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ON SEEDLIKE STRUCTURES ASSOCIATED
WITH *ARCHAEOPTERIS*, FROM THE
UPPER DEVONIAN OF NORTHERN
PENNSYLVANIA

BY

CHESTER A. ARNOLD



UNIVERSITY OF MICHIGAN PRESS
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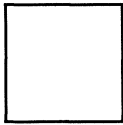
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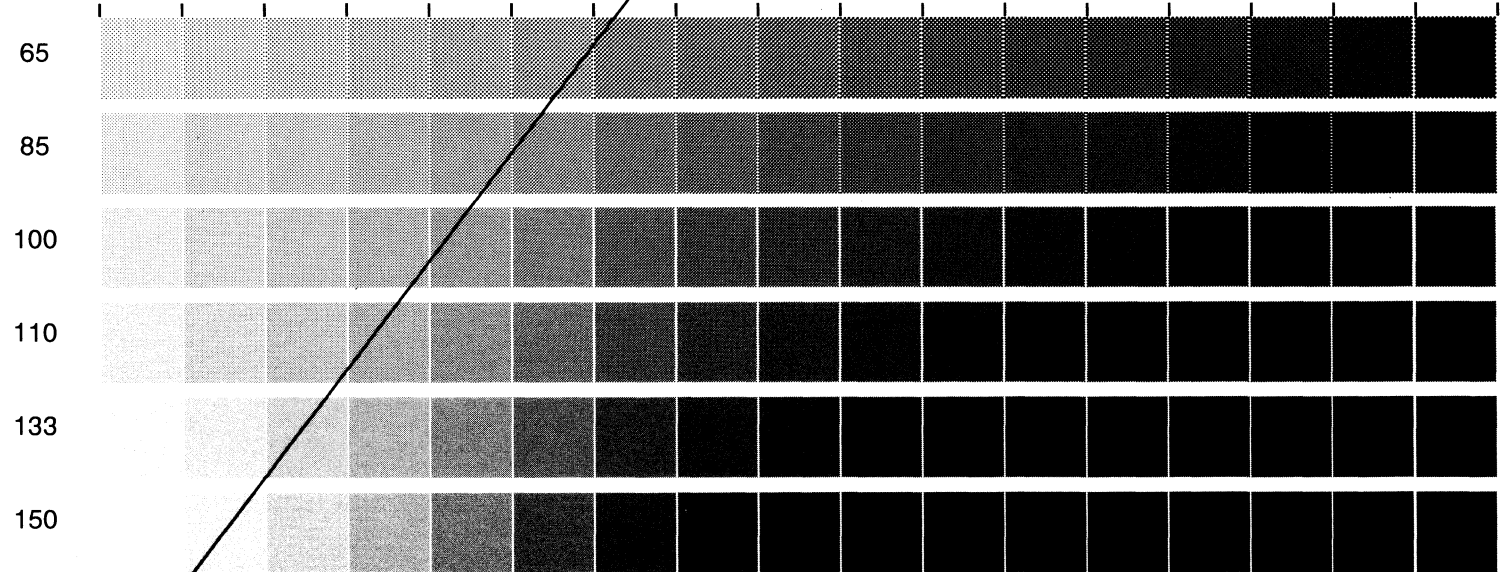
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(Continuation of Contributions from the Museum of Geology)

UNIVERSITY OF MICHIGAN

Editor: EUGENE S. McCARTNEY

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(Continued on inside of back cover)

ON SEEDLIKE STRUCTURES ASSOCIATED
WITH *ARCHAEOPTERIS*, FROM THE
UPPER DEVONIAN OF NORTHERN
PENNSYLVANIA

By CHESTER A. ARNOLD

A FEW objects closely resembling small detached seed cupules were recently found among a collection of vegetative and spore-bearing fronds of *Archaeopteris*. Specific determinations of the fronds have not been made, but they show many resemblances to *A. hibernica*, the type species of the genus. All the material came from a road cut along the recently constructed highway (No. 59) between Smethport and Port Allegany, McKean County, Pennsylvania, at a place locally known as Bush Hill, which is about six miles west of Port Allegany.

The fossiliferous horizon, though within the Upper Devonian, has not been definitely placed stratigraphically. According to the older interpretations concerning the stratigraphic succession in northern Pennsylvania and southern New York, this bed would be at about the Chemung level, but recent investigations show that this may be incorrect. The horizon here referred to is probably somewhat above the true Chemung, but well below the lowest member of the Mississippian, as is attested by the abundance of *Archaeopteris* and the fossil remains of numerous *Lingulae*, eurypterids, and scales and teeth of fish.

The structures here recognized as indicating seeds are small objects suggestive of the fibrous husks surrounding the seeds of certain pteridosperms. They are borne in pairs upon forked pedicels, each having a total length, measured from the point of bifurcation of the pedicel to the apex, of about 1 centimeter (Fig. 1). The main body of the cupule, exclusive of the short

stalk, is about 8 mm. long and the apex, which apparently is the rim of a campanulate organ, is deeply cut for about half of the length of the cupule into four or five long, tapering prongs. The exact number of these prongs in any given specimen has

not been determined. The striations on the surface suggest either that the cupules were open from the start or that the prongs spread apart along definite sutures in the walls of an originally closed structure. The pedicels bearing the individual cupules are about 2 mm. long. Seeds have not been definitely recognized within them, although in one cupule a thicker carbonaceous mass about $1\frac{1}{2}$ mm. long is suggestive of them.

The intimate association of these structures with *Archaeopteris* introduces the possibility that they are the seeds of this plant. Many investigators maintain that *Archaeopteris*, although originally described as a fern, shows pteridospermic affinities, but since it lacks the seeds, this view has been derived entirely from the rather



FIG. 1. Pair of seedlike structures showing the fibrous husk and the tapering prongs at the apex, number 16069 U.M. $\times 5$.

meager evidence shown by the impressions of the foliage and associated spore-bearing organs, neither of which is sufficient as proof. Johnson (1911) made a detailed study of the fertile and the sterile pinnae of *A. hibernica* and concluded that the genus represents a primitive type intermediate between the Pteridospermae and the Ophioglossaceae. He argues that the spore-bearing organs of *A. hibernica* are not at all typical of the microsporophylls of the pteridosperms, but are more suggestive of a generalized type. This may well be, yet it must be remembered that our knowledge of the male organs of the pteridosperms

is entirely too incomplete to be of much use in making generalizations of this kind. This is especially true since there are so few authenticated instances in which the seeds and the male organs of the pteridosperms have both been found attached to the vegetative organs of the same species. Furthermore, for not a single pteridosperm known in the petrified condition has the identity of the male organs been established.¹ Also, it must be realized that, if the pteridospermous nature of *Archaeopteris* were to be conclusively proved, many primitive features could probably be recognized.

A few objects externally resembling fossil seeds are known, but an examination of the internal structure has shown them to be something else. An example is *Codonothea* (Sellards, 1903). Halle (1933) has recently made a detailed investigation of several forms, of which *Whittleseyia* and *Rhabdocarpus glomeratus* are examples (the latter was originally believed to be a seed), and has concluded that these structures are complex microsporangia probably referable to the Medullosaceae.

The possibility of the cupules from Pennsylvania being microsporangia seems remote because plants to which they might belong other than *Archaeopteris* are rare or absent at this locality. Were the cupules to be found in actual attachment with *Archaeopteris* there would remain very little doubt whether or not they are seeds, because their occurrence with the already known spore would necessitate the interpretation of the latter as the microspore. The only other possibility in this event would be that *Archaeopteris* represents an extinct genus of heterosporous ferns which bore its megaspores in large campanulate sporangia. But the probability of this seems too remote to warrant serious consideration.

These cupule-like structures do not seem to be directly comparable to any of the seedlike structures heretofore described from the Devonian, but there are certain superficial resemblances to the Carboniferous seed, *Lagenostoma Sinclairi* (Scott, 1923). These

¹ See "Discussion on the Position of the Pteridosperms in the Plant Kingdom and Their Relation to Ferns," by Scott, Jongmanns, Gothan, and others in Section PB: Paleobotany, in *Report of Proceedings of the Fifth International Botanical Congress*, Cambridge, 1930.

were borne in pairs similar to those constituting the subject of this account, and the margin is deeply cut or lobed in a like manner. There is also a resemblance in size. The seedlike structures assigned by Miss Goldring to *Eospermatopteris* (1924) are similar to our material, and there is also some resemblance to the problematic seed cupules described by Arber and Goode (1915) from the Upper Devonian of Devon as *Xonetheca devonica*. However, none of these have ever been reported with *Archaeopteris*, and they also show structural differences which distinguish them from the type under consideration here.

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