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A New Dickinsonid from the Upper Vendian of the White Sea Winter Coast (Russia, Arkhangelsk Region)

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Abstract—A description and reconstruction of the new fossil are based on the rounded isometric imprints, which are composed of two rows of transverse elements. The elements are arranged in the manner of glide reflection symmetry. The lateral flanks of the elements are pointed and curved in identical directions. It is suggested that this fossil was preserved as imprints of different appearances (positive and negative) including "trilobite-like" forms. The relief of the imprints could be positive or negative. The fossils occur as isolate imprints or in accumulations.

INTRODUCTION

The remains of soft-bodied organisms in the Upper Vendian rocks of the White Sea Winter Coast were extensively described (Fedonkin, 1978, 1981, 1983, 1985, 1987). These localities remain the source of many new and extraordinary finds. In the present paper a new fossil collected during recent years in the locality of the Lighthouse of Zimnie Gory is described. The new form was called *Yorgia waggoneri* gen. et sp. nov.

The material collected on *Yorgia* is very interesting because of the variety of preservation. Probably, this particular feature could be explained by the different state of decomposition at the burial. The different types of the fractures and breaks of the bodies could provide very important data on the structure and physical properties of the organisms. Through the study of such breaks we can observe the general morphology of the body, and sometimes even the details of tissue structure.

The term "body" is used to denote the buried remains. The correlation of the buried remains and the whole body of the organism is left to separate investigations and techniques.

MATERIAL

The first specimens of *Yorgia* were collected in 1994 by the joint expedition of the Paleontological Institute and the University of Berkley (USA). The main part of the material was found by the expedition of the Paleontological Institute during field studies in 1995–1996. The studied collection is housed in the Paleontological Institute, Russian Academy of Sciences (PIN), no. 3993.

LOCALITY

Yorgia remains were found in the unit of aleurolite-shale alternation, which includes numerous lenses of fine-grained sandstone. The unit lies at the base of the "Fifth Cyclite" (Grazhdankin and Ivantsov, 1996), or slightly above the base of the Yorga Beds (Stankovsky *et al.*, 1985). The level can probably be correlated with the middle part of Bed 7 described by Fedonkin (1987). The fossils were found in two localities of similar stratigraphic levels (Fig. 1).

Level 1. The level corresponds to the sandstone lenses, which lie at the base of the unit. Their length is unknown due to the outcropping across the lenses' strike while the width is up to 2 m, and the thickness up to 0.6 m. The lenses are possibly the gutter casts which arose from storm activity (Grazhdankin and Ivantsov, 1996). *Yorgia* imprints are rare, isolated and represented by the negative relief. Besides *Yorgia*, the following fossils were found here: *Dickinsonia costata* Sprigg, 1947, *Kimberella* Wade, 1972, *Cyclomedusa* Sprigg, 1947, *Tribrachidium* Glaessner, 1959, and some undescribed forms.

Level 2. This level is stratigraphicaly slightly higher than Level 1 and corresponds to the base of the lens-like sandstone bed. The bed's thickness is about 0.10 m. The bed can be traced 200–300 m along its strike.

The numerous remains of *Yorgia* form isolated accumulations with several specimens in each. The imprints are both negative and positive. The following fossils were found along with *Yorgia*: *Dickinsonia costata* Sprigg, 1947, *Dickinsonia* cf. *tenuis* Glaesner et Wade, 1947, *Vendia sokolovi* Keller, 1969 (the second known specimen; the first one originates from the Yarensk Borehole, 1552 m depth, Ust-Pinega Formation (Keller, 1969)), and several undescribed forms from the Petalonamae group.

IMPRINT MORPHOLOGY

Yorgia remains occur as isolated imprints (Pl. 1, fig. 3; Pl. 2, fig. 2), or in accumulations (Fig. 2; Pl. 1, fig. 4; Pl. 2, fig. 1). The imprints are negative with

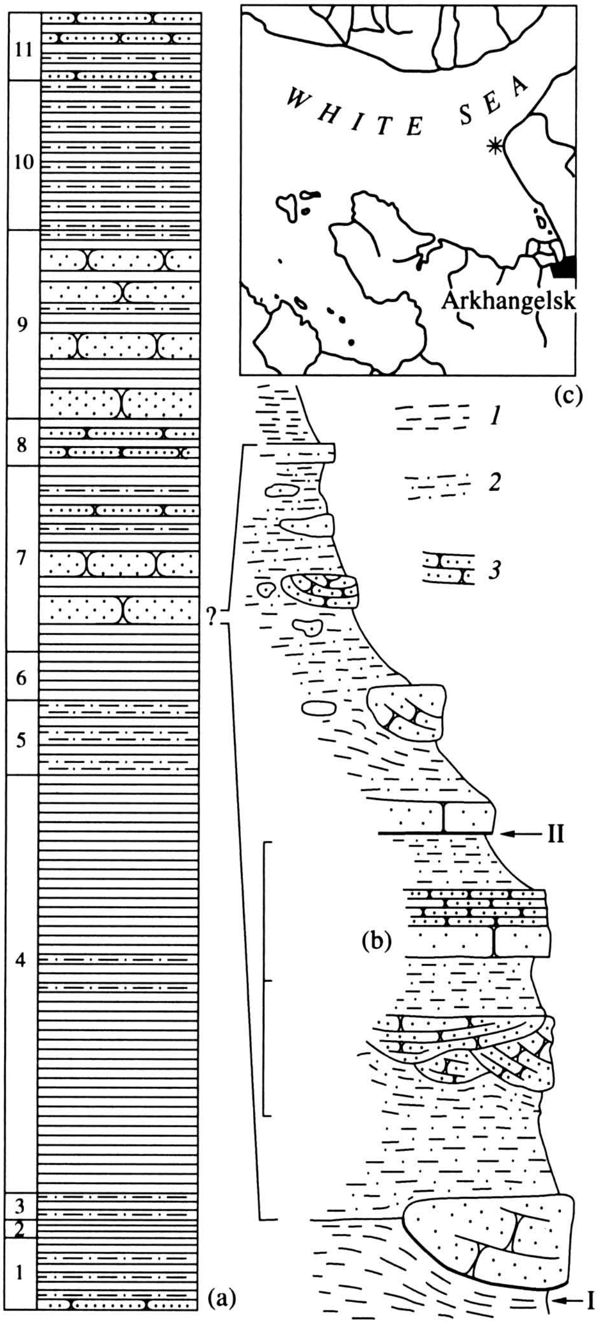


Fig. 1. Position of the locality with *Yorgia waggoneri* sp. nov.: (a) stratigraphic section of the Upper Vendian deposits near the Zimnie Gory Lighthouse according to Fedonkin (1981; 1987), (b) fragment of the combined section (I and II—the levels of *Yorgia* occurrence, *1*—mudstone, *2*—aleurolite, *3*—sandstone, scale bar is 1m), (c) locality position (marked with asterisk).

coarse relief or positive with fine relief. The imprints occur completely on the bottom of the bed, or partly on the bottom and partly within the bed. The relief's amplitude of the negative imprints may reach a value of 1.5–2.0 mm, while of the positive imprints—it never exceeds fractions of a millimeter. Sometimes, the relief of the positive imprints is almost smooth, and fine details can be observed only in some well preserved areas.

The arguments for the assignment of the two different types of imprints to a single species are the following: (a) imprints of both types occur in common compound accumulations; (b) the sizes of imprints of both types from the same accumulation are approximately equal; (c) imprints of both types have similar general outlines and structural plans; (d) complex positive-negative imprints are known.

The common features of the imprints of two different types are the following: (a) the imprints are rounded or slightly elongated, egg-shaped in outline; (b) the imprints are composed of two rows of narrow and long elements, pointed from one edge; the elements are arranged with glide reflection symmetry; (c) the elements are orientated cross the imprints axis on the blunt edge and almost parallel the axis on the pointed edge; (d) the lateral flanks of the elements are bent towards the pointed edge; (e) the relative width of the transverse elements within a single specimen is almost equal.

The main differences between the imprints of two different types are the following: (a) the relief is positive or negative; (b) the presence of numerous coarse folds on negative imprints (probably the result of the bodies crumpling), while the surface of positive impression is relatively smooth; (c) the depth and the width of the furrows, which are the borders of transverse elements, are different (this fact can be explained by the difference in the way in which the furrow's originate in different types of imprints).

Some well preserved areas of the positive imprints show a faint ornamentation on the surface of the transverse elements, which looks like V-shaped hatches (Pl. 1, fig. 1) or axial ribs (Pl. 2, fig. 4).

The borders between the transverse elements of some negative imprints become indistinct or even disappear on the blunt edge (at a distance of 1/4 imprint's length) or near their axial furrow as well. In such cases the imprint gains a trilobite-like appearance. A segmented, posteriorly pointed "thorax" and large crescent-like "cephalon" can be observed (Pl. 1, fig. 3; Pl. 2, fig. 1). However, the style of segmentation with the glide reflection symmetry is not typical for arthropods (Ivantsov, 1996).

The narrow strip occurs on the blunt edge of two negative imprints (specimen nos. 3993/5024 and 3993/5007). It goes between the last transverse element and the edge of the imprint and bears short radial buttresses and furrows (Fig. 2b; Pl. 1, fig. 4; Pl. 2, fig. 1). The width of the stripes is almost equal on both specimens (7–9 mm), while the length of the imprints differs fourfold (table).

Occurring in dense accumulations, the imprints of *Yorgia* often overlap each other to different extents. This suggests that the bodies themselves or the imprints overlapped. Sometimes the ornamentation is preserved

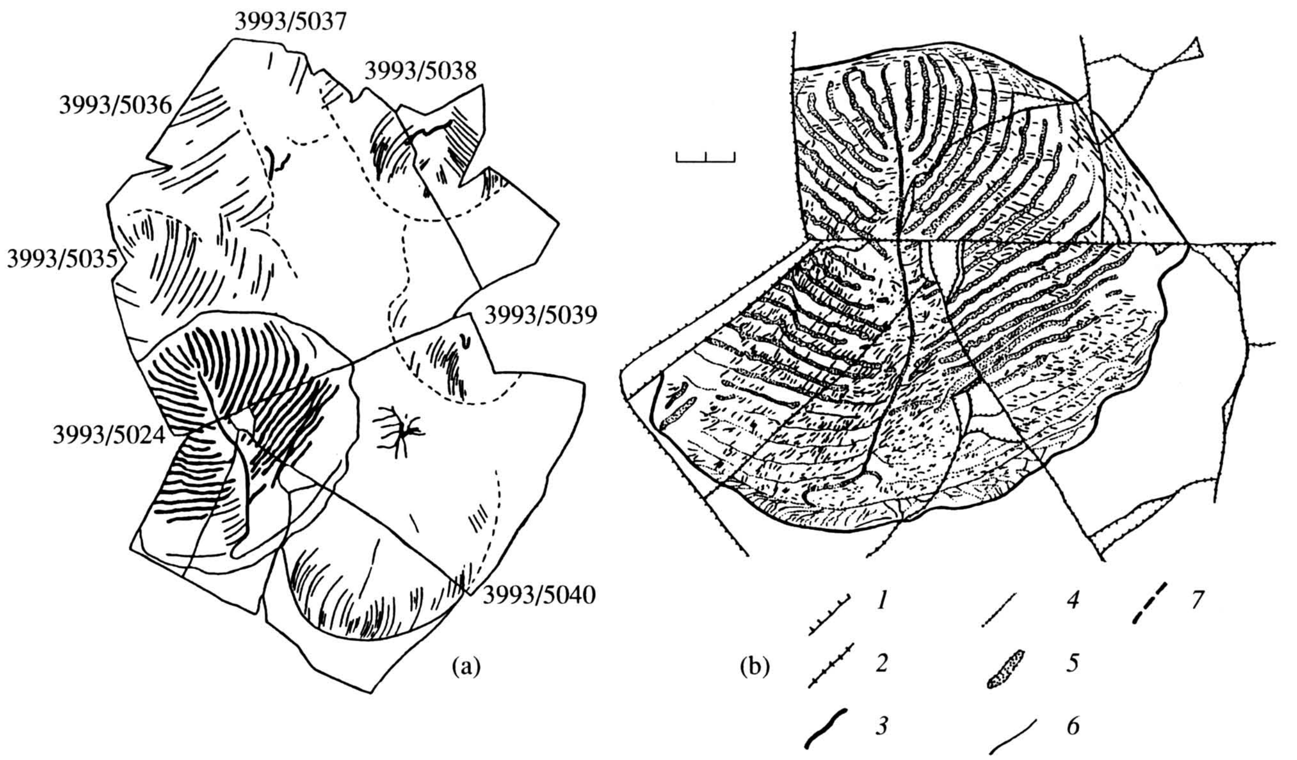


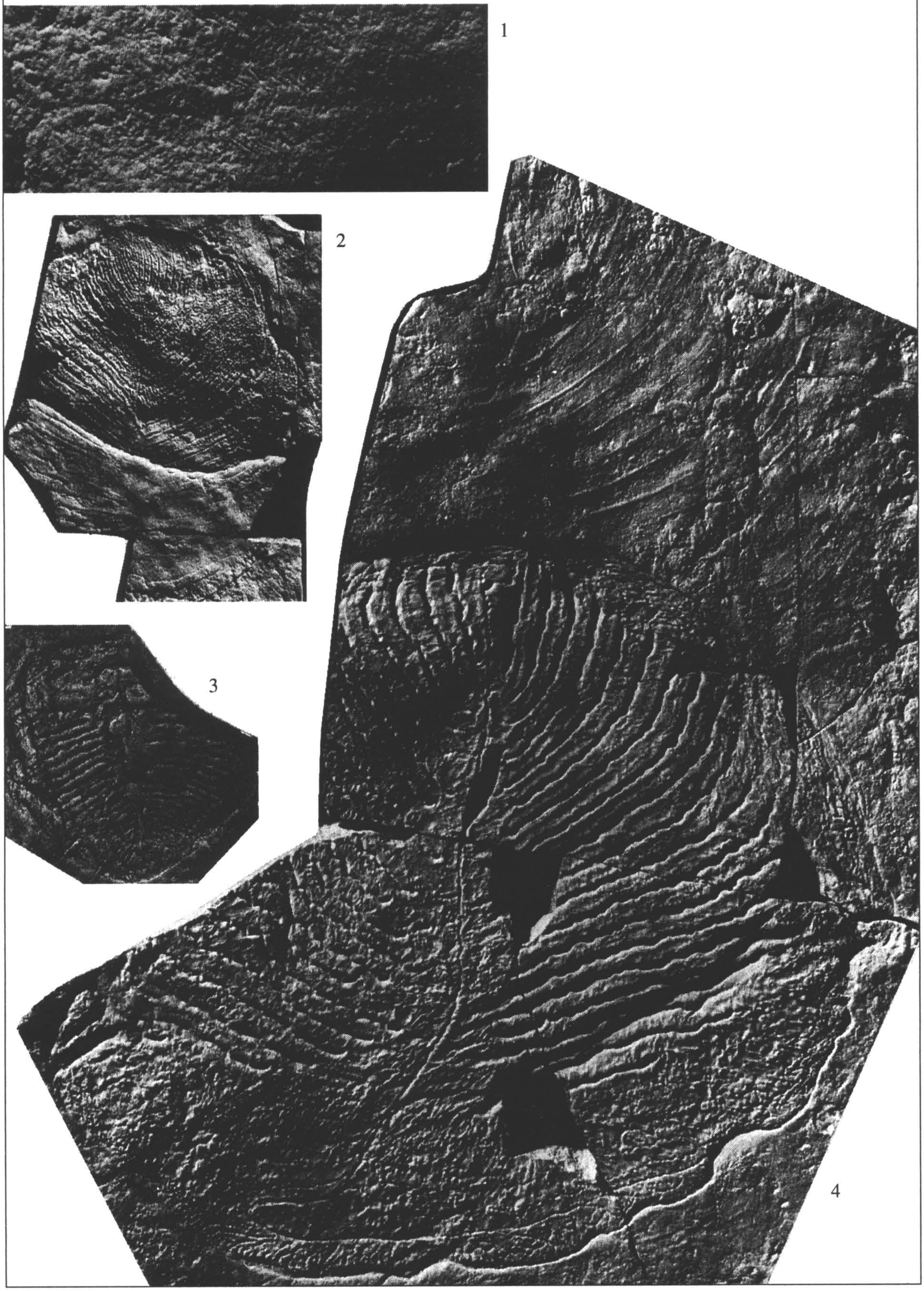
Fig. 2. The plate with imprints of six large specimens of *Yorgia waggoneri* gen. et sp. nov. (one imprint has negative relief, while all other are positive): (a) general view, all imprints overlying each other to a different extent; in a single case (specimens nos. 3993/5035 and 3993/5036) the structure of one imprint is observable through the structure of another one, the surface of other positive imprints (specimens nos. 3993/5038 and 3993/5039) bears the locomotory traces of unknown benthic organisms (bold lines), (b) holotype, no. 3993/5024, the specimen is extended transversely, the borders between the transverse elements are prominent through out the whole body almost to the blunt edge; the axial furrow darts left on the blunt edge and transforms into the transverse furrow, which outlines the marginal transverse element. Up to the edge of the imprint, the zone with dense radial branching furrows takes place (explanatory drawing of the specimen, shown on Pl. 1, fig. 4). Key: *1*—edges of the samples and fragments of overlaying rock, *2*—rocks cracks, *3*—edges of imprints, *4* and *5*—furrows, *6*—buttresses, *7*—additional lines and borders. Scale bar is 2 cm.

in the area of overlap of the positive imprints (specimens nos. 3993/5036 and 3993/5035; unfortunately because of very low imprints relief photography was not possible). Commonly ornamentation disappears in the overlapping area of one of the imprints. The positive imprints preserve the relief of the lower body (Pl. 2, fig. 1; Fig. 2). While the positive and negative imprints are overlain, the relief of the negative imprint is always preserved in spite of the original disposition (Pl. 1, figs. 2, 4; Pl. 2, fig. 1, Figs. 2 and 3).

Several specimens have complicated imprints with the positive relief on one part and the negative relief on another. Thus, specimen no. 3993/5018 (Pl. 1, fig. 2) has the upper part of the imprint (in terms of the photograph orientation) with the negative relief, and the lower part with the positive relief. At the same time the border between two types of relief crosses the transverse elements. Viewed from the lateral side of the positive part of the specimen the imprint displays the borders of the transverse elements looking like membranes that plunge into the rock. If it is not an aberration, and the positive part of the specimen preserves the membranes, the type of preservation of the specimen is reminiscent of *Pteridinium* and *Ventogyrus* (Ivantsov and Grazhdankin, 1997).

The edges of some negative imprints are outlined by the fringe, which is positive in relief (Pl. 2, figs. 1, 4; Fig. 3). As far as the borders of the transverse elements extend from the negative imprints to its positive fringe, it seems that both types of imprints belong to a single organism and are not the result of overlapping of several bodies. It is probably the result of contraction, a post mortem phenomena observed on the imprints of *Dickinsonia costata* (Wade, 1968; Runnegar, 1982; Seilacher, 1989). Hence, the specimens under discussion are composed of the cast from the bottom imprint of the lower surface of the body in its original size (the positive fringe) and the cast from the upper surface of the post-mortem contracted body (the main negative imprint). Another specimen (Pl. 2, fig. 4; Fig. 3) shows overlapping of the simple positive imprint and the complex one. The first specimen (no. 3993/5043) overlaps the positive fringe of the second one (no. 3993/5028) and disappears within its negative part. It indicates that

Plate 1



Values of the key parameters in measured specimens of *Yorgia waggoneri* gen. et sp. nov.

No. 3993/–	L	D	h1	h2	h3	h4	h5	α2	α3	α4	α5
5009	160	–	2.8/2.3	4.0/4.0	4.9/5.5	5.3/4.3	–	35/45	62/57	72/72	85/–
5020	215	175	–	5.0/5.0	5.0/5.8	–/5.5	–	50/50	75/80	–/95	–
5030	120	137	2.3/2.5	3.5/3.2	4.0/3.5	3.5/3.8	3.2/3.5	45/45	60/70	80/85	90/90
5049	175	148	2.4/2.6	3.1/3.0	6.0/6.2	6.2/5.5	–	45/45	70/65	80/80	–
5048	150	156	2.4/2.5	3.5/2.7	4.5/4.1	5.5/4.8	–	50/40	65/60	85/85	–
5018	172	154	3.1/3.1	3.3/3.1	4.7/4.5	4.5/4.8	5.3/–	23/28	57/55	82/77	90/–
5014	22.8	18.4	–	–	–	–	–	–	–	–	–
5007	41.4	35.4	–	1.1/1.1	1.5/1.5	–/2.2	4.5/2.8	45/47	60/60	78/78	78/78
5031	40.5	40	–	–	–	–	–	–	–	–	–
5032	42	41	–	–	–	–	–	–	–	–	–
5024	166	200	6.0/6.0	4.6/4.8	5.1/5.0	4.7/6.3	4.5/6.2	40/50	65/50	50/97	55/115
5004	51	51	–	1.4/1.4	2.2/1.8	2.4/2.5	–	55/60	70/75	80/80	–
5022	9.8	10.3	–	–	–	–	–	–	–	–	–
5028	165	150	2.3/3.0	4.0/4.2	5.1/5.4	3.8/4.8	4.6/–	55/70	70/70	90/95	90/98

Note: For abbreviation see Fig. 6. The parameters h1, h2, h3, etc. are the width of the elements for which the angles α1, α2, α3, etc. were measured. In the columns "h" and "α" the upper number is the parameter's value measured on the right side of the imprint (viewed as on the Figs. 5 and 6), the lower—on the left side.

the body preserved as a complex imprint overlay the body preserved as a positive imprint, or as an imprint of its basal surface on the sediment.

The specimen no. 3993/5003 (Pl. 2, fig. 5; Fig. 4) is of special interest. The imprint is negative in relief, but the borders of the transverse elements look like sharp ribs and not like furrows. The shapeless mass of sandstone occurs in the axial zone of the imprint and at its blunt edge. The surface of the sandstone is ornamented with numerous faint buttresses. The buttresses of the axial zone are directed across the longitudinal axis, while the laterally located buttresses are elongated along the axis. The axial border between the transverse elements is represented by a wide furrow. The furrow extends across the mass of sandstone and falls outside the edge of the main imprint. The upper right edge (in terms of the photo and drawing orientation) of the imprint is curved and its imprint lies with the angle toward the bedding plane.

The body was probably significantly damaged just before burial: the upper part was detached, displaced from the lower part and partly bent. Only few buttresses among the numerous observed on the surface of the imprint can be interpreted as drag marks of the body parts along the surface of the bottom. Such buttresses are long, rough and orientated along the displacement direction.

The faint buttresses, directed across the longitudinal axis of the imprint, are probably the molds of thread-like structures of the tissue of *Yorgia*. The structures may be analogous to the vessels discovered in *Ventogyrus chistyakovi* (Ivantsov and Grazhdankin, 1997). The relief inversion of the main imprint can be explained by the original perfusion of the underlying silty sediment through the crack on the lower surface of the body and not by embedding of the overlying sandy sediment. The secondary mineralization (pyritization) of the tissues probably played some role since many other fossils from the localities of Zimnie Gory are partly pyritized.

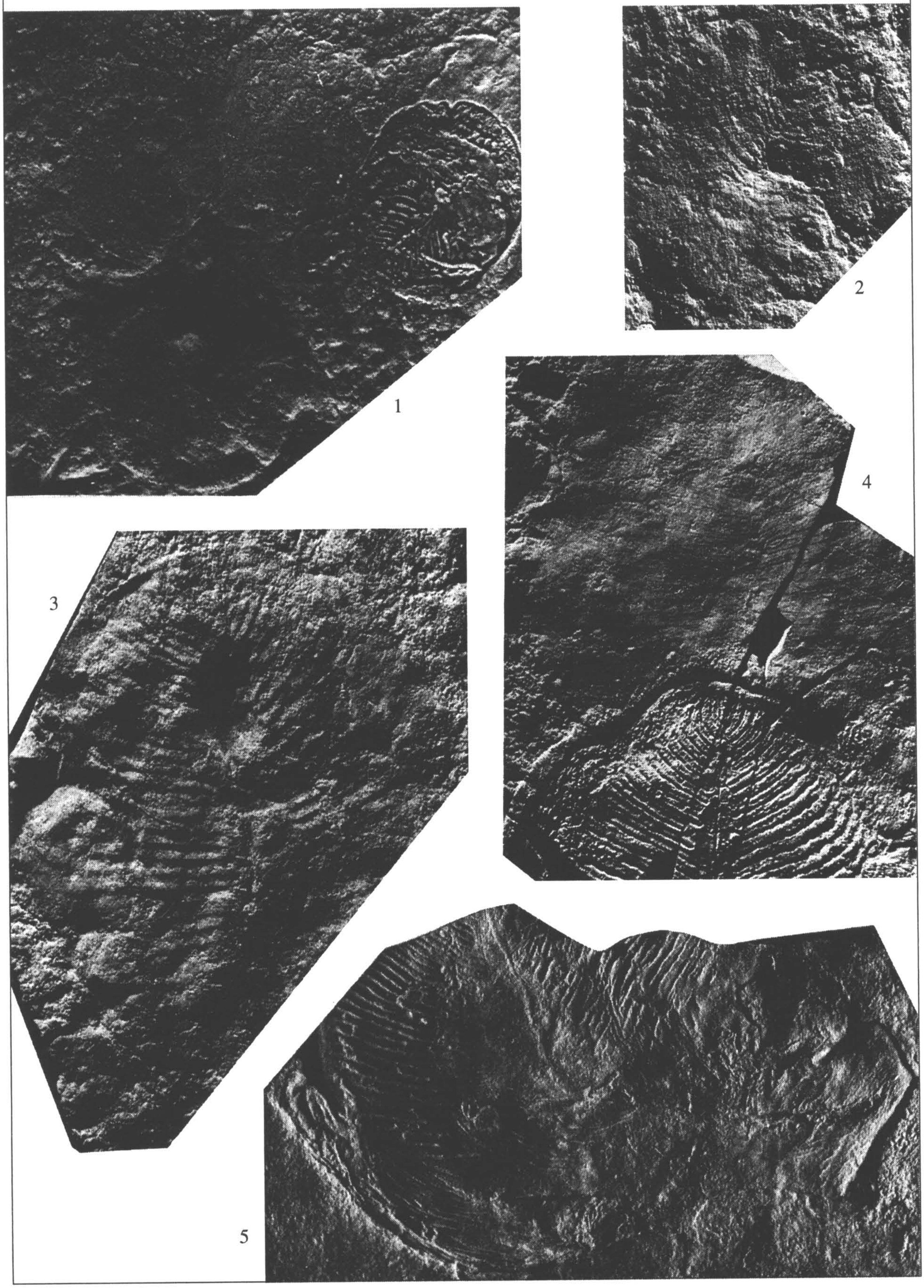
The positive imprints preserve the original irregularity of the bottom and trace-fossils of some animals often seen on them (Pl. 2, fig. 3; Fig. 2a). The negative imprints do not show such details.

The generalized reconstruction of the positive and negative imprints of *Yorgia* is given in Figs. 5a and 5b. This reconstruction is based on the features of the imprints discussed above.

Explanation of Plate 1

Figs. 1–4. *Yorgia waggoneri* gen. et sp. nov., Arkhangelsk Region, the White Sea Winter Coast; the Upper Vendian, Mezen' Formation, Yorga Beds: (1) specimen no. 3993/5011, fragment of the surface of positive imprint, longitudinal axis of the imprint is vertical, the ornamentation of V-shaped hatches is observable, ×1.8; (2) specimen no. 3993/5018, complex imprint, consisting from negative (the upper part of the imprint) and positive parts, ×0.4; (3) specimen no. 3993/5004, negative "trilobite-like" imprint; such a pattern is probably the result of a weak prominence of the borders between transverse elements near the blunt edge of the body, ×0.9; (4) holotype, no. 3993/5024, ×0.8.

Plate 2



RECONSTRUCTION OF THE FOSSIL REMAINS OF YORGIA

A tentative hypothesis on the formation of the imprints of the Vendian organisms serves as a basis for the fossils' reconstruction in the present work. The hypothesis was partly discussed in many works on the Vendian Metazoa (Wade, 1968; Fedonkin, 1987; Seilacher, 1989). The bodies, lying on the silty bottom could have belonged to either live or dead organisms. The bodies of dead organisms could have had different stages of decay. The traces and imprints of fully decayed bodies could also take place in the same area. Hence, during burial by new sedimentation (the sandy sediment at this stage), the casts from the traces and imprints without bodies originated. The buried bodies warped under the sediment pressure and, proceeding the decaying process, decreased in volume. Such a decrease took place not only vertically, but sometimes also in a horizontal direction. The sediment gradually filled the new space: the sandy sediment from—above, and the silty sediment—from below. During this process the tissues that were more elastic and more stable in terms of decay, decreased in volume less. As a result, after the lithification of the sandy sediment, the imprints became pitted above the areas of such tissues, and formed projections above the less stable tissues. In this way the bottom of the sandstone made the casts from the body imprints on the sea floor. These casts included the positive type of relief (i.e., the relief corresponding directly with the relief of the body). In the same manner, the casts were formed from the bodies, but with a negative type of relief (i.e., the relief is opposite to the relief of the body). The positive imprint reflects the structure and ornamentation of the lower surface of the body, while the negative imprint reflects the upper surface and mainly the internal structure of the body (if the tissues were heterogeneous).

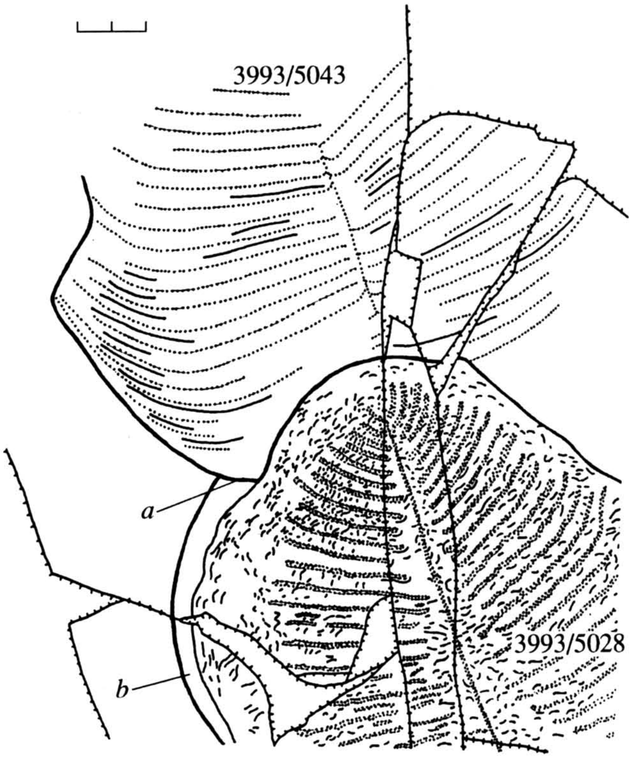


Fig. 3. Two partly overlying imprints of large specimens of *Yorgia waggoneri* gen. et sp. nov., in negative and positive relief (the explanatory drawing of the specimen shown on Pl. 2, fig. 4). A narrow strip, going along the left side of the negative imprint (specimen no. 3993/5028) is positive (*b*) and, probably, caused by post-mortal contraction of the body. The positive imprint (specimen no. 3993/5043) lies over the strip and forms a projection (*a*), then its relief disappears within the negative part of the first imprint. Style of the imprint's superposition suggests, that the body, formed a complex imprint, laid over the body and preserved as a positive imprint. Scale bar is 2 cm.

From the above observations it is possible to reconstruct the outer appearance and, as far as possible, the internal structure of *Yorgia*. The presence of deformations, which are almost all plastic, shows, that the body of *Yorgia* and its integuments were soft and flexible. The morphology of the positive imprints indicate that the outer surface of the organism was smooth and was divided throughout its length by narrow furrows into transverse elements. The elements were ornamented by V-shaped hatches. The body and separate transverse elements were closed, as can be seen from the negative imprints. The walls of the transverse elements were more resilient than the other internal tissues. In this feature *Yorgia* is similar to *Dickinsonia* (Seilacher, 1989), but the body was higher (as indicated by the numerous sharp folds of creases on the imprints from the upper surface of the buried animals). The upper and lower surfaces of the body were flattened as indicated by the position of the axial furrow, which is present in the middle of the majority of imprints. In contrast in the higher body, the axial furrow would have been displaced laterally after the creasing.

On the negative imprints the borders between the transverse elements are less prominent at the blunt edge and near the axial furrow. This may be explained by the

Explanation of Plate 2

Figs. 1–5. *Yorgia waggoneri* gen. et sp. nov.: (1) group of the imprints, one of them (specimen no. 3993/5007) has the negative relief, other are positive (nos. 3993/5031–5034), ×0.9; (2) specimen no. 3993/5014, positive imprints of one of the smallest specimens, ×2.7; (3) specimen no. 3993/5020, ×0.5; (4) two specimens—positive one (upper imprint, specimen no. 3993/5043) and complex (lower imprint, specimen no. 3993/5028), ×0.5, note transverse ribs on the positive surface of some transverse elements; (5) specimen no. 3993/5003, the negative imprint largely overlaid by the shapeless mass, probably broken lower wall of the body, natural size.

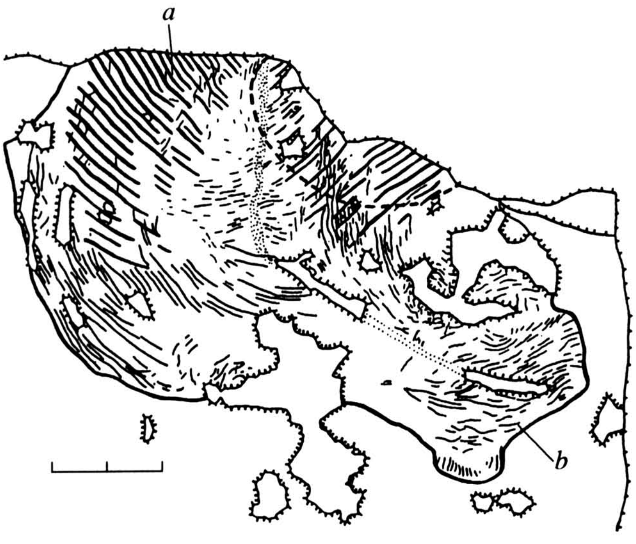


Fig. 4. Partly broken specimen of *Yorgia waggoneri* gen. et sp. nov. (specimen no. 3993/5003). Probably, the upper part (*a*) of the body (left and upper parts of the imprint with transverse elements) were displaced respectively by the lower part (*b*) and partly bent (shapeless mass in the right part of the sample). Dashed line outlines the contour of the bent fragment situated on the reverse side of the sample, fine lines indicate the buttresses (supposed marks of fibers of vessels). The figure drawn on the specimen shown in Pl. 2, fig. 5. Scale bar is 2 cm.

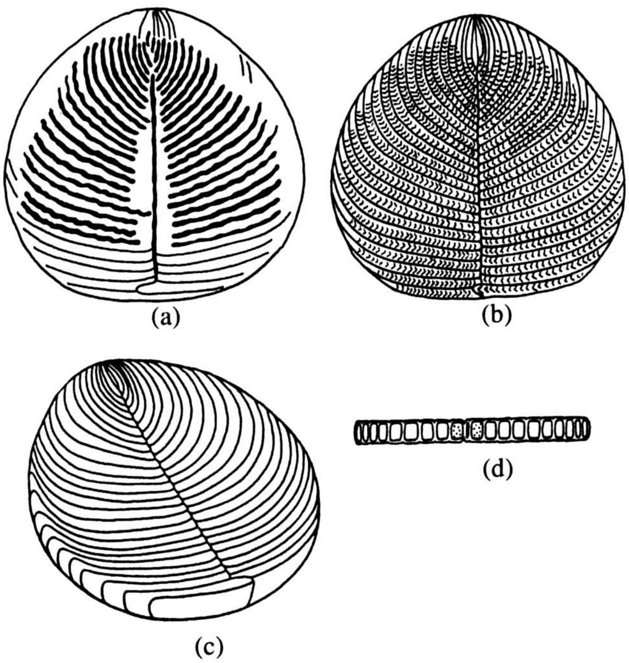


Fig. 5. *Yorgia waggoneri* gen. et sp. nov.: (a–b) the generalized scheme of the imprints: (a) negative, (b) positive; (c–d) reconstruction of the buried remains: (c) general view, (d) transverse section through the middle of the body, dots illustrate the area of possible position of some interior structures.

presence of the elements of the digestive system, in which radial appendages are observable as branching buttresses or furrows on the strip, outlining the blunt edge of some imprints. This view is in agreement with that of Professor J. Dzik (personal communication) and based on comparison of *Yorgia* with arthropods (Ivantsov, 1996). It is noteworthy, that *Dickinsonia* is also supposed to possess a digestive system consisting of not only the axial channel, but also of long lateral dichotomizing appendages (Wade, 1972; Jenkins, 1992). However, a similar pattern of imprints could also originate from other circumstances. The weak and sometimes absent borders between the transverse elements could result from an increase in the tissues density or change in the inclination of the membranes. During burial process the membranes might preclude the upper wall from fitting deep into the interior of the elements. Consequently, the borders between the elements would become weaker or disappeared completely within the folds of the creases. The narrow strip, outlining the blunt edge of some imprints (specimens nos. 3993/5024 and 3993/5007, the width of the strip is equal on both specimens) could be formed by the body wall. The branching structures on the strip are supposedly imprints of fibers or vessels which extended within the tissues. It is difficult to speculate that *Yorgia* possessed a branched digestive system since the mouth and anal openings of the organism are still unknown. Thus, such curious phenomena cannot be reliably interpreted based on the material available.

All of the specimens in our collection with preserved elements at the blunt edge (both positive and negative) show that the last element was on the right side (left, viewed from above). This indicates that the orientation of the bodies just before burial was similar. It is also supported by the presence of V-shaped hatching only on the imprints of the lower surface of the organism (if the same hatching was not masked by the crumpling folds). If this is consistent with other observations, it can be assumed that *Yorgia* was a sessile organism, and that its remains are *in situ*, at least in Level 2.

The reconstruction of *Yorgia* following the above discussion (Figs. 5c, 5d) is similar to that of the fossil *Dickinsonia* (Seilacher, 1989). The body of *Yorgia*, like *Dickinsonia*, was composed of two rows of elements, similar in structure. The walls of the elements were more rigid than its interior. The main difference between the new form and *Dickinsonia* is the sharp inequivality of the edges of *Yorgia*. The axial structure, which occurs on some imprints of *Dickinsonia* as a depression, is less prominent on *Yorgia* specimens. But some alteration in the mechanical properties of the tissues took place. It is noted by the rapid decrease of the depth of the furrows (the borders between the transverse elements) near the axis of the negative imprints. As compared to *Dickinsonia*, the negative imprints of the new forms appear coarser because of their greater depth, the bordering furrows between transverse elements are wider and more prominent. Perhaps, it is a consequence of the greater relative elasticity and the thickness of the walls of *Yorgia*. If the buttresses of *Yorgia*, which were found on a single specimen, are actually formed by the fibrous structure, the elasticity of the walls could have been increased by these fibers.

I do not consider the differences between the new form and *Dickinsonia* as very important, i.e., no more than generic. The glide reflection symmetry in the arrangement of the transverse elements of *Yorgia* and that of *Dickinsonia* (Fedonkin, 1987) supports uniting the two forms.

The diagnosis of the family Dickinsoniidae (Harrington and Moore, 1956; Glaessner, 1979) should be modified to include the genera *Palaeoplatoda* Fedonkin (1981) and *Yorgia* gen. nov. once a re-examination of *Palaeoplatoda* (with atypical for dickinsoniids bi- or even triblastic structure) is made.

SYSTEMATIC PALEONTOLOGY

Family Dickinsoniidae Harrington et Moore, 1955

Genus *Yorgia* Ivantsov, gen. nov.

Etymology. From the Yorga River.

Type species. *Yorgia waggoneri* gen. et sp. nov.; Arkhangelsk Region, White Sea Winter Coast; Upper Vendian, Mezen' Formation, Yorga Beds.

Diagnosis. Body with flattened upper and lower surfaces, relatively high, rounded in outlines. One margin pointed, opposite blunt. Body composed of two rows of narrow transverse elements of equal width. Elements of row displaced with respect to elements of opposite row along longitudinal axis approximately at one half of element's width. Angle between elements and longitudinal axis varies from 0° on pointed edge to 90° on blunt edge. Lateral flanks of elements pointed and bent towards pointed edge of body.

Composition. Type species.

Comparison. The new genus is similar to *Dickinsonia* Sprigg, 1947 in the following features: the upper and lower surfaces of the body are flattened, the body consists of two rows of transverse elements, the elements of the row are displaced in respect to the elements of the opposite row along the longitudinal axis approximately at a distance of one half of the element's width. But *Yorgia* can be distinguished from *Dickinsonia* by several features. Firstly, *Yorgia* has almost isometric outlines of the body, and the relative width of the transverse elements is greater. However, the juvenile specimens of *Dickinsonia costata* do not support this. Further they do not compare with *Yorgia* because of their sizes. Secondly, the angle between the elements and the longitudinal axis slightly exceeds (and only in few specimens) 90° (*Dickinsonia* shows the change of the angle from 0° on the one edge of the body to 180° on the opposite one). Thirdly, *Yorgia* differs from *Dickinsonia* by the pointed lateral flanks of the elements and their curvature toward the pointed edge of the body.

From *Palaeoplatoda* the new genus can be distinguished by almost isometric outlines of the body and the greater relative width of the transverse elements. Beside this, *Yorgia* lacks an axial structure, which is typical for *Palaeoplatoda*.

Remarks. On several features, including the bend of the transverse elements in the same direction, the genus is similar to representatives of the family Pteridiniidae Richter, 1955, but differs from them by a significantly lower axial zone of the body (see reconstruction of *Pteridinium* and *Ventogyrus*: Ivantsov and Grazhdankin, 1997).

The curvature of the transverse elements in the same direction unites *Yorgia* with *Valdainia* Fedonkin, 1983 and *Podolimirus* Fedonkin, 1983, but the equal width of the transverse elements in the major part of the imprints and their greater number distinguish *Yorgia* from these forms.

The presence of the crescent-like zone near the blunt edge on the negative imprints with a weak or even absent transverse partition makes *Yorgia* similar to *Spriggina* Glaessner, 1958, *Marywadea* Glaessner, 1976, *Vendia* Keller, 1969 and *Vendomia* Keller, 1976. The remains of the these genera, as the "trilobite-like" specimens of *Yorgia*, are negative imprints. However, only *Yorgia* specimens showed that the crescent-like zone has transverse elements similar to that of other areas of the body. The presence of such a zone itself may be generated by internal structures and requires study.

Yorgia waggoneri Ivantsov, sp. nov.

Plates 1 and 2

Etymology. In honor of B. Waggoner, who found the first specimen.

Holotype. PIN, no. 3993/5024; Arkhangelsk Region, White Sea Winter Coast, the locality near the Zimnie Gory Lighthouse; Upper Vendian, Mezen' Formation, the lower part of the Yorga Beds.

Description (Figs. 2–6).The body with flattened upper and lower surfaces, rounded, slightly egg-shaped in outline, relatively high. The length of complete specimens varies from 10 to 215 mm. The length/width ratio is approximately equal to 1 (Fig. 6).

The body is divided by the axial and transverse membranes into two rows of transverse elements. The elements of the row are displaced along the longitudinal axis with respect to the elements of the opposite row at a distance of one half of the element's width. The marginal element on the blunt edge strongly protrudes into the opposite row.

Transverse elements are long and narrow, their length increases towards the blunt edge. The width of the elements is almost equal in the different areas of the body and consists of about 0.02–0.04 of the element's length (table, Fig. 6). The mean ratio h1/L is 0.019, h2/L—0.024, h3/L—0.034, h4/L—0.036, h5/L—0.030. The maximum observed width of the transverse

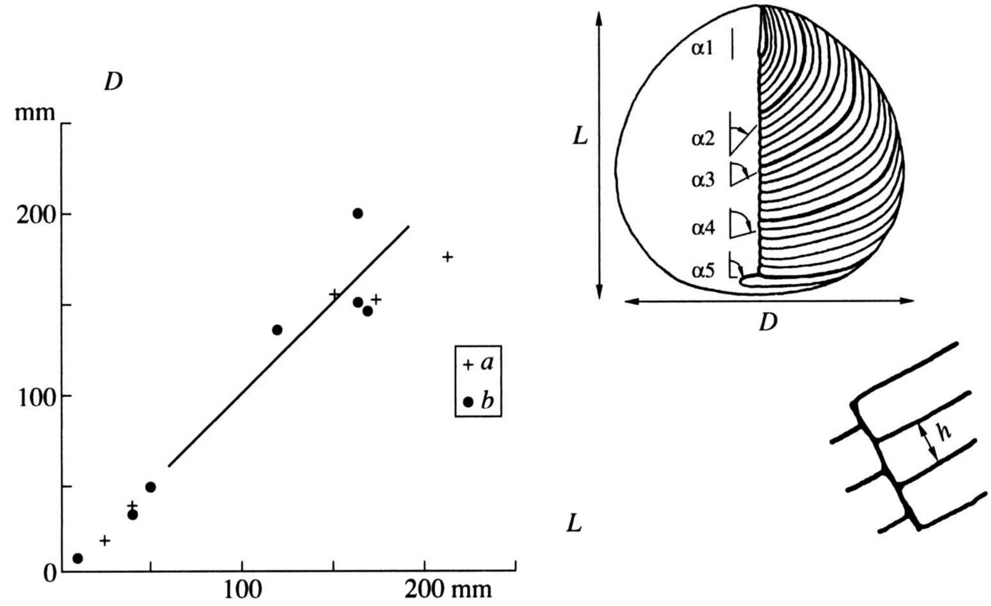


Fig. 6. Width/length ratio of *Yorgia waggoneri* gen. et sp. nov. and the measured parameters: (*a*) positive imprint, (*b*) negative imprint. Abbreviations: *L*— imprint's length, *D*—imprint's width, *h*—width of the transverse element in its middle area, α—angle between the transverse element and the longitudinal axis (α1—marginal element from the pointed edge, α5—marginal element from the blunt edge, α2—approximately 7–8 element from the pointed edge, α3—approximately 13–15 element from the pointed edge, α4—approximately 19–22 element from the pointed edge).

element is 7.2 mm (specimen no. 3993/5016). The lateral flanks of the elements are pointed and bent towards the pointed edge of the body. The angle between the elements and longitudinal axis varies from 0° on the pointed edge of the body to approximately 90° on the blunt one (Fig. 6). The mean value of the angle is: α1 = 0°, α2 = 45°, α3 = 60°, α4 = 80°, α5 = 90° (table).

The number of the transverse elements is about 25–35 pairs: holotype no. 3993/5024 has 25 elements on both sides, specimen no. 3993/5009—23 on the right side (viewed as on the Figs. 5 and 6), specimen no. 3993/5030—31 on the left side, specimen no. 3993/5049—35 on the right side, specimen no. 3993/5018—27 on the right side, specimen no. 3993/5007—23 on the left side, specimen no. 3993/5028—33 on the right side and 27 on the left one. As one can see from the analyses of the specimen of length 41.5–175 mm, the number of transverse elements does not depend upon body size.

The outer surface of the elements is ornamented by V-shaped hatches and the axial rib.

The tissues of the body possibly include thin fibers or vessels.

M e a s u r e m e n t s. See table.

M a t e r i a l. 65 specimens (40 imprints of positive relief and 25 of negative) from the type locality.

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