A C T A P A L A E O N T O L O G I C A P O L O N I C A

Vol. IV 1959 No. 1

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STUDIES ON GRAPTOLITES
I. DEVELOPMENT AND STRUCTURE OF *PRISTIOGRAPTUS GOTLANDICUS* (PERNER)

Abstract. — This paper describes the astogeny and structure of *Pristiograptus gotlandicus* (Perner), etched from Silurian erratic boulders. This species differs from typical pristiograptids in certain characters of the thecal aperture whose morphological significance is discussed.

INTRODUCTION

During the winter of 1958, fairly numerous graptolite specimens were etched by the present writer from an erratic boulder collected in Czarnków, about 60 km NW of Poznań. The recovered graptolites proved conspecific with another form previously yielded by one of the dissolved boulders. Its development and structure could not, however, be studied until more adequate material had been obtained, on which it was identified as *Pristiograptus gotlandicus* (Perner).

The present paper has been written in the Institute of Palaeozoology of the Warsaw University and of the Polish Academy of Sciences, under the guidance of Professor Dr Roman Kozłowski, to whom the most sincere thanks are due. The writer also feels indebted to Professor Dr. O. M. B. Bulman (Cambridge) and to Dr. J. D. Lawson (Birmingham) for the help given in securing the necessary literature and comparative material. He also thanks Miss M. Czarnocka and Miss L. Łuszczewska for doing the photographs, and Mrs. J. Humnicka for the English translation of this paper.

MATERIAL AND STATE OF PRESERVATION

The investigated material has been obtained from two erratic boulders, numbered S. 120 (Rewal), and S. 162 (Czarnków). The boulder from Rewal has yielded only very few proximal parts which, owing to their characteristic form, could be referred to *Pristiograptus gotlandicus* (Perner). The Czarnków boulder contains a great abundance of fragments of rhabdosomes, apparently belonging to a ten or so of relatively long rhabdosomes. The boulder, most probably a concretion, about 20 × 10 cm

in size, consists of strongly argillaceous marl, of a grey-greenish colour. This concretion most likely belonged to the flat type. Numerous graptolites were discernible on the surface of the boulder (pl. I, fig. 1). After dissolution it yielded about 12 proximal parts fairly well preserved, and numerous distal fragments. The majority of specimens are more or less flattened, with the periderm strongly carbonized, not readily discoloured, partly decomposed and with the fusellar structure obscured. The details of the fusellar structure could, however, be studied on some of the better preserved specimens, particularly so under the microscope in light reflected from white background.

All the described and figured specimens are housed in the collection of the Palaeozoological Laboratory of the Warsaw University and of the Polish Academy of Sciences. Owing to great fragility, the specimen in text-pl. I, fig. 1 was lost, and in pl. II, fig. 1-2 damaged during attempt of mounting. To replace the damaged specimens vicarious preparations were made.

DESCRIPTION

Pristiograptus gotlandicus (Perner, 1899)
(pl. I-II; text-pl. I; text-fig. 1-3)

1890. *Monograptus* sp. Holm; G. Holm, Gotlands Graptoliter, p. 18-19, pl. 1, fig. 27-30.
1899. *Monograptus gotlandicus* Perner; J. Perner, Studie o českych graptolitech, p. 20-21, pl. 14, fig. 22.
1900. *Monograptus gotlandicus* Perner; E. M. R. Wood, The Lower Ludlow..., p. 460-461, pl. 25, fig. 7.
1910. *Monograptus* cf. *gotlandicus* Perner; G. L. Elles & E. M. R. Wood, Monograph of British Graptolites, p. 382-383, pl. 37, fig. 8, text-fig. 252.
1936. *Monograptus gotlandicus* Perner; B. Bouček, Graptolitová fauna..., p. 11-12, fig. 1 a-c.
1942. *Pristiograptus gotlandicus* (Perner); A. Münch, Die Graptolithenfauna..., p. 251, pl. 4, fig. 1-2.
1943. *Pristiograptus gotlandicus* (Perner): A. Přibyl, Revise zástupcu rodu Pristiograptus..., p. 23-24, pl. 2, fig. 5, fext-fig. 3-B.

Development of sicula and budding of first theca. — The study of the ontogeny of the sicula and budding of the first theca was made difficult by the bad state of preservation of most specimens. It was necessary to

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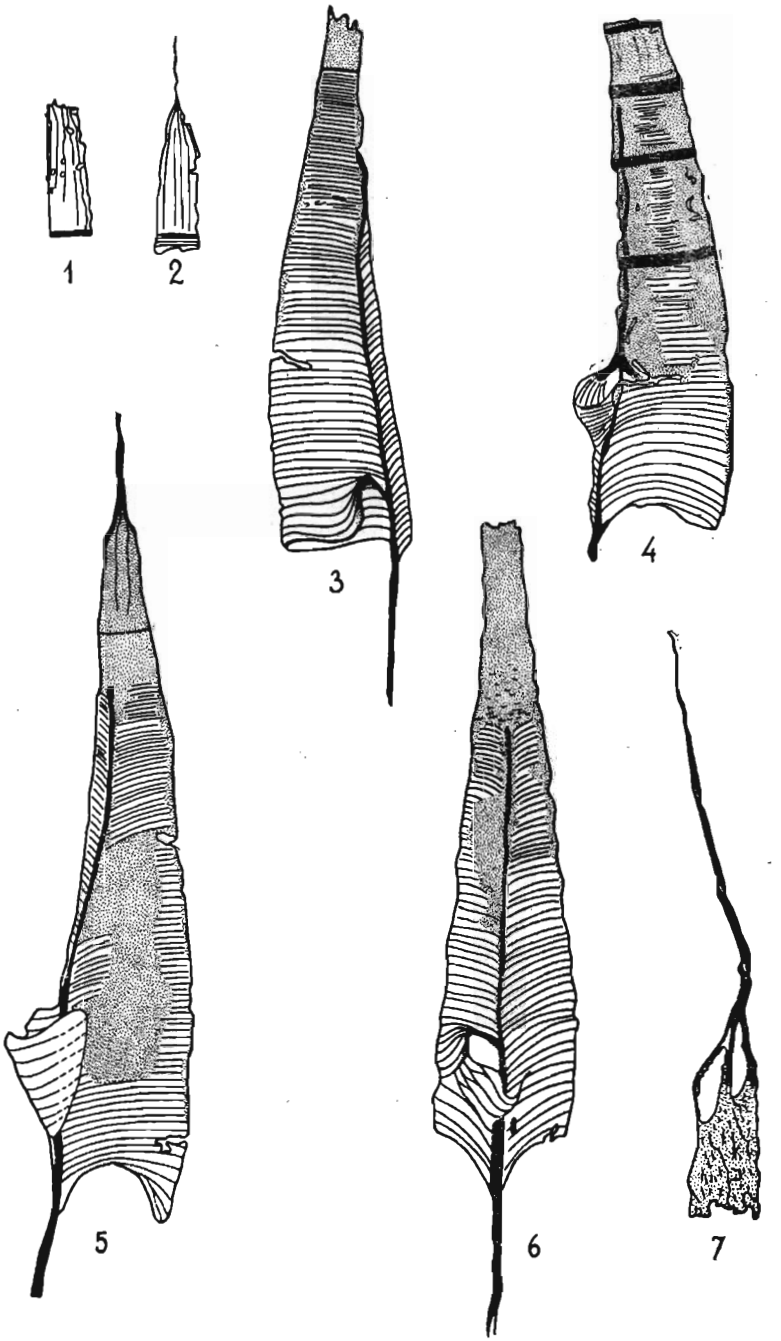
Ontogeny of sicula and budding of 1st theca: *1* young prosicula, *2* sicular fragment with complete prosicula provided with nema, *3* metasicula in sinus stage, *4* metasicula with peridermal rings, *5* complete sicula with fragmentary protheca of th1, *6* metasicula and earliest fuselli of protheca th1, showing zigzag suture, *7* apex of prosicula with distinct spirally coiled nema (S. 162. Czarnków); *1-6* × 43 approx., *7* × 80 approx.

TEXT—PL. I



Pristiograptus gotlandicus (Perner)

(explanations-see p. 12)

combine fragmentary specimens so as to be able to investigate details of fusellar structures indispensable for a full reconstruction of the ontogenic pattern (text-pl. I).

The length of prosicula varies from 0.36 to 0.44 mm. Frequently it displays a damaged apex at an early stage so characteristic of the monograptids (text-pl. I, fig. 1). A complete prosicula is discernible on a prosicular fragment of sicula (text-pl. I, fig. 2). It has distinct longitudinal ribs, while the helical line could not be detected. A typical form of the apex of the prosicula in an older individual is seen in text-pl. I, fig. 7, with secondarily thickened bands and nema distinctly spirally coiled.

Fig. 1 shows a young metasicula with a score or so of fuselli and the basal part of virgella which has been, as usually, formed on the zigzag ventral suture by the superposition of fuselli. In *Pristiograptus gotlandicus* the virgella forms early, about 0.12 mm from the aperture of prosicula. A more advanced stage of metasicula (sinus stage) is represented on text-pl. I, fig. 3. The earliest ontogenetic stages of protheca of the 1st theca are shown in text-pl. I, fig. 4-6. The assemblage etched from boulder S. 162 (Czarnków) contains, in addition to ringless metasiculae which predominate numerically, some forms provided with peridermal rings, too (text-pl. I, fig. 4). Since no other monograptids than the above described form have been found in this boulder, the ringed siculae probably belong to *Pristiograptus gotlandicus*. As in other graptolites, they seem to express certain intraspecific variability.

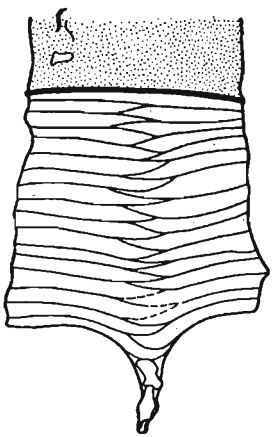


Fig. 1. — *Pristiograptus gotlandicus* (Perner), young metasicula with virgella basis (S. 162, Czarnków); ×195 approx.

Thus in *Pristiograptus gotlandicus* the development of sicula agrees with the monograptid type of ontogeny, ascertained in numerous graptolites.

A mature metasicula (text-pl. I, fig. 5) has the aperture provided with a relatively short and blunt dorsal lip. A mature sicula is nearly straight, 2.04-2.08 mm long, while the metasicula is up to 1.7 mm long. The aperture of the metasicula is about 0.32 mm in larger diameter.

Rhabdosome. — After the rhabdosomes had been etched, they broke up into smaller fragments, not exceeding 1 cm in length. The attached photograph showing unetched specimens on the rock surface gives, however, a fair idea of its general shape (pl. I, fig. 1). The longest fragment is about 65 mm. The rhabdosome is straight. Proximally 11-12 thecae in 10 mm, there being 5.5 thecae in the first 5 mm of the rhabdosome

length. Distally 10 thecae in 10 mm. The maximum rhabdosome height increases from 0.8 mm at the first thecae to about 2 mm in the better preserved distal parts, which have been measured. On data of other authors, both the length and width of mature rhabdosomes in *Pristiograptus gotlandicus* are considerable. G. Holm (1890) described a distal part 85 mm in length. The rhabdosome length of this species may reasonably be supposed to be at least 100 mm. The maximum width may attain 2.4 mm. as in Perner's holotype (B. Bouček, 1936, p. 11).

Thecae are essentially of the pristiograptid type, in shape resembling those of *Pristiograptus dubius* (Suess). Solely the presence of certain apertural differences distinguishes *P. gotlandicus* from typical pristiograptids. The thecae in the proximal part of the rhabdosome differ from those in distal part. They are diagrammatically illustrated in fig. 2.

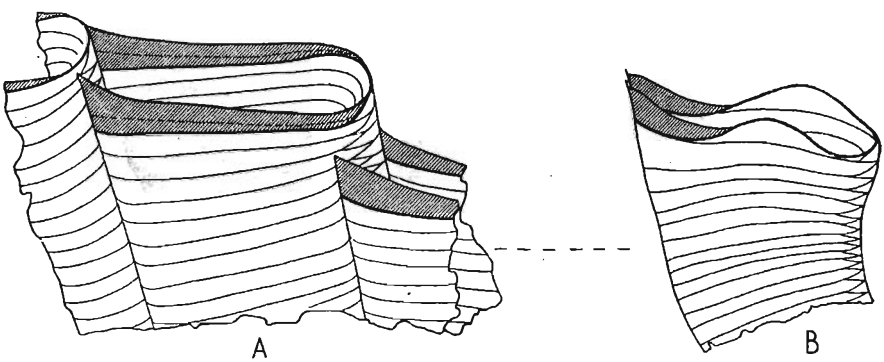


Fig. 2. — Diagram of fusellar structure in thecae: *A* distal, *B* proximal, in *Pristiograptus gotlandicus* (Perner); angular fusellus stippled.

In proximal thecae the apertures are initially smooth, but subsequently they are modified by the symmetrical addition of one fusellus on both sides of the aperture. This fusellus is arcuately curved and gently wedges out in both directions. It forms a small, wing-like lateral elevation on both sides of the aperture (fig. 3). Antero-medially, however, it forms a recess or depression. Most likely this is so because the two fuselli forming the wing-like apertural processes thin out here completely, probably without contacting at their oblique suture. Distally from both processes there are concavities (fig. 3), giving a characteristic outline to the aperture of the young proximal thecae. With further growth, however, these processes are no longer stressed by additional superposition of fuselli. Another change alters the shape of aperture. Namely, the concavity

occurring in the corner between the wing-like process of the apertural edge and the metatheca of the next theca is filled in by an accessory short fusellus. The writer suggests to call it the "angular fusellus". Thus, the wing-like apertural elevations of the aperture become more or less levelled. The aperture takes on a shape characteristic of older proximal thecae, i.e. nearly straight, with wing faintly indicated, and with the edge oblique to the longer axis of the rhabdosome, while the anterior edge of the aperture is incised (fig. 3 *B*).

The filling up of the distal depression by the angular fusellus probably followed soon on the completion of the proper growth of thecae. In a specimen of the 1st theca belonging to a young rhabdosome (stage th_2) this depression is partly filled in by the forming fusellus (fig. 3 *A*). Hence

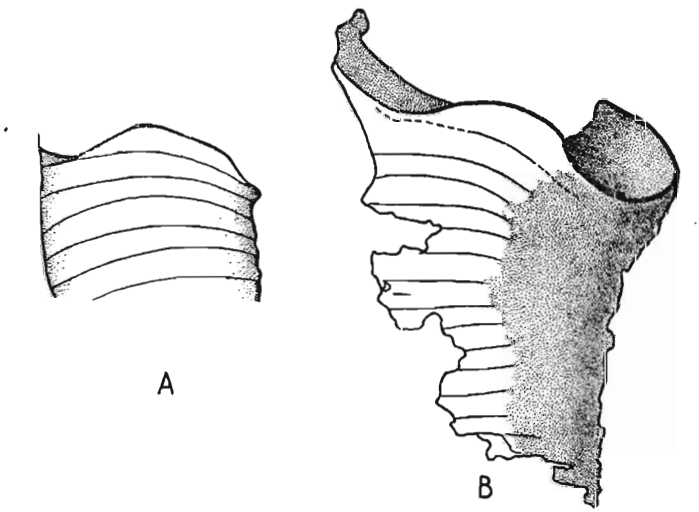


Fig. 3. — *Pristiograptus gotlandicus* (Perner), fusellar structure of apertural edges in a young (*A*) and more advanced (*B*) 1st theca (S. 162, Czarnków); × 75 approx.

the filling in process must have occurred together with the growth of the next theca. In older specimens the filling in has been completed (fig. 3 *B*). In gerontic thecae another fusellus was perhaps superimposed on the angular fusellus. This is suggested by the shape of aperture in some rhabdosomes being perfectly smooth and provided with the anterior apertural notch only.

Three up to five, no more, proximal thecae of the rhabdosome display this type of structure and its secondary modifications, while in others

the thecal pattern is more or less characteristic of the distal part of rhabdosome.

During their growth the distal thecae do not apparently form wing-like processes. Owing to strongly carbonized periderm, the writer has not been able to obtain satisfactorily discoloured apertural fragments of distal thecae; still this supposition is suggested on an analysis of the course followed by the noted fusellus and the shape of the apertural border. Even fairly young distal thecae have straight aperture edges without the slightest curvature which would indicate the presence of a wing-like process ascertained in proximal thecae. Hence it is inferred that initially these thecae have perfectly smooth and straight apertures. With matural growth the shape of the aperture is modified by the superimposition on its edge of one or two fuselli, probably analogous to the angular fuselli of proximal thecae (comp. fig. 2 *A*). However, it was not possible to ascertain beyond doubt whether the oblique sutures of these fuselli are in contact, though this seems quite probable. The edge of aperture which has been thus modified is oblique to the long axis of the rhabdosome, seemingly suspended high up on the walls of the next thecae (pl. II). Further growth of the aperture is sometimes noted, without, however, modifying the outline of the margin.

This shape of aperture in distal thecae, characteristic of *Pristiograptus gotlandicus,* has been frequently observed in forms occurring on the surface of rocks (G. Holm, 1890, p. 19; J. Perner, 1899, p. 21; E. M. R. Wood, 1900, p. 461). On the other hand, the majority of authors have failed to note the structure of proximal thecae in this state of preservation. Bouček, however, mentions that the edges of proximal thecae are "curved, but not to such an extent as in *M. colonus*" (1936, p. 11, Czech text.)[1].

Astogenetic changes in the structure of thecae are moreover expressed by increase of thecal length (height). Proximally the rhabdosome seems to grow in height more rapidly than distally. This is shown by the following measurements:

Rhabdosome height *(in mm)*

Thecae	Rhabdosomes		
	I	II	III
1	0.92	0.84	0.80
3	1.16	0.96	0.92
6	1.28	1.28	1.28?

[1] In the French text this remark is missing.

Likewise the ventral edges of apertures seem gradually to be slightly more spaced, as is suggested by the following measurements.

Distance between ventral edges of adjacent thecae *(in mm)*

Thecae	Rhabdosomes	
	I	II
1 — 2	0.72	0.68
2 — 3	0.72	0.72
3 — 4	0.76	0.70
4 — 5	0.76	0.76
5 — 6	0.80	0.80
6 — 7	0.80	—

In result of astogenetic changes the distal thecae take on the shape of long, rather slender tubules. While the second theca is 1.2 mm long, with the aperture 0.6 mm wide, the distal thecae measured on distal fragments of the rhabdosome are about 2.4 mm long, with the aperture about 0.88 mm in diameter. Thus the thecal length to the apertural width ratio changes from 2/1 to 3/1. According to Wood (1900) and Bouček (1936) in *Pristiograptus gotlandicus* this ratio may even be 5/1.

Faunal assemblage and stratigraphic range. — In boulder S. 120 (Rewal) this species is found in association with fairly numerous fragments of *Gothograptus nassa* (Holm), and with less numerous and badly preserved pristiograptid remains, probably referable to *Pristiograptus dubius* (Suess).

In boulder S. 162 (Czarnków) the accompanying fauna consists of *Retiolites* cf. *clathrospinosus* Eisenack and *Holoretiolites münchi* Eisenack. The form identified as *Retiolites* cf. *clathrospinosus* is satisfactorily preserved, but from the holotype (A. Eisenack, 1951, pl. 23, fig. 1) it differs in having rather smaller pores in reticula. If *Ret. clathrospinosus* Eisenack is conspecific with *Spinograptus spinosus* (Wood), as B. Bouček and A. Münch postulated (1952, p. 36), its occurrence may indicate the *Pristiograptus nilssoni* horizon as the probable age of the original matrix from which the boulder was derived. The specimens identified as *Holoretiolites münchi* consist of a fragmentary proximal part and of detached bifurcating processes, very characteristic of that species.

In neither of the mentioned cases does the associated fauna provide quite reliable evidence regarding stratigraphic horizon. The accompanying Retiolitidae are either stratigraphically widespread forms, or their stratigraphic range has not been definitely determined. Hence it seems reasonable to recognize the described form as also referable to one of the lower horizons of the Lower Ludlow (most probably the *P. nilssoni* horizon).

Pristiograptus gotlandicus (Perner) has thus far been described from Ludlovian beds of Gotland (Pterygotuslagret, grå kalk), Czechoslovakia (*P. nilssoni* horizon), Thuringia (*P. nilssoni* horizon), and the erratic

boulders of Poland. It has been reported from the Polish Holy Cross Mountains (*P. nilssoni* horizon), (H. Tomczyk, 1956).

Specific identification and comparison with allied forms. — The characteristic features of the here described form are the long, nearly straight rhabdosome, peculiar shape of proximal and distal thecae, and the considerable rhabdosome height. These features, together with dimensions of specimens, suggest that it is conspecific with *Pristiograptus gotlandicus* (Perner) — a species probably referable to the group of *P. vulgaris* (Wood), into which B. Bouček (1936) and A. Přibyl (1943) have included a number of Upper Wenlockian and Lower Ludlovian pristiograptids.

Only distal parts of this species were described by the ealier authors (Holm, 1890; Perner, 1899). The holotype is likewise a distal part of the rhabdosome. The oblique shape of the edge of aperture was at that time considered as the main index character of this species. Wood (1900) was the first to investigate the proximal part of the only one specimen in her possession. She established its specific position on the shape of the rhabdosome and structure of distal thecae which have the "aperture concave, apparently oblique to the direction of thecae" (p. 461). Bouček was the first to have at his disposal more copious material of this species, partly preserved in relief in limestones. He, too, emphasized the characteristic shape of proximal thecae (comp. p. 17). Later papers did not contain new morphological data. This species has, so far, been inadequately known. Its structure could not be thoroughly studied until specimens etched from erratic boulders were made available.

The relationship of *Pristiograptus gotlandicus* (Perner) to other Lower Ludlovian pristiograptids has not been elucidated. Its relation to *P. vulgaris* calls for a closer study of the last named form. On the whole — outside of thecal structure not definitely determined in *P. vulgaris* — these are closely allied forms. *P. kosoviensis* Bouček and *P. gotlandicus* are likewise exceedingly similar forms. The establishment of relationship between *P. gotlandicus* and *M. gerhardti* Kühne (W. G. Kühne, 1955), which is similar in outline of apertural border, needs better knowledge of the fusellar structure in that latter form.

Pristiograptus frequens Jaekel is not discussed here, because according to reliable opinion of Kühne (1955, p. 377), who examined the type specimens, it is partly a synonym of *Saetograptus chimaera* (Barr.) and partly that of *Pristiograptus dubius* (Suess).

MORPHOLOGICAL SIGNIFICANCE OF APERTURAL ACCESSORIES IN *PRISTIOGRAPTUS GOTLANDICUS* (PERNER)

In *Pristiograptus gotlandicus* the proximal thecae are a modification of the simple pristiograptid type of thecae, expressed mainly by the

formation of wing-like symmetric elevations of the apertural edge. To a certain extent they remind us of the differentiated apertures in Saetograptinae (A. Urbanek, 1958), particularly so those in *Colonograptus* (Přibyl). They may, perhaps, be regarded as initial apertural processes, built of one fusellus only, while the apertural processes in *Colonograptus* may have resulted from the progressive modifications of such initial structures. If so, Saetograptinae or at least *Colonograptus* may have derived from progressive pristiograptids with apertures initially differentiated, similarly as in *P. gotlandicus*. A similar conception has been briefly suggested by Wood (1900, p. 453) when she wrote that "the group of *M. colonus* and *M. chimaera* are probably only developments of that of *M. dubius*".

A thorough investigation of the fusellar structure in *Pristiograptus gotlandicus*, however, does not provide adequate evidence in support of this conception. The wing-like process of *P. gotlandicus* is invariably made up of one fusellus only, while that of *Colonograptus colonus* (Barr.), (fig. 4), which has been more closely studied, consists as a rule of 6 some-

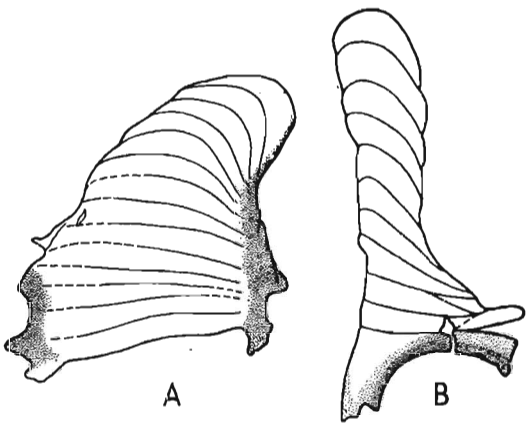


Fig. 4. — *Colonograptus colonus* (Barr.), fusellar structure of apertural process in 1st theca, lateral (*A*) and distal (*B*) views (S. 38, Jarosławiec); × 1l10 approx.

times even 9 fuselli. The monofusellar process of *P. gotlandicus* may, however, be regarded as an equivalent of the first basal fusellus of the apertural processes in *Colonograptus*. Still the shape and position of these fuselli differ. Distally, the basal fusellus of *C. colonus* (fig. 4) terminates with a fairly broad edge, curving postero-medially. Hence, observations of the fusellar course call for an inspection of the process on both sides. Proximally, it gradually thins out. All the fuselli that follow apparently converge on the anterior edge, forming a node (fig. *4 A*), as it has

previously been noted (Urbanek, 1958), while on the distal edge, medially curved, they terminate bluntly and abruptly as is shown in fig. 4 *B*. The fusellus in the process of *Pristiograptus gotlandicus*, on the other hand, thins out symmetrically on both sides (fig. 3 *B*). These two fuselli, though occurring in a similar position and both developing processes, do not seem to be homologous.

The correctness of this opinion is supported by the nature of post-matural and gerontic changes of the aperture in *P. gotlandicus*. Admitting that in *Colonograptus* the processes owe their formation to a gradual increase of the number of fuselli, in processes of the *P. gotlandicus* type this phenomenon closely resembles or is identical with the anabolia of A. N. Severtzoff (1931) and the hypermorphosis of G. R. de Beer (1954), or in the widest sense constitutes a certain ontogenetic acceleration in this evolutionary line. It ought then to be recognized that the gerontic ancestral characters resemble those occurring during the early ontogenetic stages of descendants. Hence the evolution here was in the nature of gerontomorphosis (de Beer, 1954, p. 90), i.e. that the shape of the aperture characteristic of mature ancestral stages persisted in descendants as a pre-mature feature. We do not, however, note here the addition of accessory fuselli to the initial fusellus of the process. On the contrary, with further growth *Pristiograptus gotlandicus* develops new features which may be regarded as "specializations" in this sense only that they do not occur in Saetograptinae. The formation of angular fusellus is, therefore, inexplicable and apparently contradicting the earlier hypothesis. The character of distal thecae is likewise an argument refuting this opinion. Namely, the angular fuselli present in distal thecae of *P. gotlandicus*, seem to be absent in representatives of *Colonograptus*.

Finally, the only one, thus far known representative of pristiograptids, with modified thecal structure, which may possibly be regarded as the ancestor of Saetograptinae, has been recorded from the *P. nilssoni* horizon, where it occurs together with highly developed forms of *Colonograptus* and *Saetograptus*. Hence it does not agree with the stratigraphic requirement justifying its being considered as the direct ancestor of this phyletic line.

It should be, however, stressed that the general shape and the mode of the formation of processes in *Colonograptus* resembles those in some Monograptinae, particularly so in forms provided with apertural lobes of the "hooked" type (*M. priodon*, *M. uncinatus*). In both these cases the mode of the formation of processes is very much alike. They are formed abruptly. The processes in the first theca have been definitely developed before the formation of the second protheca is completed. The postero--medial curvature of process in *Colonograptus* is not comprehensible, if its

pristiograptid ancestry be recognized, but may be reasonably accepted on the hypothesis that it is the vestige of a previously uniform apertural lobe. Hence, on the ground of supplementary evidence (Urbanek, 1958), the writer feels inclined to support the hypothesis of G. L. Elles (1922) that *Colonograptus* is a descendant of Monograptinae. The phyletic line, however, by Elles stated to lead to *Colonograptus* from forms with the "hooked" type of aperture, calls for revision, since it is based on the phylogenesis of "graptolite silhouettes", and has the value of a working hypothesis only. The origin of these elements will remain an open question until it has been possible to ascertain a continuous phyletic line connecting these two types of accessory apertural elements. So far, forms linking *Monograptus priodon* and *Colonograptus* are not known with any certainty. The absence of these transition forms, however, constitutes a distinct problem calling for separate studies.

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of the Polish Academy of Sciences
Warszawa, June 1958

REFERENCES

BEER, G. R. de. 1954. Embryos and ancestors. 9+159, Oxford.

BOUČEK, B. 1936. Graptolitová fauna českého spodního ludlowu. — *Rozpr. II Tř. Česke Akad. Ved.*, **46**, 16, 1-26, Praha.

BOUČEK, B. & MÜNCH, A. 1952. Retioliti středoevropskeho svrchniho wenlocku a ludlowu. — *Vestn. Ustř. Ust. Geol.* **19**, 1-54. Praha.

EISENACK, A. 1951. Retioliten aus dem Graptolithengestein. — *Palaeontographica*, C, Abt. A, **5/6**, 129-163, Stuttgart.

ELLES, G. L. & WOOD, E. M. R. 1901-1918. Monograph of British Graptolites, Pts. I-XI. — *Palaeontogr. Soc.*, **21**, 171+539, London.

ELLES, G. L. 1922. The graptolite faunas of the British Isles. A study in evolution. — *Proc. Geol. Assoc.*, **33**, 168-200, London.

HOLM, G. 1890. Gotlands Graptoliter. — *Bihang. K. Svenska Vet. Akad. Handl.*, **16**, 4, 7, 1-29, Stockholm.

KÜHNE, W. G. 1955. Unterludlow-Graptolithen aus Berliner Geschieben. — *N. Jb. geol. palaeont. Abh.*, **100**, 3, 350-401, Stuttgart.

MÜNCH, A. 1942. Die Graptolithenfauna des unteren Ludlow von Ronneburg und Umgebung. — *Beitr. Geol. Thüringen*, **6**, 5/6, 241-264, Jena.

PERNER, J. 1899. Studie o českých graptolitech, III, B. — *Palaeontogr. Bohemiae*, 1-38, Praha.

PŘIBYL, A. 1943. Revise zástupcu rodu Pristiograptus, ze skupiny P. dubius a P. vulgaris z českeho a čižiho siluru. — *Rozpr. II Tř. Česke Akad. Ved.*, **53**, 4, 1-48, Praha.

SEVERTZOFF, A. N. 1931. Morphologische Gesetzmässigkeiten der Evolution. After Russ. transl.: „Morfologičeskie zakonomernosti evolucii". Sobranie sočinenij, **V**, 1-535, Moskva, 1949.

TOMCZYK, H. 1956. Wenlok i ludlow w synklinie kieleckiej Gór Świętokrzyskich (Wenlock and Ludlow in the Kielce syncline of the Święty Krzyż Mts.). — *Inst. Geol., Prace*, **16**, 1-77, Warszawa.

URBANEK, A. 1958. Monograptidae from erratic boulders of Poland (Monograptidae z głazów narzutowych Polski). — *Palaeont. Pol.*, **9**, 1-105, Warszawa.

WOOD, E. M. R. 1900. The Lower Ludlow formation and its Graptolite-Fauna. — *Quart. J. Geol. Soc.*, **56**, 415-495, London.

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BADANIA NAD GRAPTOLITAMI
I. ROZWÓJ I BUDOWA *PRISTIOGRAPTUS GOTLANDICUS* (PERNER)

Streszczenie

W pracy opisano budowę i rozwój astogenetyczny *Pristiograptus gotlandicus* (Perner) na podstawie okazów, wypreparowanych metodami chemicznymi z dwu głazów narzutowych (S. 120 — z Rewala, woj. koszalińskie i S. 162 — z Czarnkowa, woj. poznańskie). Graptolit ten, opisany dotychczas z dolnego ludlowu wyspy Gotland, Czechosłowacji, W. Brytanii, Turyngii i Polski, był jednak słabo poznany pod względem morfologicznym. Rozwój astogenetyczny, wyjaśniony prawie kompletnie, reprezentuje normalny typ monograptidowy. Dorosła sikula jest prawie prosta i ma 2,04—2,08 mm długości. Prosikula ma 0,36—0,44 mm długości, metasikula zaś około 1,70 mm. Rabdozom jest prosty, przy czym w części proksymalnej na 10 mm przypada 11—12 tek. Wysokość rabdozomu waha się od około 0,80 mm przy pierwszej tece — do około 2,00 mm w pomierzonych częściach dystalnych.

Budowa tek, w zasadzie typu pristiograptusowego, odznacza się obecnością pewnych cech, odróżniających ten gatunek od typowych pristiograptusów (por. fig. 2).

Teki proksymalne (3—5 pierwszych tek) mają początkowo apertury gładkie, następnie zaś podlegają pewnej modyfikacji przez dodanie z obu stron apertury dodatkowego fuzellusa (fig. 3). Jest on łukowato wygięty i wyklinowuje się stopniowo w kierunku wentralnym i dorsalnym. Tworzy on rodzaj skrzydełkowatego wyniesienia, nadającego tekom charakterystyczny wygląd. W miarę dalszego wzrostu, wyniesienie to nie akcentuje się, a nawet ulega niwelacji przez pojawienie się w kącie dorsalnym wyrostka nowego krótkiego fuzellusa, który autor nazywa „kątowym". Nadaje to tekom proksymalnym postać definitywną.

Teki dystalne są pozbawione łukowato wygiętych fuzellusów. O ile można było ustalić, są one początkowo gładkie, następnie zaś przyjmują postać definitywną przez pojawienie się jednego lub dwu fuzellusów kątowych. Ścianki tek stają się przez to skośne w stosunku do osi rabdozomu, co stanowi charakterystyczną cechę tego gatunku. Różnice w budowie apertury tek proksymalnych i dystalnych ilustruje diagram (fig. 2).

Znaczenie opisanych tu zróżnicowań aperturalnych *Pristiograptus gotlandicus* (Perner) nie jest jasne. Można je traktować zarówno jako specjalną modyfikację tek typu pristiograptusowego, nie mającą związku z innymi typami apertury monograptusów, lub uważać za pierwsze stadia tworzenia się parzystych wyrostków aperturalnych Saetograptinae, zwłaszcza zaś typu *Colonograptus*.

Dokładne porównanie budowy fuzellarnej tych obu typów wyrostków aperturalnych skłania autora do przyjęcia pierwszej alternatywy. Zróżnicowania aperturalne *Pristiograptus gotlandicus* nie stanowiłyby zatem zaczątkowych wyrostków prowadzących do *Colonograptus*, ale byłyby raczej wyrazem specjalizacji typowych pristiograptusów. Wskazuje na to kształt ostatniego fuzellusa aperturalnego, obecność fuzellusów kątowych, a także występowanie *P. gotlandicus*, stwierdzane stale w poziomie *P. nilssoni*, obok przedstawicieli *Colonograptus*.

W obu zbadanych głazach, opisanemu tu gatunkowi nie towarzyszyły odpowiednie formy przewodnie, pozwalające ustalić poziom graptolitowy, z którego pochodziły głazy. Towarzyszące formy retiolitesowe wskazują jednak na dolny ludlow, jako najprawdopodobniejszy ich wiek.

OBJAŚNIENIA DO ILUSTRACJI

Fig. 1 (p. 14)

Pristiograptus gotlandicus (Perner), młoda metasikula z bazalną częścią wirgelli (S. 162, Czarnków); ca. × 195.

Fig. 2 (p. 15)

Diagram przedstawiający budowę fuzellarną apertury tek: *A* dystalnych, *B* proksymalnych, u *Pristiograptus gotlandicus* (Perner); fuzellusy kątowe zakreskowano.

Fig. 3 (p. 16)

Pristiograptus gotlandicus (Perner), budowa fuzellarna krawędzi apertury. *A* młodej i *B* starszej, teki pierwszej (S. 162, Czarnków); ca. × 75.

Fig. 4 (p. 20)

Colonograptus colonus (Barr.), budowa fuzellarna wyrostka aperturalnego teki pierwszej, widziana *A* lateralnie i *B* dystalnie (S. 38, Jarosławiec); ca. × 110.

Text-Pl. I (p. 13)

Pristiograptus gotlandicus (Perner), rozwój ontogenetyczny sikuli i pączkowanie pierwszej teki: *1* młoda prosikula, *2* fragment sikularny z kompletną prosikulą opatrzoną nemą, *3* metasikula w stadium sinus, *4* metasikula z pierścieniami perydermalnymi, *5* kompletna sikula z fragmentem proteki th_1, *6* metasikula i pierwsze fuzellusy proteki th_1 z widocznym szwem zygzakowatym, *7* wierzchołek prosikuli z widoczną nemą, wyraźnie spiralnie skręconą (S. 162, Czarnków); *1-6* ca. × 43, *7* ca. × 80.

Pl. I

Fig. 1. Fragment powierzchni narzutniaka S. 162 (Czarnków), przed rozpuszczeniem. Widoczne liczne okazy *Pristiograptus gotlandicus* (Perner); wielk. nat.

Fig. 2-3. *Pristiograptus gotlandicus* (Perner), proksymalna część rabdozomu, widziana *2* lateralnie i *3* wentralnie (S. 162, Czarnków): ca. × 12.

Fotografie retuszowane.

Pl. II

Pristiograptus gotlandicus (Perner): środkowa część rabdozomu, widziana *1* lateralnie i *2* wentralnie; dystalna część rabdozomu, widziana *3* lateralnie i *4* wentralnie (S. 162, Czarnków); ca. × 12.

Fotografie retuszowane.

АДАМ УРБАНЭК

РАЗВИТИЕ И СТРОЕНИЕ *PRISTIOGRAPTUS GOTLANDICUS* (PERNER)

Резюме

В настоящей работе дано описание строения и астогенеза *Pristiograptus gotlandicus* (Perner), основанное на образцах отпрепарированных химическими методами из двух валунов (S. 120, из Реваля, Кошалинского воеводства, и S. 162, из Чарнкова, Познаньского воеводства). Этот граптолит, описанный до сих пор из нижнего лудлова острова Готланд, Чехословакии, Великобритании, Тюрингии и Польши, был однако морфологически мало изучен. Астогенетическое развитие, почти вполне выявленное, представляет нормальный монограптидовый тип. Развитая сикула — почти прямая, длина ее 2,04—2,08 мм. Просикула длиною 0,36—0,44 мм, а метасикула — около 1,70 мм. Рабдосома прямая, причем в проксимальной части на каждые 10 мм приходится 11-12 тек. Высота рабдосомы изменяется от около 0,80 мм при первой теке, до около 2,00 мм в измеренных дистальных частях.

Строение тек, в основном по пристиограптусовому типу, отличается проявлением известной дифференциации, отличающей этот вид от типичных пристиограптусов (ср. фиг. 2 *A*, *B*). Проксимальные теки (3-5 первых тек) обладают в начале гладкими апертурами, в последствии же подвергаются изменению путем прибавок по обеим сторонам апертуры добавочного фузеллюса (фиг. 3 *A*, *B*), который изгибается дугообразно и постепенно выклинивается в вентральном и дорсальном направлении. Образует он нечто в роде крылообразного возвышения, придавая текам характерный вид. По мере дальнейшего роста это возвышение не становится более отчетливым, а даже подвергается нивелировке вследствие появления в дорсальном углу отростка нового короткого фузеллюса, который автор называет „угловым". Это придает проксимальным текам окончательный вид.

Дистальные теки лишены дугообразно изогнутых фузеллюсов. Поскольку возможно было установить, они первично гладкие, впоследствии же принимают

окончательный вид с появлением одного либо двух угловых фузеллюсов. Вследствие этого стенки тек становятся наклонными по отношению к оси рабдосомы, что является характерной чертой этого вида. Различия в строении апертуры проксимальных и дистальных тек иллюстрирует диаграмма (фиг. 2).

Значение описанной тут апертуральной дифференциации *Pristiograptus gotlandicus* (Perner) пока еще не является ясным. Можно ее рассматривать с одинаковым правом, как специальное видоизменение тек пристиограптусового типа, не имеющее связи с другими типами апертуры монограптусов, либо считать это как первую стадию парных апертуральных отростков Saetograptinae, в особенности же типа *Colonograptus*. Тщательное сравнение фузеллярного строения этих обоих типов апертуральных отростков побуждает автора принять первую альтернативу. Апертуральные дифференциации *P. gotlandicus* не составляют, таким образом, зачаточных отростков, ведущих к *Colonograptus*, но скорее являются проявлением специализации типичных пристиограптусов. На это указывает форма последнего апертурального фузеллюса, наличие угловых фузеллюсов, равно как стратиграфическое распространение *P. gotlandicus*, установленное как постоянное в горизонте *P. nilssoni*, на ряду с представителями *Colonograptus*.

В обоих исследованных валунах, описанному виду не сопутствовали соответственные руководящие формы, которые дали бы возможность установить граптолитовый горизонт, из которого происходили валуны. Тем не менее, сопутствующие ретиолитесовые формы указывают однако на нижний лудлов, как наиболее вероятный возраст валунов.

EXPLANATION OF PLATES

PL. I

Fig. 1. Fragment of the surface of boulder S. 162 (Czarnków), before dissolving. Numerous specimens of *Pristiograptus gotlandicus* (Perner) visible; nat. size.

Fig. 2—3. *Pristiograptus gotlandicus* (Perner), proximal parts of rhabdosome, lateral (*2*) and ventral (*3*) views (S. 162, Czarnków); × 12 approx.

Photographs are retouched.

PL. II

Pristiograptus gotlandicus (Perner)

Medial part of rhabdosome, lateral (*1*) and ventral (*2*) views. Distal part of rhabdosome, lateral (*3*) and ventral (*4*) views (S. 162, Czarnków); × 12 approx.

Photographs are retouched.

1

2

3

1

2

3

4