A Lower Cretaceous Species of Schizaeaceae from Eastern North America.

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With Plate XII and one Figure in the Text.

THE present brief communication is published in order to demonstrate that certain leaf impressions from the lowermost Cretaceous of the Atlantic coastal plain, which have been referred to the Ginkgoales, are to be referred to the Filicales, and considerable evidence will be brought forward for the reference of these remains to the family Schizaeaceae or to the Mesozoic representative of the modern family.

When Professor Fontaine undertook the study of the flora of the Potomac group, which culminated in Monographs XV and XLVIII of the U.S. Geological Survey, a variety of *Baiera*-like forms were figured and described. These were made the basis of the genus *Baieropsis* referred to the order Ginkgoales, in which ten species were described, and the genus *Acrostichopteris* referred to the Filicales, in which five species were described. In a re-study of the original, as well as a large amount of additional material, it became obvious that the specific differentiations which had been put forward were absent in nature, and that the remains of both *Baieropsis* and *Acrostichopteris* were for the most part congeneric in cases where they were not specifically identical, and that all were indubitably ferns, as shown by the habit of the fronds and their manner of subdivision and fructification. These fructification characters are obscure in all but two of the forms, and hence in a recent revision¹ the writer has dropped the name *Baieropsis* altogether and referred all of the forms except these two to the genus *Acrostichopteris*, whose exact position among the Filicales remains unknown.

The two forms above referred to as showing fructification characters of value, although described by Professor Fontaine as *Baieropsis macrophylla* and *Baieropsis expansa*, prove to be identical. They have furnished certain rather definite criteria for their reference to the family Schizaeaceae, using

¹ Berry, Proceedings U.S. Natural Museum, vol. xxxviii, pp. 625-632, 1910.

that term in a somewhat general sense, and since the term *Baieropsis* is not available as well as grossly inappropriate, a new generic name is demanded, and *Schizaeopsis* is here proposed. The single known species with its synonymy becomes as follows :—

Schizaeopsis expansa (Font.).

Baieropsis expansa, Fontaine, Potomac Flora, 1890, p. 207, Pl. LXXXIX, Figs. 1, 3 ; Pl. XC, Fig. 1 ; Pl. XCI, Fig. 2 ; Pl. XCII, Fig. 5.

Baieropsis macrophylla, Fontaine, *ibid.*, p. 212, Pl. XC, Fig. 6.

Fronds relatively large, about 11 cm. in length by 6 cm. in width, apparently short stalked, divided almost to the base into two principal ribbon-like divisions, which in turn are almost immediately subdivided dichotomously into two similar subordinate divisions, which are dichotomously forked in a like manner at varying heights. In the nearly complete specimen figured, from which the restoration has been made, the outer main division of the frond is somewhat less developed and less cut up than the inner main division. The texture is coriaceous. The veins are thin but strong, in some specimens suggesting a double vascular strand ; they fork dichotomously near the region where the frond forks, and then repeatedly at varying intervals, but they are for the greater part of their course unbranched and approximately parallel. They are somewhat more numerous than in the comparable modern species of *Schizaea*. The fructifications as preserved are brownish spindle-shaped bodies about 4 mm. in length and 1 mm. in diameter. They were observed and figured by Fontaine in the specimens named by him *Baieropsis macrophylla*, and were considered to be of a pathological nature, i.e. fungal, but were not noticed on the specimens which he described as *Baieropsis expansa*, although they are readily seen in the figure here reproduced, which is from a photograph of the specimen from which Fontaine drew his Fig. 1 on Pl. LXXXIX of the Potomac Flora. These fructifications are borne at the distal ends of certain of the veins at varying heights, usually along the margins, but occasionally on the face of the laminae. Ordinarily they are massed towards the distal ends of the ultimate divisions of the frond, as in the modern *Schizaea elegans*, the ultimate ones appearing as continuations of the ultimate teeth which terminate the distal lacinae. Numbers of these fructifications are in organic connexion with the fronds, so that there is no room for any mistake in observation. These objects are found upon microscopic examination to be made up of masses of closely packed, relatively large spores, in the ground mass of which there are traces of other tissues which cannot be made out, but which evidently represent peduncles and synangial walls. These spores are nearly spherical in form, a feature common to the genera *Aneimia* and *Lygodium*, but apparently not to

Schizaea. They are of large size, averaging about $\frac{1}{10}$ mm. in diameter. The tetrad scars are small but well marked, but show no protuberances or ornaments at the outer angles. The walls are thick and strongly striated, another feature of the modern Schizaeaceae, especially of the genus *Aneimia*, and well shown in the camera lucida drawings of the fossil spores reproduced on Pl. XII, Fig. 2. The spore contents are for the most part dissipated, only the yellowish exine remaining, and the walls are frequently collapsed, so that with a low power they appear cross-lined because of their juxtaposition.

Since only the spores are preserved, the morphology of these fructifications is conjectural. They have the appearance of simple fusiform sporangia of gigantic size, but it is believed that they represent a large number of pairs of more or less confluent, or at least close packed, sporangia.

The specimens are found in a partially lithified sandy clay, almost an argillaceous sand, but the sand is fine-grained, so that the fossils are well preserved, as indicated by the specimen photographed. In this specimen the spores were evidently nearly mature, as indicated by their size and configuration. None seen are in tetrads, and yet the sporangia could hardly have dehisced before fossilization, since each tiny rock cavity which represents these fructifications is packed with the spores. In some of the impressions there are faint transverse lines on the matrix, as if they marked the line of demarcation between successive pairs of sporangia, and in one case the vein upon which the fructification was borne can be traced the entire length of the fructification, clearly indicating that it is not a gigantic simple sporangium, but an aggregate of sporangia comparable to that of the modern genus *Schizaea*.

With regard to the botanical affinity of this species, the writer's convictions are indicated in the generic name. No modern group of ferns fulfils the conditions as does the family Schizaeaceae. The fossil fern is identical with various modern tropical members of this family in vegetative habit, no other modern ferns known to the writer resembling it in the character of the fronds except the genus *Rhipidopteris* of the Polypodiaceae, which has a quite different habit and type of fructification. The venation is closely similar to *Schizaea*. The fructifications are similarly borne and the spores are similar in form and markings to the closely allied modern species of *Lygodium* and *Aneimia*. It is believed that the combination of close agreement in vegetative characters with a similar close agreement in fructification characters, in so far as they are determinable from the nature of the material, justifies the reference of these ferns to the family Schizaeaceae, a family which on theoretical grounds we would expect to find represented in the lower Cretaceous. Whether the detailed organization of the fructifications conforms to that which obtains in the modern members

of the family cannot be determined ; presumably there were differences, but these were probably not greater than those between the existing genera referred to this family. A restoration of the fossil drawn from the specimen figured in Pl. XII is shown in the Text-Fig., enlarged $1\frac{2}{3}$ times.

TEXT-FIG. Restoration of a frond of *Schizaeopsis expansa*. $1\frac{2}{3}$ natural size.

The species occurs in the oldest formation of the Potomac group, the Patuxent formation, which in age corresponds in a general way with the upper Wealden of Europe. The figured specimens come from Fredericksburg, Virginia ; comparable, but more or less fragmentary, specimens have been found at a number of other localities in Virginia. The fern genus

Acrostichopteris, which is very similar in vegetative character, is best retained for the somewhat similar remains of fronds until definite information is obtainable regarding their reproductive structures, although it is extremely probable that some at least of the species of *Acrostichopteris* should be referred to the Schizaeaceae, and the same remark is equally applicable to certain species ordinarily referred to the genus *Baiera*.¹ To mention a specific case, the homotaxial species *Baiera cretosa* of Schenk is very close to *Schizaeopsis expansa*, and was originally compared by Schenk with the modern *Schizaea elegans*.

As has already been mentioned, there are abundant theoretical reasons for expecting to find representatives of this family as far back at least as the later Mesozoic. Such still earlier ferns as have been supposed to exhibit affinities with the Schizaeaceae are too obscure and indefinite to be of much value, and it seems certain that the older Mesozoic and Palaeozoic ferns, at least the Leptosporangiate ones, were too generalized to admit of their being referred to the accepted families based, as the latter are to such a large extent, upon existing species. There is, however, abundant collateral evidence for the view that by the dawn of the Cretaceous the main lines of cleavage which separate the families as we now know them were rather clearly defined. In addition to the *Schizaea*-like species here described, the Schizaeaceae were represented in the lower Cretaceous rocks of both Europe and America by several species referred to the genus *Ruffordia*, which in the character of its fructifications and sterile fronds resembles the modern genus *Aneimia*. There is of course the well authenticated Jurassic genus *Klukia* of Raciborski,² which seems to fall within this family, and Professor Zeiller³ has recently called attention to certain fern-remains from the Wealden of Peru which show sterile fronds similar to those of *Cladophlebis Browniana*, which bore annulate sporangia of the *Schizaea* type. Stopes and Fujii⁴ have also described structural material from the upper Cretaceous of Japan sufficiently preserved to show some of the soral characters and to warrant the restoration of the sporangium of what they have named *Schizaeopteris mesozoica*. While the genus *Schizaeopsis* is thus far confined to the eastern United States, the fern genus *Acrostichopteris*, which so closely resembles it in vegetative habit and geological range, has been found in the Kootanie formation of the western United States and in the Wealden of England, and identical forms have been described as various species of *Sphenopteris* from the lower Cretaceous rocks of Portugal by Saporta.

¹ This is, of course, not true of all species of *Baiera*, some of which, in their fruiting characters, show conclusively a relationship with *Ginkgo*.

² Raciborski: Englers Bot. Jahrb., vol. xiii, 1891, p. 1.

³ Zeiller: Comptes rendus, tome cl, 1910, p. 1488.

⁴ Stopes and Fujii: Philos. Trans. Royal Soc., vol. 201 B, 1910, p. 6, text-figs. 1-3, pl. ii, fig. 1.

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SUMMARY.

1. The genus *Baieropsis* of Fontaine is shown to belong to the Filicales and not to the Ginkgoales.
2. Certain forms heretofore referred to *Baieropsis* show fructification characters which justify their reference to the family Schizaeaceae.
3. This affinity is corroborated by the identity of the frond characters between the fossils and certain modern species of *Schizaea* with which they have been compared.

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EXPLANATION OF PLATE XII

Illustrating Mr. Berry's paper on a Lower Cretaceous Species of Schizaeaceae.

Schizaeopsis expansa (Fontaine). Above, reproduction of the type from the Patuxent formation of Fredericksburg, Virginia, natural size. Below, camera lucida drawings of spores from the same specimen, $\times 380$.

x 380.

BERRY — SCHIZAEOPSIS EXPANSA

Huth, lith. et imp.

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