A history of the fossil fruits and seeds of the London clay

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A

HISTORY

OF

THE FOSSIL FRUITS AND SEEDS

OF THE

LONDON CLAY:

BY

JAMES SCOTT BOWERBANK, F.G.S., &c.

ILLUSTRATED BY NUMEROUS ENGRAVINGS ON COPPER.

LONDON:
JOHN VAN VOORST, 1, PATERNOSTER ROW;
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1840.

INTRODUCTION.

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MR. EDITOR, I HAVE been so frequently applied to by geologists, as to the best mode of procuring the fossils of the London clay from the Isle of Sheppey, that I am induced to send you a few hints as to the mode of collecting in that locality. Although one of the most accessible, it is probably the least known of any of the rich geological fields that are within a short distance of the metropolis. As a trip to this interesting spot can be accomplished by an absence from London of only three days, and yet the collector be amply laden with fossils on his return, I will endeavour to put your readers in possession of the best mode of conducting such an excursion. The best conveyance is by the Southend and Sheerness steam-packets, which leave London Bridge on Tuesdays, Thursdays, and Saturdays, at 11 o'clock in the morning, and reach Sheerness about 4 or 5 o'cloek in the afternoon. The town is divided into two parts,—the one contained within the limits of the garrison being designated the Blue-town, while that beyond the fortifications to the north-east is designated the Mile-town ;—and it is to this portion that I should recommend the visitor to proceed, and to take up his quarters either at the Royal Hotel, or at the Wellington : the latter is an exceedingly snug and comfortable house, and is the one which I have resorted to for many years. After having established yourself in your inn, request the Boots to desire the attendance of Mr. Hays, (better known perhaps by the name of Paddy Hays), from whom you may purchase, at a very reasonable rate, some good fossils, such as crabs, lobsters, heads and portions of fishes, and numerous species of fossil fruits. Our traveller will then have accomplished all that can be done towards the acquisition of fossils until the following morning ; there not being, I believe, any other collector in the town from whom purchases can be made.

On the following morning I should recommend an early breakfast, as a considerable extent of ground is to be traversed. It is advisable to go provided with five or six sheets of soft paper, to wrap fragile specimens in, and a few cotton or linen bags, of about four or five inches in diameter, to separate the large from the small fossils ; the whole to be carried in a good sized blue bag or haversack, no chisel or hammer being necessary on this occasion. If our geologist has a desire to view the great section of the London clay, afforded by the cliffs of the north shore of Sheppey, and is content with comparatively the few fossils which he may be able to procure by his own exertions, he may proceed in the following manner.—Leaving Sheerness by the new town, he will pass along the sea wall, towards Minster, until he reaches Scapsgate, where the cliffs begin to rise from the low lands of the western end of Sheppey. A few cottages are scattered round this point, some of the inhabitants of which work upon the beach, either collecting cement stone or *pyrites*, the latter being better known by the name of copperas. To these, application should be

made to know if they have any "curiosities," and very frequently excellent specimens, and at a small price, will be thus procured. From this point the route will then be beneath the cliffs upon the shingle, amidst which, dark patches, ten or fifteen yards in length, will be observed, composed of nodules of *pyrites*, intermixed with pyritized fragments of branches of trees, in great abundance. It is at such spots that the numerous and beautiful specimens of fossil fruits are found; but, to ensure success, the collector must be content to go upon his knees, and carefully search among the fragments. The whole of the beach, from about the parallel of Minster Church, Warden Point, abound with these patches of *pyrites*, and I have by this means obtained in the course of a morning, upwards of one hundred fine fruits of various sizes. Care must be taken in such an investigation of the coast that it be undertaken during the falling of the tide. or unpleasant consequences may arise from being shut in between the shoots of mud which are projected into the sea at many points of the coast.

If the principal object be the attainment of the greatest quantity of fossil organic remains, a different course should be pursued. The collector should then, after having made his purchases at Scapsgate, direct his steps towards Minster church, passing which, he will proceed on the road towards Warden. About three quarters of a mile beyond the church, he will find a lane on his left hand, leaving towards the Royal Oak, in which lives a woman named Mummery, and several others, who work upon the beach, and from whom fossils are frequently to be procured. These people will direct the traveller to the cottage of a family named Crockford, where there is usually a good assortment of fossils, and will direct our fossil-hunter to many other parties who also work upon the beach, and who reside between this point and Hensbrook, to which our traveller must now direct his steps. At Hensbrook enquiry should be made for a man named Pead, who has usually a considerable number of good specimens in his possession. From this point, Hensbrook, the collector must proceed along the top of the cliff towards Warden, calling at the various cottages in his way, until he arrives at Warden Point, at which place he must enquire for Mud Row, many of the inhabitants of which work upon the beach, and from whom a considerable addition to the specimens already collected may be purchased. Beyond this point, nothing will be obtained, and the best way to return to Sheerness is by the road which runs through the most level portion of the country; the path along the north cliff undulates considerably more than the road.

The course of proceeding thus sketched applies to the supposition that the time is limited to three days, but if a greater extent of time can be spared, I should recommend the tourist not to leave Sheerness without viewing the dockyard; and the return to London may be made by the way of Chatham and Gravesend, affording the gratification of a view of the dock-yard and lines at Chatham, and of the fine old cathedral and castle at Rochester; and, at the same time, enabling him to arrive in London on the evening of the same day that he quits Sheerness.

I remain, Mr. Editor,
Yours, &c., &c.,

J. S. BOWERBANK.

19, *Critchell's Place, Hoxton,*
March 24th, 1840.

NIPADITES.

(Pl. 1 to 6).

Pandanocarpum, Ad. Brongniart, Prodr. p. 135.

Drupes fibrous, angular, one-seeded.*

The Fruits of which this group is composed, are found in considerable abundance on the beach at Sheppy, forming a portion of the organic remains impregnated with *pyrites*, so plentifully discovered there. They are known among the women and children, by whom they are usually collected, by the name of Figs. The epicarp and endocarp are thin and membranous; the sarcocarp is thick and pulpy, composed of cellular tissue, through which run numerous bundles of vessels. The cells are about the eight hundredth part of an inch in diameter. Nearly in the centre of the pericarp is situated a single large seed (see plate 1, figs. 8 and 10 *a*; plate 3, fig. 7 *a*; and plate 4, fig. 2 *a*). This, when broken, is usually found to be more or less hollow. It is frequently not more than half a line in thickness, as in plate 1, fig. 10 *a*; but in the more perfect specimens, as in plate 1, fig. 8 *a*, which represents a longitudinal section of the fruit, it generally presents the appearance of a close, granulated structure, in which small apertures, containing carbonaceous matter, occasionally occur. These apertures possess much uniformity, both in size and shape, and are of about the same dimensions as the cells of the sarcocarp. This seed in one species—*Nipadites Parkinsonis*,—when in the most perfect state of preservation, was found to consist of regular layers of cells,

* Thunberg, in his 'Nova Genera Plantarum,' p. 90, in describing the generic characters of *Nipa*, says,—"Pericarp,—Drupæ plurimæ, aggregatæ in capitulum magnitudine capitis, angulatæ, angulis inæqualibus, acutis vel obtusis, infernè attenuatæ, supernè obtusatæ, glabræ, magnitudine nucis castaneæ."

radiating from a spot situated near the middle of the seed, and apparently enclosing a central embryo.

Brongniart, in his 'Prodrome d'une Histoire des Végétaux Fossiles,' mentions one of the fossils of this group, which appears to be *Nipadites umbonatus*. At page 135 he says,—"The third fruit of which I wish to speak here, is very common in the Isle of Sheppy. It is pretty large, long, of a form more or less swelled in the middle; has four, five, or six irregular surfaces, which appear to have been produced by the compression of other neighbouring fruits. Its base is large, and always appears torn; no indication of the insertion of a calyx is visible on its surface. The summit is conical. In general the form and the dimensions of this fossil vary very much; which may be equally observed in fruits which grow close to each other in great numbers, as those of *Sparganium* for example. This fruit has the greatest analogy with the fruits of *Pandanus*, and we scarcely doubt that they belong either to that genus, or to a plant very nearly allied to it. Some broken specimens of these fruits even show in their interior a single central nut, as may be observed in *Sparganium* and in *Pandanus*. Only, when several ovaries are not cemented together, this nut or seed appears much larger in proportion to the pericarp than in the generality of the plants of that family."*

In consequence of the suggestions contained in this passage, I carefully examined longitudinal and transverse sections of the

*"Le troisiéme fruit dont je veux parler ici, est très commun à l'ile de Sheppey: il est assez gros, alongé, d'une forme plus ou moins renflée dans son milieu, a quatre, cinque ou six faces irreguliéres, qui paroissent produites par la compression d'autres fruits voisins; sa base est large, et paroît toujours déchirée: on ne voit sur la surface aucun indice d'insertion de calice; son sommet est conique. En général la forme et les dimensions de ce fossile varient beaucoup, ce qu'on observe également dans les fruits, qui croissent rapprochés en grand nombre, comme ceux des *Sparganium*, par example. Ce fruit a la plus grande analogie avec les fruits des *Pandanus*, et nous ne doutons presque pas qu'il n'appartienne à ce genre, ou à une plante très voisine. Quelques echantillons cassés montrent meme dans l'intérieur de ces fruits un noyeau central unique, comme on l'observe dans les *Sparganium* et dans les *Pandanus*, lorsque plusieurs ovaires ne sont pas soudés ensemble; seulement ce noyeau ou cette graine paroit plus grosse, proportionellement au pericarp, que dans la plupart des plantes de cette famille."—Prodrome d'une Histoire des Végétaux Fossiles, par M. Adolphe Brongniart. Paris: 1828. Page 135.

fruits of a *Pandanus*, with a power of 120 linear; and the accordance in the form and arrangement of the cells, and in the disposal of the bundles of vessels, with the microscopic appearance of the structure of these fossils, was so exact as to convince me fully that the views entertained by M. Brongniart, as to these fruits being closely allied to *Pandanus*, were perfectly correct.

But although in the respects just mentioned they agree very nearly in structure with *Pandanus*, there are points in which they differ materially. Thus, in the fossil *Nipad. Parkinsonis*, the nut (plate 4, fig. 1, and fig. 2 *a*) is easily to be separated, and at all times readily to be distinguished, from the surrounding pericarp; while in the recent fruit compared with it, which I believe to be *Pandanus humilis*, there was no nut or seed that could be distinguished from the general mass of the pericarp. The recent fruits of *Pandanus* examined were likewise each furnished with two embryos; and the remaining unbroken specimens indicated the possession of the same number, by having their apices formed of two distinct small umbones.

In the fruits of several other species of *Pandanus* in the collection of the British Museum, the number of embryos thus cemented together into apparently one fruit, considerably exceeded this number, being in some cases as many as seven or eight; and in one of these aggregate fruits of which a transverse section had been made, I observed that the seeds had each been distinct and readily separable from the pericarp, as the cells in which they had been enclosed alone remained.

One very fine fruit of a species of *Pandanus* in the possession of my friend Mr. Ward, which is nearly four inches in length and two inches and a half mean diameter, approaches very nearly in external form to the fossil *Nipadites Parkinsonis* (plate 4), excepting that instead of being terminated somewhat acutely, like the fossil alluded to, it is depressed at the apex, and has eleven umbones, which are nearly equidistant from each other. Upon making a transverse section of this fruit at about its middle, eleven embryos were seen, arranged exactly in the manner indicated by the umbones at the apex of the fruit, and passing nearly in

straight lines from that point towards its base. The cells containing the embryos were about the eighth of an inch in diameter.

Unlike some of the species of *Pandanus*, in which the embryos appear to have been separate from each other at an early stage of their growth, but to have run into a state of aggregation at a subsequent period, in this fruit they appear to have always been united, as the mass by which they are surrounded is uniformly dense and bony to within about a quarter of an inch of its external surface, where it suddenly becomes loose and fibrous in its texture, the whole being surrounded by a six-angled epicarp. The spaces between the angles are uniform and even, and in no part indicate, by the slightest depression or projection of any portion of their surfaces, the existence of the numerous embryos within the pericarp.

In the fossil species, on the contrary, I have not hitherto seen an instance of a fruit containing more than one seed, nor of anything approaching to, or in the remotest degree indicating, an aggregation of several embryos into a mass, such as we find occur so frequently in the recent *Pandanus*. Nor do we, among the whole of the fossil species, observe any of those appearances of compression near the base of the fruit, which is so characteristic in all the well known species of recent *Pandanus* that I have examined.

But of all the fruits that I have yet seen, there are none which approach so nearly to the fossil *Nipadites* as one of which my friend Mr. Ward has lately received two specimens from Captain Roberts, of the ship Indemnity, who met with them floating in the sea off the island of Java, at the mouth of a small river. These fruits my friend Mr. G. Loddiges recognized as the seed-vessels of *Nipa fruticans*. The largest of the two is four inches and a half long, four and a quarter wide, and two and a half inches in thickness. The widest part of the fruit is at about one third of its length from the apex, so that it has somewhat of a cordate form. It has three very strongly produced angles, two of which are situated at one edge of the fruit and one at the other, with several smaller angles interspersed between them. In their dis-

position and general character, they very nearly resemble the corresponding parts in several species of our fossil *Nipadites*, especially *Nipad. umbonatus*. The apex is furnished with a single prominent umbo, nearly four lines in height, very like that of the fruit figured in plate 1, fig. 7; and the vascular and cellular structures agree, both in form and arrangement, with those of the same fruit. The epicarp is thin and smooth, and furnished near the apex of the fruit with numerous punctæ, strongly resembling, both in form and extent, those occurring near the apex of the fruit figured in plate 4, fig. 3.

Upon making a longitudinal section of this fruit, it was found to contain a single seed, situated nearly in the centre of the pericarp, and very closely resembling, in structure, colour, and appearance, that of the cocoa-nut, being furnished with a large cavity in the middle of the albuminous mass, the interior surface of which presented every appearance of having been formerly filled with fluid. The cell in which the seed is contained, is formed of indurated cellular and vascular structure, upon which the thumb-nail could scarcely make an impression, but it does not appear to be a distinct bony endocarpium, like that of *Cocos*. At the base of the fruit this indurated shell or case was reflected inwards and upwards, towards the base of the seed, and gradually became narrower as it approached it, so as to form a funnel-shaped aperture, through which, in consequence of the partial germination of the seed, the plumule was projected for nearly two and a half inches in length.

The base of the pericarp has undergone a partial decomposition, so that numerous bundles of vessels project for about an inch beyond the remaining cellular tissue of its posterior portion.

My friend Mr. G. Loddiges has also two specimens of these fruits in his collection, which are somewhat smaller, but in every other respect very closely resemble, in external appearance, those in the cabinet of my friend Mr. Ward. Upon making a section of the largest of these, it exhibited appearances similar to those described as occurring in Mr. Ward's specimen; but germination having proceeded in the latter fruit to a greater extent than

in the former one, the nucleus had assumed the form of a light spongeous mass. The indurated interior surface of the pericarp was also, in a slight degree, harder than it was in the fruit first examined. Three other specimens, which came from Ceylon, are in the collection of the British Museum; their form, size, and other external characters, agree with those of the fruits before described. They do not appear to have germinated; and their bases, although they have suffered in a slight degree from decomposition, are in a more perfect state of preservation than those of any of the other specimens, presenting, instead of a regular point of attachment, that irregular truncated appearance of this part, which seems to be common to all the species of our fossil genus, as well as to the fruits of the recent genus *Nipa*. Rumphius figures this plant (the *Nipa*) in the 'Herbarium Amboinense,' vol. i. tab. 16; but it is not so satisfactorily exhibited as in a beautiful drawing by an Indian artist, which is in the possession of Mr. G. Loddiges, in which these fruits are represented as growing together in a terminal globular head, very similar to the mode assumed by the fruits of several species of *Pandanus*: but from the absence of every indication of close compression, as well as from the prominent angles and flowing outlines of all the parts of the external surface of these fruits, I am induced to believe that they are not by any means so densely packed together as those of any of the species of *Pandanus* that I have yet seen.

But, on the other hand, in the predisposition to solution of the base, as well as in the structure and mode of arrangement of its vascular and cellular tissues, this fruit closely resembles *Pandanus*, in many species of which this premature decomposition of the base of the pericarp is frequently to be observed.—The general aspect of the plant is that of a palm; but as it is not our object to discuss the relative degrees of alliance existing between *Nipa* and the natural orders *Palmeæ* and *Pandaneæ*, more than is necessary to establish the connections existing between our fossils and their recent analogues, I shall beg to refer my reader for further information on this subject to Thunberg's

'Nova Genera Plantarum,' page 90, and to Rumphius' 'Herbarium Amboinense,' vol. i. page 72, tab. 16. In the latter work it is described as occurring "rarely in Amboyna, but frequently in Ternate, and the other Molucca islands, and also in the Phillippines, where the rivers are larger. Also in Celebes, especially in the Gulph of Bogi, and in the district of Loebo. It is also found abundantly in Boero, in the Gulph of Kayely. That from the banks of the great rivers in Woabbo, &c., agrees so closely with the sago, that it is used instead of it. It also occurs on the shores of North Ceramæ. It thrives in watery and marshy places, where the soil is black clay, and which are frequently covered with water. Hence it is observed at the mouths of all the great and rapid rivers, and also in such places as are overflowed by the sea or by brackish water; for this tree grows best in soil impregnated with salt. Thus it is found of the largest size near the great rivers of Aracan, Pegu, and Malacca, and throughout all the Golden Chersonesus. These fruits are often carried by the sea from Boero, and thrown on shore in distant places, and thus are propagated where they find suitable soil.—Hence these trees also grow in the Gulph of Amboyna, also on the shores of Hitae, near Larique and Mamalo. Its height, however, is so trifling that it does not merit the name of a tree."*

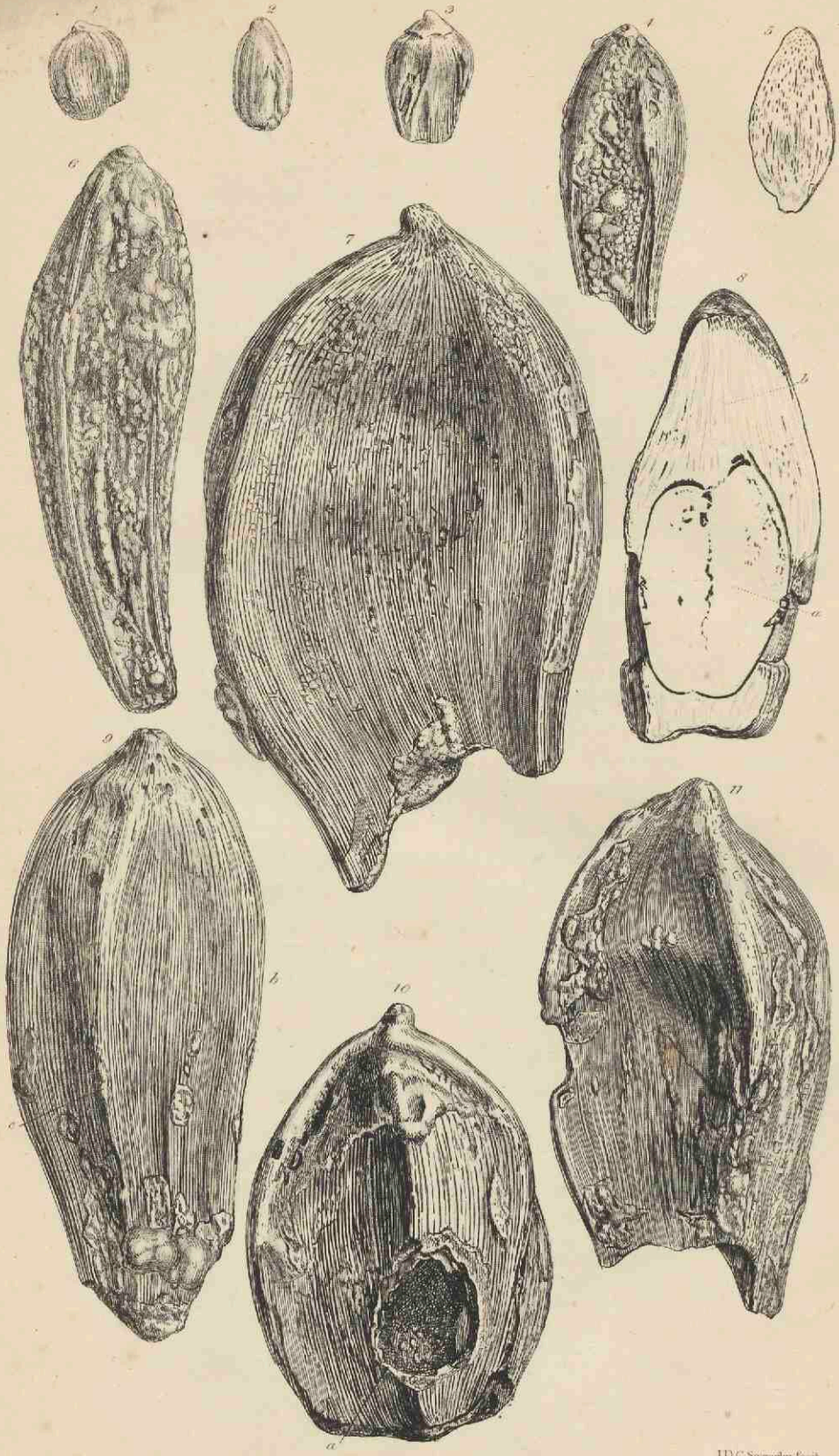
If the habits of the plants which produced our fossil fruits were similar to those of the recent *Nipa* thus described by Thun-

* *Nipa*, 'Herbarium Amboinense,' page 71.—"Rarò in Amboinâ occurrit hæc arbor frequentèr vero in Ternatâ, uti et in aliis Moluccæ insulis et Phillipcis quoque, ubi majora sunt flumina. Itèm in Celebe, præsertìm in Sinu Bogico et in Loebo regione. Multùm quoque invenitur in Boero in Sinu Kayely, ab utraque fluminis majoris Woabbo ripa, &c., tali modo cum sagu convenit, ut pro ea haberetur, in Boreali Ceramæ orâ quoque occurrit, aquosa et paludosa amat loca, ubi argilla est nigra, et quæ sæpè aquâ inundatur, uti ad oras omnium majorum et declivium fluminum observatur, uti et iis in locis, in quibus aqua marina seu salina superfluit, hæc enim arbor in salso crescere amat solo, unde et optimè viget ad majora flumina, Aracanæ, Pegu, Malaccæ, et in toto Chersoneso aureo, a Boero sæpè etiam fructus trans mare advehuntur, et appellunt, sicque propagantur ubi sese sedunt, aptumque inveniunt solum, ita ut hæ quoque arbores intra Sinum crescunt Amboinicum, item in ora Hitae, propè Larique et Mamalo, tam alte autem hic non excrescit, ut arboris nomen mereatur."

berg, and it is highly probable that such was the case, it will account for their amazing abundance in the London clay; which formation, from the numerous species of crabs, the fresh-water turtles, and the great variety of fossilized small stems and branches, mixed up with *Asteria*, *Mollusca*, and *Conchifera* of numerous marine and fresh-water genera, is strikingly stamped as having been the delta of an immense river, which probably flowed from near the Equator towards the spot where these interesting remains are now so abundantly deposited.

The resemblance existing between the whole of the species of *Nipadites*, both as regards their external form and their internal structure, with those of *Nipa*, is so close as to leave scarcely a doubt of their being members of the same genus, the only difference being that the recent fruit has the interior surface of the pericarp somewhat in a state of induration, which is not perceptible in that of any of the fossil species, although it may have been so to a considerable extent in their original state, before fossilization, without our being able, at this period, to determine such to have been the case, with any degree of certainty. And when we take into consideration the great variation in different species in the degree of thickness of the bony endocarp of the nearly-allied genus *Cocos*, we can scarcely consider this single discrepancy sufficient to remove the fossil from the recent genus. I have therefore thought it advisable to reject M. Adolphe Brongniart's name of *Pandanocarpum*, and to apply that of *Nipadites*, as more expressive of their true relation to their recent analogues.

The same author (Brongniart) in his work 'Sur la classification et la distribution des Végétaux Fossiles,' in alluding to the specimens figured in Parkinson's 'Organic Remains,' again mentions one of the fruits of this group, which, in accordance with the views entertained by that author, he refers to the genus *Cocos*: but as we shall have occasion hereafter to return to this subject in describing *Nipadites Parkinsonis*, I shall not in this place point out in what respects these fossils differ from the fruits of that genus.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NIPADITES UMBONATUS.

(Plate 1).

Pericarp five-angled, compressed, and elongated. *Apex* umbonate. *Epicarp* smooth. *Seed*, testa minutely corrugated.

This is an exceedingly abundant species, and by far the most variable in form and proportion of any which compose the group. The specimens vary in length from half an inch to four or four and a half inches. Their proportions are also very uncertain, for while the breadth of some nearly equals their length, in others it does not exceed one third or one fourth of it. In like manner their relative thickness is equally uncertain; the specimen figured in plate 1, fig. 7, is not more than two lines in thickness near the centre; while the thickness of fig. 10 in the same part is nearly ten lines.

The whole of the five angles of the pericarp are usually to be traced very readily and distinctly; but in some instances, more particularly in young or immature specimens, they are somewhat obscure. There is also no degree of certainty in their position in the fruit; for in some we find, at each edge, two of these angles very closely approximating to each other, while the fifth is situated nearly in the centre of the back, thus leaving a disproportionately large space in the front of the fruit, which space is somewhat depressed, and without any appearance of an angle, as in plate 1, fig. 7. Sometimes, as in plate 1, fig. 9, the margins *a* and *b* are each formed by a single angle, while another is situated in the centre of the front, and two at nearly equal distances from each other and from the edges of the fruit, occupy the back. Occasionally, but comparatively rarely, the angles are nearly equidistant, as in the specimen figured in plate 1, fig. 6, which is more than usually elongated, but unfortunately has its surface much obscured by a frothy incrustation of *pyrites*, which renders it rather indistinct.

The compressed form in which this fruit is usually found does not appear to have been the result of mechanical pressure, as in many cases the angle occupying nearly the centre of the flattened surface (as in plate 1, fig. 9 *c*) projects very considerably, and terminates in a sharp edge. In a specimen in my possession this is even more strikingly exemplified, for the angle occupying the same relative position as the angle *c* (plate 1 fig. 9), projects nearly three fourths of an inch from the surface of the fruit, and terminates in an edge almost as fine as that of a knife; while another angle projects on the contrary side of the fruit, but which does not rise to more than half the height of the first. It would therefore appear that this flattened state of the fruit, is due rather to a natural predisposition towards this form than to any accidental pressure; and we are the more confirmed in this opinion by not finding, in other species belonging to this group, anything like the same degree of compression.

These peculiarities in the form and position of the angles, would lead us to imagine that in this species the inflorescence had been in the form of a diffuse panicle, rather than in that of a closely packed head, like those of *Pandanus* or *Sparganium*.

The appearance of the umbo at the apex of the fruit varies much in different specimens. In figs. 7 and 10, plate 1, it is more produced than is usually the case: the most frequent form is that which occurs in figs. 6, 9, and 11, while occasionally, as in fig. 8, it is scarcely to be perceived.

The epicarp is but rarely met with in these fossils; where present it is thin and smooth, presenting occasionally a faint impression of the bundles of vessels which ran beneath it.

The cellular structure of the sarcocarp is usually found in the most perfect state of preservation, at near either the base or the apex of the fruit. The vascular bundles which traverse it in great abundance are, however, very rarely so well preserved as to be distinctly made out, although a considerable microscopic power may be used for that purpose. In some, the spaces formerly occupied by the vessels are found filled with a transparent resinous-looking matter; in others, they are charged with a black


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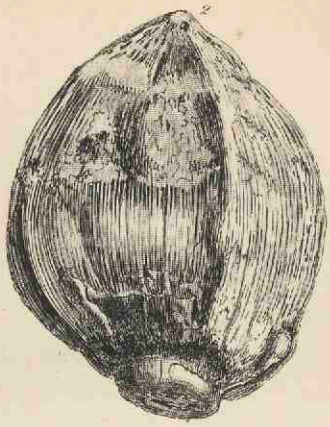
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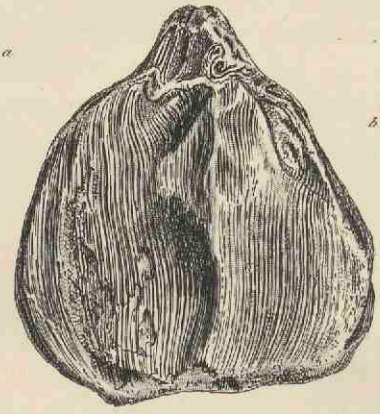
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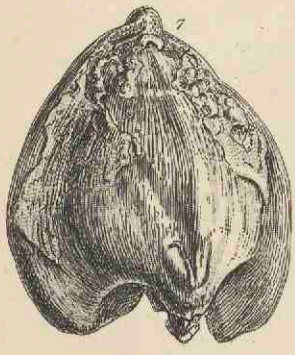
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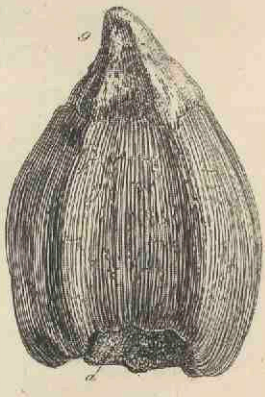
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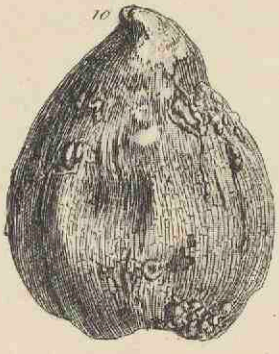
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carbonaceous powder, probably the result of the decomposition of the vessels which they formerly contained.

The testa, when in a good state of preservation, is covered with a net-work of minute corrugations, having very much the appearance of being the impression of a fine, reticulated, endocarpal tissue. The body of the seed is not often found perfectly solid. It is somewhat oval, but variable in form, and frequently has a deep furrow down the centre of one of its broadest sides, with a depression at the base and apex. Fig. 8 plate 1 represents a longitudinal section of a fine specimen of this description; *a*, the seed, *b*, the pericarp with its numerous vascular fasciculi.

Many of these fruits are found in such a state as to render it highly probable that they were abortive. Thus in the small one of which a longitudinal section is represented at fig. 5, plate 1, not even the rudiment of a seed can be perceived.

It sometimes happens that the whole of the parts of these fruits have not been converted into *pyrites*. The seed is often found composed of this material, while the pericarp is completely carbonaceous; or the entire fruit has become pyritical, excepting only the testa, which remains in the form of a fine film of carbon.

Figs. 1, 2, 3, and 4, plate 1, are young fruits exhibiting progressive stages of development.

It is probable that this species is the *Pandanocarpum oblongum* of Brongniart; but as the description which he gives of that fossil is not sufficient, without a figure, to distinguish it from some of the other species, I have thought it most advisable to reject the specific name *oblongum*, and to adopt that of *umbonatus*.

Nipadites ellipticus.

(Plate 2, figs. 1, 2, and 3).

Pericarp four- to six-angled, compressed, elliptical. *Epicarp* smooth. *Seed*, testa smooth.

This species is much more rare than the preceding one, neither is it so variable in form. I have met with only thirteen

specimens; and these, although varying in size from nine lines to two inches and two lines in length, have very much the same form. The epicarp is smooth, with faint lines indicating the course of the bundles of vessels beneath, which, with the cellular structure, much resemble the same tissues in *Nipadites umbonatus*. Of the thirteen specimens in my possession, one only has six angles, three have four angles, and the remainder have five angles. I have in one instance only been able to obtain a good view of the surface of the seed. In this it appeared to be without the minute corrugations described as existing in well-preserved specimens of *Nipad. umbonatus;* but, as in that species they are not always to be seen, either from partial decomposition of the surface, or other causes, so in this they may hereafter be found to exist in more perfect or better preserved specimens than those which have hitherto come into my possession. In fig. 1 the apex is wanting, and in fig. 3 the base. Fig. 2 is one of the most perfect I have hitherto seen, but has the apex rather more acute than usual; in another about the same size which is in my possession, the attachment at the base is rather smaller, the thickness at the centre of the fruit somewhat greater, and the termination more obtuse even than in fig. 3.

Nipadites crassus.

(Plate 2, figs. 4 and 5).

Pericarp three- or four-angled, not compressed. *Epicarp* smooth. *Seed,* testa minutely corrugated.

This species differs from the preceding ones, not only in the number of its angles, but also in its internal structure, the vascular fasciculi being considerably larger, but much less numerously dispersed through the cellular structure. Amid these large bundles, which run in the direction of the axis of the fruit, there are numerous smaller ones, interlacing them and spreading in every direction, as at *b b*, fig. 5, plate 2. Neither does this

fruit assume any appearance of compression. The average width of fig. 4 at the point *a*, is fifteen lines, and its thickness ten lines, but in several other specimens which I have become possessed of since 4 and 5 were figured, the proportions are much nearer equal. Fig. 5, from its appearance, might be imagined to be triangular; but the fourth angle, very slightly produced, is situated on the under surface. Of nine other specimens in my possession, none have attained the size of the figured ones, the smallest being only eight lines in length; and of these nine, six assume a nearly regular quadrangular figure, but one has three angles, presenting on a reduced scale much the appearance of fig. 5, and the remainder nearly resemble fig. 4 in form.

The seed which is seen at *a a*, fig. 5, through two holes in the pericarp, is slightly corrugated; but I have not met with a specimen in which I have been able to determine its form. One specimen, having every appearance of containing a seed, which I divided longitudinally, proved to be abortive.

Nipadites cordiformis.

(Plate 2, figs. 6—10).

Pericarp three- to six-angled, compressed, cordiform. *Epicarp* smooth.

Of this fruit I have thirty-nine specimens; only one of these has three angles, twelve have four angles, twenty-five have five angles, and one specimen only has six angles. Its thickness is usually in the proportion of about half its greatest width, and it is much less variable in its form than any of the preceding species. Figs. 6, 7, 8 and 9, are wholly composed of *pyrites*; fig. 10 has the sarcocarp of this material, but the epicarp is composed of carbon, which, from its contracting as it became dry, has given it the appearance of having minute striæ at right angles to the axis, but which form no part of its character.

I have not as yet been fortunate enough to get a good view of the seed of this species. At *a* in fig. 9, a small portion of it

projects from its base; and in another specimen which I have in my possession there is, towards the base of the fruit, a regular oval space, which has apparently been occupied by it: but in nine other specimens, which had every external appearance of being prolific, and which I fractured for the purpose of examination, there was not even the slightest rudiment of a seed to be perceived, the whole of the substance being composed of vascular bundles dispersed amid the usual cellular tissue.

Nipadites pruniformis.

(Plate 2, figs. 11 and 12).

Pericarp ovate, not compressed; angles three or more.

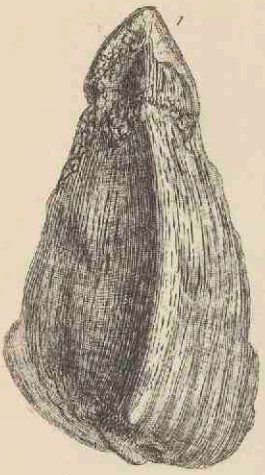
Three other specimens of this fruit have come into my possession besides the two figured; of these one is smaller and very similar in form to fig. 12, but differs from it in having between the three larger angles, several elevated ridges in the direction of the axis of the fruit: these may probably have arisen from the fruit not having been fully developed. The other two resemble fig. 11. The apex of fig. 12 is wanting, but it exhibits at the base a small portion of the seed. The three other specimens, when broken, proved entirely abortive, but exhibited throughout the whole of their substance, that arrangement of vascular and cellular structure which is so characteristic in the fruits of this group.

Nipadites acutus.

(Plate 3, figs. 1, 2, and 3).

Pericarp four- or five-angled, largest near the base, and gradually tapering towards the apex, not compressed. *Epicarp* smooth.

Of eight specimens which I have of this species, but one has five angles; the fifth angle in this case being only very slightly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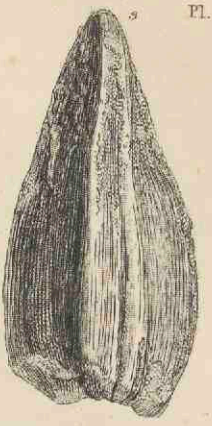
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produced. They are all nearly alike in form, being largest near the base, and gradually tapering away towards the apex. Fig. 2 would at first sight appear to be an exception to this character, but the apex in this instance has been partially depressed and thrust on one side. Of the five other specimens in my possession, two are similar to fig. 1; one to fig. 2, but more acutely terminated; and two agree in form with fig. 3. I have not seen the seed of this fruit; two specimens which I fractured in search of it proved to be abortive, but presented the appearance of having the vascular bundles much finer than in some of the other species.

Nipadites clavatus.

(Plate 3, figs. 4, 5, 6).

Pericarp four- or five-angled, not compressed, smallest at the base, thickest near the apex, which is umbonate. *Epicarp* smooth, slightly punctate near the apex.

Figures 5 and 6 agree remarkably in all their characters, each having but four angles. Fig. 4 has five angles, and the greatest enlargement of the fruit is not so near its termination as in the other two; but this latter difference may probably arise from its not having been so fully developed: and I am further confirmed in my belief that by placing it under the head of this species I have assigned it to its proper situation, from having received through the kindness of Mr. Jas. De Carle Sowerby, a fourth specimen found near Primrose Hill, in the excavation for the tunnel of the Birmingham rail-road, which closely resembles figs. 5 and 6 in all its essential characters, but which has the fifth angle very slightly produced. In figs. 5 and 6 the epicarp has not been preserved; but in the specimen presented to me by Mr. Sowerby, it remains in the state of a thin carbonaceous coat, enveloping the remainder of the fruit, which has been converted into *pyrites*. Near the apex of the fruit there are small punctæ irregularly dispersed over its surface. I have not seen

the seed of this species. Patches of extraneous *pyrites* are represented at *a* in figs. 4, 5, and 6.

Nipadites lanceolatus.

(Plate 3, figs. 7 and 8).

Pericarp three- to five-angled, compressed, lanceolate. *Epicarp* smooth. *Seed,* testa minutely corrugated.

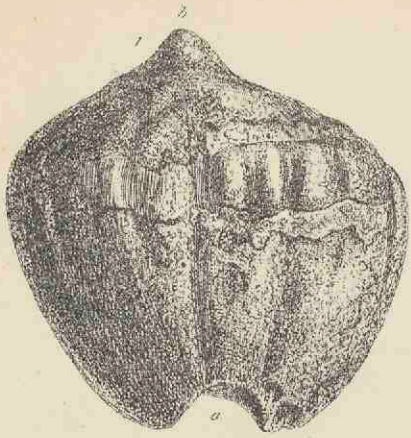
The fruits figured are the two most characteristic specimens out of six which have come into my possession; the remaining four agree both in size and form with the figured ones. Fig. 7, about the centre, is only five lines in thickness: one of the unfigured specimens is nine lines thick; the other three are nearly the same as fig. 7: the greatest thickness of fig. 8 is six lines. The epicarp is well preserved; on a portion of fig. 8 it is smooth, like that of most of the preceding species. A considerable portion of the seed is displayed at *a*, fig. 7, in consequence of the absence of a part of the pericarp. Two of the unfigured specimens display the seed, and the remaining two have also every appearance of being fruitful. With the aid of a lens of one inch focus, the seed appears thickly covered with minute corrugations. It would therefore seem that this species is not so liable to be abortive as some of the preceding ones. Extraneous patches of *pyrites*, which partially obscure the true surface of the seed, are represented at *b b*, fig. 7, and *a a a*, fig. 8.

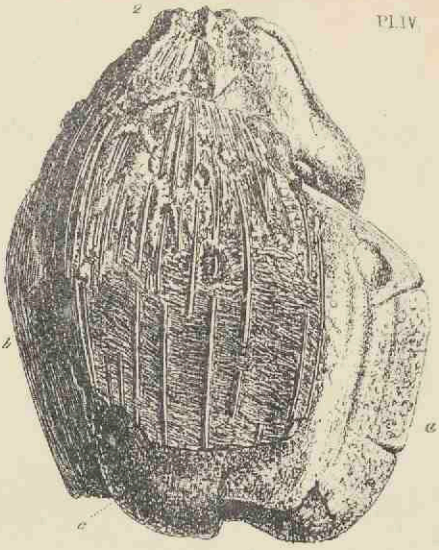
Nipadites Parkinsonis.

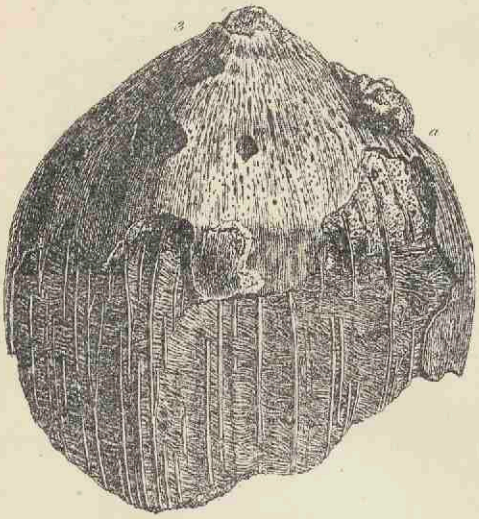
(Plate 4).

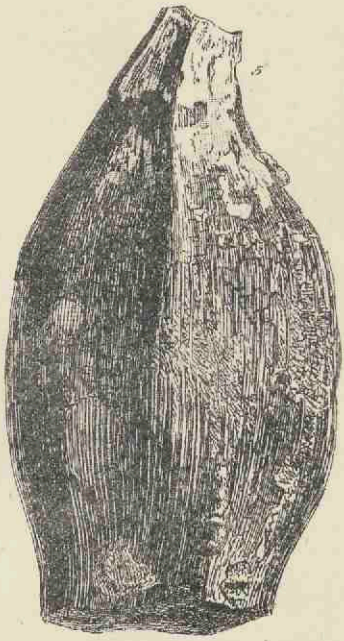
Cocos Parkinsonis, Ad. Brongniart, Prodr. p. 121.

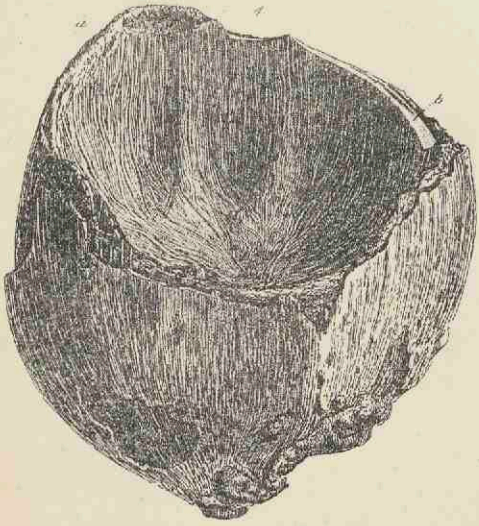
Pericarp five- or six-angled, not compressed, angles nearly equidistant.—*Epicarp* thick, minutely striated and punctate near the apex, smooth towards the centre and base. *Sarcocarp* composed of longitudinal vascular bundles, thickly

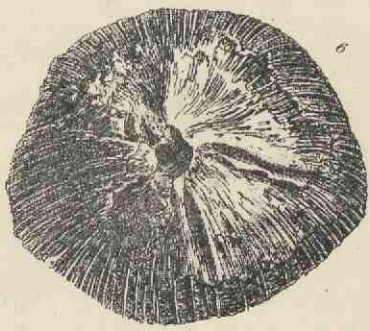












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interlaced at right angles with smaller ramifying vascular fasciculi. *Seed* somewhat pyriform, with a deep indentation at the base. *Testa* minutely corrugated.

This beautiful species, which has been named after the late Mr. Parkinson, author of the 'Organic Remains of a Former World,' is figured by him in that work, vol. i. plate 7, figs. 1—5, and described at page 457 of the same volume. He says,—"Figs. 1, 2, and 3 are representations of a specimen presented to the British Museum by the late Sir Joseph Banks." Figs. 4 and 5 in the same plate he states are "from a specimen presented to the British Museum by Mr. Douglass, by whom it is figured and described in his ingenious Essay on the Antiquity of the Earth." He likewise observes, in speaking of the first specimen, "It is totally unlike anything at present known, but perhaps may be referred to the genus *Cocos*." A careful examination of the internal structure of other fruits of this species does not warrant our coming to the same conclusion; as, besides a total absence of the bony endocarpium of *Cocos*, there is not the slightest vestige of the three indentations opposite the seat of the embryo, indicating the originally three-celled state of the ovary in that genus.

This is by no means an abundant fruit, although I have as many as sixteen specimens of it in my possession. Fig. 5 is the form it usually assumes before it is quite ripe. There is no part of the pericarp of this specimen through which the seed can be seen; this is likewise the case with three others that I have, which very much resemble it in form and proportion. When the fruit has arrived at maturity, it is considerably increased in bulk, as in fig. 2, and is less acutely terminated, as in fig. 3. One very perfect specimen which I have is more obtusely terminated than fig. 3, and its mean diameter is equal to its height. When the fruit is quite ripe, the pericarp becomes very thin at about one third of the height of the seed above its base, and finally the base of the seed is exposed by a gradual solution or premature decomposition of the posterior portion of the pericarp, or it is entirely liberated by an irregular transverse separation of the pericarp at about that point. The evidence afforded by the specimens of *Nipadites Parkinsonis* in my possession, does not

leave a reasonable doubt as to this mode having frequently been the one by which the seeds have been liberated from the pericarp in this species: but whether this is the proper mode of dehiscence, thereby rendering it a modification of the pyxidium;—or whether it may be considered an accidental mode, arising out of the tendency of the pericarp to dehisce by solution, and this operating upon its weakest portion,—is a question which requires a more extensive acquaintance with these interesting fossils before we can come to a decision upon the subject. Such has been the case in fig. 2,—*a* being the seed, *b* the pericarp, and *c* the line of separation. Figures 3 and 4, which are two views of the anterior portion of a very fine pericarp that has shed its seed, likewise exhibit precisely the same mode of division, as the edges of the specimen present (as at *a*, fig. 4) a rounded blunt appearance, such as might be expected to take place by a gradual absorption of the part, and not a rough angular fracture, such as violent or accidental causes would produce. The whole of the edge in this specimen preserves this character, except the point indicated by *b*, fig. 4, which is an accidental fracture of a part of its edge since it has been fossilized. Figure 6, which presents us with a view of the base and attachment of the pericarp, and which, when reversed, has an appearance much like the cup of an acorn, also exhibits the same roundness at its edge as the last-described specimen. In others in my possession, a similar appearance is also observable.

The epicarp, in figs. 2 and 5, is not in a good state of preservation; but in fig. 3 it is in part well preserved, and is about half a line in thickness. Towards the apex of the fruit we find it, in this and other similarly perfect specimens, marked with fine aciculated lines and punctæ, as at the parallel of *a*, fig. 3, but at *b* on the same fruit, the lines have become almost obsolete, and the punctæ are entirely wanting. On the underside of the specimen fig. 2 near the base, there is a small portion of the epicarp, and the same absence of lines and dots is observed as at *b* fig. 3.

The sarcocarp in this species is much more vascular than in any of the preceding ones, and the longitudinal bundles are

larger in size. From the base to about the centre of the fruit they do not often divide, but as they approach towards the apex, ramification becomes much more frequent. Amid these large longitudinal bundles there are numerous smaller ones thickly interspersed, running at right angles to the axis of the fruit, and forming a close net-work of vascular tissue, the interstices being filled up with highly-compressed cellular structure, very much like that so frequently found amid the fibres surrounding the endocarp of many recent palmaceous fruits.

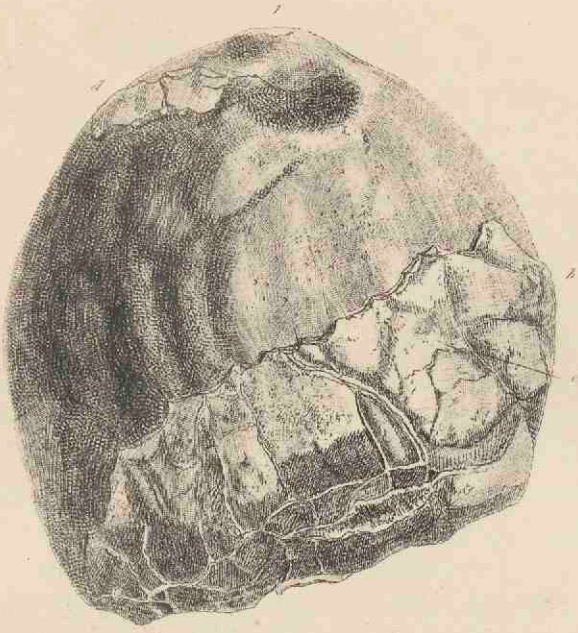
The state in which the seed of this species is usually found, is singularly different from that of the other members of the group that have been described. While in their case it is formed entirely of *pyrites*, in this, in eleven out of thirteen specimens which I possess, it is composed of indurated earthy matter, excepting only the testa, which is, as usual, converted into *pyrites*. Of the two which are entirely formed of *pyrites*, one, when broken, afforded only very faint traces of organic structure ; but in the other, when viewed as an opaque object, by the aid of a Lieberkuhn and a power of eighty linear, a series of vegetable cells, regularly disposed in lines radiating from near the centre of the seed towards the circumference, were distinctly to be seen. The centre of the seed, which was of a much looser texture, was occupied by indistinct laminæ of *pyrites* from the base to near the apex of the seed. In another specimen, the interior of which is earthy matter and the testa *pyrites*, we have the casts of the cells presented in a very perfect state, but instead of being disposed in radiating lines, as in the former instance, they are in this case mixed up together, as if they had so far suffered from maceration as to have their natural arrangement totally destroyed: and this is rendered still more probable from the circumstance of some of them being found attached to a part of the outside of the testa, apparently occasioned by a portion of the detached cells having escaped from their natural situation through a fracture of that part, and become embedded in a narrow space which appears to have existed between it and the pericarp.

The usual form of this seed is that represented at fig. 1 plate

4; *a* is the base and *b* the apex, which is not, in all cases, quite so much produced as in this instance. At the base, *a*, we observe a deep excavation, which, in a specimen that I have received since the plate was engraved, is occupied by a small and somewhat conical mass of *pyrites*, having every appearance of being a portion of the proper receptacle of the fruit, which, passing through a large circular orifice that appears at its base, very much like that represented at fig. 6, is projected into this basal orifice of the seed. The state of the basal orifice of the pericarp seems to indicate this to be the case, as the portion of it which remains has receded slightly from the base of the pyritical mass, and is even, and gradually rounded off, as if the process of solution of the tissues, which is so commonly observed to have taken place at the base of the pericarp of all the fruits of this family, had just commenced. The testa is thin, and covered, as in the other species, with minute corrugations.

In the specimen of *Nipa fruticans* before mentioned, presented to me by my friend Mr. G. Loddiges, and of which a longitudinal section was made, germination had taken place to a considerable extent; the embryo was projected through the funnel-shaped basal orifice of the indurated endocarp, and numerous rootlets were thrown off from the radicle, while the nucleus, in the form of a shrunken, distorted, spongeous mass, remained within the testa, which, having become indurated, preserved its form and situation, although slightly separated from the endocarp. This state of the recent fruit after partial germination, may perhaps assist in explaining the reason of our so often finding the cavity of the seed in *Nipadites Parkinsonis* filled with earthy matter; for it would naturally follow, supposing the germination of *Nipa* to have been completed under the circumstances described by Rumphius in his 'Herbarium Amboinense,' vol. i. p. 72,* that the exhausted and hollow fruit would be filled with the mud amid which it is deposited. And as we find, in the recent fruit, the testa retaining its form and situation after the nucleus

* See description of *Nipa fruticans*, page 7 of this work.



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within has been absorbed by the process of germination, it is natural that we should find the testa of the fossil species retaining its form and converted into *pyrites*, while the mass within is indurated clay.

The seeds of *Sparganium ramosum* have a great resemblance in form to these fruits, but the structure and arrangement of the vascular and cellular tissue in the fossil, indicates a closer relation to *Pandanus* than to *Sparganium:* and it is highly probable from the regularity of the angles and the flatness of the faces of this fruit, that in its mode of inflorescence it approximated much nearer to *Pandanus* than any other species of this group.

Nipadites turgidus.

(Plate 5).

Pericarp three-angled. *Epicarp* striated. *Seed* turgid, *testa* smooth.

It is very probable that these characters may hereafter require considerable addition or modification, as the specimens figured are the only ones I have seen.

Figure 2, for which I am indebted to the kindness of the Rev. F. W. Hope, has a portion only of the pericarp remaining, and this is in so imperfect a state that I am unable to speak with any degree of certainty as to its form. Two angles, situated at *a* and *b*, are tolerably well developed, and a small portion of the third remains at *c:* no farther indication of angularity is apparent in any other part of the fruit. At *d*, a small part of the epicarp fortunately remains in so good a state of preservation as to enable me to ascertain its character with tolerable certainty. It is about one fourth of a line in thickness, and is covered with distinct parallel striæ. The vascular fasciculi are not so large as those belonging to the last species, neither are they so thickly interlaced at right angles with smaller bundles of vessels.

The seeds in both specimens (figs 1 and 2) are ventricose, but somewhat compressed. The dimensions of fig. 1, from *a* to

b, is two inches ten lines, while in the contrary direction it is two inches and two lines only. In fig. 2 the proportions appear to be nearly the same. In neither of them do we see the corrugation of the testa observable in so many of the other species.

Fig. 1 is covered, at *c* and *d*, with a regular layer of carbonate of lime, about half a line in thickness, as if an infiltration of that substance between the pericarp and the seed had taken place during the process of fossilization, and while the latter was loosely enclosed within the former. In the nearly-allied recent fruit — *Nipa fruticans* — presented to Mr. Ward by Captain Roberts, and which we have described in the introductory observations to this genus, there is a similar space intervening between the nut and the pericarp.

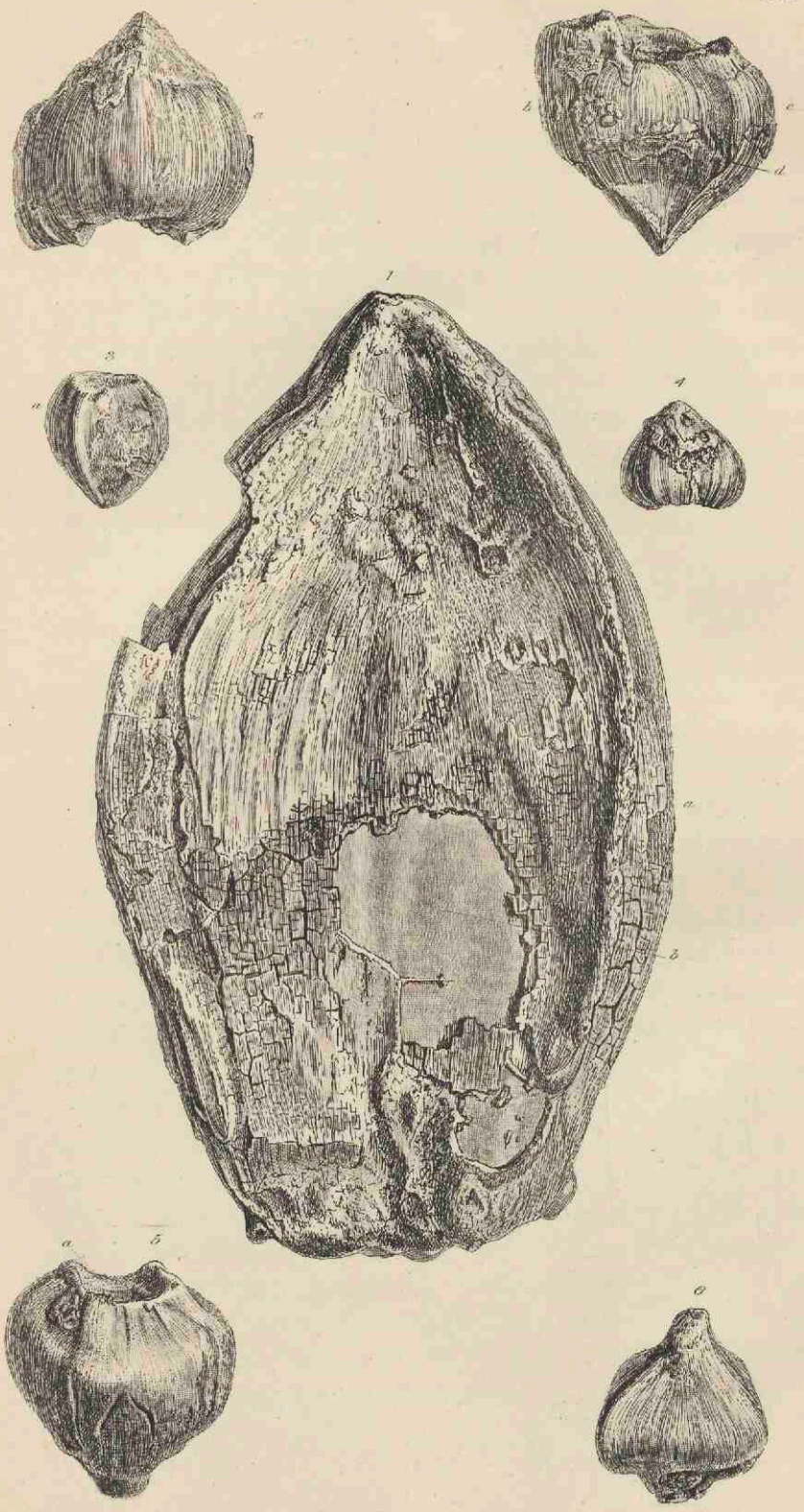
Nipadites giganteus.

(Plate 6, fig. 1).

Pericarp four-angled, compressed. *Epicarp* striated. *Seed*, testa minutely corrugated.

This species is much the largest of the group. The one figured is the most characteristic specimen, but the smallest, excepting one, that I have seen. The dimensions of the two largest in my possession are as follows. Length of the first seven inches, greatest width four inches and three quarters, thickness about the centre, seven lines: length of the second, six inches, greatest width five inches and a half, thickness at about the centre five lines; but as in this specimen some of the posterior portion is apparently wanting, it is probable that it was originally much longer. The smallest specimen that I have is three inches and a half long, two inches and three quarters wide, and five lines thick.

The situation of the angles of the pericarp is singular and very characteristic; two being placed at each side of the fruit, leaving wide depressed areas on its back and front. The two angles at each edge gradually diverge as they proceed from the



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apex, until they reach about the centre of the fruit, and then converge towards the base; so that in the specimen fig. 1 plate 6, at *a* the thickness of the fruit is one inch four lines, while in its centre it is only nine lines.

In consequence of nearly the whole of the pericarp being composed of carbonaceous matter, there is no portion of the epicarp in a sufficiently good state of preservation to enable us to determine its character; but in another specimen, it presents much the same appearance, only somewhat coarser, that the epicarp of *Nipadites turgidus* exhibits at *d*, in fig. 2, plate 5. The sarcocarp is thin, the vascular fasciculi small and less numerous than usual, and no traces of the small interlacing bundles of vessels have been detected.

The seed in this species is very large in proportion, occupying nearly the whole central portion of the fruit. In one specimen in my possession, which presents the seed nearly detached from the pericarp, it measures three inches and a half in width, and about the same in length. The apex, which is partly obscured by extraneous pyritical matter, appears to terminate abruptly.—The testa is minutely corrugated, like that of the generality of the preceding species of this group.

The apex of the pericarp in one specimen is crowned with a strongly-produced umbo; but as in the one figured, and in other instances, this does not appear, we can regard it only as an accidental variation. Part of the seed is seen at *b*, fig. 1, through a hole in the pericarp.

Nipadites semiteres.

(Plate 6, figs. 2, 3, 4).

Pericarp broad, short, and semicircular; three- or four-angled. *Epicarp* faintly striated.

I have met with but three specimens of this fruit, but these coincide remarkably in all their essential characters. The largest

and best-developed specimen is represented at *a* and *b*, fig. 2, plate 6. It is sixteen lines in breadth, fourteen in length, and eleven in thickness; nearly flat on one side, and swelling out on the other into somewhat more than a semicircle. Fig. 2 *a* is a view of the gibbous side, and fig. 2 *b* of the flat side, of the fruit. The angles in this specimen are three in number; these are irregularly disposed, two of them being placed near one edge (*d* and *c*, fig. 2), and one on the other at *b*: but on the smaller specimen (fig. 3 plate 6) they are four in number, three of them being situated exactly as in fig 2, and the fourth slightly developed in the centre of the gibbous side of the fruit, (*a*, fig. 3).

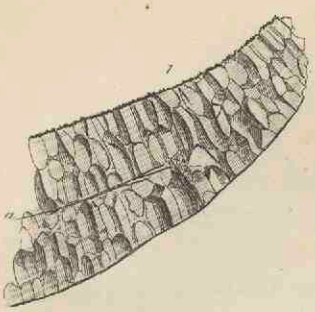
Fig. 4 presents a view of the gibbous side of a younger specimen, in which the angles are not so well developed as in the former ones, although in other respects the general character is equally well preserved. In fig. 2 the epicarp is wanting, which gives it the appearance of being striated in a much stronger manner than is natural to it. In figs. 3 and 4 it is well preserved, and is nearly smooth, with only very faint longitudinal striæ.—I have not seen the seed of this species.

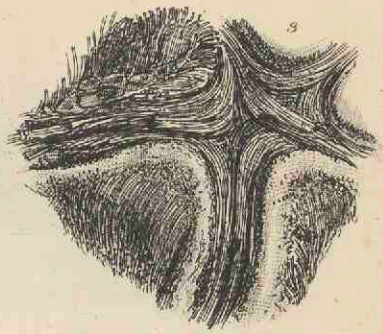
Nipadites pyramidalis.

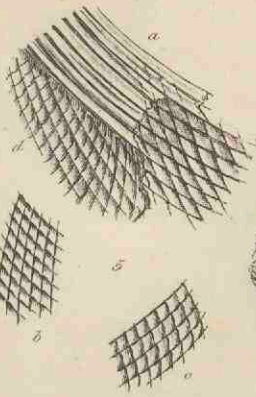
(Plate 6, figs. 5 and 6).

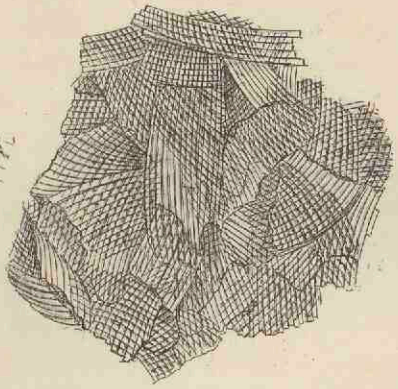
Pericarp short, quadrangular, and pyramidal. *Epicarp* smooth.

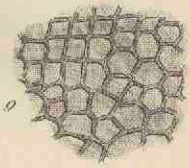
Figures 5 and 6 represent the two most characteristic specimens of this species out of seven which I possess: fig. 5 is the largest of the seven, the smallest is only five lines in length.—The whole of them coincide in their general proportions, and in having four angles, nearly equidistant from each other. At the base of fig. 5 there is a large and deep indentation at *a*, which has probably been caused by the impression of the receptacle: a similar depression exists at the base of fig. 6, *a*, but it is not so evident as in the former specimen, in consequence of a partial contraction of the fleshy substance of the base of the pericarp.—

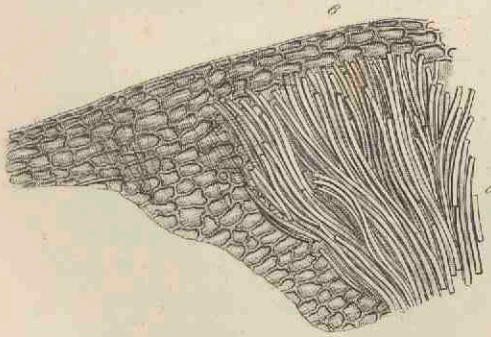


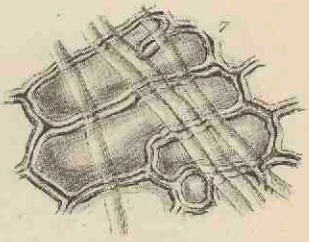


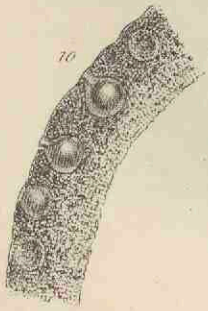


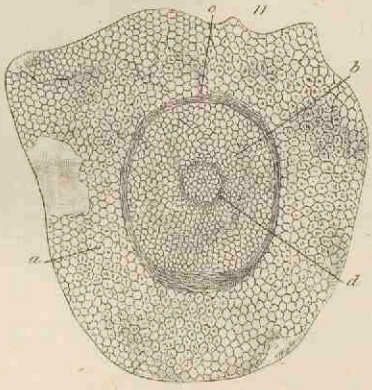












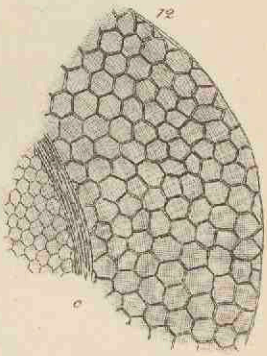


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Fig. 6 has lost nearly the whole of the epicarp, but in fig. 5 it is in a tolerably good state of preservation, and presents, where it is in the best state, no indications of striæ.

I have not seen the seed of this species: two specimens which I fractured in search of it proved to be abortive.

HIGHTEA.

(Plates 7, 8, and 9).

Pericarp one-celled, valveless. *Placenta* central, usually five- rarely four- or six-angled, obconical and very large, with one or more seeds attached to each angle. *Seeds* and placenta enveloped in a mass of downy or filamentous structure, which fills up the whole of the remaining space within the pericarp. Seed about two or three times its own diameter in length, angular and somewhat curved. *Testa* reticulated.

I have named this genus in honour of an able botanist and an early and highly-esteemed friend, John Hight, Esq.

Figure 1 plate 8 represents a pericarp of *Hightea* which has lost a great part of the epicarp, *a*. Fig. 2 is a view of the same fruit, cleft longitudinally through its centre, exhibiting the placenta and seeds in their proper situations: *a*, the placenta; *b*, a seed attached to one of its angles; *c*, the impression of another seed; *d*, the mass of filamentous structure filling up the remainder of the pericarp. Fig. 3 is a fruit deprived of its pericarp: *a a a*, seeds embedded in the mass of filaments. Fig. 4, a placenta with the seeds attached to it, and totally freed from the filamentous structure: *a a a*, *b b*, five seeds attached to its angles. Fig. 5 is a placenta deprived of its seeds: *a* the depression where one of them has been attached. Fig. 6, the seeds separated from the placenta: *a a a a*, are from the situation indicated by *a* in figs. 4 and 5; *b*, a shorter variety of seed which is situated above the others, at the top of the angles of the placenta, as at *b b*, fig. 4.

It is extremely difficult to determine whether these fruits have five valves, or whether they are valveless; as many of them, to the unassisted eye, exhibit every appearance of having five or more regular valves, as represented in figs. 15, 19, and 26, plate 8: yet after a careful examination of many dozen specimens which afforded these appearances, with a power of eighty linear, I have not seen any instance in which the sutures have been at all separated, or indeed where they could be clearly demonstrated as existing. In many instances there are five furrows at regular distances from each other, radiating from the apex of the pericarp, having the appearance of being produced by the sutures of as many valves, but these are frequently lost before they have passed over one third of the length of the fruit, as at *a*, fig. 20. In other cases they are continued on to the base of the fruit, but generally becoming fainter as they recede from the apex. In one fruit, where the greater part of the epicarp and sarcocarp were wanting, and but little besides the endocarpal membrane remained enveloping the contents of the pericarp, there appeared, with a power of eighty linear, bundles of vessels occupying situations similar to those where we might expect to find the valves; how far these may be connected with, or be the cause of, the furrows upon the surface of the pericarp, it is difficult to say. At first I was inclined to believe that these furrows were produced by the impressions of the nervures of a strong fibrous calyx, such as we find in some species of *Campanula*, or possibly similar to that which envelopes the pericarp of *Nigella;* and I felt the more inclined to attribute the furrows to one or the other of these causes, from occasionally seeing minute ramifying sulci spreading over the whole surface of the pericarp, as represented in figs. 7 and 24, plate 8; and this view appears to be further warranted by our frequently finding a portion of the calyx remaining at the base of the fruit, as in figs. 10, 18, and 25, plate 8, the edges of which do not exhibit, in any instance that I have seen, the smooth and rounded appearance which we should expect to find if it were the proper margin of that part of the fructification. But, on the contrary side of the question, I must however observe, that it ap-

pears highly improbable that I should not have met with any remains of such an extension of the calyx, amidst hundreds of specimens of these fruits that have passed through my hands, while in other cases the fine fibrous structure coating palmaceous and other fruits, is found in so perfect and beautiful a state of preservation as it usually is.

The pericarp in these fruits is generally in a good state of preservation. It consists of thin epicarpal and endocarpal membranes, enclosing a cellular sarcocarp. Fig. 1 plate 7 represents a portion of a pericarp, fractured at right angles to the axis of the fruit, as seen by a power of one hundred and twelve linear. Near the centre of the mass of cellular structure, at *a*, there are apparently a few very fine vascular fibres, but not in a sufficiently good state of preservation to allow of their structure being ascertained by the application of a much higher power than that used to exhibit the cells. The thickness of the pericarp varies in different specimens; in some instances it is extremely thin, while in others it attains a line in thickness.

The placenta is obconical, and singularly large in proportion to the other parts of the fruit. Figs. 9, 11, 16, 17, 21, and 28, plate 8, represent sections of several species, in which the placenta is seen occupying the greater part of the interior of the pericarp. It is by no means constant in its size or form, even in the same species, as may be seen by figs. 16 and 17, plate 8, which are sections of two specimens of *Hightea attenuata*.— Figs. 37, 38, 39, 42, 43, 44, 45, 46, and 47, plate 8, and fig. 2, plate 7, exhibit some of the very numerous varieties of form into which the placenta runs; the whole of these have five angles, and it is in three cases only that I have found this number exceeded:—these three specimens have each six angles. Fig. 41 plate 8 represents the base, and fig. 42 the apex, of one of these specimens. The placenta of the fruit represented in fig. 4 plate 9 is another of them. Since these six-angled ones were figured, I have examined ninety-eight additional specimens of detached placentæ, and among them I have found one with only four angles; but as the specimen of *Hightea turgida* represented

in figs. 1, 2, 3, and 4, plate 9, is the only one among several of that species in my possession which has more than five angles, it is apparent that this deviation from the normal number can be considered only as an accidental variation.

In one instance (fig. 40 plate 8) two placentæ were found united in such a manner as plainly to indicate that they had once formed a portion of a double fruit, the adherent faces of each being so much extended as to allow the five angles of each placenta to be clearly developed. The contracted basal portion of each was separated from the other, as at *a a*, fig. 40, plate 8; and a seed, embedded in a portion of the filamentous structure, is attached at the point *b*.

The placenta very rarely affords a good view of the cellular tissue of which it is composed. Two specimens only out of a considerable number that were examined, gave a satisfactory view of it. Fig. 8 plate 7 represents a small portion of one that was fractured longitudinally, and fig. 9 plate 7 a small part of one that was cut and polished in a similar direction. In one that I have fractured since these were engraved, I have seen the cells in a more perfect state of preservation, and presenting very much the appearance of those of the sarcocarp;—fig. 1 plate 7.

Surrounding the seeds and placenta, and filling up the whole remaining space in the interior of the pericarp, we find a mass of closely-compressed downy fibres, which does not appear to assume any certain direction, but to be disposed in irregular patches, the fibres forming each mass crossing others in every direction, as represented at fig. 4, plate 7, which is a portion of the filamentous structure that adhered to a spot about midway between the base and apex of the placenta of the fruit from which it was taken, and was viewed with a power of one hundred and twelve linear. With a higher power, (two hundred and twenty-five linear), it assumes the appearance represented in fig. 5, *a, b, c;* the checquered appearance at *a, b,* and *c,* being produced by the impress of bundles of fibres which have crossed others in a diagonal direction. Very frequently the filaments present a flattened appearance, as at *a,* fig. 5, plate 7,

from their having been in a state of close compression, and this is more frequently the case in the neighbourhood of the sides of the placenta than elsewhere; but between the summit of the placenta, and the apex of the pericarp, when broken at right angles to the line of their direction, the appearance is that of the section of numerous round tubes, varying in diameter from the five hundredth, to the one thousand three hundred and sixtieth part of an inch. In fig. 3, plate 7, (which is a magnified view of a portion of the summit of the placenta, fig. 2), they are seen filling up the deep furrows which converge from the angles towards the centre of the summit of the placenta, and at fig. 6, *a*, plate 7, we perceive a portion of the downy mass closely embracing the fragment of a seed. In both these cases the fibre has preserved its rotundity. When viewed with a high power under favorable circumstances, the filaments occasionally exhibit indications of being furnished at intervals with septa, and are frequently found hollow, with minute crystals of *pyrites* lining their surface.

The seeds are somewhat angular and curved, varying in length from about two to four and a half or five lines, and are about a line or a line and a quarter in diameter. They are attached to the angles of the placenta, and are frequently partially embedded in its substance. Each angle has usually one seed situated about midway between the base and summit, (as at *b* and *c*, fig. 2, plate 8), and another above it which is much shorter, and reposes partly upon the summit, as represented at *b b*, fig. 4, plate 8. Sometimes two seeds side by side are found on one angle, as at *a*, fig. 36, plate 8, but this is but rarely met with. The occurrence of two seeds to one angle appears also to have taken place at *a*, fig. 27, plate 8, but this appearance is not in reality to be attributed to the seeds, it is only the termination of one of the deep sulci which, in many cases, radiate from the centre to the circumference of the summit of the placenta, and cause the upper termination of the angles to present an emarginate appearance, as seen at *a*, figs. 43 and 44, plate 8. This bifid termination of the angles appearing through the mass of

downy fibres similar to that at *a*, fig. 27, is likewise observable at *b b*, fig. 36, where these points are seen projecting between the upper and lower seeds.

The seeds are furnished with a reticulated testa, very much in appearance like that of the seeds of two closely-allied pericarps in the cabinet of my friend Mr. Ward, of Wellclose-square, the names of which I have been unable to obtain, but which present strong evidence of belonging to the *Malvaceæ*. When viewed with a microscopic power of eighty linear, the testa presents the appearance shown at fig. 6, plate 7, which represents the fragments of a seed having a portion of the filamentous structure (*a*) adhering to it, and which had the testa preserved in a more than ordinary state of perfection. Fig. 7 is a part of the same testa as seen under a power of two hundred and twenty-five linear; it has the impression of four of the downy fibres remaining upon its surface. In one instance where I had broken a pericarp at right angles to its axis, and had thus made transverse sections of the seeds, the testa appeared to consist of three separate layers of nearly equal thickness, coinciding with the description of the primine, secondine, and tercine, given by Dr. Lindley in his 'Introduction to Botany,' page 183. In another case it assumed the appearance represented at fig. 10 plate 7, which is a transverse section of the testa of the seed fig. 11 plate 7; in this case it appears to be furnished with a series of flask-shaped glands or cells, but does not exhibit any indication of more than one coat. Excepting in this instance I have not been able to obtain so clear and distinct a view of these curious organs; in other tranverse sections the single layer of cells forming the outer of the three coats of the testa, is distinctly visible, but the two inner coats are rarely to be distinguished from each other.— When the mass contained within the testa is *pyrites*, there is seldom any trace of orgaization to be observed; but when composed of carbonate of lime, which is sometimes the case, although very rarely, the structure is then usually very distinctly to be seen.— Fig. 11 plate 7 represents a transverse section at about the middle of a seed, under such circumstances, and it is seen to consist

of a cellular albumen (*a*) with the embryo (*b*) enclosed within it. At *c*, figs. 11 and 12 (the latter being a portion of the same seed more highly magnified), there is the appearance of the remains of a fine membranous substance surrounding the embryo, which may probably be the quintine, the situation being the one in which we should expect to find this tissue in the recent seed. The smaller circle *d*, fig. 11, is produced by a slight condensation of the cellular tissue of that part. In another specimen similar to the one figured it was present, but so faintly marked as scarcely to be perceived.

From the size and form of the pericarp, and the great abundance of downy structure, I was at first strongly inclined to believe that these fruits were nearly allied to *Gossypium ;* but a closer examination convinced me that this could not be their proper situation, as all the fruits of *Gossypium* which I have yet seen have a three-valved pericarp, seeds without the reticulated testa, and a small columnar placenta. The structure of the fibre of the true cotton likewise differs materially from the downy or filamentous structure of *Hightea ;* the former being a flattened or tape-formed thread, which has the appearance of having made several revolutions upon its own axis during the period of its growth, while the latter is a cylindrical fibre, presenting, under favorable circumstances, the appearance of being furnished at intervals with joints, and bearing no appearance of having made any of those revolutions upon its own axis which are so characteristic in the structure of the true cotton fibre. It is difficult to say with any degree of certainty, to which of the natural orders these fruits should be referred, but probably their proper situation will be found to be among the *Malvaceæ*. Their seeds agree with those of the recent pericarps before alluded to, in the form and arrangement of the reticulations of the testa, and in the structure and abundance of the downy filamentous mass ; but they differ materially both in the form and position of the seeds, and in the shape of the placenta.

Hightea elliptica.

(Plate 8, figs. 7, 8, and 9).

Pericarp elliptical; diameter about half its length.

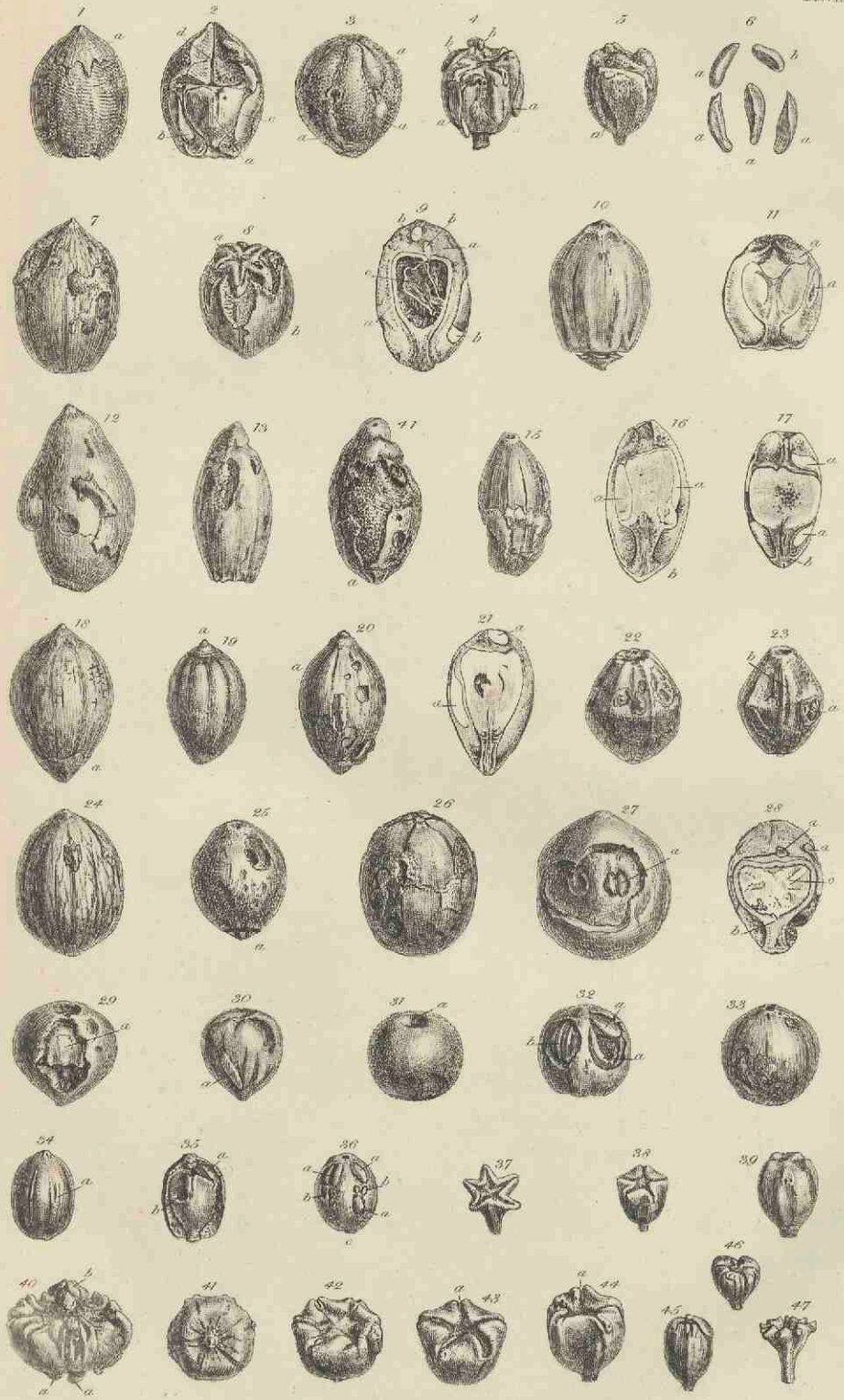
This species is by no means of rare occurrence: I have in my possession thirteen well-characterized specimens. The only other species with which it is liable to be confounded is *Hightea ovata*, from which it may readily be distinguished, not only by the greater degree of length in proportion to its breadth, but likewise by the greater length of its placenta, which, in this species, usually attains to nearly three fourths the length of the pericarp, while in *Hightea ovata* it generally terminates at or near its centre. Fig. 7 is one of the most perfect specimens that I have seen; it is ten lines and a half in length by six in breadth, and has the surface of the pericarp covered with minute ramifying sulci. Fig. 8 represents a pericarp, about one third of which has been destroyed. It presents us with a good view of a portion of the placenta; *a* is the summit of the placenta, *b* the posterior portion of the pericarp. Fig. 9 is from a longitudinal section of a fruit of this species which has lost nearly the whole of its pericarp: *a a* the mass of downy filaments; *b b b* portions of seeds cut through in making the section; *c* the placenta, partly hollow and lined with minute crystals of *pyrites*.

Hightea elegans.

(Plate 8, figs. 10 and 11).

Pericarp broad at the base, and gradually increasing in diameter for about two thirds of its length, and then terminating in an obtuse summit.

This is a very rare species; I have met with only one specimen besides the two figured, but this, although smaller, agrees remarkably well in form with fig. 10; it is somewhat shorter in



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proportion, forming an intermediate link between it and fig. 11. Fig. 10 has five equidistant sulci, which pass from the base to the apex of the fruit, where they terminate in as many slight depressions, giving it a somewhat stellated appearance. The calyx in fig. 10 is in a good state of preservation. Fig. 11 is from a longitudinal section through about the centre of a pericarp of this species; *a a* are sections of two of the seeds.

The placenta in this specimen has a deep depression in the centre of its apex, and does not present any appearance of having had the angles much produced. This is also the case in fig. 10, from which a small portion of the pericarp was removed, whereby I was enabled to view a part of one of its angles; but as I have not seen a detached placenta of this species, I cannot speak with any degree of certainty as to its form.

Hightea attenuata.

(Plate 8, figs. 12—17).

Pericarp broadest at about the middle, attenuated towards the apex.

This is rather an abundant species: I have in my possession twenty-five well-characterized specimens. It is much longer in proportion to its diameter than any of the others. Fig. 12 is the largest, excepting one, that I have met with; fig. 13 is nearer the average size. In this, and in fig. 15, we have the appearance of a greater number of sulci radiating from the base of the pericarp, than is usual in the fruits of this family. On the part of the fruit presented to view in fig. 13, there are four sulci apparent on the remaining portion of the pericarp, which are so indistinct as not to be traced with any degree of certainty; but from the space which these four occupy, there is reason to believe that they were as many as ten in number. In like manner, on fig. 15 we have three sulci distinctly marked, and the remainder indistinct; and here again the space which these oc-

cupy would indicate ten to be the number we might expect to find on the perfect pericarp. The apex of fig. 15 presents us with a singular foraminated appearance, as if the extreme point of the pericarp had been gradually absorbed, and an opening had thus been made into it, by which means, it is probable, dehiscence finally took place.

In an unknown recent pericarp in the cabinet of my friend Mr. Ward, which appears to belong to the *Malvaceæ*, dehiscence seems to take place by a separation of the base from the receptacle, in consequence of the expansion of the downy fibres within; and the pericarp separates longitudinally into two or three irregular portions. It is not improbable that in like manner, possibly in consequence of the gradual weakening of the apex of the fossil pericarp, and the expansion of the downy fibres within, dehiscence might ultimately have taken place by an irregular longitudinal fracture, but in this case commencing at the apex instead of the base.

In fig. 20 we have an indication of a foramen similar to that of fig. 15, but in the former the apex has not either fallen off or been absorbed, as in the latter. In several other specimens I have observed appearances similar to those exhibited in figs. 15 and 20. Fig. 13 has lost the calyx, and exhibits the size and form of the base of the pericarp. Upon fig. 14, *a*, it is present, and in a tolerably good state of preservation. Figs. 16 and 17 are sections of two fruits of this species, in which the size and proportions of the placenta differ materially: *a a*, fig. 16, portions of the seeds; *b*, the calyx: fig. 17, *a a*, portions of seeds; *b*, the calyx.

Hightea fusiformis.

(Plate 8, figs. 18—21).

Greatest diameter of the pericarp at about one third of its length from the apex, from which place it gradually tapers downwards to the base.

This is not a very common species. I have met with only ten specimens; of these figs. 18 and 21 are the most characteristic. The fruit, of which fig. 18 is a representation, is in a very fine state of preservation. The longitudinal sulci are not very distinct, but there appear to have been six or seven, instead of the usual number of five. The calyx, *a*, is well preserved, and presents faint indications of having had eight or ten fine angles, and the base has the mark of the attachment of the peduncle well preserved, the scar being about half a line in diameter. In another specimen in my possession, which is about two thirds of the length of fig. 18, and which likewise has the scar of the attachment of the peduncle, it appears to have been still smaller, not exceeding the fourth part of a line in diameter: this likewise is about its diameter in fig. 19 *a*, where a very small portion of it remains attached to the calyx. This specimen differs from figs. 18, 20, and 21, in being largest near the base; but this variation in form probably arises from its not having arrived at a state of maturity. The longitudinal lines in this are distinctly ten in number, and the thin epicarpal membrane is nearly in a perfect state of preservation. Some portions of these lines assume the usual sulcate appearance, while in other parts they present the appearance of slightly raised ridges, such as minute bundles of vessels, running beneath a fine membrane, might be expected to produce. This specimen is figured with its base upwards, for the purpose of giving the best view of the calyx, and of the longitudinal sulci. Fig. 21 represents a section of a fine specimen of this fruit; *a a* are portions of two of the seeds.

Hightea inflata.

(Plate 8, figs. 22 and 23).

Pericarp, greatest diameter at about the middle, where it is somewhat inflated, obscurely five-angled; apex obtuse and depressed.

The two fruits figured are the only specimens of this very rare species which I have been fortunate enough to meet with.

Neither of them has the calyx remaining. Fig. 22 has the pericarp in a beautiful state of preservation; it is somewhat corrugated, and without any appearance of sulci. Fig. 23 has lost a considerable portion of the epicarp, and at the point *a* a small part of one of the seeds is seen. At the angle *b* is a deep sulcus, and there is a similar appearance at each of the other four angles, although less strongly marked. Between the angles the surface of the fruit is somewhat depressed, giving it much the appearance of having five flat sides. The apex in both specimens is depressed in a somewhat similar manner; but in the imperfect pericarp fig. 23, the centre of the depression is a shallow indentation, while in the perfect pericarp, fig. 22, it is filled up with a slightly projecting mass of the substance of the epicarp. The bases of these fruits do not exhibit any marks or remains of the peduncle; but from the position of the seed, *a*, fig. 23, conjoined with other indications, there is little doubt that the position of the figures is correct, although, as I have not yet seen a section of this species, there is a remote probability that we have erred in figuring them in their present positions.

Hightea oviformis.

(Plate 8, figs. 24, 25, 26, and 28).

Pericarp oviform, largest towards the base.

This species is the most abundant of the whole group. By far the greater number assume the shape of fig. 24, but when not fully developed have the form of fig. 25. Occasionally, instead of being of the usual oviform figure, they are nearly as much expanded towards the apex as they are near the base, as in fig. 26; but this appears to be only when they are more than usually developed. The surface of fig. 24 has five large longitudidinal sulci, situated at nearly equal distances from each other: between these are five smaller ones, which do not run in so straight a direction as the larger ones, and from which numerous

small branches are given off, which assume an ascending direction.

Figure 25 has the calyx (*a*) well preserved; it has five equidistant angles, but the margin, as in many other cases, does not appear to be in a perfect state of preservation. The sulci are not apparent, probably in consequence of the fruit not having been perfectly developed. Fig. 26 has five large sulci strongly marked near its apex, but unfortunately the fruit has a thin coat of extraneous *pyrites* covering so much of its surface as to prevent our following them for any considerable distance. There is no part of the calyx remaining, but at the base of the fruit there is a well-defined circular area, marking its point of attachment; and which, from the regularity of its form, and other peculiarities of the scar, conjoined with its well-developed shape and size, would seem to indicate that this was a pericarp which had arrived at the period of its full maturity.

Figure 28 exhibits a longitudinal section of a fruit of this species, apparently in a state of development intermediate between figs. 24 and 25 : *a a* are sections of two seeds, the small size of which would seem to indicate that they had not arrived at maturity.

The interior of the placenta of this fruit was composed, at *c*, of a mass of carbonate or sulphate of lime; while the base, *b*, and the exterior of the placenta, were as usual formed of *pyrites*.

The fruits of this species vary considerably in size. I have one specimen in my possession which does not exceed six lines in length, and four in breadth, and others are found of all intermediate dimensions between it and figs. 24 and 26, which are the largest I have seen.

When this plate was engraved I included fig. 27 in this species, believing it to be a pericarp in a state of extraordinary development. At that time I possessed no other specimens with which it could be compared, but have since been so fortunate as to obtain six others, which, from the form of their placentæ and other peculiarities, convince me that it must be considered as a species distinct from *Hightea oviformis*. But as I have made a reference to it for another purpose, I have allowed the figure to retain its place in the plate.

Hightea turbinata.

(Plate 8, figs. 29 and 30).

Pericarp turbinate.

These fruits are readily to be distinguished from all other species by their peculiar turbinate form. I have met with only five specimens; of these fig. 29 is the most characteristic, and in the best state of preservation. The apex of the pericarp is somewhat depressed, and there is a fracture of a part of it through which the placenta (*a*) is seen. There are no appearances of sulci to be detected in this specimen, but in another which I possess, and which has a portion of the pericarp in a good state of preservation, they are present, and exhibit much the same appearance as they assume in fig. 24, plate 8. The other two unfigured specimens have lost the pericarp; one of them agrees in form and proportion with fig. 30, and the other with fig. 29, only that it is shorter and broader,—its length being only five lines, while its breadth is seven and a half. Fig. 30 has lost a great portion of the pericarp; it is slightly depressed at the apex, but not in so great a degree as fig 29: *a* is one of the seeds projecting from among the mass of filamentous structure in which they are embedded.

Neither of the five specimens has any part of the calyx remaining.

Hightea orbicularis.

(Plate 8, figs. 31—33).

Pericarp nearly spherical, smooth.

This species is by no means scarce: I have met with twenty-two specimens, none of which have the calyx remaining.

In many instances the separation of the pericarp from the calyx has taken place in a somewhat singular manner, by means

of a transverse fracture of the foot-stalk of the placenta within the pericarp, leaving a circular aperture in its base, about two lines in diameter, as shown in fig. 31, *a* being the base of the fruit. Fig. 32 has a similar aperture at its base: a portion of the pericarp of this specimen is wanting opposite to each of the five angles of the placenta; through one of these openings two of the seeds (*a a*) are seen *in situ*, and through another the rounded and emarginate termination of one of the angles of the placenta projects at *b*. Neither of the fruits figured at 31 and 32 exhibits any sulci upon the surface of the pericarp, but in the specimen figured at 33, they are well marked and five in number. In another specimen in my possession they are still more apparent, and assume a similar ramified appearance to those shown in the figures 7 and 24, plate 8. In three well-defined specimens, which were broken for the purpose of examination, the placenta was found to vary greatly in form. In one case it was almost spherical; in another it assumed a conical form, the apex being very broad and flat; and in the third it presented a form intermediate between the two former specimens.

Since the figures 31, 32, and 33 were engraved, I have received specimens much exceeding them in size, the largest being nine lines in diameter and seven in height: but excepting in size they did not differ in any respect from those figured.

Hightea minima.

(Plate 8, figs. 34—36).

Pericarp ovate or elliptical, not exceeding six or six and a half lines in length. *Seeds* numerous.

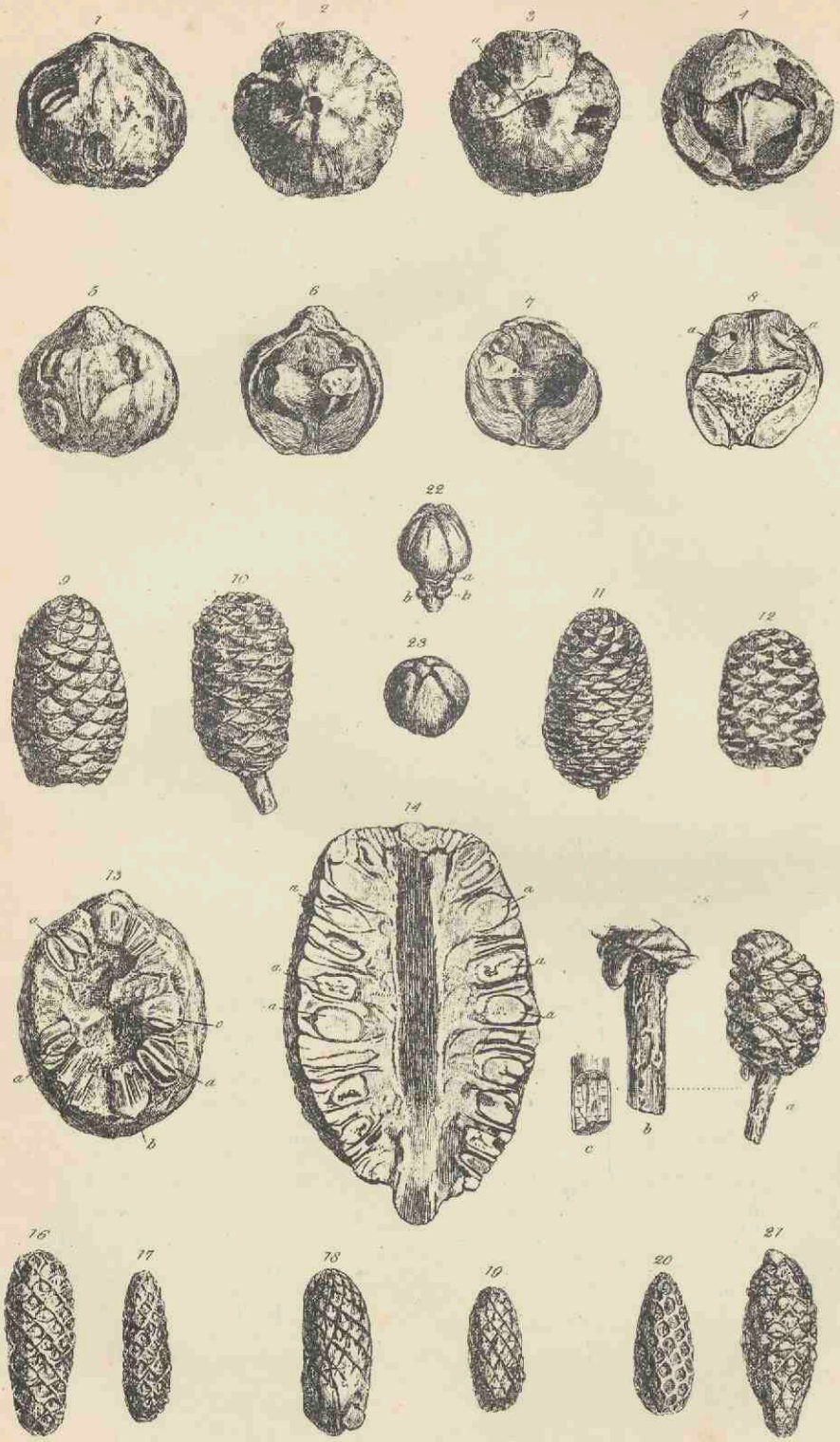
Upon examining the first two or three specimens of this fruit, I thought they were immature examples of *Hightea elliptica;* but having since met with as many as twenty specimens in the whole, I have been induced to alter my opinion, and to consider them as belonging to a truly distinct species. Young and im-

mature specimens of *Hightea elliptica* which I have in my possession, are longer in proportion than our present species, and the seeds, although immature, are both longer and larger in proportion than those found in pericarps of *Hightea minima*, of a corresponding size.

Generally speaking, this species is likewise more prolific in seeds than *Hightea elliptica*. Upon two specimens only out of twenty that I possess, are there any remains of the calyx, and in these it is so badly preserved as to afford us but little information respecting its true form and proportions. We may therefore, I think, fairly infer, that although small, the pericarps were in a state of maturity when separated from the parent plant. Independently of these facts, nearly the whole of our specimens exhibit every indication that we observe in fully-developed pericarps of other species of this group, both as regards the pericarp and seeds, of their having attained a state of full maturity.

Figures 34 and 35 are two views of a specimen which was fractured to obtain a sight of its interior. In place of the usual sulci there were five lines, slightly projecting from the surface; one of these lines, as seen at *a*, fig. 34, divides into two, and then becomes obsolete. Upon another specimen which I have, the usual five sulci are seen diverging from the apex of the pericarp, and running for a short distance down the surface of the fruit; but they cannot be traced in any of the other specimens. Fig. 34 is a view of a section of the same fruit, half of the pericarp having been removed, but the placenta and seed (*a*) remain uninjured. This fruit does not exhibit the usual profusion of seeds observable in the greater number of specimens of this species; but this may probably be attributed to its having been perforated by an insect, as there is a deep excavation (*b*) in the placenta, such as we often observe in recent fruits which have been thus attacked.

Figure 36 has a portion of the pericarp wanting, opposite to each of the five angles of the placenta. These portions exhibit at *a a a*, four of the seeds, and at *b b* we have a view of the bifid terminations of two of the angles of the placenta. In this little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pericarp there appear to be at least as many as eleven seeds.—In another of my specimens, which has the apertures of the pericarp opposite to the angles of the placenta larger than in the former one, there are twelve seeds to be seen; and it is probable that were the pericarp to be broken, the true number of seeds would prove to be twelve or fourteen, a number far exceeding that usually found in any of the preceding species. At the base of this specimen, at *c*, there is a small portion of the calyx remaining.

Hightea turgida.

(Plate 7, fig. 27, and Plate 9, figs. 1—8).

Pericarp nearly spherical. *Placenta,* terminations of the angles very much produced and emarginate.

This species does not differ in external form from *Hightea orbicularis,* excepting that the apex of the pericarp is somewhat more produced, as seen in fig. 27, plate 8, and figs. 1 and 5, plate 9. It usually presents a more uneven surface than *Hightea orbicularis,* as is represented in figs. 1, 2, and 3, plate 9, presenting very much the appearance of having been a fleshy or pulpy fruit. The pericarp in fig. 27, plate 8, is considerably thicker than in either of the three specimens figured in plate 9, and its surface is much more even; probably this may have arisen from its not having been quite ripe.

The fruit represented by figs. 1, 2, 3, and 4, plate 9, is the most perfect of six specimens in my possession. The pericarp is open at the apex, as shown in fig. 2, plate 9; and it distinctly exhibits the usual five sulci from the apex to nearly half way towards the base. The attachment of the placenta to the calyx is broken off just within the base of the pericarp, as seen at *a* in fig. 3, plate 9. No part of the calyx remains on any of the specimens of this species which I have seen.

The placenta is short and broad, and has the angles very

much produced at their termination at the apex, which has five deep sulci radiating from its centre to the termination of each angle, and causing them to be deeply emarginate. See fig. 2, plate 7; figs. 4, 6, and 8, plate 9; and fig. 8, plate 8.

From the number of the angles of the placenta and the space occupied by them, in the fractured part of the specimen represented by fig. 4 plate 9, there is every reason to believe that it has as many as six angles;* but in all the other specimens their number is, as usual, only five.

The seeds are few, and appear to be usually seated upon the apex of the placenta, as represented in the section fig. 8, *a a*, plate 9. I have in no case seen them beneath the projecting terminations of the angles at the apex of the placenta. They are about the usual size, and possess a similarly reticulated testa to that of the other members of the group.

It is extremely probable that many other species of this interesting genus will hereafter be discovered, as the detached placentæ, figs. 37 and 47, plate 8, cannot be assigned to any known species, unless it should hereafter be proved that one of them belongs to *Hightea inflata*. Fig. 39 plate 8 likewise differs so much in form from any of the well-known species, as to render it highly probable that it may hereafter be found to belong to a new one.

* Since the plate was engraved and the above passage written, this fruit has decomposed so much as to allow of this supposition being proved to be correct.

PETROPHILOIDES.

(Plate 9, figs. 9—21 : and Plate 10, figs. 1—8).

Fruit, a strobilus. *Squamæ* usually confluent, rarely separate. *Seed* bilobate, without a comose or foliaceous appendage.

When I first examined specimens of *Petrophiloides Richardsonii*, I was much inclined to believe them to be allied to *Casuarina ;* but upon a more careful inspection, I saw that they differed from the fruits of that genus, in having the squamæ of the cones, and the seeds, inserted in a transverse direction instead of being parallel to the axis of the fruit, and also in the squamæ being confluent in the fossil, while in the fruit of *Casuarina* they are separate from each other.

Upon showing the fossil cones to Dr. R. Brown, he very kindly pointed out to me the affinity existing between them and the genera *Petrophila* and *Leucadendron*, and particularly with one species of the former genus—*Petroph. diversifolia*—described in his 'Prodromus Floræ Novæ Hollandiæ,' page 365. To this species our fossil cones approach nearer than to any other known plant with which I am acquainted. In both the recent and the fossil fruits, excepting in one species of the latter—*Petrophiloides imbricatus*, the confluent squamæ form well-defined cells, each containing a single somewhat lenticular seed. But the seeds inthe fossil differ from those of the recent fruit, in having, in all the species in which I have been able to separate them, a deep longitudinal furrow down the middle of each of their broadest surfaces, as seen at *a*, fig. 13, plate 9 ; and at *c* and *d*, fig. 4, plate 10 : but in no instance have I been able to detect anything in the form of a comose appendage in the fossil.

Upon examining the fractured portion of the stem represented at *c*, fig. 15, plate 9, I found it to exhibit a striking resemblance in structure to the stalks of several recent genera nearly allied

to *Petrophila:* and neither in the specimen figured, nor in several others which were fractured in a longitudinal direction, could I perceive, with a microscopic power of one hundred and sixty linear, the slightest traces of the dotted ducts and the peculiar form of structure so characteristic of the true *Coniferæ*.

With this evidence of our fossil cones belonging to the *Proteaceæ* rather than to the true *Coniferæ*, and of their approximation to *Petrophila*, I have thought it better to call them *Petrophiloides*, rather than to designate them by any other name which would not serve as an indication of their nearest affinity with genera existing at the present period.*

Petrophiloides Richardsonii.

(Plate 9, figs. 9—15; Plate 10, figs. 5—8).

Cone oviform, about one diameter and a half in length. *Squamæ* confluent, with slightly gibbous apices. *Seed* compressed, oval, obtuse and bilobate.

I have named this beautiful and interesting fruit in honour of my friend Wm. Richardson, Esq. F.G.S. &c., to whose kindness and liberality I am indebted for nearly three hundred specimens.

They were found during the autumn and winter of 1837, on the beach near Swale Cliff, Herne Bay, where they had been washed out from a considerable mass of clay that had recently fallen from the face of the cliff. The greater number of the specimens were by no means in so fine a state of preservation as those figured in plate 9, having apparently suffered much from compression and maceration previously to their becoming fossilized. Fig. 9 represents a cone in which the squamæ are perfectly closed, no advance towards dehiscence having taken place.

* The learned author of the 'Prodromus Floræ Novæ Hollandiæ,' in describing the generic characters of *Petrophila*, writes thus of the cones.—"Strobilus ovatus: nux lenticularis, hinc comosa v. samara basi barbata." The species forming this genus are separated into four divisions; to the third of these belongs *Petrophila diversifolia*. The characters of this division are,—"Strobilus, squamis connatis, samara foliacea dilatata."

Fig. 10 represents one in a somewhat more advanced state, the transverse line of separation being distinctly visible, and to a very slight degree open. Fig. 11 is a cone in a remarkably fine state of preservation, still further advanced towards dehiscence; two thirds of its length from the base upwards being in a state similar to that of fig. 10, while the upper third has shed its seeds, leaving a series of deep cells with semicircular mouths; while fig. 12 is one in which the whole of the operation of dehiscence has been completed, nothing remaining but a series of empty cells.

Figure 13 represents a transverse section of a cone which is half the size of the figure; the fracture has apparently taken place previously to the fruit becoming a fossil. I have made many transverse sections of the cones of this species, but have never succeeded in procuring one so good as that figured: *a a a* are three seeds *in situ; b* is another enveloped in the thin membranous portion of one of the scales; and *c* is a fifth seed, a small part of which is seen through a fracture in the scale that covers it. Fig. 14 is a longitudinal section through the centre of a cone, magnified to twice the natural size, showing the manner in which the seeds are disposed in the cells formed by the confluent scales of the cone: *a a a a a* are five out of the numerous seeds exhibited by the section. Fig. 15 represents a portion of a cone with nearly half an inch of the stalk attached to it: *a* is the natural size of the specimen; *b* a magnified view of the stalk in the same position as at *a; c* is a view of the contrary side of the end of the stalk, showing the divergent layers of the wood in a distinct and very beautiful manner.

Upon comparing the structure exhibited in this and in other similar specimens, with the wood of small stalks of cones of a *Petrophila* from near Sydney, a striking similarity was perceived. I have not, in any instance, been able to detect in the fossil any traces of the dotted ducts, which are so abundant in the woody structure of the recent and fossil *Coniferæ*.

Figures 5, 6, 7, and 8, plate 10, are different views of a very interesting specimen of this species, belonging to the Canterbury Museum, and of which, through the kindness of W.

Masters, Esq., the able and zealous curator of that Museum, I have been favoured with the loan. At first I was strongly inclined to believe it to be a distinct species. It is only after a very close inspection that the confluent character of the squamæ can be at all detected, and then in no other part than the small portion of the fruit represented near the centre of fig. 5, plate 10, and even there only when the light falls upon it in the most advantageous direction. This slight indication of confluence of the squamæ, with the apparently strong evidence of their separation presented in the views 6, 7, and 8, plate 10, would, I believe, have led me to consider it as a distinct fruit from *Petrophiloides Richardsonii*, had I not fortunately found, among the numerous duplicates of that species in my possession, one that unites in a singular manner the characters of the cone represented by figs. 5, 6, 7, and 8, plate 10, and those of figs. 9, 11, and 12, plate 9. The whole of one side of this singular specimen, which has apparently suffered much from decomposition and partial compression, presents the same appearance as fig. 7 plate 10; while the opposite surface combines, in a very distinct manner, the characters presented by figs. 9, 11, and 12, plate 9. We can therefore only consider the specimen belonging to the Canterbury Museum as a variety, arising probably, not only from the cone having entirely shed its seeds, but also from its having been very far advanced in a state of decomposition before it was embedded in the clay, and had become fossilized: and this opinion is strongly confirmed by the broken state of the squamæ and the disruption of their cellular structure, which is perceived when examined microscopically.

Figures 5 and 6, plate 10, represent the two broadest surfaces of the cone, which is somewhat compressed. Fig. 7 presents a view of one side of it, and fig. 8 is a foreshortened view representing its apex.

Plate 10 was engraved a considerable time before the specimens figured in plate 9 came into my possession, otherwise figs. 5, 6, 7, and 8 plate 10, would have followed in their proper places in plate 9.

The fruits of this species vary much in size; the largest I have seen measures sixteen lines in length and ten and a half in mean diameter at about the middle: the smallest I have met with was only five and a quarter lines in length, by four and a half in diameter.

Petrophiloides cellularis.

(Plate 9, figs. 16 and 17).

Cone cylindrical, about three times its own diameter in length. *Squamæ* confluent: apices depressed, with a small central umbo.

The two beautiful little specimens figured were among the numerous cones from Herne Bay, presented to me by my friend Wm. Richardson, Esq., and were the only two of this species that I had then seen. In character they differ materially from the species last described, being twice as long, in proportion to their diameter, as *Petroph. Richardsonii.* The normal form is probably, as nearly as possible, cylindrical; fig. 16 varying from it by a slight increase of its anterior portion, and fig. 17 by a slight decrease of the same part: probably the variation, in the latter case, may have arisen from the fruit not having been quite so fully developed as in the former instance.

The apices of the confluent squamæ are uniformly and considerably depressed, having in the centre of each of the little sunken areas thus produced, a minute conical umbo.

A third specimen which I have recently received, through the kindness of Thos. Hunt Esq., of Herne Bay, has nearly half an inch of the stalk attached to the base of the cone. It is of about the same size, and very similar in its external appearance to that of *Petroph. Richardsonii* represented at *a* and *b*, fig. 15; the size of the cone is equal to that of fig. 16, and the form similar to that represented fig. 17. In every other respect it closely resembles the figured specimens.

I have not seen the seeds of this species.

Petrophiloides cylindricus.

(Plate 9, figs. 18 and 19).

Cone cylindrical, about two and a half times its own diameter in length.—*Squamæ* confluent: apices not depressed.

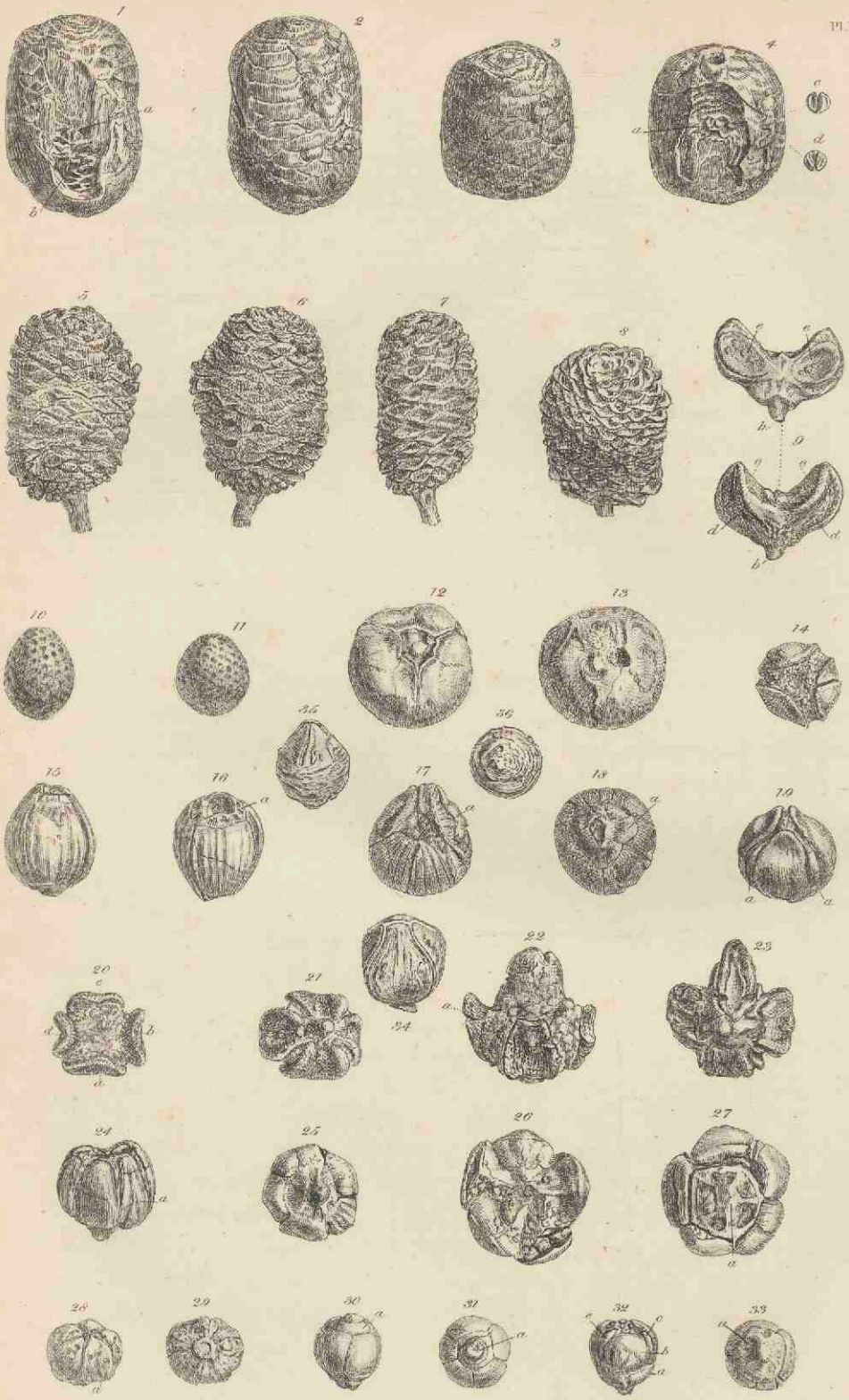
These two cones are remarkably alike, excepting in size.—Their form, in both instances, approaches very nearly to that of a cylinder. Fig. 18 is very slightly compressed, but its mean diameter and length are as nearly as possible the same in proportion as those of fig. 19. The apices of the squamæ are entirely free from depression, and present an even surface over the whole of the fruit. Neither of the specimens shows any signs of dehiscence. I have not seen the seeds of this species, those figured being the only two specimens I have met with. They were found among the cones from Herne Bay, presented to me by Mr. Richardson.

Petrophiloides conoideus.

(Plate 9, fig. 20).

Fruit conical. *Squamæ* confluent: apices slightly depressed.

This is the only specimen of the present species that I have seen: it came from Herne Bay, among the cones already mentioned as presented by Mr. Richardson. It is very different in form from the whole of the species of this group before described. The areas formed by the confluence of the squamæ are somewhat sunken, but not so deeply as in *Petroph. cellularis;* and it likewise differs in not possessing the distinct and prominent umbones found upon the apices of the squamæ in that species. The side of the apex of the cone opposite to the one figured, has a small piece broken away, but the fracture does not exhibit any portion or indication of the seeds.



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Petrophiloides ellipticus.

(Plate 9, fig. 21).

Cone elliptical, about twice its greatest diameter in length. *Squamæ* confluent, apices gibbous and umbonate.

This specimen has undergone a very slight degree of compression, but not enough to induce me to believe that its form has ever been otherwise than as it is represented. The squamæ are confluent, with their apices slightly concave near the marginal lines, and their central portions projecting considerably beyond the margin. They are terminated, when in the most perfect state of preservation, by a small, sharp umbo. When the umbo is not present, a depressed circular area occupies its place.

For this specimen I am indebted to my kind friend Wm. Richardson, Esq. I have seen but one other specimen of this fruit, and for that I have to thank Thos. Hunt, Esq., of Herne Bay. In all its essential characters it agrees with the figured specimen, but is rather larger in proportion near its base.

I have not seen the seeds of this species.

Petrophiloides oviformis.

(Plate 10, figs. 10 and 11).

Cone oviform. *Squamæ* confluent.

This fruit was found on the beach at Sheppey, nearly parallel with Minster Church. It is the only one of the species which I have seen. The specimen is not in the slightest degree compressed, but has unfortunately suffered too much from attrition upon the beach, to allow of our gaining a knowledge of the details of its structure. However, the form of the cone, and the minuteness of the cells arising from the confluence of the squa-

mæ, are characters sufficient to warrant us in regarding it as distinct from all the other described species of this group.

Figure 10 is a view of the cone in an erect position; fig. 11 is a foreshortened view, exhibiting the apex.

Petrophiloides imbricatus.

(Plate 10, figs. 1—4).

Cone elliptical, about twice its own diameter in length. *Squamæ* not confluent, thin and broad. *Seeds* compressed, circular, bilobate.

This fruit has undergone considerable compression, being five lines in thickness and ten in breadth; its mean diameter is therefore about seven and a half lines, or perhaps something more. But its principal distinction is not so much dependant upon its form, as upon the marked difference exhibited in its squamæ from those of all the preceding species. In this instance, instead of standing out from the middle of the cone, at nearly right angles to its axis, in the manner observed in the whole of the species before described, they are disposed in the form of a series of imbricated scales, to all appearance unconnected with each other, as the closest scrutiny has failed in detecting any appearance of confluence. In structure and mode of disposition the squamæ strongly resemble those of the cone of an *Isopogon*, which I have lately received from the neighbourhood of Sydney, Australia; excepting that in the fossil they are broader, and without the spinous termination at their apices, so observable in the recent cone of *Isopogon*.

The seeds are broader in proportion to their length than those of *Petrophiloides Richardsonii*, but in other respects they very much resemble them. One seed is seen *in situ*, as represented at *a*, in figs. 1 and 4, plate 10; and another, which was removed from the spot indicated at *b*, fig. 1, plate 10, is figured separate from the cone at *c* and *d*, fig. 4, plate 10: the former being in

an erect position, and the latter reversed, and showing the contrary side of the seed.

Figure 1 represents one of the broadest surfaces of the cone, with a portion of the squamæ removed to exhibit the seed *in situ;* fig. 2, the contrary side to fig. 1. Fig. 3 is a foreshortened view of the cone in an erect position, exhibiting its apex. Fig. 4 is a foreshortened view of the cone reversed, to show its base, from which the stalk has been broken away close up to the cone.

CUPRESSINITES.

(Plate 10, figs. 9 and 12—36).

The fruits forming this group are evidently members of the natural order *Cupressinæ;*—some of them closely resembling in their structure the recent fruits of *Cupressus*, while others approach equally near to those of recent species of *Thuja*, especially of *Th. orientalis*. Another species is very similar in structure to the fruit of a *Callitris* from Australia, but with this difference, that the cupula of the recent fruit is divided into six segments, while that of the fossil has only five. Other members of this group are not to be referred, with so great a degree of certainty, to any of the known genera belonging to the *Coniferæ*, but at the same time they present such evident proofs of their close alliance with the remaining species of the group, that I have thought it advisable to place the whole of them together, and to term them *Cupressinites*, which will allow of our uniting under one designation, a greater number of these evidently very nearly allied fruits, than could have been done had I attempted to refer them to M. Adolphe Brongniart's genus *Cupressites*.*

* Brongniart, in his 'Prodrome d'une Histoire des Végétaux Fossiles,' describes a genus *Cupressites*, which is thus characterized.—"Rameaux disposées sans ordre, feuilles insérées en spirale sur six ou sept rangs; sepales élargies à leur base, fruit

Div. 1.—*Cupula double; inner one three-cleft.*

CUPRESSINITES GLOBOSUS.

(Plate 10, figs. 12, 13, 14, 32 and 33).

Fruit globose; inner cupula three-cleft, outer cupula cup-shaped. *Seed* single, somewhat conical; testa smooth.

These fruits vary considerably in size: figs. 12 and 13 represent the largest, and figs. 32 and 33 the smallest specimens of the species that I have seen. I have five others in my possession, of different intermediate sizes; one of which is represented at fig. 14. The whole of the specimens present nearly the same form, with the exception of the fruit represented by figs. 12 and 13, and another specimen, which are somewhat depressed; but probably this is only an accidental variation. In the specimen represented by fig. 14, the inner cupula is more open than is usually the case; in the greater number it is closed, as in fig. 12. The outer cupula is cup-shaped and fleshy, and closely embraces the base of the inner one, in most cases for about one third of its length, as at *a*, in figs. 32 and 33, plate 10.—The inner cupula envelopes the seed so closely, as usually to leave but a very small portion of its apex visible through the triangular opening at the apex of the fruit. The apices of the divisions of the inner cupula, are nearly semicircular in the younger specimens, as at figs. 14 and 32, plate 10; while in the more mature ones, as in fig. 12, they are still more obtuse. The divisions in the inner cupula do not appear to extend to more than about two thirds of its length, or to about the spot where the outer cupula terminates; but it is difficult to decide exactly what their extent may be, as all the specimens of this species in my posses-

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composé d'ecailles peltées, marquées d'une mammelon conique dans leur centre." One species only is mentioned,—*Cupressites Hulmanni*, Bronn, in Leonh. Min. Zeit.—Grès bigarré, (Bronn).

sion have a portion of the outer cupula remaining attached to their bases.*

In a specimen of this fruit which was fractured for examination, the inner cupula, at about the middle, was somewhat more than a line in thickness; and when examined with a microscopic power of one hundred and sixty linear, appeared to be composed of an irregular mass of cellular tissue. Within the cupula was found a single somewhat conical seed, four lines in length, and three and a half in diameter at its greatest circumference, which was at about one third of its height from the base. The seed was enveloped by three distinct and well-defined coats; the outer one was the one hundred and twentieth part of an inch in thickness,—the middle one the three hundred and thirty-third part of an inch,—and the inner one the one hundred and fiftieth part of an inch in thickness. The outer and middle coats appeared to be composed of minute irregularly-disposed cells, while the inner one was formed of a single layer of large elongated cells, disposed in lines radiating from the centre of the fruit, and presenting a very beautiful appearance when viewed with a microscopic power of one hundred and sixty linear. Between this third or inner coat and the seed, there was a thin stratum of shining granular *pyrites*, of about the same thickness as the true inner coat, and which had the appearance of being a fourth coat; but upon a close examination the inequality of its thickness, its brightness,—arising from its not containing any remains of carbonaceous matter, and the total absence of organic structure, proved it to be merely an infiltration of *pyrites* into a space which had existed between the inner coat of the testa and the seed. In a second specimen fractured for examination, the inner cellular membrane was found closely adhering to the surface of the seed. A longitudinal fracture of the seed afforded but very faint traces of cellular structure, and no indication of the presence of an embryo.

*The seeds of the common beech (*Fagus sylvatica*) are contained within a four-cleft cupula, which divides for only about two thirds of its length from the apex towards the base.

Figure 12 plate 10 represents a view of the apex of a very fine specimen of this species, belonging to the Canterbury Museum, for the loan of which I am indebted to the kindness of W. Masters, Esq. Fig. 10 is a view of the base of the same fruit, which is partly obscured by an incrustation of *pyrites*. Fig. 14 represents a small specimen of this species, having the divisions of the cupula wider apart than usual.

Figure 32 represents another small specimen. In this the divisions of the inner cupula are somewhat apart, but not to so great an extent as in fig. 14: *a* is the outer cupula; *b* the inner cupula; *c c*, portions of the seed seen through the partially opened cupula. Fig. 33 is a view of the base of the same fruit.

Cupressinites elongatus.

(Plate 10, figs. 15—18).

Fruit elongated, somewhat oviform: outer cupula short, obsoletely three-lobed; inner cupula three-cleft, sulcate. *Seed* single, oviform; testa rugose.

I have met with but four specimens of this fruit, and of these the two figured were in the best state of preservation: the unfigured specimens agree closely in size and form with the figured ones. The outer cupula, in this species, is smaller in proportion to the size of the fruit, and of less thickness, than in the last; and it also differs from it in being obsoletely lobed, as represented at *a* in figs. 16 and 18.

In the specimen represented at fig. 18, the lobes of the outer cupula are more produced than in the fruit represented by fig. 16: but as the outer cupula of the latter is not in so good a state of preservation as that of the former, I am inclined to believe that the form of the outer cupula in fig. 18 is the most correct.

Upon fracturing one of the unfigured specimens in a longitudinal direction, the seed, which was a mere hollow shell of *pyrites*, was unfortunately broken into so many pieces, as not to allow of

its form being determined with the same degree of accuracy as in the last species: but from the impression presented by the interior of the inner cupula, there is every reason to believe it to be oviform. The fragments of the seed displayed three distinct coats, very similar in structure and proportion to those of *Cupres. globosus;* but the surface of the outer one, unlike that of the last species, was distinctly rugose. The division in the cupula in the fruit represented by fig. 16, may be traced as far down as to the superior margin of the outer cupula.

Figure 15 represents a fruit in an erect position: fig. 16 the same fruit in a reversed position, exhibiting an irregular triangular aperture, from which the stalk has apparently been torn. Fig. 17 is a view of the apex of another specimen; *a* is a small patch of extraneous *pyrites:* fig. 18 is a view of the base of the same specimen.

Div. 2.—*Cupula single, three-cleft.*

Cupressinites recurvatus.

(Plate 10, fig. 19).

Fruit globose: cupula smooth, three-cleft; apices attenuated, recurved.

This is the only specimen I have seen of this species. It differs from the only species with which it might be confounded,—*Cupres. globosus,*—in the greater degree of attenuation of the apices of the three-cleft cupula, and in the points being distinctly and uniformly recurved. No trace of an outer cupula appears in this species.

I have not examined the interior of this fruit, but from a portion of the seed visible through the divisions of the cupula, at *a a*, fig. 19, plate 10, I believe it to be single, and probably very similar in structure to that of the preceding species.

Cupressinites subfusiformis.

(Plate 10, figs. 35 and 36).

Cupula somewhat fusiform, corrugated, three-cleft to about midway between the base and apex of the fruit.

I am indebted to Thos. Hunt, Esq., of Herne Bay, for this beautiful and unique specimen. It is six and a half lines in length, and five lines in diameter at about its middle, from which it decreases in size in about an equal degree to its base and apex, thus assuming a short fusiform figure. The epicarp is in a perfect state of preservation; it is exceedingly rugged, being covered from the base to the apex with deep irregular furrows, intermixed with faint aciculated lines, which run in a direction at right angles to the axis of the fruit. The peduncle appears to have been very slight, as scarcely a trace of its attachment to the base of the cupula remains. Not even the slightest appearance or impression of an outer cupula can be traced in this fruit.

Figure 35, plate 10, is a foreshortened view of the fruit in nearly an erect position, exhibiting its apex: fig. 36, plate 10, represents the base of the fruit.

Div. 3.—*Cupula four-cleft.*

Cupressinites curtus.

(Plate 10, figs. 20 and 21).

Cupula four-cleft, short; apices of the sections very obtuse.

This beautiful little fruit belongs to the Canterbury Museum, and is one of those with the loan of which I have been favoured by their able Curator, W. Masters, Esq.

The divisions in the cupula extend very nearly to its base, and are somewhat unequal in their proportions; *a* and *b*, fig. 20

plate 10, being five lines in length from their insertion on the stalk to their apices, while *c* is only four lines, and *d* but little more than three lines in length.* The interior of this specimen is unfortunately filled up with crystallized *pyrites*, and the exterior surface having suffered from a partial decomposition, I have been unable to gain any certain knowledge of its external structure: but to all appearance it has been somewhat rugose, or coarsely striated.

Figure 20 presents a view of the interior of the fruit, and the apices of the divisions of the cupula. Fig. 21 exhibits the base of the fruit, with a small portion of the foot-stalk, about a line in length, remaining attached to it.

Cupressinites Comptonii.

(Plate 10, fig. 34).

Cupula four-cleft, divided to the base, quadrangular; sections of the cupula unequal, the two opposite to each other being broad and obtusely terminated, while the alternating sections are narrow, and acutely terminated.

I found this beautiful and unique specimen in the collection of the Marquis of Northampton, who kindly favoured me with a loan of it. It is six and a half lines in height, and a little more than five lines in thickness from side to side. It is broadest at about one third of its height from the base, and gradually diminishes in size to the apex. The epicarp is in a fine state of preservation on three of the sides, where it is smooth, but gathered up into irregular rugæ, as if it had partially suffered by maceration, and had been slightly detached from the surface beneath before it became fossilized. The fourth side has lost the greater part of its epicarpal tissue; on the denuded portion are seen a

* This disproportion in the sections of the cupula frequently occurs in the fruits of the nearly-allied recent genus *Thuja*, and occasionally to a much greater extent than in our fossil specimens, especially in *Thuja orientalis*.

few vascular bundles, running parallel to each other, from near the base towards the apex of the fruit. A very small portion of the peduncle remains attached to the base; it is about a line and a half in diameter.

Cupressinites thujoides.

(Plate 10, figs. 22 and 23).

Cupula four-cleft, elongated; sections acuminate.

This fruit, in the number and form of the divisions of the cupula, as well as in the depth to which it is cleft, approaches very nearly to the fruit of *Thuja orientalis*, but differs from it in not being furnished with the spur on the exterior surface of the apex of each of the divisions of the cupula. Whether there have been two seeds situated at the base of each of the divisions of the cupula, as in the recent plant, *Thuja orientalis*, it is impossible to ascertain, as the interior of our fossil is so incrusted with extraneous *pyrites* as totally to prevent our determining this interesting point. A thin film of extraneous *pyrites* is spread over nearly the whole of the external surface of the cupula, which prevents us from gaining a satisfactory view of its structure; but from some small portions which are not thus obscured, it appears to have been somewhat rugose, and to have had a depression towards the middle of the base of each of the segments.

The divisions of the cupula are unequal in size: *a*, fig. 22, plate 10, is the smallest in the specimen figured, and is but six lines in length, while the longest is somewhat more than eight lines long, although a small part of its apex has evidently been lost; the other two sections are of intermediate dimensions. Fig. 22 is a view of the fruit in an erect position; and fig. 23 represents the base of the fruit.

Cupressinites crassus.

(Plate 10, fig. 9).

Cupula four-cleft; divisions fleshy, nearly triangular and terminating in a point.

The specimen figured is only the half of a cupula, but it is in so good a state of preservation as to afford us much interesting information.

The segments of the cupula are nearly of equal dimensions, and are so fleshy, that if a transverse section of one of them were to be made at about midway between its base and apex, the form it would present would be nearly that of an equilateral triangle. The external surface is lacunose and slightly depressed from the apex to very near the base. The middle of the internal surface, from the base to the apex of its segments, is projected forwards to so great a degree, as to form two out of three sides of an equilateral triangle, as represented at *c c*, fig. 9, plate 10; *d d* being the exterior surfaces of the two divisions remaining of the cupula. Upon each of these internal faces of the segments, there is a slightly depressed oval area, as represented at *e e*, fig. 9, indicating that each segment had been furnished with two seeds; and in this respect it agrees exceedingly well with its recent congener, *Thuja orientalis*, in which we find two seeds attached to the base of each segment of the cupula, which causes an angular projection down the centre of the interior surface of each, but not to so great an extent as in the fossil fruit. The seeds in the recent fruit of *Thuja orientalis* are oviform; and in this respect likewise they agree with those of our fossil, which, as far as we can judge from the impression left upon the segments of the cupula, are very similar in form. A small portion of the stalk remains attached to the base of the cupula, as represented at *b b*, fig. 9, plate 10; the lower figure being a view of the exterior of the fruit, and the upper one of the interior surface.

Div. 4.—*Cupula five-cleft.*

CUPRESSINITES SUBANGULATUS.

(Plate 10, figs. 24 and 25).

Cupula five-cleft: exterior surfaces of the segments subangular.

This beautiful specimen is the only one of the species which I have yet met with. The cupula is cleft to very nearly its base. The external surface is smooth, and each segment, when perfect, is carinated for about one fourth of its length from its apex downwards towards the base, when the carina resolves itself into two lines, which pass off in curves towards the respective sides of the base of the segments of the cupula, as represented at *a*, fig. 24, plate 10. In the specimen figured, the whole of the segments of the cupula do not present this appearance; upon two of them the characters are very clearly developed, upon one but very faintly, and upon the remaining two they are not to be traced at all; but as these last present a broader and more flattened aspect than the other three segments, it is probable that the absence of the carina and the two curved lines, may be attributed to accidental circumstances.

The nearest approximation to our fossil among the recent fruits with which I am acquainted, is presented by the fruit of a species of *Callitris* from the Swan River settlement, Australia, with which I have been furnished through the kindness of my friend N. B. Ward, Esq.; but the recent fruit differs from the fossil, in the cupula being divided into six segments instead of into five.

Figure 24, plate 10, represents the fruit in an erect position, with a small portion of the stalk remaining attached to its base. Fig. 25 is a view of the base of the same fruit, exhibiting the extent to which the cupula is cleft.

Cupressinites corrugatus.

(Plate 10, figs. 28 and 29).

Cupula five-cleft, segments lanceolate, somewhat concave, and corrugated on their outer surface.

I have seen but one specimen of this species of fruit. The cupula is somewhat depressed in form, fleshy, and divided nearly to the base into five equal segments; each of which is slightly concave towards the base of the exterior surface, as at *a*, fig. 28, plate 10: and the whole exterior surface of the cupula is very much corrugated. No part of the stalk remains attached to the fruit, but its point of attachment is marked by a small circular area, surrounded by an elevated fleshy ring, as represented in fig. 29, plate 10. Upon cleaving this fruit through its centre in a longitudinal direction, it proved to be filled up with fine granular *pyrites*, and no traces of a placenta, seeds, or organized structure could be detected.

Figure 28 represents the fruit in an erect position: fig. 29 is a view of its base.

Cupressinites sulcatus.

(Plate 9, fig. 22).

Cupula five-cleft, subovoidal, segments lanceolate, gibbous, smooth, with a single longitudinal sulcus in the centre of each external surface.

The cupula of this fruit is in an unusually fine state of preservation. It is divided down to its base into five equal gibbous segments; the external surface of each segment is perfectly smooth, with a shallow sulcus extending from the apex to about half way towards the base. The outer portion of the apices of the segments has been partially removed, apparently by decomposition previously to their becoming fossilized, as they do not present the

appearances usually produced by attrition. Each segment is composed of a series of layers of vegetable tissue, which project beyond each other in succession, from the lower portion of the fracture to the apex of the segment. At the base of the cupula, as at *a*, fig. 22, plate 9, there is an appendage which very much resembles the remains of an outer cupula: but I have been unable to prove it to be so, as I have seen no other fruit of this species, nor have I been able to detect organized structure in any part of its surface, with a microscopic power of one hundred and sixty linear. A portion of the stalk, about two lines in length, still remains attached to this supposed outer cupula. Appended to this stalk, and closely embracing it (as represented at *b b*, fig. 29), are two small, opposite, projecting masses, similar in size and form, separated by an equal space on each side of the stalk, and presenting every appearance of being the remains of the bases of two sessile leaves. It is possible that these singular appendages may be accidental; but their coincidence in form, size, and position, render it extremely probable that they are the remains of bracteal or other leaves: although in the species of *Callitris* alluded to in treating of *Cupressinites subangulatus*, as nearly allied to the fruits now under consideration, there are no indications of either a second cupula or of bracteal leaves, although an inch in length of the stalk remains attached to one of the specimens.

Cupressinites semiplotus.

(Plate 9, fig. 23).

Cupula spheroidal, five-cleft, slightly rugose; divisions about one third the length of the fruit.

The specimen figured is slightly compressed in a direction diagonal to its axis, but the normal form of the fruit appears to be spheroidal. It differs from the three preceding species in the cupula not being cleft for more than about one third of its length,

from the apex towards the base of the fruit. It is slightly rugose upon some parts of the cupula, especially near the base of that portion opposite to the side figured.

The divisions of the cupula are equal and rather gibbous; and upon one of them there is a slightly elevated line, extending from the apex of the section to near the base of the cupula: but as similar lines are not to be traced with any degree of certainty upon the remaining sections, we cannot place any dependence upon them as a specific character. The base of the fruit exhibits a slight depression, indicating the situation of the peduncle, of which organ no portion remains.

The specimen figured is the only one I have seen.

Cupressinites tesselatus.

(Plate 10, figs. 26, 27, 30 and 31).

Fruit globular, smooth, with five lateral and one terminal scutiform plates, the latter somewhat umbonate.

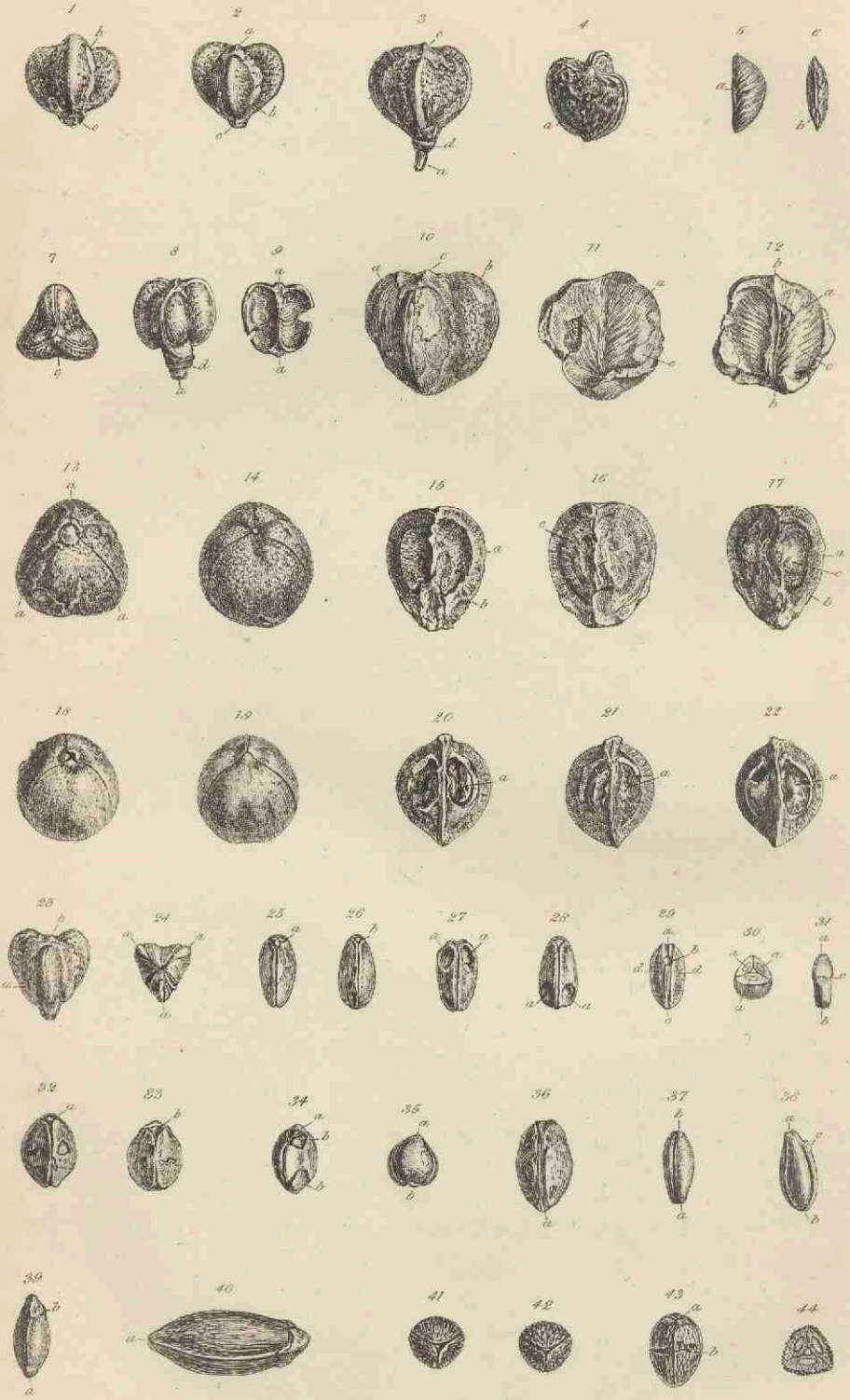
I have met with but three specimens of this fruit, which all agree in the number, form, and mode of arrangement of the parts of which they are composed. When not in a state of expansion this fruit is nearly globular, as represented by figs. 30 and 31, plate 10; the former presenting a view of it in an erect position, the latter exhibiting its base. Figures 26 and 27 are two views of a much larger specimen of the same species.

The external appearance of this fruit strongly induces me to believe it to be closely allied to the recent genus *Cupressus*, especially when compared with *Cupr. sempervirens*, the fruit of which is composed of an irregular number of broad peltate scales, supported upon very short pedicels, and each terminating in a prominent umbo, which projects from about the centre of the upper surface of the scale. Our fossil is, in like manner, composed of five lateral, scutiform, scales or plates, but without umbones,

fitting closely to a broad, angular base, as represented at fig. 31, plate 10, which is a view of the base of a fruit, with a small portion of the stalk (*a*) remaining attached to it. The five lateral plates do not extend to the apex of the fruit, which is formed by a sixth plate or scale, as seen at *a*, fig. 30, plate 10, and which, in this instance, is considerably more gibbous at about its centre than the lateral ones. This is also the case, although in a less degree, with the terminal plate (*a*) of the fruit represented at fig. 27, plate 10; but in the corresponding plate in the third specimen which I have, there is no difference in this respect between it and the surrounding ones.

In all the fruits of the recent species of *Cupressus* which I have hitherto seen, dehiscence seems to be effected by a gradual contraction of the masses forming the peltate terminations of the squamæ of the galbulus, by which means a sufficient space occurs between their edges to allow of the free egress of the seeds; but in our fossil, this would appear to have been effected in a very different manner. Figs. 26 and 27, plate 10, represent the largest specimen of this species which I have yet seen. The whole of the lateral plates, with the terminal one remaining attached to them, appear to have separated spontaneously from the broad angular base of the fruit, as not the slightest appearance of injury is visible upon any of the posterior edges of the lateral plates represented in fig. 26, plate 10, which is a view of the interior of the fruit given in fig. 27, plate 10. I should have been inclined to suppose the singularly expanded state of the fruit an accidental circumstance, had I not met with a third specimen, which, although very much smaller, agrees perfectly in the number, form, and position of its plates, with fig. 27.

It is much to be regretted that in both these expanded specimens, the interior of the fruit is filled up with extraneous *pyrites*, whereby we are prevented from ascertaining whether any portions of the pedicels of the scales still remain attached to them.



J.D.C. Sowerby Lith.

CUPANOIDES.

(Plate 11, figs. 1 to 24 inclusive).

Capsule superior, three-celled, three-valved, and three-seeded; dehiscence loculicidal. *Seed* erect, face straight: testa woolly. *Placenta* central, triangular.

The fruits composing this group appear to approximate very closely, in all their essential characters, to the description given by Cambessides of Aublet's genus *Trigonia*;* but in the form of the pericarp (the interior of which I have not seen), they differ very considerably from the specimen of *Trigonia* in the herbarium of the British Museum. The shape of the pericarp of *Cupania Americana* comes much nearer to the form of our fossil than that of any other fruit with which I am acquainted. The external form varies in a very trifling degree from that of fig. 8, plate 11, and the valves of the pericarp separate precisely in the same manner as in the fossil; but the seeds of the recent fruit differ materially from those of the fossil. In *Cupania* they are oviform, and have the base, and nearly half the seed, enveloped in a cupuliform arillus; the testa is destitute of all woolly or downy fibre; and the hilum is situated at the lowest point of the base of the seed: a few straggling downy fibres are found interlacing each other within the valves of the pericarp. In all these points it will be seen that the recent seeds differ materially from those of our fossils.

In the fossil fruits of this genus the epicarp is thin and membranaceous, the sarcocarp more or less pulpy or fleshy, and the endocarp membranaceous, somewhat like paper in its texture, and frequently presenting the appearance of a series of wrinkled lines. These lines, originating at the placenta, pass off towards the exterior of the pericarp in an ascending direction, as seen in figs. 11 and 12, which exhibit the interior of the fruit represented by fig. 10, after it had been fractured longitudinally

* See Lindley's 'Natural System of Botany,' 2nd Edition, p. 121.

through the valves *a* and *b*: the endocarpal membrane *a a*, figs. 11 and 12, having separated from the sarcocarp, remains attached to the seeds, a portion of one of which is seen through a fracture at *c*, fig. 11. The seeds (figs. 5 and 6, the former exhibiting a view of the side, and the latter of the face) were separated from a decomposing specimen of *Cupan. inflata*. The face *a*, fig. 5, is straight, and closely applied to the central triangular placenta. The hilum is situated a little above the basal point of the seed, as represented at *b*, fig. 6, and its point of attachment is nearly at the base of the placenta. The sides of both these seeds are compressed, and marked with wrinkled lines similar to those represented at *a*, fig. 12: the direction of these lines affords a ready means of distinguishing the base from the apex, when the seed is separated from the placenta, and when the hilum is not so apparent as it is in fig. 6. When the testa is viewed with a power of eighty linear, it is seen to be coated with a very fine thickly-set pile or down, the direction of the fibres of which is from the face towards the back of the seed.

When an attempt is made to fracture the capsules longitudinally, and in the line of their valves, the pericarp always divides into loculicidal sections; and in many fragments of these fruits which appear to have separated naturally, I have found that the division of the parts has always followed the same law. I have fractured many of the seeds in search of cotyledons and embryo, but without any satisfactory result; in two instances I observed a small, oval, black mass, near the base of the seed and opposite to the hilum, but I could not, with a microscopic power of one hundred and twenty linear, detect any traces of vegetable structure.

M. Ad. Brongniart, in his 'Prodrome d'une Histoire des Végétaux Fossiles,' page 129, under the head of *Canneæ*, appears to describe one of these fruits. He says,—"In a deposit of a much more recent date, namely, in the clay of the Isle of Sheppey, have been discovered several specimens of a fruit, which, in many respects, bears a great resemblance to that of *Amomum*. These fruits are in a very good state of preservation. They are triangular, much depressed, and umbilicate at the sum-

mit. They appear to have three valves; and the depression at the summit seems to present a very small circular area, which may indicate the cicatrix of an adherent calyx. All these characters agree with what we observe in the fruits of some species of *Amomum*.

"Notwithstanding this striking analogy, I am aware that other fruits, especially in their most important external characters, present nearly as well-marked a resemblance to these fossils. For example, not only do the fruits of several of the *Irideæ* and *Liliaceæ* agree with them in being equally three-angled and adherent to the calices, but even those of some dicotyledonous plants (such as *Gouania*) as well. However, in the fossil fruits, and in those of the *Canneæ*, we find a slight furrow in the centre of each plane surface, which furrow never could have existed in the fruits of *Gouania*, as the part where it occurs corresponds to the cell which, in that genus, contains the seed; while, in the *Canneæ*, it answers to the septum which exists in the centre of each valve.

"As we cannot positively affirm these fruits to be generically identical with those of *Amomum*, or of some other plant belonging to the family of the *Canneæ*, although we may have a strong presumption that such is the case, we shall give them the name of *Amomocarpum*, and leave them among the yet uncertain monocotyledonous plants." *

*"On a découvert dans un terrain d'une époque bien plus récente, dans l'argile de l'île de Sheppey, plusieurs échantillons d'un fruit qui a beaucoup de rapporte avec ceux des *Amomum*. Ces fruits sont très bien conservés; ils sont trigones, très déprimés et ombiliqués au sommet; ils paroissent à trois valves, et la dépression du sommet nous semble présenter une très petite aréole circulaire, qui indiqueroit la cicatrice d'un calice adhérent. Tous ces caractères s'accordent avec ce qu'on observe sur les fruits de quelques espéces d'*Amomum*.

"Malgré cette analogie frappante, je sais que d'autres fruits présentent avec celui-ci des rapports presques aussi marqués, surtout dans les caractères extérieures les plus importans. Ainsi non seulement les fruits de plusieurs d'Iridées et de quelques Liliacées, mais même ceux de quelques plantes dicotylédones, telles que les *Gouania*, sont également trigones et adhérens aux calices. Cependant on remarque sur le fruit fossile et sur les fruits des Cannées un léger sillon au milieu de chaque surface plane, sillon qui ne peut jamais exister sur les fruits des *Gouania*, cette partie correspondant

From the whole of this passage I have but little doubt that the fruits now under consideration are those described by Brongniart; and I am the more strongly confirmed in this opinion, from never having seen any others from the London clay, which answer so well to his description as our genus *Cupanoides*. It is true, there are some discrepances existing between our fruits and those described by the learned author of the 'Prodrome d'une Histoire des Végétaux Fossiles.' Thus, in no instance have I seen any indication of "a small circular area" upon the apex of the capsule; but, on the contrary, in the best-preserved specimens out of fifty-eight which I have in my possession, there is usually a slight projection at the junction of the valves, as represented at *c*, figs. 3, 7, and 10; and at the base of the fruit a projecting ring or collar, represented at *d*, figs. 3 and 8, which bears every appearance of having been the proper receptacle upon which the calyx and other parts of fructification were seated. It is also evident that M. Brongniart had not fractured any of the specimens in his possession, otherwise he would have been aware of the fact that each cell of the capsule contained but one seed, which at once removes our fossil from the genus *Amomum*. But let it be remembered that such discrepances may very readily arise, from the fruits under consideration being so subject to an alteration of their external surface through partial decomposition; and that, in addition to this, it is highly probable that M. Brongniart was not well supplied with specimens.—Under all these circumstances of the case, I have thought it advisable to apply another name to these fruits, and have adopted that of *Cupanoides*, as affording the best clue to their affinities among recent plants.

à la loge qui contient la graine; tandis que, dans les Cannées, elle répond à la cloison que chaque valve port sur son milieu.

"Ne pouvant pas affirmer l'identité générique de ces fruits avec ceux des *Amomum* ou de quelque autre plante de la famille des Cannées, quoique nous la présumions beaucoup, nous leur donnerons le nom d'*Amomocarpum*, et nous les laisserons parmi les monocotylédones encore incertaines."

Cupanoides lobatus.

(Plate 11, figs. 1 and 2).

Capsule three-lobed, apices of the lobes slightly projecting beyond the apex of the capsule: base attenuated: dissepiments very narrow. *Seeds* semicordate: base pointed.

The dissepiments of this species are so narrow as to cause the capsules to assume the appearance of three strongly-produced lobes, each of which is slightly elevated above the apex of the central axis of the fruit, *a*, fig. 2. The angles formed by the projection of the cells were filled up with extraneous *pyrites*, as seen at *b b*, figs. 1 and 2; but upon removing a portion of this substance from one of them, it was apparent that the dissepiments at that part could not have exceeded half a line in depth. The epicarp appears to have been removed by maceration; but a small part of the stalk, *c c*, figs. 1 and 2, remains attached to the fruit. The specimen represented by figs. 1 and 2, is the only one of this species that I have seen.

Cupanoides corrugatus.

(Plate 11, figs. 3 and 4).

Capsule three-sided, slightly gibbous near the base: apices of the valves on a level with the apex of the capsule: base attenuated. *Epicarp* corrugated.—*Seed* semicordate: base pointed: apex compressed laterally.

This beautiful fossil is one of the most common species of the present group. I have in my possession as many as eighteen fine specimens, six of which have more or less of the receptacle and peduncle remaining attached to them. Fig. 3 represents one of the finest of these, but is not quite in a state of maturity. When the capsule is fully matured, a transverse section at about midway between the base and apex forms nearly an equilateral triangle, the sides of which very slightly incline towards the axis

of the fruit. Near the base of the capsule the middle of each of the sides is slightly gibbous.

In the greater number of my specimens the epicarp is wanting; but in the fruit represented by fig. 4, and in several other well-preserved specimens, it exhibits an uneven corrugated appearance, as shown on the surface at *a*, fig. 4. The seed, when viewed sideways, presents a semi-cordate outline; at the apex it is very much compressed laterally, but towards the base it swells out suddenly and very considerably, so as to assume nearly the same form as that of the common edible mussel,—*Mytilus edulis*. The receptacle (*d*, fig. 3) is well preserved; and the remaining portion of the peduncle (*a*), when viewed with a power of eighty linear, exhibits the bark in a fine state of preservation: it is smooth, but somewhat wrinkled longitudinally. I have not been able to obtain a satisfactory view of the woody structure of the stalks, but from their general appearance should suppose it probable that these fruits have been the produce of trees or shrubs.

Cupanoides subangulatus.

(Plate 11, figs. 7, 8, and 9).

Capsule three-sided, angles obtuse: base nearly equal to the apex in breadth. *Epicarp* transversely corrugated. *Seeds* reniform, slightly compressed laterally at the base.

This species may readily be distinguished from all its congeners by the great obtuseness of the angles of the capsule, and by its expanded base, which is very much larger in proportion to the size of the capsule, than in any other known species. When viewed in the direction of the axis of the fruit, with the apex towards the eye, as represented at fig. 7, the sides are seen to curve inwards, but so slightly, that the outline bears the form of nearly an equilateral triangle, with the angles rounded off. The apex of the capsule is slightly umbonate at the junction of the valves, as represented at *c*, fig. 7. Fig. 8 is a view of the capsule in an

erect position, with one of the valves (fig. 9) removed, by which two of the seeds in fig. 8 are exhibited *in situ*, and the dissepiment *a a*, fig. 9, is exposed to view, together with the interior surface of the valve.

The seeds are reniform, and not so much compressed as those of the preceding species, but towards the base there is a slight degree of lateral compression.

The receptacle *d*, fig. 8, is in a good state of preservation, and is very much larger in proportion than that of *Cupanoides corrugatus*, fig. 3, *d*. Beneath the receptacle there remains a small piece of the stem, *a*, fig. 8, with a portion of the bark, which appears to be corrugated in a longitudinal direction. The peduncle is nearly twice the diameter of that of *Cupan. corrugatus*.

Cupanoides grandis.

(Plate 11, figs. 10, 11, and 12).

Capsule semilobate: angles somewhat obtuse: base ventricose. *Epicarp* smooth. *Sarcocarp* fleshy. *Seeds* mytiliform.

This is by no means a rare fruit: I have in my possession fifteen specimens. It is very variable in size; the smallest not exceeding five lines in length, and six in breadth from angle to angle, while the largest is eight lines long and ten wide: the whole of them agree in form and proportion. Fig. 10 represents one of the largest specimens I have seen; the apex of the capsule is umbonate at the junction of the valves, but in the greater number of specimens this is not the case, or but very slightly so.

The capsule is much more ventricose near its base than at any other part; and this appears to arise, in a great measure, from the seeds expanding in a lateral direction at about the point *c*, fig. 12, in consequence of which they very generally assume nearly the form of the *Mytilus edulis*, or common edible mussel: but when very strongly developed, as in the specimen exhibited by figs. 11 and 12, if viewed in a lateral direction, a tendency to

take somewhat of a reniform outline will be perceived, in consequence of the back of the seed, near the points opposite to *c*, figs. 11 and 12, being more produced than usual.

The sarcocarp, at the part midway between the base and apex of the capsule, is about a line in thickness; the cells of which it is composed are not arranged with any degree of regularity.—When viewed with a microscopic power of eighty linear, a few minute sacculi were observed, around which the cells assumed a radiating direction for a short distance: fasciculi of very minute vessels were also seen amid the mass of cellular tissue. A small portion of the stalk remaining attached to the base of one of the largest specimens of these fruits, measured one line and a half in diameter.

Figures 11 and 12 represent a capsule divided longitudinally; *a a* two of the seeds, *b b* the triangular placenta.

Cupanoides tumidus.

(Plate 11, figs. 13—17).

Capsule fleshy, tumid, largest towards the apex, which is slightly depressed; angles obscure. *Epicarp* covered with minute tubercles. *Seeds* somewhat mytiliform.

Figure 13 represents the base of this fruit, somewhat inclined towards the eye for the purpose of exhibiting the portions of the valves as they are seen at that part of the capsule. Fig. 14 is a view of the apex of the same fruit in a similar position to fig. 13. Figs. 15, 16, and 17 are views of the interior of the three valves of the same fruit, after having been separated from each other.

The capsule, in this fruit, appears to be considerably thicker in proportion than in any of the preceding species. At about midway between the base and apex (*a*, figs. 15 and 17) it is a line in thickness, and near the base (*b*, figs. 15 and 17) about a line and a half. It is tumid, and presents the appearance of having possessed a much more succulent sarcocarp than any

of the preceding species. The apex, as represented in fig. 14, is somewhat depressed, and there are also three longitudinal depressions immediately over and following the line of the dissepiments, but which gradually lessen in depth as they recede from the apex, and finally disappear before they have quite passed over one third of the length of the pericarp. The angles of the capsule, *a a a*, fig. 13, are very much rounded, and the epicarp is closely studded with minute, irregularly disposed, tubercles, which do not exceed the one hundred and fiftieth of an inch in diameter. Two of the seeds, *c c*, figs. 16 and 17, are seen *in situ;* they are large, and fill the whole of their respective cells. The apex is less acute than the base, and is somewhat compressed laterally, so as to cause the seed to assume, in a slight degree, the mytiloid form.

The fruit figured is the only specimen of this species that I have seen.

Cupanoides inflatus.

(Plate 11, figs. 18—22).

Capsule fleshy, inflated, apex umbonate; angles obsolete. *Epicarp* covered with minute tubercles. *Seeds*, apex acute, not compressed.

Figure 18 represents the base of one of these fruits in a position slightly inclined towards the eye: fig. 19 is a view of the apex of the same specimen in a similar position. Figs. 20, 21, and 22 exhibit the interior surfaces of the three valves of the same fruit separated from each other.

In its general appearance this species strongly resembles the preceding one, but differs from it in always having the apex of the capsule umbonate, and in the apices of the seeds being universally terminated nearly as acutely as their bases. Nor have I observed, in any one of the seven specimens of this species in my possession, any indication of the depressions immediately above and in the line of the dissepiments, which are so fully

displayed in *Cupanoides tumidus*, (fig. 14). In two out of the seven, the capsule is not nearly so much inflated as in the one represented by figs. 18 and 19, and the angles are more produced than those represented at *a a a*, fig. 13; but upon separating the valves of these two specimens, the difference was satisfactorily accounted for, by finding the seeds very much smaller in proportion, and the pericarp, although less inflated, considerably thicker, than the corresponding parts in the fruit represented by figs. 20, 21, and 22; thus indicating that the variation in form is to be attributed rather to the immaturity of the specimens under consideration, than to any specific difference.

The seeds in the sections figs. 20, 21, and 22, have been fractured longitudinally, so that each half of the cells has a portion remaining within it, excepting that represented at *a*, fig. 21. At *a a*, figs. 20 and 22, the nucleus, very much contracted in size, is seen through the fractured testa; but the best view of the seeds is offered by figs. 5 and 6, plate 11, which represent two of them in a particularly fine state of preservation. Fig. 5 is a side view, *a* being the face of the seed: fig. 6 represents the face of another seed, equally well preserved, with the hilum (*b*) situated a little above the base.

The minute tubercles upon the epicarp very closely resemble those upon the same part in *Cupanoides tumidus;* but they are not apparent upon the specimen figured, although very distinct in some others which I have obtained since plate 11 was engraved.

Cupanoides depressus.

(Plate 11, fig. 23).

Capsule sublobate: base attenuated, turgid: apex depressed, umbonate.

When plate 11 was engraved, I had but one specimen of this fruit in my possession, and was much inclined to believe it to be a variety, probably of *Cupanoides lobatus;* but since that period I have obtained another specimen, somewhat more fully

developed, but in other respects agreeing so exactly with the fruit represented by fig. 23, that I no longer hesitate to consider it a true species. In size and form the capsule comes nearer to those of *Cupanoides lobatus* than to any other species in the present group; but it is considerably more turgid towards the base. The latter character is not well exhibited in fig. 23, the specimen there represented being unfortunately obscured by patches of extraneous *pyrites*, which extend from the base to the apex, between each of the lobes: but in the better-developed specimen which I have since acquired, the distension of the capsule at the point corresponding to that indicated by *a*, fig. 23, is so great, that a transverse section of the fruit made at that spot would present, as nearly as possible, the three sides of an equilateral triangle.

The apex of the best-developed specimen is still more depressed than in the fruit represented by fig. 23; and at the junction of the valves, immediately above the summit of the placenta, there is a distinct and well-produced umbo, but which, in fig. 23, *b*, is scarcely perceptible.

I have not seen the seeds of this fruit; but judging from the turgid form of the base of the capsule, and the rounded and somewhat compressed apices of the lobes, I have little doubt of their being mytiloid in form.

I know not to which of the fruits of this genus M. A. Brongniart has applied the name of *Amomocarpum depressum*, but presuming from his description that it is this species, I have named it accordingly.

Cupanoides pygmæus.

(Plate 11, fig. 24).

Capsule depressed, diameter greater than its height: base attenuated, posterior and anterior halves equal.

When fig. 24 was engraved, I had not met with any other specimen of this fruit than the one there represented, and was therefore in some doubt whether to consider it a true species;

but since that time I have met with two others. One of these is a starved and meager specimen, while the other is somewhat rounded between the valves, and more fully developed than that represented by fig. 24.

In the specimen figured, which is better developed than the other two, the seeds are seen projecting from between the valves, as represented at *a a a*, fig. 24, which is a view of the fruit with the apex of the capsule presented to the eye. In both instances this appears to have arisen, not from this mode of dehiscence being a natural one, but from a partial decomposition of the sarcocarpal tissues near the angles of the capsule; as in both cases portions of the endocarpal tissue remain, closely enveloping the seeds. In all the three specimens the junction of the valves at the apex of the capsule is without either umbo or depression.

I have not seen the seeds of this species separate from the capsule, but to all appearance they are nearly the same in form as those represented by figs. 5 and 6, but less compressed laterally, and not quite so acute at the back. No vestige of the peduncle remains in either of the fruits.

TRICARPELLITES.

(Plate 11, figs. 25 to 44).

Capsule three-celled, three-valved, three-seeded; dehiscence septicidal.—*Seeds* erect, compressed from back to face: hilum a little above the base of the seed. *Placenta* central, triangular; angles tumid near the base.

The form usually presented by these fruits is that of an elongated, three-angled, capsule, as represented by figs. 25, 26, 32, 36, 39, and 43, plate 11. If a transverse section be made of one of these capsules, it will be found to consist of three cells, each containing a single seed, closely embraced by the capsule, as seen in the sections represented by figs. 30 and 44. When an attempt is made to separate the cells from each other, through

the line of the valves, they are always found to divide septicidally; the surfaces thus separated from each other present, under a microscopic power of eighty linear, even and unbroken faces, covered with a regular and beautiful reticulation, produced by impressions of the cells upon the thin membrane covering the cellular tissue of which the dissepiments are formed. None of these cells are broken into, as must inevitably have been the case had the plates of which the dissepiments are constructed, been naturally strongly cemented together. We are therefore, I think, justified in concluding, both from the structure of the dissepiments, and the facility with which the valves separate from each other, that the original mode of dehiscence of these fruits was septicidal.

The seeds contained within the cells are erect and somewhat compressed from back to front, as represented by fig. 31, *a* being the base and *b* the apex. These seeds, when in a state of maturity, very frequently have a slightly-curved line passing transversely over the back, as represented at *c*, and the space between this line and the base *a*, is very frequently more compressed than the remainder of the seed.

This would appear to arise from a singular occurrence which takes place in the capsules. In the fruit represented by figs. 27 and 28, there are three, uniform, deep excavations at the base of the pericarp, at the point marked *a* in both figures; and in this instance these excavations extend, not only through the walls of the capsule, but also deep into the substance of the seeds. But this is not always the case; as in some other instances of the occurrence of these excavations, the basal portion of the capsule is perforated, while the seed remains uninjured, being however marked in the manner represented at *c*, fig. 31. These perforations are not, as might have been supposed, the effects of the instinctive attack of an insect upon that part of the seed in which it is highly probable the embryo is situate, for I have in my possession some capsules in a very perfect state of preservation, the epicarp not being in the slightest degree injured, in which the transverse line *c*, fig. 31, is represented upon the epicarp, on one

of the valves, by an indented curved line, on the second valve by a raised line, but on the third face, there is no indication of it to be perceived. Hence it would appear that this curious circumstance is a natural habit of the fruit, and not an accidental mutilation.

Out of twenty-eight specimens examined in search of this peculiarity, the capsules of eleven were not perforated at all; eight were penetrated on one face, five on two, and four on all the three faces.

The hilum is situated at about the length of a line from the base of the seed, which is attached to the placenta by a short funiculus, the ninetieth part of an inch in diameter. The testa is thin, not exceeding the two hundred and fiftieth part of an inch in thickness, and is composed of four or five layers of cellular tissue; the cells in the outer layer being of a depressed form, and of greater size than in the inner ones, and giving the surface of the testa a beautifully reticulated appearance. The form of the areas is trapezoidal, and their diameter about the five hundredth part of an inch. In one seed, of which a transverse section was made, this outer layer of cells had separated from the other portion of the testa, for nearly three fourths of its circumference, from which it would appear that the outer layer of the testa was formed by it: but in other seeds examined in the same manner, there was no indication that the outer layer belonged to a coat distinct from the other cellular structure of the testa, except the marked difference in the size of the cells composing it.

The surface of the nucleus, when viewed with a microscopic power of eighty linear, is seen to be faintly striated longitudinally with fine aciculated lines, which, on a spot near the base of the seed where they were most distinct, were not more than the two thousand five hundredth part of an inch asunder.

The placenta is central and triangular, and extends from the base to the apex of the capsule. It is largest towards the base, and the angles are tumid near the spots from which the *funiculi umbilicales* originate; above this part it gradually decreases in size, and the angles become sharper, so that it assumes the form

of a well-defined prism. The funiculi originate from the faces of the placenta near its base, at points equidistant from its angles.

It is singular that among the number of specimens of this family which have passed through my hands, there should not exist upon any of them the slightest remains of the peduncle.

Tricarpellites communis.

(Plate 11, figs. 25—31).

Capsule smooth, largest near the base, gradually decreasing in size to the apex: length of the valves rather more than twice their greatest width. *Seeds*, testa reticulated.

I have twenty-three well-preserved specimens of this fruit, the smallest of which is three and a half lines in length, and the largest six lines: the whole of them agree in form and proportions. The capsule is smooth and even, and is largest at about one third of its length from the base. The length of the valves in proportion to their breadth, is as twenty-three to ten. The testa of the seeds of this species is beautifully reticulated; but when the seed is forcibly separated from the cell, by which it is closely embraced, the testa is usually left behind; the best specimens are obtained by allowing the capsules to become somewhat decomposed, when the seed generally retains the testa.

Figures 25 and 26 are two views of the same fruit; the former, at *a*, exhibits the base of the placenta, the tumid angles of which give it a three-lobed appearance. The latter figure, at *b*, displays the small triangular apex of the placenta.

Figures 27 and 28 are two views of a second specimen, exhibiting at *a* the deep excavations at the base of the capsule, described in the introduction to the fruits of this family. Fig. 29 exhibits the interior surfaces of one of the valves of a capsule separated from the placenta: *a* is the base; *b*, the *funiculus umbilicalis*; *c*, the angular groove impressed by the placenta; *d d* surfaces of the dissepiments. Fig. 30 represents a transverse

section at about the middle of the seed-vessel: *a a a* are three immature seeds, closely embraced by the fleshy valves of the capsule. Fig. 31 is a view of the back of a mature seed; *a* the base, *b* the apex.

Tricarpellites patens.

(Plate 11, figs. 32—34).

Capsule smooth, largest near the middle, decreasing equally towards the base and apex; breadth of the valves about four-fifths of their length.

I have met with but two specimens of this species; figs. 32 and 33 represent the finest of these, *a* being the apex and *b* the base. Fig. 34 is a view of the second specimen, which is not in so good a state of preservation as the former one: *a* is the apex of the fruit.

The capsule of this species, like that of *Tri. communis*, is smooth and even, but in other respects it differs materially. The broadest part of the valve is about equidistant from the base and apex of the fruit, and at this part its breadth in proportion to its length, is as four to five. The base and apex of the placenta in the fruit represented by figs. 32 and 33 are well displayed, and very much resemble those of the preceding species.

The fruit of which fig. 34 is a representation, is in a trifling degree longer in proportion than that given in figs. 32 and 33; but as it is also smaller, it is probable that this may arise from its not having arrived at so mature a state as the other.

I have not obtained the seeds of this species separate from the pericarp, but a portion of the nucleus is seen through the fractures at *b b*, fig. 34, by which it would appear that they are shorter and broader in their proportions than those of *Tri. communis*, represented by fig. 31. One of the valves of the smaller of these fruits is excavated at the base, in a manner similar to *a*, figs. 27 and 28; but the excavation is confined to the pericarp, and does not enter the back of the seed.

Tricarpellites curtus.

(Plate 11, fig. 35).

Capsule smooth, largest near the middle; breadth of the valves nearly equal to their length.

I have met with but three specimens of this species. Fig. 35 represents the only one that was in a perfect state of preservation; the remaining two are much mutilated, but their valves appear to have been somewhat less acute at their bases than those of the figured specimen.

The surface of the capsule is smooth and even. The average breadth of the valves in proportion to their length is as eleven to thirteen, and their greatest breadth is midway between the base and apex, or very little above that point. The seeds are broad and short in proportion to the valves, and the testa is reticulated. I have not seen the placenta of this species.

In fig. 35, *a* is the base and *b* the apex of the capsule, which is somewhat distorted in form.

Tricarpellites crassus.

(Plate 11, fig. 36).

Capsule smooth, largest near the middle; length of the valves somewhat less than twice their greatest breadth.

Next to *Tricarp. communis* this is the most abundant species of the present group. It varies considerably in size, but the proportions of the smaller specimens are not different from those of the larger ones. Fig. 36 represents the largest I have seen; it is six and a half lines in length, while the smallest is but four lines long.

The capsule is smooth and even, and the valves are widest at about midway between the base and apex, where their breadth

in proportion to their length is as fourteen to twenty-three. The seeds are long, and much compressed from back to front; the length of one of those belonging to the capsule represented by fig. 36, which was fractured longitudinally from back to face, was five lines and a half, and its thickness near the middle only about two thirds of a line.

Of seven specimens in my possession none were excavated at the base of the valves, in the manner represented at *a*, figs 27 and 28, but several of them exhibited the curved line, indicating their participation in that singular habit. The testa exhibits indications of being reticulated in a similar manner to that part in the preceding species, but I have been unable to obtain a satisfactory view of it.

Fig. 36 *a* represents the base of the capsule.

Tricarpellites gracilis.

(Plate 11, figs. 37 and 38).

Capsule smooth, or obsoletely striated longitudinally, largest towards the apex: base somewhat attenuated: length of the valves exceeding three times their greatest breadth.

I have seen but two specimens of this fruit, both of which I have figured. The general aspect and proportions of each are very nearly the same. The greatest breadth of the valves is at a point somewhat nearer to the apex (*b*, figs. 37 and 38) than to the base, and each is marked alike with faint indications of longitudinal furrows: their breadth is to their length as six to twenty.

The larger specimen has been perforated by an insect at *c*, fig. 38.

I have not seen the seeds of this species.

Tricarpellites aciculatus.

(Plate 11, figs. 39 and 40).

Capsule largest a little below the middle, covered with minute aciculated lines running in a longitudinal direction; length of the valves exceeding twice their greatest breadth.

This fruit may readily be distinguished from its congeners by the abundance of aciculated confluent lines which cover the whole of its surface in a longitudinal direction. The length of the valves in proportion to their greatest breadth, is as forty-six to twenty-one. The placenta is rather more tumid near its base than in some of the preceding species, but in other respects it is very similar in form.

I have not been able to obtain any further view of the seeds than that afforded by a transverse fracture of the pericarp: they appear to be somewhat less compressed than those of *Tricarp. gracilis*. Fig. 39 represents the fruit of its natural size, *a* being the base; the apex is unfortunately obscured from *b* upwards by a coat of extraneous *pyrites*. Fig. 40 is a view of the same specimen, magnified to twice the natural size, for the purpose of exhibiting the confluent aciculated lines upon the surface of the capsule; *a* the base of the seed.

This is the only fruit of the present species that I have seen.

Tricarpellites rugosus.

(Plate 11, figs. 41—44).

Capsule covered with irregular, coarse, longitudinal furrows. *Seed*, testa reticulated.

The marked rugose structure of the epicarp of this fruit readily distinguishes it from all the preceding species. Fig. 43 represents the capsule of the natural size; *a* being the base. The

length of the valves in proportion to their breadth, is as twenty to twelve, and their greatest width is very near the middle.—Fig. 44 represents a transverse section of the capsule, showing the placenta and the seeds *in situ*, the section being made at the point *b*, fig. 43. The testa exhibits a beautifully reticulated surface. Fig. 41 is a view of the apex of the fruit, and fig. 42 one of its base.

The capsule figured is the only one of the species that I have seen.

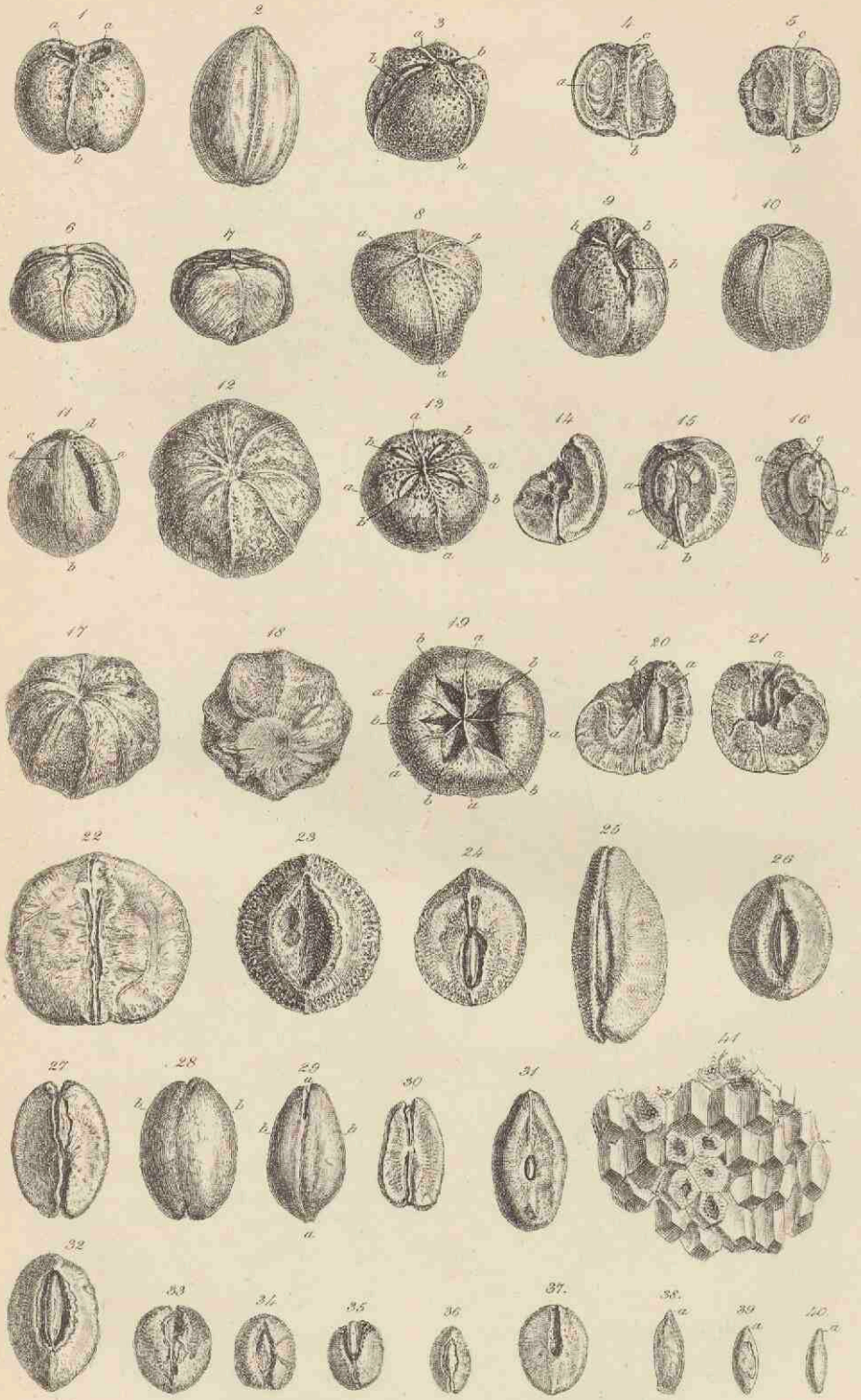
WETHERELLIA.

(Plate 12).

Fruit, pericarp three- four- or five-celled, each cell containing a single seed, enclosed within a thin compressed sac, the internal surface of which is pubescent. *Sac* containing the seed surrounded by pulpy cellular structure, which fills the whole of the remaining space in each cell, and which, when the fruit is ripe, is divided into two lobes by the expansion of the seed. *Seed* pendulous, compressed sideways, elliptical, nearly three times as long as it is broad, attached to a central placenta by a short funiculus, which passes off from the smallest end: testa reticulated.

I have named this genus in honour of my friend N. T. Wetherell, Esq., of Highgate, who, for many years, has made the London clay the especial object of his study, and to whom we are indebted for the knowledge of a considerable number of new and highly interesting species of fossils from that formation.

It is perhaps the most abundant of all the fruits found in the Isle of Sheppey, and is well known throughout the island by the name of Coffee, to which some of the sections of the fruit, when separated from each other, bear a very strong resemblance. In this state it is much more frequently met with than in the more perfect form. Figs. 22 to 37 inclusive represent a series of these portions of the fruit, which vary very considerably both in size



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and form, some of them exceeding an inch in length, while others are very little more than three lines. In some of the figured specimens, as in figs. 22 and 30, the seed is completely buried within its sac; in others, as in figs. 24, 25, 26, 27, 31, 32, 34, 35, and 36, it is more or less exposed to view; and in some instances, as represented in figs. 23, 33, and 37, it has escaped from the cell. The whole of these fourteen figures represent that surface of the sections of the fruit which is nearest the centre. Figs. 28 and 29 are views of the outer surface.

The pericarp is smooth and thin, being about the hundredth part of an inch in thickness, and is very rarely found in a good state of preservation. It is divided into two, three, four, or five sections by as many thin dissepiments, which appear to originate in, and to proceed from, the placenta, and which become thinner as they recede from it and approach the pericarp, as represented at *a* in figs. 3, 8, 13, and 19. Within each of these primary cells is a secondary cell or sac, situated about midway between the dissepiments forming the sides of the primary cells, as represented at *b*, figs. 3, 13, and 19; each of these sacs contains a single seed, as seen at *b*, figs. 3, 13, and 9. The remaining space intervening between the interior surfaces of the dissepiments (*a*, fig. 19) and the sac (*b*, fig. 19), is filled up with a coarse, pulpy, vegetable tissue, a portion of which is represented by fig. 41, as seen beneath a microscopic power of two hundred and twenty-five linear. It often happens that the cells are not so angular and regular in their form as those exhibited by the figure, but assume the appearance of a loosely-connected pulpy structure, very like that of the fruit of the orange tribe. The cells are often found either entirely empty, or with a loose ovoid mass of carbonaceous matter within them; and the walls frequently exhibit their duplicate structure, a thin line of carbonaceous matter marking the division between them.

The secondary cells or sacs of the pericarp differ materially in their structure from the primary dissepiments, the latter being formed of two plates of compressed cellular tissue, after the manner of fruits subject to septicidal dehiscence, having their surfaces

perfectly smooth; while the sacs are composed of a single layer of compressed, very minute, cellular tissue, and have their interior surfaces lined with an extremely fine pubescence, the fibres of which vary from the eight hundred and eightieth, to the two thousandth part of an inch in diameter, and are disposed in the direction of lines radiating from the centre of the fruit to its circumference. If one of the sections of the fruit, such as that represented by fig. 29, be divided longitudinally through the line *a a*, it will be seen that this secondary cell or sac is considerably larger than the seed contained within it, and that the portion of it which is situated without the marginal line of the backs of the seeds, *a a a*, figs. 4, 15, and 16, is closely compressed together; and in this state it extends to the interior surface of the pericarp, dividing the pulpy mass in which it is embedded into two equal parts, as represented by *b b*, figs. 28 and 29. From the form and disposition of these secondary cells or sacs, it is probable that each of them is composed of two valves, like those of the apple; but I have not been able to determine whether this is really the case, as I have not, in any instance, obtained them separate from the surrounding pulpy matter, which, in all stages of the fruit, appears to adhere strongly to their outer surfaces.

The seeds are compressed, elliptical, and nearly three times as long as they are broad, (figs. 38, 39, and 40). They are pendulous, and attached by their apices (*a a a*) to a central placenta, by a short curved funiculus, which passes off from an incrassate portion of the placenta, situated at about one third or one fourth of the length of the pericarp from its apex. Figs. 4, 15, 16, and 20, exhibit the seeds *in situ; b* indicating the apex of the fruit. The funiculus is not apparent in any of the specimens figured, but I have obtained a remarkably satisfactory view of it in a specimen fractured since this plate was engraved. The testa is beautifully reticulated, presenting, beneath a microscopic power of eighty linear, minute trapezoidal areas, of the average diameter of the six hundred and fiftieth part of an inch. I have been unable to detect any traces of cotyledons or of an embryo, although I have fractured numerous specimens in search of them.

It is a singular circumstance that among seventy-four specimens of this fruit, in which the whole of the sections are present, there is not one in a sufficiently perfect state of preservation to allow of our deciding which end is the base and which the apex: and it is only by the position of the seeds, and their pendulous mode of attachment to the placenta, that we have been enabled to determine this question.

There are circumstances attending the mode of dehiscence of this fruit, which are very remarkable. The general mode seems to be septicidal, the cells separating from each other through the middle of their common dissepiments, and presenting the appearance of coffee-shaped cocci, each having a single seed within its secondary cell or sac; in this form it is exhibited at figs. 22 to 37 inclusive. Another mode is by the solution of the apex and base of the fruit, and more especially of the latter, by which means the seeds are allowed to escape from their cells. Fig. 1 represents a two-seeded variety of the fruit in the latter state, *a a* being the bases of the two seeds exposed by the partial solution of the pericarp. The apex of the pericarp (*b*) has also lost a portion of its substance, but not nearly so much as the base. Fig. 13 represents a specimen of the four-seeded variety in a still farther advanced state of decomposition: so much of the base of the pericarp having been lost by solution that the seeds (*b*) project from the surrounding cellular tissue. The apex of this fruit also has suffered much from solution, but not to so great an extent as its base. Fig. 19 represents a perfect five-seeded fruit, in which this mode of dehiscence appears to have been completed, the solution of the base having gone forward to such an extent as to have consumed about one third of the length of the pericarp, and consequently to have allowed the whole of the seeds to escape. The apex also of this fruit has undergone solution to such an extent as to present five small orifices, evidently occasioned by the destruction of the apices of the five sacs which contained the seeds.

In these three instances of dehiscence by this mode, and in every other analogous case which I have seen, the solution of the

base has been in a greater proportion than that of the apex; so that the comparative state of perfection of the opposite ends of the fruit, when found in this state, affords a good approximate mode of distinguishing the base of the pericarp from the apex.—Of the seventy-four fruits of this genus in my possession, in which the whole of the sections are present, thirty-eight exhibited evidences of this mode of dehiscence.

There is a third mode of dehiscence which is sometimes observed, but which, when compared with the two former modes, is of rare occurrence; and this is by a separation of the fruit into sections through the sacs containing the seeds, instead of through the primary septa or valves of the pericarp. Fig. 11 represents a specimen of the four-seeded variety, in which solution of the pulpy cellular structure has taken place immediately over the sac containing the seed, which has consequently escaped through the orifice *a*, which also indicates the line of the true dissepiment of the pericarp. The section opposite to that indicated by *a* has not undergone solution to so great an extent, and the base of the seed is seen at *c*, projecting a little beyond the partially-dissolved cellular structure. At *d* a very slight degree of solution has taken place, while at *e* no action is observable, as neither the base nor the apex has suffered diminution. Fig. 9 exhibits a three-valved fruit. In this specimen both the bases and the apices of the sections are in a good state of preservation; but having been separated from each other to a considerable extent, in consequence of the solution before mentioned, the bases of the seeds are exposed, as seen at *b b b*. Fig. 3 represents a two-seeded specimen, in which this separation in the direction of the seeds has proceeded to a still greater extent, the seeds *b b* being exposed for nearly their whole length, and the valves of the fruit adhere to each other only where they are connected with the placenta.—The general mass of cellular structure near both the base and the apex of the fruit, remains in an undecomposed state.

The normal form of these fruits is best represented by figs. 17 and 12, which, in both instances, exhibit a view of the bases of the pericarps. Fig. 18 exhibits the apex of the fruit repre-

sented by fig. 17; and in this case it appears to be flat, and somewhat discoid. Fig. 12 is the largest specimen I have seen, excepting one, which had four seeds, and was thirteen lines in diameter, and nine in height. As the number of seeds decreases the fruits vary to a greater extent from the normal form; thus, we find them oviform, as in figs. 9 and 10; with the sections irregularly and greatly produced outwards, as in fig. 8, *a*; flattened or compressed, as in figs. 6 and 7, which are two views of the same fruit. In the two-seeded variety a still greater deviation from the normal form may be observed. Of these the compressed form, represented by figs. 1 and 3, is perhaps the most common; while the elongated variety, fig. 2, is of but rare occurrence: one very fine specimen in my possession exceeds fig. 2 in length by about a line and a half. Occasionally, but very rarely, we find them assuming the normal form. The sections of the fruit, which are found in such abundance in a state of separation, cannot at all times be referred with certainty to either of the described varieties, as they frequently differ from each other in size and proportion, even in the same fruit.

Wetherellia variabilis.

(Plate 12, figs. 1—40).

Fruit, when perfect, five-valved and five-seeded, diameter greater than its height, somewhat pomiform: frequently four- three- or two-seeded by abortion.

These fruits having been sufficiently described in the course of the enumeration of their generic characters, it is unnecessary to enter further upon the subject than to refer the reader to the following description of the plate.

Figures 1, 2, and 3, specimens of the two-seeded variety.

Figures 4 and 5, a two-seeded variety divided through the plane of the seeds. Fig. 4 exhibits the seeds *in situ;* fig. 5, their impression on the corresponding half of the fruits; *b* the base of the pericarp; *c c* the placenta.

Figures 6, 7, 8, 9, and 10, represent specimens of the three-seeded variety.

Figures 11, 12. and 13, fruits of the four-seeded variety.

Figures 14, 15, and 16, a four-seeded fruit separated into three pieces, so as to exhibit the seeds *in situ* at *c c c*, and the placenta, *d d*, figs. 15 and 16.

Figures 17, 18, and 19, two four-seeded fruits.

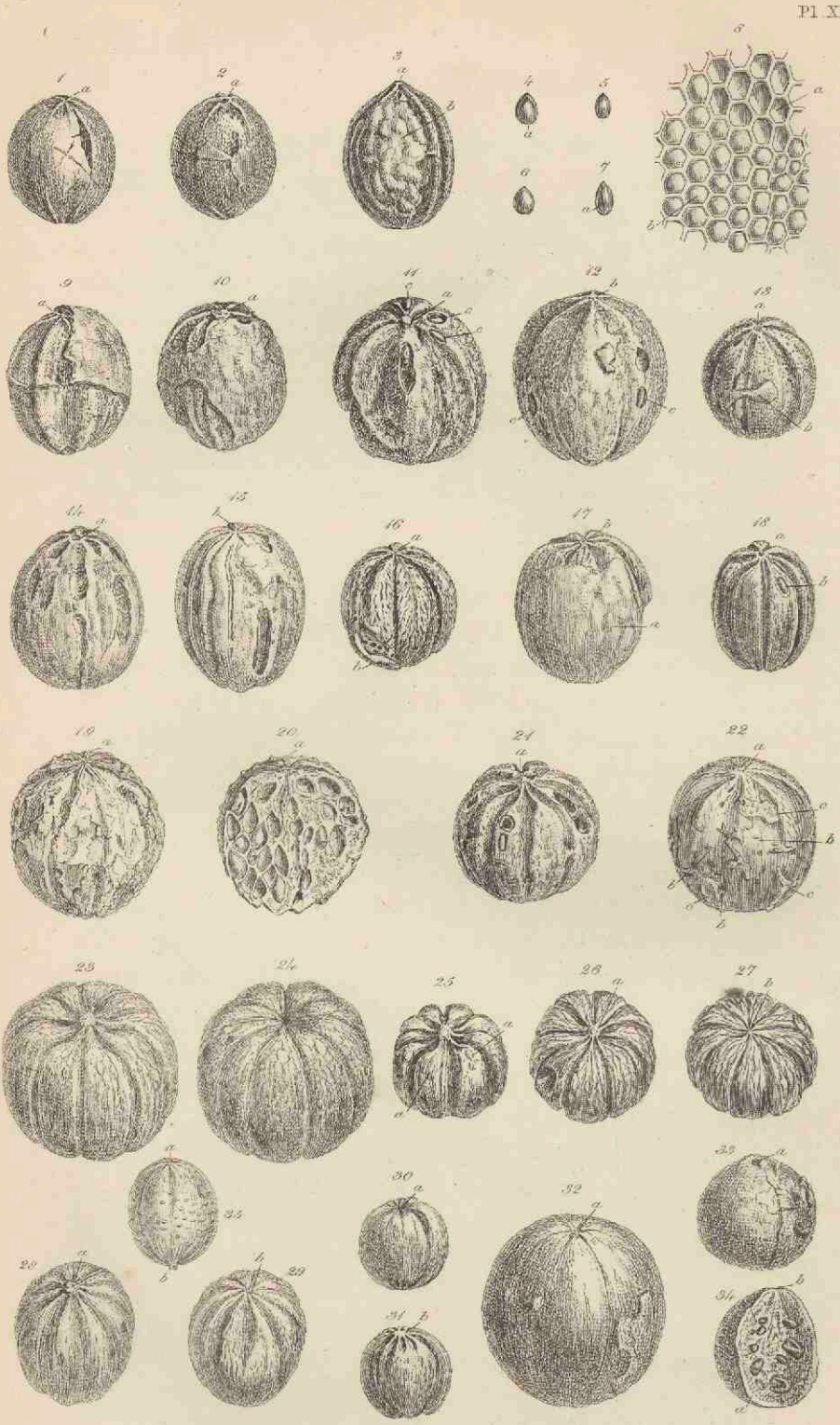
Figures 20 and 21, a five-seeded fruit divided to show the seeds, two of which are seen *in situ* at *a a*.

CUCUMITES.

(Plate 13, figs. 1—35).

Pepo succulent, one-celled, many-seeded. *Seeds* ovate, enveloped in a thin membranous arillus.

All the parts of these fruits so closely resemble those of various members of the recent genus *Cucumis*, both in their outward form and their internal structure, that no reasonable doubt can remain of their being true *Cucurbitaceæ*. The succulent one-celled nature of the fruit, the number and disposition of the seeds, and the thin membranous arillus surrounding them, so strikingly point out their alliance to their recent congeners, as to render it unnecessary to enter into a detailed description of their generic characters. I shall therefore refer the reader, who may require further information respecting the recent genus *Cucumis*, to DeCandolle's 'Prodromus,' or to any other modern botanical work which treats of the same subject; and, for an account of the anatomical structure of these plants, I must refer him to the following description of the specific characters of *Cucumites variabilis*.



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Cucumites variabilis.

(Plate 13, figs. 1—34).

Pepo round or somewhat oval: epicarp tuberculated: placental mass many-lobed. *Seeds* numerous: arillus loose, membranaceous: testa reticulated.

I have in my possession more than seventy fine specimens of this fruit: the smallest is but four lines in length, while the largest is thirteen and a half lines long. The normal form appears to be spheroidal, as represented in figs. 19, 23, 24, and 25, and in fig. 20, which is a view of a longitudinal section through the axis of the fruit represented by fig. 19. But in consequence of the extremely succulent nature of these fruits, and their great liability to compression, they vary from this form in every possible degree, according to the direction of the line in which they have been compressed. Thus, the specimen represented by fig. 3, is seven lines broad, while its greatest thickness does not exceed four lines; on the contrary, the fruit represented by figs. 26 and 27, having been compressed nearly in the direction of its axis, is nine lines in breadth and but seven in length. The fruits represented by figs. 14, 15, and 18, have undergone considerable compression in a lateral direction, and to this cause they are evidently indebted for much of their greater proportional length.

When the pericarp is in a good state of preservation, as in the fruits represented by figs. 1, 2, 32, and 33, there are few or no traces of the strongly-produced lobes, which are buried beneath its surface. In other cases where the pericarp is well preserved, as in the specimens represented by figs. 11, 12, and 22, there are stronger indications of their presence, probably from a softening of the substance of the pericarp by maceration, previously to its becoming fossilized, and a partial contraction of the highly succulent mass beneath, which fills the spaces between the lobes. For although the side of the fruit represented by fig. 22 presents strong indications of the presence of the lobes, the

opposite side is perfectly round and even, and without the slightest appearance of the existence of the lobes beneath.

The base of the pericarp is not very readily to be distinguished from the apex, the scar left by the calyx being small, inconspicuous, and very rarely visible, while the point of attachment to the peduncle is generally indicated only by a slight depression of the surface; sometimes, although rarely, there is a small perforation, as represented at *a*, fig. 33. In the specimens which have lost the pericarp these points may more readily be distinguished, the base being usually indicated by a small tumid mass, as in figs. 21, 23, 25, 26, and 28, while the apex is devoid of such an appendage, as seen in figs. 24, 27, and 29.—Another indication of the base is a greater proportional degree of attenuation of the lobes of the interior mass of succulent matter at their bases, as represented in fig. 23, than is observable at their apices, as shown in fig. 24, which exhibits a view of the apex of the fruit the base of which is represented by fig. 23.

When the epicarp is in a perfect state of preservation, it is thickly studded with minute, elongated, warty excrescences, the apices of which are sharply carinated, and their greatest length is in the direction of lines at right angles to the axis of the fruit. The specimen represented by fig. 35 exhibits these excrescences to a greater extent than any other that I have seen. In the fruit represented by fig. 22, they are thinly scattered over the side opposite to that shown in the plate; and in the specimens represented by figs. 11, 12, 30, and 31, only very faint indications of them remain.

The sarcocarp varies in thickness according to the size of the fruit. At *a*, in the section represented by fig. 34, it amounts to about one third of a line: in the fruit represented by figs. 9 and 10, it is about half a line in thickness immediately over the most prominent part of the lobes beneath, but its thickness is considerably greater above the spaces between the lobes, since it descends into these spaces, and completely fills them up.

When a section of the pericarp, at right angles to the axis of the fruit, is viewed with a microscopic power of eighty linear,

it presents the appearance of an irregular mass of cells; those nearest the epicarp being very much compressed and distorted, but becoming larger and more definite in their form as they approach the endocarpal membrane.

The whole of the interior of the pericarp is filled with the placentæ* and seeds. When entirely free from the pericarp the mass appears to be divided into lobes or sections, as represented in figs. 13, 16, 18, 21, 23, 24, 25, 26, 27, 28, and 29. The number of lobes presented by sixty-eight fruits is as follows. Two were five-lobed, twenty-two six-lobed, twenty-two seven-lobed, fifteen eight-lobed, five nine-lobed, and two ten-lobed.—At the base and apex of these lobes, there is frequently an indication of the existence of the dissepiments, as at *a*, in figs. 1, 2, 9, 10, 19, and 20; but this is a deceptive appearance, as not the slightest vestige of such organs could be detected in any of the numerous specimens which I have fractured at right angles to the axis of the fruit in search of them.

The placentation of this fruit is anomalous and exceedingly curious. I have made numerous sections, both in the direction of the axis and at right angles to it, but have been unable to discern its origin or mode of development. Viewed with a microscopic power of thirty-five linear, the appearance is that of a spongy mass, hollowed out into numerous irregular cavities, which are filled with highly-succulent cellular structure, the cells being loosely disposed, round or oval in form, and scarcely ever with any appearance of angularity. The substance bounding these cavities is dense in its structure, and exhibits but faint traces of organization. The seeds are embedded in the mass without any apparent order or arrangement, as represented in fig. 20, which is a view of a longitudinal section through the centre of the fruit represented by fig. 19. Fig. 34 also exhibits a longitudinal section of the fruit given in fig. 33; but in this specimen the seeds are neither so numerous nor so well developed as in the former one.

* Presuming them to be three in number, and parietal, in accordance with the recent members of the natural order *Cucurbitaceæ*.

The seeds are ovate, with the apex acuminate, (figs. 4, 5, 6, 7). Occasionally, when very fully developed, they approach nearly to an ovoid form, but they usually exhibit a considerable degree of compression. They are enveloped in a thin membranous arillus, which, in some cases, exists in the form of a filmy carbonaceous coat surrounding the seed; under more favourable circumstances it is composed of *pyrites*. When viewed with a microscopic power of one hundred and twenty, it appears to consist of fine reticulated tissue, the reticulations being very much elongated in the direction of the axis of the seed, so as to cause it to assume the appearance of being finely striated in that direction, the striæ being the two thousand eight hundred and fifty-sixth part of an inch asunder.

In some specimens the arillus is immediately incumbent on the testa; in others there is a slight space between them, which is filled with bright, semi-crystalline *pyrites*. The surface of the testa is beautifully reticulated, and when viewed with a microscopic power of one hundred and twenty linear, presents the appearance represented in fig. 8, plate 13. The average diameter of the reticulations, when measured at right angles to the axis of the seed, was the one thousand four hundred and fortieth part of an inch. Sometimes the areas of the reticulations are depressed, as represented by the cells at *a*, fig. 13; while in other parts of the same testa they are protuberant, as at *b*, fig. 13. This depression of the areas appears to arise from the absence of the cells, their impression alone remaining. And this was demonstrated to have been the case, in one instance, in a very striking manner, the reticulations and depressed areas being composed of shining yellow *pyrites*, while the protuberant areas or cells consisted of black, shining, carbonaceous matter, presenting to the eye, when viewed with a microscopic power of one hundred and twenty linear, the appearance of a beautiful mosaic work, composed of hexagons of polished jet, set in a shining ground of gold-coloured metal. Within the testa we find a nucleus formed of two cotyledons, which, in well-developed seeds, fill the whole of the interior; but in some instances they do not extend from the

base for more than about two thirds of the length of the testa; the inner surfaces of which, for the remaining space, are closely pressed together. We occasionally find very flat seeds, presenting every appearance of having been barren, the sides of the testa mutually approaching each other, or one of them cupping inwards until it reaches the internal surface of the opposite side.

The cotyledons are covered with a fine reticulated integument, the interstices of which are four sided, and arranged in a somewhat quincuncial order, or evenly dispersed over the surfaces, not disposed in lines like the cells of the testa, or the reticulations of the arillus. The hilum is situated at *a*, fig. 4: in the fully-developed seeds it is nearly round, in those of a compressed form it presents an oval figure. Its circumference assumes the form of a double ring, the outer one being the turgid base of the arillus, while the inner one is that of the testa. Its diameter, in a large-sized mature seed, including the base of the arillus, was the ninety-fifth part of an inch.

In size and form these interesting fruits are so exceedingly variable, that when I first examined them, I was much inclined to believe that there would prove to be at least as many as five or six species; but upon a subsequent investigation of the internal structure of the pericarp, and of the form and structure of the seeds, and by a comparison of the figured specimens with a considerable number of others, which I have received since the plate was engraved, I am induced to be of opinion that the variations in size and form do not amount to specific distinctions, and especially as the greater number of the fruits which I have seen, are deprived of the pericarp. I have therefore divided them into the following varieties.

Variety A.—*Placental mass five-lobed.*

Figure 1 represents a fruit which has lost its epicarpal membrane, but which has the sarcocarp in a nearly perfect state of preservation: *a*, the apex of the fruit.

Figure 2 is a view of the contrary side of the same fruit: *a*, the base.

Figure 3, a second specimen with five lobes, much compress-in a lateral direction: *a*, the base of the pericarp; *b*, a mass of extraneous *pyrites*.

Figures 4, 5, 6, 7, seeds separated from the placental mass, and representing the varieties in size and form which frequently occur in the same fruit: *a*, fig. 4, is the base of the seed.

Figure 7 represents a seed, apparently abortive, one side of the testa having cupped inwards at *a*, so as nearly to approach its opposite side.

Figure 8 is a view of the testa, as seen with a microscopic power of one hundred and twenty linear: *a*, a part with the areas of the reticulations depressed, *b*, with the areas protuberant.

Variety B.—*Placental mass six-lobed.*

Figures 9 and 10, two views of a fruit which has lost the greater part of the pericarp, but in which the epicarp is obscured by a thin coat of extraneous *pyrites*..

Figures 11 and 12, two views of a fruit which has the pericarp nearly perfect; *a*, the base; *b*, the apex; *c*, seeds projecting through apertures in the pericarp.

Figure 13, a smaller specimen of the same variety, in which the pericarp is entirely wanting: *a*, the base, *b*, a small patch of extraneous *pyrites*.

Variety C.—*Placental mass seven-lobed.*

Figures 14 and 15, two views of a fruit which has been compressed in a lateral direction, and has lost a considerable portion of its pericarp: *a*, the base, *b*, the apex.

Figure 16, a smaller specimen of the same variety, which has entirely lost the pericarp: *a*, the apex of the fruit; *b*, a patch of extraneous *pyrites*.

Figure 17, a specimen upon which a portion of the pericarp remains, but which has the epicarp obscured by a thin coat of extraneous *pyrites*: *b*, the apex of the fruit.

Figure 18, a small specimen which has suffered much by com-

pression in a lateral direction: *a*, the base of the fruit; *b*, a seed embedded in the placental mass.

Variety D.—*Placental mass eight-lobed.*

Figure 19, a fruit which has lost the epicarp, but which has nearly the whole of the sarcocarp remaining. The upper portion of the figure exhibits the apex, with the fallacious appearance of dissepiments.

Figure 20, a longitudinal section through the centre of the fruit represented in fig. 19, exhibiting the mode in which the seeds are embedded in the pulpy placental mass.

Figure 21, a fruit which has lost the whole of its pericarp: *a*, the base, exhibiting the attenuation of the bases of the pulpy lobes of the placental mass, which causes the fallacious appearance of dissepiments in some specimens.

Figure 22, a fruit which has the pericarp in a very perfect state of preservation: *a*, the apex of the fruit; *b b b*, minute, elongated, warty excrescences which are found upon the epicarp when in a perfect state of preservation; *c c c*, patches of extraneous *pyrites*.

Variety E.—*Placental mass nine-lobed.*

Figures 23 and 24, two views of a fruit which has lost the whole of its pericarp. Fig. 23 exhibits the base, and fig. 24 the apex of the fruit.

Figure 25 presents a view of the base of a small specimen of the same variety which has lost its pericarp: *a a*, seeds embedded in the placental mass.

Figures 26 and 27, two views of a fruit which has lost its pericarp, and which has been compressed in the direction of its axis: *a*, the base, *b*, the apex.

Variety F.—*Placental mass ten-lobed.*

Figures 28 and 29, two views of a fruit which has lost its pericarp: *a*, the base, *b*, the apex.

Figures 30 and 31, two views of a small specimen of the same

variety, which has lost but a small portion of the pericarp: *a* the apex, *b*, the base of the fruit.

Figure 32 represents a fruit of the variety D, which has lost its epicarp, but which has the sarcocarp in a remarkably fine state of preservation: *a*, the base of the fruit.

Figure 33 is a view of a fruit which has lost the epicarp, but which has the sarcocarp in a very fine state of preservation: *a*, the base of the fruit.

Figure 34, a longitudinal section through the centre of the fruit represented in fig. 33, exhibiting the seeds embedded in the placental mass: *b*, the base of the pericarp.

Figure 35 represents a very beautiful little fruit of the variety B, which has a portion of its pericarp in an unusually fine state of preservation, and which exhibits the minute, elongated, warty excrescences of the epicarp in a very distinct manner: *a*, the apex of the fruit; *b*, the base, with a small portion of the stalk remaining attached to it.

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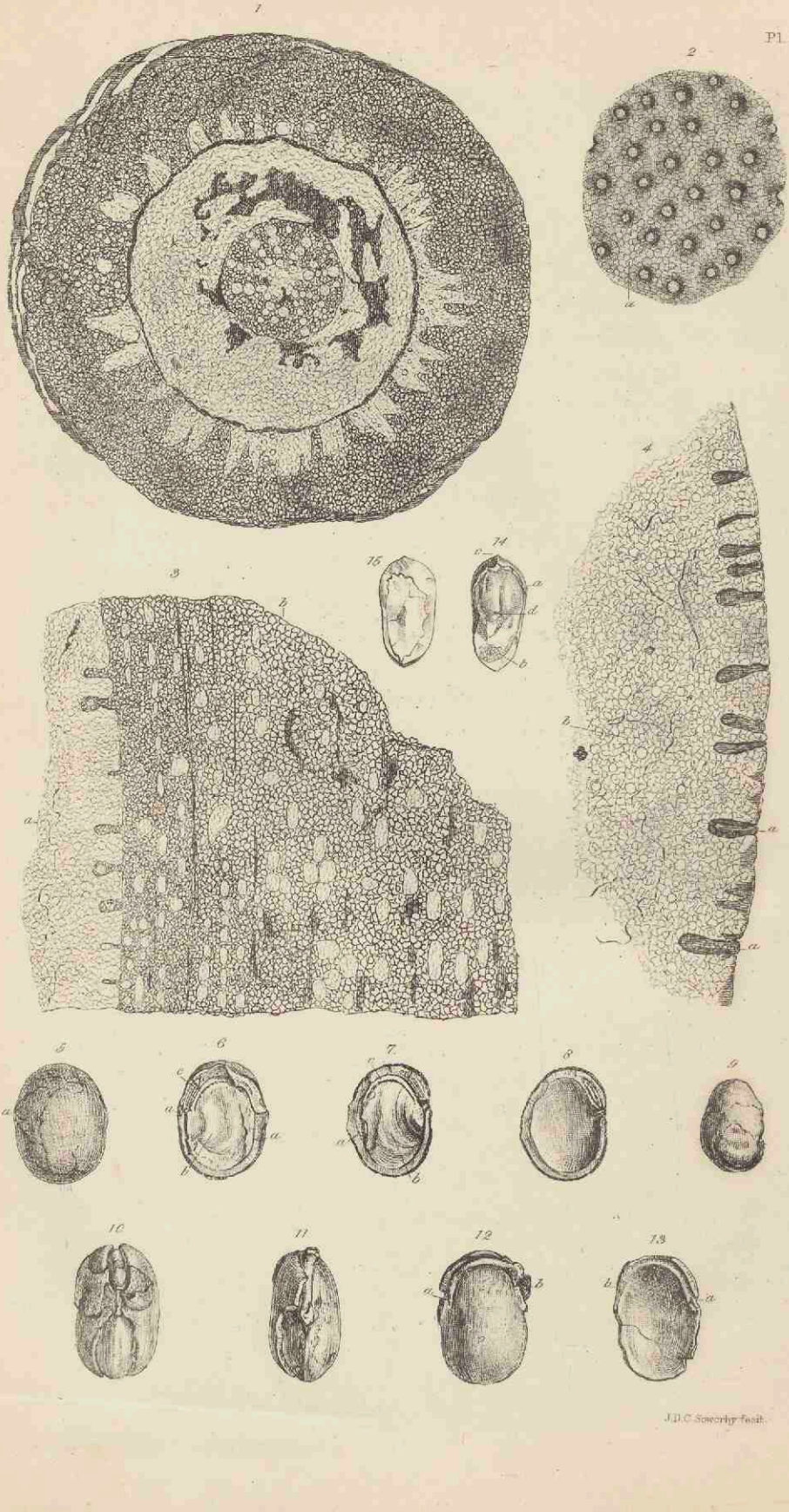
(Plates 14, 15, and 16).

Seeds bean-shaped: testa coriaceous: nucleus covered with minute punctæ, and furnished with a funiculus passing beneath the testa, round the end of the seed, to a point nearly opposite to that where it had its origin, at which place it emerges from beneath the testa. *Embryo* central, anatropous, the radicle occupying the end of the seed round which the funiculus passes.

In external form these singular seeds very closely resemble several species of our common garden beans, such as *Faba sativa* and *Phaseolus vulgaris* and *multiflorus;* but in other respects they differ from every true leguminous seed that I have hitherto seen. The form most frequently to be observed is that of the seed of the common scarlet runner of the gardens (*Phaseolus multiflorus*), with slight variations, such as are represented in plates 15 and 16.

The testa closely envelopes the seed, and is, in some species,



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as much as a line in thickness, but does not usually exceed about half a line. Fig. 5 plate 14 represents one of these seeds, with the testa in a good state of preservation; figs. 6 and 7 exhibit the same seed cleft in a longitudinal direction, *a a* being the testa, and *b b* the two halves of the nucleus. Fig. 8 represents the same half of the seed as fig. 7, but from which the fractured half of the nucleus represented by fig. 9 has been removed, so as to exhibit the internal surface of the testa, which is smooth, and without any impression from the surface of the nucleus. When the testa is fractured in the direction of a line either parallel, or at right angles, to the axis of the seed, it presents the appearance of numerous circular and oval areas, of the average diameter of the four hundredth part of an inch, thickly dispersed amid a mass of small irregular cells, as represented at *b*, fig. 3, plate 14, *a* being a small portion of the nucleus to which the testa is attached. The fine reticulated lines represented within these circular and oval areas, have their origin in the crystalline form of the *pyrites*, and are not any portion of the original organic structure of the part. The testa is very rarely found perfect, as in fig. 5, plate 14; and is frequently entirely wanting, as in figs. 18 to 25, plate 16. Occasionally a portion only remains, as represented in fig. 10, plate 16, and figs. 10, 13, and 33, plate 15.

The nucleus is closely embraced by the testa, and when separated from it, presents a singularly close resemblance to the united cotyledons of some species of leguminous seeds when deprived of their testa, excepting that we do not, in any case, find even the slightest indication of an embryo, in the same relative situation we should expect to find it in, were the seed one belonging to the true *Leguminosæ*. The surface of the nucleus in the fossil, is also widely different from that of the cotyledons of any leguminous seed that I have yet seen, being furnished with numerous depressed circular areas, from the centre of each of which projects a slightly-elevated cylindrical body, as represented at fig. 2, plate 14, with a microscopic power of two hundred and twenty-five linear. Upon making a transverse section of the nucleus, and viewing it with the same microscopic power, it ap-

pears as represented at *a a*, fig. 4, plate 14, proving that these circular areas are the mouths of pits or sacs, which penetrate the nucleus to a considerable depth: the cylindrical bodies projecting from the areas, as represented in fig. 2, plate 14, and at *a a*, fig. 4, plate 14, being merely masses of *pyrites* with which they have been filled up on becoming fossilized. The mouths of the sacs vary from the six hundred and twenty-fifth to the eight hundred and thirtieth part of an inch in diameter, and their depth is upon an average, the three hundred and sixty-fourth part of an inch. They are occasionally much more numerous than in the specimen represented by fig. 2, plate 14; and in one specimen examined they were only the one thousand six hundred and sixty-sixth part of an inch apart, or about half of one of their own diameters. The mass of the nucleus is composed of minute, compressed, cellular tissue, as represented at *a*, fig. 3, and *b*, fig. 4, and also at *a*, fig. 2, plate 14; where it gives to the whole surface of the nucleus a beautifully reticulated appearance.

Upon examining that part of the seed where we should expect to find the hilum in a leguminous fruit, we discover none of the usual appearances which indicate the point of attachment to the placenta; but in their stead we generally find a slightly-tumid projection, as at *a*, fig. 5, plate 14. On carefully removing the testa, this projection is found to be the point of insertion of a singular funiculus, which, having its origin at this spot, as represented at *a*, fig. 12, plate 14, passes round the end of the nucleus beneath the testa, and emerges from it at about the point *b*, fig. 12, plate 14. Fig. 13 in the same plate is a view of the internal surface of the half of the testa removed from the seed represented by fig. 12, showing the impression of the funiculus from its insertion, *a*, to the spot *b*, at which point it passes out of the testa. Fig. 11, plate 14, is a view of the same seed, in the direction of a right angle to the position of fig. 12. Fig. 10 is a view of the edge of the seed contrary to that represented by fig. 11, and before it had been deprived of any part of its testa.

This mode of attachment of the seed to the placenta is exceedingly singular; and I am not aware of any instance among

recent plants in which the *funiculus umbilicalis* passes in a similar manner beneath the testa, before it emerges from the seed, thus removing the hilum from its usual position as regards the placenta, into precisely the opposite situation to that in which we should naturally expect to find it.*

Upon making a transverse section of the funiculus, and viewing it with a microscopic power of two hundred and twenty-five linear, it presented the appearance represented by fig. 1, plate 14, and appeared to be formed of three distinct layers; the inner one consisting of indistinct and irregular cells, with layers of apparently vascular tissue radiating from the centre; the outer one of an indistinct mass of what appeared to be principally, if not entirely, cellular structure; and the intermediate layer of a mixture of vascular and cellular tissue, portions of which appeared to radiate from, and to penetrate into, the substance of the surrounding outer layers. A longitudinal section of a small piece of a funiculus presented some distinct portions of annular or spiral vessels, apparently belonging to the central layer; but the fracture was so irregular as not to allow of their position being determined with certaity.

Upon examining, for the sake of comparison with the fossil funiculus, a transverse section of the funiculus of the seed of a recent *Acacia* from New Holland, I found the centre of it to be composed of numerous large vessels, with a single, thick, outer layer of cellular tissue. The spurious funiculus of the hasel-nut, when examined with the same power and in a similar manner, was found to be composed of a central mass, consisting of numerous spiral vessels, with an outer coat of cellular tissue, in which I could not detect more than one layer.

In some of the species of *Faboidea*, the funiculus attains to nearly a line in diameter; while, in others, it is not more than about half that size. Fig. 14 plate 14 represents half of a seed

* In the seeds of several species of *Acacia*, and others among the *Leguminosæ*, and in *Arabis Turrita*, and many other cruciferous plants, we have good examples of the *funiculus umbilicalis*, but in these cases it passes off immediately from the hilum to the pericarp.

which was fractured in a longitudinal direction through its broadest surface. It is the only one out of nearly three dozen, fractured in that and in other directions, in which any satisfactory indication of an embryo could be detected: and in this case it appears to be developed to perhaps its greatest extent, and to have absorbed nearly the whole of the surrounding nucleus, and occupies the greater part of the interior of the seed. It is situated in the centre of the seed, and appears to be anatropous. The larger extremity of the embryo nearly fills that end of the seed which is without the funiculus, while the smaller and more attenuated portion, which I believe to be the radicle, occupies the end around which the funiculus passes. The larger part of the embryo, *a*, fig. 14, plate 14, has separated freely from the portion of the nucleus in which it was embedded, and when viewed with a microscopic power of one hundred and twenty linear, was found to be enveloped in a beautiful reticulated tissue, forming minute trapeziform areas, of the average size of the two thousand three hundred and thirty-third part of an inch in diameter.

The plumula assumes a nearly globular form, as it narrows considerably towards its junction with the radicle, at which part a deep groove has its origin (at *d*), and passes upwards as far as we can trace it, to the point *c*, and is most probably continued over the crown of the embryo to the opposite part at *d*. This groove does not penetrate deeply into the plumula, as the fine reticulated tissue which surrounds that part can be traced, by the microscope, in such a manner as to prove that it merely follows the undulations of the surface, and does not terminate in the groove, but passing over its deepest parts, it returns to the surface. From the situation and appearnce of this groove, it is probable that the embryo is dicotyledonous. Fig. 13 represents another fruit, cleft in the same direction as fig. 14, but in this the fracture has passed through the centre of the embryo. This specimen does not appear to have been so fully developed as the one represented by fig. 14. The half of the seed opposite to that represented by fig. 13, was carefully fractured in such a manner as to separate the half of the embryo from that portion of the nu-

cleus in which it was embedded. When thus separated, it presented a very irregular rugose surface, with no distinction between the plumule and the radicle, and not the slightest remains of the beautiful reticulated tissue that was found enveloping the specimen represented by fig. 14.

In a third specimen in which traces of the embryo were found, it was much less developed than in the fruit represented at fig. 15 plate 14. In this specimen also it was situated in the centre of the seed, and did not occupy more than about one third of its length; but in the present case a small piece of the reticulated tissue of the embryo was observed. In the longitudinal section, figs. 6 and 7, plate 14, at the point indicated by *c*, there is a curved line in each of the two halves of the nucleus, exactly in the situation where we should expect to find the raphe. This, when examined with a microscopic power of one hundred and twenty linear, was found to be an open fissure or groove, until it reached a point (*c*, fig. 6) very near to the insertion of the funiculus, whence it was continued onwards towards the insertion of the funiculus at *a*, by a curved line of a darker and coarser material; but neither in this curved line, nor in any part of the open groove of the larger curve, could any remains of vascular tissue be detected: so that although the size and direction of the line, added to the position of the embryo, as shown in fig. 14, would seem to indicate it to be the remains of the raphe, yet from the total absence of organic structure, we must content ourselves with the hope that future investigation may lead to a more certain knowledge of this part of the fruit. In another specimen which I examined in search of the raphe, I found faint indications of a curved line similar to that represented at *c c*, figs. 6 and 7; but in the remainder of the fruits examined no traces of it were to be observed.

The whole of the species represented in plates 15 and 16, are figured with that end of the fruit round which the funiculus passes, uppermost, as it is most probable that such was their position when attached to the placenta. The position of the seed, therefore, as regards the embryo, is reversed, the plumula being

situated at the end opposite to that around which the funiculus passes.

These seeds, like those of the true *Leguminosæ*, bear so strong a resemblance to each other, that it is extremely difficult to decide which of them possess a just claim to be considered distinct species; and it is only by having been in possession of a very considerable number of some of the species, that I have satisfied myself of the justness of their title to be considered distinct from each other. Let any one attempt to divide into species a considerable number of mixed leguminous seeds, of genera nearly allied to each other, and each consisting of numerous species, and in doing this let him reject the aid afforded by colour,—and he will be able to form a tolerably just conception of the difficulties surrounding the task of arranging such a group as that composed of the fossils now under consideration.

Faboidea longiuscula.

(Plate 15, figs. 1 and 2).

Seed sideways elliptical, edgeways slightly ovate, nearly twice as long as it is deep from front to back, and more than twice as long as it is thick: testa smooth.

This seed is much longer, in proportion to its depth and thickness, than any of the following species. With the side towards the eye, the outline presents the form of a nearly regular ellipse; but when the back (as in fig. 2) or the face of the seed is presented to the eye, there is a slight contraction towards the middle, which gives it an elongated ovate form. The surface of the testa is unfortunately somewhat obscured by patches and veins of extraneous *pyrites*, as at *a a*, figs. 1 and 2; but in other respects it presents a smooth and uniform surface. The funiculus is deeply buried beneath the testa for about the first two thirds of its length, after which it rises to the surface and emerges, as represented at *b b*, figs. 1 and 2.

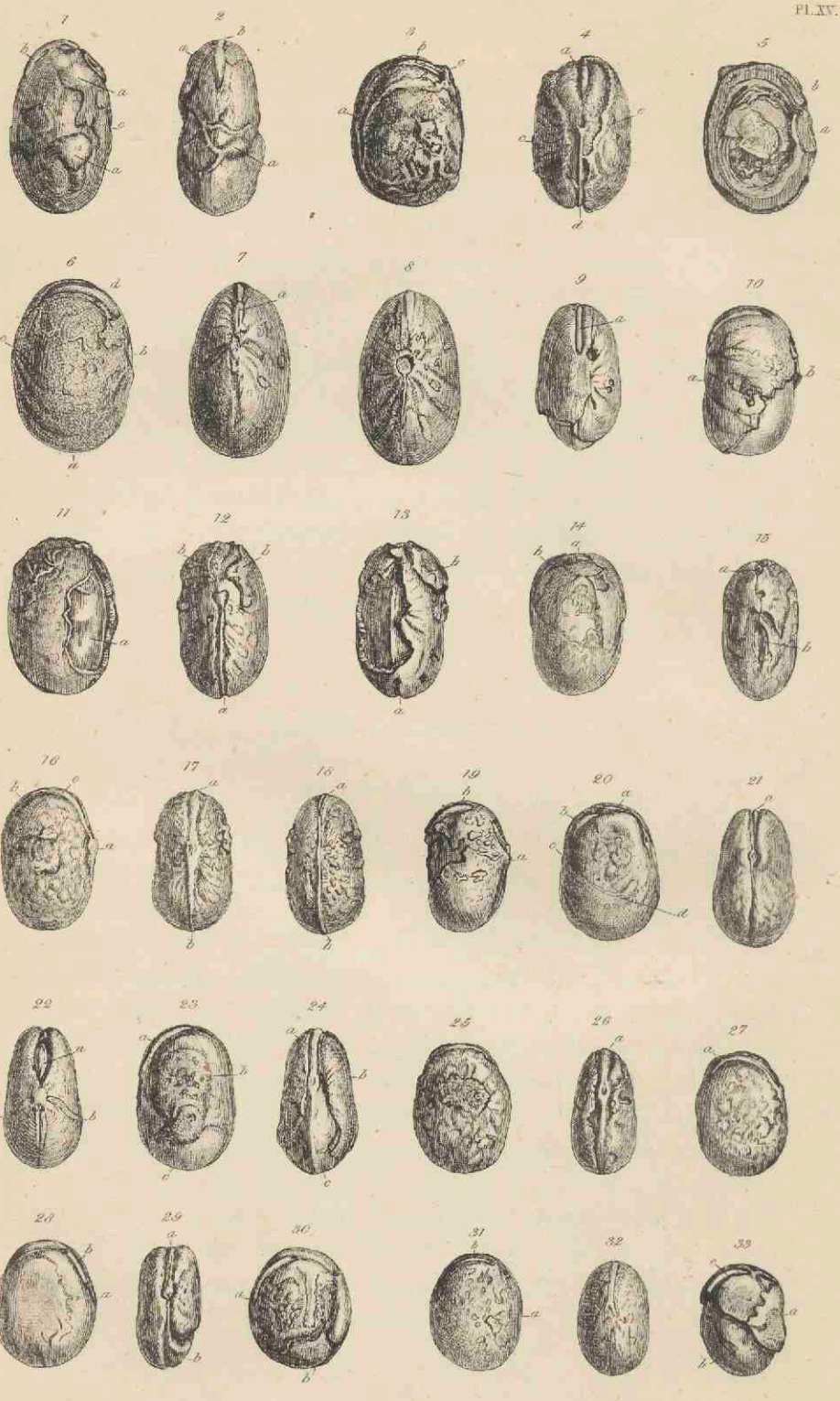

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Figure 1 is a side view of the seed; *c* the face. Fig. 2 represents the back of the seed, with the funiculus emerging from the testa at *b*.

The one figured is the only specimen I have met with.

Faboidea crassa.

(Plate 15, figs. 3—5).

Seed sideways and edgeways obtusely elliptical; thickness from front to back nearly equal to its length: testa thick, surface smooth.

The length of this seed is ten and a half lines, its depth from front to back eight and a half lines; presented to the eye either sideways or edgeways, its outline is in a greater or less degree of an obtusely elliptical form. Fig. 3 represents one of the sides of the seed, *a* being the face, and *b* the funiculus emerging from beneath the testa. The end of the funiculus is obscured, at *c*, by a patch of extraneous *pyrites*, which spreads over a great portion of both sides of the testa, as represented at *c*, figs. 3 and 4, but which is very thin at *c c*, fig. 4, while its edges are of considerable thickness, as at *c*, fig. 3. Fig. 4 is a view of the seed with its face towards the eye, and somewhat foreshortened, to present a better view of the funiculus as it emerges from beneath the testa. A slight partial solution of the testa has taken place in the direction of a line encircling the seed, and passing through its back and front, which has had the effect of producing a sharp projecting line, commencing at a spot opposite the hilum, and passing to a short distance beyond *d*, where it terminates. This sharp line is not, as might be supposed, a portion of the edge of the nucleus projecting through the partially-dissolved testa, as may readily be perceived by referring to the longitudinal section of the same seed represented by fig. 5, in which the testa is seen to be of considerable thickness, at the same part of the seed in fig. 4.

The surface of the testa, where not covered by extraneous *pyrites*, is smooth, and without any indications of lines or furrows. Fig. 5 represents a longitudinal section of the same seed through its centre, in the direction of a line from front to back. The nucleus had undergone decay, and its interior was partially hollow and lined with granular *pyrites*: *a* is the face of the seed; *b* a small portion of the funiculus exhibited by the fracture.

I have met with one other specimen of this seed. It is somewhat compressed and distorted, but in all the essential characters agrees exceedingly well with the one figured.

Faboidea crassicutis.

(Plate 15, figs. 6—8).

Seed sideways elliptical, edgeways ovate; depth from front to back, in proportion to the length, as three to four; thickness very little more than half the length: testa very thick, and furnished with broad and deep furrows passing across each side from front to back, and which curve towards the apex of the seed.

This species is the largest of the whole group: its dimensions are,—length, twelve lines, depth, nine lines, and thickness, seven lines. Fig. 6 presents a view of one of the sides of the seed, upon which we see a series of broad, irregular, curved lines, passing from the front to the back of the seed, and dipping towards the end, *a*. These lines differ in number, depth, and mode of disposition on the two sides of the seed, and seem principally to terminate in two points, the one being the place of the hilum and the other the point immediately opposite to it, as represented at *b* and *c*, fig. 6, the former indicating the face of the seed. Fig. 8 represents the face of the seed, from which we see the curved lines radiating over each of its sides. At the spot immediately over the attachment of the funiculus there is a singular, depressed, circular area, which very much resembles a true hilum, but for which, there is much reason to believe, the seed is indebted only to accidental circumstances: the interior of this area is filled

up with extraneous *pyrites*, the face of which presents a fractured surface. Upon attempting to make a longitudinal fracture of this seed, through the centre of the circular area, I fortunately succeeded in detaching a portion of the testa, about seven lines in length and five in breadth, and found the commencement of the funiculus immediately beneath that spot, more than usually enlarged, so much so, indeed, as almost to cause it to approach the external surface of the testa. This enlargement of the funiculus did not extend for more than about one and a half line in length; after which it was seen pursuing its usual course, with more than a line in thickness of the testa above it, and did not again approach the surface until it finally emerged from it at the point *a* on the opposite side of the seed, as represented in fig. 7, *a*. The testa was full a line and a half in thickness, both in the specimen figured, and in an imperfect one which I have in my possession.

Faboidea planodorsa.

(Plate 15, figs. 9 and 10).

Seed edgeways elliptical, sideways reniform: testa smooth, with shallow, dichotomous lines, radiating from the back of the seed. *Funiculus* thin.

I have had but three of this species in my possession; the whole of these agreed in size and form with each other, having the back, *a*, fig. 10, nearly straight, while the front, *b*, fig. 10, was considerably curved. The radiating dichotomous lines were most distinct in the specimen represented figs. 9 and 10; in one of the others they were somewhat less distinct, and in the third specimen they were not to be traced on account of the partial decomposition of the testa.

The funiculus was present in two of the three specimens, and appeared to be less in diameter in proportion to the size of the seed than is usually the case in fruits of this group. Figure 9 is a view of the back of the seed, with the funiculus, *a*, emerging from beneath the testa.

Faboidea symmetrica.

(Plate 15, figs. 11—13).

Seed sideways and edgeways elliptical: testa smooth, thick at the base and thin at the apex of the seed. Insertion of the funiculus nearer to the base than to the apex.

This seed is not a very uncommon species, but the one figured is the best I have seen. It differs from *Fab. crassa* in being longer in proportion, not only to its depth from back to front, but also to its thickness, and in being less obtusely terminated than that species, and it is altogether more symmetrical in its form.

The upper half of the nucleus is somewhat larger than the lower or funicular one, but this inequality is counterbalanced in the perfect seed, by a greater degree of thickness in the lower half of the testa than in the upper portion, which thus renders the unequal proportion of the nucleus imperceptible while surrounded by the testa. The surface of the testa is smooth.

Fig. 11 is a view of one of the sides of this seed, with a part of the testa broken away, and exposing to view a portion of the nucleus. Fig. 12 represents the front of the seed, exhibiting a partial solution of the testa from the end, *a*, to about a line and a half beyond the point of insertion of the funiculus, by which means the front edge of the nucleus is exposed to view. Fig. 13 exhibits the back of the seed, with a large portion of the testa broken away, thus exposing the back edge of the nucleus, the indentation *a* being the commencement of the line of the partial solution of the testa so prominently displayed in fig. 12; *b b b*, figs. 12 and 13, are patches of extraneous *pyrites*.

Faboidea plana.

(Plate 15, figs. 14 and 15).

Seed sideways obtusely ovate, broadest at the base, edgeways elliptical: testa smooth.

This is the only specimen I have met with of this singular

species, which is readily distinguished from all others by the obtuseness and great depth from the front to the back of its end *a*, fig. 14; *b*, the funiculus emerging from beneath the testa. Fig, 15 is a view of the back of the seed; *a* the point of the funiculus, *b* an excavation produced by the partial solution of the testa.

Faboidea marginata.

(Plate 15, figs. 16—19).

Seed sideways elliptical, edgeways elliptical with a slight contraction at about the middle of each side, edge of the seed more or less produced in the form of a raised marginal ring, passing through its face and back: testa smooth and thin.

The specimen represented by figs. 16, 17, and 18, is the most perfect of three which I have in my possession, but unfortunately has nearly the whole of its surface defaced, by a very thin frothy incrustation of *pyrites*, but which does not materially interfere with, or alter its proportions. Fig. 16 is a view of one of the sides of the specimen, *a* being the face of the seed, and also indicating the spot at which the funiculus commences, and from which it passes beneath the thin testa, raising it in the form of a thick prominent ridge, as at *c*, and finally emerging from it at the point indicated by *b*. Fig. 17 represents the face of the seed, *a* being the prominent ridge produced by the passage of the funiculus beneath, and *b* the produced marginal line, very prominent towards the insertion of the funiculus, and gradually becoming attenuated as it approaches the apex of the seed.—Fig. 18 is a view of the back of the seed; *a* representing the front of the funiculus as it emerges from beneath the testa, and *b* the marginal line extending from one end to the other of the seed. Fig. 19 represents a second specimen of this species, in which the testa is not so perfect as in the first, but which has not its surface so much obscured by extraneous *pyrites*. The surface in this specimen appears smooth and even, as it also does in a third in my possession.

This specimen does not exhibit the marginal line so prominent in the former one, and it has undergone, to a very considerable extent, that partial solution which so frequently commences at this part of the seed: *a* is the face of the seed, and the spot at which the funiculus commences; *b* the spot at which it emerges from the testa. The third specimen in my possession agrees with the two former ones both in form and in the degree of thickness of the testa, but has not the marginal line quite so much produced as in the one first described.

Faboidea semicurvilinearis.

(Plate 15, figs. 20—22).

Seed sideways ovate, with two curved lines originating at about the middle of the back of the seed, passing on each side over about half its width, and dipping towards the larger end of the seed; edgeways ovate: testa thick, surface smooth but irregular.

This is by no means a rare species. I have as many as ten fine specimens in my possession, besides many others not in so good a state of preservation. The whole of these, with very trifling variations, exhibit the same marked characters both of form and striation as the specimen figured. Fig. 20 is a view of one of the sides of the seed which presents us with an ovate outline, somewhat obtuse at the smallest end; *a* the funiculus emerging from beneath the testa, *b* a portion of the nucleus exposed by a partial solution of the testa, and *c* the back of the seed, and the spot from which the curved lines originate, one of which is seen passing more than half way across the seed, and dipping towards its larger end. Fig. 21 represents the face of the same seed, with the spot immediately above the attachment of the funiculus marked by two prominent carunculæ, but which do not furnish a specific character, as I have not observed them to occur, excepting in one other specimen out of many I have received since the plate was engraved; *a* is a portion of the funiculus emerging from beneath the testa. Fig. 22 is a view of

the back of the same seed; *a* is part of the nucleus exposed by the partial solution of the testa, *b b* the two curved lines originating at about the middle of the back of the seed. The curved lines which form so prominent a character in this species, vary considerably in their structure, sometimes appearing upon the surface of the testa (as in figs. 20 and 22) in the form of a slightly-indented line, while in other specimens they project considerably above the surface; but upon examining the nucleus of several specimens which were divested of the testa, they were always found to exist in the form of raised lines, more or less strongly produced. Upon making sections both of the testa and of the nucleus of a specimen in which these lines projected in a more than ordinary degree, I could not discover, in either case, any organic difference in the structure of the seed which could account for their existence.

Faboidea larga.

(Plate 15, figs. 23 and 24).

Seed sideways elliptical, somewhat obtuse, edgeways ovate: testa thick, surface smooth. *Funiculus* large, inserted nearer to the radicular than to the plumular end of the seed. *Nucleus* thin, broad, and sharp-edged.

I have three specimens of this fruit besides the one figured, two of which are of the same size, and the third a trifling degree smaller; the whole of them agree in form, proportions, and other essential characters, with the specimen figured.

Fig. 23 is a view of one of the sides of the seed; *a* part of the funiculus, *b* the testa, with a large patch of extraneous *pyrites* upon it, and *c* the apex of the nucleus. Fig. 24 represents the face of the same seed; *a* the funiculus, *b* the testa, and *c* the nucleus. The patch of *pyrites* existing upon the testa, as represented in fig. 23, has been omitted in fig. 24, that an idea of the general form of the outline of the fruit might be given; it is also

somewhat thicker in proportion to its size than the unfigured specimens in my possession.

Faboidea complanata.

(Plate 15, figs, 25—27).

Seed somewhat compressed in a lateral direction; sideways, oblong; edgeways ovate. Insertion of the funiculus nearer to the radicular than to the plumular end of the seed: testa, surface smooth.

This species is not so long in proportion to its depth as *Fab. larga*, nor is the nucleus so sharply produced at its edge. Fig. 25 presents us with a side view of the seed, with the surface of the testa obscured by a thin, frothy incrustation of *pyrites*. The upper portion of the figure, or funicular end of the seed, does not afford so correct an outline as the lower portion, in consequence of the testa, at the funicular end, having undergone a solution of that part of its substance which covered the funiculus. In other specimens of the seed in my possession, the funicular end resembles the other in its form, instead of presenting the sudden contraction observable in fig. 25. Fig. 26 represents the face of the seed, with the funiculus (*a*) uncovered by the testa, and passing round the end of the nucleus. The edge of the nucleus, immediately in the neighbourhood of the insertion of the funiculus, is somewhat produced in the form of a thickened marginal line, but it loses that form as it approaches the end of the seed. Fig. 27 is a view of the side of the seed contrary to that represented by fig. 25, and exhibits the funiculus (*a*) passing round the end of the nucleus, to the part at which it usually emerges from beneath the testa.

Faboidea subdisca.

(Plate 15, figs. 28—30).

Seed sideways orbicular, edgeways oblong, compressed: testa smooth. Insertion of the funiculus at about the middle of the face of the seed.

The strongly-compressed form and the orbicular outline presented by this species, when viewed sideways, render it very easily distinguishable from any other; and these characters are equally well displayed in three other specimens in my possession, one of which is a little larger than the figured one, while another is not more than about two thirds of its size.

The testa of the figured specimen has suffered much by the solution of its substance, especially in the direction of the line of the edge of the nucleus, by which means the outline of the funicular end of the seed is rendered less obtuse than it should be in fig. 28, and more so than it really is in fig. 29. In one of the unfigured specimens in my possession, the testa is perfect at the funicular end of the seed, and a slight degree of depression exists, which causes that end to be a little more obtuse than the opposite one when viewed in the same position as fig. 29. Fig. 28 is a view of the side of the seed upon which the testa is in the best state of preservation: *a* the face of the seed, *b* a portion of the funiculus. Fig. 29 represents the face of the seed with the funiculus (*a*) exposed to view by the partial solution of the testa; *b* a portion of the nucleus. Fig. 30 exhibits a view of the side of the seed contrary to that represented by fig. 28: *a* the face and insertion of the funiculus, *b* a part of the nucleus.

Faboidea oblonga.

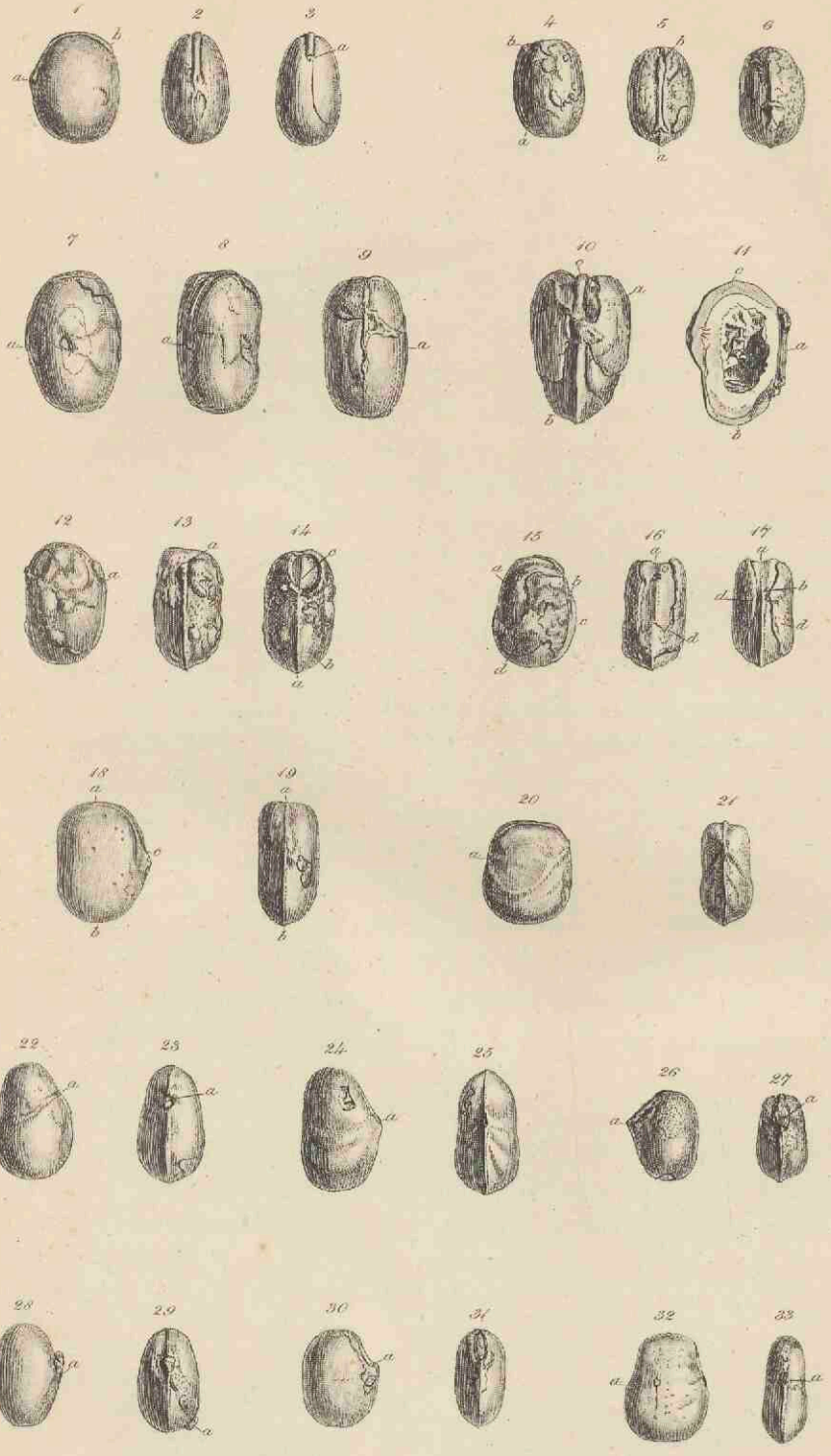
(Plate 15, figs. 31—33).

Seed sideways oblong, obtuse, edgeways oblong: testa thick, surface smooth. Insertion of the funiculus at about the middle of the face of the seed.

The symmetrical oblong form of this fruit when viewed both sideways and edgeways, and its great thickness in proportion to its length, serve well to distinguish it from its congeners. Fig. 31 is a side view of an exceedingly perfect specimen: *a* is the face of the seed, and *b* the funiculus emerging from beneath the testa. Fig. 32 represents the face of the same specimen with the funiculus exposed to view by the partial solution of that part of the testa which was immediately above it, and which, in this instance, must have been extremely thin at that part.

The bifurcated insertion of the funiculus is very prominently displayed in this seed, but forms no specific character, as in five other well-preserved specimens of the same species it could not be distinguished. Fig. 33 represents another seed of this species, in which, by a fracture of the testa, a considerable portion of the nucleus is exposed: *a*, the face of the seed; *b*, the nucleus; *c*, the funiculus emerging from beneath the testa. In this specimen the funiculus is considerably larger than in any other of the same species in my possession, the size in the greater number of the specimens being similar to that represented in fig. 32.

This is not an uncommon species. I have six well-preserved specimens in my possession, which closely resemble each other in all their essential characters, excepting one, which differs only in being somewhat thicker in proportion to its length and breadth than fig. 32.



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Faboidea ovata.

(Plate 16, figs. 1, 2, 3).

Seed sideways oblong, obtuse, edgeways ovate: testa smooth. Insertion of the funiculus at the middle of the face of the seed.

The great depth of this species, from the face to the back of the seed, which is nearly equal to its length, and the regular ovate outline which it presents when viewed edgeways, causes it to be readily distinguished from those to which it approaches nearest in form.

Fig. 1 is a side view of the seed: *a* the face of the seed, and insertion of the funiculus; *b* the termination of the funiculus, which appears to be only partially embedded in the substance of the testa: but whether this appearance of the funiculus above the surface of the testa throughout the whole of its course, is peculiar to this species, or only an accidental occurrence, I have no means of determining, as the fruit here represented is the only perfect one I have seen of the species. It may probably be, that the testa being thin, while the funiculus is large in proportion to the size of the seed, has caused it to project in this manner above the general level of the surface of the seed, but at the same time, it may have been covered, for the greater part of its length, with the smooth and thin cuticular portion of the testa; and this is the more probable, as we do not find an instance in any other species of these seeds, of the funiculus running for the whole length of its course, uncovered by the testa.

Fig. 2 represents the face of the seed, with the insertion of the funiculus at about the centre. Fig. 3 is a view of the back of the seed; *a*, the termination of the funiculus. Figs. 30 and 31 are two views of a nucleus, which, from its form and proportions, when viewed either sideways or edgeways, I am strongly induced to believe belongs to this species. Fig. 30 is a side view of the nucleus; *a*, the face of the seed and insertion of the funiculus. Fig. 31 represents the face of the seed.

Faboidea ventricosa.

(Plate 16, figs. 4—6).

Seed sideways and edgeways elliptical, thickness equal to its depth from face to back. Insertion of the funiculus near the plumular end of the seed.

This species may readily be distinguished from all others by the singular position of the insertion of its funiculus, and by its great thickness. The funiculus, in this seed, as in the species last described, is uncovered by the testa throughout its whole course; but in the present species, unlike the last, there is every appearance of its having been, at one period, enveloped in at least the cuticular portion of the testa, as the whole surface of the seed appears to have suffered by superficial decomposition. This is more apparent at the plumular end of the seed than at any other part. At that spot a thin projecting line of the testa still remains, as represented at *a*, fig. 5, which appears to mark the level formerly attained by the remaining portion, as the prominent edge is smooth and even, while the surrounding parts of the testa exhibit the remains of numerous casts and impressions of cellular structure; and upon no other part of the seed is there any portion of the cuticular surface of the testa remaining.

Fig. 4 is a side view of the seed; *a*, the face of the seed and insertion of the funiculus. Fig. 5 represents the face of the seed, with the funiculus occupying nearly the whole of its length; the bifurcate form which it frequently assumes at its insertion, in different species, is here very prominently displayed. Its termination at *b* presents a fractured surface, which would naturally lead us to infer, that when perfect, it was continued over the end of the nucleus to the spot at which, in other species, it usually emerges from beneath the testa; but as no groove remains on the base of the seed to indicate its course, and as the point of its insertion differs so much from other species, so in like manner its terminating point may also be different. Fig. 6 is a view of the back of the seed.

This is the only specimen of this singular species that I have seen.

Faboidea robusta.

(Plate 16, figs. 7—9).

Seed sideways and edgeways oblong, obtuse, nearly as thick as it is deep from the face to the back, and nearly twice as long as it is thick. Insertion of the funiculus at the centre of the face of the seed. *Testa* thick.

I have met with two specimens of this seed, which, with a slight exception, very closely resemble each other in all their essential characters. Fig. 8 is a view of one of these in such a position as to show one of its sides, and at the same time to exhibit the face of the seed, with the point of insertion of the funiculus at *a*, and the groove in the testa in which it was embedded. The funiculus is not present; but from the size of the space which it occupied, it appears to have been of considerable dimensions, and to have been either but very slightly embedded in the testa, or to have had its upper surface entirely exposed. The groove is continued round the end of the seed, to the spot at which the funiculus usually quits the testa. Fig. 9 is a view of one side of the same seed; *a* the face of the seed somewhat disfigured by an irregular cruciform patch of extraneous *pyrites*.— Fig. 7 represents a side view of another specimen, which varies from the last only in being a little deeper in proportion from the face to the back. The funiculus is wanting in this specimen also.

Faboidea pinguis.

(Plate 16, figs. 10 and 11).

Seed edgeways and sideways oblong, obtuse: testa very thick, ventricose on each side, surface smooth. *Funiculus* inserted nearer to the radicular than to the plumular end, large, and deeply buried beneath the testa.

The strikingly ventricose form of this species immediately distinguishes it from the whole of its congeners. The specimen represented by fig. 10 is the largest and most perfect of four

which I have in my possession. Its depth from face to back is about equal to its thickness; and its length, when perfect, probably exceeded that of fig. 10 by about three lines, as the testa of a much smaller specimen in my possession was about a line and a half in thickness. The whole of the four specimens have suffered much from the partial solution of the testa, especially in the line of the sharp edge of the nucleus. Fig. 10 is a view of the face of the fruit: *a* the testa, *b* the nucleus, and *c* the funiculus, which passes round the end of the seed to the point at which it usually emerges from the testa. Fig. 11 represents a longitudinal section of another specimen, which is figured in a position the reverse of the other seeds in the plate, *b* being the funiculus, *c* the plumular end, and *a* the face of the seed. The testa at *c*, is about a line in thickness, although decomposition of its surface has taken place to a very considerable extent. The interior of the nucleus is hollow, and lined with crystallized *pyrites*. The other two specimens in my possession are somewhat smaller than the two figured ones, but one of them is thicker and more ventricose in its form than the seed represented by figure 10.

Faboidea subrobusta.

(Plate 16, figs. 12—14).

Seed sideways and edgeways oblong, depth from face to back in proportion to its thickness as five to four: testa very thin, surface smooth. *Funiculus* inserted nearest to the radicular end of the seed.

This species very much resembles *Fab. robusta* in its form and proportions, but is considerably smaller and more symmetrical. It is best distinguished from that species by the difference in the situation of the insertion of the funiculus, and by its extremely thin testa. Fig. 12 is a view of one of the sides of the seed, unfortunately covered to a considerable extent by a large patch of extraneous *pyrites*: *a* is the face of the seed and insertion of the funiculus. Fig. 13 represents the face of the seed:

a the broken end of the funiculus, from the base of which a strongly-produced carinated line proceeds, and passing thence along the face of the seed, over its plumular end and up its back, terminates at a point about opposite to the spot at which it has its origin. Fig. 14 is a view of the back of the seed: *a* the carinated line; *b* the testa, and *c* a small portion of the nucleus, seen through a fracture in the testa, which at this spot is not more than about one third of a line in thickness. The minute, depressed, circular areas of the surface of the nucleus are beautifully preserved in this specimen. Unfortunately the surface of the specimen is much defaced by patches of extraneous *pyrites;* but where it is not thus obscured, as at *b* fig. 14, and at other parts of the seed, the testa presents a smooth and even surface.

This is the only specimen I have seen of this species.

Faboidea planimeta.

(Plate 16, figs. 15—17).

Seed sideways somewhat reniform, edgeways oblong, compressed: testa thin. *Funiculus* inserted nearer to the radicular than to the plumular end of the seed: base of the nucleus wide and depressed.

The form of this seed is singular, and different from that of any of the preceding species. If the specimen represented by fig. 15 had the whole of the testa preserved, the back would present nearly a straight line, or but a very slight curve, while the face, and especially that part nearest to the plumular end, is produced in a more than ordinary degree, the upper half of that part of the nucleus being compressed and projected forward in the form of a sharp edge, as at *c* fig. 15, while the radicular end of the nucleus is depressed, as represented at *a a*, figs. 16 and 17. Fig. 15 presents a side view: *a* the nucleus; *b* the insertion of the funiculus, and *d* a portion of the testa. Fig. 16 represents the back of the seed and the testa: *a* the nucleus with its depressed concave end. Fig. 17 is a view of the face of the seed:

a the nucleus; *b* the insertion of the funiculus; *d d* parts of the testa.

Faboidea quadrapes.

(Plate 16, figs. 18 and 19).

Nucleus sideways reniform, edgeways, plumular end nearly a semicircle, funicular end depressed, forming a right angle with the axis of the seed. Point of insertion of the funiculus at about the middle of the face.

This is the first of a series of seven species, of which I have seen nothing more than the nucleus, and which I have been unable to recognise as the nuclei of any of the preceding ones. The names, therefore, must be considered rather as provisional than as those most appropriate to the species, but which can only be changed for more characteristic ones when we shall become better acquainted with the characters of the remaining parts of the seed. Fig. 18 is a side view of the seed: *a* the radicular end; *b* the plumular end; *c* the face and the insertion of the funiculus.

This is the only specimen of this species I have met with.

Faboidea bifalcis.

(Plate 16, figs. 20 and 21).

Nucleus sideways, plumular end semicircular, radicular end depressed: depth of nucleus from back to face, nearly equal to its length, with a falciform curved line projecting from the surface of the nucleus, and reaching from the face to the back on each side; edgeways compressed, slightly curving inwards on each side, plumular end semicircular, radicular end depressed, forming nearly a right angle with the axis of the seed. Insertion of the funiculus nearest to the funicular end.

This nucleus, in some of its characters, resembles that of *Fab. semicurvilinearis*, while in others it differs essentially from

that species. Like that it is furnished with two falciform curves, one on each side of the nucleus, which extend from the back to the front, and which dip towards the plumular end of the seed.

The insertion of the funiculus is also in the same relative position as in *Fab. semicurvilinearis*, but in other respects these seeds differ very considerably. Thus in viewing the nuclei of ten specimens of *Fab. semicurvilinearis* edgeways, it was found that the whole of them were considerably thicker near their plumular end than towards their funicular one; while in *Fab. bifalcis* the proportions were equal. Upon viewing the two species sideways, in the former the depth from face to back at near the plumular end was very considerably more than at near the opposite end, while in the latter the proportions were very nearly equal. The length also in the former is greater in proportion to the width than in the latter. Fig. 20 is a view of one of the sides of the nucleus: *a* the face of the seed and the point of insertion of the funiculus. Fig. 21 represents the back of the seed.

This seed is the only one of the species I have seen.

Faboidea tenuis.

(Plate 16, figs. 22 and 23).

Nucleus sideways, back nearly straight and parallel to the axis of the seed, front very much more produced towards the plumular end, with a falciform furrow curving towards the plumular end of the seed; edgeways ovate, elongate.—Insertion of the funiculus very near the funicular end of the seed.

This species resembles the nucleus of *Fab. semicurvilinearis* in form, excepting that it is much thicker in proportion than that species. The falciform line is a furrow instead of being raised above the surface, and it differs also in having the insertion of the funiculus very considerably nearer to the radicular end of the seed. It is the only specimen I have seen of this species.

Fig. 22 represents the side of the seed; *a* the face and point of insertion of the funiculus. Fig. 23 is a view of the face of the seed; *a* the insertion of the funiculus.

Faboidea subtenuis.

(Plate 16, figs. 24 and 25).

Nucleus sideways, back nearly straight and parallel to the axis of the seed, face more produced towards the plumular end than towards the opposite one, with a faintly-raised falciform line, passing across each side, and curving towards the plumular end of the seed; edgeways elliptical, compressed. Insertion of the funiculus near the middle of the face of the seed.

I have three specimens of the nucleus of this species, which closely resemble each other in every respect. They are less attenuated towards the funicular end, when viewed either edgeways or sideways, than the last species, and the position of the insertion of the funiculus is also different. Fig. 24 is a side view of the seed; *a* the face and insertion of the funiculus. Fig. 25 represents the face of the seed.

Faboidea rostrata.

(Plate 16, figs. 26 and 27).

Nucleus sideways oblong, with the point of attachment to the funiculus very much produced; edgeways ovate, with the funicular end of the nucleus slightly depressed. Insertion of the funiculus near the middle of the face of the seed.

I have been unable to refer this singular specimen to any of the preceding species, from all which it differs more especially in the disproportionate development of their point of attachment to the funiculus, which assumes the form of a strongly-produced rostrum, as at fig. 26, which represents one of the sides of the seed, *a* being the face, and the point of insertion of the funiculus. Fig. 27 is a view of the face of the nucleus, with a very small portion of the substance of the testa adhering to it at *a*. From the plumular end of the seed, fig. 26, there is a small piece of the surface of the nucleus broken away, about a line and a half in diameter, through which the trapeziform reticulations of the

membrane surrounding the embryo are distinctly visible. The portion of the nucleus surrounding this part of the embryo is extremely thin, and the embryo itself very large; there being no doubt of this being a fully-developed and distinct fruit, and not an abortion of any of the preceding species.

Faboidea doliformis.

(Plate 16, figs. 28 and 29).

Nucleus sideways somewhat doliform, edgeways ovate. Insertion of the funiculus near the middle of the face of the nucleus.

The ventricose form of this species, when viewed sideways, readily distinguishes it from all others. Fig. 28 represents the nucleus in this position; *a*, the face of the seed and insertion of the funiculus, with a small portion of it remaining attached. Fig. 29 is a view of the face of the seed; *a*, a small patch of extraneous *pyrites*.

Faboidea acuta.

(Plate 16, figs. 32 and 33).

Nucleus sideways pyriform, with a slightly-raised falciform line passing from the face to the back of the seed, and curving towards the plumular end; edgeways ovate, elongated, slightly compressed on each side. Insertion of the funiculus about the middle of the face of the seed.

This is the only specimen I have seen of this singularly-formed nucleus. It is much thinner in proportion to its depth from face to back, than any of the preceding species, and has the edges of the nucleus produced in a much sharper manner upon its back and face, than in any other specimen I have met with.

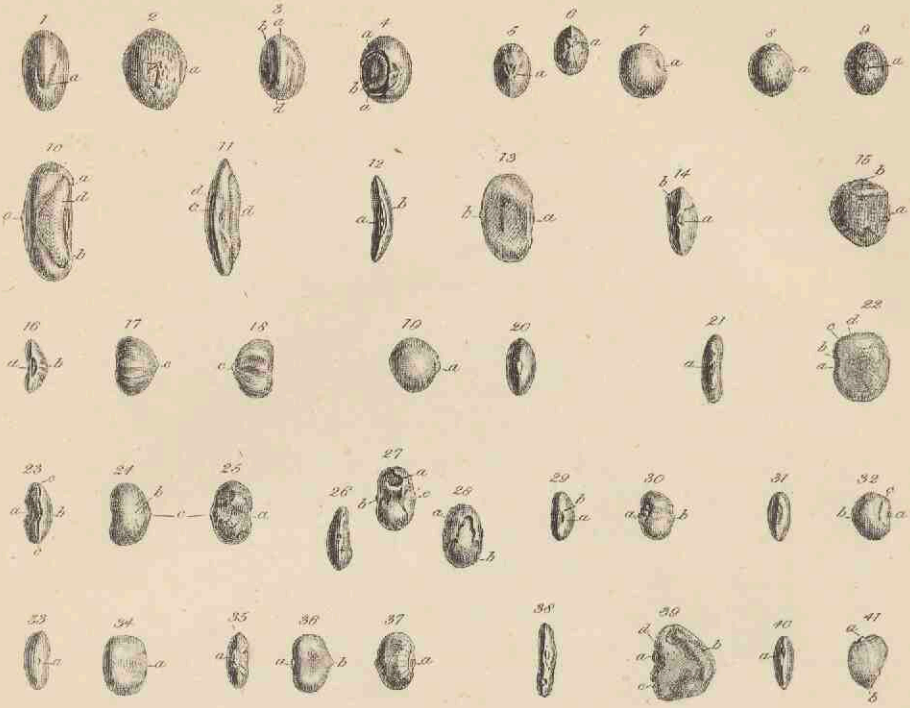
Figure 32 is a view of one of the sides of the nucleus; *a* the face of the seed, and insertion of the funiculus. Fig. 33 represents the face of the seed; *a*, the insertion of the funiculus.

LEGUMINOSITES.

(Plate 17, figs. 1—41 inclusive).

Seeds of true *Leguminosæ*, the pericarps of which are unknown.

The seeds arranged in this group present, both in form and structure, all the characteristic features observable in numerous recent genera of true leguminous fruits. The position of the embryo (as represented at *a*, in figs. 1, 2, 5, 6, 7, and 19) is in many cases distinctly apparent; and the hilum, when the testa is well preserved, may generally be determined with accuracy. In some species it is of considerable magnitude, as represented at *a* in figs. 12 and 13; while in other cases (as at *a*, figs. 15, 16, and 37) it is much smaller in its dimensions. Indications of the division of the nucleus into two cotyledons are almost always to be observed; and in many instances, when the seed has been deprived of its testa, the line of separation may be distinctly traced round the whole margin of the nucleus. The testa, like that of the recent species of leguminous seeds, is principally formed of elongated cells, radiating in the direction of lines at right angles to the surface of the nucleus; and these cells, both in the number occurring in a single line, and in their dimensions and proportions, agree very closely with those found in the testa of many of the recent species of *Leguminosæ*. When examined with a microscopic power of one hundred and twenty linear, the outer surfaces also, both of the nucleus and of the testa, agree in their structure and general appearance with those of recent leguminous seeds viewed in the same manner. We may therefore justly conclude that the whole of these interesting remains of an ancient Flora are true *Leguminosæ*. It would however be extremely difficult, if not impossible, to identify these seeds with those of existing genera, supposing them to belong to such, without the assistance of their pericarps: I have therefore thought it most advisable to place the whole of them in one group, and to designate them *Leguminosites*.



J.D.C.Sowerby fecit.

Leguminosites subovatus.

(Plate 17, figs. 1 and 2).

Seed subovate, thickness slightly exceeding half its length, depth from front to back exceeding three fourths of its length. *Embryo* near the middle of the face of the seed.

From the position and form of the well-developed radicle of this seed (*a a*, figs. 1 and 2), there is little doubt that it belongs to the *Curvembriæ:* but as it is the only one of the species that I have seen, I have not ventured to fracture it in search of further information on this point. Its greatest thickness in proportion to its length, is as twelve to twenty; and its greatest depth from face to back, is to its length as sixteen to twenty. When viewed edgeways, as represented in fig. 1, it presents a well-proportioned ovate outline: when placed sideways, as seen in fig. 2, its form is still ovate, but much broader in proportion than when viewed in the former position. The testa has suffered greatly from decomposition; by which means also all traces of the hilum have been obliterated. As nearly as can be ascertained from its remains, the testa was thin and smooth.

Leguminosites crassus.

(Plate 17, figs. 3 and 4).

Seed oval, thickness nearly equal to its depth; depth from face to back exceeding three fourths of its length: testa smooth.

The seed represented by figs. 3 and 4, is the only one of the species that I have seen. Its greatest thickness from side to side is eleven fiftieths of an inch; its greatest depth from the face to the back, thirteen fiftieths; and its length, sixteen fiftieths of an inch: but as it appears depressed on one side, it is probable that in its original state it was somewhat thicker than in its present

condition. The testa is smooth, and about the fiftieth part of an inch in thickness at the points *a a*, fig. 4, which presents us with a view of one side of the seed, from which a portion of that integument has been removed. The part of the cotyledon exhibited within this space is irregularly contracted and partially depressed, and has its surface covered by impressions of numerous minute vessels. This fracture of the testa unfortunately extends over so great a portion of the face of the seed, as to render it impossible to ascertain, with any degree of certainty, the proper situation of the hilum; but from the remains of a deep depression in the testa, at the point *b*, fig. 4, and from the convergence of the impressions of the numerous minute vessels upon the surface of the cotyledons towards that point, I am strongly inclined to believe it to be the true situation of the hilum.

Figure 3 presents us with a view of the back of the seed,—*a d* indicating the true median line, the blunt carina being produced by a partial contraction of the left side of the seed, as represented in the figure.

Leguminosites elegans.

(Plate 17, figs. 5—7)

Seed edgeways subovate, sideways oblong, obtuse: radicle conspicuous, situated above the middle of the face of the seed: testa smooth: hilum inconspicuous.

The two seeds represented in figs. 5, 6, and 7, differ in some respects from each other, but not to such an extent as to warrant our considering them as distinct species. The larger of the two has the apex of the radicle reaching to about the middle of the face of the seed, as represented at *a*, figs. 5 and 7; while in the smaller specimen, given in fig. 6, it does not, as shown at *a* in that figure, extend quite to that point: but the difference may probably arise from this part not having been so fully developed as in the larger and perhaps more mature seed. In every other

respect the two specimens closely resemble each other, especially in the relative proportions of their length, breadth, and thickness. In both specimens the testa appears to be about the one hundredth part of an inch in thickness, smooth, and without any external indication of the hilum.

In the specimen represented by fig. 6, the radicle projects somewhat beyond the parallel of the face of the seed, which is not the case with the one represented by figures 5 and 7; but this difference would not amount to a specific distinction. The seeds of *Cytisus Austriacus* and *Laburnum* somewhat resemble those of *Leg. elegans* in form, but they have the radicle projecting beyond the general level of the face of the seed, to a much greater extent. It is very probable that if we were in possession of more certain means of determining the relation of the plants producing our fossils to the recent genera, than those afforded by the seeds alone, we should find they were either extinct species of *Cytisus*, or very closely allied to that genus.

Leguminosites rotundatus.

(Plate 17, figs 8 and 9).

Seed sideways nearly circular, edgeways somewhat ovate: hilum minute, situated at about the middle of the face of the seed.

I have seen but three of this species, the one figured is that which is in the best state of preservation; two of them very closely resemble each other in size and proportion, the third has lost its testa, but when perfect would have been of about the same dimensions. The thickness of the seed is very nearly equal to its depth from face to back, and its depth is nearly as great as its length. The hilum, *a*, fig. 9, is minute and situated at about the middle of the face of the seed, but in consequence of a partial decomposition of the surface of the testa, it is not very distinctly exhibited in either of the specimens in my possession.

Figure 8 presents a side view of the seed: *a*, the face.
Figure 9 is a view of the face of the seed: *a*, the hilum.

Leguminosites longissimus.

(Plate 17, figs. 10 and 11).

Seed, length exceeding twice its depth from face to back, and three times its greatest thickness: hilum conspicuous, half as long as the seed.

The seed represented by figures 10 and 11, is the only one of the species I have seen. Unfortunately it has lost, by decomposition, the greater part of the testa, but the marked difference in its proportions between this and the other figured species, will readily serve to distinguish it from its congeners. From the fragments of the testa still remaining, it may be presumed that that integument has been about the fiftieth part of an inch in thickness. No portion of its epidermal tissue is preserved. If the testa had been in a perfect state of preservation, the form of the seed would probably have approached nearly to that of the seed of the common scarlet runner of the gardens, (*Phaseolus multiflorus*), with the exception of being somewhat more elongated. But it differs from *Phaseolus* in the shape and proportion of the hilum, which, in a perfect specimen of *Leg. longissimus* would be equal in extent to about half the extreme length of the seed. In the seed represented by fig. 10, plate 17, its extent is from *a* to *b*. The back of the seed, *c*, figs. 10 and 11, is carinated in about the same proportion as in the seeds of the scarlet runner.

Figure 10 presents a view of one side of the seed: *a*—*b* indicates the length of the hilum; *c*, the back of the seed; *d*, a portion of the testa.

Figure 11 presents a view of the back of the seed: *c*, the carinated edge; *d d*, portions of the testa remaining attached to the cotyledons.

Leguminosites gracilis.

(Plate 17, figs. 12 and 13).

Seed edgeways slender, curved, sideways oblong, doubly convex on one side, singly convex on the other: hilum conspicuous, central, about one third the length of the seed.

The seed represented in figs. 12 and 13, is the most perfect of three specimens which I have in my possession. The whole of them are in a fine state of preservation. When viewed with the face towards the eye it appears slender and of a concavo-convex form, its thickness at the centre being in proportion to its length, as four to twenty-five. One side of the seed, as represented by figure 13, is furnished with two convex areas, one towards each end, and an intermediate concave space in a line with and occupying a portion of the seed, about equal to the length of the hilum: while the contrary side presents an uniform convexity, which occupies the whole of its surface, as represented at *b*, fig. 12. The back of the seed is sharply carinated, and the regularity of its curve is broken at the point *b*, fig. 13, by a very slightly produced projection.

The hilum *a*, figs. 12 and 13, is situated at about the middle of the face of the seed, and occupies a space equal to one third of its extreme length. An elongated angular ridge runs through the middle of this long and narrow scar, for nearly the whole of its length. At about the central and most elevated portion of this ridge is situated the *omphalodium*, an oval depression about twice as long as it is broad, through which passed the vessels that conveyed the nutriment from the plant to the seed.

Leguminosites enormis.

(Plate 17, figs. 14 and 15).

Seed obscurely reniform, compressed laterally: hilum conspicuous, small, somewhat carunculate.

Of five specimens of this seed which are in my possession, four are very similar in form and proportion to figs. 14 and 15,

the fifth is somewhat less in depth from the front to the back.—Four of the specimens, when viewed with the side of the seed towards the eye, as in fig. 15, present a very irregular outline; the remaining one is more equally reniform: the whole of them are compressed laterally to about the same extent. One extremity of the right cotyledon is slightly depressed, as represented at *b*, figs. 14 and 15; and this partial depression is in the same relative situation, and of about the same extent, in all the specimens. The testa is smooth and shining.

In two of the specimens the epidermis was partly wanting, and it then assumed a punctate appearance from the depression of the outer side of the cells immediately beneath. The cells of which the testa is composed, are arranged in lines which pass off in curves towards the back of the seed, and are the one thousandth part of an inch in diameter. From this arrangement of the cells it is probable that these seeds are rectembrionic. The hilum is situated at the middle of the face of the seed; it is about the seventeenth of an inch in length, and is surrounded by a slightly-elevated fleshy ridge. The omphalodium, or part through which the nourishing vessels pass, is oval in form, and of about the fiftieth of an inch in length.

Figure 14 is a front view of the seed: *a*, the hilum; *b*, the depressed termination of the right cotyledon.

Figure 15, a view of the right side of the same seed: *a*, the hilum; *b*, the depressed termination of the cotyledon.

Leguminosites dimidiatus.

(Plate 17, figs. 16, 17, 18).

Seed edgeways, one side nearly flat, with two slight convexities at each end, the other side with a single prominent convexity: testa smooth, thin: hilum conspicuous, long, oval, equal to about one third of the greatest length of the seed: omphalodium central, oval, about one fifth the length of the hilum.

The seed represented in figs. 16, 17, and 18, is the only well-preserved specimen of this species that I have seen. When

viewed with the face of the seed towards the eye, as represented in fig. 16, the cotyledons appear very unequal in size; the right one having two convexities, with a slight intervening depression, while the left cotyledon, *b*, fig. 16, is singly convex and very gibbous. The greater part of the epidermic portion of the testa is wanting, but the small part that remains proves that it has been very thin. The cellular structure of the testa is arranged in lines which pass off in curves from the face towards the back of the seed, when they converge towards the point *c*, figs. 17 and 18, from which we may infer that it is probably rectembrionic. The hilum is large and very conspicuous, of an oval form, and nearly equal to one third of the greatest length of the seed; it is furnished with an elevated ridge, which passes through its centre in a longitudinal direction, and upon which the omphalodium is seated.

A second specimen of this species which I have, agrees with the figured one in its form and proportions, but is in a slight degree larger. The hilum is also similar to that of the figured specimen, but not in a sufficiently good state of preservation to exhibit the omphalodium.

Leguminosites lentiformis.

(Plate 17, figs. 19 and 20).

Seed lentiform, radicle conspicuous: testa smooth, thick.

I have seen but two specimens of this species; the one represented by figs. 19 and 20 has lost the whole of the epidermic portion of the testa, but in other respects is in a very good state of preservation. The radicle (*a*, fig. 19) is situated at the middle of the face of the seed, and elevates that portion of the testa to a considerable extent. A lens of an inch focus exhibited a slightly-depressed line running round the whole edge of the seed, and indicating the line of separation of the cotyledons. In the second specimen the testa was in a perfect state of preservation,

excepting a small portion only in the neighbourhood of the hilum. It was the seventieth part of an inch in thickness; the epidermis is smooth and somewhat shining, with the cellular structure beneath arranged in lines radiating from the centre towards the surface of the seed. The radicle was broken off, but the part at which it entered between the cotyledons was indicated by a well-defined circular area, the one hundredth part of an inch in diameter; and this junction of the radicle and plumule was in exactly the same relative situation as that of the same parts in the figured specimen. The hilum could not be defined with any degree of certainty in either of the specimens. From the form and position of the radicle in this seed, there can be but little doubt that it belongs to the *curvembriones*.

Figure 19, a side view of the seed: *a*, the radicle.

Figure 20, a view of the face of the seed.

Leguminosites planus.

(Plate 17, figs. 21 and 22).

Seed, depth from face to back nearly equal to its length, thickness slightly exceeding one fourth of its length: testa thin, smooth: hilum near the centre of the face of the seed: embryo curving from the face on to the end of the seed.

I have two of these seeds, which agree in their form and proportions, but vary very slightly in size, the one figured being rather the larger of the two. The sides are compressed, and are nearly of an equal thickness throughout the whole of their surface. The testa is thin, and its epidermis smooth and even. The hilum is situated near the centre of the face of the seed, it is small and oval, *a* fig. 21 and 22. The embryo, in the seed figured, is covered by the testa, but in the second specimen it was distinctly and beautifully exhibited when the portion of that integument immediately above it was removed. The termination of the radicle is situated at the point *b*, fig. 22. At its junction with the plumula, *c*, fig. 22, it is bent abruptly backward to the

end of the seed, where the plumula is seen buried deeply in an excavation between the cotyledons, and extending as far as the point *d*, fig. 22. The fossa for the reception of the plumula is so deep, and the immersion of that part within it so perfect, that when the whole is covered by the testa no indication of the presence of the embryo beneath is afforded.

Leguminosites lobatus.

(Plate 17, fig. 23—25).

Seed reniform, with two prominent convexities on one side and one on the other; back umbonate: testa thick, coriaceous: hilum in the middle of the face of the seed, minute, circular.

The seed figured is fortunately in a very fine state of preservation, and it is the only one of the species I have seen. Its average thickness is equal to half its length, and its greatest depth from face to back equals two thirds of its length. One of the cotyledons is furnished with two convexities of equal size, with a deep intervening indentation extending from the face to the back, as represented at *a*, figs. 23 and 25, while the contrary side of the seed presents a single convexity, extending uniformly over the whole of its surface, as represented at *b*, figs. 23 and 24. At the back of the seed opposite to the hilum there is a well-produced umbo, *c*, figs. 24 and 25. The testa appears thick in proportion to the seed, it is about the one hundredth part of an inch in thickness, its surface smooth, but slightly uneven, and when viewed with a lens of half an inch focus, it assumes a coriaceous appearance.

The hilum, situated in the middle of the face of the seed, is scarcely visible without the assistance of a lens. It is a minute circular excavation, with a rounded edge, the greatest diameter not exceeding the nineteenth part of an inch. There is a crack in the testa of this specimen, which extends through the whole length of the face of the seed and over a portion of both its ends,

as represented in fig. 23, passing between the points *c c*, which prevents the hilum from being distinguished in the figure.

Leguminosites inconstans.

(Plate 17, figs. 26—28).

Seed reniform, thin: testa thin, smooth: hilum in the middle of the face of the seed, conspicuous, nearly one third as long as the seed.

The form of this species approaches somewhat to that of *Leg. lobatus*, but in all the specimens I have seen it is less thick in proportion to its size. Of three specimens in my possession, which are in a fine state of preservation, two have the ends of the seed unequal in thickness, as represented at fig. 26, but not in the same proportion, while in the third specimen they are nearly of an equal thickness. The average thickness of these seeds is in proportion to their length, as five to sixteen. The testa is thin, being but the hundred and sixty-seventh part of an inch in thickness; its surface is smooth, even and shining.

The hilum is elliptical in its form, and attains a length nearly equal to one third of that of the seed. The omphalodium is oval, about twice as long as it is broad, and is not elevated above the level of the surrounding hilum in either of the specimens examined. At the middle of the back of the seed, opposite to the hilum there is, in two of the three specimens, a very slight indication of an umbo, *c* fig. 27, but in the third it is not perceptible.

Figure 26 represents the back of the seed.

Figure 27 is a view of one of the sides, having a circular excavation at *a*, which presents every appearance of having been the work of an insect; *b*, the face of the seed, with a small speck of extraneous *pyrites* projecting from the side of the hilum.

Figure 28 represents the side of the seed contrary to that seen in fig. 27: *a*, a portion of the testa remaining upon the seed; *b*, the nucleus deprived of the testa.

Leguminosites reniformis.

(Plate 17, figs. 29 and 30).

Seed reniform; length very slightly exceeding twice its thickness: testa smooth, shining: hilum circular, large, a slight space removed from the middle of the face of the seed: foramen distinct, near the middle of the face of the seed.

Figure 29, which is a view of the face of the seed, represents the general aspect of this species. Fig. 30 exhibits a side view of the same seed; and as far as regards the proportion between the length and the depth from face to back, it conveys a tolerably correct idea of the ordinary appearance of this species: but in other specimens which I have received since the plate was engraved, the inequalities which are represented at *a* and *b*, on the back and face of the figured specimen, do not exist. Upon a close examination there is strong reason to believe, that these inequalities were produced by a slight decomposition of the fossilized substance of the testa at those parts. The general proportions of the present species may be expressed by the following numbers:—length eleven; thickness five; and depth from face to back eight. The testa is even, smooth, and shining. In the specimen which is in the best state of preservation, the hilum has the form of a deep, circular excavation, the twenty-fifth part of an inch in diameter, being about twice the size of the same organ in the seeds of either *Cytisus Austriacus* or *Laburnum*, or in those of *Colutea arborescens*, the whole of which are as nearly as possible of the same general dimensions as our fossils. The position of the hilum, as represented at *a*, fig. 29, is removed a trifling space from the middle of the face of the seed; and immediately above it, at the spot indicated by *b*, fig. 29, is the place of the foramen, being an excavation similar in form to the hilum, but not exceeding the fiftieth part of an inch in diameter. The space intervening between the two organs is not more than about the hundredth part of an inch. From the comparatively large size of both these organs, it might be imagined that their diameters had possibly been enlarged by decomposition or other

accidental causes; but upon a careful examination of them under a microscopic power of fifty linear, the testa, covered with its epidermis, was seen gradually to round off and to descend a short distance into each of the cavities.

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Leguminosites curtus.

(Plate 17, figs. 31 and 32).

Seed nearly as deep from the face to the back as it is long, greatest thickness equal to about half its length: testa smooth: hilum about the middle of the face of the seed, small, circular: foramen at the back of the seed opposite the hilum.

I have four well-defined seeds of this species, which agree very closely in all their essential characters. The dimensions of the figured specimen may be expressed in the following manner; —length, twelve; depth from face to back, ten; and greatest thickness, six. When viewed sideways, the whole of the specimens present an irregular outline, as seen in fig. 32. The testa is smooth, and somewhat shining. The situation of the hilum varies in a trifling degree in some of the specimens, but in the whole of them it is situated very nearly in the middle of the face of the seed. It is a small, circular, excavation, which, in the figured specimen, measured the fiftieth part of an inch in diameter, (fig. 32, *a*). The foramen is situated at the middle of the back of the seed, immediately opposite to the hilum: it is small, circular, and excavated, and measures the one hundred and twenty-fifth part of an inch in diameter. One of the four seeds has lost nearly the whole of its testa, and at two separate places has had a considerable portion of the surface of the nucleus eaten away by some mandibulated insect. The cellular structure of the nucleus is preserved in the most perfect and beautiful manner, and every indentation made by the mandibles of the insect, and the eroded edges of the spaces attacked, remain as sharply and distinctly marked upon the nucleus as if it were a recent fruit, and the insect had been driven at the instant from its repast.

Figure 31 represents the face of the seed. Fig. 32 is a view of one side of the seed: *a*, the hilum; *b*, the situation of the foramen; *c*, an accidental crack in the testa.

Leguminosites subquadrangularis.

(Plate 17, figs. 33 and 34).

Seed when viewed sideways somewhat quadrangular; depth from face to back about two thirds of its length, thickness slightly exceeding half its depth from the face to the back: testa smooth, shining: hilum in the middle of the face of the seed, minute, circular.

I have three specimens of this seed, which agree very closely in their size and proportions. When viewed sideways, as represented in fig. 34, there is a considerable approach towards a quadrangular outline, and this obtains, to an equal degree, in all the specimens. The testa is smooth, even, and shining. The hilum is situated at the middle of the face of the seed, and has the form of a circular excavation, the three hundred and seventieth part of an inch in diameter. I have been unable to determine the place of the foramen. On the back of one of the injured specimens, immediately opposite to the hilum, there was an appearance closely resembling the foramen; but in consequence of a partial decomposition of the testa, I could not satisfy myself of its really being that organ.

Figure 33 is a view of the face of the seed: *a*, the hilum.

Figure 34, a side view of the same seed: *a*, the face.

Leguminosites æquilateralis.

(Plate 17, figs. 35—37).

Seed reniform: cotyledons nearly equal in bulk: testa smooth: hilum conspicuous, oval, about one fourth the length of the seed: omphalodium small, slightly oval.

This seed, without a careful examination, may readily be mistaken for *Legumin. dimidiatus*, but it differs from that species in having the cotyledons nearly equal to each other in bulk,—in the hilum being somewhat less in proportion,—and in the form and comparative size of the omphalodium.

The seed represented in figs. 35, 36, and 37, is the only one I possessed when the plate was engraved, and, unfortunately, it had lost the whole of its testa; its natural size would therefore have slightly exceeded that of the figures. I have since acquired another specimen, in a fine state of preservation, which agrees with the figured one in every respect, excepting that it is not quite so thick in proportion, and that it has not the umbo at the back of the seed, represented at *b*, fig. 36, so much developed; but it is probable that it would not have appeared so prominent in the figured specimen had that retained its testa. The testa, in the unfigured specimen, is smooth, even and shining. The hilum is situated in the middle of the face of the seed, and occupies a space equal to about one fourth of its length. The omphalodium is small, very nearly circular, and elevated considerably above the general level of the hilum. The foramen is situated at the back of the seed, immediately opposite the hilum.

Figure 35 represents the face of the seed: *a*, the hilum.

Figures 36 and 37 exhibit the sides of the seed: *a*, fig. 37, the hilum; *b*, fig. 36, the situation of the foramen.

Leguminosites trapeziformis.

(Plate 17, figs. 38 and 39).

Seed compressed, thin, when viewed sideways somewhat trapeziform: hilum about the middle of the face of the seed, elongated, large.

The specimen represented by figs. 38 and 39, is the only seed of this species I have seen; unfortunately it has lost the greater part of its testa. When viewed with the face towards the eye, as represented in fig. 38, it appears thin, and much

compressed. With the side presented to the eye, as in fig. 39, its outline is irregular and somewhat trapeziform. A small portion only of the testa remains, the greater part of which is seen towards the back of the seed at *b*, fig. 39. It appears to have been thin and smooth, but the bad state of its preservation does not allow of our determining these points with any degree of certainty. The hilum is situated at about the middle of the face of the seed, its length is nearly equal to half that of the seed. Near the centre of the hilum there is a small projecting mass, *a*, fig. 39, which appears to have been a portion of the *funiculus umbilicalis* remaining attached to the omphalodium, such as may be frequently observed adhering to the hilum of recent leguminous seeds. I have a recent seed in my possession very similar in form and proportions to our fossil *Leg. trapeziformis*, but slightly exceeding it in size, in which the foramen is situated at the point corresponding with *d*, fig. 39, at which spot there is, in our fossil, a slight circular depression; but this portion of the seed has suffered so much from decomposition and other causes, as to allow of our surmising only, that it possibly may have been a true foramen; and this is rendered the more probable from there being no appearance of that organ upon any part of the back of the seed.

LEGUMINOSITES CORDATUS.

(Plate 17, figs. 40 and 41).

Seed compressed, when viewed sideways heart-shaped: testa smooth: hilum oval, elongated: omphalodium circular: foramen at the apex of the seed, minute, oval.

The specimen figured is the only one of the species I have seen; unfortunately it has suffered much by partial decomposition. When viewed edgeways, as represented in fig. 40, it is seen to be compressed in a lateral direction, but when the side is presented to the eye, as in fig. 41, the outline is heart-shaped. The

testa, from a small portion remaining upon one side of the seed, appears to have been smooth and even. The hilum has suffered much by decomposition of its surface, but the raised marginal line which marks its former boundary remains, and from this it appears to have been of an oval form and about a line in length. It is situated at the middle of the base of the seed, *a*, figs. 40 and 41, which part, in the first of these figures, is slightly inclined towards the eye, in order to afford a more direct view of it. The omphalodium is circular, and measured the fiftieth of an inch in diameter. It is situated exactly beneath the line *a*, fig. 41, and appears to have been elevated above the surrounding area of the testa. The foramen is situated at the apex of the seed, *b*, fig. 41; it is minute, oval, and about twice as long as it is broad. It measured the one hundredth part of an inch in length.

MIMOSITES.

(Plate 17, fig. 42).

Fruits which belong to the natural order *Mimoseæ*.

Mimosites Browniana.

(Plate 17, fig. 42).

Legume about six times as long as it is broad: sutures broad and strongly marked: apex acuminate: base attenuated: *seeds* numerous, oval, compressed.

This beautiful and unique specimen was found embedded in the middle of a mass of cement-stone, from a pit at Ossington, Suffolk. It is in the collection of John Brown, Esq., of Stanway, who, at the suggestion of Dr. Mitchell, very kindly favoured me

with the loan of it. I have therefore given it the name of *Brownniana*, in honor of its liberal and scientific possessor.

The substance of the legume, unlike the greater number of the Sheppey specimens of fossilized fruits, is composed of carbonaceous matter, and the interior of the fruit appears to be filled with the same material as that in which it is embedded.

The form and general appearance of this fossil is strikingly similar to the legume of *Vachellia Farnesiana*, but the valves appear to have been more compressed, and they do not exhibit any traces of impressions of the numerous, ramifying, vascular bundles, which produce the strongly-marked striated appearance seen over the whole of the surface of the recent fruit. The legumes of a specimen of *Bauhinia candida* in the herbarium of the British Museum, also resemble our fossil in the proportions of their length and breadth, and are compressed laterally in about the same degree, but the apex of the pod is more acute, and its termination, for about the last half inch of its length, is subulate. The compressed figure of the fossil legume does not appear to be the result of mechanical pressure, as there is not the slightest distortion or fracture in any part of it. This compressed form of the pod also prevails in the fruits of many species of *Acacia*. The seeds are at least eight or nine in number, and present every appearance of being of a similar compressed oval form to those of *Vachellia Farnesiana*, but larger, the form of the one indicated by *a*, fig. 42, being particularly well displayed.

Little doubt can remain that this beautiful fossil is either an *Acacia*, or very closely allied to some of the neighbouring genera comprised in the natural group of the *Mimoseæ*. I have therefore designated it *Mimosites*.

XULINOSPRIONITES.

(Plate 17, figs. 43—47).

Legumes valveless, woody, two-seeded.

The pericarp of the fruits of this genus unites, in a singular manner, the characters of the legume and the drupe. The fruit represented by figs. 43 and 44 exhibits the normal form of the legume, while its structure is precisely that of the drupe. When divided longitudinally, as represented in fig. 43, it is seen to consist of a thick, bony or woody endocarpium (*b*, fig. 43), composed of highly-compressed cellular structure, arranged in lines radiating from around the longitudinal axis of the fruit, and having bundles of vascular tissue running in a longitudinal direction sparingly dispersed through it, and closely embracing the endocarp. In the same specimen there is a thin sarcocarp, a portion of which is seen at *a a*, fig. 43, and which, from the appearance of the external surface of the pericarp, seems to have been soft and pulpy. The epicarp is thin and membranous. The endocarp (*a*, figs. 46 and 47) in the fruit represented by figs. 45, 46, and 47, very closely resembles that of the one described above, the cellular structure being somewhat larger in proportion. The sarcocarp is much thicker, as seen at *b*, figs. 46 and 47, and is composed of very large cells (*c*, figs. 45 and 46), arranged in lines parallel to the axis of the fruit, and presenting every appearance of having been dry and pith-like in their structure. The epicarp in this instance also is thin and membranous. The seeds in both fruits are two in number. There is not the slightest indication of valvular structure in either of the specimens.

I have been unable to find any fruits among the existing *Leguminosæ*, which agree, in all respects, with the structure of *Xulinosprionites*. The pericarp of *Arachis* is without valves, and is two-seeded, but it has not the drupaceous structure of the fossils. *Detarium* is drupaceous, but has only one seed. The

legume of *Pterocarpus glaber* is somewhat reniform, and about the same size and substance as fig. 43, but it has only one seed, and is neither drupaceous like *Detarium*, nor valveless like *Arachis*.

Xulinosprionites latus.

(Plate 17, figs. 43 and 44).

Legume short and broad, apex umbonate: epicarp rugose and mammillated: sarcocarp thin: endocarp thick.

The specimen represented by figs. 43 and 44 is the only one of the species that I have seen. It was found on the beach, at the parallel of Warden Church, Isle of Sheppey. Its length is fourteen lines, its greatest width nine lines, and its extreme thickness six and a half lines. There is a shallow depression at the base (*c*, fig. 43), indicating the point of attachment of the footstalk; immediately beneath which there is a slight break in the woody texture of the endocarp, through which the nourishing vessels have passed. The apex, as represented at *d*, figs. 43 and 44, is slightly umbonate.

A great part of the surface of this beautiful fruit is coated by a thin film of extraneous *pyrites*, but the portion of it which is not thus obscured is covered with irregular corrugations, which are frequently terminated by small mammillated excrescences. The sarcocarp is thin, and has apparently been soft and pulpy. The seeds of this specimen are unfortunately hollow, and their internal surface is incrusted with *pyrites*. They are separated from each other by a thin plate of irregular, compressed, cellular structure, but which does not exhibit any trace of the woody structure that characterizes the endocarp.

Xulinosprionites zingiberiformis.

(Plate 17, figs. 45—47).

Legume lomentaceous, irregular: epicarp somewhat coriaceous: sarcocarp pithy, cells very large: endocarp thick.

This singular fruit has very much the external appearance of a piece of the root of the ginger of commerce; and until it is fractured it is difficult to feel convinced of its being truly a leguminous seed-vessel. It differs from *Xulinos. latus* in being distinctly lomentaceous, the septum dividing the seeds being composed of a continuation of the woody structure of which the endocarp is constructed. The epicarp, when viewed with a lens of an inch focus, is slightly rugose, and has somewhat of a coriaceous appearance. The sarcocarp, at the point *b*, figs. 46 and 47, is the seventeenth of an inch in thickness. Immediately beneath the epicarp it is composed of large, elongated, quadrangular cells, about the fiftieth of an inch in diameter, arranged in parallel lines, which coincide with the axis of the seed-vessel, as represented at *c*, figs, 45 and 46. These cells are hollow, excepting a slight incrustation of *pyrites*, which uniformly coats the whole of their internal surfaces. The endocarp has a dense, woody appearance, very similar to the structure exhibited in the seed-vessel of a species of *Hakea*, a proteaceous plant from the Swan River, Australia; but the fossil has a greater proportion of divergent layers interspersed in its structure.

The seed, when viewed with a lens of an inch focus, appears slightly rugose, with a few obscure impressions of ramifying bundles of fibrous tissue. No portion of the peduncle remains, and it is difficult to decide with certainty which end of the seed-vessel is really the base, but there is strong reason to believe that the point of attachment to the peduncle was at *d*, fig. 45.