

Notes on the Geological History of Monocotyledons.

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With Plate XIV.



THERE are few more interesting problems from a botanist's point of view than the evolution of angiospermous plants. It is not proposed in the present contribution to discuss the lines of development of the Monocotyledons and Dicotyledons, or to take up the question of a separate or common origin of these two groups; but merely to examine the evidence of palaeobotany as to the geological antiquity of Monocotyledons. The records of fossil Angiosperms are in many cases entirely untrustworthy, and stand in need of careful revision. It is often a matter of primary importance to ascertain the relative age, or first appearance in time, of different groups of plants; but unfortunately the statements in palaeobotanical literature are frequently so conflicting and based on such insufficient evidence, that it is by no means easy—in some cases impossible—to arrive at any definite conclusion. It will not, therefore, be by any means a superfluous task to attempt to critically investigate the records of the rocks with reference to the earlier history

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of Monocotyledons, and to endeavour as far as possible to arrive at some conclusion as to the value of the palaeontological evidence.

It is often assumed that monocotyledonous plants are older than Dicotyledons, and this assumption would seem to be supported by the facts of geological history. If, however, we examine more closely into the nature of the palaeontological data, the conclusion is almost forced upon us that no undoubted and satisfactory monocotyledonous plant has so far been recorded from strata older than those in which typical Dicotyledons first occur¹. To discuss in detail the numerous fossils described as Monocotyledons, would take us far beyond the limits of a single article; it will suffice to refer more especially to some of the better-known earlier records, and to disregard for the present the undoubted representatives of this class discovered in the Upper Cretaceous and Tertiary rocks.

In a paper on Mesozoic Angiosperms, contributed to the Geological Magazine in 1886 by Mr. Starkie Gardner², numerous supposed genera of Monocotyledons are fully discussed, and the author is led to the conclusion that these plants may probably be traced back to Triassic, and certainly to the Oolitic rocks. He writes: 'The oldest definite Monocotyledons known are the well-marked Pandanaceous fruits from the Oolites³,' and quotes as examples the genus *Podocarya* from the Oolite of Charmouth, and *Kaidacarpum* from Inferior Oolite beds at Kingsthorpe, Northampton. The former was originally described and figured by Buckland⁴ and referred by him to the Pandanaceae. The specimens are unfortunately not available for re-examination, but an inspection of Buckland's plates in the light of our present

¹ A. C. Seward, Proc. Phil. Soc., Cambridge, Vol. ix, 1896, p. 24.

² Geol. Mag. 1886, p. 193.

³ Ibid. p. 198.

⁴ Geology and Mineralogy considered with reference to Natural Theology, London, 1858, p. 466, Pl. 84. Buckland writes that the generic name was suggested by Robert Brown, to whom he owed much of his information on the subject of the fossil.

knowledge of the genus *Bennettites*, leaves little room for doubt that the Charmouth fossil is a well-preserved bennettitean inflorescence. The generic name *Kaidacarpum*, as will be shown later, should probably be replaced by *Araucarites*. In the palaeobotanical volume of Zittel's 'Handbuch der Palaeontologie'¹, Schenk refuses to accept many of the older records, and inclines to the opinion that no trustworthy monocotyledonous plants have been described from Precretaceous rocks. In Lester Ward's 'Sketch of Palaeobotany,' the Monocotyledons are represented as being in existence in Permo-Carboniferous times, at an epoch very much more remote than that in which Dicotyledons first appeared; it is suggested that 'the step from the Monocotyledons to the Dicotyledons is very great, and it seems to have required a vast period of time to accomplish it'². Warming, in his admirable Systematic Botany, speaks of the two divisions of the Angiosperms as having probably had a common origin, and adds that—'it is scarcely proved that the Monocotyledons are the older class'³. It is unnecessary to quote more of the numerous conflicting opinions expressed by botanical writers.

*Difficulties and sources of error in the determination of
fossil Monocotyledons.*

In the Cretaceous and Tertiary strata specimens of silicified Palm-stems are by no means uncommon, and the preservation is such that an accurate diagnosis of the species may frequently be given; with this exception, however, we depend very largely for our knowledge of fossil Monocotyledons on more or less imperfect casts or impressions of structureless stems and leaves. If the tissues of such a plant as *Myeloxylon*, or the petioles of certain Ferns and Cycads, have been only partially preserved, it is conceivable that such structures

¹ Abth. ii. Palaeophytologie. Munich and Leipzig, 1890, p. 357.

² Fifth Annual Report, Geol. Surv. U. S. A. p. 448.

³ Translation by M. C. Potter, London, 1895, p. 273.

might be referred to monocotyledonous species; Schenk¹ points out that the wood of a Conifer, if preserved in patches, as frequently happens as the result of local mineralization, might be erroneously described as monocotyledonous. The close correspondence between the stems of some recent Dicotyledons and those of Monocotyledons, affords sufficient warning as regards the test of histological structure in identifying the stems of angiospermous plants. The parallel venation of monocotyledonous leaves is relied on much too extensively in the determination of fossil specimens. This form of venation is obviously an unsafe guide. Among Dicotyledons, such leaves as those of *Eryngium Lassauxii*, Decne., *E. montana*, Coult., *E. rostratum*, Car., &c., and various dicotyledonous phyllodes and phylloclades might be described as Monocotyledons if found in detached fragments². The linear tapering leaves of these forms of *Eryngium*, with their marginal spines, resemble in a striking degree the leaves of *Pandanus* or certain species of Bromeliaceae. Among the Proteaceae³, of which the protean nature of the leaves was insisted on by Bentham⁴ and again by Bunbury⁵ in connexion with sources of error in palaeobotanical determinations, there occur leaf-forms which might well be referred to Monocotyledons. On the other hand, a comparison of the leaves of certain species of *Smilax* with the genera *Pleroma* or *Cinnamomum*, not to mention other examples, shows the danger of following too closely venation-characters. Lindley gave expression to this dicotyledonous form of venation among Monocotyledons by the institution of the family of Dictyogens⁶. The leaves of *Agathis*, certain forms of *Podocarpus* (section *Nageia*), and detached pinnae of Cycadean fronds, may be quoted as possible sources of error where venation is accepted as the most important test.

¹ Die fossilen Pflanzen (Schenk's Handbuch, Vol. iv, 1890), p. 200.

² Cf. Drude, in Schenk's Handbuch, Vol. iii (ii), p. 304; see also Henslow in Journ. Linn. Soc. Vol. xxix, 1893, p. 485.

³ My thanks are due to Mr. Rendle, of the British Museum, for calling my attention to some of the less known forms in this family.

⁴ Annual Address, Linn. Soc., 1870, p. 13.

⁵ Botanical Fragments, p. 310.

⁶ The Vegetable Kingdom, 1846, p. 211.

In the pinnae of the Mesozoic Cycad *Ctenis*, which in some species attain a considerable breadth¹, the parallel veins are united here and there by oblique cross-connections, thus closely simulating certain types of monocotyledonous leaves. The superficial resemblance between a palm-leaf, such as *Calamus ciliaris*, Blume, and the frond of a Cycad, would not readily mislead the practised eye of a botanist, but with this form of leaf imperfectly preserved on a piece of sandstone or shale, such a mistake might easily be made. It is not to be wondered at that the older palaeobotanists referred Unger's genus *Cordaites* to the Palms. Schenk² has remarked that we do not know at what date *Cordaites* became extinct, and it is quite possible that some of the so-called monocotyledonous leaves should be referred to this genus. Nathorst³ has demonstrated how the impression of a drifted seaweed on the surface of fine sand may simulate parallel venation. The impression of a radial section of a woody stem of homogeneous structure, such as a Conifer, may be misleading, unless we are able to detect the cross-lines of cells forming the medullary rays. Flattened and imperfect stems of equisetaceous plants, e. g. *Equisetites* and *Schizoneura*, and indeed the leaves of the latter, may well be confounded with angiospermous leaves. Sufficient examples have been cited to illustrate the need of caution, and other instances are supplied by the examples dealt with below.

PALAEOZOIC AND MESOZOIC 'MONOCOTYLEDONS.'

Pothocites. The specimen described many years ago by Paterson⁴ under this name, was referred to by Williamson⁵

¹ E. g. those figured by Raciborski in *Flora Kopalna-Kracow*, 1894, Pls. XVI, XVII, and XVIII.

² *Die fossilen Pflanzen*, p. 200.

³ *Om nagra förmodade Växtfossilier*. [Öfversigt Kongl. Vet. Akad. Förhand. 1873, No. 9]. Pls. XV and XVI. See also, Kongl. Svensk. Vetenskaps-Akad. Hand. Vol. xviii, No. 7, 1880, Pls. IX and X.

⁴ *Trans. Bot. Soc. Edinburgh*, Vol. i, 1844, p. 45, Pl. III.

⁵ *Anomalous Oolitic and Palaeozoic forms of vegetation*, 1883, p. 11, Fig. 9.

in 1883, as probably the fructification of an *Asterophyllites* type. More recently Kidston¹ has described several examples of the same fossil, and it is now generally admitted, as this writer shows in his paper, that *Pothocites* is the strobilus of the calamitean genus *Bornia*.

The genus **Palaeoxyris** (*Spirangium*), ranging from the Coal-Measures to the Wealden, and referred by some palaeobotanists to Monocotyledons, is now generally regarded as the egg-capsule of a fish². Other Palaeozoic fossils which have been incorrectly described as Monocotyledons, need not be treated of here as possible pitfalls in phylogenetic investigations.

Passing to the Triassic system, we find such genera as **Yuccites**, **Aethophyllum**, **Echinostachys**, and others recorded as monocotyledonous plants. From the Grès bigarré (Bunter) of the Vosges, Schimper and Mougeot³ figured and described certain parallel-veined fossils, which in shape and size are spoken of as resembling the leaves of *Yucca*. In *Yuccites vogesiacus*, as represented in Pl. XXX of the memoir on the Vosges plants, we have a very imperfectly preserved impression of torn plant-structures, which apparently possess a parallel venation. This same genus does duty for various specimens described by Zigno⁴, and Saporta⁵, and others from rocks of Jurassic age. As an example may be mentioned *Yuccites Schimperianus*, which is possibly a portion of a large Cycadean frond⁶. In a recent monograph on the fossil flora of Portugal, Saporta figures a Lower Lias frond as a species of *Yuccites*⁷; but an inspection of the figure will probably suffice to convince botanists of the absence of any real

¹ Ann. Mag. Nat. Hist. Vol. xi [v], 1883, p. 297.

² For references to the literature, see Catalogue of the Mesozoic Plants in the British Museum, Wealden Flora, Part II, 1895, p. 224.

³ Plantes fossiles du Grès Bigarré, 1840.

⁴ Flora fossilis formationis Oolithicae, Vol. ii, 1873-85.

⁵ Paléontologie Française, Vol. iv, 1891 (Plantes Jurassiques), Pls. VIII-X.

⁶ Zigno, loc. cit. p. 7, Pl. XXVI, Figs. 1-4.

⁷ Saporta, Flore fossile du Portugal (Direct. trav. géolog. Portugal. Lisbon, 1894), Pl. I, Fig. 24.

justification for the employment of a generic name, and still less of one implying a monocotyledonous affinity.

A fragment figured by the same author in the *Flore Jurassique*, as an example of *Yuccites*¹, may, as Nathorst has suggested, be a piece of the rachis of a Fern. In no case do we appear to have evidence enough to warrant the use of this generic term for Triassic and Jurassic specimens. The genus *Aethophyllum*² stands for certain specimens of which the real nature is still 'very little understood'.³ There seem to be no good reasons for accepting the suggestion that these problematical fossils should be placed among Monocotyledons. The woody stems and linear leaves are not inconsistent with a coniferous plant, but it is useless to speculate as to the affinity of the imperfect and structureless impressions.

Starkie Gardner⁴, in the paper previously referred to, has called attention to a fossil described in 1850 by Buckman⁵, from the base of the Lias in the neighbourhood of Bristol, as *Najadita*, and expresses the opinion that it should probably be regarded as a Moss resembling the recent *Fontinalis*. He adds in a footnote, that a capsule had been received since the paper was written, but this has not been described or figured. In Pl. V, Fig. 2, accompanying Gardner's paper, a specimen is represented as 'undoubtedly' a monocotyledonous leaf. The long and narrow parallel-veined pinnae of such a Cycad as *Zamia angustifolia*, Jacq., offer a striking resemblance to linear monocotyledonous leaves⁶, and it is a bold assumption that the small Purbeck fossil is certainly a Monocotyledon.

In 1851 Bunbury⁷ described a specimen from the collection of Mr. Bean under the name of *Calamites Beanii*; the fossil

¹ Paléontologie Française, Vol. iv, Pl. XXII.

² Schimper and Mougeot, loc. cit. p. 37.

³ Solms-Laubach, Fossil Botany, Oxford, 1891, p. 366.

⁴ l. c. p. 203.

⁵ Quart. Journ. Geol. Soc. Vol. vi, 1850, p. 415.

⁶ This specimen, now in the British Museum collection, is represented in Gardner's figure approximately natural size, not half natural size as stated in the plate. It may possibly be equisetaceous, but there is at least no sufficient reason for describing it as a true monocotyledonous leaf.

⁷ Quart. Journ. Geol. Soc. Vol. vii, 1851, p. 189.

has since been figured by Gardner¹, who quotes a suggestion by Williamson² that it may be a portion of an arborescent monocotyledonous stem. Unfortunately the original specimen has not been found, but the drawing is rather more suggestive of an imperfect cast of an *Equisetites* stem.

The Jurassic fossils figured by Heer³ as species of *Bambusium*, and the Cretaceous specimens referred by Hosius and von der Marck⁴ to a liliaceous genus *Eolirion*, do not call for special discussion; these forms, and the fossil described under the name of *Pitcairnia*, which as Schenk remarks is no doubt a coniferous twig, and other indeterminable examples of fossil plants, cannot be accepted as authentic records of Monocotyledons. There are numerous other instances of fossil stems and leaves described by different writers as Monocotyledons, but to deal with them *seriatim* would be a tedious and unprofitable task. There remain, however, a few examples of fossils recorded as monocotyledonous, which it is important to consider rather more fully.

Aroides. In 1867 Carruthers⁵ described a small cylindrical fossil from the Stonesfield slate as *Aroides Stutterdi*, and expressed the opinion that it might reasonably be regarded as part of an aroid spadix similar to that of the recent genus *Xanthosoma*. It has since been suggested that the fossil may possibly be a portion of the anal sac of a Crinoid⁶. Mr. Bather, of the British Museum, who was good enough to examine the specimens, considers that this view cannot be accepted; he is unable to recognize any trace of Echinoderm structure. There are two specimens of this so-called *Aroides* in the British Museum collection⁷; the larger of the two

¹ Geol. Mag. 1886, Pl. IX, Fig. 3.

² Loc. cit., p. 4.

³ Flora fossilis Helvetiae, Zürich, 1877, p. 86, Pl. XXX, &c.; also Heer, Contributions à la flore fossile du Portugal [Secc. Trav. Géol. Portugal, 1881], p. 22, Pl. XIX.

⁴ Palaeontographica, Vol. xxvi, 1879–80, p. 9, Pl. XXIV, Fig. 6; and p. 93, Pl. XLIV, Figs. 210, 211.

⁵ On an Aroideous Fruit from the Stonesfield Slate, Geol. Mag. Vol. iv, 1867, p. 146.

⁶ A suggestion quoted by Gardner (loc. cit.), p. 198.

⁷ Numbers V. 3442 and 52871, in the Museum Register.

presents an appearance precisely similar to that of the specimen figured by Carruthers, it is sub-cylindrical in form, and in surface view appears to be made up of small plates with irregularly crenulated margins; the smaller and more perfect example referred to the same species, exhibits four rows of hexagonal plates with much more even margins. Without attempting to determine the nature of these fossils, or even to decide whether they are casts of an animal or plant structure, it may be safely asserted that we are not justified in accepting them as proofs of a Jurassic Monocotyledon. Zigno¹ quotes this species as an example of a fossil monocotyledonous plant, but does not offer any comment on the value of the identification.

Kaidacarpum. In a paper on British fossil Pandaneae, written in 1868, Carruthers² institutes a new genus, *Kaidacarpum*, and defines it as follows:—‘Fruit composed of pyramidal rhomboidal single-seeded drupes, sessile or subsessile on a thickened spadix.’ Among other specimens included in this genus, there is the imperfectly preserved fossil represented in Pl. XIV, Fig. 4; this rolled and worn example from the Lower Greensand beds of Potton was named by Carruthers *K. minus*. It must be pointed out that the author of the genus has modified his views as to the nature of some of the species, and inclines to the opinion that they are rather araucarian than monocotyledonous. In Fig. 4 A the external surface shows indistinct traces of spirally arranged depressions; towards the lower end of the cone the stout central axis projects and is marked by more clearly defined and regular pits. Fig. 4 B represents the central axis with portions of the imperfect cone-scales on either side. Had we no better specimens than this to guide us, it would, perhaps, be rash to express a decided opinion as to botanical affinity, but a comparison of the Potton cone with more perfect specimens from the Wealden rocks, brings out very distinctly a close agreement with the female cones of recent

¹ Loc. cit. Vol. ii, p. 2.

² Geol. Mag. 1868, Vol. v, p. 153.

Araucarias. The earliest recorded example of one of these supposed pandanaceous fruits is figured in Lindley and Hutton's Fossil Flora¹, and named by them *Strobilites Bucklandi*. A still more perfect example has been figured by Carruthers under the name of *Kaidacarpum ooliticum*², from the Great Oolite of Kingsthorpe, Northamptonshire; there is a good specimen of this form in the British Museum collection which shows very clearly the characteristic features³. Another example, of what I regard as an imperfectly preserved female cone of *Araucarites*, is represented in Carruthers' well-known memoir on Mesozoic Cycads as probably the male flower of *Bucklandia*⁴. A comparison of the figured specimen with certain cones from the Wealden rocks of Sussex, affords good grounds for regarding it as araucarian. The female cones of recent species of *Araucaria* possess well-marked characters, which enable us to recognize with reasonable probability fossil cones of the same type. In *Araucaria imbricata* the large cones have a short and thick axis, of which the surface is marked with regularly disposed pits or scars of the carpophylls. Each carpophyll is hollow and contains a comparatively large seed, suggesting an angiospermous ovary. In *A. brasiliensis*⁵ the stout axis is still more conspicuous, and in *A. Cookii* we have a smaller form conforming to the same type of structure. A section of a large cone of *A. Bidwilli* in the botanical department of the British Museum shows very clearly the nature of the carpophylls and the manner of occurrence of the seeds. If we compare the recent examples with such fossils as *Kaidacarpum ooliticum*, *K. minus*, *Araucarites Huddlestoni*⁶, and others, we cannot fail to realize the very striking resemblance. I have elsewhere⁷ drawn attention to the similarity of *Kaidacarpum minus* to some Wealden

¹ Vol. ii, Pl. 129.

² Loc. cit., Pl. IX, Figs. 1 and 2.

³ No. 52840 in the Museum Register.

⁴ Trans. Linn. Soc. Vol. xxvi, Pl. LIV, Fig. 6.

⁵ See Martius' figure in Flora Brasiliensis, Pl. CX.

⁶ Carruthers, Quart. Journ. Geol. Soc. Vol. xxxiii, p. 402.

⁷ Wealden Flora, Pt. II, p. 190.

cones described by Carruthers as different species of *Cycadeostrobus*¹. The latter I ventured to speak of under the generic name of *Conites*², but a comparison of them with more recently acquired Wealden cones, leads me to refer them all to *Araucarites*. One of the best specimens figured by Carruthers as a cycadean cone is that which he named *Cycadeostrobus Brunonis*³; in a transverse section the seeds are clearly seen, and an examination of the specimen tends to confirm my view as to its araucarian affinity. It seems quite impossible to separate under distinct specific types the several pyritized Wealden cones figured in Carruthers' paper on gymnospermous fruits. As a matter of convenience, a specific name must be adopted, but in dealing with imperfect detached cones it is impossible to arrive at any satisfactory conclusions as to different specific forms. Taking Carruthers' species *Cycadeostrobus elegans*, we may briefly define the type as follows:—Cones about 6 cm. in length, and 4 cm. broad; central axis stout, marked with spirally arranged diamond-shaped areas to which are attached broadly triangular carpellary scales, narrowed towards the base, and slightly winged laterally.

This diagnosis is merely intended as a guide to general characteristics, and cannot be accepted as a very precise specific definition. The size of the cones varies considerably, and it is quite possible that more than one species is included in the following list under *A. elegans*. It may tend to remove some of the existing confusion in nomenclature, and to express the conclusions arrived at, if we enumerate those forms which I propose to include in the genus *Araucarites*.

***Araucarites elegans* (Carr.)⁴.** Carruthers, Journ. Bot., Vol. v, 1867, p. 9, Pl. LVII, Fig. 9.

Cycadeostrobus elegans, Carr.

C. truncatus, Carr.⁴ Ibid. p. 8, Pl. LVII, Fig. 3.

¹ Carruthers, Journ. Bot. Vol. v, 1867, p. 1.

² Seward, loc. cit., p. 113.

³ Carruthers, loc. cit., Pl. LVII, Figs. 4, 5. See remarks on these *Cycadeostrobus* cones in Solms-Laubach's Fossil Botany, p. 92.

⁴ The figured specimens are in the British Museum collection.

C. Brunonis, Carr.¹. Carruthers, Journ. Bot. Vol. v, 1867, p. 10, Pl. LVII, Figs. 4 and 5.

C. ovatus, Carr.¹. Ibid. p. 8, Pl. LVII, Figs. 1 and 2.

Conites elegans (Carr.). Seward, Wealden Flora, Pt. II, p. 115.

Kaidacarpum minus, Carr. Carruthers, Geol. Mag., Vol. v, 1868, p. 156.

Araucarites, sp. Seward, loc. cit., p. 190.

Bucklandia (male cone)¹. Carruthers, Trans. Linn. Soc., Vol. xxvi, 1870, Pl. LIV, Fig. 6.

Araucarites ooliticum (Carr.). Carruthers, Geol. Mag., Vol. v, 1868, p. 156, Pl. IX, Figs. 1–6.

Kaidacarpum ooliticum, (Carr.).

Pandanocarpum ooliticum, Zigno. Flor. foss., Oolit., Vol. ii, p. 3.

Araucarites Bucklandi (L. and H.). Lindley and Hutton, Fossil flora, Vol. ii, Pls. I and IX.

Strobilites Bucklandi, L. and H.

Among other fossils described under *Kaidacarpum* may be mentioned *K. suecicum*², Nath., *K. sibiricum*³, Heer, *K. stellatum*⁴, Heer, *K. parvulum*⁵, Heer, and *K. cretaceum*⁶, Heer. In none of these forms have we any satisfactory evidence in favour of a monocotyledonous alliance.

Dracaena Benstedtii. The specimen represented in Pl. XIV, Fig. 3 was originally described and figured by Mackie in 1862⁷ as a stem very like that of *Dracaena*. His figure does not convey a very accurate idea of the nature of the fossil.

¹ The figured specimens are in the British Museum collection.

² Nathorst, Bidrag till Sveriges fossila flora. II. Floran vid Höganäs, &c. [Kongl. Svensk. Vetenskaps-Akad. Handlingar, Vol. xvi, No. 7, 1878], p. 52, Pl. VI, Fig. 14.

³ Heer. Flor. foss. Arct. Vol. iv, 1877, p. 84, Pl. XV, Figs. 9–16.

⁴ Ibid. p. 85, Pl. XL, Fig. 3 b, and Pl. XV, Figs. 18–20.

⁵ Ibid. p. 86, Pl. XV, Fig. 17.

⁶ Ibid. Vol. vi, 1882, p. 19, Pl. LXIV, Fig. 9 b.

⁷ Geologist, Vol. v, p. 401, Pl. XXII.

This and other specimens from the same locality were named by König *Dracaena Benstedtii*, after Mr. Bensted who discovered the stems in the 'Iguanodon' quarry, but no diagnosis of the species seems to have been published. König's name was adopted by Morris in his Catalogue of British fossils¹; also by Mantell, who mentions a specimen two and a half feet in length and eight inches in diameter, the surface being marked with 'annular ridges, indicating amplexicaul leaves².' In a later work he adds—'until the internal structure of these fossils has been examined, the correctness of this identification is, however, uncertain³.'

Carruthers in 1868⁴ expressed the opinion that Bensted's specimens show a closer resemblance to *Pandanus* than to the stem of *Dracaena*. Gardner⁵ alludes to what are probably the same stems as possibly cycadean. I have previously⁶ pointed out the close agreement in external form between these Maidstone fossils of Lower Greensand Age and the stems of certain recent Cycads. The example represented in Pl. XIV, Fig. 3, is the same which Mackie described in 1862; the preservation is fairly good; the stem has a girth of 34 cm. and is 9.5 cm. in length along the median line which represents the boundary between two approximately equal branches. The surface is characterized by numerous interrupted transversely running grooves, which curve upwards towards the upper end of the stem where the axis appears to be bifurcating. Numerous small, elliptical, and transversely elongated elevations are scattered over the surface without any regularity of arrangement. Here and there occur patches of a bluish white mineral deposit which do not, however, exhibit any internal structure. In some of the other specimens in the British Museum collection there seem to be traces of a woody structure lining a central cavity occupying

¹ p. 8.

² Mantell, *Petrifactions and their Teachings*, 1851, p. 49.

³ *Ibid.*, *Medals of Creation*, Vol. i, 1854, p. 194.

⁴ *Geol. Mag.* 1868, p. 154 (footnote).

⁵ *Ibid.* 1886, p. 201.

⁶ *Wealden Flora*, Pt. II, p. 170.

the axis of the stem ; unfortunately the wood-like texture is the result of the crystallization of carbonate of lime, and not organic.

Probably this central cavity represents the pith and a portion of the wood of the original stem.

The largest specimen in the British Museum collection measures 41 cm. in length and 15 cm. in breadth ; this and some of the other examples show a number of distinct scars which probably mark the position of lateral buds¹.

In some species of the recent Cycad *Zamia*, e.g. *Zamia Skinneri*, Warsz., *Z. Loddigesii*, Miq., *Z. Fischeri*, and *Z. pumila*, L. the stem differs very considerably in external characters from the usual cycadean trunk with its characteristic armour of petiole-bases. In this less familiar form the surface is marked by irregular and transverse shallow grooves, and there are frequently found numerous oval corky protuberances scattered irregularly over the surface of the stem². In Pl. XIV, Fig. 2, a portion of a stem of *Zamia Skinneri* is drawn natural size, and in Fig. 1 part of a much branched trunk of *Z. Loddigesii*. A comparison of the two figures with Fig. 3 reveals a fairly striking resemblance. It is not proposed to rely on this correspondence, as regards external features, to the extent of describing the Maidstone fossils as cycadean stems, but simply to draw attention to the possibility of such an identification being correct. In the stem of *Pandanus* there is a distinct similarity to that of *Dracaena Benstedtii*, but on close examination the former shows the leaf-scars and leaf-trace-bundle scars much more distinctly than in the latter ; the resemblance of the fossils to stems of *Zamia* is I believe much closer.

The existence of such cycadean stems as those shown in Figs. 1 & 2, seems to have been overlooked by many writers on fossil plants. It need not be pointed out how important it is to pay special attention to the less common and some-

¹ Nos. 8357 and 1765.

² The stem of *Cycas siamensis*, Miq., and other Cycads shows in a less degree surface features similar to those of the fossil forms.

what aberrant forms among recent plants, when we are seeking for aids in the determination of fossil specimens.

Instead of retaining the generic name *Dracaena*, I propose to adopt a term which does not imply any particular botanical affinity, and suggest, therefore, that of *Benstedtia*, after the discoverer of the fossil stems. This genus may be defined as follows :—

BENSTEDTIA, gen. nov.

Stems having the surface marked by irregular and interrupted grooves and broader ridges running transversely, with occasional small elliptical protuberances irregularly disposed on the surface of the stem. No distinct leaf-scars; branch-scars may be present, and in addition to smaller lateral branches, a bifurcation of the stem may be indicated by the converging upwards of the transverse lines on the surface of the stem.

Without attempting any specific definitions, we may include under this generic name the stems of the Kentish Rag of Maidstone, and an example recently described from the Wealden rocks of Sussex¹.

CONCLUSION.

In the above incomplete examination of some of the recorded examples of monocotyledonous plants, I have endeavoured to draw attention to the dangerous and misleading practice of assigning generic names, implying definite botanical affinity, to imperfect and in many cases indeterminate fragments. It has been pointed out that the resemblance of the so-called Monocotyledons from Mesozoic rocks to the stems or leaves of recent genera, although in some cases fairly close, is not sufficiently well marked to warrant the conclusion that the fossil specimens should rather be classed with angiospermous than with gymnospermous plants. The discovery of better specimens of certain fossils has supplied us with more complete evidence than was available when these forms were

¹ Wealden Flora, Pt. II, p. 171, Pl. XII, Fig. 5.

first described, and thus it has been found desirable to modify or entirely depart from the determinations of some previous writers. Without venturing to speak dogmatically as to the correctness of some of the suggested alterations, it may be safely urged that it is of extreme importance to critically examine the records of fossil angiospermous species before accepting them as trustworthy contributions towards the history of plant-evolution. The evidence at present available does not, I believe, afford any proof of the existence of Monocotyledons in Pre-cretaceous strata.

EXPLANATION OF FIGURES IN PLATE XIV.

Illustrating Mr. Seward's paper on Fossil Monocotyledons.

Specimens figured Natural Size.

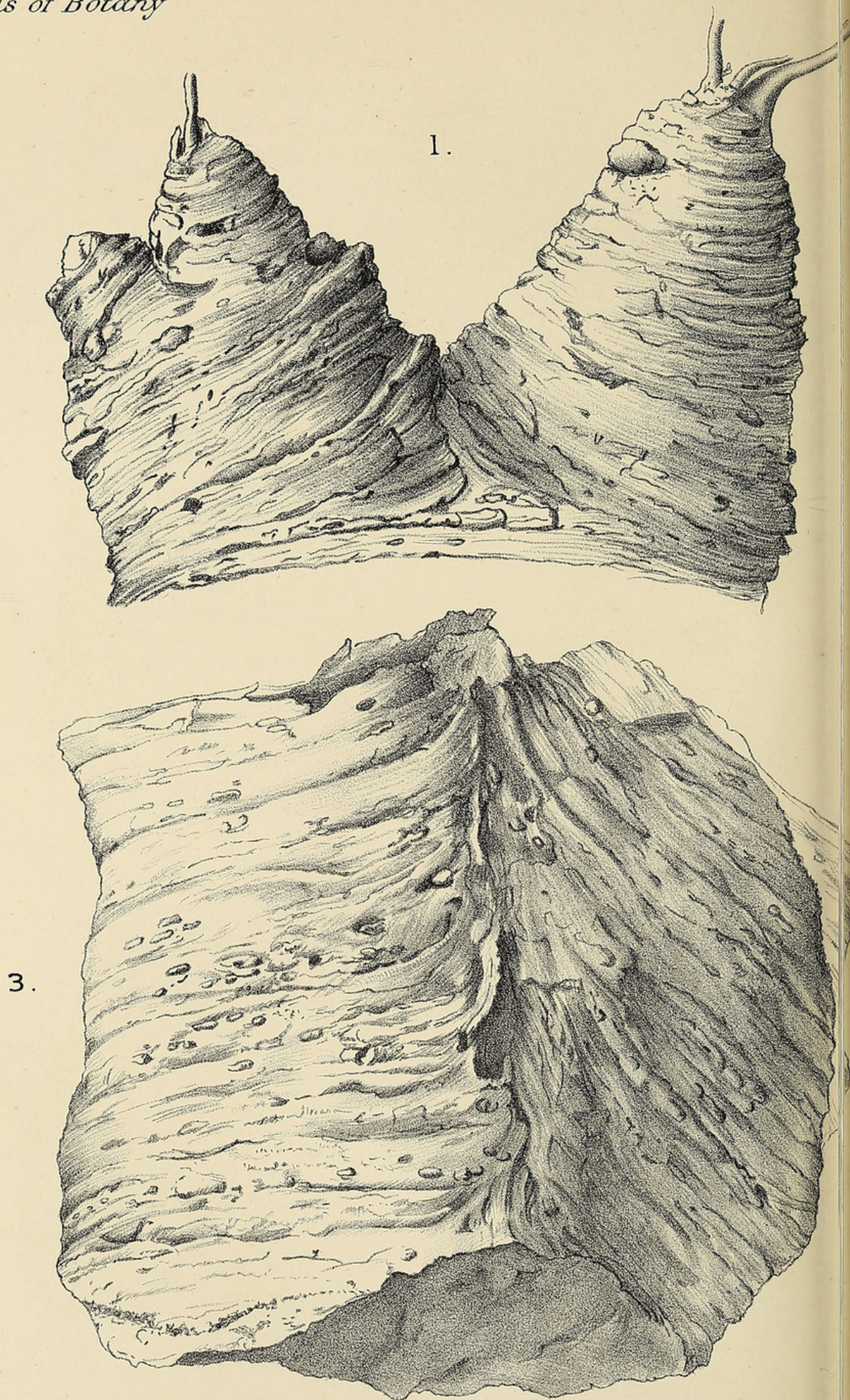
For the drawings reproduced in the Plate, I am indebted to my Wife.

Fig. 1. *Zamia Loddigesii*, Miq. Portion of a much branched stem. (Plant in the Botanic Gardens, Cambridge.)

Fig. 2. *Zamia Skinneri*. Warsz. Portion of erect stem, 26 cm. in girth. (Plant in the Royal Gardens, Kew.)

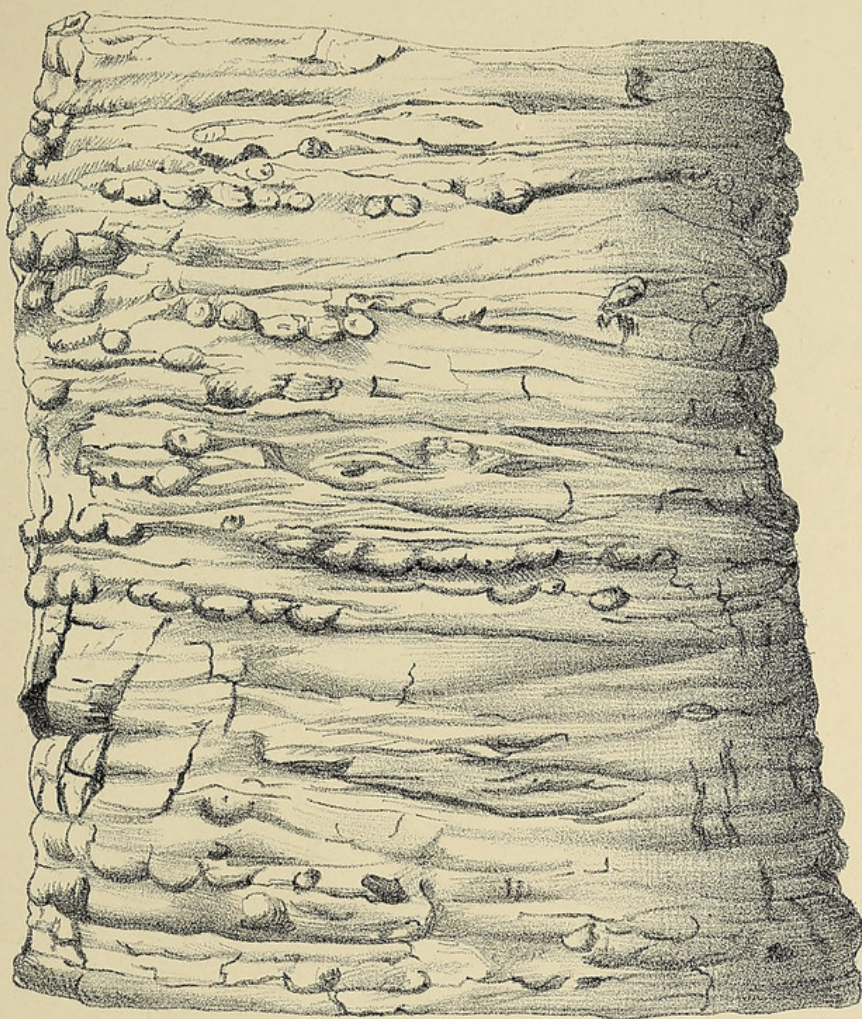
Fig. 3. *Benstedtia*, sp. Specimen originally figured on a smaller scale by Mackie in the *Geologist*, Vol. v, 1862, Pl. xxii, (No. 1764 in the British Museum Register).

Fig. 4. *Araucarites elegans* (Carr.). Waterworn specimen from the Lower Greensand beds of Potton (Bedfordshire); in the Woodwardian Museum, Cambridge.

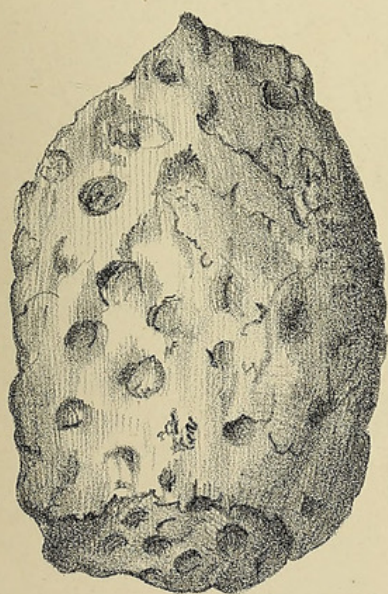


M. Seward del.

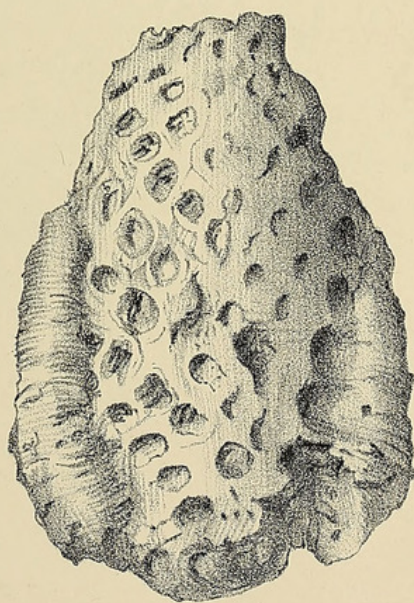
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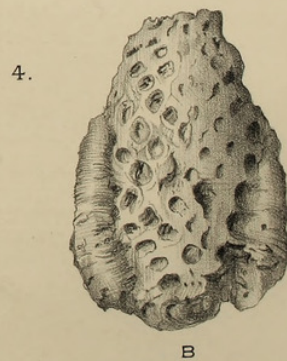
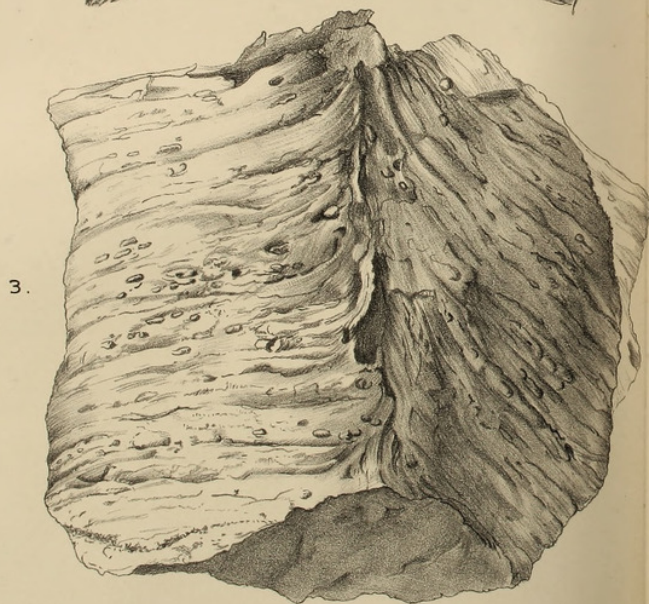
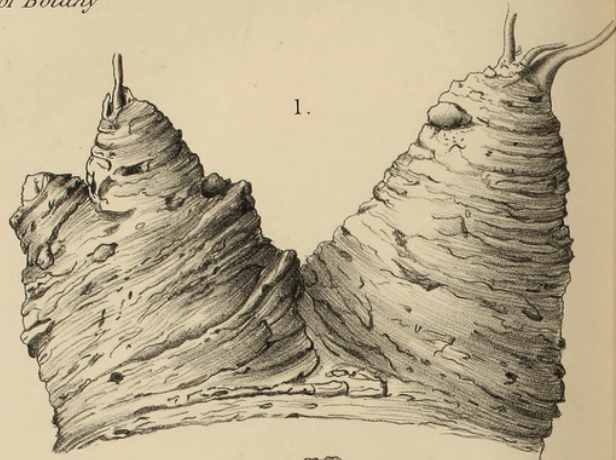
4.



A



B



M. Seward del.



Seward, A C . 1896. "Notes on the geological history of Monocotyledons."
Annals of botany 10, 205–220.

<https://doi.org/10.1093/oxfordjournals.aob.a088609>.

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