

12. *On some small SEED-VESSELS (FOLLICULITES MINUTULUS, Brown) from the BOVEY TRACEY COAL.* By J. D. HOOKER, M.D., F.R.S., F.G.S.

[PLATE XVII.]

THE remarkable fruit which forms the chief subject of the present communication was first brought under my notice by my lamented friend the late Prof. E. Forbes, who pointed out to me specimens of it in the Museum of the Geological Survey, and entrusted me with a couple for examination. Shortly after having made a complete analysis of these, a very fine series of Bovey Tracey peats and lignites was sent to the Museum of the Royal Gardens of Kew, by Dr. Croker, amongst which were numerous specimens of the same fossil in an excellent state of preservation. An examination of several of these has enabled me to add a little to the analysis which I had previously made, and has confirmed it in all essential points.

As was the case with *Carpolithes ovulum**, there are no fossil vegetable remains accompanying the *Folliculites* that suggest any clue to its botanical affinity. The mass of the lignite appears to be formed of coniferous wood, some in the state of charcoal, and the remainder more or less highly bituminized.

From Dr. Croker's description and accompanying sections †, the main body of the formation seems to consist of

1. A bed of peat containing trunks of trees not now found in the immediate neighbourhood, but which appear to me to agree in microscopical character with the common Maple (*Acer campestre*). These are quite fresh and white, and lie in immediate contact with the surface of the uppermost bed of lignite.

2. The upper layers of lignite are very different, and in them was found a cone, so closely resembling that of a Scotch Fir (*Pinus sylvestris*), that I doubt its being specifically distinct from that plant. The only specimen hitherto discovered appears to have been nearly or fully ripe, and contains winged seeds, also quite agreeing with those of the Scotch Fir. This upper lignite, when microscopically examined, is found to be composed of coniferous wood, and is similar to the lower lignite.

3. Beneath the upper layers of the lignite is a thick bed of ferruginous granitic sand.

4. Ten beds of good coal (lignite), the upper of which are parted by beds of blue clay.

Below the blue clay is the layer containing the *Folliculites*, which are thickly strewed over the surfaces of the laminæ of lignite, and slightly imbedded in them, as if the latter had been soft when the deposit was formed. They lie in all directions, but always on their flat sides, as if they had been floated into the places they occupy; though this by no means follows, as their compressed form may be due to pressure.

Small pieces of resin, similar to the "Highgate Resin," are found

* See above, p. 562.

† See also Parkinson's 'Organic Remains,' vol. i. p. 126 &c.

in the clay, and were probably secreted by the coniferous trees whose wood appears to form the mass of the coal.

The existence of a Pine-cone, so closely resembling that of a tree still existing in Great Britain that it cannot be specifically distinguished from it, would seem to refer the Bovey Tracey Coal-field to the Post-pliocene epoch without any doubt, and is an extremely interesting discovery. This cone is wholly carbonized, and the woody interior of its scales and axis is highly bituminized. The seeds, however, may be easily separated from the cone, and their membranous wings are, though carbonized, quite perfect. From a microscopical analysis of the wood-cells of the cone, I see no reason to doubt that it belonged to the species that yielded the coniferous wood with which it is associated; and I find no character in this wood either that prevents its being referred to the Scotch Fir. It must, however, be borne in mind that this identification is provisional only; for, after a study of a very complete collection of cones of existing Pines in the Museum of Kew, I have found that it is quite impossible to distinguish by the cones alone several species from very distant countries, which are nevertheless amply characterized by their leaves and other organs. So also the cone of the Scotch Fir is not the only one to which that found in the Bovey Tracey lignite might be referred; though I do not think that it agrees better with any other species than with this.

Genus FOLLICULITES, Bronn.

Sporangium oblongum vel lineari-oblongum, compressum, utrinque obtusum, leviter curvum, infra apicem paulo constrictum, longitudinaliter leviter sulcatum, uno latere a basi ad apicem longitudinaliter dehiscens, cavum; cavitas ovato-oblonga, supra basin paulo constricta, saccum continens. *Saccus* membranaceus, hyalinus, loculo conformis, fundo constricto loculi adnatus, apice attenuatus, rima brevi oblonga lateraliter versus apicem dehiscens. *Sporæ*? minimæ, irregulares, subglobosæ vel oblongæ.

Sporangium crassum, crustaceum, $\frac{1}{4}$ unc. longum, e stratis plurimis cellularum minutarum dense compactarum conflatum. *Superficies* exterior sub lente punctato-areolata; interior strato cellularum majorum vestita, cellulæ oblongæ vel lineares, aliæ transverse clathratæ vel scalariformes, punctatæ, cribratæ vel varie porosæ, parietibus contiguis rectis vel undulatis. *Saccus* internus transparens, e membrana simplici formatus, cellulis compressis transverse oblongis quadratisve areolatus, cellulis versus apicem minoribus et magis distinctis, lineis intercellularibus sub lente maxime augente subtilissime moniliformibus.

FOLLICULITES MINUTULUS, Bronn, Lethæa Geognost. p. 849, pl. 35. fig. 11.

Hab. In terra carbonacea pleiocena?, ad "Bovey Tracey," Comitæ "Devon."

The specimens of this fossil agree well with the somewhat rude figure of Bronn's quoted above, which is taken from a specimen found in the Brown coal; but it may be doubted whether they are

not also referable to another presumed species, that on which the genus was established, the *F. Kaltennordhemensis*, Zenker (in Leonhard and Bronn's Jahrbuch, 1833, p. 177. pl. 4. fig. A. 3-7), which, however, represents a rather larger and narrower fossil than the present.

The original species of *Folliculites* is the *F. thalictroides*, Zenker (*Carpolithes thalictroides*, Brongniart), a fossil first noticed by the elder Brongniart, in 1810, in a paper published in the 'Annales du Muséum,' vol. xv. p. 382. pl. 33. fig. 17. It is there referred to the vegetable kingdom, though an alliance with Insects is hinted at; the species is a large one. In 1822 it was twice described by the younger Brongniart, who named it *C. thalictroides*, in a paper, by Cuvier and himself, on the Geology of the Environs of Paris, pl. 11. fig. 4 & 5, and in his "Classification des Végétaux fossiles," Mémoires du Muséum, vol. viii. p. 317.

Brongniart was not aware of the dehiscence of the fruit, and considered it to be allied to *Thalicttrum*. Two varieties of it are described; one, var. *Parisiense*, from Miocene beds near Paris,—the other, var. *Websteri*, from the Eocene formation of the Isle of Wight. More lately, in his 'Tableau des Genres de Végétaux fossiles,' he considers these as distinct species (*C. thalictroides* and *C. Websteri*), and follows Unger in referring them to *Naiadeæ*, who, he says, is perhaps right in this reference, though they differ very much from any existing genus of the Order (p. 87). Zenker's genus *Folliculites* appears not to be alluded to in the 'Tableau des Genres de Végétaux fossiles' of M. Brongniart, though published sixteen years before that excellent work.

Whatever may be the true affinities of *Folliculites*, I think they are very remote from both *Naiadeæ* and *Ranunculaceæ*. The internal sac is regarded as an arillus by Zenker, a view which appears to me to be untenable; and, if not the membrane of a sporular sac, it is most likely the proper coat of an embryo or albumen.

I have examined about twenty-five specimens of this remarkable fossil, all in a very perfect state as regards the sporangium and enclosed sac, but differing a little in the nature of the cellular layer forming the inner lining of the sporangium. Owing to the very brittle and perfectly opaque carbonized state of the fossil, I was unable to make sections or slices, and the tissues of the inner surface were obtained piecemeal.

The substance of the walls of the sporangium is dense, opaque, thick, and brittle, formed of many rows of densely crowded cells; the outer surface is undulated and minutely dotted; the thickened apex is rounded and vertically striated. The dehiscing surfaces are smooth and polished, and a groove or canal leads from the upper end of the internal cavity to the apex of the fossil.

The membrane lining the inner wall of the sporangium is formed of large turbid cells, having a glistening appearance; they are transparent, membranous, brittle, and of a rich brown colour. The individual cells are oblong, cylindrical, with blunt bases, often produced into a convex sac (8 a), and their upper ends frequently terminate in

blunt, opaque, prominent cones that stand out from the surface of the membrane. The cell-wall is marked with very faint oblique lines, appearing more like undulations of the cell-wall than a thickening of it or deposit on it. Under a very high magnifying power, the lines marking the junction of the contiguous cell-walls have a beautifully beaded appearance (fig. 8).

Beneath this investing coat of the cavity I occasionally found broken pieces of tissue, represented by figs. 9-13, which approach vascular tissue in character.

The attachment of the sporular sac is by a broad base, that adheres to the somewhat excavated base of the cavity of the sporangium; the apex of the sporular sac is drawn out into a very fine point, which projects into the tubular canal at the apex of the sporangium, and is there united to the cellular tissue lining the latter. The sporular sac finally becomes retracted from this canal, and tears away a portion of its lining membrane with it (fig. 5).

The substance of the sporular sac is extremely delicate, but firm and brittle, transparent and glassy; it does not expand in water like that of *Rhytidosporum* *, but is dissolved in hot nitric acid, and presents no action with iodine.

The very different-looking cellular tissues figured are all evidently referable to one type, but they may have belonged to more than one layer. Some of the longer (fig. 10-13) approach vascular tissue in character; but I was quite unable to detect any stronger evidence of vascular tissue, which, however, may very well be supposed to exist along the edge of the fossil opposite the suture.

The sporular sac, in its origin, insertion, membranous nature, &c., closely resembles that of *Carpolithes ovulum*, but differs in many remarkable points of form and anatomy; thus it bursts by a minute oblong slit below the narrow sharp apex, and appears to be formed of but one layer of very compressed cellular tissue. Under a very high magnifying power ($\frac{1}{20}$ lin. doublet, or $\frac{1}{2}$ inch object-glass), this tissue presents the same beautiful appearance that the lining membrane of the sporangium does, the boundary-lines between the cells being formed of strings of minute spherical bodies of various diameters, and the intermediate membrane is either transversely undulated, or appears so from the presence of excessively fine, parallel, waved lines. What I have regarded as spores were the only contents of the sac in one of the specimens, and consisted of a mass of extremely minute spherical or oblong transparent bodies, of various sizes. In the other specimens the sac was perfect; but its cavity, and that of the sporangium, were filled with fine silt, amongst which I could detect no definite remains of vegetable tissue.

With regard to the affinities of this fossil it is exceedingly difficult to speak. The sporular sac at once suggests an alliance with Mosses, and the traces of vascular tissue in *Carpolithes ovulum*, to which it may be assumed to be allied, with Ferns. There are, however, very grave objections to these affinities for either of the fossils. Thus, as regards

* See above, p. 564.

Mosses, their sporular sac has a very different insertion and origin from that of these plants, being almost invariably traversed by an intruded duplicature of itself, called the columella, and being attached to the walls of the sporangium by a delicate confervoid arachnoid tissue, of which these fossils present no traces.

The apical dehiscence of the inner sac of *Folliculites* and the lateral dehiscence of that of *Carpolithes* do not form valid objections to the alliance with *Musci*, though unknown in that Order. The porous and barred cells of *Folliculites* may be considered analogous to the curious cellular tissue of *Sphagnum* leaves; but there is in Mosses no known analogue of the vascular bundle of *Carpolithes*.

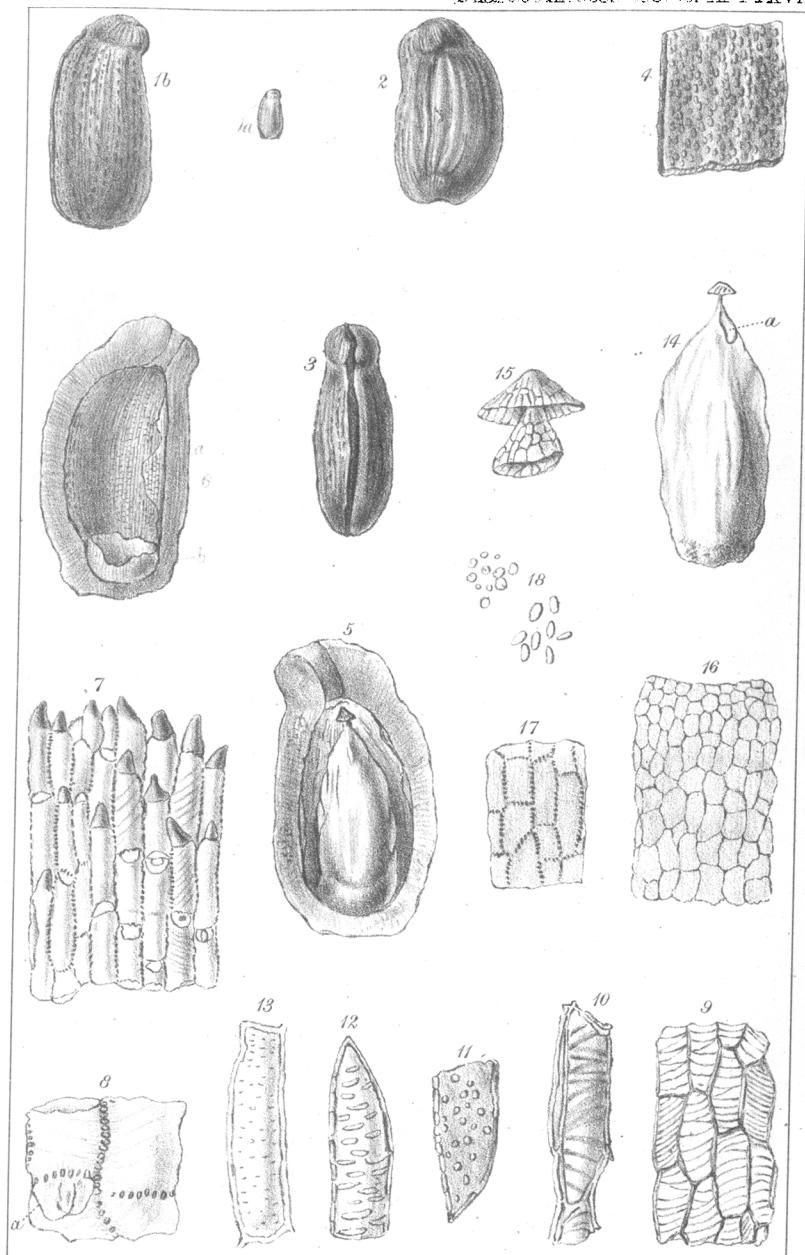
Upon the whole I think it probable that these bodies may have belonged to a group of plants more nearly allied to Ferns than to any known living Order, if not absolutely belonging to the Filicoid alliance; and, considering how little we know of these fossils on the one hand, and, on the other, the very great diversity of form and anatomy in the sporangia of Ferns, it appears to me to be unadvisable to found upon these specimens an independent family. Added to this is the fact, that the recent discoveries in the reproductive organs and mode of germination of the Cryptogamic plants generally have thrown a light upon these families, which tends rather to enlarge our views of their limits than the contrary.

DESCRIPTION OF PLATE XVII.

(All the figures except 1 *a* are more or less highly magnified.)

- Fig. 1, *a*. *Folliculites minutulus*, natural size; 1, *b*. the same magnified.
- Fig. 2. Magnified view of another specimen.
- Fig. 3. The same, presenting the dehiscing face.
- Fig. 4. Portion of the outer wall of the sporangium.
- Fig. 5. Vertical section of the sporangium, showing the position of the sporular sac.
- Fig. 6. Vertical section of another specimen, showing the inner lining membrane (*a*) and the base of the sporular sac (*b*), the upper part of which has been removed.
- Fig. 7. Portion of the lining membrane, formed of cylindrical turgid cells with often convex bases and conical opaque apices.
- Fig. 8. More highly magnified view of a portion of the same, showing at *a* the convex base of a cell.
- Fig. 9. Portion of a fragment of a membrane that appeared to line the cavity of another specimen, but which I suspect was originally beneath that figured at 7.
- Figs. 10-13. Various cells with dots, perforations, &c. in their walls, or transverse bands, and which appeared to underlie the superficial membrane of the cavity at different parts of the sporangium.
- Fig. 14. The sporular sac; showing its acuminate apex with the oval opening (*a*) below it, and above the opening the remains of the membrane that lined the base of the canal at the apex of the sporangium.
- Fig. 15. Very highly magnified view of the apex of the sporular sac, &c.
- Fig. 16. Membrane of the sac.
- Fig. 17. A portion of the same, showing the beaded appearance of the cell-walls.
- Fig. 18. Spherical and oblong sporules?

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J.D. Hatcher del. Geo. West lith.

Hood & West. Imp.

FOLLICULITES MINUTULUS.
from Bovey Tracey.