment lay in the position of a root in the rock, subtending a stem, probably of *L. veltheimianum*. It was three times the length of the portion figured.

Fig. 10. Stem of *Calamites radiatus*, half natural size. This must have been an upper portion of a branch, as seen by the great distance between the septa, and therefore was a large tree.