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RICHARD B. RICKARDS

The Arenig graptolite genus *Pseudotrigonograptus* Mu & Lee, 1958

ABSTRACT: Topotype material of *Graptolithus ensiformis* J. Hall, 1858 (= *Retiolites ensiformis* J. Hall, 1865) is revised and compared with three dimensional material from the Gaspé peninsula. This latter is shown to be scandent quadriserial, is considered conspecific with the topotype material, and with recently described, etched collections from Spitsbergen (Fortey 1971). It is concluded that the genus *Pseudotrigonograptus* Mu & Lee (1958) based upon *P. uniformis* is a valid genus with clear priority over *Tristichograptus* Jackson & Bulman (1970), a genus erected to embrace the morphology of the Spitsbergen triserial rhabdosomes and at the same time exclude the invalid *Trigonograptus lanceolatus* Nicholson (1869).

INTRODUCTION

The scandent graptoloid long called *Trigonograptus ensiformis* J. Hall is important in being almost an index fossil of the *hirundo* zone of the Arenig Series. Recent work by Jackson & Bulman (1970) demonstrated that Nicholson's (1869) type of the genus (*Trigonograptus lanceolatus*) was based upon the distorted distal portion of one pendant *Didymograptus* specimen, probably *D. bifidus* J. Hall. In consequence they erected the genus *Tristichograptus* to include the species *Graptolithus ensiformis* J. Hall as type, whilst at the same time being aware of Fortey's (1971) work on the triserial Spitsbergen specimens of *T. ensiformis*. Fortey (1971) then gave an immaculate and detailed account of the development of the only known triserial graptolites.

Both papers (Jackson & Bulman 1970, Fortey 1971) considered the Spitsbergen specimens conspecific with Hall's types and regarded the

species referred to *Pseudotrigonograptus* by Mu & Lee (1958) as conspecific with and junior synonyms of *Tristichograptus ensiformis* (J. Hall).

The present writer agrees with these conclusions but the finds of quadriserial specimens of *Graptolithus ensiformis* from the *D* zone (high Arenig, approximately *hirundo* zone) at the mouth of Patate Brook, Tourelle Area, Gaspé demonstrates that the similar observations of Mu & Lee (1958) followed by Mu & Zhan (1966) were substantially correct and that the genus *Pseudotrigonograptus* Mu & Lee (1958) is valid and has clear priority over *Tristichograptus* Jackson & Bulman (1970).

That the species *Pseudotrigonograptus uniformis* and *P. magnus* Mu & Lee (1958) are junior synonyms of *Graptolithus ensiformis* J. Hall is apparent, and means that the type species of *Pseudotrigonograptus* is *Graptolithus ensiformis* J. Hall (= *Retiolites ensiformis* J. Hall, 1865). Bearing in mind that the name *Tristichograptus* is not yet widely used in the literature the writer can see no reason why it should not be replaced by *Pseudotrigonograptus.*

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Family **Dichograptidae** Lapworth, 1873
Genus *PSEUDOTRIGONOGRAPTUS* Mu & Lee, 1958

Type species: *Graptolithus ensiformis* J. Hall, 1858, p. 133 and as *Retiolites ensiformis*, 1865, p. 114, Pl. 14, Figs 1—5.

Genolectotype: Geol. Surv. Canada, 949g; figd. Hall, 1865, Pl. 14 Fig. 4, Quebec Group, near Point Lévis. The actual locality can only be on Côte Fréchette, Lévis (*see* Rickards, 1972, p. 104).

Occurrence: worldwide; late Arenig in European and Pacific provinces, and probably into Llanvirn in Pacific province.

Generic diagnosis. — Rhabdosome scandent triserial or quadriserial, lanceolate with more rapid distal taper, to elongate with tapering proximal and distal ends; development basically isograptid (th 1^2 dicalycal); nema short, enveloped after early stages of growth.

Occurrence of genus. — As above, but Ross & Berry (1963) record *Trigonograptus martelli* from the *bicornis* zone in the Basin Ranges.

Remarks. — Numbers of species have been referred to the geus *Trigonograptus*, but it is clear that many are junior synonyms (see below) of *P. ensiformis* or are invalid for various reasons. Thus Jackson & Bulman (1970) were able to dismiss *T. lanceolatus* Nicholson, 1869; *T. lineatus* Hsu, 1934; and *T. truncatus* Hopkinson & Lapworth, 1875. The various species of *Trigonograptus* and *Pseudotrigonograptus* described by Mu & Lee (1958) fall within the range of variation of *P. ensiformis* as defined below from topotype and near-topotype collections.

In addition to *P. ensiformis* the following species are recognized herein: *P. martelli* (Ross & Berry, 1963); *P. tenvis* (Obut & Sobolevskaya, 1964); ? *P. wilkinsoni* (T. S. Hall, 1899).

Fortey (1971) suggests *Tetragraptus* (of *bigsbyi*-like development) as a possible ancestor of *P. ensiformis*, and in this respect it is of interest that some tetragraptid species may occur as three or four stiped forms as proposed in this paper for *P. ensiformis*.

Pseudotrigonograptus ensiformis (J. Hall) (Figs 1—3)

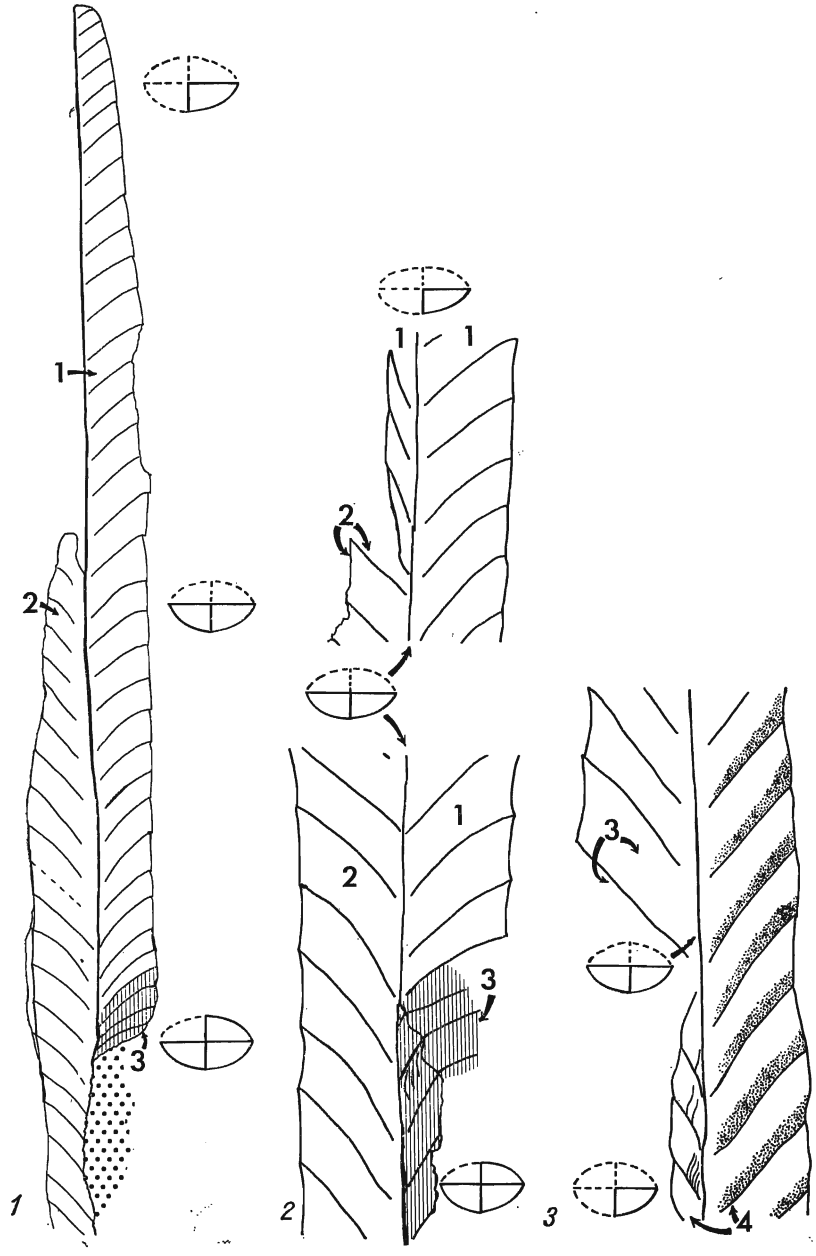
1858. *Graptolithus ensiformis* Hall; Hall, p. 133.
1865. *Retiolites ensiformis*, Hall; Hall, p. 114, Pl. 14, Figs 1—5.
1875. *Trigonograptus ensiformis*, Hall, sp.; Lapworth (*in* Hopkinson & Lapworth), p. 659, Pl. 34, Figs 8*a*—*c*.
1890. *Trigonograptus ensiformis*, Hall, sp.; Nicholson, p. 340, Figs 1—2.
1898. *Trigonograptus ensiformis* (Hall); Elles, p. 523, Fig. 34.
?1899. *Trigonograptus Wilkinsoni*, n. sp.; T. S. Hall, p. 450, Fig. 13.
1904. *Trigonograptus ensiformis* (Hall); Ruedemann, p. 727, Pl. 17, Figs 1—9.
1908. *Trigonograptus ensiformis* (Hall); Elles & Wood, p. 302, Pl. 35, Figs 1*a*—*c*.
1934. *Trigonograptus ensiformis* (Hall); Hsu, p. 53, Pl. 14, Figs 1*a*—*i*.
1938. *Trigonograptus ensiformis*. J. Hall; Harris & Thomas, Pl. 2, Fig. 46.
1947. *Trigonograptus ensiformis* (Hall); Ruedemann, p. 447, Pl. 76, Figs 49—57.
1947. *Trigonograptus ensiformis* (Hall) var. *obtusus* n. var.; Ruedemann, p. 448, Pl. 76, Fig. 58.
1954. *Trigonograptus ensiformis* (Hall); Keller & Lisogor, p. 74, Pl. 5, Figs 8, 13; Text-fig. 28.
1954. *Trigonograptus praelongus* sp. nov.; Keller & Lisogor, p. 75, Pl. 4, Fig. 12.
1955. *Trigonograptus ensiformis* (Hall); Bulman, p. V87, Fig. 64. 1.
1958. *Trigonograptus ensiformis* (Hall); Mu & Lee, p. 395, Pl. 2, Figs 1—10.
1958. *Trigonograptus ensiformis* var. *minor* Mu et Lee (var. nov.); Mu & Lee, p. 396, Text-fig. 3.
1958. *Pseudotrigonograptus uniformis* Mu et Lee (gen. et sp. nov.); Mu & Lee, p. 397, Pl. 3, Figs 1—10.
1958. *Trigonograptus angustus* Mu et Lee (sp. nov.); Mu & Lee, p. 396, Pl. 2, Figs 11—12, Text-fig. 4.
1958. *Pseudotrigonograptus magnus* Mu et Lee (gen. et sp. now); Mu & Lee, p. 398, Pl. 2, Figs 13—14.
1960. *Trigonograptus ensiformis* (Hall); Mu, Lee & Geh, p. 36, Pl. 1, Figs 5—6.
1960. *Trigonograptus ensiformis* (Hall); Berry, p. 94, Pl. 12, Fig. 10; Pl. 13, Figs 6—7.
1960. *Trigonograptus ensiformis* J. Hall; Thomas, p. 48, Pl. 5, Fig. 63.
1962. *Trigonograptus ensiformis* (Hall); Jackson, p. 303 et seq.
1964. *Trigonograptus ensiformis* (Hall); Obut & Sobolevskaya, p. 24, Pl. 1, Figs 7—8.
1966. *Trigonograptus ensiformis* (J. Hall); Larson & Jackson, Pl. 3, Fig. 15.
1970. *Tristichograptus ensiformis* (J. Hall); Jackson & Bulman, p. 108.
1970. *Tristichograptus ensiformis* (J. Hall); Bulman, pp. V116, V132, Fig. 98.
1971. *Tristichograptus ensiformis* (J. Hall); Fortey, p. 188, Pls 26—29, Text-figs 1—7.
1971. *Trigonograptus ensiformis;* Erdtmann, p. 1514 et seq.
1971. *"Trigonograptus" ensiformis* (J. Hall); Skevington, p. 77 et seq.
1972. *Tristichograptus ensiformis;* Aitken & *al.*, p. 37.
1972. *Tristichograptus ensiformis* (Hall); Lenz & Pedder, p. 26 et seq.
1972. *Tristichograptus ensiformis;* Riva, p. 40.
1972. *Tristichograptus ensiformis* (Hall); Rickards, pp. 103—104.

Material. — Numerous specimens from the type and other nearby localities in the *D* zone, Levis Shales, and specimens in full relief collected by William H. McGerrigle in 1949 from locality 12 (McGerrigle 1954), mouth of Patate Brook, 700' from St. Lawrence shore at old dam, Gaspé, Canada.

Horizon. — *D* zone, Levis Shale, that is approximately *hirundo* zone, Arenig, Ordovician; and approximate time equivalent at Patate Brook. Other specimens recorded at the McGerrigle locality include: *Phyllograptus* sp., *Glossograptus* sp., *Didymograptus* ex gr. *extensus*, *Glyptograptus dentatus*, *D. hirundo*, *?Amplexograptus* sp., *Pseudoclimacograptus* aff. *pungens*, *?D. hirundo*.

Brief description of topotype material. — Rhabdosomes occasionally longer than 70 mm, but most mature specimens are between 30 and 40 mm with a maximum

width (flat or low relief) of 3.2 mm. Thecal spacing varies from 10—12 in 10 mm proximally to 9—11 in 10 mm distally: measurements taken over the first few thecae of the rhabdosome may exceed the rate of 12 in 10 mm. Other localities in the neighbourhood of the type locality, possibly at fractionally different horizons, have specimens with a width in excess of 4 mm but other measurements are the same. For comment upon thecal apertures and angles of inclination see under "Remarks" below.



Early growth stages (less than 10 mm long) have the narrowest widths, for example a Laval University specimen from Davidson Hill, Levis, horizon 14, has a length of 9 mm and a width of 1.5 mm. There is, therefore, some addition to the apertural regions of the thecae as the length of 30—40 mm is achieved. Presumably, when this addition terminates, the rhabdosome becomes more parallel-sided than fusiform as the distal end grows further: the longest rhabdosomes are usually the most parallel sided, but the exceptional broad variants in many collections probably result when distal and lateral increments continue to be added throughout the growing life of the colony.

Description of the Gaspé material. — The specimens are preserved in three dimensions, with no traces of diagenetic flattening or tectonic distortion, in a coarse sand containing quartz, felspar and rock fragments. The rhabdosomal cross section is elliptical with the long axis parallel to the bedding plane. This axis coincides with a "median septum" along which the specimens split to reveal that there are *four* thecal series (Figs 1—3) separated by "median septa" mutually at right angles. The larger "median septum" measures 3.0 mm at most (= the rhabdosomal width) and the short one 2.0 mm. Some specimens are as narrow as 2.5 mm on the long axis of the ellipse. The rhabdosomal width would be increased upon flattening but to what degree it is difficult to predict with such an internal structure. If the strengthening effect of the "median septa" and interthecal septa can be ignored a 3 mm diameter *circular* rhabdosome would flatten to about 4.7 mm. An elliptical specimen, strengthened internally, might possibly flatten to approximately 4 mm.

The thecal spacing varies from 10—12 in 10 mm, the latter values being closer to the proximal end. The nature of the thecal profiles and apertures is obscure but as far as can be ascertained is similar to that described by Fortey (1971). Thecal angles are actually only apparent angles seen on the "median septa", but may be as low as 30° towards the axis and over 50° in the apertural regions of each series. The concave nature of the interthecal septum thus seen in profile suggests that the ventral wall of each thecal tube is also slightly concave.

Remarks. — In the original description Hall gives the maximum width as 16/100 inch (*i.e.* about 3.5 mm) and a thecal spacing of 28 to 1 inch (*i.e.* just over 10 in 10 mm), whilst his illustrations depict a width of 2.5—3.0 mm and a thecal spacing of 10—12 mm.

The work on isolated triserial material by Fortey (1971) has demonstrated what has long been suspected, namely that the true thecal profile is not seen in the usual mode of preservation, including the type and topotype collections. Thus the angles of thecal inclination usually quoted are actually *apparent* angles: in each case the true thecal angle should be slightly greater. Fortey quotes 40—50° for the

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Figs 1—3

Pseudotrigonograptus ensiformis (J. Hall)

Specimen in full three dimensions, split mostly along the wider, "horizontal median septum" (*see* text) showing thecal series 1 & 2 (below) and 3 (above). The cross section at each portion of the rhabdosome is shown inset. Proximal portion of this specimen, with series 3 preserved, is shown enlarged in Fig. 2, and the counterpart with the series 4 preserved in Fig. 3. Fig. 1, × 5; Figs 2—3, × 10. Coarse stipple indicates obscuring rock matrix; fine vertical shading indicates thecal series 3. Series labelled 1—4 for purposes of these diagrams only. Mouth of Patate Brook, 700 feet from St. Lawrence shore at old dam, Gaspé; William H. McGerrigle Colln. from his (1949) lot 12

true inclination in the Spitsbergen specimens, but the literature records figures varying from 30—55° for (mostly) apparent angles (*see* Fortey 1971, Table 1). In these latter figures it is rare to see correction for tectonic distortion, so it is reasonable to expect a greater spread of values than Forthey's measurements even without geographical variation.

Similarly it is true that the nature of the thecal apertures is rarely seen, and the only reliable account is that given for the Spitsbergen specimens; whilst thecal overlap, for the reasons outlined by Fortey (1971, p. 191), *appears* to be complete (*see* Fig. 3 herein) but in fact is nearer one half.

Fortey has explained the manner in which a triserial rhabdosome would flatten during normal diagenesis, resulting in a "median septum" lying roughly parallel to the bedding plane. In the quadriserial Gaspé specimens, with their elliptical cross section, the result would be similar but the already horizontal "median septum" (the long axis of the ellipse) would remain horizontal whilst the vertical "median septa" would crumple or rotate in various ways. Upon splitting the rock would tend to part along the long axis of the ellipse.

Sedgwick Museum
Downing Street,
Cambridge CB2 3EQ, England.
Cambridge, May 1973

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R. B. RICKARDS

ARENIGSKI RODZAJ *PSEUDOTRIGONOGRAPTUS* MU & LEE, 1958

(Streszczenie)

Poddany został rewizji materiał topotypowy *Graptolithus ensiformis* J. Hall, 1858 (= *Retiolites ensiformis* J. Hall, 1865) i porównany z okazami trójwymiarowymi pochodzącymi z półwyspu Gaspé (Kanada). Te ostatnie reprezentują formy o gałązkach czteroseryjnych wzniesionych i po starannej analizie wydają się być konspecyficzne z materiałem topotypowym i z formami opisanymi przez Forteyego (1971) ze Spitsbergenu. Stwierdzono, że rodzaj *Pseudotrigonograptus* Mu & Lee (1958) oparty na *P. uniformis* jest rodzajem ważnym taksonomicznie i posiada priorytet w stosunku do rodzaju *Tristichograptus* Jackson & Bulman (1970), utworzonego celem charakterystyki morfologii spitsbergeńskich trzyseryjnych graptolitów i jednocześnie wykluczający ważność *Trigonograptus lanceolatus* Nicholson (1869).

Muzeum Sedgwicka
Downing Street
Cambridge CB2 3EQ, Anglia
Cambridge, w maju 1973 r.