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TUBOTHECA — A PECULIAR MORPHOLOGICAL ELEMENT IN SOME GRAPTOLITES

Abstract. — Peculiar tubelike elements, called by the writer tubothecae, occur on the specimens of a few genera of the Ordovician graptolites of the Tuboidea and Dendroidea. Tubothecae fundamentally differ from normal graptolite thecae in 1) a continuous increase, 2) irregular morphology and 3) lack of a fusellar microstructure characteristic of all graptolites. In view of such differences, the writer concludes that the tubothecae are elements strange to graptolite colonies. These are tubes of other animals which lived in association with graptolite colonies. Most likely, they were Annelida Polychaeta of the class Eunicea, which nowadays happen to be commensals of the corals Scleractinia and which secrete tubes similar to tubothecae. The remains of the Eunicea abundantly occur in the Ordovician along with the remains of graptolites and their associations might be realized as early as that epoch.

INTRODUCTION

In 1902, a fragment of rhabdosome of *Dictyonema peltatum* Wiman to which, according to Wiman (Wiman, 1902, Pl. 8, Fig. 10), "a worm tube" was attached, was described by this author. Visiting Professor Carl Wiman in 1937 in Uppsala, I had an opportunity to see this specimen and find that the tube observed by this palaeontologist was not a strange body attached to the surface of a graptolite but an element belonging to the rhabdosome from which it grew on the antiapertural side of stipe. This tube at the base equalling the stipe in diameter, extended gradually, reaching at its broken off end an almost twice as large diameter. The walls of the tube were smooth.

Mentioning this interesting specimen in my work devoted to the Tremadoc graptolites of Poland (Kozłowski, 1949, p. 46), I set forth the sugges-

tion that the tube might be an equivalent of rhizoidal processes, sometimes occurring at the base of rhabdosome of the sessile Dendroidea.

In 1963, in his work on the Ordovician graptolites of the Island of Öland Skevington (1963, p. 11, Fig. 9) illustrated and characterized an interesting specimen of *Dendrograptus rigidus* Bulman, from whose rhabdosome a long, irregularly bent tube without traces of thecae grew. This author maintained that the tube was an integral part of rhabdosome. Similar tubes were also observed by Skevington on other specimens from Hagudden. According to this author, after bleaching a tube "fuselli are faintly discernible". Skevington took no heed of either the specimen of *Dictyonema peltatum* with a similar tube, described by Wiman, or my mention of it from 1949 (*loc. cit.*, p. 46).

Since in the course of my studies on the Ordovician graptolites I succeeded in collecting a certain number of specimens provided with the said enigmatic tube and which belonged to the Dendroidea and Tuboidea, I resolved to go further into this problem. The present note is a result of these studies.

I was convinced that the knowledge of microstructure of the walls of its periderm is important to the morphological and biological interpretation of this tube for which I suggest the name of a *tubotheca*. For this purpose, I did my best to bleach the specimens as intensively as possible. The examination of thus prepared specimens in a strong transmitted light allowed me to find that the walls of all tubothecae are devoid of any traces of a fusellar structure. This being so, of interest became to examine the structure of tube of the specimen of *Dendrograptus rigidus* formerly studied by Skevington, now housed at the Palaeontological Institute of the University of Uppsala under No. Öl. 1,048 and which, according to Skevington, allegedly displayed slight traces of fuselli. To this end, I applied to Dr. Anders Martinsson (University of Uppsala) with the request to make me a favour and examine the microstructure of the specimen in question. Dr. A. Martinsson kindly complied with my request and carried out as careful an observation as possible of the specimen already embedded in a special preparation. In his letter of February 19, 1969, Dr. A. Martinsson let me know the following: "I have now examined No. Öl. 1,048 with all light angles and at all magnifications possible, and have not been able to identify any fuselli. I believe, however, to understand which faintly discernible structure Dr. Skevington refers to. There are some subtransversal striae or wrinkles near the mouth of the tube as now preserved, but I can find no evidence that there are even likely to be fuselli."

In my opinion, Dr. A. Martinsson's observations constitute a sufficient evidence that the tube in *Dendrograptus rigidus*, the same as the tubothecae of other graptolites, described in the present paper, are devoid of microfusellar structure.

Characteristics of the material studied

My specimens of graptolites, provided with tubothecae, have been collected over twenty years of studies during which I systematically dissolved Ordovician erratic boulders found in various parts of Poland. One of them comes from the Middle Ordovician boring core at Mielnik on the Bug. As a total, eleven specimens were collected of which only seven were preserved to such an extent as to enable figuring them and a detailed description. In fact, even these specimens mostly represent very small fragment of rhabdosomes.

To examine the microstructure of their tubothecae, the specimens have been subjected to intense clearing, during which some of them were damaged. The main aim of the studies was to find: 1) the relation of tubotheca to rhabdosome and 2) the microstructure of the tubothecal walls.

Since all specimens under study were fragmentary, very brittle and of the size of 1 to 2 mm, they were not fit for making microtomic sections and, for this reason, the relation between tubotheca and rhabdosome could not be accurately determined in all cases.

The fact that of several hundred rhabdosomes prepared out of the Dendroidea and Tuboidea, the presence of tubothecae was found in eleven cases only gave evidence that we had to do with an element appearing in the graptolites mentioned above only exceptionally. The presence of tubothecae in other groups of graptolites has not as yet been observed by anybody.

DESCRIPTIONS

Of the seven specimens described below four belong to the Tuboidea and three to the Dendroidea. In view of their fragmentary state of preservation in some cases, their generic and the more so specific assignment could not be accurately determined. For this reason, species are designated by numbers only. The following designation has been used in figures:

a — authotheca
b — bitheca
c — conotheca
P — pachytheca
T — tubotheca

The figures given with individual thecae are arbitrary.

Order **Tuboidea** Kozłowski, 1938
Genus *Reticulograptus* Wiman, 1901
Reticulograptus sp.
(Fig. 1)

Material. — A fragmentary, well-preserved, about 1.5 mm long rhabdosome, etched out from an erratic pebble (No. O.71) found at Pobierów on the Baltic coast. The pebble is a compact, cream-coloured limestone.

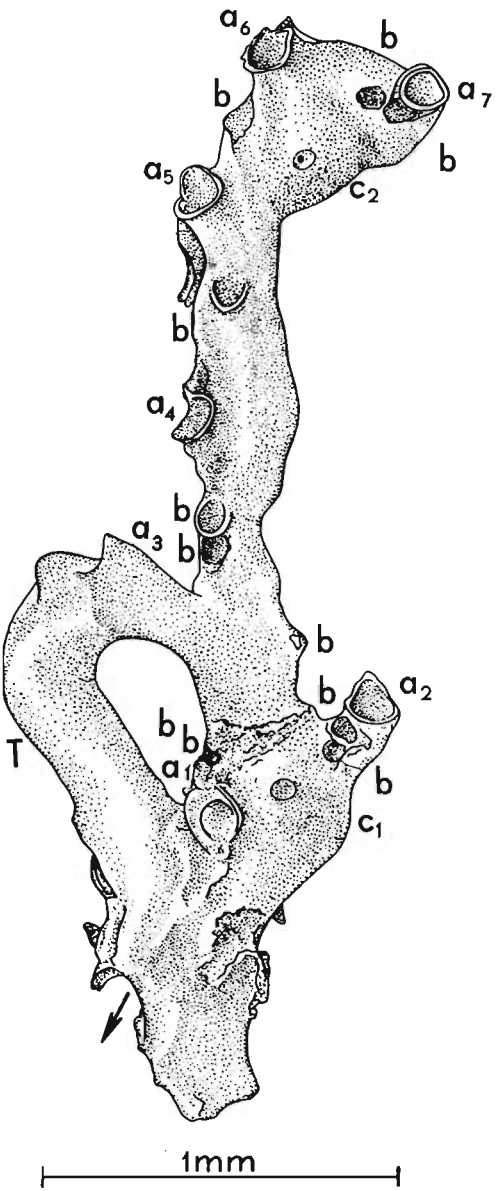

Fig. 1. — *Reticulograptus* sp. Ordovician erratic pebble No. O. 71. Pobierów, Baltic Coast.

Description. — At least seven autothecae (a_1 — a_7), twelve bithecae and two conothecae (c_1 — c_2) are discernible on the stipe with both ends broken-off. Except for one (a_3), all autothecae are broken-off at the base. The arrangement of auto- and bithecae does not display any distinct regularity. The position of bithecae in relation to autothecae is very variable. Two conothecae (c_1 and c_2), one of which is situated at the proximal end of

the stipe and the other at its distal end, are well-preserved. The diameter of conothecae amounts to 0.15 and of their round apertures to 0.04 mm. In both conothecae, apertures are occluded and covered with a regular, flat lamella. A tubotheca (T) with its diameter 1.5 times as large as the diameter of the autotheca at the base, emerges from the aperture of a completely preserved autotheca a_3 from between its fairly clearly marked ventral and dorsal apertural lobes. The beginning of the tubotheca is slightly oblique to the dorsoventral plane of the autotheca and partly covers its ventral apertural lobe. Further on, the tubotheca bends at an almost right angle to the axis of autotheca and runs towards the proximal end of the stipe to which it is fused with its distal end, forming a loop. The end of tubotheca is strongly fused with the stipe and, together with it, covered with a thick cortical layer. The aperture of tubotheca being broken-off, it is not unlikely that it ran further on along the stipe. Both at its proximal end situated between the apertural lobes of autotheca and over its entire length, the tubotheca is covered with a thick cortical layer.

Remarks. — The irregular arrangement of bithecae and their number considerably greater than that of autothecae, as well as the presence of conothecae, induce one to assign the specimen under study to the genus *Reticulograptus* Wiman recently studied in detail by Bulman & Rickards (1962) and rightly assigned by these authors to the order Tuboidea.

Genus *Idiotubus* Kozłowski, 1949

Idiotubus sp. 1

(Fig. 2 *A*, *B*)

Material. — A specimen, about 2×1 mm in size, etched out of the erratic pebble No. O.48, found at Jarosławiec on the Baltic coast. The pebble is a light-coloured organodetritic limestone.

Description. — The specimen of graptolite is a fragment of thecorhiza, on which four auto- (a_1 — a_4), four bithecae and three conothecae (c_1 — c_3) have been preserved. Originally this fragment was somewhat larger but part of it was broken-off during clearing and thecae a_4 and c_3 — after drawing figures.

A tubotheca (T), oriented perpendicularly to the ventrodorsal plane of autotheca emerged from the aperture of a_1, from between its apertural lobes. The tubotheca is round in cross section and its diameter is more or less equal to that of autotheca from which it grows. At first it runs steeply to the surface of thecorhiza to which it fuses with the central part of its lower wall. Subsequently, it ascends over the surface of thecorhiza and runs between thecae a_3 and a_4, fusing to their walls with its sides. The aperture of tubotheca with a slightly frayed margin, is marked by three

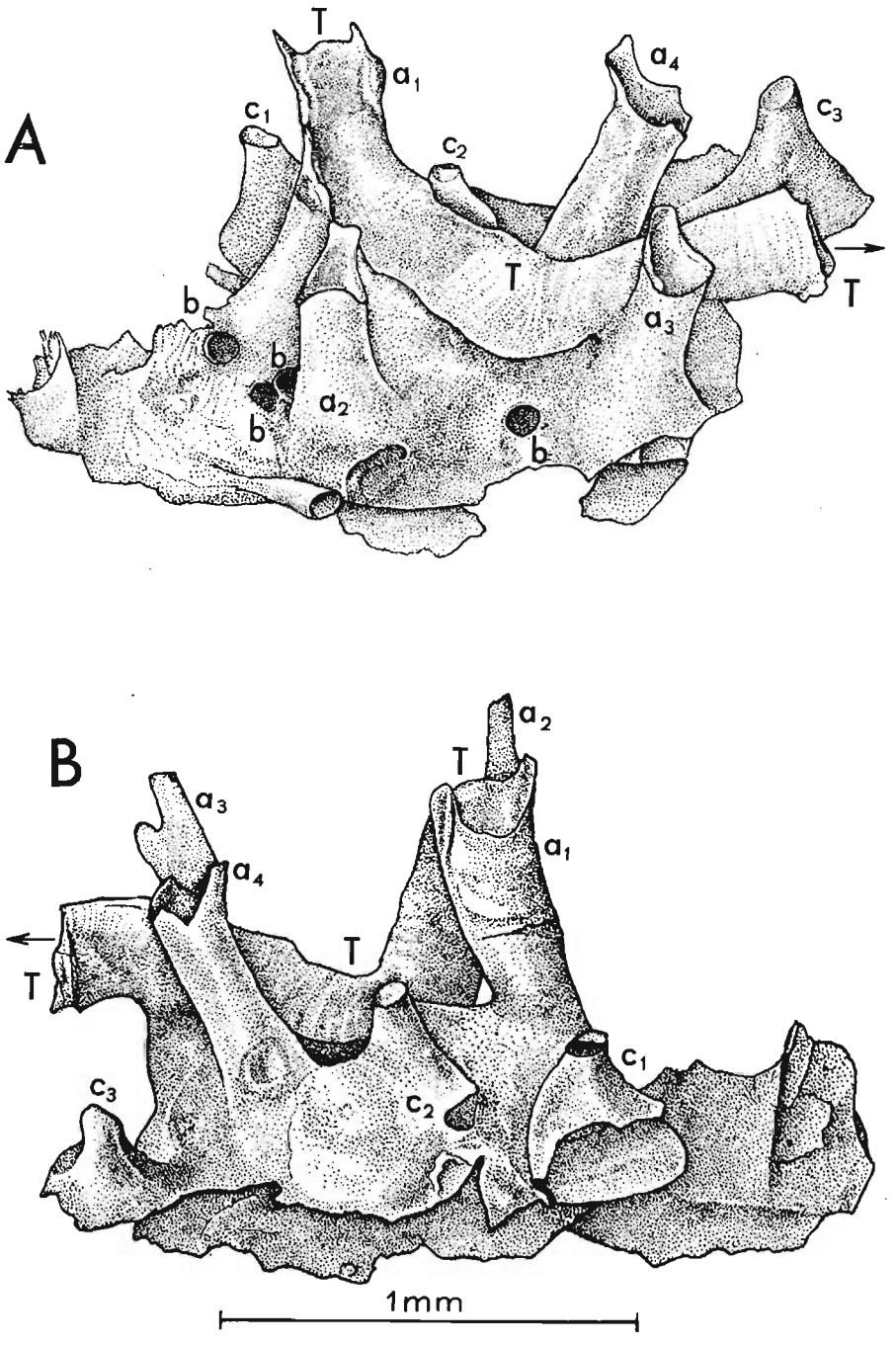

Fig. 2. — *A*, *B*. *Idiotubus* sp. *1*. Ordovician erratic pebble No. O. 48. Jarosławiec, Baltic Coast.

sharply outlined growth lines. Its margins, transparent after bleaching, do not bear any traces of a fusellar structure.

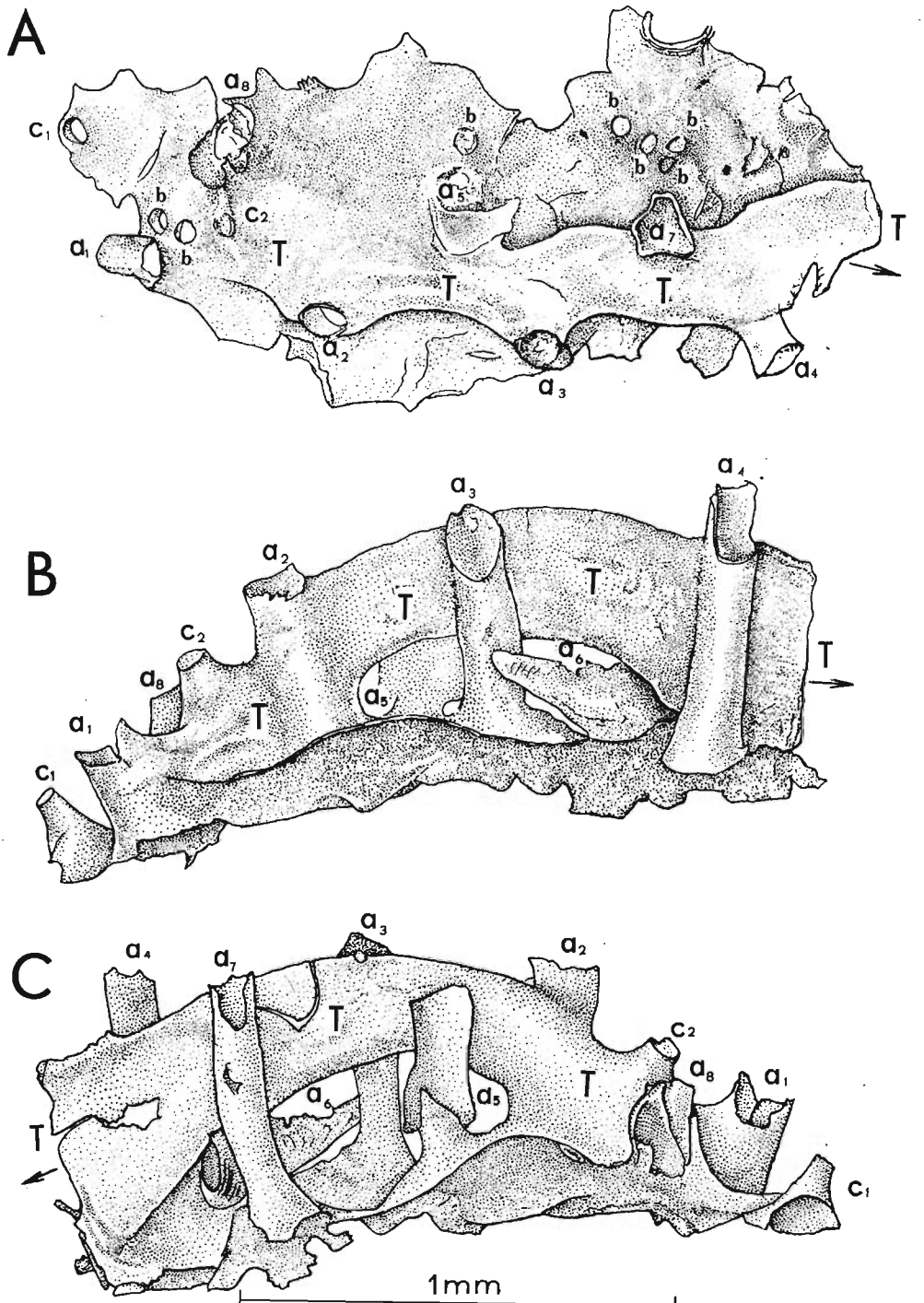

Fig. 3. — *A*, *B*, *C*. *Idiotubus* sp. 2. Ordovician erratic pebble No. O. 129. Wyszogród, the Vistula River valley.

Idiotubus sp. 2
(Fig. 3 *A*, *B*, *C*)

Material. — A specimen, about 2×1 mm in size, etched out of an erratic pebble (No. O.129), found at Wyszogród. The pebble is an organodetritic, fine-grained, light-coloured limestone.

Description. — Eight autothecae (a_1 — a_8), seven bithecae and two conothecae (c_1 — c_2) have been preserved on a fragment of thecorhiza. A tubotheca (T), which in the form of a gentle arch raises over the surface of thecorhiza over the entire length of the specimen, grows out directly from thecorhiza at the base of conotheca C_2. Its diameter increases gradually from 0.2 mm at the beginning to 0.5 mm at the aperture. Its cross section is elliptical with a longer diameter perpendicular to the plane of thecorhiza. The tubotheca runs between two rows of autothecae so that on the one side it adheres to three autothecae (a_2, a_3 and a_4) and, on the other, to two of them (a_5 and a_7). All the autothecae are fused with their lateral walls to the tubotheca and, together with it, covered with a common layer of cortical tissue. Autotheca a_2 is particularly strongly fused with the tubotheca. One of the autothecae (a_6) occurs, in a reclining position, under the tubotheca, between thecae a_4 and a_7. Since it is fused with its lateral wall to the surface of thecorhiza and with the end of the ventral apertural lobe to autotheca a_3, one should suppose that this abnormal position was caused by the growth of tubotheca in the process of its development over a_6.

The margin of the tubothecal aperture is frayed and fused ventrally with the surface of thecorhiza. No traces of fusellar structure occur on the transparent distal part of tubotheca, three thin growth lines being visible instead.

Genus *Discograptus* Wiman, 1901
Discograptus sp
(Fig. 4*A*, *B*)

Material. — A specimen, about 2.6×1 mm in size, etched out from the erratic pebble No. O.489, found at Mochty. The pebble is a compact pelitic limestone of the type of Baltic limestone (Ostseekalk), probably of Ashgill age.

Description. — The specimen is a fragment of thecorhiza, originally somewhat larger, but broken partly during bleaching and handling in glycerine. Seven auto- (a_1 — a_7) and five bithecae are discernible on the preserved part, including five single autothecae (a_3 — a_7) and two (a_1 — a_2) combined in a stipe. In addition, parts broken from a colony include a piece

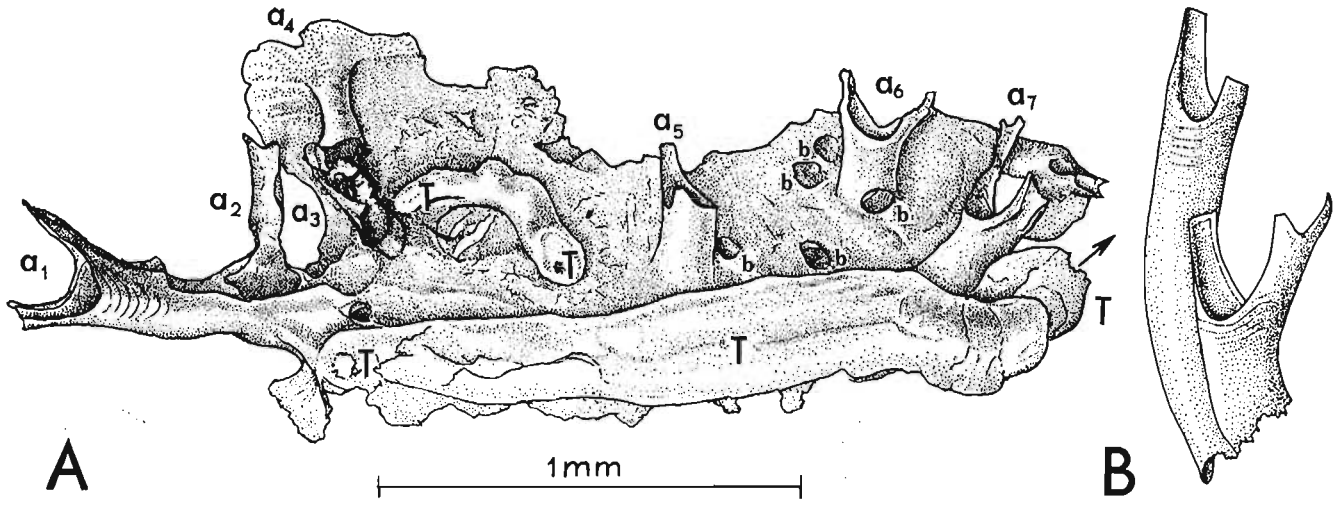

Fig. 4. — *A*, *B*. *Discograptus* sp. Ordovician erratic pebble No. O. 489. Mochty, the Vistula River valley.

of a stipe composed of two, well-preserved autothecae (Fig. 4*B*). The preserved bithecae, numbering five, are grouped between autothecae a_5 and a_6.

A tubotheca (T) emerges directly from thecorhiza near the middle of the fragment. Initially, this is a tube a bare 0.1 mm in diameter, which subsequently turns towards autotheca a_3 and plunges into thecorhiza below thecae a_3 and a_2, to emerge on the surface once again on the opposite side of the stipe, composed of thecae a_1 and a_2. The continuity of tubotheca may, however, be traced on the bottom side of thecorhiza. This enables the conclusion that autotheca a_3 and a stipe consisting of a_1 and a_2 were formed after development of tubotheca and covered it from the outside. After emerging on the surface of thecorhiza at the base of the $a_1 — a_2$ stipe, the tubotheca continues over the entire length of the fragment of thecorhiza up to its opposite end. It extends gradually to reach a maximum diameter of about 0.26 mm. Over most part of its trace, tubotheca is strongly compressed, which is, however, a result of a secondary deformation, as indicated by a crack along its central part as well as by an almost round cross section of its terminal part. This terminal part, describing an arch around the base of theca a_7, is very thin, with sharply marked growth lamellae. No traces of fusellar structure may be detected on its transparent walls.

Remarks. — The fact of coupling some of the autothecae and forming stipes indicates that the specimen described does not belong to the genus *Idiotobus* Kozł., but probably to *Discograptus* Wiman. In its ventral apertural process, it is similar to *D. schmidti* Wiman.

Order **Dendroidea** Nicholson, 1872
Genus *Acanthograptus* Spencer, 1878
Acanthograptus sp. 1
(Fig. 5)

Material. — A specimen of a stipe about 4 mm long and 0.7 mm in diameter, with a periderm wrinkled secondarily and bifurcating in the inferior part. Etched out from a Middle Ordovician boring core at a depth of 1.118–1.124 m in Mielnik on the Bug.

Description. — Numerous autothecae, mostly broken-off at the base, occur on the stipe. Some better preserved autothecae, isolated over the entire length, are about 0.5 mm long. The aperture of these thecae is oblique to their axis and provided with an moderately elongated, lingulate ventral apertural process. Dorsal lip rounded, without process. Bithecae invisible, probably covered by the peridermal wrinkles.

A tubotheca (T), 0.4 to 0.5 mm in diameter, grows out directly from the wall of stipe below its bifurcation. The course of the tubotheca is very

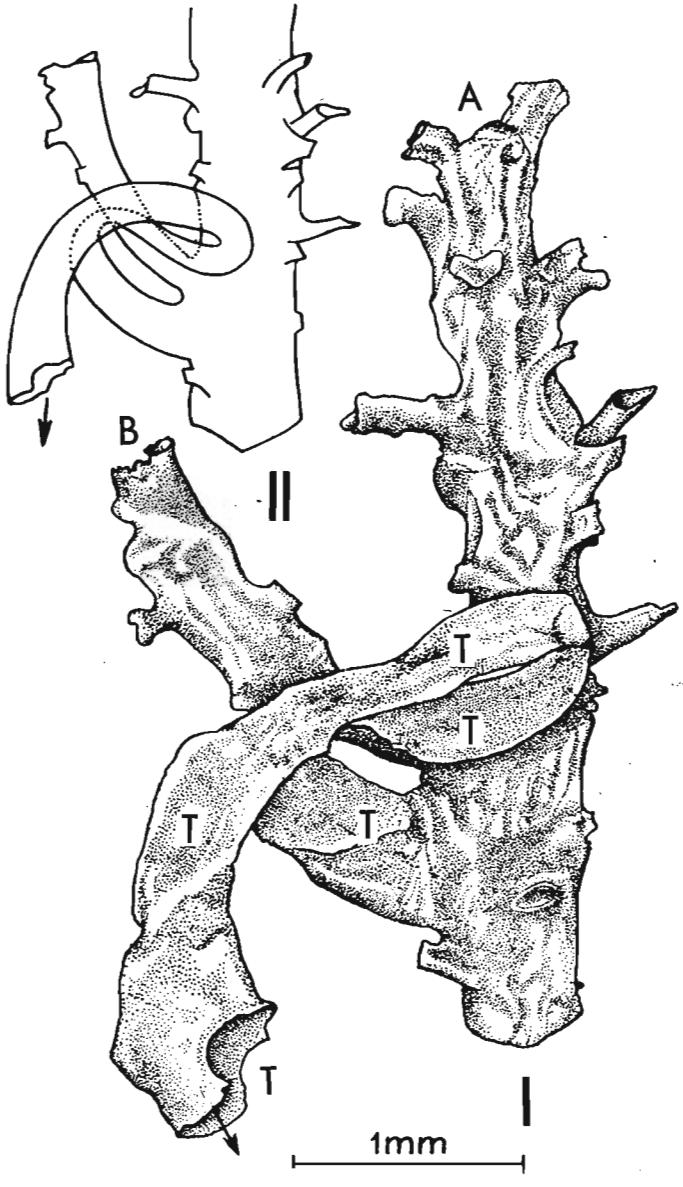

Fig. 5. — *Acanthograptus* sp. *1*. Middle Ordovician, a boring core from a depth of 1,118–1,124 m. Mielnik on the Bug.

I, a stipe in apertural view; II, a diagram illustrating the course of tubotheca. A, main stipe; *B*, side stipe.

tortuous: first, it raises laterally towards the top of stipe at an angle of 60°, then, turns abruptly once again to the main stipe and, after reaching its margin, violently bends, describes a sharp arch, forming a loop and, finally, runs towards the proximal end of the stipe. Its diameter increases gradually to reach 0.7 mm at its open end. The tubothecal margin is frayed

and the aperture proper torn-off. Over most part of its trace, the tubotheca is strongly compressed and deformed. Observing its distal, transparent part, one may find that its periderm is devoid of any traces of fusellar structure.

Remarks. — The specimen described is related to the greatest extent to *Acanthograptus musciformis* (Wiman) from the Upper Ordovician of Öjle Myr on the Island of Gotland, described in detail by Bulman & Rickards (1960).

Acanthograptus sp. 2
(Fig. 6)

Material. — A specimen etched out from an erratic pebble No. O.327, found at Mochty. The pebble is a coarse-grained, organodetrital, light-grey limestone with the remains of the Orthoceratidae and *Glyptograptus* cf. *teretiusculus* (Hisinger).

Description. — The original fragment of a stipe has been broken into three parts. Bases of detached autothecae characteristic of the genus *Acanthograptus* Spencer are preserved on one of them. A tubotheca (T), which describes an arch around the stipe so that its distal end reaches an opposite side of the stipe, grows out directly from the wall of the latter at the end of the largest fragment (Fig. 6). The diameter of tubotheca at its

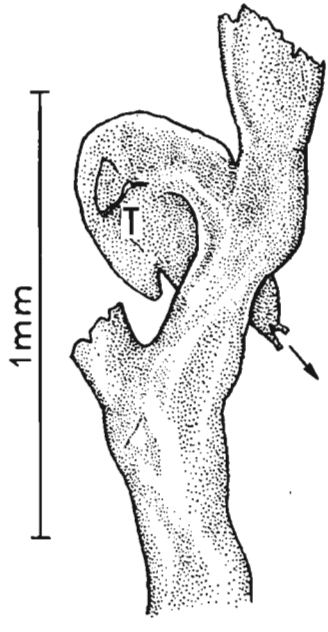

Fig. 6. — *Acanthograptus* sp. 2. Ordovician erratic pebble No. O. 327. Mochty, the Vistula River valley.

base is almost two times smaller than the diameter of stipe from which it grows out. Further on, it increases gradually to reach at the torn-off end the same thickness as that of the stipe. The original length of tubotheca was surely considerably larger. No traces of fusellar structure have been found at its distal, bleached part.

Acanthograptus sp. 3
(Fig. 7)

Material. — A specimen, 3.5×0.5 mm in size, etched out from an erratic pebble No. O.93, found in Rewal on the Baltic coast. The pebble is a fine-grained, organodetrital, light-grey limestone.

Description. — The fragment represents a bifurcating stipe with its distal end, formed by two autothecae. Autothecae preserved, numbering ten ($a_1 - a_{10}$). Bithecae invisible. Autothecae cylindrical, 0.2 to 0.5 mm long and 0.08 to 0.09 mm in diameter, irregularly spaced. Their apertures are oblique to the axis of theca and provided with a lingulate, elongate, ventral apertural process and a rounded dorsal lip.

In two places, an autotheca conspicuously different from normal ones in a considerably larger diameter reaching 0.2 to 0.25 mm, occurs each near the proximal and below the distal end. The aperture of these thecae, slightly wavy, is devoid of the ventral apertural process, but is marked by growth striae. These thecae are not isolated but adhere with their dorsal wall to the stipe and, what is most important, their periderm is without any traces of fusellar structure. The lack of such a structure cannot be caused by the state of preservation, since normal thecae, occurring nearby, maintain a distinct fusellar structure. These great thecae do, therefore, deserve to be distinguished by a special name. To designate them, I suggest the name of *pachythecae*. Their large diameter and amorphous structure of walls seem to be evidence for their being similar to tubothecae. Since the margins of their peristome are slightly thickened, which seem to indicate that their growth was already completed, it is doubtful if they could correspond to still not fully grown tubothecae.

Remarks. — In its general appearance, particularly cylindrical shape of autothecae, their irregular distribution and tendency to grouping in pairs, the specimen described, much the same as the previous one (p. 402), is related to *Acanthograptus musciformis* (Wiman).

GENERAL CONSIDERATIONS

As follows from the specimens here described and from Wiman's and Skevington's observations the presence of tubotheca has so far been found in the genera *Dictyonema*, *Dendrograptus* and *Acanthograptus* of the order

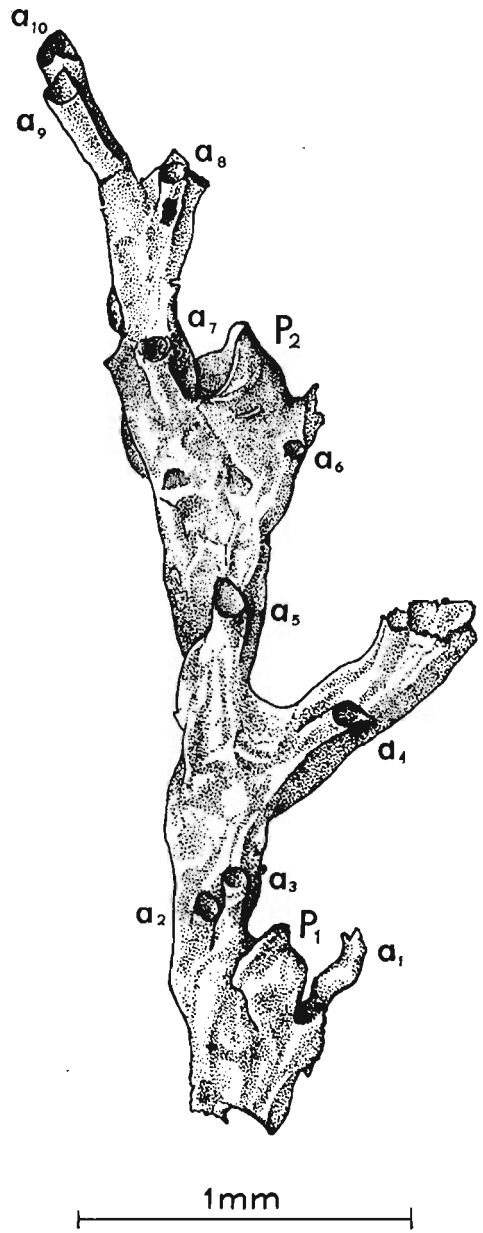

Fig. 7. — *Acanthograptus* sp. 3. Ordovician erratic pebble No. O. 93. Rewal, Baltic Coast.

Dendroidea, as well as *Idiotubus*, *Discograptus* and *Reticulograptus* belonging to the order Tuboidea. In addition to a typical tubotheca, a pachytheca perhaps corresponding to it, may occur in the genus *Acanthograptus*.

In all the genera referrd to above, the tubotheca occurs only sporadically and very rarely at that. It differs radically from normal thecae mostly

in the following characters: 1) an unlimited growth, 2) quite irregular shape and 3) amorphous periderm, that is, the lack of the fusellar microstructure so characteristic of all graptolites. There is no definite correlation between the situation of tubotheca on rhabdosome and distribution of autothecae. When a tubotheca grows out of the autothecal aperture it may be oriented obliquely to the dorsoventral plane of autotheca (*Reticulograptus* sp. 1, Fig. 2) or even at a right angle to this plane (*Idiotubus* sp. 1, Fig. 2). Growing directly out of the wall of rhabdosome, as is the case in the specimens of *Acanthograptus* (Figs. 5 and 6), the tubotheca does not display any regular orientation.

If we assumed that the tubotheca was built by the zooid of a graptolite, the assumption should be also made that such a zooid — for instance, in the case in which the tubotheca grows out of the autothecal aperture — has previously underwent some radical physiological and morphological metamorphosis, since both the microstructure and morphology of the tubotheca it secreted fundamentally differ from the microstructure and morphology of the autotheca. No instances of the metamorphosis of such type are known in the Recent colonial animals. Admittedly, in the case of the formation of ovicells, considerable transformations in zooids are observed in the Bryozoa Cyclostoma, but ovicells, sometimes quite irregular, are normal, regularly occurring components of a colony. In addition, the walls of ovicells maintain the same microstructure as that of normal zooecia.

These fundamental differences between the tubotheca and normal thecae of the graptolites induce one to conclude that the organism building the tubotheca was not a graptolite zooid, but a separate animal which lived as a commensal or parasite on a graptolite colony.

Seeking analogous instances of the association of animals producing tubes and living on colonies of other animals, the first place should be given to the Annelida Polychaeta of the group of Errantia, whose various representatives produce organic tubes with parchment consistency and without any special microstucture. Many of them display the tendency to the association with other animals either as commensals, or as pronounced parasites, the distinction between these two types of coexistence being sometimes rather difficult.

An instance, one of the most interesting in this respect, is supplied by some of the Eunicea, particularly noteworthy being the association of *Eunice florideana* (Pourtalès) with colonies of the representatives of the anthozoans of the order Scleractinia, such as, the genera *Lophohelia* M. Edw.-H. and *Amphihelia* M. Edw.-H. (recte *Madrepora* L.). An instance of the association of *Eunice florideana* with *Amphihelia oculata* (L.) was described in detail by Pruvost & Racovitza (1895). The larva of this annelid settles as a rule on the colonies of the coral mentioned above. In the

process of its development, the annelid secretes a thick tube of parchment consistency. With the growth of this tube, it becomes completely surrounded by the coral's coenosarc which abundantly secretes calcium carbonate settling on it. As a result, the entire tube, except for its aperture, becomes embedded in coenenchyme of the coral. In this case, there undoubtedly occurs a striking analogy to the relation between tubothecae and colonies of the graptolites described. In both cases, we have to do with an organic, amorphous tube. As in *Eunice florideana* the tube becomes covered with coenenchyme secreted by the coral, so in the case of the tubotheca it becomes covered with a cortical layer secreted by graptolite zooids.

If we assumed that tubothecae were secreted by the annelids, the question arise what was the type of coexistence between the annelid and the graptolites, whether it was the commensalism or parasitism. In this respect, significant is the fact that sometimes (*Reticulograptus* sp., Fig. 1; *Idiotubus* sp. 1, Fig. 2 *A*, *B*) the tubotheca grows directly out of the autothecal aperture. If such is the case, it is beyond any doubt that the animal which secreted a tube completely occluded the theca of the graptolite, and consequently had to cause its death. This seems to be an evidence of the phenomenon of parasitism.

If, on the basis of the analogy between the association of an annelid with a coral colony and that of a tubotheca with a graptolite colony, we assume, therefore, that tubotheca corresponds to annelid tube, the question arises whether or not such an association was possible in the Ordovician. In her classic work, devoted to jaw apparatuses of the Ordovician and Silurian annelids, Kielan-Jaworowska (1966) has shown that the class Eunicea was then abundantly represented and that their remains occurred commonly together with the remains of graptolites. It is not unlikely that the associations between these animals might be developed even in these epoch.

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June, 1970

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TUBOTEKA — DZIWNY ELEMENT MORFOLOGICZNY U NIEKTÓRYCH GRAPTOLITÓW

Streszczenie

Praca zawiera rezultaty badań nad pewnymi rzadkimi i dziwnymi składnikami kolonii niektórych graptolitów należących do rzędów Dendroidea i Tuboidea. Są to rurki nazwane przez autora tubotekami. Tuboteki rozwijają się już to z apertur normalnych autotek, już to „wyrastają" bezpośrednio na gałązkach lub na tekoryzie. Różnią się one od normalnych tek graptolitowych tym, że 1° przyrost ich jest ciągły, 2° mają kształt nieregularny i 3° peryderma ich jest bezstrukturalna, bez śladów tak charakterystycznej dla wszystkich graptolitów mikrostruktury fuzellarnej. Nie mniej tuboteki są pokryte tą samą warstwą korową, która pokrywa kolonię graptolita. Wobec zasadniczych różnic między tubotekami a normalnymi tekami graptolitów autor dochodzi do wniosku, że tuboteki nie były wytwarzane przez zoidy graptolitów lecz przez jakieś obce zwierzęta, które mogły być komensalami lub pasożytami graptolitów. Uderzająca jest analogia tubotek występujących w koloniach graptolitów z rurkami wydzielanymi przez współczesnego annelida *Eunice florideana* (Pourtalès) z grupy Polychaeta Errantia, żyjącego na koloniach koralowca *Amphihelia oculata* (L.). Tak jak tuboteka pokryta jest przez warstwę korową graptolita, tak rurka organiczna *Eunice* zostaje pokryta cenenchymem wydzielanym przez koralowca. Jeżeli się weźmie pod uwagę fakt, że w ordowiku występują obok graptolitów licznie szczątki annelidów z grupy Eunicea, nie jest wykluczone, że już wówczas mogły powstać asocjacje między tymi zwierzętami.

РОМАН КОЗЛОВСКИ

ТУБОТЕКА — СТРАННЫЙ МОРФОЛОГИЧЕСКИЙ ЭЛЕМЕНТ НЕКОТОРЫХ ГРАПТОЛИТОВ

Резюме

В статье изложены результаты исследования некоторых редких и странных элементов колонии граптолитов, принадлежащих к отрядам Dendroidea и Tuboidea. Это трубки названы автором туботеками. Туботеки развиваются или из устьев нормальных автотек, или „вырастают" непосредственно на ветвях или на текоризе. Туботеки отличаются от тек граптолитов 1) постоянным ростом, 2) нерегулярной формой и 3) безструктуральной перидермой, без следов типичной для всех граптолитов фузеллярной микроструктуры. Тем не менее туботеки покрыты тем самым кортикальным слоем, который покрывает колонию граптолита. Вследствие принципиальных различий между туботеками и нормальными теками граптолитов, автор приходит к выводу, что туботеки ее были образованы не зооидами граптолитов, а какими-то животными, которые могли быть или комменсалами, или паразитами граптолитов. Особенно поразительна аналогия туботек в колониях граптолитов с трубками, выделяемыми современным кольчатым червем *Eunice florideana* (Pourtalès) из группы Polychaeta Errantia, живущем на колониях коралла *Amphihelia oculata* (L.). Подобно тому как туботека покрыта кортикальным слоем граптолита, так и органическая трубка *Eunice* покрыта ценехимой, выделяемой кораллом. Если принять во внимание, что в ордовике рядом с граптолитами встречаются многочисленные остатки кольчатых червей из группы Eunicea, не исключено, что уже тогда могли возникнуть сообщества между этими животными.