

ART. XXXIX.—*On the Fossil Fruits found in connection with the Lignites of Brandon, Vt.*; by LEO LESQUEREUX.

PROF. EDWARD HITCHCOCK (this Journal, 2d series, vol. xv, pag. 95–104,) has already given excellent descriptions accompanied with drawings, of the Brandon fruits and most satisfactory details concerning the strata with which they are connected. I owe to the celebrated Professor of Amherst College not only the communication of the original specimens from which the drawings have been made, but also a number of corresponding specimens that he had the kindness to present to me.

It cannot be expected that the examination I have been requested to make of these fruits can afford any exact botanical determinations. Indeed an accurate analysis of fossil plants is mostly impossible, their form being generally more or less obliterated and the preserved part, the hardest of course, being often of slight value, as a botanical character. By cutting a few specimens, I was enabled to find some details of anatomical structure in one of the species only, and thus to mark its botanical characters somewhat more accurately than it is generally done for fossil fruits. It is then only to point out the relation of some of the Brandon fruits with fossil species found elsewhere, or with genera of plants still living, and especially to try to come to a satisfactory understanding about the geological age of the lignite deposit where they are found, that the few following remarks are made:*

To facilitate further quotations and discussions about the Brandon fruits, I think that it is also convenient to give a short description of their essential characters and to name them.

* The numbers marked in this paper correspond with those of the still unedited report of Vermont by Prof. Ed. Hitchcock. As they are not the same as some of the Journal, (loc. cit.) it is necessary to correlate them.

This Jour., Fig. 1 is equivalent to Fig. 111 to 117 of the Report.

"	"	2	"	118	"
"	"	3	"	119	"
"	"	4	"	132	"
"	"	5	"	133	"
"	"	6	"	123	"
"	"	7	"	145	"
"	"	8	"	142	"
"	"	9	"	146	"
"	"	10	"	134	"
"	"	11	"	136	"
"	"	12	"	126	"
"	"	13	"	153	"
"	"	14	"	154	"
"	"	15	"	151	"
"	"	16	"	148	"
"	"	17	"	149	"
"	"	18 and 19	"	150	"
"	"	20	"	159	"

No. 1. *Carpolithes Brandoniana*, sp. nov. Capsule thick-walled, oval or nearly round, flattened, obtuse at both ends, valvate. Valves obscurely pointed, opening from the base to half the length of the capsule.

Var. α , elongata. Fig. 111 to 113.

Var. β , obtusa. Fig. 114 to 117.

Specimens figured 111 to 117 are certainly various forms of the same species and I think that those of 118, 119 and 124 ought to be referred to the same genus.

No. 2. *Carpolithes fissilis*, sp. nov. (Fig. 118, 119 and 124.) Capsule, a little flattened, ovate, lanceolate, obtuse or rounded at one end, pointed at the other, obscurely tencostate, irregularly tri-valved, dehiscent or closed. In this species as in the former, the size of the fruit varies from one to two inches in length and from half an inch to one inch or a little more in breadth.

Nothing like the fruits of these two species has been before published by palæontologists. The only fossil fruit to which they might be compared is the capsule of an *Embothrium* (Heer, Flor. tert. Helv., pl. 93, fig. 30,) and especially that of *Embothrium salignum*, a living species of the *Proteaceæ* family, a figure of which is given by the same author on the same plate. But the fruits of the genus *Embothrium* are borne on a strong woody stem generally preserved in the fossil state, while our fossil fruits of Brandon have no scars showing the point of attachment to a pedicel. They both, on the contrary, appear to have been enclosed, either in the spathe, or a fibrous capsule, like the fruits of some palms, or partly immersed in a cupula, like those of some *Cupulifereæ*. It may be that the thick, fibrous and woody capsule contained originally some seeds that have escaped by the dehiscence of the valves, as Prof. E. Hitchcock remarks; but the total absence of seeds, even within unopened specimens, led me to suppose that the thin pellicle which is seen within these peculiar fruits contained a mealy cotyledon, whose form and matter have been destroyed by maceration. It is useless however to speculate on these fruits till something more is known about their relation to some living species. Specimens of No. 1 are extremely abundant at Brandon.

No. 3. *Carpolithes irregularis*, sp. nov. (Fig. 120, 121, 123, 125, and 128.) Fruit capsular, about one inch in diameter, irregularly somewhat flattened, sometimes obscurely trigonal, round-oval, costate in its length.

These may be unopened and less flattened specimens of the same species as No. 2. They would compare well with some species of *Carya*, if they were not generally a little flattened or trigonal. Perhaps fig. 128 belongs to another species; but it looks like a deformed specimen of this.

No. 4. *Carpolithes Grayana*, sp. nov. (Fig. 122.) Fruit oval-elongated, obtuse at one end, marked by a sharp abrupt point

at the other, a little flattened, one inch long, less than an inch broad, obscurely costate.

This species has just the form of the kernel of the almond. It is nearly related to *Carpolithes pruniformis* Heer, (l. c. vol. iii, p. 139, tab. 141, fig. 18 to 30,) abundant in the upper tertiary of Europe, especially at Eningen.

No. 5. *Carya verrucosa*, sp. nov. (Fig. 129.) Fruit oval, slightly costate, obtuse at both ends, warty.

This fruit is like *Carya Brauniana* Heer, (l. c., vol. iii, p. 93, tab. 127, fig. 50 and 51) from Eningen. It is a little larger than the following, but may be the same species still covered with the husk.

No. 6. *Carya Vermontana*, sp. nov. (Fig. 130.) Nut small, about half an inch long, oval, pointed at one end, obtuse at the other, six-costate.

It is extremely like *Carya Bruckmanni* Heer, (loc. cit., vol. iii, pag. 93, tab. 127, fig. 32) perhaps identical with it, also from Eningen, like the former.

No. 7. *Fagus Hitchcockii*, sp. nov. (Fig. 126 and 127.) Nut large, trigonal, with the angles somewhat obtuse, striated on the sides.

The fruit has nearly the same form as a nutlet of *Fagus ferruginea* Michx. It is only proportionally a little shorter and broader, and twice as large. Fig. 127 represents a specimen slightly open on one side at the point, with the angles more obtuse. It may be a different species or even belong to another genus. The fruit fig. 126 is indeed very large for the nut of a Beech; but Unger, in his *Chloris Protogæa* (pag. 101, tab. 27, fig. 1 to 4), has published *Fagus Deucalionis* with nuts as large as those of the Brandon species. It comes from the tertiary of Bohemia.

Genus *Apeibopsis* (Heer). (*Cucumites* Bowerbank.) Prof. Heer has referred this genus to the family of *Tiliaceæ*, comparing it to *Apeiba*. It is characterized as follows: Fruit capsular, five to sixteen-valvate, polyspermous; seeds small, sub-globose, biseri-ate in each cell. On the characters of these fruits, the author further remarks: (Flor. tert. Helv., vol. iii, p. 38) "Where the bark of the fruit is preserved, it is marked with elongated warts and the fruit was externally verrucose. Within, it was probably filled with a fleshy matter containing the seeds in small cavities. In one specimen, (fig. 20 of Bowerbank) the seeds are placed without order in the central mass; in another (ibid., figs. 11, 12, 21, 34,) they appear to be placed in rows along the suture. Probably the fruit was divided into as many cells as there are furrows marked on the surface; but the walls were very thin and lost within the fleshy mass."

This description and the remarks of Prof. Heer agree well enough with what I was enabled to see by cutting a few of our

Brandon fruits, evidently referable to this genus, and by a microscopical examination of their internal structure. In the American species, the parietal follicle of the capsules appear thick and each one is distinct and separated from the other in its whole width, from the folding of it at the surface to the suture with the central axis, also pretty thick. There are thus internally six or seven loculi or carpels, separated by double walls. The seeds, very small indeed (less than one millimeter in diameter) and very numerous, fill the cells entirely and are apparently mixed with a fleshy or cellular matter. Those nearest to the placenta and of both sides of each cell appear placed in rows upon the whole width of the parietes, being there perpendicular to it, and more oval or a little longer than in the middle of the cells, where they are nearly globose. These seeds are enclosed in a yellowish somewhat pellucid envelope, easily separated from them and marked on its inner concave surface by regular black points (or papillæ?). The seeds appear also somewhat papillous or rugose, just like the outer surface of the fruit. The largest specimen of these fruits that I have seen is scarcely more than half an inch in diameter, nearly exactly globular, or a little elongated or oval. The surface is not regularly verrucose, but rather irregularly deeply rugose, marked by seven or eight furrows a little elevated on the borders, along the line of flexure of the parietal tissue. The extremities of the central axis are marked on both sides of the fruit by a small round scar, only a little larger at the point of attachment.

On the distribution of this remarkable genus, Prof. Heer says that it appears at first in the Eocene of England, and takes its greatest development in the lower Molasse of the Tertiary of Switzerland where four species have been found. It has also been found in the lower Miocene of Italy and also in Bohemia, and is then apparently lost. From this it would appear that as the Brandon deposit, where specimens of this genus are abundant, belongs apparently to the Upper Miocene, as will be seen presently, this genus has appeared later or persisted longer in America than in Europe. The size of our fruit, compared with that of the European *Apeibopsis*, (which have sometimes a diameter of two inches) shows that our species are diminutive. Although the general form of our specimens is somewhat alike, I think nevertheless that we have two species.

No. 8. *Apeibopsis Heeri*, sp. nov. (Fig. 131, 132, 133.) Fruit globular, deeply grooved or rugose, distinctly marked by seven furrowed costæ.

No. 9. *Apeibopsis Gaudini*, sp. nov. (Fig. 139 and 140.) Fruit smaller, oval, depressed on one side; costæ more numerous and less marked, surface nearly smooth.

It is on specimens of this last species that my examination was made. They appear abundant at Brandon but I have seen only three specimens of the former.

No. 10. *Aristolochia Eningensis*, Heer. (Fig. 134.) Fruit capsular, oval, six-costate, smooth or obscurely transversally rugose.

I cannot see any difference between our American specimen and Heer's figure of this species, except perhaps that the surface of the specimen appears somewhat transversally rugose. This appearance may be due to the process of maceration. Prof. Hitchcock's figure in this Journal (loc. cit. 1853) is quite the same as that of Heer (tab. 100, fig. 11, C. 1856), from a specimen of Eningen.

No. 11. *Aristolochia curvata*, sp. nov. (Fig. 135 and 136.) Fruit capsular, small, half an inch long, oval, pointed, marked with eight strong costæ, somewhat curved on one side.

No. 12. *Aristolochia obscura*, sp. nov. (Fig. 137, 138, and 141.) Fruit capsular, small, one third of an inch in diameter, six or seven-costate, globular or a little flattened.

This species is uncertain. The specimens are not well preserved and I had not any for anatomical examination. I believe nevertheless that it is a specimen of this kind that Prof. Bailey has critically examined by a cross section. He found it a *six-valved pod, with seeds apparently flattened*. This agrees with the structure of the fruit of *Aristolochia*.

No. 13. *Sapindus Americanus*, sp. nov. (Fig. 142, 143, 144, 145.) Fruit oval-reniform, either smooth or irregularly rugose, depressed or flattened on one side, about half an inch in its greatest diameter.

These fruits have the general form of the fruit of *Cocculus Indicus* or of some fossil species of *Pavia*. They are smaller than the fruits of *Pavia* and moreover the cross section of one of the specimens (fig. 144) shows a fleshy cotyledonous substance enclosed in a thick putamen. The fruits also bear a marked round scar, showing a point of attachment at the upper end. It is not marked in the figure. These characters agree well enough with those of *Sapindus*. The nearest fossil species to that of No. 13 is *Sapindus lignitum* Ung., (l. c. pl. 1, page 33, tab. 6, fig. 3 to 5) from the lignites of Wetterau.

No. 14. *Carpolithes bursæformis*, sp. nov. (Fig. 146 and 147.) Fruit obovate, narrowed at one end, where it bears a round small cavity, inflated and obtuse at the other end, a little curved on one side, smooth.

I do not know of any fossil species to which this could be related. It is pear-shaped, as Prof. Hitchcock describes it; but it is a little curved on one side, a character that separates it from *Laurus*. As the specimens are much broken, this curved appearance may result from maceration, and if so, the species would

well agree with *Laurus princeps* Heer, (l. c. vol. ii, page 77, tab. 89, fig. 176) from the upper tertiary of Europe, especially abundant at Eningen.

No. 15. *Cinnamomum Novæ-Angliæ*, sp. nov. (Fig. 148.) Fruit small, one sixth of an inch in diameter, globular, enlarged above, narrowed below to an obscurely costate point, apparently a broken pedicel, smooth.

I could not discover on the specimen the horizontal striæ marked on the figure. The fruit resembles that of a *Cinnamomum*, a genus well represented in the different stages of the tertiary of Europe. Of nine species described by Prof. Heer, five are found at Eningen. This genus as it is established by the same author is also represented in the Tertiary of America. Among a small number of fossil leaves collected by Dr. J. Evans in the Tertiary of Vancouver, there are specimens of two fine species of leaves of *Cinnamomum*. One other is abundant in the strata of the Tertiary of Mississippi (State).

No. 16. *Illicium lignitum*, sp. nov. (Fig. 149.) Seed small, one eighth of an inch long, oval, pointed, marked at the point by a small scar and by a ring on one side, very smooth and shining.

I can not but refer this seed to *Illicium*. It is a little thicker and more pointed than that of *Illicium anisatum* of China; but about the same size and the same form. Two species of *Illicium* are still living in the southern part of the United States (Gray's genera, vol. i, pag. 56.) On comparison with the published species of fossil plants, our seed is like the one figured by Göppert, under the general name of *Drupa* (Flora of Shossnitz, tab. 26, fig. 34). The tertiary of Shossnitz is of the same age as that of Eningen (Heer, vol. iii, pag. 306).

No. 17. *Drupa rhabdosperma*, sp. nov.? (Fig. 150.) Seed small, about of the same size and of the same form as the former, oval, pointed, or slightly beaked, finely and deeply striated, marked under the point by a deep triangular scar.

These seeds resemble those of *Pinus rhabdosperma* Heer, (vol. i, pag. 60, tab. 21, fig. 14) from the Miocene of Switzerland. The likeness is not enough to prove that our seeds are of the same species, or even of the same genus. Analogous forms of such small ribbed seeds are found in different genera. The putamen is pretty thick, very hard, bony, and in all the specimens that I have broken the kernel has been destroyed or the seed is empty. The kernel is covered with a brownish skin, like that enveloping the albumen of the seeds of the Pines. However the affinity of these seeds with those of a Pine is rendered doubtful by the absence of every trace of a wing in all the specimens, six in number, that I have seen.

No. 18. *Carpinus grandis*? Heer (l. c., vol. ii, pag. 40, tab. 72, fig. 15.) Nutlet oval, about one eighth of an inch in length, ribbed or striated.

I have not seen any specimen of this species. Prof. Hitchcock's figure 151 is like that of Prof. Heer for this species. *Carpinus Grandis* Heer, is from the upper Miocene of Switzerland.

No. 19. *Leguminosites pisiformis*? Heer (l. c., vol. iii, p. 129, tab. 133, fig. 37 to 40.) Seed globose, perfectly smooth, shining, one sixth of an inch broad.

Round small seeds like this are found in great number in the Tertiary of Europe and have been described under various names. The *Drupæ* (fig. 29 and 30 of tab. 26) of Göppert's flora of Shosnitz; the seeds of *Menianthes tertiaria* Heer (l. cit., vol. iii, pag. 20, tab. 104, fig. 20); some species of *Podogonium*; *Podogonium Knorrii* Heer (vol. iii, pag. 114, tab. 135), a characteristic plant of the upper Miocene of Europe, especially abundant at Eningen; and a number of *Carpolithes* or undetermined seeds. Though the identity of our Brandon *Leguminosites* with that of Eningen, (*L. pisiformis*) is far from certain, it is however remarkable that most of those fossil seeds that have about the same form as ours belong to the upper Tertiary.

No. 20. *Nyssa complanata*, sp. nov. (Fig. 153.) Fruit oval, a little flattened, bicostate with a deep furrow in the middle.

This species particularly resembles *Nyssa Vertumni* Ung., (Sill., pl. p. 16, tab. 8, fig. 19 and 20) from the lignites of the Rhine.

No. 21. *Nyssa microcarpa*, sp. nov. (Fig. 154.) Fruit oval, scarcely compressed, regularly ribbed, short.

Fig. 155 is longer; the point of the specimen is obliquely broken and thus its form can not be seen. It is perhaps some other species of the same genus. Our No. 21 is related to *Nyssa ornithobroma* Ung., (loc. cit., p. 16, tab. 8, fig. 15 and 18,) a species also from the lignites of Vetteravia.

No. 22. *Nyssa lævigata*, sp. nov. (Fig. 156.) Fruit cylindrical-oval, obtuse at one end, abruptly cut at the other, smooth.

The position of these fruits, as they are figured and their form, recall immediately the general appearance of the fruits of *Nyssa multiflora*. The likeness is still greater in comparing dry drupes of this species with the fossil specimens. The thick putamen of some *Nyssæ* is well adapted for preservation in the lignites. Though our fossil species is related to the living *Nyssa multiflora*, it differs by the size of the nutlets and the absence of striæ.

No. 23. *Carpolithes venosus*? Sternberg (Vers., vol. ii, pag. 208, tab. 58, fig. 18 to 20.) Fruit oval, about one inch long, irregularly and deeply sulcate and veined (fig. 157 to 160).

This is apparently a *Carya*. But the likeness with the species published by Sternberg, under the above name, is too great to permit a separation. Some pieces of the putamen, figured 159 and 160, have about the same thickness as that of *Carya olivæformis*, and are marked on the inner surface by irregularly crossed

wrinkles like those of the *Carya*. This *Carpolithes venosus* is a species of the lignites of Bohemia.

To close this examination, I have still to mention a piece of the wood found in the lignites of Brandon. This wood, somewhat hardened and blackened, is still in a good state of preservation. It is soft enough to be cut with a knife, or at least easily broken, and on a section, it shows evidently the character of a Dicotyledonous wood. It cannot be specifically determined, of course; but it looks like the wood of a *Juglans* or a *Carya*.

Before I had had an opportunity of examining the fossil fruits of Brandon, and judging only from the drawings and descriptions published by Prof. Hitchcock (l. c.) I had, in a letter to Prof. J. D. Dana, given the opinion that the Brandon lignites were of the same age as the upper Tertiary deposits of Eningen. This opinion is fully confirmed by all that has been said above of the relation of those fruits with species of Eningen. It is true that the identity of species is not ascertained; but this, of course, can not be expected; and it is enough that the greatest number of the Brandon species are more generally related to species of Eningen, than to species of any other stage of the Tertiary, to authorize the above conclusion and to render it credible.

It is to be regretted that the fossil flora of the Tertiary of Mississippi is not better known. I have indeed found below Columbus, Ky., some specimens of fruits of a *Carpinus* and of a *Carya*, this last referable to *Carya olivæformis*, in the chalk banks, overlaid by ferruginous conglomerate. And in some red shales, received from Mississippi, I have found the fruit of a *Fagus*, resembling *Fagus ferruginea* if not identical with it. These data are too scanty to afford a point of comparison. But judging from the position of the lignites of Brandon, or rather from the nature of the strata overlying it, as it is described in Prof. Hitchcock's paper, I must believe that they are of the same age as the upper lignite formation that extends on both sides of the Mississippi, and which I had opportunity to explore in Arkansas, in company with my friend Prof. E. T. Cox. His general section of the Tertiary of Dallas county, Arkansas, presents in an exact manner a resumé of a number of local sections of that country. It is given in detail in the Geological Report of Arkansas by Dr. D. Dale Owen (vol. ii, p. 410) thus:—

General Section of the Tertiary of Dallas county, Arkansas.

Waterworn pebbles and gravel cemented by ferruginous conglomerate.

Place of fossil, generally silicified wood.

Red sandy clay, sometimes containing good iron ore and ferruginous sandstone, the last much fluted.

Light colored sand.

Upper lignite bed.
 Ash-colored sandy clay.
 Plastic potter clay.
 Lower lignite.

The Copperas bluffs in St. Francis county, Ark., (same report, p. 418) show a section much like the above. A number of sections of the Geological report of Mississippi, by Dr. Eug. W. Hilgard, especially that of page 118, may be compared also with those of the strata accompanying the lignite deposit of Vermont. All show the same characters, viz., lignitic strata overlaid at some distance by strata of iron-ore or deposits of various kinds charged with iron. I know that it is still a question if all these lignite strata of the Mississippi shores, which I consider as upper tertiary, belong to the same age. Palæontology only can decide, when sufficient materials are collected. I will only remark that the lignites of Lauderdale, Miss., presenting with their accompanying strata a section resembling the above, are placed by Dr. Hilgard near the base of the tertiary, while their fossil plants show the greatest affinity with species of our time and are apparently of as recent an epoch as the fruits of Brandon, Vt.

Columbus, Ohio, Sept. 12, 1861.