THE
GEOLOGICAL MAGAZINE.

NEW SERIES. DECADE III. VOL. III.

No. V.—MAY, 1886.

ORIGINAL ARTICLES.

I.—ON MESOZOIC ANGIOSPERMS.

By J. STARKIE GARDNER, F.L.S., F.G.S.

(PLATE V.)

THERE can scarcely at the present time be a problem more interesting than that of the first appearance of Angiosperms, nor one regarding which there is less trustworthy information at the disposal of the geologist. In attempting to bring together a summary of what is known regarding the earlier forms of this most important division of the vegetable kingdom, I make little claim to originality; nor are such criticisms as I may venture upon entitled to the same weight as if put forward by a trained botanist.

It is quite unnecessary to recall the many supposed representatives of Angiosperms that were formerly included in the Palæozoic Floras, for they have long since been dismissed from our lists of fossils and forgotten. Though less fanciful in degree than some of the still earlier geological fallacies, they are no less mythical, and at present the names *Yuccites*, *Palmacites*, *Antholites*, *Poacites*, *Culmites*, etc., are no longer included among the plants of the Coal-measures. Now that *Pothocites* has been shown to be part of a Sigillarian plant, there is in fact no longer any Angiosperm remaining of Palæozoic age. At the same time, it must not be overlooked that Corda described two species of Carboniferous and Permian endogenous wood, while the exhaustive studies of Prof. Williamson, extending over a great number of years, have brought to light the existence of some anomalous woods and other plant-structures from the Coal-measures, in the most perfect preservation, so that it is certainly within the bounds of possibility that we may some day come to a clearer appreciation as to the lines through which Angiosperms were differentiated from the older Cryptogams or Gymnosperms.

There are met with, however, in the Coal-measures, the exceedingly problematical remains of a plant which is claimed in the latest work of Saporta and Marion to be a "pro-Angiosperm," or, in other words, an Angiosperm imperfectly differentiated from a Cryptogamic or Gymnospermic stock. The widely-distributed fossil, known as *Spirangium*, consists of acutely-pointed spindle-shaped bodies, which are believed to be composed of from five to ten linear valves, supposed to envelope a central cavity. These valves usually appear to be spirally twisted, but in some specimens, which seem to

be in more perfect preservation, there is no twist visible,¹ so that it is probable that either the spiral arrangement was confined to an inner part of the structure, or that the purpose they had to serve could be equally fulfilled without the twist. They seem to have been seated on a pedicel, and according to Schimper, a number were joined to form a sort of umbel; but in England at least they are generally found detached. Examples were figured in the Transactions of the Geological Society as long since as 1840,² under the name of *Carpolithes helicteroides*. No better idea of their enigmatical nature can be given than the bare enumeration of some of the guesses that have been made as to their affinities. They were thought to be allied to *Helicteres*, a genus of *Sterculiaceæ*, by Prestwich and Morris: they are *Palæobromelia* of Ettingshausen, allied to the Pine-apple family; the *Palæoxyris*, of Brongniart, related to *Xyris*,³ a sedge-like Monocotyledon principally confined to the Tropics; the radicular appendages of *Equisetum* according to Lesquereux; they were named *Sporlederia* by Stickler, who regarded them as Bromeliads; and *Spirangium* by Schimper, who hazards no opinion as to their position in the vegetable kingdom, beyond such as is implied by placing them after the Monocotyledons. Finally, they are claimed to be "pro-Angiospermous" fruits by Saporta and Marion, but it is almost superfluous to say that their affinities remain to this day completely unknown. They are found in all stages, from the Carboniferous up to and including the Wealden, and any discovery tending to shed further light upon them would be of very great importance.⁴

Next in point of age comes a leaf with reticulated venation from the Permian of Russia, and named *Dichoneuron Hookeri*, Sap. It is stated to be of a firm consistence, with a long petiole, slightly dilated at the base and detached naturally from the stem; and an engraving shows it to be bipartite, indented, and lobed and cut laterally into two segments. Saporta and Marion⁵ claim that the venation resembles that of *Pistia* (a tropical Duckweed), and that the leaves of the aroideous *Amormophyllum* are similarly bilobed, and suggest the association with it of a spathe-like body from the same formation. Sir Joseph Hooker, however, to whom the specimen was shown, thought that it was probably a cryptogam allied to *Ceratopteris*, a genus of tropical and aquatic Ferns. It is in any case quite obvious that very little importance can be attached to a mere leaf with such undecided characters, when we reflect that leaves greatly resembling each other with not dissimilar venation are common alike to Cryptogams, Gymnosperms, and both divisions of Angiosperms. Another

¹ There is an admirable specimen showing this condition in the Museum at Owens College.

² Prestwich, Geology of Coalbrook Dale, Geol. Trans. vol. v. part iii. plate 38, fig. 12, and explanation by Prof. Morris.

³ A view recently upheld by Nathorst.

⁴ The species described as *Palæospathe* by Unger from the Carboniferous and Permian, may possibly also belong here. A list of them is given in Schimper, *Pal. végétale*, vol. ii. p. 505.

⁵ *Evolution des Phanérogams*, vol. i. p. 231.

problematic plant, of which the outline at least is perfectly known, is the *Cethophyllum speciosum*, Sch. and Moug., from the Trias of the Vosges. It possessed linear leaves, with fine linear veins without mid-rib, which are decurrent and grouped by threes on a woody and branching stem. The branches are terminated by cylindrical and more or less elongated spikes, whose scales or bracts bore smooth shining seeds in their axils. These spikes were imperfectly articulated at the base and furnished at that point by a ring of paleæ or hairs, and were probably caducous.¹ It has been suggested by several writers that *Cethophyllum* may be allied to the *Typhaceæ*, and though it is by no means even certain that they belong to the Monocotyledons at all, it appears difficult to avoid regarding them with interest as at least possible "pro-angiospermic" types. Certain fruit-spikes from the same formation were named *Echinostachys* by Brongniart.

Synchronous with the last, and also common to the Jurassics, are narrow ribbon-like leaves known as *Yuccites*, Sch. and Moug., five species of which are described by Zigno.² They are broad or narrow linear leaves, with entire margin, and without mid-rib, with fine longitudinal veins united by transverse veinlets and sessile or amplexicaul base. As stated by Schimper,³ "It is useless to remark that these fossils may proceed from very different types, and perhaps without real analogy with the living type to which we compare them." They most resemble the leaves of *Dracæna* or *Fourcroya*.

In the Rhætic we meet for the first time with the remarkable organism known as *Williamsonia*, a fossil familiar to us from its not uncommon occurrence in the Oolite of Yorkshire. It appears to have been figured first as a flower⁴ in Bird's Yorkshire, pl. ii. fig. 6, associated with *Zamites*, and later by Mantell in 1844, Medals of Creation, vol. i. p. 161, as the fruit of *Zamites lanceolata*, in consequence of a conjecture by Lindley that the supposed petals were scales and the stamen and pistil the fractured axis. It was first described by Prof. Williamson in a communication to the Linnean Society,⁵ in 1868, and was named after the Professor by Carruthers; but at that time it was considered that the Cycadean foliage associated with it, and known as *Zamites gigas*, might very probably belong to the same plant. The fructification is very rarely attached to stems with spirally arranged leaves, and to such stems and the fruit the genus is now restricted. It seems no longer possible to regard it as even an utterly abnormal Cycad, and the question therefore arises as to whether Saporta and Marion have sufficient grounds for ranking it among their "pro-Angiosperms." Mr. Carruthers and Prof. Williamson appear uncertain as to which section of the vegetable kingdom it should enrich, while Dr. Nathorst advances the rather untenable proposal to place it in *Balanophoraceæ*, a small natural order of succulent leaf-less,

¹ Schimper and Mougeot, Monogr. d. pl. foss. du Grès bigarré, p. 39, pl. xix. xx.

² Flora foss. forma. oolithicæ, i.-iv.

³ Pal. végétale, vol. ii. p. 427.

⁴ A closed bud is apparently figured as a nut, pl. iii. fig. 7.

⁵ Linn. Trans. p. 663, pls. 52 and 53.

parasitic Dicotyledons, to which *Rafflesia* belongs, while Newberry appears to regard them as possible Composites.¹

The branches of *Williamsonia gigas*, Carr., are stout, densely clothed, with remarkably thick and short sheathing leaves, amplexicaul, loosely imbricated, dorsally keeled or convex, inferiorly canaliculate, and with lanceolate, stiff, and even spinous apex. They are coriaceous, smooth, with entire margins and parallel veins, united by a delicate network of oblique veinlets only visible with a lens. Many of these stems are terminated by more or less developed globose involucre, composed of at least one whorl of converging linear bracts, bent inwards so as to form a chamber, which is sometimes empty, showing the basal scar from which the interior organ had become detached. The largest of these involucre are formed of several rows of bracts enveloping a peculiar gourd-shaped body or axis invested with a dense covering of compressed long narrow cells, which Saporta regards as an investing mass of filaments and anthers, such as that covering the spadix of *Typha*. Prof. Williamson calls this a cortical layer, but has inferred that it possibly bore antheridial organs: Saporta adds that these fell away after the pollen was shed, leaving the axis bare. Saporta asserts, and Williamson thinks it not improbable, that this involucre represents the male organ of the plant.

Associated with them are found verticils of incurved bracts united at their bases into a cup-shaped organism, which Williamson on the one hand is confident have never been found attached to any other, but which Saporta maintains are sometimes present in the interior moulds, in which condition all the English specimens are found, adhering to the gourd-shaped axis which he says it surmounted. The important collection of Mr. Yates is now in the Jardin des Plantes, and I have not had the opportunity of examining it since I became interested in the subject; but on the other hand Professor Williamson certainly possesses a specimen in which each bract is furnished with a pair of oblong depressions, which are clearly not accidental markings as Saporta would believe, and are obviously adapted for bearing a pair of ovules. The remarkable thing is that none of the other numerous specimens, so far as I know, in our public museums show any such marks. Moreover, the gourd-shaped axis is sometimes prolonged into a peculiar point which can be most readily described as in shape like a light-house, and which finds no place in Saporta's restoration.²

The rest of the description of *Williamsonia* is taken wholly from

¹ Dr. Newberry describes a number of helianthoid flowers which he calls *Palæanthus*, from the Cretaceous Amboy Clays, which are three to four inches in diameter and greatly resemble *Williamsonia*. He remarks that though "so much like flowers of Compositæ, we are not yet warranted in asserting that such is their character," Bull. Torrey Botanical Club, vol. xiii. p. 37, 1886.

² The cup is described by Saporta and Marion, *Evolution des Phanérog.* vol. i. p. 240, as a large cup or bell-shaped expansion with fringed or lobed margin, composed of coriaceous and fibrous tissue, comparable to the spongy apex of the fleshy spadix of *Amorphophallus*, and more remotely with the tuft of leaves crowning the Pine-apple.

Saporta and Marion,¹ as the specimens preserved in museums in this country do not appear to reveal the characters claimed by these distinguished French authors. They say that in addition to the male involucre are others, smaller, less regularly globose, generally empty, with a broad cicatrix at the base, corresponding to the insertion of an organ which has evidently become detached in a natural manner. Complete specimens, however, show a globular receptacle or spadix, shrunk as if empty and surrounded by the bracts forming the involucre. Sometimes this involucre appears to have been detached entire, but more often the globular spadix with the inner row only of bracts was disarticulated. The surface of the spadix itself is areolate, the compartments irregularly polygonal, either grouped in rosettes of five or six round central points, which appear to be stigma of ripe pistils, or with these latter more irregularly interspersed among them. The areolæ are presumably barren carpels. An Indian specimen shows the female spadix to have possessed a fibrous covering which was shed in a single piece. A

A. Fruiting organ of *Williamsonia Morieri*, Sap., naturally shed. The specimen is preserved as carbonate of iron. Some of the bracts of the involucre remain, and beneath the areolæ an accident has exposed some of the ripe seeds in their natural position. The specimen, magnified twice, is from the Oxfordian of Vaches-Noires. B. Areolæ formed of carpels grouped together and compressed, the central points being the scars of the stigmas. C. A seed greatly magnified. After Saporta and Marion.

¹ Saporta has an exhaustive treatise on the subject in the press, which will be superbly illustrated, in which he intends to demonstrate the absolute identity of *Williamsonia* with *Podocarya*.

very perfect specimen of *Williamsonia Morieri*, beautifully preserved in carbonate of lime, is from the Oxfordian of Calvados. In this species only the upper half of the spadix, which is ovate instead of globose, is covered with areolæ, in consequence of the fibres of which the areolate covering is formed being directed upwards obliquely, instead of at right angles to the axis. This disposition has fortunately enabled some of the ovules to be uncovered, and shows that they are situated in the interior of the rosettes in which the areolæ are arranged, each one corresponding to an entire rosette. Thus most of the pistils were unfertilized, supposing there were as many pistils as areolæ, and several of them became subsequently united into syncarps. Each areola when magnified is polygonal and convex, with the facets culminating in a small button, an arrangement exactly similar to that of *Pandanus frāgrans*. The ovules or seeds were attached by the base, which was rounded, while the other end was more pointed.

The spadix was not a true inflorescence, or spike composed of a number of flowers on one axis, as in the true *Spadicifloræ*, but a branch with every leaf metamorphosed into carpels, and thus the morphological equivalent of the gynœcium of the *Magnolia*. Consequently it represents a single flower composed of an indefinite number of unisexual elements, a structure of a kind that might *a priori* have been expected to occur in an early type of pro-Angiosperm.

Small buds, as well as the more mature organisms, are met with in the Yorkshire Oolites. Other and distinct species have been met with in the Oolites of India,¹ France, and some of the Baltic provinces, in some of these cases apart from any associated Cycadean remains.² An organism found by Griffiths in the Grey Chalk between Dover and Folkestone, in which the coaly substance of the plant is preserved, was forwarded by me to Saporta, who pronounced it without hesitation to be a *Williamsonia*. It would be interesting to have this determination confirmed, as it strengthens the evidence already in existence, tending to show that no great change took place in the Flora of the British area, from the Jurassic to the Cretaceous, inclusive.³

The oldest definite Monocotyledons however are the well-marked Pandanaceous fruits from the Oolites, which therefore take rank as the earliest known Angiosperms. One of the most distinct of these was figured by Buckland in 1836 from the Inferior Oolite of Charmouth,⁴ to which, at R. Brown's suggestion, he gave the name

¹ Feistmantel lays great stress on their occurrence in the rocks of the Rajmahal group as supporting his view that they are of Jurassic age. There are two species besides the one considered identical with the Yorkshire *W. gigas*, Pal. Indica, Flora of Kach, p. 73, 1876.

² Williamson, On some Anomalous Oolitic and Palæozoic Forms of Vegetation, Proc. Roy. Institution of Great Britain, Feb. 16, 1883.

³ Saporta writes to me under date April 2nd, 1886, regarding this fossil:—"Je crois bien que c'est un véritable *Williamsonia*, mais écrasé et méconnaissable et je n'ose pas le décrire dans l'état où il est, ne sachant même si ce ne serait pas quelque type spécial." It appears, however, that it is to be figured in a forthcoming work.

⁴ Geol. and Min. vol. i. p. 504; vol. ii. p. 101. Unger, Gen. et Spec. Plant. Foss. p. 327.

Podocarya. Carruthers redescribed it¹ as of "the size of a large orange, and composed of an indefinite number of cells, each containing, near the surface, a single longish seed, about the size of a grain of rice. The cells were separated from the spadix by long fibrous footstalks, and were surmounted by hexagonal tubercles, in the centre of which could be seen the remains of a stigma." The resemblance of this fruit to that of *Williamsonia* when deprived of its involucre should not be overlooked.² Another Pandanaceous fruit from the Great Oolite of Kingsthorpe, near Northampton, is named *Kaidacarpum* by Carruthers and is thus described (p. 155, *op. cit.*):³—

"The fruit consists of a thick spadix,—not so thick, however, in proportion to the drupes as in *Bryantia butyrophora*, Webb. The drupes leave the spadix at a right angle about one-third from the apex, those above have an ascending and those below a descending direction, increasing as it reaches the fruit-stalk, which is seen in the fossil, and shown in the drawing. This arrangement is precisely that of *Sussea conoidea*, Gaud. The drupes are rhomboidal at the base, spreading out laterally towards the apex, where their form is a broad compressed rhomb two or three times longer than it is broad. The cell containing the seed is near the base of the fruit, leaving only a short pedicle or being really sessile, as in the recent species with single-seeded drupes. Each drupe contains a single seed; and although the whole structure is replaced by calcite, yet the details are so beautifully shown that the connection of the seed by an internal unilateral placenta adnate to the whole length of the cell is in many cases obvious. The seed is ovoid and compressed and the cicatrix at its base, by which it was attached to the placenta, can be detected." A comparison of the fossil with *Sussea conoidea*, Gaud., places it beyond doubt, in the author's opinion, "that it is a true Pandanaceous fruit." Another less perfectly preserved species is in the Woodwardian Museum from the Potton Sands of Cambridgeshire, and figured by Lindley and Hutton, but it is certainly a derived fossil, and of Jurassic age. Another is recorded from the Upper Greensand of Wiltshire. It was originally figured

¹ GEOL. MAG. Vol. V. April, 1868, Pl. IX. pp. 153-156.

² See note *ante*. I was not in the least aware of Saporta's conclusion when this was written.

³ The mode of preservation is important, and is stated to be as follows:—"The matrix in which it is preserved is an amorphous cream-coloured limestone, which has abounded in Molluscan remains, but the shells have been removed, and the spaces they occupied, as well as the other larger cavities in the rock, are lined with or entirely filled up by crystallized calcite. The fruit also is only a cast, in the same material, of the cavity which originally contained it. The fine white mud had insinuated itself into every crack and opening of the fruit, and filled the decayed interior of the upper portion of the drupes. The walls of the seed cavity and the seeds themselves, as well as the outer membrane of the drupes, resisted decay until the matrix was somewhat compacted. These hard portions at length decayed, but the insoluble carbon remained as a black amorphous substance, giving an external coloured coating to the crystallized carbonate of lime, which in the end filled the cavity, preserving in the most perfect manner the form of the fruit, and even some of the minute details as to the relation of the different parts." GEOL. MAG. *l.c.*

by Lindley and Hutton as *Strobilites Bucklandi*, in their Fossil Flora, vol. ii. pl. 129, published in 1833-35, from a drawing by Miss E. Benett, made for Dr. Buckland, without the least clue as to age or locality in the descriptive letterpress. In Miss Benett's "Catalogue of the Organic Remains of Wiltshire," published in 1831, the only fossil referred to, which could possibly be the *Strobilites* in question, is a *Cycadeoidea*? from the Portland Beds, under the heading "Woods," p. 9. In the first edition of Morris's Catalogue, 1843, it is put down as from "Gr. S. Wilts," which cannot mean either Lower or Upper Greensand, the abbreviations for which are "L. G. S.," and "U. G. S." but which looks like a misprint for "Gr. O.," the sign for Great Oolite. In the second edition Morris, 1854, it appears as from "U. G. S. Wiltshire." The question is whether in correcting the printer's error of the first edition, due care to ascertain the facts *de novo* was used. The circumstances are such as to leave the age of the fossil in considerable doubt.

Part of a similar fruit is also described by Heer from the Cretaceous of Patoot in Greenland.

A not dissimilar but still smaller fruit has been found in the Coraline Oolite and the Kimmeridge Clay in France. These, named *Goniolina*, are small ovoid, aggregated fruits, like those of *Pandanus*, borne on a naked, cylindrical and relatively slender petiole. The heads of the very numerous fruits are arranged in spirals and regular, closely pressed together and barely a millimetre across. They are of hexagonal shape, and six keels extend from the angles and meet in a raised point in the centre. The interior axis is cylindrical, and impressed with scars made by the bases of the fruits, completing its likeness to *Pandanus*.

Goniolina. Fruiting organ. From the Jurassic, in the Paris Museum. After Saporta and Marion.

The *Aroïdes Stutterdi*, from the Great Oolite,¹ must, it appears on the other hand, be expunged from the list of fossil plants, for Dr. Woodward has well-nigh conclusive evidence proving that this calcareous organism is part of an Echinoderm, *Apiocrinus* (*Milleriocrinus*) *Prattii*. *Poteriocrinus* and *Platyocrinus* are furnished with

¹ See paper by W. Carruthers, F.R.S., GEOL. MAG. 1867, Vol. IV.

singular prolongations emerging from the calyx, known as the "proboscis" (really the efferent orifice), which exactly resemble externally the spadices of large Aroideous flowers.¹ Though the calyx and "proboscis" have not been found united in this particular species, the fact that the supposed spadix is calcareous, and is far from uncommon in a purely marine formation, renders it in the highest degree improbable that it could be any portion of the flower of an Aroid such as *Xanthosoma*. These singular crinoid probosces were however not known when the determination was made. It is a remarkable fact, that up to the present, there are no fossil representatives of the *Aroideæ* described, save a single fragment from the Tertiary of Eriz, in Switzerland, named *Aronites dubius* by Heer, a determination thought by Schimper to be doubtful. Our Eocene Flora, however, contains several important representatives of the group.

Several quite distinct types of Monocotyledons have been recorded from the Lias, the principal of these being *Bambusium liasinum*, Heer,² a leaf very similar to those mentioned as *Yuccites* without mid-rib and with two to four fine veins alternating with every more decided one. Stems supposed to have been solid and cylindrical and jointed are said to have been found associated with the leaves. Some other fragments described as *Cyperites protogæus*, Heer, supposed to be a species of *Cyperaceæ*, and *Zosterites tenuistriatus*, Heer, possess no characters whatever on which any opinion should have been expressed, and must certainly be expunged. The stems of *Endogenites erosa*, so common in the Wealden and Neocomian, are now known to be Cycadeous, and it is probable that the *Dracena*-like stems from Tilgate Forest and elsewhere, so often referred to by Mantell, are referable to the same group. There are also many Jurassic-Cretaceous fruits which may quite conceivably prove to be angiospermous, and which deserve careful study.

The remarkably fine stem I have figured is in the possession of Prof. Williamson, who states that it is the *Calamites Beanii* of Bunbury.³ Sir Charles, however, remarks on the tumid articulations, "the stem being much thicker in those parts than in the intermediate spaces," so that he must have had specimens of *Equisetum columnare*, which occur abundantly in the same beds, in his mind. In speaking of it Prof. Williamson observes that "so far as external appearances are concerned, it more closely resembles the stem of one of the arborescent *Gramineæ*. But such appearances have very little Taxonomic value. Nevertheless, the plant stands out in prominent distinctness from amongst the Ferns, Cycads, and Conifers that grew around it, forcibly suggesting the idea of an arborescent Monocotyledon; and if such has been its character, its position amongst these older Oolites would make

¹ Although this conclusion seems highly probable, it must be borne in mind that at present we know of no Secondary stalked crinoid with a "proboscis" like *Poterioerinnus* or *Platyrrhinus*. All the forms with this appendage being of Palæozoic age.—H. W.

² Heer, *Flora Helvetiæ*, p. 138, pl. 55.

³ Quart. Journ. Geol. Soc. vol. vii. p. 189, *C. giganteus*, Bean MS.

it, if not the earliest, one of the earliest representatives of the Monocolytedonous group."¹ The stem is somewhat compressed, and the piece preserved is evidently from near the base, the three joints of which it is composed diminishing rapidly, the first measuring 2 inches, the second $1\frac{3}{4}$, the third $1\frac{1}{2}$ inches in height. The diameter of the middle joint is about 5 inches, but its crushed condition has no doubt considerably added to the width, which was probably nearer $3\frac{1}{2}$ inches before compression. The exterior has a smooth and silky look, with fine longitudinal veins. The nodes are depressed, about $\frac{1}{8}$ of an inch wide, and bordered by slight collars or thickenings. The stem seems to have been hollow, though it may perhaps have been solid like the sugar-cane; it has an altogether different texture to that of *Calamites* or *Equisetum*. There are unfortunately no other organs in these beds which can be even tentatively united with it.

Supposed Monocolytedonous stem from the Jurassic of Yorkshire.

[Owing to the unfortunate loss of the wood engraving in transit by rail, the figure of Prof. Williamson's specimen had at the last moment to be omitted, but will be inserted in the June Number.—
EDIT. GEOL. MAG.]

The specimen figured, Plate V. Fig. 1, *a* and *b*, is now in the Woodwardian Museum, and is also stated to have come from the Yorkshire Oolites. As in all fossil vegetables from these deposits, there is no internal structure preserved, and we are therefore only able to deal with the exterior. This appears to represent on one side a rosy ligneous stem, slightly twisted, and with a half-lunar section. On the other side is a thick, closely adherent spathe, rather smoother than the stem, but furrowed, very thick and leathery, acutely pointed at the top, and narrowed and amplexicaul at the base. The spathe or pod is 9 inches long, $2\frac{1}{2}$ broad, and $1\frac{1}{2}$ inches deep in its greatest diameter. There is a slight swelling near the base, with two or three projections, as if there were ovules under the spathe, then a contraction, and then the main swelling with apparent traces of more ovules under it, especially towards the apex. The seeds or fruits would appear to be oval and about half an inch in length. At the base, where the spathe joins the stem, its substance is seen to be $\frac{1}{8}$ th of an inch in thickness, and it is an inch across; the stem itself being $1\frac{1}{4}$ inches wide, rather compressed and squarish. It increases upward with the spathe, becoming more crescentic in section, and again diminishes as the spathe commences to taper to a point. Though the transverse section reveals no structure, it shows clearly the demarcation between spathe and fruit and the stem.

It forcibly reminds us of some palm spathes and fruits, and if it should prove to be merely concretionary, it would certainly be a case of most extraordinary mimicry. Such a view seems however, quite out of the question, and we cannot help regarding it as a mono-

¹ On some Anomalous Oolitic and Palæozoic Forms of Vegetation, Royal Institution, Feb. 16, 1883.

cotyledonous fruit of some kind, and greatly regret that its precise locality and horizon cannot be fixed with greater precision.

The supposed *Najadita*, on the other hand, is quite certainly no Angiosperm, but a Cryptogam.

These remains, which must obviously have belonged to a fresh-water plant, occur in some profusion in the fissile limestone at the base of the Lias or top of the Rhætics in the neighbourhood of Bristol.¹ The precise beds are called by the Rev. Mr. Brodie "Estheria beds," from the quantity of *Estheria Brodieana*, var. (T. R. Jones), which they contain, while the valves of a species of *Cyclas* are also very abundant with them.² The plant remains were determined by Prof. Buckman to belong to the Monocotyledons, and named by him *Najadita* on account of the relationship which he believed they bore to the family of *Najas* or Pond-weeds, and were described and figured in the Quarterly Journal of the Geological Society, 1850, vol. vi. p. 415. The supposed early appearance of this group of Monocotyledons has excited considerable interest, and has frequently been quoted and referred to in works on palæontology and botany. Wishing to re-examine them, I communicated with the Rev. P. B. Brodie, in whose cabinet many of the original specimens are preserved, with the result that a number of them were placed at my disposal.

My first examination convinced me that far from being Monocotyledons, they were cellular Cryptogams of some kind, the supposed rectangular venation being nothing more than the cell walls of the tissue forming the leaf-blades. I next took them to Manchester, where Prof. Williamson kindly looked at them, and without a moment's hesitation pronounced them to be the remains of cellular plants. Since then Mr. Carruthers has examined them, when Mr. Ridley, who has charge of the Monocotyledons, and Mr. Murray, in whose care the Cryptogamic section of the British Museum Herbarium is placed, were also invited to express their opinions, the result being that all these botanists agreed in regarding them as Cryptogams resembling *Fontinalis* in habit. They in fact bear the strongest possible resemblance to these fresh-water mosses, and without wishing to place them definitely in the genus *Fontinalis*, it does appear to me to be useless to seek further among existing plants for their affinities. This group of fresh-water mosses has not previously been included in any fossil flora, and it would indicate a temperate climate, thus corroborating the evidence of the insects associated with it, and that the water was limpid, with a feeble current. I am most pleased to be able to state that Mr. Brodie quite concurs in the transfer of his specimens to the aquatic mosses.³

The *Lilia*, *Bensonia*, and other supposed Monocotyledons and

¹ Q.J.G.S. vol. vi. p. 415, 1850.

² Mr. Brodie informs me that he regards them as a junction bed between the two formations.

³ Mr. Brodie has since sent me a capsule from these beds, which appears to belong to the same moss.

Dicotyledons of Buckman¹ seem to be either Cycadaceous or too indistinct to be determinable, and no importance whatever can be attached to their supposed Angiospermous affinities.

Among many specimens lent me by Mr. Brodie, however, is one undoubtedly Monocotyledonous fragment from the Purbeck of Swindon (Plate V. Fig. 2), three millimètres wide, with nine parallel equal longitudinal veins. It has a rush or grass-like appearance, but may possibly belong to an aquatic plant.

The records of some of the supposed early Angiosperms may have escaped me, but some have purposely not been included in this notice, because they are not deserving of mention.

No new types come in during the Lower Cretaceous, and our knowledge of the Angiosperms of this period remains in a most imperfect state. There are still jointed stems and occasional fragments of sword-like leaves, and the important *Dracana*-like *Eolirion*, of Schenk. I have found rolled pellets of palm-like wood in the Gault at Folkestone, and, as already stated, an organism in the Grey Chalk which Saporta pronounced to be a *Williamsonia*. The most remarkable thing is that not the smallest trace of an Angiosperm has been found in the Wealden deposits, though these appear to have been pre-eminently likely to have preserved such, had they existed. A host of Dicotyledons as well as many of the principal families of Monocotyledons, come in with the Upper Cretaceous, but the relative ages of the beds in which they occur are by no means satisfactorily determined, and, as Floras, they are rather to be grouped with those of the Tertiaries than those of the Wealden, Neocomian and Gault.

The mystery in which the early development of Angiosperms is still shrouded is the more inexplicable, since the presence of a flower-sucking moth in the Solenhofen beds is a well-ascertained fact. From a remark made by Prof. Marsh, at Aberdeen, there is some hope that welcome revelations regarding American Jurassic Angiosperms may reach us ere long. In the meantime I refrain from encumbering this communication with any of the obvious speculations that have occurred to me, and probably to others, as possible explanations of their extreme rarity in præ-Cretaceous deposits. The evidence tends to show that Monocotyledons (?) of some sort existed as far back as the Trias, possessing leaves of the most primitive type, such as we now meet with in *Yucca*, *Dracana*, etc., and that during the Jurassics decided Monocotyledons, which can be placed in the *Pandanaceæ*, and others with jointed stems like *Gramineæ*, flourished side by side with more problematical plants such as *Williamsonia*. Little more than this can yet be said, though Saporta and Marion bring forward an array of arguments and inferences wherewith to build up a family tree,² which if not quite carrying conviction, are certainly highly suggestive, and deserve the most careful consideration.

¹ Murchison and Buckman, *Outline of the Geology of Cheltenham*, 1845.

² *Evolution des Phanérogames*, Saporta and Marion.