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## ***Pristiograptus* (Graptoloidea) from the *perneri* - *lundgreni* biozones (Silurian) of Lithuania**

**Sigitas RADZEVIČIUS<sup>1</sup>**

**Abstract:** Two new forms of *Pristiograptus dubius*, here designated as varieties "A" and "B", are described and figured. Both were found in core samples representing the *perneri* through *lundgreni* biozones of the Wenlock epoch. The cores are from boreholes Šiupyliai-69, Parovėja-9, Likėnai-396, Paežeriai-222 and Sutkai-87 in central and northern Lithuania. The associated graptolites *Cyrtograptus perneri* BOUČEK, *C. radians* TÖRNQUIST, *C. lundgreni* TULLBERG, *Monograptus flemingii flemingii* (SALTER), *M. testis testis* (BARRANDE), *Monoclimacis flumendosae* (GORTANI) and *Pristiograptus pseudodubius* (BOUČEK) (= *P. parvus*) are all indicative of the *perneri*, *radians* and *lundgreni* biozones of the Wenlock. Two species of *Pristiograptus* occur in this time-stratigraphic interval: *P. dubius* and *P. lodenicensis*. In *P. dubius* the degree and manner of extension of the thecal apertural lip (thecal hood) onto the succeeding theca distinguish it from otherwise very similar taxa. The thecal morphology of *P. lodenicensis* differs from that of a typical *Pristiograptus* in that the apertural lip has a central depression and is rounded into small lobes laterally.

**Key Words:** *Pristiograptus*; Graptoloidea; graptolite; Wenlock; Silurian; Lithuania

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**Résumé :** *Pristiograptus* (Graptoloidea) des biozones à *perneri*, *radians* et *lundgreni* (Silurien) de Lithuanie.- Deux formes nouvelles de *Pristiograptus dubius*, appelées ici variétés "A" et "B", sont décrites et illustrées. Toutes deux ont été découvertes dans des échantillons de carottes dans un intervalle rapporté aux biozones à *perneri*, *radians* et *lundgreni* du Wenlock. Les carottes proviennent des forages Šiupyliai-69, Parovėja-9, Likėnai-396, Paežeriai-222 et Sutkai-87 de Lithuanie centrale et septentrionale. Les graptolites rencontrés en association : *Cyrtograptus perneri* BOUČEK, *C. radians* TÖRNQUIST, *C. lundgreni* TULLBERG, *Monograptus flemingii flemingii* (SALTER), *M. testis testis* (BARRANDE), *Monoclimacis flumendosae* (GORTANI) et *Pristiograptus pseudodubius* (BOUČEK) (= *P. parvus*), sont tous caractéristiques des biozones à *perneri*, *radians* et *lundgreni* du Wenlock. Deux espèces de *Pristiograptus* sont connues dans cet intervalle stratigraphique : *P. dubius* et *P. lodenicensis*. Chez *P. dubius* le développement (importance et morphologie) des lèvres aperturales des thèques le long du rhabdosome permet de le distinguer d'autres taxons autrement très voisins. La morphologie des thèques chez *P. lodenicensis* est distincte de celle d'un *Pristiograptus* typique dans la mesure où la lèvre aperturale présente une dépression médiane et s'arrondit latéralement en petits lobes.

**Mots-Clefs :** *Pristiograptus* ; Graptoloidea ; graptolite ; Wenlock ; Silurien ; Lithuanie

### **Introduction**

In the Baltic states the graptolite genus *Pristiograptus* occurs throughout the *cyphus* to *parultimus* - *ultimus* biozones of the Llandovery to Pridoli. Previously, the genus has been studied only cursorily in the interval comprising the upper Sheinwoodian-lower Homerian *perneri* through *lundgreni* biozones, probably because the index taxa for those biozones are *Cyrtograptus* species, quite distinct from those used for zonation of the upper Homerian where *Pristiograptus* species are the markers (Fig. 1). Consequently, this paper is a taxonomic review of the representatives of the genus *Pristiograptus* found in these middle Wenlockian levels where it has been passed over.

*Pristiograptus* of a *dubius* type dominate in the *perneri* - *lundgreni* biozones. *Pristiograptus* of a new *lodenicensis* type appear first in the

*lundgreni* Biozone (see below). It has proved very difficult in the past to subdivide the *dubius* group and, thus, indiscriminate identifications like *Pristiograptus* ex gr. *dubius* and/or *P. dubius* (SUESS) *sensu lato* abound in the literature.

### **Previous work on *Pristiograptus***

The *Pristiograptus* group was investigated in detail by PŘIBYL (1943) who distinguished two 'types' based on *P. dubius* and *P. vulgaris* (= *Colonograptus ludensis*) respectively. He described 23 species of a *P. dubius* type and 19 of a *P. vulgaris* (= *Colonograptus ludensis*) type ranging in age from the Late Llandovery to the Ludlow of the Czech Republic. URBANEK (1953, 1959, 1997) and TELLER (1964) investigated the genus in Poland. TELLER (1964) described ten species and subspecies of the *dubius* group from the Ludlow, eight of which were new.

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JAWOROWSKI (1965) studied *Pristiograptus* from the *lundgreni* Biozone. He illustrated five taxa and described a new subspecies: *P. lodenicensis peribalticus*. JAEGER (1959, 1991) studied the genus in the upper Wenlock of Germany and described two new species. Some species originally described as *Pristiograptus* by these authors are now assigned to other recently established genera such as *Colonograptus* (e.g. KOREN and URBANEK, 1994; LENZ and KOZŁOWSKA-DAWIDZIUK, 2002) and *Pseudomonoclimacis* (e.g. URBANEK, 1997). LENZ and MELCHIN (1991) recorded nine *Pristiograptus* species as occurring in the Wenlock of Arctic Canada, and described three of them. LENZ (2001) described only *P. dubius* from the *lundgreni* zone of Arctic Canada; he did not separate the *dubius* group

into other species or subspecies. HOLLAND *et alii* (1969) described the new species *P. jaegeri* from the upper Wenlock and lowermost Ludlow of Great Britain and Poland. ZALASIEWICZ and WILLIAMS (1999) recorded the *Pristiograptus* group from the Wenlock of central Wales, recognizing only one subspecies, *P. dubius pseudolatus* (RICKARDS).

ULST (*in* GAILITÉ *et alii*, 1967) worked on the graptolites of the Baltic area. She described 12 species and subspecies of *Pristiograptus* from the Silurian of Latvia, including one new species, *P. piltenensis* KOREN *et* ULST (*in* GAILITÉ *et alii*, 1967), from the upper Wenlock. PAŠKEVIČIUS (1974, 1979) studied *Pristiograptus* in Lithuania and described the new species *P. virbalensis* from the upper Wenlock *ludensis* Biozone.

Series	Stage	Regional Stage	Graptolite biozones				
			Lithuania	Arctic Canada	Poland	Central Wales	
Wenlock	Homerian	Gėluva	<i>ludensis</i>	<i>ludensis</i>	<i>deubeli</i> - <i>ludensis</i>	<i>nassa</i> - <i>ludensis</i>	
			<i>deubeli</i> - <i>virbalensis</i>	<i>praedeubeli</i> - <i>deubeli</i>	<i>praedeubeli</i>		
			<i>parvus</i> - <i>nassa</i>	<i>dubius</i> - <i>nassa</i>	<i>dubius</i> - <i>nassa</i>		
		<i>parvus</i> - <i>nassa</i>					
		Jaagarahu	<i>lundgreni</i>	<i>testis</i> - <i>lundgreni</i>	<i>lundgreni</i>	<i>lundgreni</i>	
			<i>radians</i>				
	Jaani		<i>perneri</i>	<i>perneri</i> - <i>opimus</i>	<i>ellesae</i>	<i>rigidus</i>	
		<i>flexilis</i>	<i>rigidus</i>				
			<i>antennularius</i>		<i>belophorus</i> (= <i>flexilis</i> )		
			<i>riccartonensis</i>				
			<i>murchisoni</i>	<i>instrenuus</i> - <i>kolobus</i>	<i>antennularius</i>	<i>dubius</i>	
	<i>centrifugus</i>	<i>riccartonensis</i>	<i>riccartonensis</i>				
	Sheinwoodian			<i>murchisoni</i>	<i>centrifugus</i>	<i>murchisoni</i>	<i>murchisoni</i>
				<i>centrifugus</i>		<i>centrifugus</i>	<i>centrifugus</i>

**Figure 1:** Correlation of Lithuanian graptolite biozones with those of Arctic Canada (LENZ and MELCHIN, 1991; LENZ and KOZŁOWSKA-DAWIDZIUK, 2002); with those of Poland (SZYMANSKI and TELLER, 1998; LENZ and KOZŁOWSKA-DAWIDZIUK, 2002) and with those of Central Wales (ZALASIEWICZ and WILLIAMS, 1999).

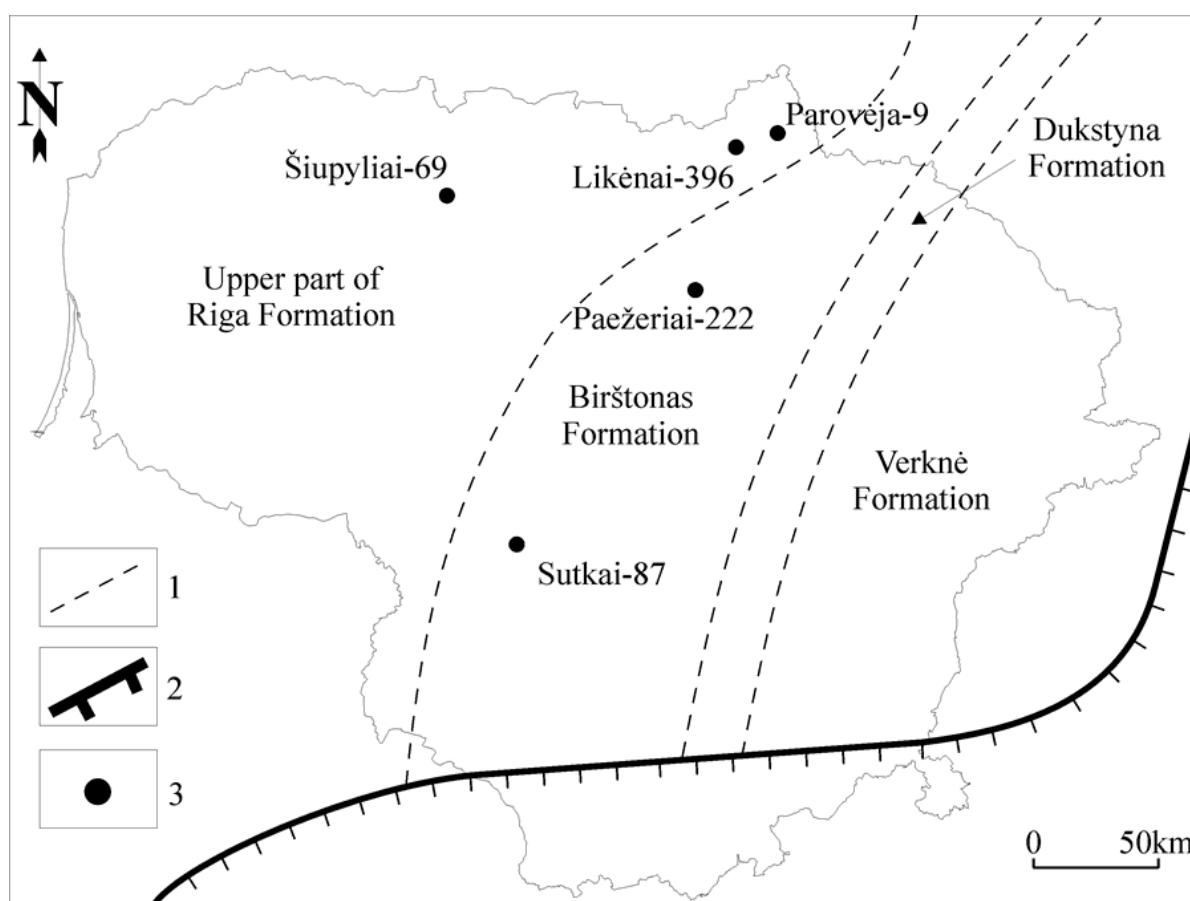
## Material

The new Lithuanian material is from the *perneri* - *lundgreni* biozones. Much of the material consists of specimens (some three-dimensional) chemically extracted from the rock. The *Pristiograptus* discussed here are from boreholes Šiupyliai-69 (interval 1080.5-1004.8 m), Parovėja-9 (interval 619.3-545.7 m), Likėnai-396 (interval 638.5-602.9 m), Paežeriai-222 (interval 736.0-690.6 m) and Sutkai-87 (interval 821.3-803.7 m) (Fig. 2). In these boreholes the maximum thickness of strata of Silurian age is 850 m. In all, about 150 samples were collected and investigated. Rhabdosomes were isolated with HCl from 50 core samples. About 300 isolated fragments of semi-flattened and 3-dimensionally preserved rhabdosomes were collected, including unusually early

astogenetic stages. The associated graptolites *Cyrtograptus perneri* BOUČEK, *C. radians* TÖRNQUIST, *C. lundgreni* TULLBERG, *Monograptus flemingii flemingii* (SALTER), *M. testis testis* (BARRANDE), *Monoclimacis flumendosae* (GORTANI), *Pristiograptus pseudodubius* (BOUČEK) (= *P. parvus*) and *P. lodenicensis* PŘIBYL are indicative of the *perneri*, *radians* and *lundgreni* biozones of the Wenlock.

Photographs were made using the scanning electronic microscope (SEM) in the Laboratory of the Materials Research at Tallinn Technical University (Estonia).

The material is stored at the Department of Geology and Mineralogy of Vilnius University (Lithuania).



**Figure 2:** The extent of the Jaagarahu regional Stage (LAPINSKAS, 2000) and location of the boreholes involved. 1) formational boundaries; 2) south of this line Silurian rocks were removed by later erosion; 3) location of boreholes.

## Biostratigraphy

The *perneri* - *lundgreni* biozones are located within a locally named regional entity called the Jaagarahu Stage (Fig. 1), which includes the upper part of Riga Formation and the Birštonas, Dukstyna and Verknė formations (Fig. 2) (LAPINSKAS, 2000). There are no graptolites in the Dukstyna and Verknė formations.

The *perneri* Biozone is composed of dark gray argillite with rare clay limestone interbeds in the Šiupyliai-69, Likėnai-396 and Parovėja-9 boreholes. In the Sutkai-87 and Paežeriai-222 holes, strata representing the *perneri* Biozone are gray marls with interbeds of micro-grained limestone but it is impossible to define its boundaries accurately because graptolites are rare. Where graptolites are present in quantity this association defines the *perneri* Biozone:

*Monograptus flemingii flemingii* (SALTER), *Monoclimacis flumendosae* (GORTANI), *Cyrtograptus perneri* BOUČEK, *C. ellesae* GORTANI. This biozone ranges in thickness from 29.5m (Šiupyliai-69) to 33.5m (Parovėja-9).

The lithology of the *radians* Biozone is like that of the *perneri* Biozone. The association of graptolites: *Monograptus flemingii flemingii* (SALTER), *M. flumendosae* (GORTANI), *Cyrtograptus radians* TÖRNQUIST, *C. carruthersi* LAPWORTH, is indicative of the *radians* Biozone. Its thickness ranges between 7.5m (Šiupyliai-69) and 10.7m (Parovėja-9).

The lithology of the *lundgreni* Biozone is identical to that of the other two. The association of graptolites that defines it is made up of two groups. One consists of species previously recognized: *Monograptus flemingii flemingii* (SALTER), *M. flumendosae* (GORTANI), *Pristiograptus pseudodubius* (BOUČEK) (= *P. parvus*) and the other is made up of more recently recognized grouping that together with the older group define the biozone: *Eisenackograptus eisenacki* (OBUT et SOBOLEVSKAYA), *Monograptus flemingii compactus* ELLES et WOOD, *M. testis testis* (BARRANDE), *M. t. inornatus* ELLES, *Cyrtograptus lundgreni* TULLBERG, *C. hamatus* (BAILY). Its thickness ranges from 31.5m (Parovėja-9) to 50.2m (Šiupyliai-69).

### Terminology

This paper employs terminology (Fig. 3) modified from TELLER (1964), URBANEK (1997) and RADZEVIČIUS and PAŠKEVIČIUS (2000):

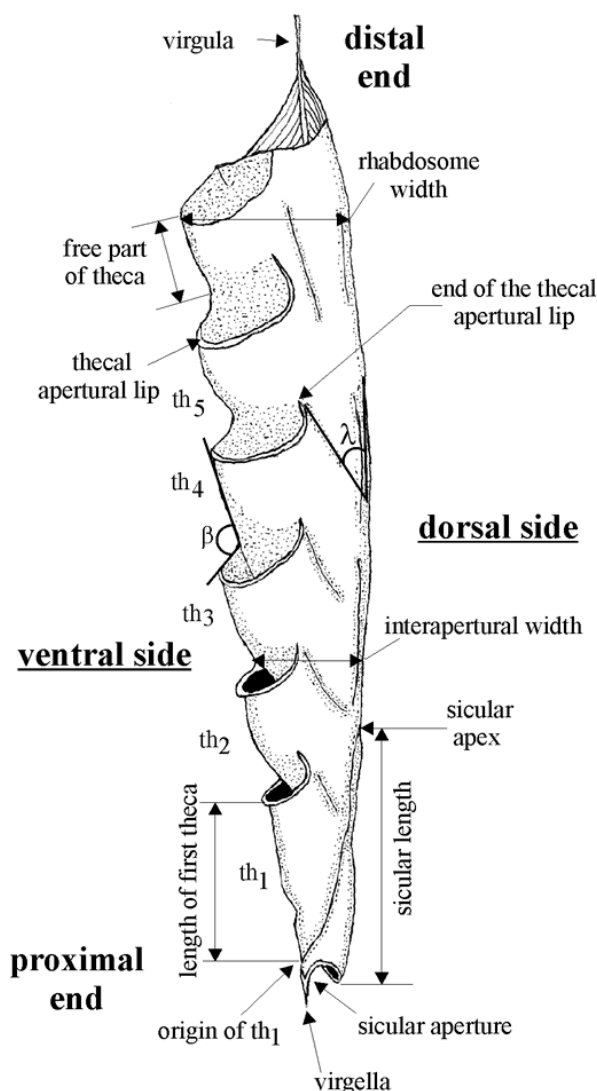
$\beta$  - the angle between the thecal apertural lip and the succeeding metathecal wall. Variations in this angle allows *Pristiograptus* to be split into groups (see below).

The *thecal apertural lip* (Fig. 4) is a thickening around the aperture. Its form is an important taxonomic feature in subdividing the genus (e.g. *P. deubeli* (JAEGER) (= *Colonograptus deubeli*), *P. lodenicensis*, etc.; see Fig. 4).

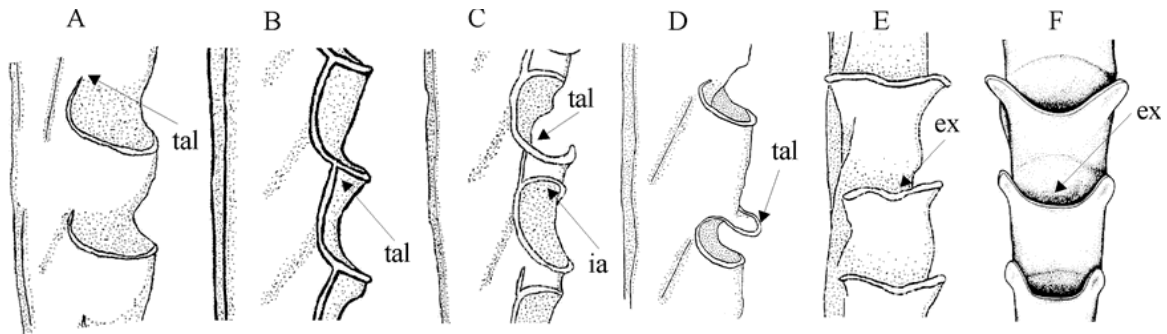
The *end of the thecal apertural lip* is at the disto-lateral margin of the thecal aperture. Its location is a very important taxonomic feature in distinguishing forms of the *dubius* group.

The author is of the opinion that the thecal apertural lip (thecal hood) may be linked to the development of the ectocortex. It is not the result of deformation because some of material is three-dimensional. The internal structure of *Pristiograptus* was not studied, but will be investigated in the future. These morphological elements should be excellent features for discriminating between the several forms assigned to *Pristiograptus* ex gr. *dubius*, making their recognition easier.

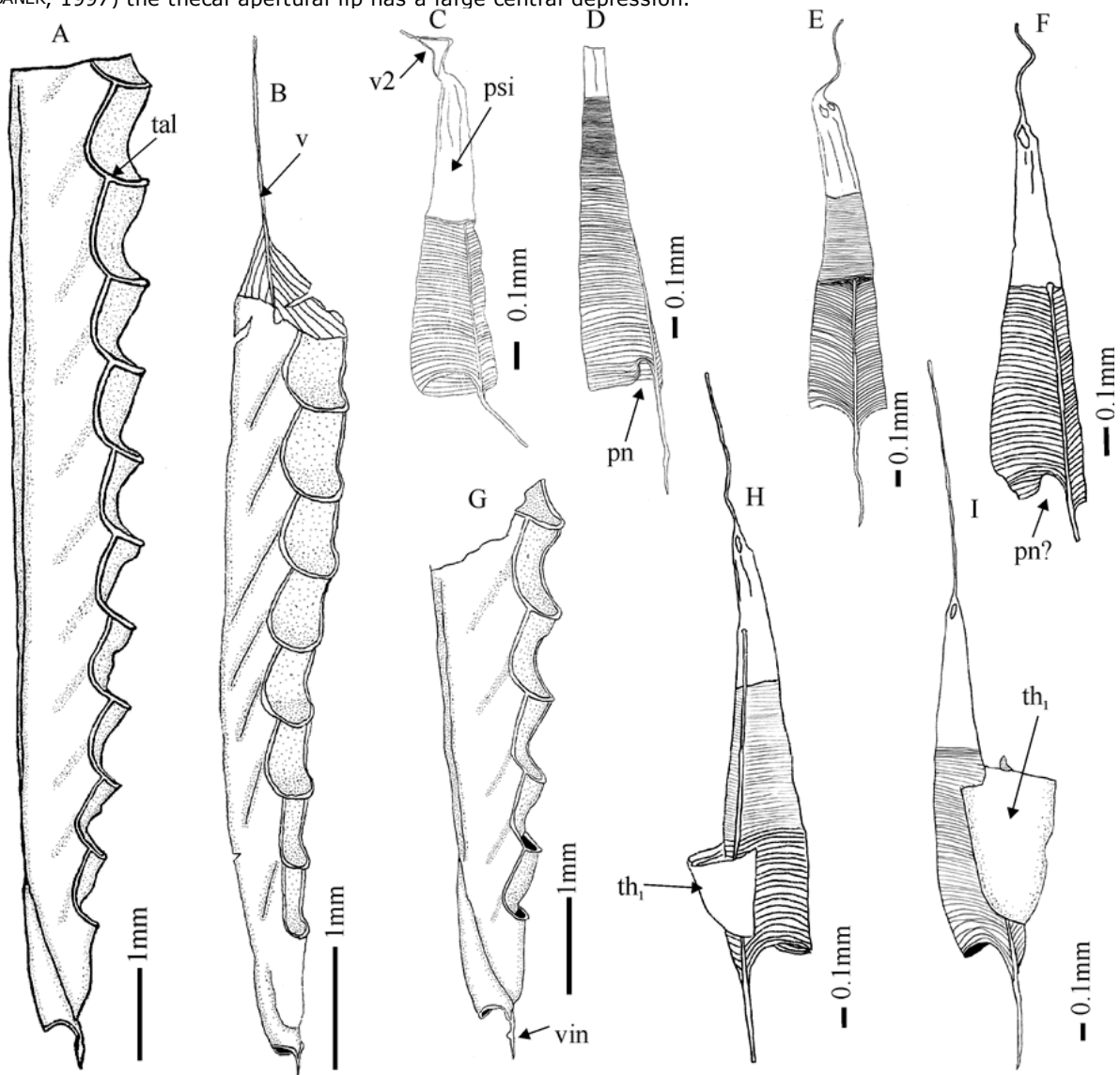
The following abbreviations are used in the descriptions below: L - length of rhabdosome including sicula; W - rhabdosome dorso-ventral width;  $th_1$ ,  $th_2$ , etc. - theca 1, theca 2, etc.



**Figure 3:** Morphological elements of a *Pristiograptus* rhabdosome:  $th_1$  - the first theca,  $\beta$  - angle between thecal aperture and succeeding theca;  $\lambda$  - angle between thecal axis and virgula.



**Figure 4:** The forms of thecal apertural lip: **A-C** *Pristiograptus* of a *dubius* type; **A** - *P. pseudodubius* (= *P. parvus*): the thecal apertural lip terminates in the middle part of the succeeding theca (tal); **B** - *P. dubius* var. "A": the thecal apertural lip joins the apertural lip of the succeeding theca (tal); **C** - *Pristiograptus* sp., the apertural lip of a theca joins the apertural lip of the succeeding theca (tal) and bifurcates to produce an intergrowth arch (ia); **D** - *Monoclimacis* sp., the apertural lip of the theca forms an apertural hood (tal); **E** - *P. lodenicensis*, the thecal apertural lip has a small central depression (dep); **F** - *Pseudomonoclimacis labiatus* (URBANEK, 1997) the thecal apertural lip has a large central depression.



**Figure 5:** **A-I** *Pristiograptus dubius* var. "A", Parovėja-9 borehole, depth 605.25-602.9m; **A** - S.P9-220, type, showing the thecal apertural lip connecting with that of the succeeding theca (tal); **B** - S.P9-223, with long virgula (v); **C** - S.P9-215a, prosicula (psi) and double juvenile virgula (v2); **D** - S.P9-215b, sicula showing the open primary notch (pn); **E** - S.P9-215c, sicula; **F** - S.P9-215d, sicula with possible open primary notch (pn?); **G** - S.P9-214, small protrusion in the middle part of virgella (vin); **H** - S.P9-215e, sicula with th<sub>1</sub>; **I** - S.P9-215f, sicula with th<sub>1</sub>.

## Systematic descriptions

Using these newly recognized morphological elements, the author describes two forms of *Pristiograptus* ex gr. *dubius*. They may well be found to be subspecies as material from other areas becomes available to demonstrate their geographic extent and persistence.

### Family Monograptidae LAPWORTH, 1873

#### Genus *Pristiograptus* JAEKEL, 1889

**Type species.** *Pristiograptus frequens* JAEKEL, 1889

#### *Pristiograptus dubius* group, PŘIBYL, 1943

**Type species.** *Pristiograptus dubius dubius* (SUESS), SUESS, p. 115, pl. 9, figs. 5.a-b, *riccartonensis* Biozone, lower Wenlock, Silurian of Vyskočilka, Male Chuchle (Czech Republic).

**Diagnosis.** The rhabdosome is robust. The proximal end generally has a slight ventral curvature up to  $th_4$ - $th_6$ ; sometimes it is straight. Thecae are uniform, cylindrical, and inclined to the rhabdosomal axis at 25-35°. There is a distinct thickening of the thecal apertural margin, the thecal apertural lip, which extends onto the lateroventral wall of the succeeding theca. The angle ( $\beta$ ) between the apertural margin of the theca and the succeeding thecal wall is always obtuse, especially in the more proximal thecae. The sicula is conical with a short and thin, slightly curved virgella.

**Age and geographic distribution.** *Pristiograptus* of the *dubius* type is widespread having been recorded from: Lithuania, Latvia, Poland, Russia, the Czech Republic, Sweden, Germany, Bulgaria, Arctic Canada, Australia, British Isles, France, Italy, Tunisia, Algeria, and Morocco, etc. The group ranges from the Upper Llandovery to the Prídolí.

#### *Pristiograptus dubius* var. "A"

Fig. 5 A-I, 6 A-E, 7 A-C

**Type.** No S.P9-220, Fig. 5 A, Parovėja-9 borehole, depth 605.25 m, *Cyrtograptus perneri* Biozone.

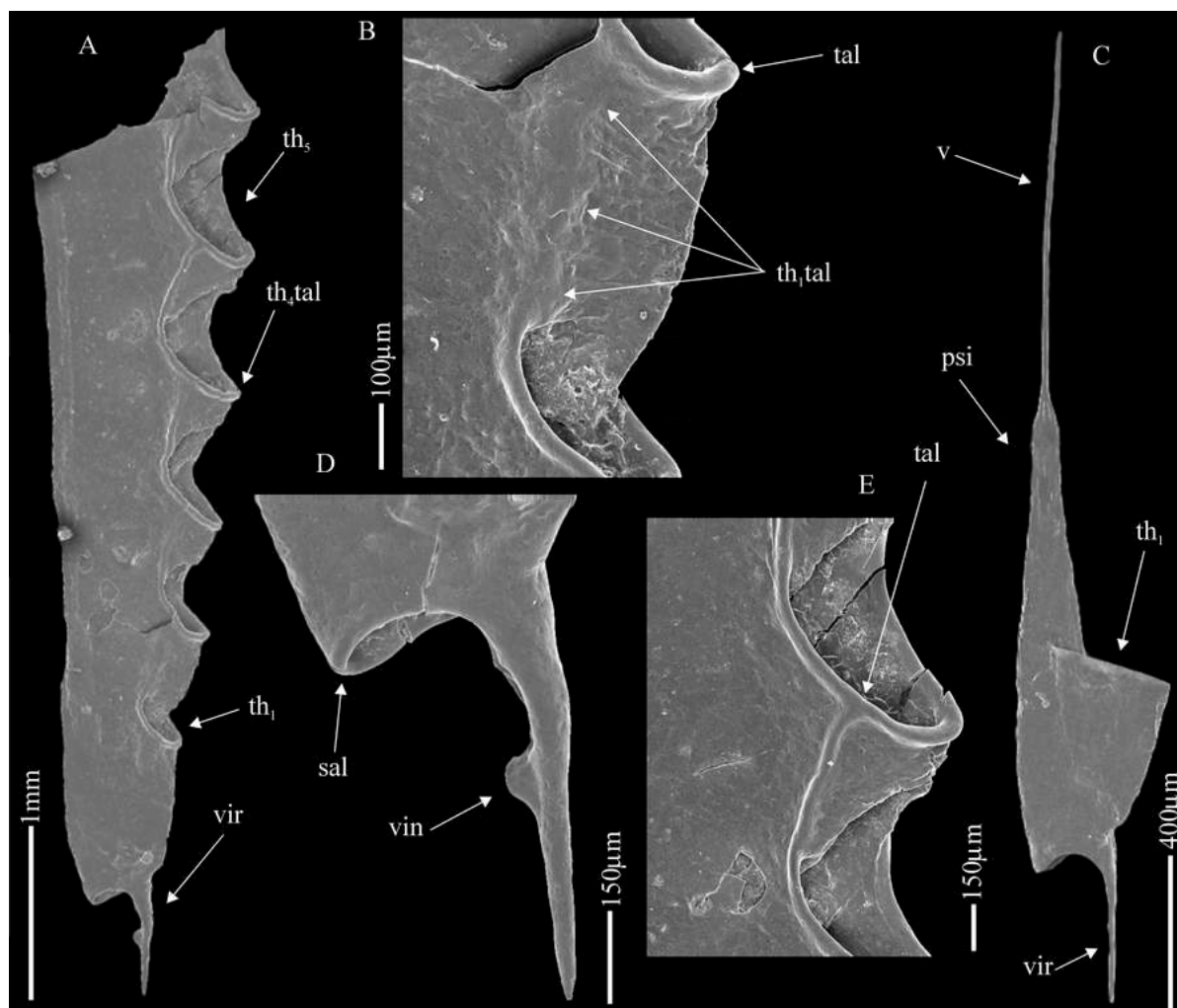
**Derivation of name.** Temporary designation pending additional confirmation of the ubiquity and persistence of the characteristics defining the variety.

**Material.** About 25 rhabdosomes and additional fragments from the Parovėja-9 borehole, depth 605.25-590.5 m.

**Description.** The rhabdosome is robust and straight, although some specimens show ventral curvature proximally. L is >11.5mm. The collection includes only one complete specimen (Fig. 5 B). The rhabdosome widens gradually from 0.8mm at  $th_1$ , to 0.9mm at  $th_2$ , 1mm at  $th_3$ , and 1.2mm at  $th_4$ .  $W_{max}$  is 1.7mm. The minimum W (= inter-apertural width) is 0.55mm at  $th_1$ , 0.65mm at  $th_2$ , 0.85mm at  $th_3$ , 0.95mm at  $th_4$ , and 1.05mm at  $th_5$ . There are 5-5.5 thecae in 5mm. Thecae are cylindrical.  $Th_1$  is 1mm long. The free part of each theca is half of its whole length. The thecal apertural lip is distinct (Fig. 5 A-B & G) and connects with that of the succeeding theca (Fig. 6 A) except apparently in  $th_1$  and  $th_2$  (Fig. 6 B) although it may have been obscured in these thecae by overgrowth of cortical tissue. The apertural lip connection is particularly obvious in the medial and distal portions of the rhabdosome (Fig. 7). The thecae are inclined at 30° to the virgella. The sicula is short and narrow. Its L is 1.8mm and apertural W is 0.4mm. The apex of the sicula reaches the base of  $th_3$ .  $Th_1$  rises 0.1mm above the aperture. The aperture is concave in profile view. The virgella is short, up to 0.6mm long. In one specimen there is a thickened protrusion (Fig. 5 A & G, 6 D).

**Comparison.** *Pristiograptus dubius* var. "A" differs from *P. pseudodubius* (= *P. parvus*), *P. dubius dubius* and *P. dubius* var. "B" in the connection of the thecal apertural lip to the succeeding theca. In *P. dubius dubius* and *P. dubius* var. "B" the thecal apertural lip does not reach the middle of the free ventral wall of the succeeding theca and in *P. pseudodubius* it reaches only the middle of the free ventral wall of the succeeding theca. Also, *P. dubius* var. "B" differs from *P. dubius* var. "A" in its longer virgella - 1.35 mm, as compared with 0.6 mm. The width of *P. dubius* var. "B" does not exceed 1.1 mm at  $th_{4-5}$ .

**Association.** *P. dubius* var. "A" is found with *Cyrtograptus perneri* (BOUČEK), *Monograptus flemingii flemingii* (SALTER), *Monoclimacis flumendosae* (GORTANI), *P. pseudodubius* (BOUČEK) (= *P. parvus*) and *P. sp.*



**Figure 6:** A-C *Pristiograptus dubius* var. "A", Parovėja-9 borehole, depth 605.25m; A-B & D-E - S.P9-214, A - proximal end: view of rhabdosome, virgella (vir),  $th_1$  ( $th_1$ ), thecal apertural lip of  $th_4$  ( $th_4tal$ ),  $th_5$  ( $th_5$ ); B -  $th_1$  and  $th_2$ , note unclear apertural lip of the first theca on the second theca ( $th_1tal$ ); D - the virgella with a small protrusion in the middle (vin) and the lip of the sicular aperture (sal); E - thecal apertural lip of  $th_4$  joining that of  $th_5$  (tal); C - S.P9-215e, sicular with virgula (v), prosicula (psi), virgella (vir) and  $th_1$  ( $th_1$ ).

**Age and geographical distribution.** *P. dubius* var. "A" is widespread throughout northern Lithuania in the upper part of the Riga Formation, in the *perneri* Biozone of the Sheinwoodian Stage itself comprising the lower portion of a locally denominated entity, the Jaagarahu regional Stage.

### *Pristiograptus dubius* var. "B"

Fig. 8 A-G, 9 A-D

**Type.** No. S.P222-229, fig. 8 A, Paežeriai-222 borehole, depth 730m, *Cyrtograptus lundgreni* Biozone.

**Derivation of name.** Temporary designation pending additional confirmation of the ubiquity and persistence of the characteristics defining the variety.

**Material.** About 20 rhabdosomes and additional fragments from Paežeriai-222 borehole, depth 734.5-730m, Likėnai-396 borehole, depth 577.0-605.9m, Šiupyliai-69 borehole, depth 1007.0m.

**Description.** The rhabdosome is straight and narrow. L is >12.5mm. The collection includes only one complete specimen (Fig. 9 A). W is 0.7mm at  $th_1$ , 0.75mm at  $th_2$ , 0.85mm at  $th_3$ , 0.95mm at  $th_4$ , and 1mm at  $th_5$ .  $W_{max}$  is 1.1mm. The minimum, inter-apertural width is 0.5mm at  $th_1$ , 0.6mm at  $th_2$ , 0.75mm at  $th_3$ , 0.8mm at  $th_4$ , and 0.9mm at  $th_5$ . There are 5-5.5 thecae in 5mm. The free part of each theca is half of its entire length. The thecal apertural lip is distinct (Fig. 8 A-B), extending onto the ventral wall of the succeeding theca, but not reaching its apertural lip (Fig. 9 A), but ending midway up the ventral wall (Fig. 9 C). Thecae are inclined at 30° to the virgula. The sicula is 2mm long and its apertural width is 0.35mm. The apex of sicula is at approximately the level of the apertural lip of  $th_2$ .  $Th_1$  arises 0.2mm

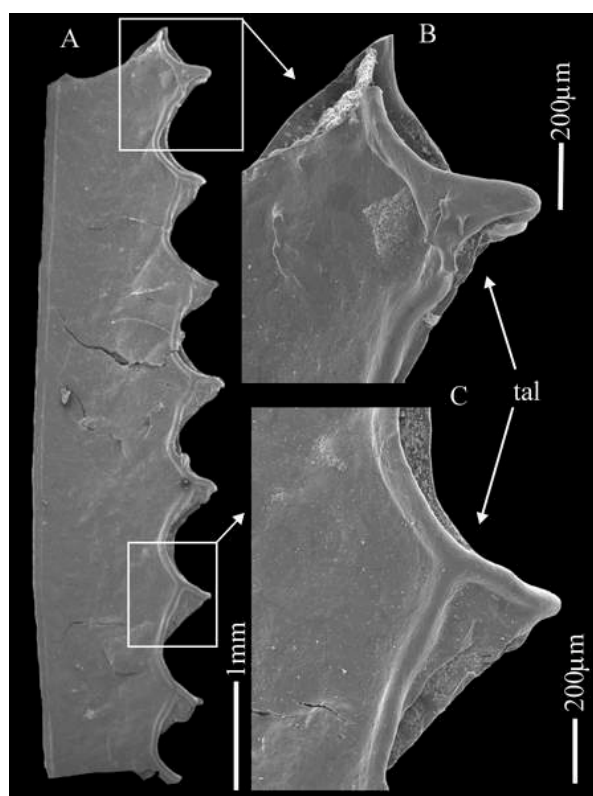


above the sicular aperture. The virgella is long (1.35 mm) and narrow (Fig. 9 D).

**Comparison.** See under *Pristiograptus dubius* var. "A".

**Association.** *Pristiograptus dubius* var. "B" is found with *Monograptus flemingii flemingii* (SALTER), *M. f. compactus* ELLES et WOOD, *M. testis testis* (BARRANDE), *M. t. inornatus* ELLES, *Pristiograptus pseudodubius* (BOUČEK) (= *P. parvus*), *Monoclimacis flumendosae* (GORTANI), *Cyrtograptus lundgreni* TULLBERG, *Paraplectograptus tenuis* (EISENACK) and *Eisenackograptus eisenacki* (OBUT et SOBOLEVSKAYA).

**Age and geographic distribution.** *Pristiograptus dubius* var. "B" is widespread throughout central and western Lithuania. It is found in the *lundgreni* Biozone of the Lower Homerian Stage within the Jaagarahu regional Stage which spans the upper part of the Riga Formation and the overlying Birštonas Formation.



**Figure 7:** A-C *Pristiograptus dubius* var. "A", Parovėja-9 borehole, depth 605.25m, S.P9-214a; A - general view of medial part of rhabdosome; B-C - connection of thecal apertural lip to the apertural lip of the succeeding theca (tal).

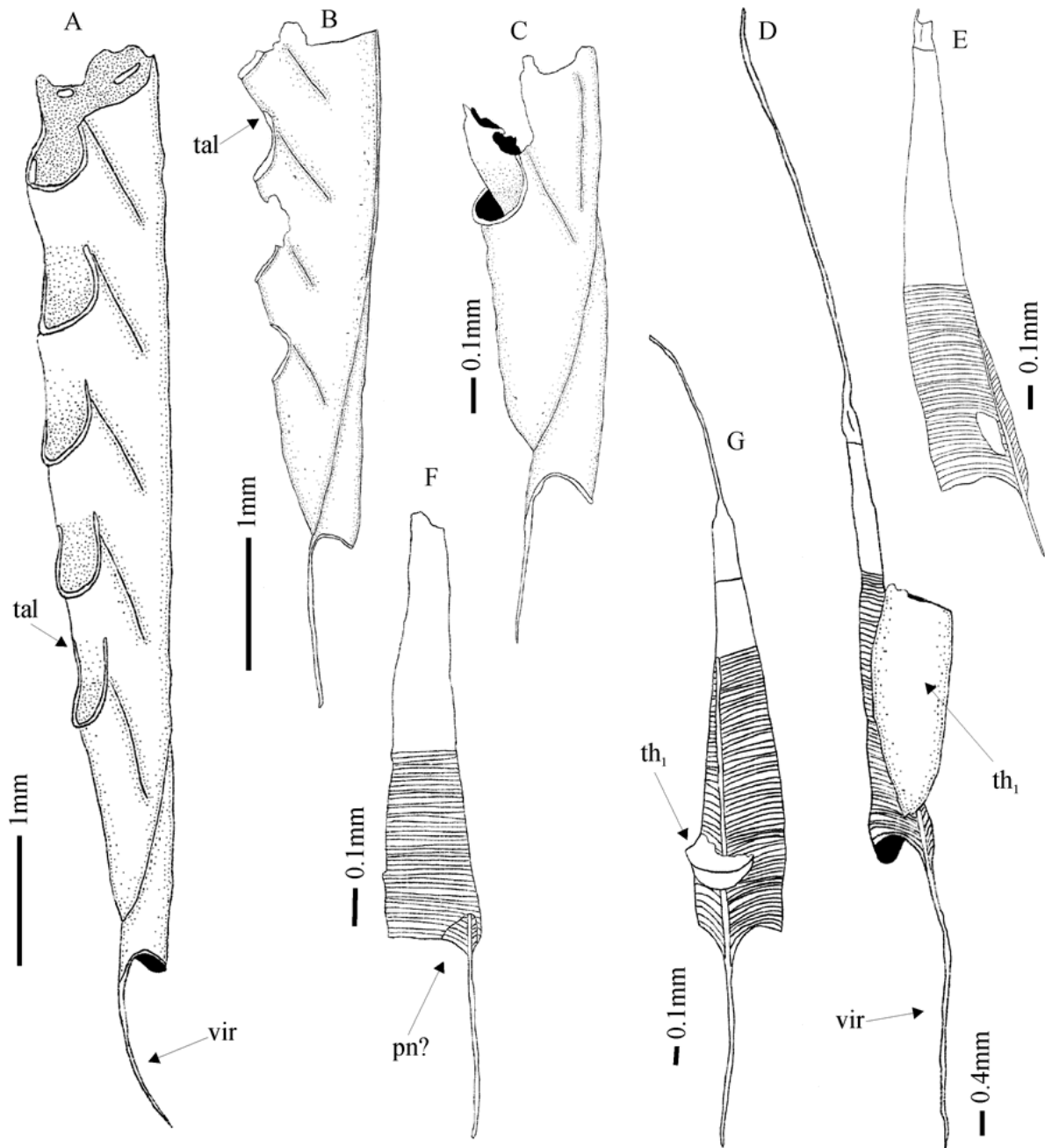
## *Pristiograptus* sp.

Fig. 10 A-E

**Material.** One specimen, no S.P9-219, from the Parovėja-9 borehole, depth 595.4m; rhabdosome with  $th_{1-8}$ .

**Description.** The rhabdosome is straight, massive. L is >11.1mm. The rhabdosome widens gradually. W is 0.8mm at  $th_1$ , 1mm at  $th_2$ , 1.1mm at  $th_3$ , 1.3mm at  $th_4$ , and 1.4mm at  $th_5$ .  $W_{max}$  is 1.6mm. The interapertural width is 0.57mm at  $th_1$ , 0.68mm at  $th_2$ , 0.73mm at  $th_3$ , 0.91mm at  $th_4$ , and 0.91mm at  $th_5$ . There are 5-5.5 cylindrical thecae in 5mm.  $Th_1$  is 1.6mm long. The free portion of each theca is equal to half of its length. The thecal apertural lip is distinct (Fig. 10 B), extending over the free part of the succeeding theca and connecting with its apertural lip (Fig. 10 A). This connection is easily discernible in the medial and distal parts of the rhabdosome.  $Th_1$  and  $th_2$  either do not have such thecal apertural lip connections or they are covered by cortical tissue (Fig. 10 D). The thecal apertural lip bifurcates (Fig. 10 D) a feature well developed in the distal part of the rhabdosome. An intergrowth arch is well developed especially in the proximal part of the rhabdosome (Fig. 10 C). The distance between the thecal apertural lip connection on the succeeding theca and the origin of its bifurcation is 0.25mm for  $th_1$  and  $th_2$ , and 0.35mm for  $th_3-5$ . Thecae are inclined at  $30^\circ$  to the virgula. The sicula is short and narrow, 2mm long with an apertural width of 0.4mm. The apex of the sicula reaches the base of the  $th_2/th_3$  intertheal septum.  $Th_1$  arises 0.15mm above the sicular aperture. The sicular aperture is strongly concave in profile view (Fig. 10 E). The virgella is thick and short (Fig. 10 E), 0.74mm long.

**Comparison.** *Pristiograptus* sp. differs from *P. pseudodubius* (= *P. parvus*), *P. dubius dubius*, and *Pristiograptus dubius* var. "A" in the length and form of the thecal apertural lip in its connection with the succeeding thecal apertural lip. The thecal apertural lip of *Pristiograptus* sp. extends over the free part of the succeeding theca and connects with its apertural lip. In *P. dubius dubius* and *P. dubius* var. "B" the extension of the thecal apertural lip does not attain the middle of the free part of the succeeding theca. In *P. pseudodubius* the extension reaches the middle of the free portion of the succeeding theca. *P. sp.* differs from *P. dubius* var. "A" in that the thecal apertural lip bifurcates in the middle of the free part of the succeeding theca. *P. dubius* var. "A" lacks such a bifurcation.

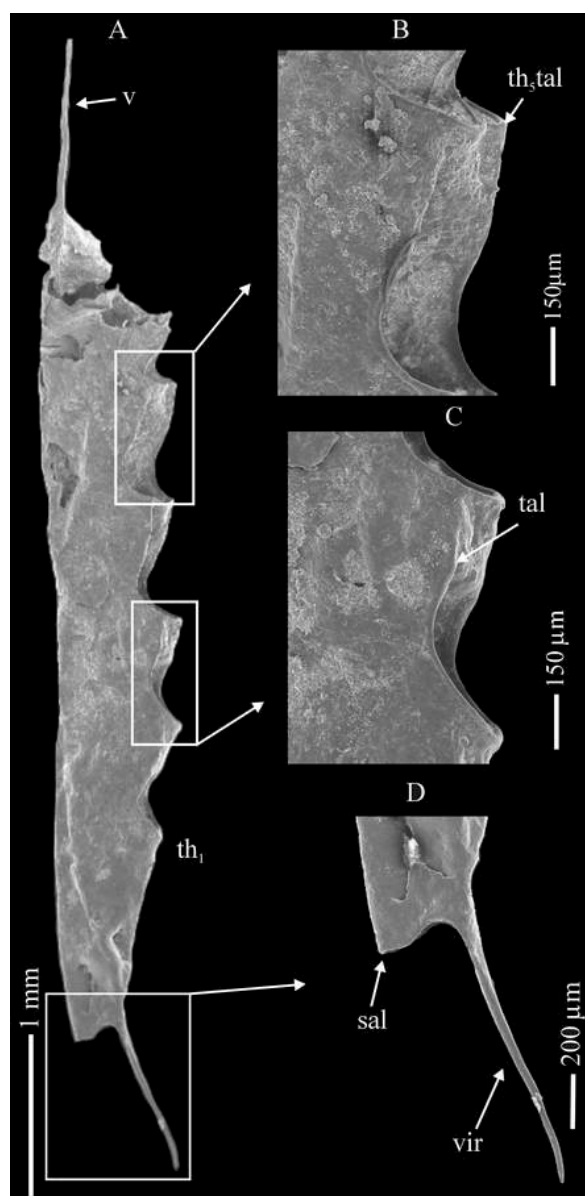


**Figure 8: A-G** *Pristiograptus dubius* var. "B". **A** - S.P222-229, type, virgella (vir), the end of the thecal apertural lip (tal), Paežeriai-222 borehole, depth 730m; **B** - S.L396-218a, proximal part of rhabdosome with the end of the thecal apertural lip (tal), Likėnai-396 borehole, depth 605.9m; **C** - S.S69-228a, sicula with  $th_1$  and  $th_2$ , Šiupyliai-69 borehole, depth 1007m; **D** - S.P222-217a, sicula with long virgella (vir) and  $th_1$ , Paežeriai-222 borehole, depth 734.5m; **E** - S.L396-231a, sicula, Likėnai-396 borehole, depth 577m; **F** - S.P222-230a, sicula with possible open primary notch (pn?), Paežeriai-222 borehole, depth 730m; **G** - S.L396-231b, sicula with incomplete  $th_1$ , Likėnai-396 borehole, depth 577m.

**Association.** *Pristiograptus* sp. is found with *Cyrtograptus perneri* (BOUČEK), *Monograptus flemingii flemingii* (SALTER), *Monoclimacis flumendosae* (GORTANI), *Pristiograptus pseudodubius* (BOUČEK) (= *P. parvus*), and *P. dubius* var. "A".

**Age and geographic distribution.** *Pristiograptus* sp. is recorded only from the Parovėja-9 borehole, northern Lithuania, in the *perneri* Biozone of the Sheinwoodian Stage.

*Pristiograptus lodenicensis* was investigated by RADZEVIČIUS and PAŠKEVIČIUS (2000). The data in the accompanying table are unchanged from that presentation. But new pictures and photos improve the appreciation of their significance.



**Figure 9: A-D** *Pristiograptus dubius* var. "B", P.P222-216, Paežeriai-222 borehole, depth 734.5m. **A** - general view of proximal portion of a rhabdosome with virgella (v) and  $th_1$  ( $th_1$ ); **B** - apertural lip of  $th_5$  ( $th_5tal$ ); **C** - end of the thecal apertural lip of  $th_2$  (tal); **D** - sicula aperture with dorsal lip (sal) and long virgella (vir).

***Pristiograptus lodenicensis* group,  
RADZEVIČIUS et PAŠKEVIČIUS, 2000**

**Type species.** *Pristiograptus lodenicensis* PŘIBYL, PŘIBYL, 1943, p. 21, pl. 1, figs. 4 & 6, *Cyrtograptus lundgreni* Biozone, Wenlock, Silurian of Lodenice-Budovice (Czech Republic).

**Diagnosis.** The rhabdosome is massive. The proximal end is straight or ventrally curved up to  $th_4$  or  $th_5$ . Thecae are uniform and widen towards their apertures, which show small depressions centrally. Thecal apertures are perpendicular to the rhabdosomal axis. The sicula is small and conical with a slender, short

virgella.

**Remarks.** All species not belonging to the *dubius* group, including *P. lodenicensis*, were previously assigned to the *vulgaris* group (PŘIBYL, 1943). Subsequently, *P. vulgaris* (WOOD) was synonymised with *P. ludensis* (MURCHISON), so this group must be renamed. The taxonomic position of the *lodenicensis* group is not clear because *P. lodenicensis* is not a typical *Pristiograptus*. The thecae are similar to those of *Colonograptus* (e.g. *Colonograptus gerhardi* (KÜHNE)), differing only in the lesser curvature of the lip of the thecal aperture, as is also the case with *Pseudomonoclimacis* (e.g. *Pseudomonoclimacis latilobus* (TSEGELNIUK)) and *Monograptus massai* JAEGER, the latter recorded from the Ludlow of NW Libya. This Libyan species can be assigned the *lodenicensis* group as it possesses a typical *Pristiograptus* sicula.

**Age and geographic distribution.** The *lodenicensis* group is known from the *lundgreni* Biozone of Lithuania, Latvia, the Czech Republic and Poland.

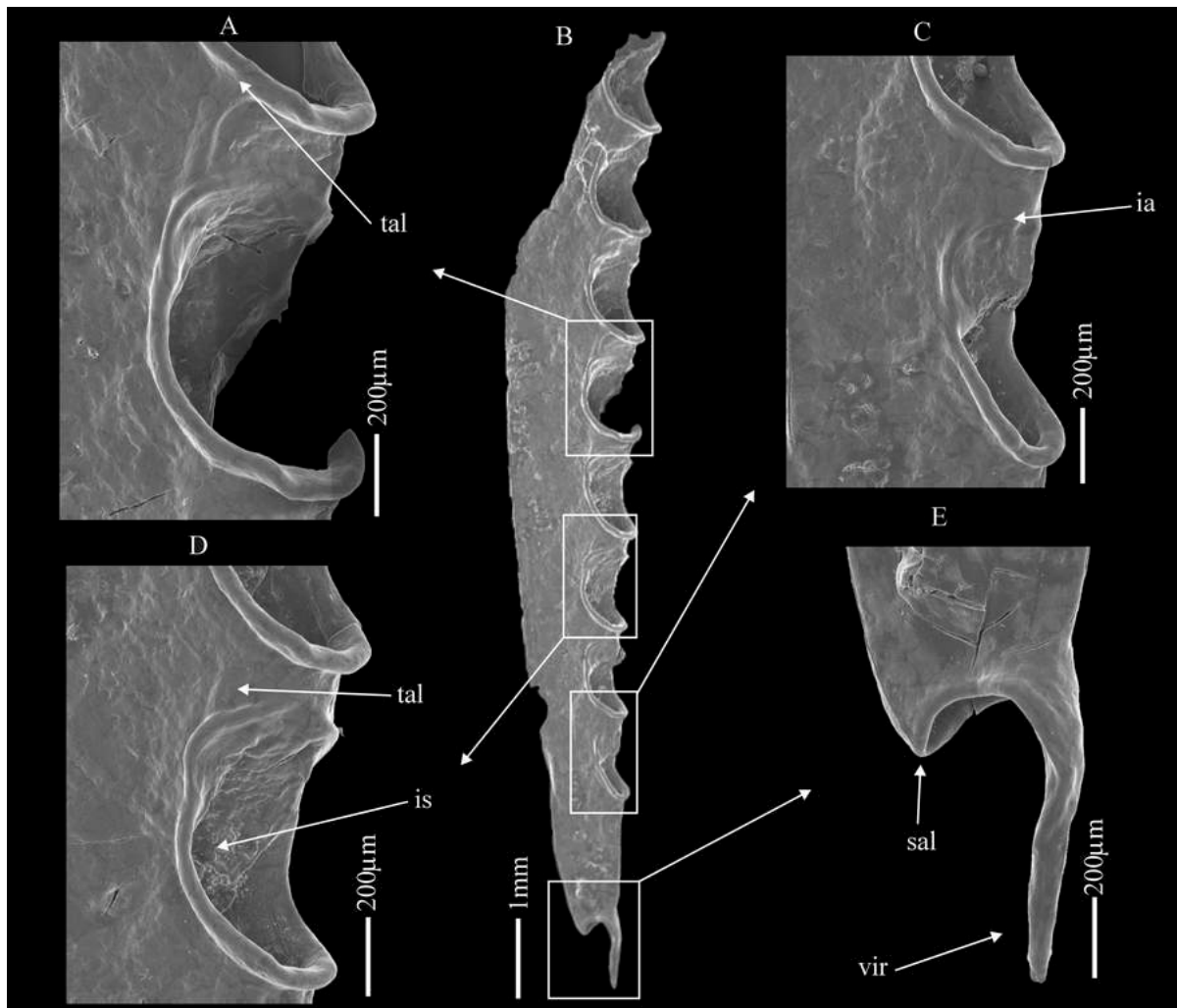
***Pristiograptus lodenicensis* PŘIBYL  
(1943)**

Fig. 11 A-H, 12 A-F

- 1943 *Pristiograptus lodenicensis* PŘIBYL; p. 23-24, text-figs. C-D & J-K; pl. III, figs. 8-11;
- 1952 *Pristiograptus lodenicensis* PŘIBYL; MÜNCH: p. 91, pl. 20, fig. 7;
- 1967 *Pristiograptus lodenicensis* PŘIBYL; KOREN and ULST in GAILITÉ *et alii*: p. 244, text-fig. 58; pl. XXIX, figs. 4-5;
- 1974 *Pristiograptus lodenicensis* PŘIBYL; ULST: p. 115, pl. XIII, figs. 1-2.a-b; pl. XI, fig 7;
- 2000 *Pristiograptus lodenicensis* PŘIBYL; RADZEVIČIUS and PAŠKEVIČIUS: p. 97-98, pl. IV, figs. 1.a-c, 2.a-c; pl. VI, fig. D.

**Holotype.** *Pristiograptus lodenicensis* PŘIBYL, 1943. Plate I, fig. 2. Upper Wenlock (Homerian stage), *Cyrtograptus lundgreni* Biozone.

**Material.** About 50 rhabdosomes and fragments from the Kurtuvenai-161, Likėnai-396 and Parovėja-9 boreholes. Some specimens from Parovėja-9 were chemically prepared.

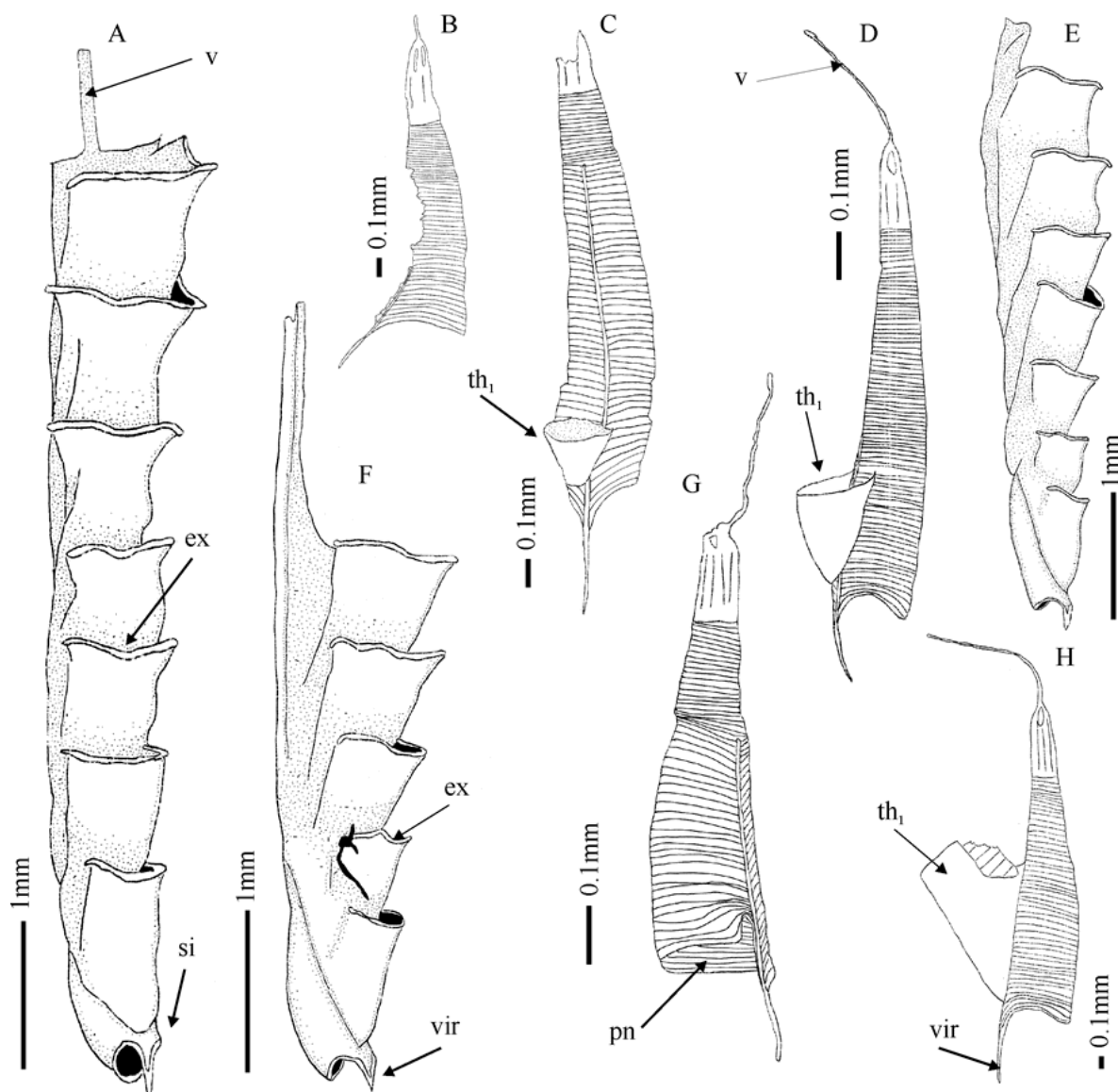


**Figure 10:** *Pristiograptus* sp., Parovėja-9 borehole, depth 595.4m, S.P9-219; **A** - thecal apertural lip joins succeeding theca's apertural lip (tal); **B** - proximal part of rhabdosome; **C** - intergrowth arch of  $th_1$  (ia); **D** - intergrowth arch of  $th_3$ , interthecal septum (is) and unclear thecal apertural lip on succeeding theca (tal); **E** - thick virgella (vir) and sicular apertural lip (sal).

**Description.** The rhabdosome is straight, massive; the proximal end of some specimens is slightly curved ventrally as far as  $th_4$  or  $th_5$ . L is at least 30mm. W is 0.7mm at  $th_1$ , 0.8mm at  $th_2$ , 0.9mm at  $th_3$ , 1mm at  $th_4$ , and 1.2 mm at  $th_5$ .  $W_{max}$  is normally 1.5mm but may reach 2mm by  $th_{16-18}$ . The inter-apertural width is 0.55mm at  $th_1$ , 0.6mm at  $th_2$ , 0.7mm at  $th_3$ , 0.85mm at  $th_4$ , and 0.9mm at  $th_5$ . Thecae are uniform, slightly curved, and widen towards the aperture. The apertural lips of symmetrically flattened thecae form an acute angle ( $\beta$ ) with the succeeding thecae. Thecae of specimens possessing relief are slightly different. They are slightly curved, widening towards the aperture, which shows (Fig. 11) a small ventral depression and curvature at the connection with the succeeding theca (Fig. 12 B & D-E). Overall, thecal apertures are perpendicular to the rhabdosomal axis.  $Th_1$  is 0.9-1mm long, and overlaps for 1/3-1/2 of its length. Thecae are inclined to the rhabdosomal axis at an angle 29-32°. The sicula is small, 1.2-1.5mm long, and

0.25-0.3mm wide aperturally (Fig. 12 F). It is slightly curved ventrally. The sicular apex attains a level between the middle and the top of  $th_2$ .

**Comparison.** *P. lodenicensis* differs from all *dubius* types of *Pristiograptus* in the existence of a depression in the central part of the aperture and in the angle of the aperture that overall is perpendicular to the rhabdosomal axis, whereas in the *dubius* group this angle ( $\beta$ ) is always obtuse. The thecae of *P. lodenicensis* are conical while those of the *dubius* group are cylindrical. The thecae of *P. virbalensis* are square in cross-section. *P. lodenicensis* differs from *P. deubeli* in the greater curvature of the thecal apertures and in *P. deubeli* only the apertures of  $th_1$ - $th_4$  are curved.



**Figure 11:** *Pristiograptus lodenicensis* PŘIBYL, all specimens from the Parovėja-9 borehole, **A** - P.P9-5, rhabdosome with virgula (v) and sícula (si); there is a small depression of the thecal apertural lip of  $th_3$  (ex), depth 558.3m; **B** - P.P9-208a, sícula, depth 558.3m; **C** - P.P9-202a, sícula with beginning of  $th_1$  ( $th_1$ ), depth 547.7m; **D** - P.P9-202b, sícula with incomplete  $th_1$  ( $th_1$ ) and virgula (v), depth 547.7m; **E** - P.P9-6, proximal part of rhabdosome, depth 561.9m; **F** - P.P9-1,  $th_1$ - $th_5$ , with a small depression on the apertural lip of  $th_2$  (ex) and a virgella (vir), depth 561.9 m; **G** - P.P9-208b; sícula with open primary notch (pn), depth 558.3m; **H** - P.P9-208c sícula, virgella (vir) and  $th_1$  ( $th_1$ ), depth 558.3m.

**Association.** *P. lodenicensis* is found with *Monograptus flemingii flemingii* (SALTER), *M. f. compactus* ELLES et WOOD, *M. testis testis* (BARRANDE), *M. t. inornatus* ELLES, *Pristiograptus pseudodubius* (BOUČEK) (= *P. parvus*), *Monoclimacis flumendosae* (GORTANI), *Cyrtograptus lundgreni* TULLBERG, *Paraplectograptus tenuis* (EISENACK) and *Eisenackograptus eisenacki* (OBUT et SOBOLEVSKAYA).

**Age and geographic distribution.** *P. lodenicensis* is widespread in the East Baltic area: (Lithuania, Latvia). It is found in the

upper part of Riga Formation and in the Birštonas Formation, in the *lundgreni* Biozone of the Homarian Stage, Jaagarahu regional Stage. *P. lodenicensis* is also found in the Czech Republic, and Poland.

### Acknowledgements

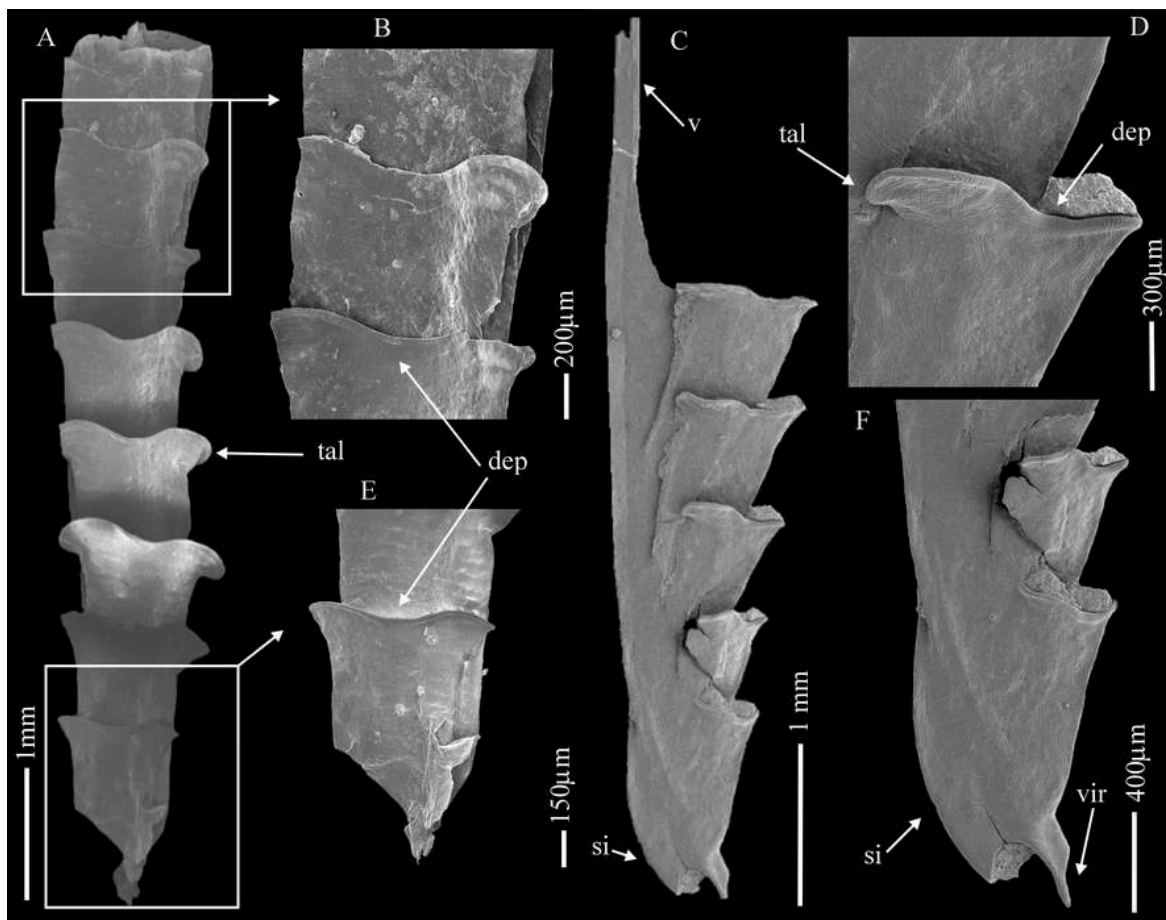
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**Figure 12:** A-F *Pristiograptus lodenicensis* PŘIBYL, A-B & E - S.P9-211a, depth 558.3m, medial part of rhabdosome with thecal apertural lip (tal); B & E - depression of thecal apertural lip (ex); C-D & F - P.P9-1, depth 561.9m; C - th<sub>1</sub>-th<sub>5</sub> with sicula (si) and virgula (v); D - thecal apertural lip of th<sub>3</sub> (tal) and its depression (ex); F - th<sub>1</sub>-th<sub>2</sub>, with sicula (si) and virgella (vir).

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