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Résumé de l'article

La base de données mondiale des ovules trigonocarpaléens (*Medullosales*) détachés est imposante; on les trouve dans les provinces fl oristiques euraméricaine et cathaysienne de la période du Pennsylvanien au Permien précoce. Malgré cette abondance, on sait encore peu de choses sur les parties de la plante-mère où sont nés les ovules, ou selon quelle disposition ils étaient fi xés. De nouvelles données sont présentées au sujet d'ovules trigonocarpaléens biologiquement jumelés, présumés triplets et axiaux ou caulinaires du terrain houiller de Sydney, en Nouvelle-Écosse.

[*Traduit par la rédaction.*]

Note on different kinds of attachments in trigonocarpalean (Medullosales) ovules from the Pennsylvanian Sydney Coalfield, Canada

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ABSTRACT

The global data base for detached trigonocarpalean (Medullosales) ovules is large, and they are found in the Euramerican and Cathaysian floral provinces, from the Pennsylvanian to early Permian Periods. Despite the abundance, little is still known on what parts of the parent plant the ovules were borne, or in what arrangement they were attached. New data are presented for organically paired, suggested triplet, and axially or cauline borne trigonocarpalean ovules from the Sydney Coalfield, Nova Scotia.

RÉSUMÉ

La base de données mondiale des ovules trigonocarpaléens (*Medullosales*) détachés est imposante; on les trouve dans les provinces floristiques euraméricaine et cathaysienne de la période du Pennsylvanien au Permien précoce. Malgré cette abondance, on sait encore peu de choses sur les parties de la plante-mère où sont nés les ovules, ou selon quelle disposition ils étaient fixés. De nouvelles données sont présentées au sujet d'ovules trigonocarpaléens biologiquement jumelés, présumés triplets et axiaux ou caulinaires du terrain houiller de Sydney, en Nouvelle-Écosse.

[*Traduit par la rédaction.*]

INTRODUCTION

Ovules of three-fold, longitudinal division, or multiples thereof, known since the 1820s, were systematically treated by Brongniart (summary: Gastaldo and Matten 1978). Commonly, these ovules are preserved either as compression/impression (*Trigonocarpus* Brongniart, 1828), some as coal-ball petrification, others in silicified peats (see *Pachytesta* Brongniart, 1874a, b), i.e., with three-dimensional structural preservation. It is recognized today that the genus *Trigonocarpus* is known from a number of different preservational stages and states of the biological ovule, and that some of these are correlative with the genus *Pachytesta* .

Bell (1938) mentioned the common association in the Sydney Coalfield between the 2–5 cm long ovule *Schizospermum* (*Trigonocarpus*) *noeggerathii* Brongniart and *Macroneuropteris scheuchzeri* (Hoffmann). However, he recorded (1962, 1969) no smaller or larger [medullosalean] ovules from the Sydney Coalfield, even though the present author collected the large ovules from nearly all of the coal seams (Table 1) from which Bell also had collected (compare Bell 1938, Fig. 1 of Zodrow and McCandlish 1980a, table 6).

Undisputedly organically connected medullosalean ovules are extremely rare in the Pennsylvanian-early Permian stratigraphic record. Only a handful have been documented to date. Of these, most are attached to fragmentary, ultimate pinnae (Halle 1927, 1933; Arnold 1937; Zodrow and McCandlish 1980b) without pinnule replacement, or to fragmentary axes (Drinnan *et al.* 1990; Zodrow 2002). This note illustrates heretofore unknown ways in which ovules could have been borne by the medullosalean parent plant, based on mostly physical association.

SAMPLE MATERIAL AND DEPOSITORY

The study specimens are compression/impression-preserved and originated from the middle upper Westphalian D and basal Cantabrian strata of the Sydney Coalfield (Cleal *et al.* 2003). Accession numbers, i.e., 003(GF)-352, are cited, and the material is curated by the author as part of the Palaeobotanical Collections at the University College of Cape Breton, Sydney, Nova Scotia.

Table 1. Summary of trigonocarpalean-ovule attachments, Sydney Coalfield, Nova Scotia (stratigraphic youngest to older coal seams).

Accession #	Coal Seam	Length/Width of ovule in cm[a]		Architecture/ attachment of ovules	Medullosalean-floral association
998-359	Point Aconi	2.5	1.2	paired	Mixed, neuropterids, macroneuropterids
985-281	Point Aconi	4.5	2.0	paired	alethopterids, neuropterid, macroneuropterid, and single, detached ovules
003-352	Unnamed	2.5	2.0	paired	*Macroneuropteris scheuchzeri* , medullosalean axes, and detached morphologically similar ovules
002-213[b]	Lloyd Cove	10-11	4-5	axial	*Alethopteris zeilleri* , medullosalean axes, and single, detached ovules
002-339	Lloyd Cove	8.0	4.0	single, cauline?	*A. zeilleri* , medullosalean axes, and single, detached ovules
004-263	Lloyd Cove	9.0	4.0	single, cauline?	*A. zeilleri* , medullosalean axes, and single, detached ovules
985-202	Stubbart	5.7	4.0	single, cauline?	*Alethopteris* sp., *Linopteris obliqua*
977-737[c]	Harbour	1.1	0.5	single rachial	Mixed, neuropterids, macroneuropterids, and single, detached ovules
004-238	Collins	4.5	2.5	cluster of three	Mostly *Alethopteris ambigua*

[a] See text. [b] Zodrow (2002, Fig. 16a) [c] Zodrow and McCandlish (1980b)

SUMMARY DESCRIPTION

Canada's largest ovular medullosalean collection contains over one hundred trigonocarpalean specimens that have been collected by the author from the Sydney Coalfield, Canada, since 1974. This would make it one of the rarest fossil collections, when compared with the ca. 15 000 specimen collections from Sydney. These ovules either show commissural compression/impressions (e.g., Fig. 1), or longitudinal primary and secondary ribbing from end to end (e.g., Fig. 6), and range in length from 1–12 cm and in width from 0.5–4.5 cm. The smallest 1 cm long ovules, preserved as the sclerotesta (see Halle, 1927), are associated with, or in organic connection with *Neuropteris flexuosa* Sternberg (Zodrow and McCandlish 1980b) which is shown in Fig. 2. The record shows at least another 10 of these 'nut-like' ovules are physically associated with *N. flexuosa* foliage from the same stratigraphic locality. The largest, 12 cm long ovules show arrangement of secondary ribs along the entire length of the ovule most comparable with *Pachytesta incrassata* Brongniart. Undoubtedly, additional species wait to be identified in the Palaeobotanical Collections.

Approximately 10% of the ovular specimens collected are physically or organically connected with certain parts of

Fig. 1 ***Trigonocarpus*** **sp. 977-737; detached ovule, illustrating two well- preserved major commissural ribs in the distal part. Lingan Mine (now closed), Harbour Seam, Sydney Coalfield, Canada (*in litteris* Prof. W. Stewart, January 9, 1978).**

fragmentary plant parts (Table 1). These extremely rare finds are recorded from the mid Westphalian D to basal Cantabrian stages (Point Aconi to Collins seams), and include:

998-359 *Trigonocarpus* sp. Fig. 3; paired ovules, not attached to the parent plant, with exposed one or two commissural ribs in the distal part. A sub-millimetre coalified layer forms the outer part. Careful dégaging did not reveal organic ovular connection.

985-281 *Trigonocarpus* sp.; paired ovules, not attached to the parent plant, slender, with exposed one or two commissural ribs or ribbing along the entire length. Organic connection could not be confirmed from the preservation.

003-352 *Trigonocarpus* sp., Figs. 4 and 5A ; organically paired ovules, not attached to the parent plant. At least two thin, surfically structureless, coalified layers, separated by sediments, are visible under the microscope. Organic connection with the 6 mm wide and 3.5 cm stalk could not be confirmed. This pair of ovules is associated with very abundant foliage of *M. scheuchzeri* (Hoffmann) over a 40 cm thick shale bed in the basal Cantabrian.

003-213 *Pachytesta incrassata* Brongniart (Fig. 5B); three ribbed ovules singly aligned along an axis (Zodrow 2002, Fig. 16a), and associated with abundant foliage of *Alethopteris zeilleri* (Ragot). Organic connection to an axis is probable, but not confirmed.

002-339 *Pachytesta incrassate* Brongniart (Figs. 5C and 6); three single, ribbed ovules in physical connection at the margin of an axis. It is preserved for a length of 24 cm and a width of 8 cm, and shows continuous longitudinal ridges or striae. The width of the axis is consistent with measurements of cauline specimens reported by Zodrow (2002). The specimen originated from the stratigraphical level above the Lloyd Cove Seam that preserved a great abundance of foliage of *Alethopteris zeilleri* (Ragot).

004-263 *Pachytesta incrassata* Brongniart; one single, ribbed ovule in physical connection at the margin of an axis that is preserved for a length of 23 cm, minimal width of 5 cm, and ridged or striated the same as the above specimen is. From the same location as 002-339.

985-202 *Pachytesta* sp. aff. *incrassata* Brongniart (Fig. 7), a single, ribbed ovule with three identifiable coalified layers

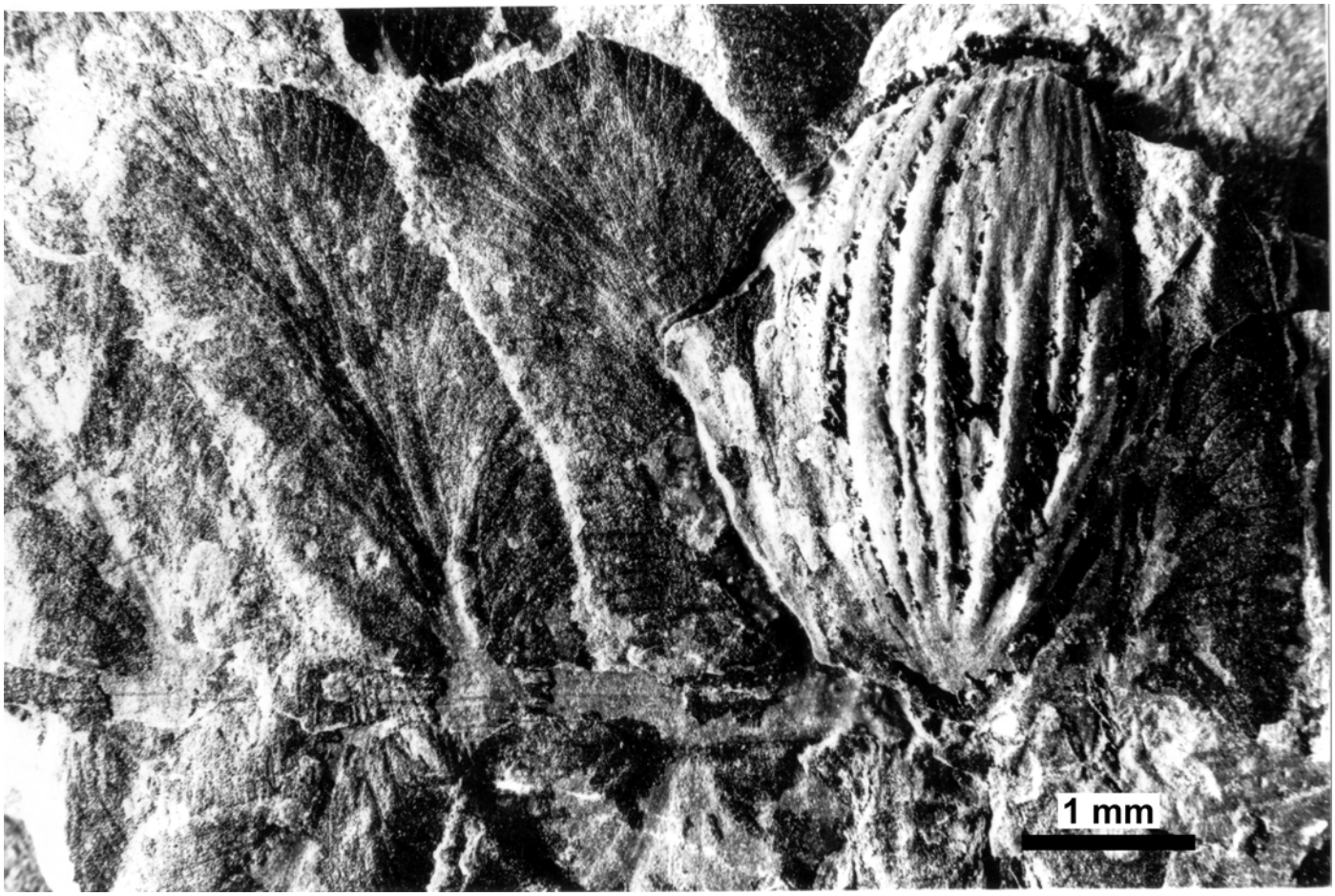

Fig. 2 ***Trigonocarpus*** **sp., 977-737a; sclerotesta organically connected with** ***Neuropteris flexuosa*** **Sternberg (Zodrow and McCandlish 1980b).**

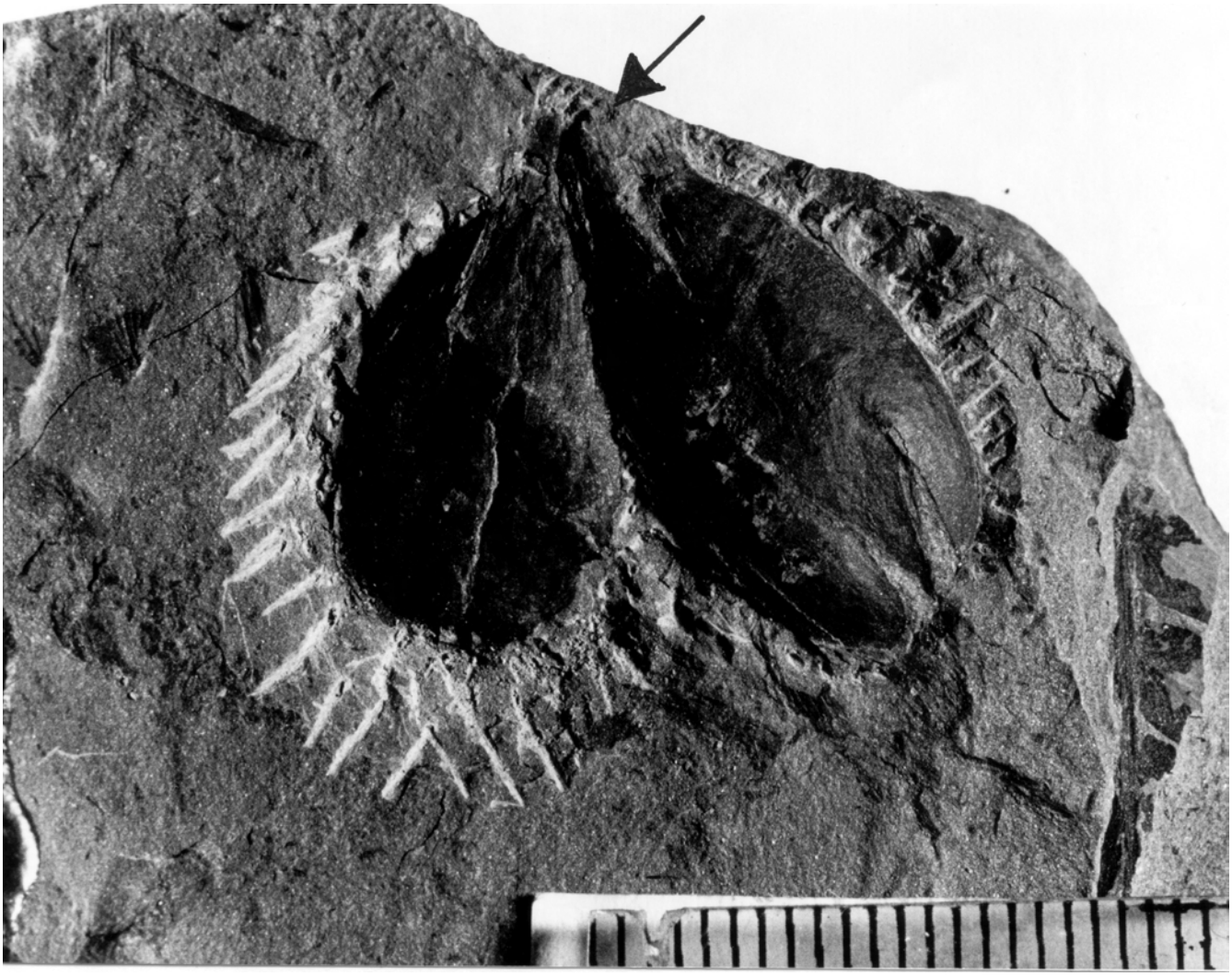

Fig. 3 *Trigonocarpus* **sp.; paired ovules with distal commissural ribs. Arrow points to assumed location of organic connection between the two ovules.**

that are separated from each other by very thin shaley layers. The ovule is physically connected at the margin. The axis, preserved for a length of 17 cm and a width of 4 cm, is ridged and striated (the same way as those in 004-263 and 02-339). Associated with abundant foliage of *Alethopteris* sp. in the Prince Mine (closed).

977-737a *Trigonocarpus* sp. (Figs. 2 and 5D): single, ribbed ovule organically connected to an ultimate rachis without replacing a pinnule of *Neuropteris flexuosa* Sternberg. The sclerotesta is preserved (Zodrow and McCandlish 1980b).

04-238 *Trigonocarpus* sp. (Figs. 5E, F and 8): three ribbed ovules physically connected with one another. The large, ribbed ovule is differently preserved from the two on the right in the sense that each of the latter shows two very thin coalified layers separated by ?sediments.

The preserved ridges and striations in specimens 002-339, 004-263, and 985-202 represent impressed cortical sclerenchymatous fibres or bundles in support of medullosalean axes or stems (see Zodrow 2002). Also, the separated coalified layers, particularly prevalent in the *P. incrassata* specimens, probably represent [presently unidentifiable] internal biological structures in the ovules.

CONCLUSION

The upper part of the Sydney Coalfield continues to furnish novel data that permit the conclusion that much greater attachment diversity existed in the trigonocarpaleans than previously thought. It is also noted that three-dimensionally preserved ovular casts were not found.

With respect to *Stephanspernum konopeonus*, Drinnan *et al.* (1990) raised the important question about cauline-borne ovules for pteridosperms. The best approximation in answer to their question is as yet supplied by the three cauline specimens described. This leaves unanswered, however, the question if

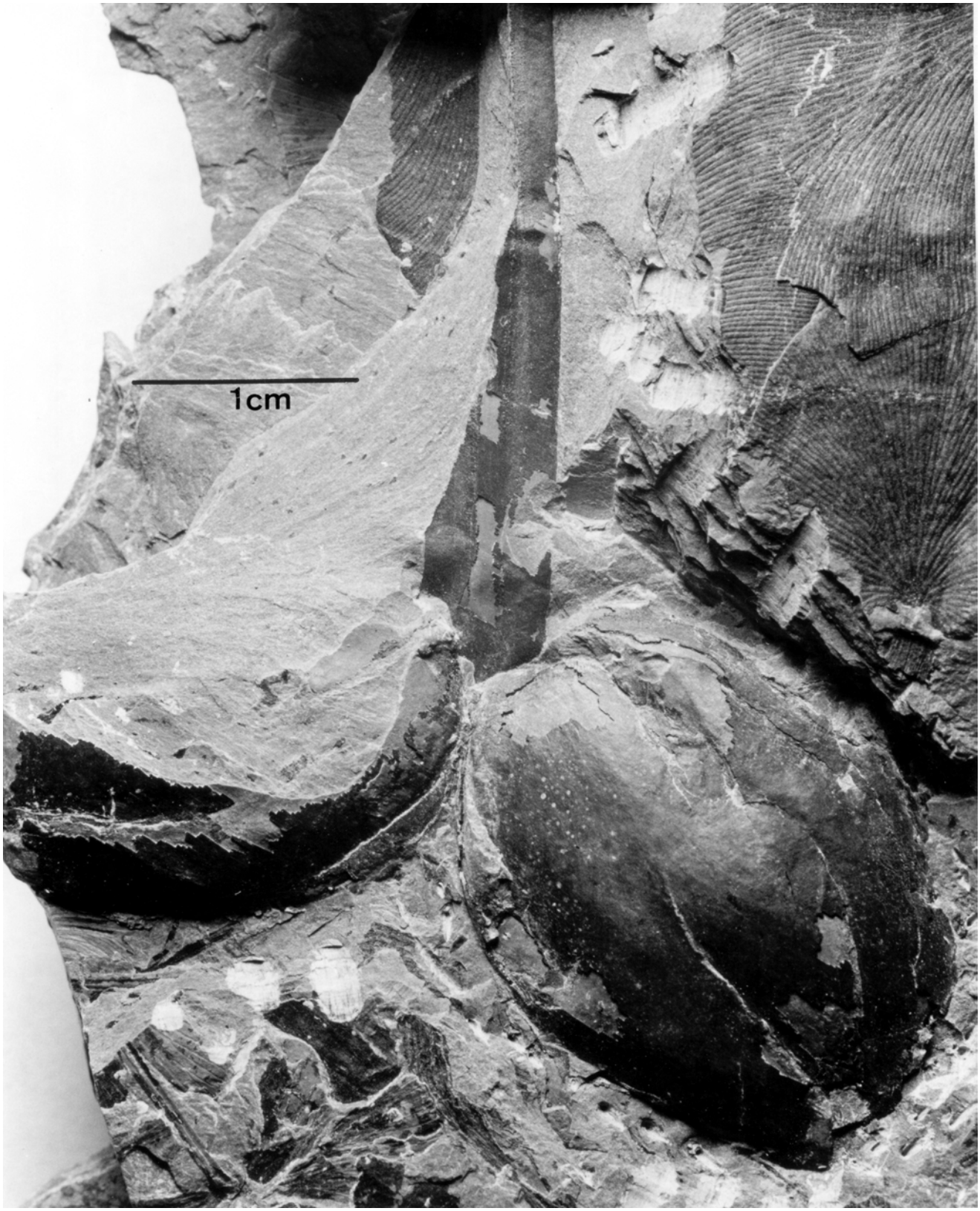

Fig. 4 *Trigonocarpus* sp. 003-352; organically paired, stalked? ovules associated with *Macroneuropteris scheuchzeri* (upper right-hand corner) and "*Odontopteris subcuneata*" (= *M. scheuchzeri*), lower left-hand corner.

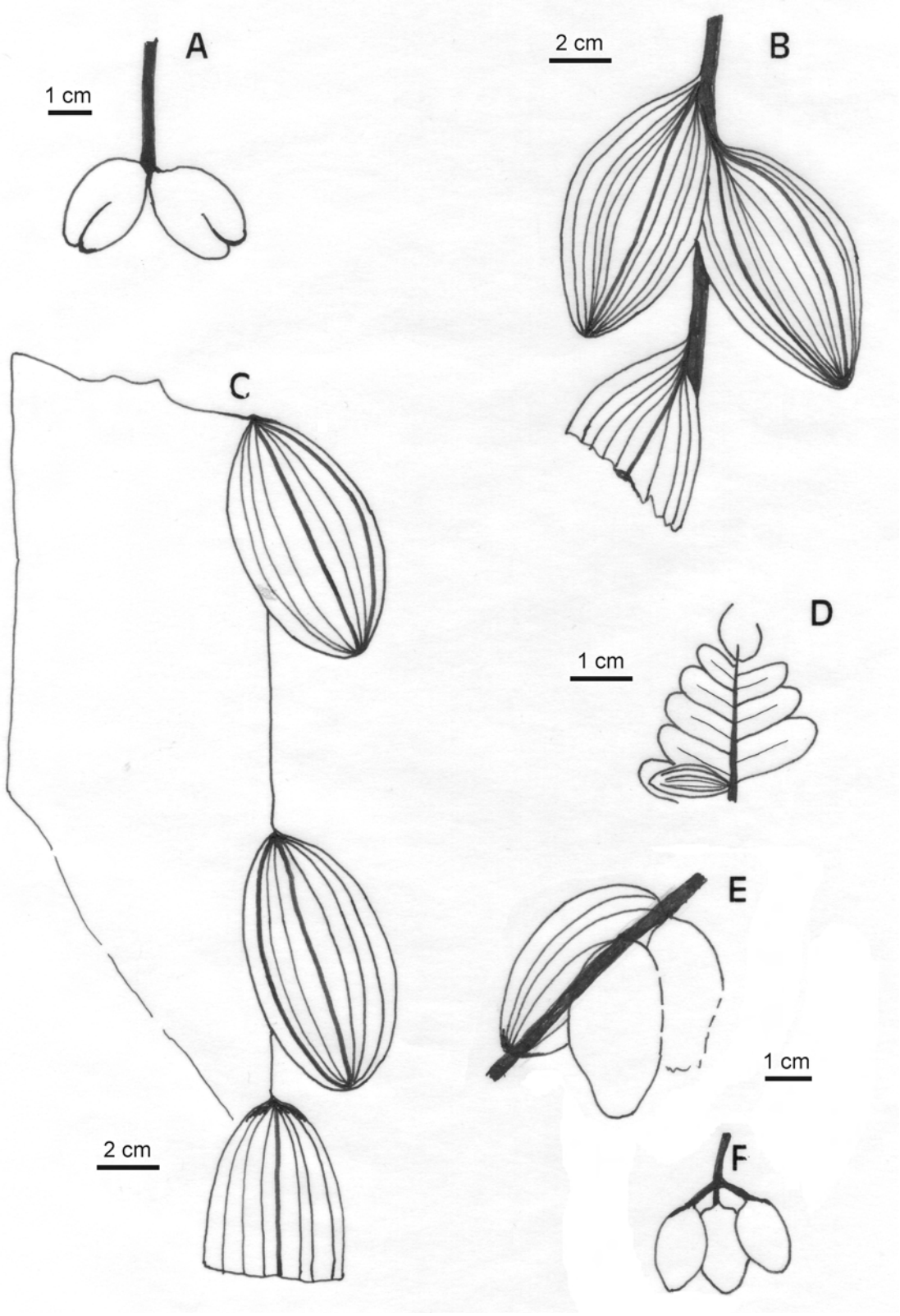

Fig. 5 Hand-drawn presentation from photographs. Interpretations of attachment of medullosalean ovules, Sydney Coalfield, Canada. (A) *Trigonocarpus* sp., 003-352; stalked, organically paired ovules. (B) *Pachytesta incrassata* Brongniart, 002-213; axially attached ovules (Zodrow 2002, Fig. 16a). (C) *Pachytesta incrassata*, 002-339; cauline-attached ovules. (D) *Trigonocarpus* sp., 977-737a; organically attached to *Neuropteris flexuosa* Sternberg (Zodrow and McCandlish 1980b). (E) *Pachytesta* sp., 004-238; cluster of three ovules attached to an axis. (F) Alternative interpretation of (E) as trichomous branching.

Fig.6 *Pachytesta incrassata* **Brongniart, 002-339; three (1, 2, 3) ovules physically aligned along the margin of a medullosalean stem. Organic connection could not be demonstrated**

Fig. 7 *Pachytesta* sp. aff. *incrassata* Brongniart, 985-202; the ovule shows three (1, 2, 3) definitive coalified layers, and it is physically aligned with a medullosalean axis. Organic connection could not be demonstrated.

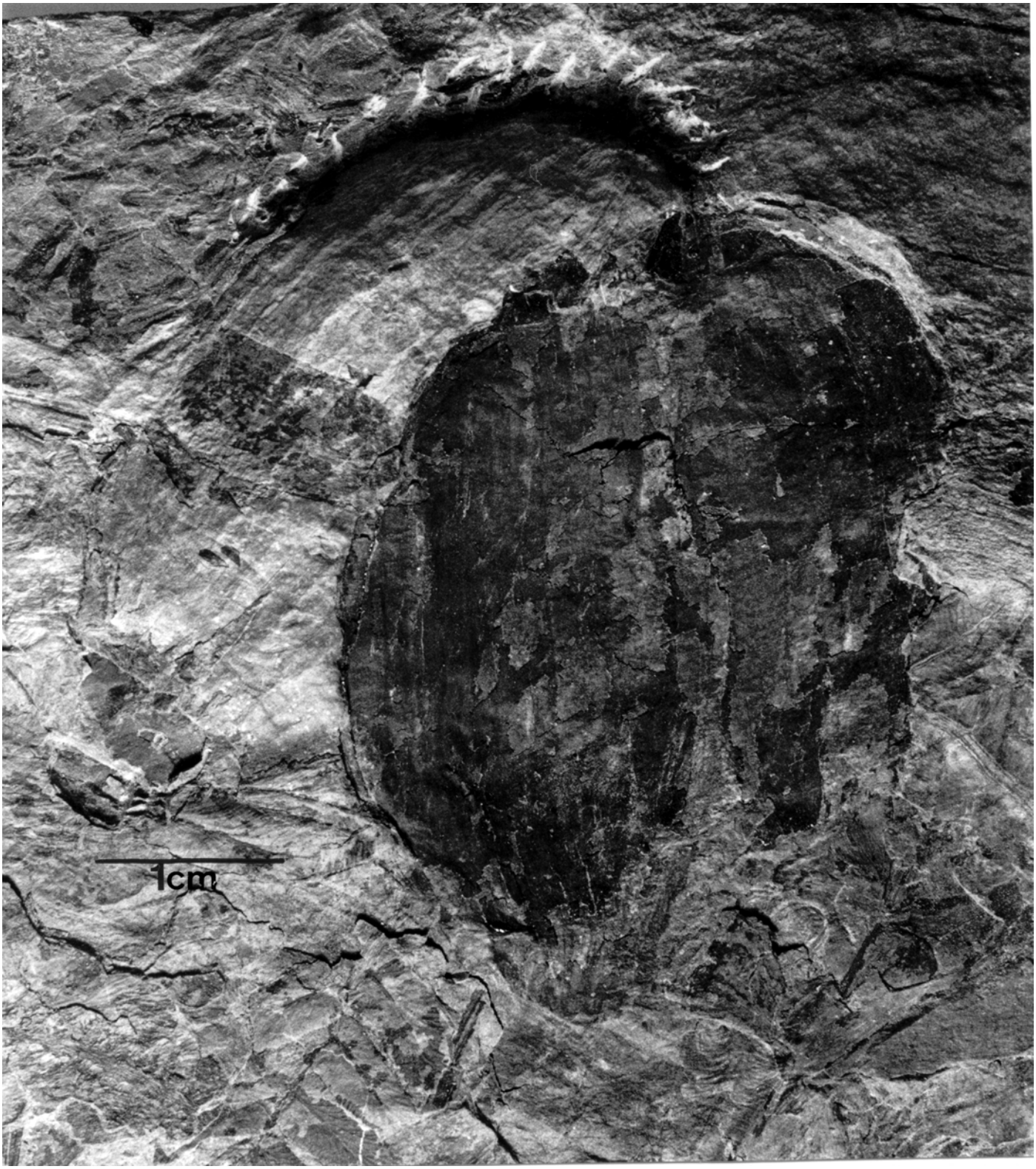

Fig. 8 *Pachytesta* **sp. 004-238; three ovules in physical connection with each other.**

cauline attachment was by single or paired ovules, or by an as yet unknown number of ovules positioned along margins of an ?axis. Moreover, paired or axially-borne ovules could represent a modified reproductive frond structure.

Dimensional measurements of compression/impression ovules (Table 1) are preservation-biased, which suggests not to use them as a basis for biological-species delineation.

Although still based on circumstantial evidence, it is suggested that paired trigonocarpalean ovules are a fructification structure of *M. scheuchzeri* agreeing with Bell (1938) in regards to the same genus *Trigonocarpus*.

Furthermore, it is interesting to consider if neuropterids are separable from alethopterids alone on the grounds of different ovular attachments, with ramification in taxonomy.

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