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A Reinvestigation of *Potonia angularis* (Lesquereux) Stidd

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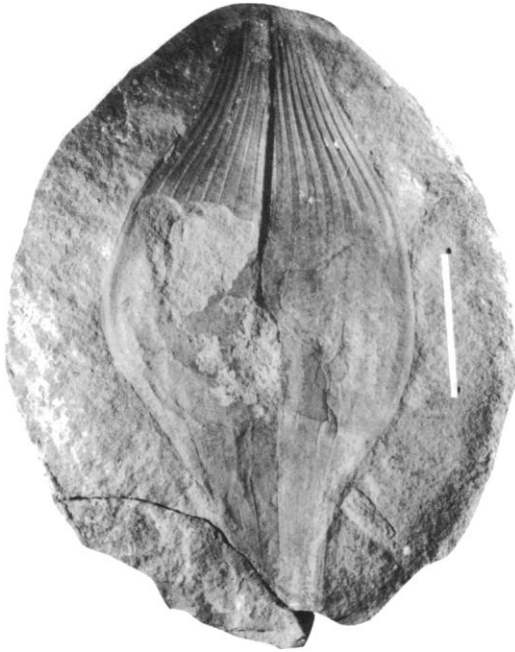
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TEXT-FIG. 1—Mazon Creek *Vetacapsula cooperi* Mackie from the Francis Creek Shale (Middle Pennsylvanian) of Illinois. Ruled line equals one cm (FMNH Cat. No. PF 8961).

zon Creek specimen is slightly smaller than the British representatives of the species, which range in size from 25–46 mm in width and 25–49 mm in length. Specimens of *V. cooperi* from Belgium, however, are as small as 5.5 mm in width and 10 mm in length (Van der Heide, 1943, Pl. 4, fig. 7). The known geographical

distribution of this species now includes Great Britain, the Low Countries, Russia, and northern Illinois, U.S.A.

Both *Palaeoxyris* and *Vetacapsula* were considered to be fossil chondrichthyan egg-cases by Crookall (1932), and the reader is referred to Zidek (1976) for an excellent discussion concerning *Palaeoxyris*. The biological affinities of *Vetacapsula*, however, remain uncertain.

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## A REINVESTIGATION OF *POTONIEA ANGULARIS* (LESQUEREUX) STIDD

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### INTRODUCTION

Lesquereux (1880) established *Lepidocystis* for coalified compressions of isolated sporangia and fragments of strobili with attached sporangia. Wood (1957) emended the generic diagnosis in order to clarify the lycopsid par-

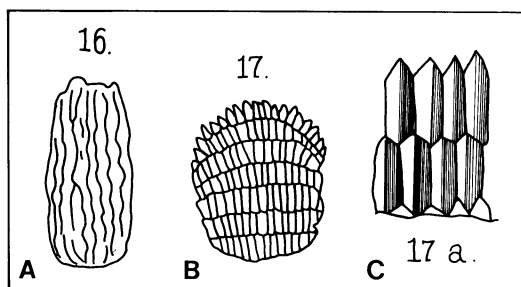
entage of the disarticulated organs. Subsequently, one species, *Lepidocystis angularis* Lesquereux, was transferred to a genus of pteridosperm pollen organ (Stidd, 1978). Stidd (1978) described a permineralized *Potoniea* from the Middle Pennsylvanian Herrin (No. 6)

coal, southern Illinois, and noted that the illustrations of *Lepidocystis angularis* (Lesquereux, 1879) were in all probability also assignable to *Potoniaea* Zeiller. Stidd (1978, p. 682) states that he was unable to examine the specimens curated at the U.S. National Museum but believed that the illustrations provided by Lesquereux (1879; redrawn in Text-fig. 1) left little doubt that both specimens should be assigned to *Potoniaea*. Therefore, based solely upon the illustrations, Stidd (1978) transferred *Lepidocystis angularis* to *Potoniaea* but did not refigure, redescribe or rediagnose the coalified compressions. The opportunity to validate the transfer by examining, redescribing, reillustrating and rediagnosing the holotype specimens was afforded to Millay and Taylor (1979), but was not done.

During the revision of *Lepidocystis* Lesquereux emend. Wood, it was recognized that the genus is composed of a number of highly diverse members including specimens assignable to *Polysporia* Newberry, *Sigillariostrobus* (Schimper) Feistmantel, and *Potoniaea* Zeiller (Gastaldo, 1981). Reinvestigation of the syntypes of *Lepidocystis angularis* confirms the assessment and transfer by Stidd (1978), but according to the diagnosis of the taxon provided by Lesquereux (1880, p. 456) the specimens are still representative of short strobili possessing imbricated sporangia arranged in circular rows upon a broad axis. As recognized by Stidd (1978), though, the coalified compressions are specimens of campanulate pollen organs with tubular sporangia and paraphyses freely projecting from the distal face. Therefore, the diagnosis, description and illustrations proposed by Lesquereux (1879, 1880) are now wholly inaccurate. The present study of the syntypes and additional museum specimens has allowed an accurate redescription and emended diagnosis to be constructed for *Potoniaea angularis* (Lesquereux) Stidd. In addition, the associated megafloreal components have been assessed and identified, a feature not previously noted, and an attempt has been made at isolation of prepollen from individual sporangia from six well preserved specimens.

#### MATERIALS AND METHODS

The syntypes of *Lepidocystis angularis* (USNM 25255–25256; Pl. 1, figs. 1, 2) and eleven additional specimens collected by La-

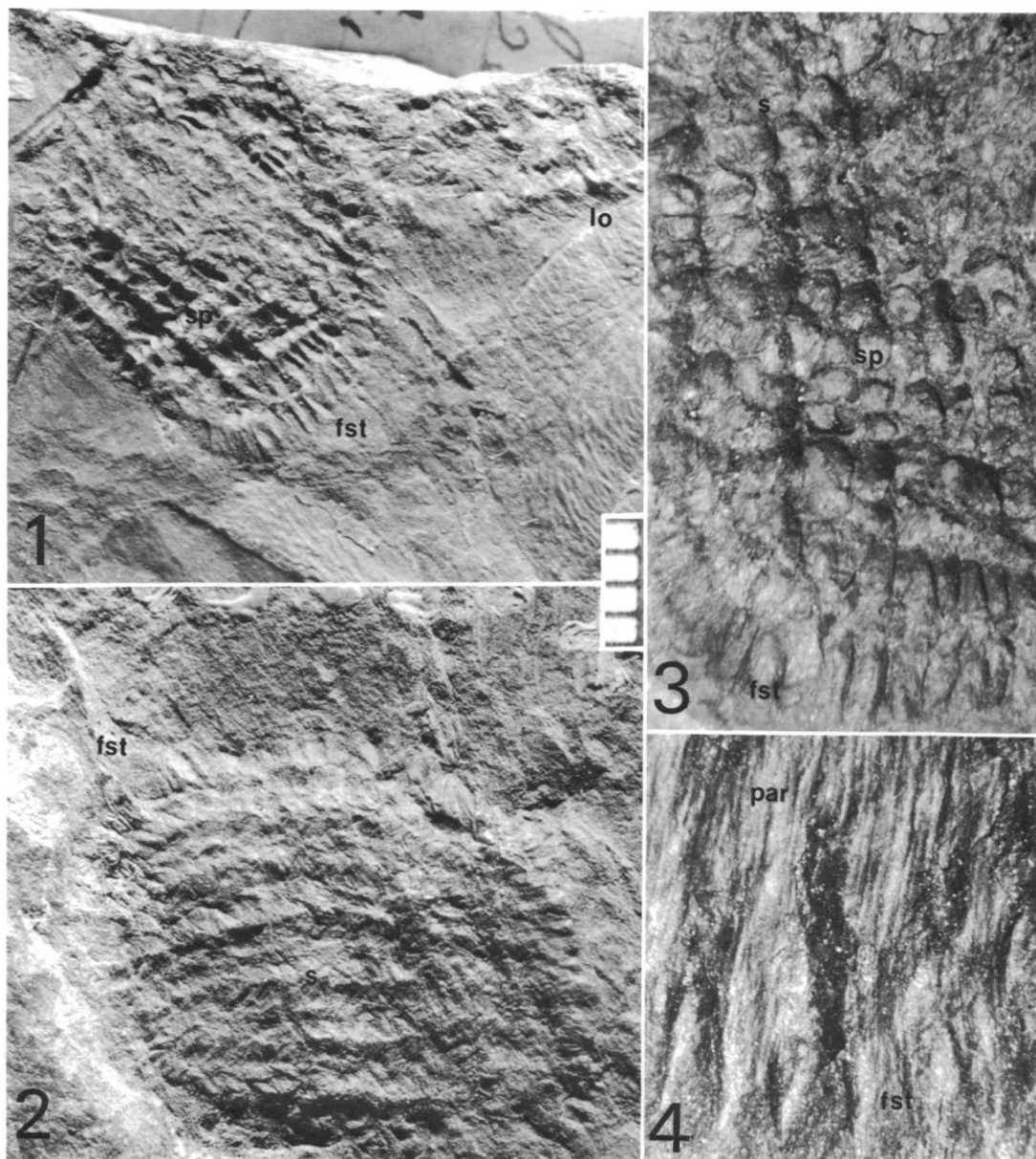


TEXT-FIG. 1—*Lepidocystis angularis* Lesquereux. A, figure 16 is redrawn from Lesquereux (1879, Pl. LXIX) and depicts specimen USNM 25256 which is illustrated in Pl. 1, fig. 2 of the present paper. B, figure 17 is redrawn from Lesquereux (1879, Pl. LXIX) and depicts specimen USNM 25255 which is illustrated in Pl. 1, fig. 1 of the present paper. C, figure 17a is an enlargement of detail as depicted in Lesquereux (1879, Pl. LXIX). Note the discrepancies between the line drawings representing the holotype illustrations and the photographs of the holotype specimens.

coe and identified by Lesquereux and D. White were obtained from the Department of Paleobiology, Natural History Museum, The United States National Museum. The specimens had been collected from Port Griffith, Pa., the Stanton Mine, Wilkesbarre, Pa., Campbells Ledge, Pa., Cannelton, Pa. and Olyphant, Pa. and are Upper Pottsville-Allegheny in age (Westphalian equivalents). Specimens were examined utilizing a Wild M-8 stereoscope and photographed with Nikon equipment. Palynological preparations of individual sporangia were made from specimens USNM 25256, 25257, 25258, 25262, 25269, and 25270 utilizing standard palynological procedures (Doher, 1980) and examined on a Leitz Ortholux II Pol-Bk microscope.

#### DESCRIPTION

The specimens of *Potoniaea angularis* (Pl. 1, figs. 2, 3; Table 1) are preserved as coalified compressions in various matrices including sandy gray shales (Port Griffith), gray siltstones (Port Griffith) and dark gray shales (Stanton Mine, Campbells Ledge, Cannelton and Olyphant). The compressed campanulate pollen organs appear rectangular-ovoid to circular in outline, ranging in size from  $10 \times 13$  mm (USNM 25255) to  $18 \times 25$  mm (USNM 25262), and may have a portion of the proxi-



## EXPLANATION OF PLATE 1

FIGS. 1-4—*Potoniaea angularis* (Lesquereux) Stidd emend. 1, lectotype. Specimen figured in Lesquereux (1879; Pl. LXIX, fig. 17). Coalified compression campanulate pollen organ with concentrically arranged sporangia (sp) in groups of 4-6 sporangia. Free sporangial tips (fst) project from the distal end of the pollen organ. A disarticulate pinnule of *Linopteris obliqua* (Burbury) Zeiller (lo) is in association with *P. angularis*. Scale in mm. (USNM 25255.) 2, paratype. Specimen figured in Lesquereux (1879; Pl. LXIX, fig. 16). Poorly preserved specimen displaying prominent concentrically and radially oriented septa (s). Free sporangial tips (fst) are preserved projecting from the distal part of the pollen organ. Scale in mm. (USNM 25256.) 3, lectotype. Terete sporangia (sp) in transverse section are concentrically arranged and grouped into 4-6's. Sporangial groups are separated by concentrically and radially disposed

mally disposed pedicel preserved. The pedicel is at least 1 mm in diameter and terete in configuration. The sporangia are elongated in longitudinal section and terete in transverse view. The diameter of the sporangia average 0.75 mm and some sporangia are preserved for at least 3 mm of their length. Sporangia are concentrically arranged, disposed in circular groups of 4–6 sporangia and number greater than 187 per campanulum (Pl. 1, figs. 2, 3; Table 1). In most cases, the preserved sporangia have been infilled by sediment prior to compression. The distal ends of the sporangia are conical and free from the campanulum extending 1.5–2 mm (Pl. 1, fig. 4). The sporangial aggregations are separated by radially and concentrically oriented septa which may impart an appearance to the compressed pollen organ of having the sporangia tangentially arranged (Pl. 1, figs. 2, 3). Spore assemblages liberated from all preparations of sporangia were composed of a highly diverse collection of taxa including *Granulatisporites*, *Punctatisporites*, *Cyclogranulatisporites*, *Reinschospora*, *Florinites*, *Lycospora* and *Calamospora*. No one taxon is found in statistically greater abundance than any other taxon represented in the macerations, and, for this reason, the spores produced by this pollen organ are, at present, unknown. Originating from the distal surface are multicellular hairs which project up to 2 mm and form a dense ramentum (Pl. 1, fig. 4). In addition, multicellular appear to be preserved on the exterior surface of the coalified compressions.

Isolated pinnules of the *Linopteris-Reticulopteris* complex are preserved in association with eight of the sixteen specimens (Pl. 1, fig. 1). The only other pteridosperm foliage associated with a specimen of *P. angularis* is a pinna fragment of *Alethopteris pennsylvanica* Lesquereux (USNM 25265). The disarticulated pinnules conform to *Linopteris obliqua* (Bunbury) Zeiller due to the following char-

acters: falcate to slightly curved pinnule outline; an obtuse apex with a slightly cordate to oblique base; a midrib extending up to  $\frac{3}{5}$  the length of the pinnule with reticulate venation originating at the midrib and extending to the margin; polygonal areolae (4–6 sided) with 6–9 areolae traversed from the midrib to the margin (Zodrow and McCandlish, 1978). Lesquereux (1880) reports the presence of *Linopteris (Dictyopteris) obliqua* from Cannelton, Pittston and Wilkesbarre, Pa.

#### SYSTEMATIC PALEONTOLOGY

##### POTONIEA ANGULARIS (Lesquereux)

Stidd emend.

Pl. 1, fig. 2

*Lepidocystis angularis* LESQUEREUX, 1880, p. 146, Pl. LXIX, fig. 17, 17a.

*Potoniea angularis* (Lesquereux) STIDD, 1978, p. 682.

*Diagnosis.*—Compressed campanulate pollen organ, rectangular-ovoid to circular in outline,  $10 \times 13$  mm to  $18 \times 25$  mm; pedicellate. Cylindrical sporangia concentrically arranged and separated by radially oriented septa into groups of 4–8 circularly arranged sporangia; sporangia may appear pluriseriate due to concentrically arranged septa; distal ends of sporangia conical, free from campanulum, extending 2 mm from campanulum. Sterile multicellular hairs projecting up to 2 mm from distal surface of campanulum, intermixed with sporangial tips. Spores unknown.

*Occurrence.*—Upper Pottsville-Allegheny (Westphalian equivalents) in Port Griffith, Wilkesbarre, Campbells Ledge, Cannelton and Olyphant, Pa.

*Lectotype.*—USNM 25255.

*Paratypes.*—USNM 25256, 25257, 25258, 25259, 25262, 25263, 25264, 25265, 25256, 25267, 25270.

*Repository.*—Department of Paleobiology, United States National Museum, Museum of Natural History.

←

septa (s). Free sporangial tips (fst) are preserved projecting from the distal part of the pollen organ.  $\times 10$ . (USNM 25255.) 4, paratype. Free sporangial tips (fst) projecting from distal part of campanulum intermixed with a dense ramentum of multicellular hairs, or paraphyses (par). The interpretation that the multicellular hairs are intermixed with the sporangial tips is based upon observations by Stidd (1978). (USNM 25266.)

TABLE 1—*Potonia angularis* (Lesquereux) Stidd. USNM specimens examined in present study.

	25255	25256	25257	25258	25259	25262
Shape	Circular ovoid	Rectangular ovoid	Ind.	Rectangular ovoid	Circular	?Circular
Dimensions (mm)	10 × 13	14 × 15	14 × 16	>11 × 21	15 × 16	18 × 25 Inc.
Pedicel	P	P	P	P	—	—
Free sporangial tips	P	P	—	P	P	P
Paraphyses	P	P	—	—	P	P
Sporangia number	>157	Ind.	>115	>118	>110	>150
Transverse section	Terete	Ind.	Ind.	Ind.	Terete	Ind.
Diameter (mm)	.75	Ind.	Ind.	Ind.	.75	Ind.
Groups	4–6's	Ind.	(?4)6–8's	4–6's	4's	4–6's
Cellular detail	P	—	—	—	—	P
Septa	P	P	P	P	P	P
Associated flora	<i>L. obliqua</i>	—	<i>L. obliqua</i>	—	<i>Neuropteris</i> sp.	<i>Pecopteris</i> sp.

Note: P—preserved feature; Ind.—indeterminable; Inc.—incomplete.

#### DISCUSSION

Zeiller (1899) established *Potonia* for coalified compression specimens exhibiting the following characteristics: orbicular outline with a slightly eccentric pedicel; free distal sporangia grouped in fours, paraphyses among the sporangial tips; small, trilete spores. These characters are displayed by *Lepidocystis angularis* and allow its inclusion within *Potonia*. The original interpretation that these disarticulated reproductive organs as short strobili with imbricated sporangia is, therefore, invalid. The recognition of the campanulate nature of the pollen organ (Laveine, 1971; Stidd, 1978) has allowed the resolution of previous misinterpretations (Carpenter, 1911, 1913, 1929; Bertrand, 1913, 1926; Halle, 1933).

Lesquereux (1880) described and illustrated two specimens from Port Griffith, Pa., but failed to designate a holotype for the taxon. Upon reexamination of the type material it was noted that, of the two specimens figured, specimen USNM 25255 was the best preserved and displayed all the essential characteristics for identification (Table 1). Therefore, it was concluded that this specimen should be designated as the lectotype and specimen USNM 25256 should be placed as a paratype along with a

number of the additional specimens curated at the Smithsonian. Two specimens (USNM 25269, 26457), though, do not possess enough characteristics to allow their retention within *Potonia angularis*. Both specimens are poorly preserved and fragmentary and it is suggested that they be classified as *incertae sedis*.

Although a majority of specimens of *Potonia angularis* are found in association with *Linopteris obliqua* and Laveine (1971) would assign this pollen organ to the foliage form genus on the basis of repeated association, the taxon should remain distinct. The organic connection between *Potonia* and either *Linopteris* or *Paripteris* has not, to date, been demonstrated. Gothan (1913) reported the organic connection with *Neuropteris (Paripteris) gigantea*, but Stidd (1978) disbelieves this claim based upon the dissimilarity of Gothan's specimens and those figured by Zeiller (1899). In addition to the lack of proven organic attachment between *Potonia* and *Linopteris obliqua* specimens that may be referable to *Neuropteris gigantea* (Lesquereux, 1879) have been reported from some of the same localities from which the specimens of *Potonia angularis* were collected. Therefore, with the absence of palynological data concerning these specimens

TABLE 1—Continued.

25263 25264	25265	25266 25267	25268	25269	25270	26457
Ovoid	Rectangular ovoid	Rectangular ovoid	Ovoid circu- lar	Ind.	Ovoid circu- lar	Ind.
12 × 16	12 × 18 Inc.	16 × 26	9 × 14; 9 × 12 Inc.	Inc.	8 × 15	Inc.
—	—	P	—	—	?	—
P	P	P	P	—	P	?
P	P	P	P	—	—	—
Ind.	>91	>187	Ind.	Ind.	Ind.	Ind.
Ind.	Ind.	Ind.	Ind.	Ind.	Ind.	Ind.
Ind.	Ind.	Ind.	Ind.	Ind.	Ind.	Ind.
Ind.	Ind.	4-6's	(?)4's	Ind.	4-6's	Ind.
—	—	—	—	—	P	—
P	P	P	—	P	P	—
<i>L. obliqua</i>	<i>L. obliqua</i> , <i>A. pennsylvanica</i>	<i>L. obliqua</i>	<i>L. obliqua</i>	—	—	<i>Neuropteris</i> sp.

due, in all probability, to the infilling of dehisced sporangia prior to coalification, and the possible presence of more than one potential parent foliage at the collection sites, it is impossible, at present, to discern an affinity for this pollen organ.

## ACKNOWLEDGMENTS

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## A SMALL TEMNOSPONDYL AMPHIBIAN FROM THE LOWER PENNSYLVANIAN OF NOVA SCOTIA

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### INTRODUCTION

Records of Pennsylvanian tetrapods are still comparatively few. The temnospondyl described here, although poorly preserved, merits description as a unique tetrapod specimen from a Lower Pennsylvanian locality. It has been reported in the literature on several occasions but has not previously been described.

The specimen, a small temnospondyl skull and associated clavicle, was collected in July, 1956 by Lucy B. Baird during a collecting trip from the Museum of Comparative Zoology, Harvard and was later registered as MCZ 2774. It was found in the core of an upright lycopod stump at the talus of the main bluff near the midpoint of West Bay, southwest of Parrsboro, Cumberland County, Nova Scotia. The locality is pinpointed on a map of the vicinity by Carroll et al. (1972, fig. 10). The lycopod stump was in the grey upper facies of the Parrsboro Formation in the Mabou Group of Nova Scotia. This horizon appears to be of late Early Pennsylvanian (=late Westphalian A) age (Carroll et al., 1972). The occurrence of tetrapod remains inside upright lycopod stumps is well known from other Pennsylvanian localities in Nova Scotia, namely Joggins and Florence, both of which have produced comparatively rich assemblages of terrestrial tetrapods. The Parrsboro specimen was first recorded in the literature by Romer (1966, p.

362) as a possible North American record for *Eugyrinus*, and was later reported as a *Eugyrinus*-like skull by Carroll et al. (1972, p. 63) and Milner (1980, p. 137). Being undescribed, it merits an attempt at systematic placement supported by a description, although its poor preservation necessarily restricts identification to a doubtful assignment at generic level.

### DESCRIPTION

MCZ 2774 (Text-fig. 1) consists of counterparts of a crushed small skull, mandibles and a clavicle. One counterpart (Text-fig. 1a) bears the impression of the dorsal surface of the dermal skull roof together with fragments of mandible, parasphenoid and right pterygoid superimposed. The other (Text-fig. 1b) bears the impression of the ventral surface of the skull roof with the palatal series and right mandible partly exposed through it. Of the skull roof, only the prefrontals, frontals and most of the skull table can be seen clearly, the snout-tip, maxillae and cheeks being obscured. The skull is 15 mm long from the anterior edge of the frontals to the posterior edge of the postparietals. The dermal bones bear pronounced striate-radiate ornamentation over their dorsal surface. No lateral-line pits or grooves are visible although the only exposed surfaces on which they might be expected to be seen, if