On Symmetry of Some Middle Ordovician Conodonts

Viive VIIRA

With 10 Figures

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Many Ordovician conodonts of the East Baltic area are characterized by right and left elements which are not exact mirror-image pairs. The right and left elements, often difficult to recognize, of species of the Middle Ordovician genera *Ambalodus*, *Eoplacognathus*, and *Polyplacognathus* are described. The conodonts dealt with belong to the class III symmetry of LANE.

Zahlreiche ordovizische Conodonten des östlichen Baltikums zeichnen sich aus durch Asymmetrie der linken und rechten Elemente. Es werden die oft schwer zu erkennenden linken und rechten Elemente von Arten der mittelordovizischen Gattungen *Ambalodus*, *Eoplacognathus* und *Polyplacognathus* beschrieben. Die beschriebenen Conodonten gehören der Symmetrieklasse III von LANE an.

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Introduction

By studying Ordovician Conodonts of the East Baltic Region it was noticable that the right and left elements of conodonts are not exact mirror-image pairings. There have been carried out only rare special investigations on this problem yet. 4 symmetry classes of conodonts have been mentioned by H. R. LANE, two of them concerning the conodont element-pairs (LANE, 1968). The material of the present paper deals with the class III symmetry according to H. R. LANE.

The asymmetry of some conodonts is remarkable; sometimes it is difficult to recognize that they belong to the same species. Therefore it is interesting to find out characteristic features both of the right and of the left elements as well as the differences between them. The asymmetry of platform conodonts can be easily recognized.

In the following the distinguishing features of three genera – *Ambalodus*, *Eoplacognathus* and *Polyplacognathus* are discussed, the species of which occur mainly in the Middle Ordovician (specimens of *Eoplacognathus* and *Polyplacognathus* are restricted to deposits of this time). The characteristics will be given by genera, the right and the left elements will be compared.

Ambalodus BRANSON & MEHL, 1933

Ambalodus is formed of a central cusp from which three processes diverge. We have examined separately two groups within the genus.

The first group includes *A. planus* SERGEEVA (fig. 1) and *A. pseudoplanus* VIIRA (fig. 2) from the upper part of the Lower Ordovician and from the lower part of the Middle Ordovician.

The general view of the left elements is comparatively lower than that of the right elements. The processes of the left elements diverge from the cusp and from lower on the cone than the right elements (fig. 1). (In all figures the left elements are placed to the left and the right elements to the right.) The cusp of the left elements is found between the denticle rows of the anterior and posterior processes. The lateral process originates from the lateral part of the cusp. In the right elements the denticle rows of the anterior and lateral processes originate from the anterior part of the cusp so that it is sometimes difficult to determine which of both is the anterior process and which is the lateral one. The anterior denticle row of the left elements runs along the middle part of the process or somewhat towards the inner side of it. In the right elements the anterior denticle row is located along the centre or towards the outer side of the process. This tendency is not so easily noticed in lateral and posterior processes. It is known that the cusp of both elements is reclined. But it is important to note that the cusp of the left elements is inclined to the inner side while that of the right elements is inclined to the outer side. The anterior and posterior processes of the left elements are located along the same line when viewed from above and the end of the anterior process is curved to the inner side. The lateral process diverges laterally. In the right elements the anterior process is distinctly curved from the very beginning whereas the lateral process is located more anteriorly than that of the left elements. The angle between the anterior and lateral processes of both the right and the left elements is the smallest in this group of *Ambalodus*. In the upper view the anterior and posterior processes of the left elements are in a straight line. However, in the right elements the lateral and posterior processes are in a straight line.

If the conodonts are placed with the posterior processes downward the anterior process of the left element and the lateral process of the right element are turned upward. Correspondingly, the lateral processes of the left elements and the anterior processes of the right elements are turned sideward.

The group of *Ambalodus triangularis* BRANSON & MEHL is characterized by a very short lateral process and by anterior and posterior processes which are almost identical in length. The oldest representatives of this group occur in the Middle Ordovician. *A. triangularis suecicus* BERGSTRÖM is

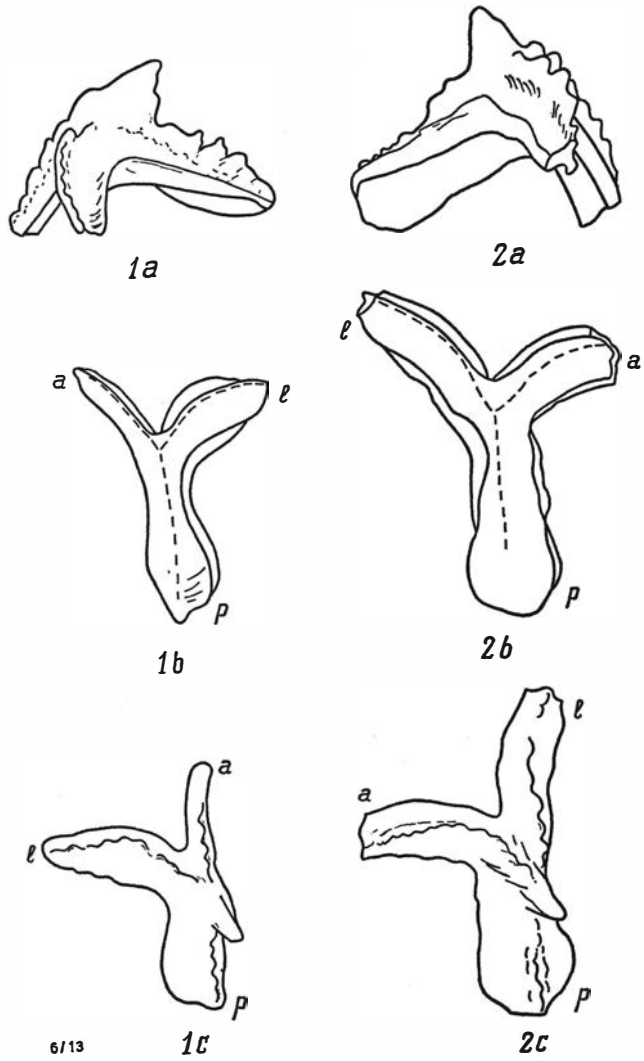

Fig. 1: *Ambalodus planus* SERGEEVA, left specimen Cn 814, right specimen Cn 815; Ohesaare boring, depth 511.15 m. 1a, 2a – lateral views; 1b, 2b – aboral views; 1c, 2c – oral views. ca. × 60

Terms used in illustrations of this paper: a – anterior process; p – posterior procecess; l – lateral process; bl – bilobate lateral process.

the left and *A. triangularis erraticus* BERGSTRÖM is the right element of the same species (fig. 3). To this group belong also *A. frognoeyensis* HAMAR (fig. 4) and *A. triangularis* ssp. (fig. 5) from the lower part of the Upper Ordovician. The left elements of this group are characterized by a high denticle row on the anterior processes (fig. 3). The cusp of the right elements is larger than that of the left though the denticle row is lower. All other characteristic features of both the

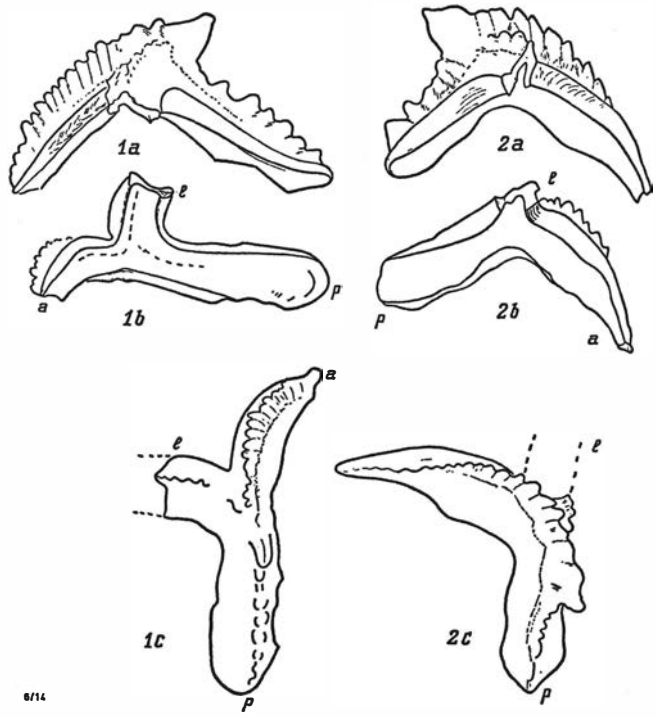

Fig. 2: *Ambalodus pseudoplanus* VIIRA, left specimen Cn 816, right specimen 817; Suhkrumägi, B_{III}. 1a, 2a – lateral views; 1b, 2b – aboral views; 1c, 2c – oral views. ca. × 40

left and the right elements are identical with those of the *A. planus* group. These are: general view, the points of origin of the processes from cusp, the position of the denticle rows on the processes, etc. The angles between the processes are almost the same (from 95° up to 135°). The smallest angle of the left elements is between the posterior and the lateral processes, whereas that of the right elements is between the posterior and anterior processes.

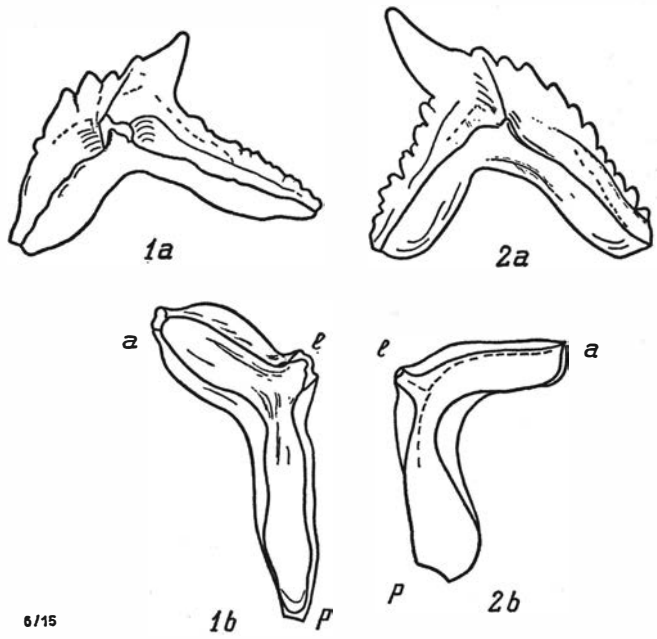

Fig. 3: 1a, b – *Ambalodus triangularis suecicus* BERGSTRÖM, left specimen Cn 818, 2a, b – *Ambalodus triangularis erraticus* BERGSTRÖM, right specimen Cn 819, Kaagvere boring, depth 298.2 m. 1a, 2a – lateral views; 1b, 2b – aboral views. ca. × 60

Studying the conodonts with their posterior processes turned downward we may distinguish two symmetrical figures. In this case the anterior process of the left element coincides with the lateral process of the right element.

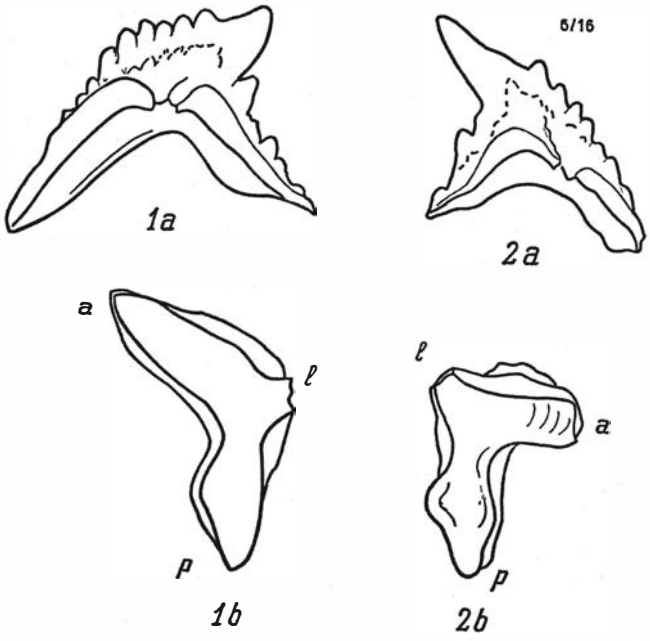

Fig. 4: *Ambalodus frognoeyensis* HAMAR, left specimen Cn 820, right specimen Cn 821; Ohesaare boring, depth 461.95 m. 1a, 2a – lateral views; 1b, 2b – aboral views. ca. × 60

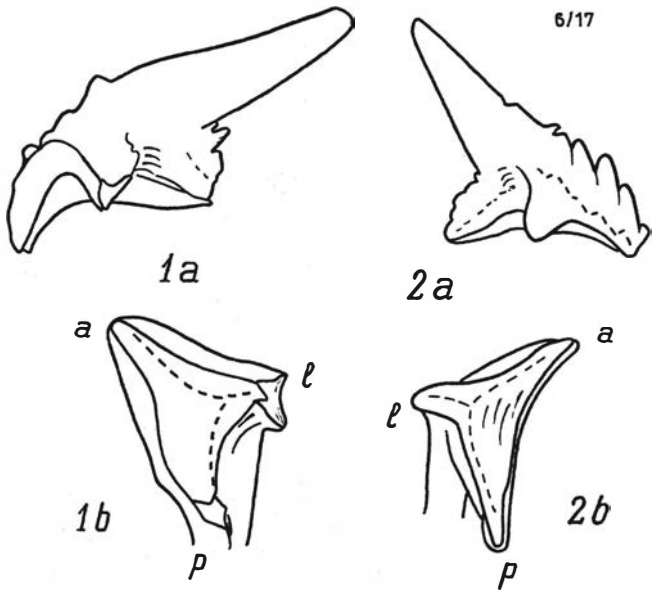

Fig. 5: *Ambalodus triangularis* ssp., left specimen Cn 821, right specimen Cn 822; Kohila, F_{Ib}. 1a, 2a – lateral views; 1b, 2b aboral views. ca. × 70

Eoplacognathus HAMAR, 1966

Eoplacognathus is characterized by a long anterior and by lateral and posterior processes which are almost of the same length. The species under discussion come from the lower part of the Middle Ordovician (figs. 6–9). The posterior and lateral processes of the left elements of *E. ambaloides* VIIRA, *E. tridens* VIIRA, *E. lobulus* VIIRA are almost of the same size. In some cases (*E.* cf. *foliaceus* FÅHRAEUS) the lateral process is somewhat shorter than the posterior process, and the anterior process is particularly long. The anterior process of the right elements is long and wide, but sometimes (*E.* cf. *foliaceus*) the lateral process may surpass the posterior in size.

The processes of left elements are positioned at the same level, with the free ends of processes in some cases being turned down (fig. 7). The anterior process of the right elements is plane, whereas the lateral and the posterior processes are curved downward, except for *E. ambaloides*. This species resembles *Ambalodus*, especially by the characteristics of the curvature of the process. The inclination of the cusp and the position of the denticle rows on the processes are also important in *Eoplacognathus*. The cusp of the left elements is positioned between the denticle rows of the anterior and the posterior processes whereas the denticle row of the lateral process originates from the lateral part of the cusp. Usually the cusp is inclined to the opposite side of the lateral process; at the same time it may not be in a straight line with the posterior process.

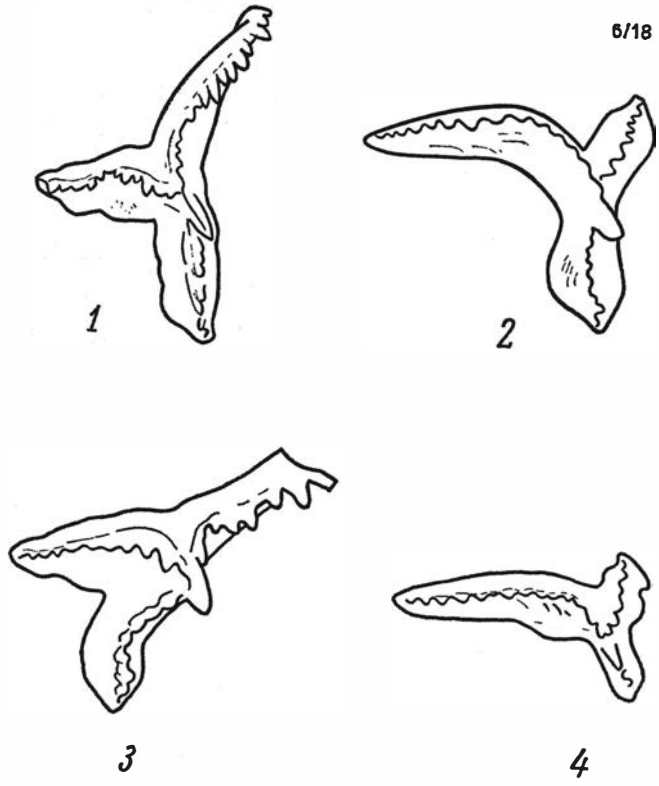

Fig. 6: 1,2 – *Eoplacognathus ambaloides* VIIRA, 1 – left specimen Cn 823, Äiamaa boring, depth 233.7 m; 2 – right specimen Cn 824, Ohesaare boring, depth 505.05 m. 3,4 – Eoplacognathus tridens Viira, 3 – left specimen Cn 825, 4 – right specimen Cn 826, Äiamaa boring, depth 227.75 m; oral views. ca. × 45

The denticle rows of the anterior and lateral processes of the right elements originate from the anterior part of the cusp, the latter being turned towards the posterior process. In the upper view the processes are placed in the following way: the anterior and the lateral processes of the left elements are in the same line whereas the posterior and lateral processes of the right elements form a straight line. The posterior and anterior processes of the left elements are cur-

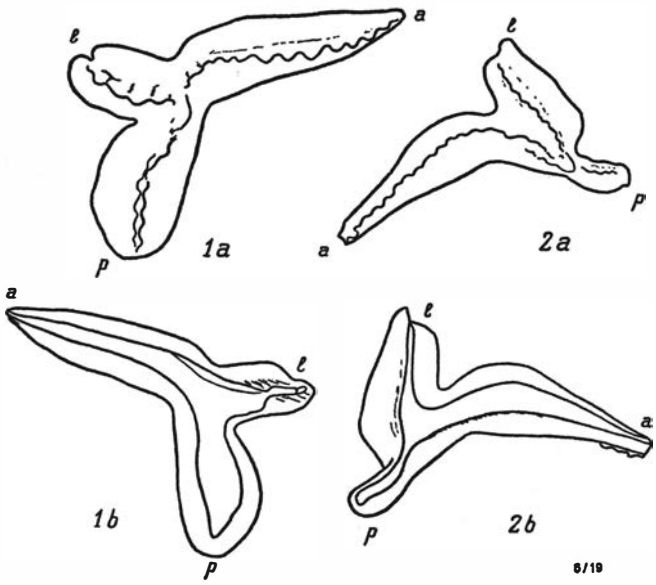

Fig. 7: *Eoplacognathus* cf. *foliaceus* FÅHRAEUS, left specimen Cn 827, right specimen Cn 828, Karula boring, depth 444.6 m; 1a, 2a – oral views; 1b, 2b – aboral views. ca. × 45

ved in the upper view and the smallest angle is between the posterior and the lateral processes. The anterior and posterior processes of the right elements form a more distinct curve than in the left elements. The smallest angle is between the lateral and the anterior process (*E. ambaloides*, *E.* cf. *foliaceus*, *E. tridens*) or the angles between the posterior and the anterior and the lateral and the anterior are almost identical (*E. lobulus*, *E. akros*). When placed with their posterior processes turned downward, gross morphology of species of *Eoplacognathus* resembles that of the species of *Ambalodus*.

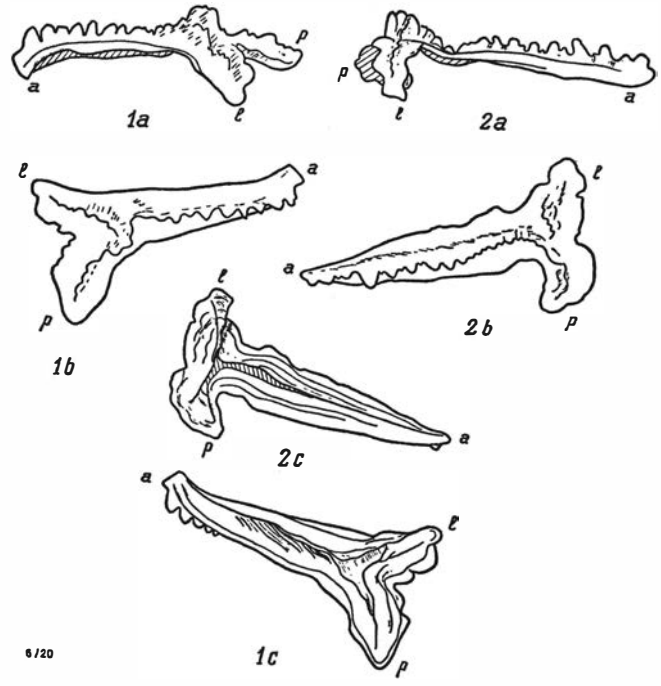

Fig. 8: *Eoplacognathus lobulus* VIIRA, left specimen Cn 829, right specimen Cn 830, Ohesaare boring, depth 497.25 m; 1a, 2a – lateral views; 1b, 2b – aboral views; 1c, 2c – oral views. ca. × 45

The only difference is between the position of the long anterior process which is curved to the inner side in the left elements and posteriorly at the lateral side in the right elements. It is difficult to see the symmetry of the left and right elements of *Eoplacognathus* because of the long anterior process, which causes confusion. The symmetry is noticeable in the distorting mirror, that is, under the acute angle on the surface of symmetry. If we place the conodonts with their cusp turned down, the posterior process of right elements remains also turned down, as in the previous case. But the posterior process of the left elements is directed posterolaterally with the anterior process being placed horizontally. As a result of it we get two symmetrical triangular figures, which are mirror-imaged pairs. By the same method (placing the cusp down) we can observe the genus of *Ambalodus* and get also a mirror-imaged pair.

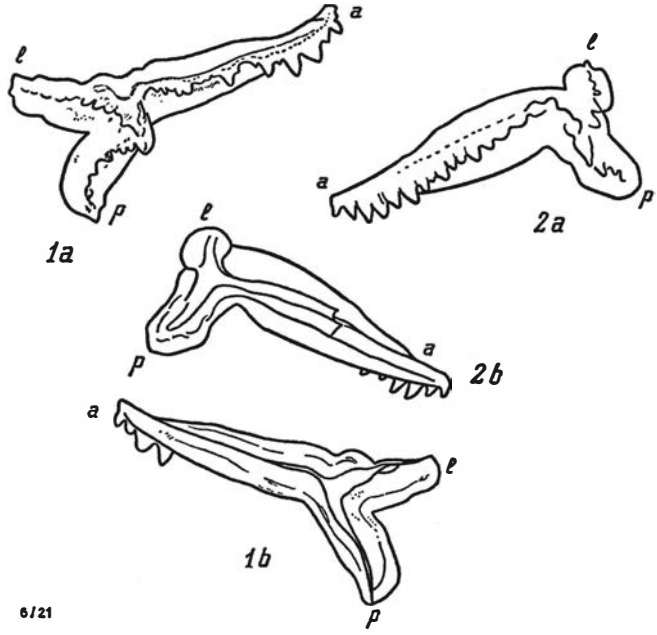

Fig. 9: *Eoplacognathus akros* VIIRA, left specimen Cn 831, right specimen Cn 832, Ohesaare boring, depth 495.95 m; 1a, 2a – aboral views; 1b, 2b – oral views. ca. × 40

Polyplacognathus STAUFFER, 1935

Polyplacognathus is characterized by five processes diverging from the centre of the conodont. The posterior process of the right elements of this genus is shorter and broader than that of the left elements (fig. 10). The outer-lateral part of the posterior process of the right elements usually forms an expansion (broadening) where the additional denticle row can be found on it. The posterior process of the left elements is longer and without the expansion as compared with the right elements. The unilobate lateral process of the right elements is narrower and longer than that of the left elements. Vice versa, the bilobate lateral process of the left elements is shorter than that of the right ones. The anterior process of the left elements is comparatively bigger and possesses a higher denticle row than that of the right elements. The denticle rows of the other processes of the right elements are also lower than those of the left elements. Studying the specimens of *Polyplacognathus* with their posterior proces-

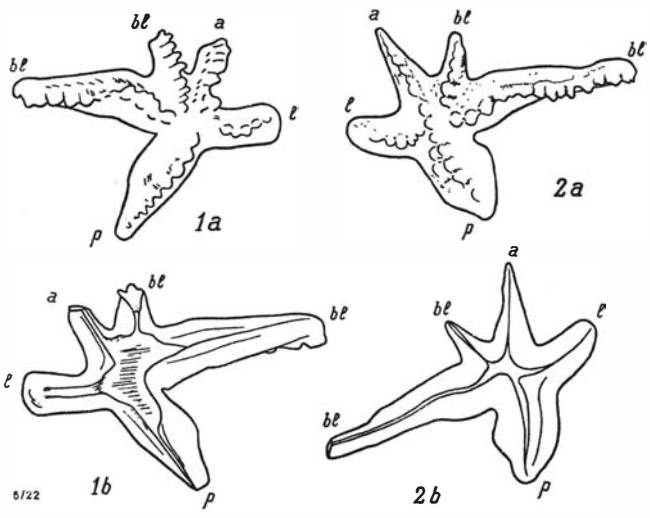

Fig. 10: *Polyplacognathus stella* VIIRA, left specimen Cn 833, right specimen Cn 834, Are boring, depth 318.2 m; 1a, 2a – aboral views; 1b, 2b – oral views. ca. × 45

ses placed downwards, we can see that the left elements as well as the right ones form symmetrical mirror-images.

As it was mentioned above, the common features of the three genera are characteristic of the right elements on one hand and of the left elements on the other hand. We can also see that the right and the left elements are symmetrical, although this is not always clear (for example in the genus *Eoplacognathus*). According to NALIVKIN's definition these figures are "curvilinearly symmetrical" (Наливкин, 1951). After MICHEYEV the curvilinear symmetry can be considered as homology (Михеев, 1951, 1961). It allows us to consider the right and the left elements of the conodonts as homologous, that is, they coincide in the curved surface. As a result of it we may conclude that the right and left elements were positioned under unequal angles relation to the surface of symmetry (homology). According to that we may assume that the right and left elements were located on the conodont-bearing animal in a twisted position with each other.

References

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