A PROBABLE PTERIDOSPERM MICROSPORANGIATE FRUCTIFICATION FROM THE PENNSYLVANIAN OF ILLINOIS

by THEODORE DELEVORYAS

ABSTRACT. *Schopfitheca boulayoides* gen. et sp. nov., a new probable pteridosperm microsporangiate organ from an 'ironstone' concretion from the Mazon Creek area of Illinois is described as a pubescent, clavate-pyriform structure with large spores of the *Monoletes* (= *Schopfipollenites*) type.

UNDOUBTEDLY the most comprehensive paper devoted to an interpretation of supposed pteridosperm microsporangiate organs is that by Halle (1933). By using ingenious softening and embedding techniques, Halle was able to section compressed fertile structures and thereby reconstruct the three-dimensional configurations. Genera of probable pteridosperm microsporangia discussed by Halle are: *Goldenbergia*, *Whittleseya*, *Boulaya*, *Aulacotheca*, *Codonotheca*, *Dolerotheca*, and *Potoniea*. *Zeilleria*, a problematic genus of synangia, was also described. Among the pteridosperm pollen-bearing organs elucidated by that author it has become obvious that there is a general structural plan which involves elongated sporangia in varying degrees of fusion.

Work in America includes the thorough treatise by Schopf (1948) on one of these genera, *Dolerotheca*, demonstrating actual anatomical structures and presenting ideas concerning the morphological interpretation and evolutionary significance of the genus. Schopf felt that *Dolerotheca* represented a septangium, derived from a septation of a simple sporangium.

Some years earlier Sellards (1903) found in 'ironstone' nodular concretions from the Mazon Creek area in northern Illinois specimens on which he based the genus *Codonotheca*, a microsporangiate fructification with fingerlike sporangia fused together at the base.

In such a small nodule from the mine spoil heaps just east of Coal City in Will County, northern Illinois, was found a flattened structure obviously related to some of the microsporangia discussed by Halle, Schopf, and others. The single specimen was compressed with almost no carbonaceous remains, but well-preserved spores were contained in it. Spores and impression features suggest that the specimen in question is another probable pteridosperm pollen-bearing organ.

SYSTEMATIC DESCRIPTION

Genus SCHOPFITHECA gen. nov.
Schopfitheca boulayoides sp. nov.

Plate 12, figs. 1–5; text-figs. 1, 2

Diagnosis. Stalked, clavate-pyriform microsporangiate fructification about 2 cm. long and 1 cm. wide; surface covered with closely spaced hairs. Contained microspores

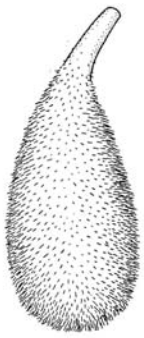
[Palaeontology, Vol. 7, Part 1, 1964, pp. 60–63, pl. 12.]

typically 420–480 μ in length and 325–590 μ wide, of the *Monoletes* (= *Schopfipollenites*) type; spore surface minutely granulose and waxy in appearance.

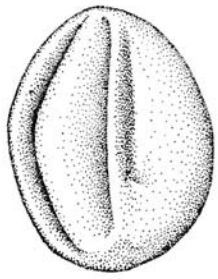
Stratigraphic occurrence. Francis Creek Shale, Carbondale Formation, Kewanee Group, Middle Pennsylvanian (Kosanke *et al.* 1960).

Holotype. Peabody Museum of Natural History, Yale University, Paleobotanical Collections No. 1003.

General description. The specimen is clavate-pyriform with the proximal end tapering imperceptibly into a stalk (Pl. 12, figs. 1, 2; text-fig. 1). It is just over 2 cm. in length and about 1 cm. wide in the flattened state; in life it was probably obovoid. The stalk is somewhat elongated, and there is no evidence of leaf material nearby, or of its mode of attachment to the parent plant.



TEXT-FIG. 1. Suggested reconstruction of *Schopfitheca boulayoides*; × 2.



TEXT-FIG. 2. *Schopfitheca boulayoides.* Distal face of a microspore showing two prominent grooves; the apparent third groove on the right side is due to collapse of the spore coat. Drawing based on photograph in Plate 12, fig. 5; × 100.

In places where the mineral material contained within the fructification has separated from the surrounding matrix it is possible to see closely-spaced fine pitting (Pl. 12, fig. 3). This feature suggests that the outer surface of the fructification was hairy, a characteristic reminiscent of the situation in *Goldenbergia* (Halle 1933).

Contained within the compressed specimen were a number of spores. Actual sporangia are not evident but on the basis of the similarity of all of the spores and the extremely large size of the spores, which were probably not easily transported, it may confidently be assumed they belong to the fructification.

Description of spores. Four of the spores were freed with dilute hydrochloric acid and mounted on slides. These spores are considerably flattened, rather opaque, and too delicate to be cleared, so only surface features are evident. The range in length of the spores observed is from about 420–480 μ; the widest portion ranges from 325–390 μ. These spores, in the isolated state, would correspond to the genus *Monoletes* as defined by Schopf, Wilson, and Bentall (1944), or, as commonly referred to in Europe, *Schopfipollenites* Potonié and Kremp (1954). The proximal suture extends for nearly the entire

length of the spore (Pl. 12, fig. 4); two conspicuous grooves are on the distal side (Pl. 12, fig. 5; text-fig. 2). Minute granulations are evenly distributed over the waxy surface.

Comparison. In general structure *Schopfitheca* resembles most closely the genus *Boulaya* (Halle 1933). Like *Boulaya*, it is widest near the distal end and has large, monolete spores. There are some conspicuous differences, however, and because of inadequacies of preservation in both *Boulaya* and the new microsporangiate structure, it is impossible to compare certain additional features. No dimensions are given by Halle, but a photograph of the fructifications in his paper reproduced at natural size indicates they are 1·8 cm. long and about 0·6 cm. at their widest point. Kidston (1914) described similar fructifications as *Whittleseya* (?) *fertilis*, but these were transferred to the genus *Boulaya* by Halle. Kidston's material included forms larger than those shown by Halle, reaching a maximum length of 2·4 cm., exceeding even that of *Schopfitheca*. Carpentier (1914) describing similar forms called *Whittleseya* (?) *fertilis*, indicated a usual length of 1·0–1·1 cm. Also described by Carpentier (1925) is fragmentary material referred to *Boulaya*, but preservation is poor and the size is much smaller than *Schopfitheca*.

Microspores found in specimens referable to *Boulaya fertilis* do not exceed 240 μ in length (about half the size of the Illinois spores), so that there is a pronounced difference between them and those of *Schopfitheca*.

Goldenbergia (Halle 1933) is another form quite similar to both *Boulaya* and *Schopfitheca*. *Goldenbergia*, however, is generally smaller (6–8 mm. in length), although the spores are larger than those of *Boulaya* (300–400 μ), more closely approximating the size of those in *Schopfitheca*. Halle admitted a similarity between *Goldenbergia* and *Boulaya* but retained the generic distinction because it was not possible to demonstrate actual relationship. For the same reason the new material is assigned to a new genus. Poor preservation makes it impossible to determine sporangial structure, but spore size is impressive and greater than that found in the fructifications in the two other genera.

Spores of other pteridosperm fructifications such as *Dolerotheca* and *Codonotheca* compare favourably with those in *Schopfitheca* but are typically smaller. Schopf (1948), however, figured a spore from a compression of *Dolerotheca* in an 'ironstone' nodule from southern Illinois that is as large as typical *Schopfitheca* spores.

Botanical affinities. It is impossible to indicate the natural affinities of *Schopfitheca* except to suggest relationships with the pteridosperms, more specifically with the medullosan seed-ferns. Carpentier's *Boulaya* was associated with alethopterid foliage, often thought to have been borne by medullosans. Because of mechanical and size considerations it would be logical to assume that *Schopfitheca* represents the microsporangiate structure of a plant that also bore large seeds. The unusually large size of the microspores means that the ovule that received the spores must have been sizeable, and the pollen chamber sufficiently commodious to contain these large microspores. It is among the seeds of the Trigonocarpales, usually considered to be medullosan, that such large micropyles and

EXPLANATION OF PLATE 12

Figs. 1–5. *Schopfitheca boulayoides*. 1, 2, Two halves of split nodule showing the compressed, stalked fructification, ×2. 3, Surface of rock matrix surrounding the fructification with closely-spaced holes representing impressions of hairs, ×70. 4, Proximal face of spore showing prominent suture, ×100. 5, Distal face of another, somewhat smaller spore. Note the two grooves (compare with text-fig. 2), ×100.

pollen chambers are known. Until additional vegetative and seed material of the plants that bore *Schopfitheca* are known, however, its medullosan affinities remain only conjectural.

Acknowledgement. This research was supported in part by National Science Foundation Grant GB 420.

REFERENCES

CARPENTIER, A. 1914. Note sur des empreintes de *Whittleseya* (?) *fertilis* Kidston sp. trouvées dans le Houiller du nord de la France. *Bull. Soc. Bot. France*, ser. 4, **61**, 363–7.

—— 1925. Note sur quelques empreintes de graines et microsporanges de ptéridospermées provenant du Westphalien du nord de la France. *Rev. Gén. Bot.* **37**, 145–56.

HALLE, T. G. 1933. The structure of certain fossil spore-bearing organs believed to belong to pteridosperms. *Kungl. Svenska Vetenkapsakad. Handl.*, ser. 3, **12** (6), 1–103.

KIDSTON, R. 1914. On the fossil flora of the Staffordshire coal fields. Part III. The fossil flora of the Westphalian series of the South Staffordshire coal field. *Trans. Roy. Soc. Edinburgh*, **50**, 73–190.

KOSANKE, R. M., SIMON, J. A., WANLESS, H. R. and WILLMAN, H. B. 1960. Classification of the Pennsylvanian strata of Illinois. *Illinois State Geol. Surv. Rept. Invest.* **214**, 1–84.

POTONIÉ, R. and KREMP, G. 1954. Die Gattungen der paläozoischen Sporae dispersae und ihre Stratigraphie. *Geol. Jb.* **69**, 111–94.

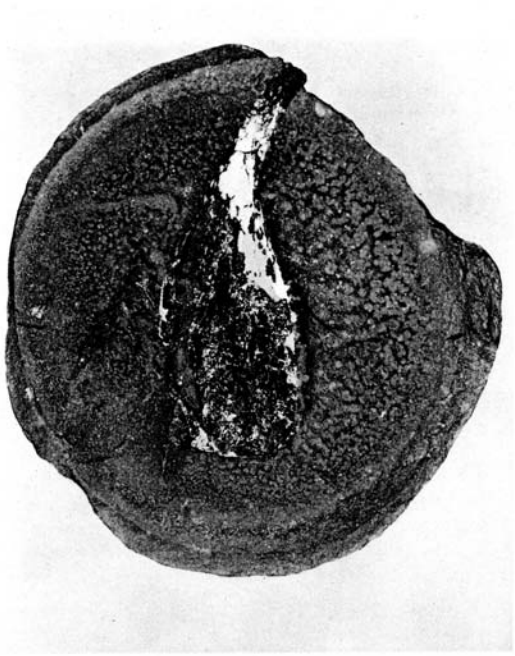
SCHOPF, J. M. 1948. Pteridosperm male fructifications: American species of *Dolerotheca*, with notes regarding certain allied forms. *Jour. Paleont.* **22**, 681–724.

—— WILSON, L. R. and BENTALL, R. 1944. An annotated synopsis of Paleozoic fossil spores and the definition of generic groups. *Illinois State Geol. Surv. Rept. Invest.* **91**, 1–73.

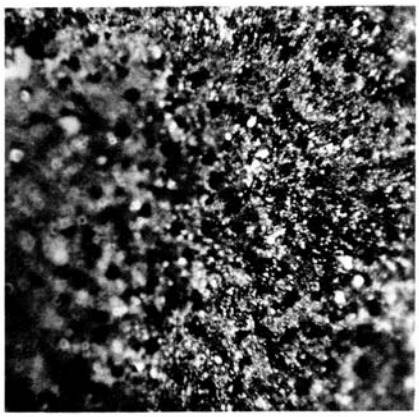
SELLARDS, E. H. 1903. *Codonotheca*, a new type of spore-bearing organ from the Coal Measures. *Amer. Jour. Sci.* iv, **16**, 87–95.

THEODORE DELEVORYAS
Department of Biology and Peabody Museum of Natural History,
Yale University,
New Haven, Connecticut, U.S.A.

Manuscript received 17 April 1963



1



3

4

2

5

DELEVORYAS, Pennsylvanian pteridosperm fructification