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**ICHTHYOFAUNA FROM DEPOSITS OF THE RECHITSA REGIONAL STAGE  
(FRASNIAN, UPPER DEVONIAN) OF THE GOMEL STRUCTURAL DAM  
(FROM RESULTS OF THE UVAROVICHI 94 BOREHOLE LOG STUDY)**

The paper presents the results of the palaeoichthyological study of the rocks of the Rechitsa Regional Stage exposed in the Uvarovich 94 borehole within the Uritsk Block of the Gomel Structural Dam. A vertebrate assemblage established in this borehole is correlated with the synchronous ichthyologic assemblages in the adjacent territories of the East European Platform. The vertebrates of this assemblage are represented by the heterostracans, placoderms, acanthodians and bony fishes. The ichthyofauna data obtained in the Rechitsa Regional Stage slightly supplement the available information on its geographical distribution and systematic composition within the country. The Stratigraphic Chart of the Devonian deposits of Belarus (2010) was assumed as a stratigraphic basis of the Upper Devonian deposit division in the studied area.

**Keywords:** Belarus, Upper Devonian, Gomel Structural Dam, ichthyofauna, Rechitsa Regional Stage, Frasnian

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**ИХТИОФАУНА ИЗ ОТЛОЖЕНИЙ РЕЧИЦКОГО ГОРИЗОНТА (ФРАНКИЙ ЯРУС, ВЕРХНИЙ ДЕВОН)  
ГОМЕЛЬСКОЙ СТРУКТУРНОЙ ПЕРЕМОЧКИ  
(ПО РЕЗУЛЬТАТАМ ИЗУЧЕНИЯ РАЗРЕЗА СКВАЖИНЫ УВАРОВИЧИ 94)**

Приводятся результаты палеоихтиологического изучения пород речичьего горизонта, вскрытых скважиной Уваровичи 94 в пределах Урицкого блока Гомельской структурной перемычки. Установленный комплекс позвоночных в этой скважине сопоставляется с одновозрастными ихтиокомплексами сопредельных территорий Восточно-Европейской платформы. Позвоночные в комплексе представлены гетеростраками, акантодами, плакодермами и костными рыбами. Полученные данные по ихтиофауне речичьего горизонта несколько дополняют информацию о ее географическом распространении и систематическом составе в пределах республики. За стратиграфическую основу расчленения верхнедевонских отложений в исследуемом районе принята стратиграфическая схема девонских отложений Беларуси (2010 г.).

**Ключевые слова:** Беларусь, верхний девон, Гомельская структурная перемычка, ихтиофауна, речичьий горизонт, франкий ярус

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**ІХТЫЯФАЎНА З АДКЛАДАЎ РЭЧЫЦКАГА ГАРЫЗОНТУ (ФРАНСКІ ЯРУС, ВЕРХНІ ДЭВОН)  
ГОМЕЛЬСКОЙ СТРУКТУРНОЙ ПЕРАМОЧКІ  
(ПА ДАДЗЕНЫМ ВЫВУЧЭННЯ РАЗРЭЗУ СВДРАВІНЫ ЎВАРАВІЧЫ 94)**

У артыкуле прыводзяцца вынікі палеаіхтыялагічнага вывучэння парод рэчыцкага гарызонту, якія былі ўскрытыя свідравінай Уваравічы 94 у межах Урыцкага блока Гомельскай структурнай перамошкі. Усталяваны комплекс хрыбетных у гэтай свідравіне супастаўляецца з іхтыякамплексамі таго ж самага ўзросту сумежных тэрыторый Усходне-Еўрапейскай платформы. Хрыбетныя ў комплексе прадстаўлены гетэрастракамі, акантодамі, плакадэрмамі і касцявымі рыбамі. Атрыманая дадзеныя па іхтыяфаўне рэчыцкага гарызонту некалькі дапаўняюць інфармацыю аб яе геаграфічным распаўсюджанні і сістэматычным складзе ў межах рэспублікі. За стратыграфічную аснову расчленення верхнедевонскіх адкладаў у даследуемым раёне прынятая стратыграфічная схема девонскіх адкладаў Беларусі 2010 г.

**Ключавыя словы:** Беларусь, верхні дэвон, Гомельская структурная перамошкі, іхтыяфаўна, рэчыцкі гарызонт, франскі ярус

**Introduction.** The deposits of the Rechitsa Regional Stage of the Frasnian Stage are widespread in the territory of Belarus within the Pripyat Trough, North-Pripyat Shoulder, Gomel Structural Dam, Bragin-Loev Saddle, in the southern part of the Zhlobin Saddle and in the Orsha Depression [1, 2]. Within the most part of the Pripyat Trough, in the North-Pripyat Shoulder and in the south of the Zhlobin

Saddle the Rechitsa Regional Stage is represented by the variegated clays, marls and dolomitic marls with an admixture of sandy-silty material, with some interbeds of the dolomites, more rarely, limestones in the middle part of the section. In the diatreme calderas of the Yelets Block of the Zhlobin Saddle, the Rechitsa Regional Stage is represented by the volcanogenic-sedimentary deposits. Some interbeds and inclusions of the volcanogenic material occur in the section of this Regional Stage within the Gomel Structural Dam, Bragin-Loev Saddle and the easternmost part of the Inner Graben. Within the territory of the Orsha Depression the clayey-marlaceous rocks lying at the bottom of the Voronezh Regional Stage sediments are related to the deposits of the Rechitsa Regional Stage.

The Rechitsa deposits contain a rather rich community of the different groups of the fossil organisms among which the most common ones are usually the scolecodonts, ostracodes, gastropods, bivalves, brachiopods, tentaculites, conodonts, ichthyofauna, carbonified plant remains and miospores. The brachiopods, conodonts, ichthyofauna and miospores are most important for this stratigraphic unit correlation. A narrow range of the vertical distribution of some of these fauna and flora species made it possible to distinguish a number of the biostratigraphic zones that are observed in the sections of the synchronous deposits of Belarus. For example, according to the conodont distribution the deposits of the Rechitsa Regional Stage may be related to the lower part of the *Palmatolepis rhenana* zone, according to the vertebrates – to the placoderm zone *Bothriolepis maxima*, and from the miospore evidences – to the local zone of *Convolutispora crassitunicata*.

As mentioned above, the deposits of the Rechitsa Regional Stage are characterized by abundant vertebrates besides the invertebrate fauna, conodonts and flora representatives. D.V. Obruchev was first to record the vertebrates from these deposits in the territory of Belarus. He determined the fish remains from the Rechitsa P74 borehole (depth of 3021 – 3027 m) drilled within the Pripjat Trough. According to his definitions the ichthyofauna remains were represented by the antiarch plates of *Bothriolepis* sp., the sarcopterygian scales and teeth of *Holoptychius* sp., *Onychodus* sp. that did not allow him to define more exactly the stratigraphic position of the Rechitsa Regional Stage [3, 4].

In the early nineties of the past century I.I. Uriev recommenced a purposeful search for large, well-defined skeletal fish elements in the cores of the Rechitsa Regional Stage. The first and single finding was made during the field season of 1991 in the core of the Babinets P28 borehole, which exposed the deposits of the Rechitsa Regional Stage. This borehole is located in the northern part of the Pripjat Trough. The fishes were found at the boundary of two core intervals: 3965.7-3973.5 m and 3973.5-3985.8 m. The core samples with large well-preserved fish remains were passed to V.N. Karatajūtė-Talimaa and J. J. Valiukevičius in the Lithuanian Geological Institute (Vilnius city), where they determined that all the plate fragments belonged to the same species of *Bothriolepis maxima* Gross [5].

The palaeontological characteristic of the Rechitsa deposits by the vertebrate evidences was supplemented as a result of the analysis of the ichthyofauna found in a variegated argillite sample from the Antonovskaya P1 borehole (depth of 4029.4 m) drilled in the southeastern part of the Pripjat Trough. The fish remains found there were *Bothriolepis* sp., *Holoptychius* sp. cf. *H. nobilissimus* Ag., *Rhinodipterus* sp., and some single acanthodian scales of *Devononchus laevis* (Gross) were determined too [5, 6].

The additional data on the ichthyofauna of this Regional Stage were obtained much later by the author of this paper. He established a representative fish assemblage in the dolomitic marls of the Zhlobin 389 borehole (depth of 184.0-201.7 m). This assemblage is represented by some isolated plates of *Bothriolepis maxima* Gross and some scales of *Holoptychius* cf. *nobilissimus* Ag. [7–10].

Another examination of the palaeontological material from the Zhlobin 389 borehole at depth of 191.9-194.2 m has recently resulted in findings of some bony fish scales of Actinopterygii indet. and Sarcopterygii indet., as well as one fragment of the fin spine of Acanthodii gen. indet. Some few vertebrate remains of the Rechitsa age were also established by the author in the Zhlobin 609, Zhlobin 593, Rechitsa P9 and Rechitsa P15 boreholes. So, the scales of *Acanthodes* sp., discrete teeth of *Strunius* sp., some small scale fragments of Sarcopterygii indet. were found in the Zhlobin 609 borehole (depths of 158.6 m and 172.5 m), and the dentine tubercle of Psammosteidae gen. indet., some small scale fragments of Sarcopterygii indet. – in the Zhlobin 593 borehole (depth of 189.5 m). Some isolated psammosteid agnathan tubercles of Psammosteidae indet. some single ray-finned fish scales of Actinopterygii

indet. and a small jaw fragment were determined in the Rechitsa P9 borehole (depth of 2736.8 m), and the teeth of *Strunius* sp. were established in the Rechitsa P15 borehole (depth of 2945.0 – 2957.05 m).

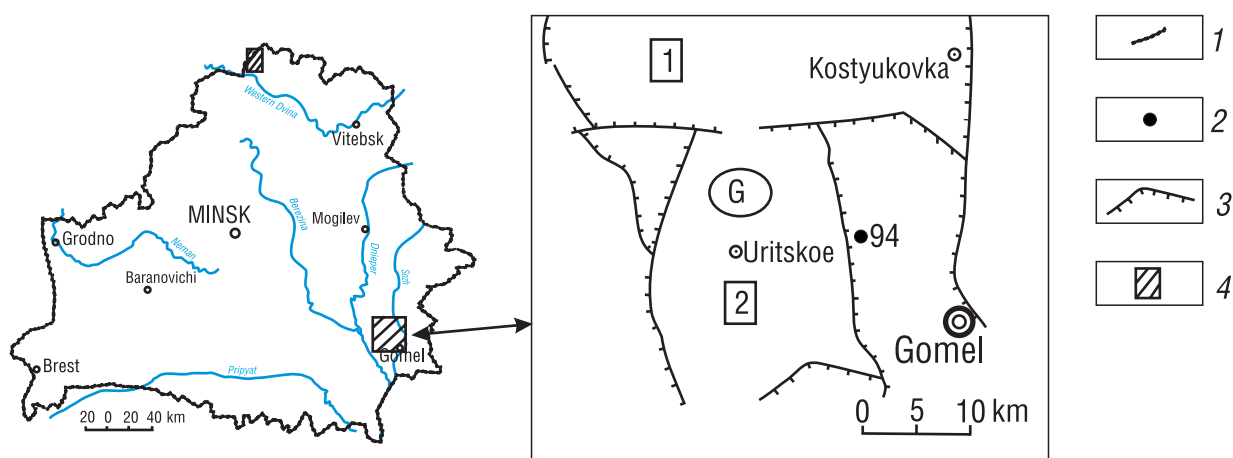
It is worth noting an interesting palaeoichthyological finding made this year by geologist Yu.V. Zaika in the “Vekshitchi” sand-gravel quarry in the Minsk region. He has found a redeposited clayey limestone fragment including a large fragment of the anterior mediodorsal plate related to the species of *Bothriolepis maxima* Gross in the Quaternary deposits exposed in the quarry. The deposits corresponding to the time of this species natural occurrence are absent in this area. Therefore, the rock containing this plate fragment was, apparently, transported by the glacier from the territory of the Baltic States or Russia, where the similar deposits occur. This is for the present the first reliable finding of the fish skeletal element of the age considered in this paper.

**Materials and methods.** The skeletal material of the agnathans and fishes presented in the paper was taken from the core of the Uvarovichi 94 borehole drilled in the territory of the Uritsk Block of the Gomel Structural Dam (Text-Fig. 1). The ichthyofauna remains obtained by dissolving the limestones, clayey limestones, marls with the acetic and formic acids are represented by the micro- and mesomeric skeletal elements: tubercles, plate fragments, small fragments of indefinable skeletal elements, fin spine fragments, scales, teeth and some small jaw fragments of satisfactory or relatively good safety. Systematically, all the mentioned skeletal elements are related to such ichthyofauna groups as the heterostracans, placoderms, acanthodians and osteichthyans.

The photomicrographs of the agnathan and fish remains with a scanning electron microscope JSM-5610 LV (JEOL, Japan) were made to illustrate the material. The pictures were processed with Adobe Photoshop CS6, the figures were created with CorelDRAW X3. The skeletal elements were studied using the microscopes MBS-1 and «LOMO» Biolam au-12.

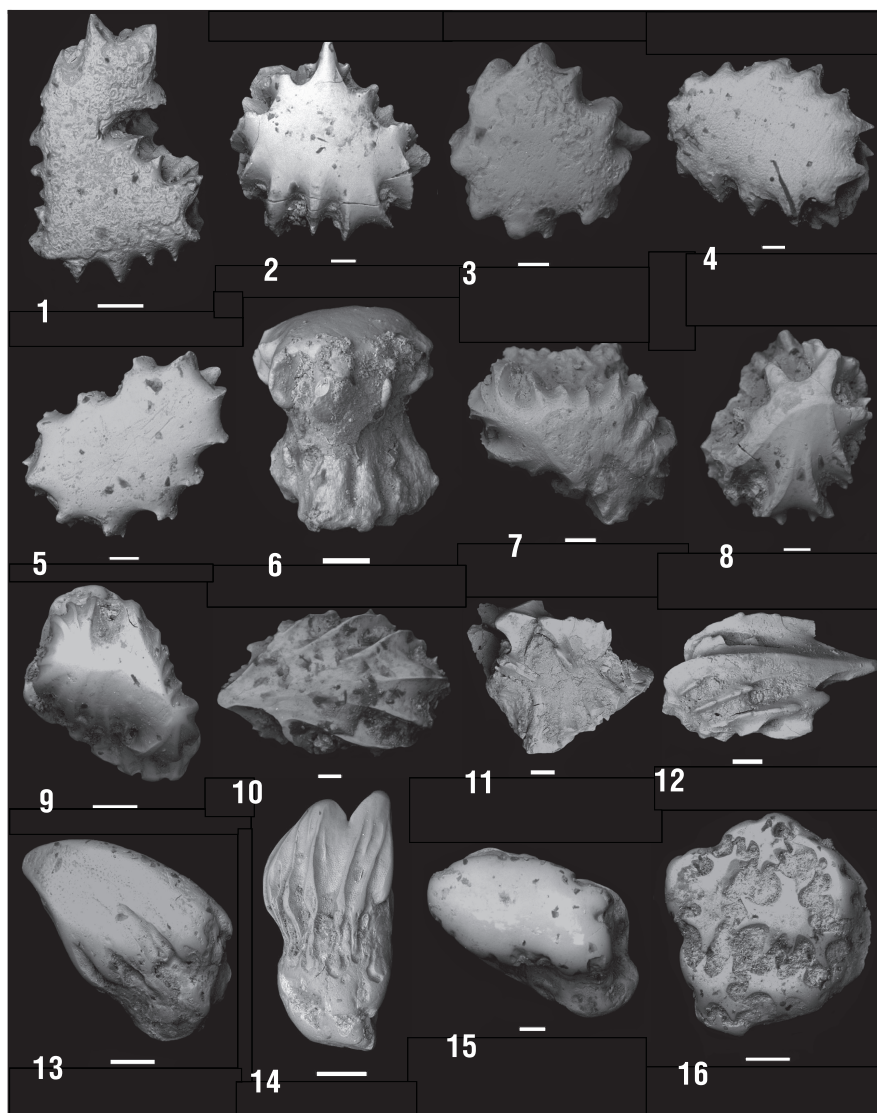
The diagnostics of the skeletal elements of the agnathans and fishes were mainly based on the external morphological features. The skeletal material fragmentation and safety degree did not allow specifying the species or genus of the specimens; therefore, the nomenclature for a number of the vertebrates was left open.

**Ichthyofauna from the rechitsa deposits of the Uvarovichi 94 borehole.** The Uvarovichi 94 borehole was drilled near the town of Gomel. Tectonically, it was drilled in the territory of the Uritsk Block of the Gomel Structural Dam. This borehole penetrated the whole of the Frasnian deposits. The only Rechitsa deposits that the author is interested in, as well as the underlying Semiluki sediments and the lower part of the Jurassic deposits covering the Rechitsa ones are described in this part of the paper (Text-Fig. 2). Their lithological and palaeontological description is given below. A detailed palaeoichthyological characteristic of the deposits of the Rechitsa Regional Stage is also presented. Some skeletal elements of the agnathans and fishes are demonstrated separately on the Plates I, II, III, IV, V, VI, VII and VIII.



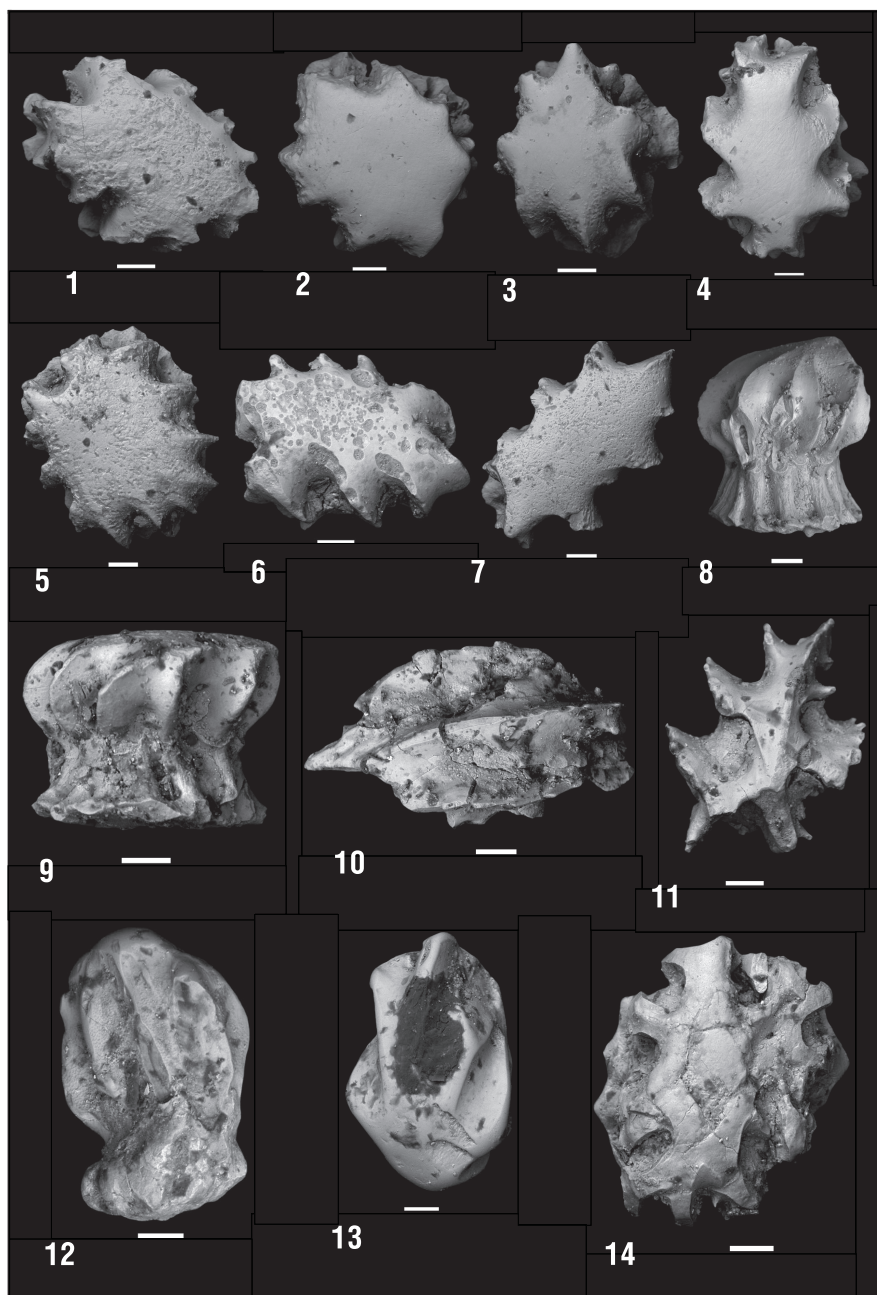
Text-Fig. 1. Sketch map showing the location of the Uvarovichi 94 borehole (from [11] with some modifications by the author): 1 – state frontier, 2 – borehole, 3 – regional fractures, 4 – studied area. G - Gomel Structural Dam, 1 – Uvarovichi block, 2 – Uritsk block





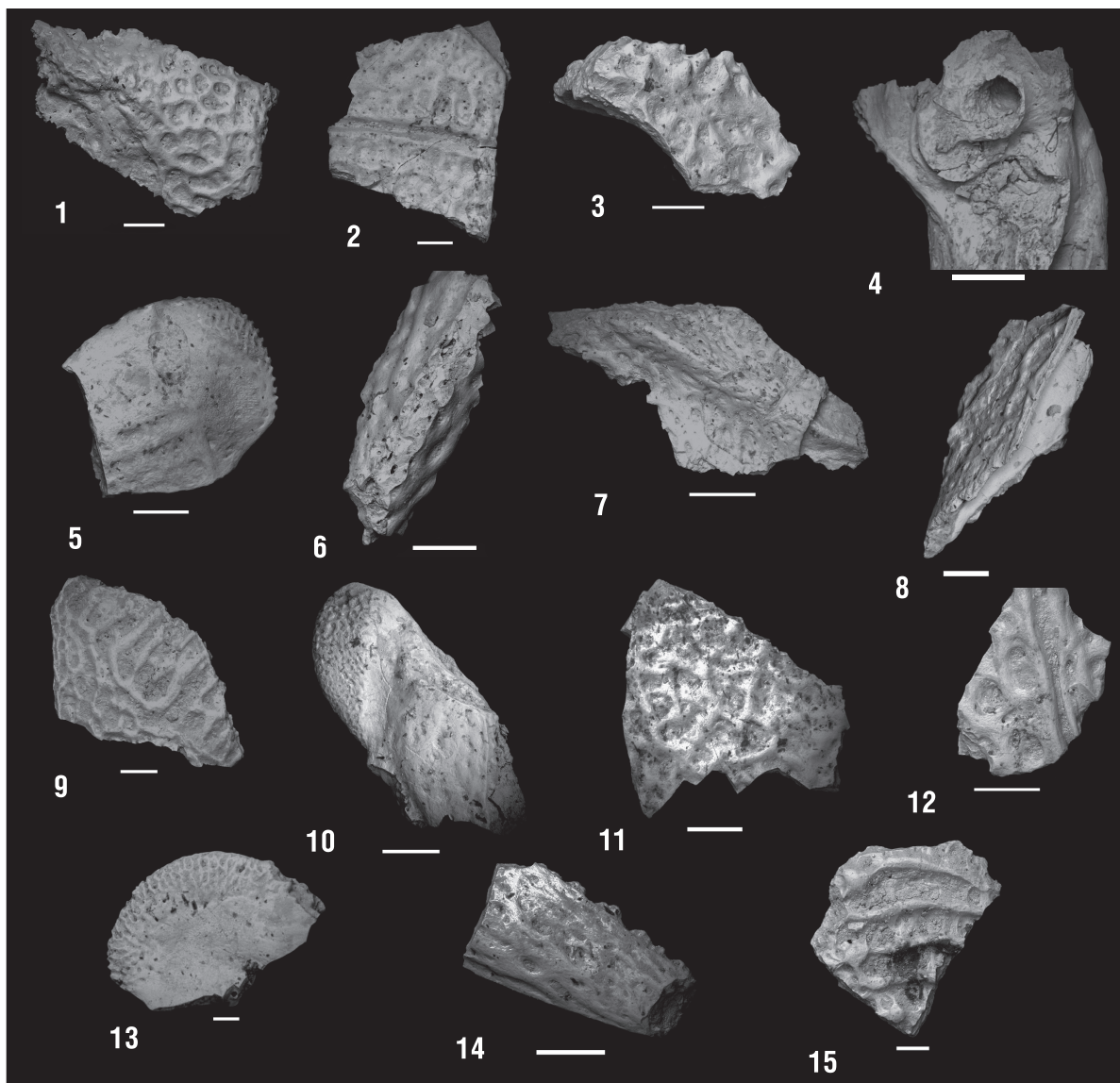
**Plate I. Heterostracan dentine tubercles from the Uvarovichi 94 borehole.** Skeletal elements of the agnathans from the Upper Frasnian Substage, Frasnian Stage, Upper Devonian. Scale bar 100  $\mu\text{m}$  for Figures 2, 3, 4, 5, 6, 8, 10, 11, 12, 15; and 200  $\mu\text{m}$  for Figures 1, 7, 9, 13, 14, 16

Figure 1 – *Psammosteus* sp. 1. Specimen № 69/4-7a, depth of 302.0 m,  $\times 65$ , dentine tubercle, top view, Rechitsa Regional Stage. Figure 2 – *Psammosteus* sp. 1. Specimen № 69/4-7b, depth of 302.0 m,  $\times 100$ , dentine tubercle, top view, Rechitsa Regional Stage. Figure 3 – *Psammosteus* sp. 1. Specimen № 69/4-7n, depth of 302.0 m,  $\times 120$ , dentine tubercle, top view, Rechitsa Regional Stage. Figure 4 – *Psammosteus* sp. 1. Specimen № 69/4-7c, depth of 302.0 m,  $\times 100$ , dentine tubercle, top view, Rechitsa Regional Stage. Figure 5 – *Psammosteus* sp. 1. Specimen № 69/4-7d, depth of 302.0 m,  $\times 120$ , dentine tubercle, top view, Rechitsa Regional Stage. Figure 6 – *Psammosteus* sp. 1. Specimen № 69/4-7f, depth of 302.0 m,  $\times 130$ , dentine tubercle, lateral view, Rechitsa Regional Stage. Figure 7 – *Psammosteus* sp. 1. Specimen № 69/4-7h, depth of 302.0 m,  $\times 70$ , dentine tubercle, oblique top view, Rechitsa Regional Stage. Figure 8 – *Psammosteus* sp. 1. Specimen № 69/4-7k, depth of 302.0 m,  $\times 100$ , dentine tubercle, top view, Rechitsa Regional Stage. Figure 9 – *Psammosteus* sp. 1. Specimen № 69/6a-5b, depth of 307.0 m,  $\times 90$ , dentine tubercle, top view, Rechitsa Regional Stage. Figure 10 – *Psammosteus* sp. 1. Specimen № 69/4-7g, depth of 302.0 m,  $\times 100$ , dentine tubercle, top view, Rechitsa Regional Stage. Figure 11 – Psammosteidae gen. indet. Specimen № 69/4-3c, depth of 302.0 m,  $\times 100$ , broken-down dentine tubercle, lateral view, Rechitsa Regional Stage. Figure 12 – *Psammosteus* sp. 2. Specimen № 69/4-3b, depth of 302.0 m,  $\times 100$ , dentine tubercle, oblique top view, Rechitsa Regional Stage. Figure 13 – *Psammosteus* sp. 3. Specimen № 69/6a-5a, depth of 307.0 m,  $\times 85$ , dentine tubercle, lateral view, Rechitsa Regional Stage. Figure 14 – *Psammosteus* sp. 3. Specimen № 69/5-4a, depth of 310.5 m,  $\times 90$ , dentine tubercle, lateral view, Rechitsa Regional Stage. Figure 15 – *Psammosteus* sp. 3. Specimen № 69/6a-5d, depth of 307.0 m,  $\times 120$ , dentine tubercle, top view, Rechitsa Regional Stage. Figure 16 – *Psammosteus megalopteryx* (Trautschold). Specimen № 69/6a-5c (clearly redeposited), depth of 308.5 m,  $\times 75$ , tessera, top view, Rechitsa Regional Stage



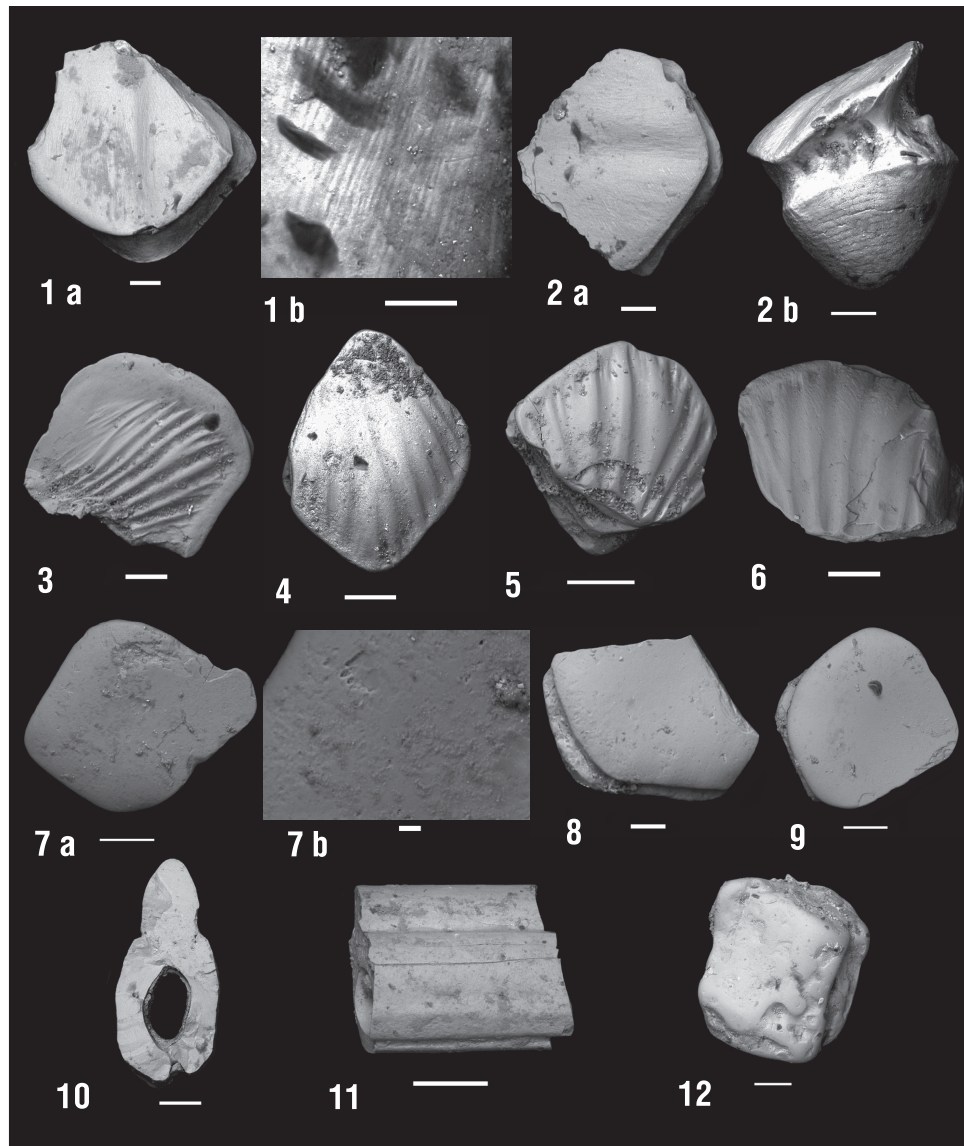
**Plate II. Heterostracan dentine tubercles from the Uvarovichi 94 borehole.** Skeletal elements of the agnathans from the Upper Frasnian Substage, Frasnian Stage, Upper Devonian. Scale bar 100  $\mu$ m for Figures 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, and 14

Figure 1 – *Psammosteus* sp. 1. Specimen № 69/4-9a, depth of 302.0 m,  $\times 140$ , dentine tubercle, top view, Rechitsa Regional Stage.  
 Figure 2 – *Psammosteus* sp. 1. Specimen № 69/4-9b, depth of 302.0 m,  $\times 140$ , dentine tubercle, top view, Rechitsa Regional Stage.  
 Figure 3 – *Psammosteus* sp. 1. Specimen № 69/4-9c, depth of 302.0 m,  $\times 150$ , dentine tubercle, top view, Rechitsa Regional Stage.  
 Figure 4 – *Psammosteus* sp. 1. Specimen № 69/4-9d, depth of 302.0 m,  $\times 100$ , dentine tubercle, top view, Rechitsa Regional Stage.  
 Figure 5 – *Psammosteus* sp. 1. Specimen № 69/4-27, depth of 302.0 m,  $\times 100$ , dentine tubercle, top view, Rechitsa Regional Stage.  
 Figure 6 – *Psammosteus* sp. 1. Specimen № 69/4-26, depth of 302.0 m,  $\times 150$ , dentine tubercle, top view, Rechitsa Regional Stage.  
 Figure 7 – *Psammosteus* sp. 1. Specimen № 69/4-44, depth of 302.0 m,  $\times 120$ , dentine tubercle, top view, Rechitsa Regional Stage.  
 Figure 8 – *Psammosteus* sp. 1. Specimen № 69/4-9f, depth of 302.0 m,  $\times 100$ , dentine tubercle, lateral view, Rechitsa Regional Stage.  
 Figure 9 – *Psammosteus* sp. 1. Specimen № 69/4-28, depth of 302.0 m,  $\times 130$ , dentine tubercle, lateral view, Rechitsa Regional Stage.  
 Figure 10 – *Psammosteus* sp. 2. Specimen № 69/4-30, depth of 302.0 m,  $\times 100$ , dentine tubercle, oblique top view, Rechitsa Regional Stage.  
 Figure 11 – *Psammosteus* sp. indet. Specimen № 69/4-47, depth of 302.0 m,  $\times 120$ , dentine tubercle, top view, Rechitsa Regional Stage.  
 Figure 12 – *Psammosteus* sp. 3. Specimen № 69/5-19, depth of 310.5 m,  $\times 120$ , dentine tubercle, lateral view, Rechitsa Regional Stage.  
 Figure 13 – *Psammosteidae* gen. indet. Specimen № 69/5-23, depth of 310.5 m,  $\times 100$ , dentine tubercle, oblique top view, Rechitsa Regional Stage.  
 Figure 14 – *Psammosteus* sp. 4. Specimen № 69/4-25, depth of 302.0 m,  $\times 100$ , dentine tubercle, top view, Rechitsa Regional Stage



**Plate III. Placoderm plate fragments from the Uvarovichi 94 borehole.** Skeletal elements of the antiarchs from the Upper Frasnian Substage, Frasnian Stage, Upper Devonian. Scale bar 200  $\mu$ m for Figures 13 and 15; 500  $\mu$ m for Figures 1, 2, 3, 5, 6, 8, 9, 10, 11, 12, 14; and 1 mm for Figures 4 and 7

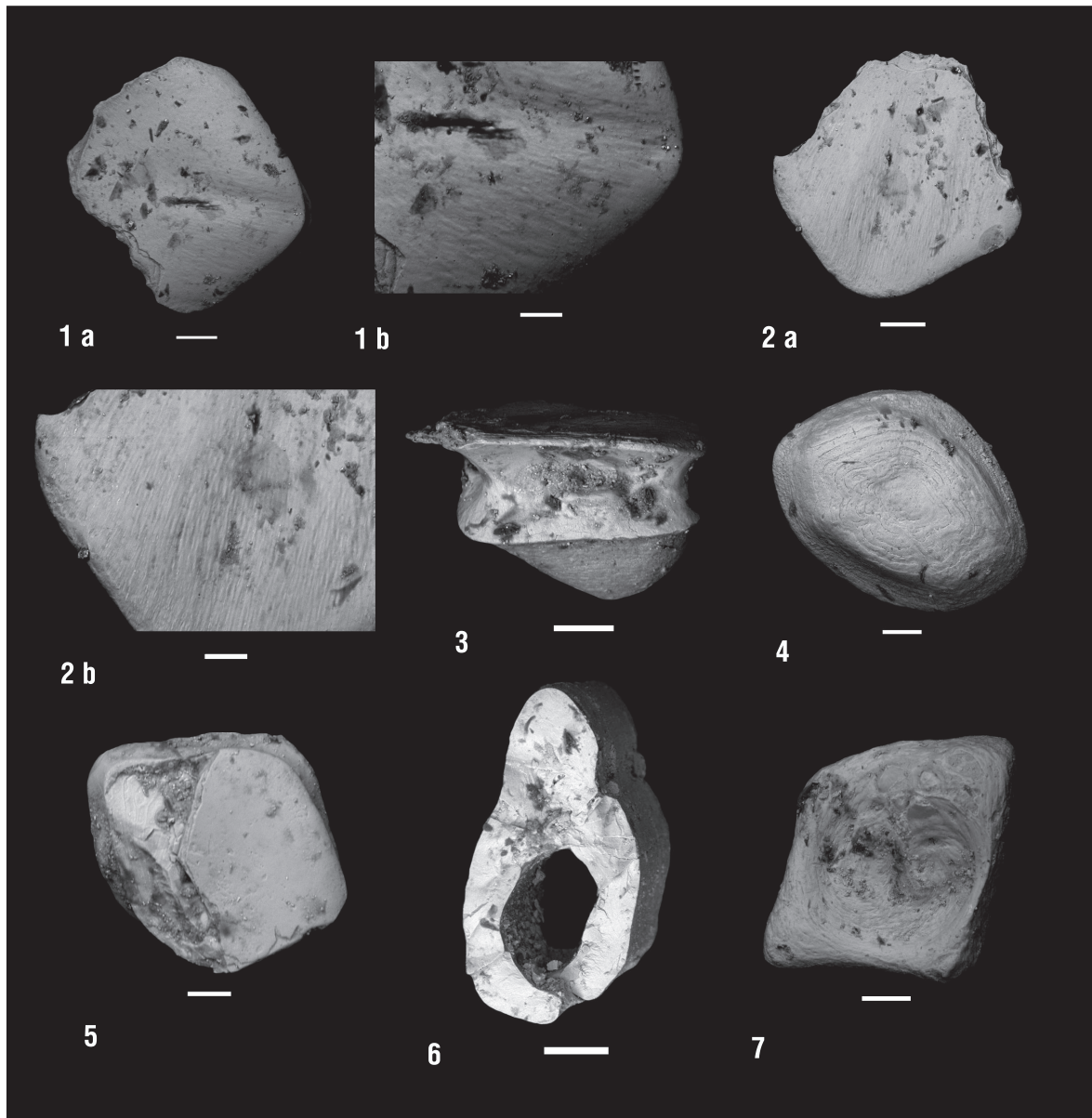
Figure 1 – *Bothriolepis* sp. Specimen № 69/4-1h, depth of 302.0 m,  $\times 35$ , plate fragment external surface, Rechitsa Regional Stage. Figure 2 – *Bothriolepis* sp. Specimen № 69/4-1d, depth of 302.0 m,  $\times 27$ , plate fragment external surface, Rechitsa Regional Stage. Figure 3 – *Bothriolepis* sp. Specimen № 69/4-1a, depth of 302.0 m,  $\times 45$ , plate fragment external surface, Rechitsa Regional Stage. Figure 4 – *Bothriolepis* sp. Specimen № 69/4-1e, depth of 302.0 m,  $\times 25$ , fragment of the anterior ventrolateral plate with processus brachialis, Rechitsa Regional Stage. Figure 5 – *Antiarcha* indet. Specimen № 69/4-1c, depth of 302.0 m,  $\times 45$ , pectoral fin plate fragment external surface, Rechitsa Regional Stage. Figure 6 – *Bothriolepis* sp. Specimen № 69/4-1n, depth of 302.0 m,  $\times 40$ , plate fragment in the lateral view, Rechitsa Regional Stage. Figure 7 – *Bothriolepis* sp. Specimen № 69/4-1b, depth of 302.0 m,  $\times 22$ , plate fragment external surface, Rechitsa Regional Stage. Figure 8 – *Bothriolepis* sp. Specimen № 69/4-1f, depth of 302.0 m,  $\times 35$ , plate fragment, Rechitsa Regional Stage. Figure 9 – *Bothriolepis* sp. Specimen № 69/4-1g, depth of 302.0 m,  $\times 30$ , plate fragment external surface, Rechitsa Regional Stage. Figure 10 – *Bothriolepis* sp. Specimen № 69/4-37, depth of 302.0 m,  $\times 40$ , pectoral fin plate fragment external surface (the fragment Cv2), Rechitsa Regional Stage. Figure 11 – *Bothriolepis* sp. Specimen № 69/4-10, depth of 302.0 m,  $\times 40$ , plate fragment external surface, Rechitsa Regional Stage. Figure 12 – *Bothriolepis* sp. Specimen № 69/4-33, depth of 302.0 m,  $\times 50$ , plate fragment external surface, Rechitsa Regional Stage. Figure 13 – *Antiarcha* indet. Specimen № 69/4-21, depth of 302.0 m,  $\times 60$ , plate fragment of pectoral fin, Rechitsa Regional Stage. Figure 14 – *Bothriolepis* sp. Specimen № 69/4-20, depth of 302.0 m,  $\times 50$ , pectoral fin plate fragment external surface, Rechitsa Regional Stage. Figure 15 – *Bothriolepis* sp. Specimen № 69/4-35, depth of 302.0 m,  $\times 65$ , plate fragment external surface, Rechitsa Regional Stage



**Plate IV. Acanthodian scales and fin spines from the Uvarovichi 94 borehole.** Skeletal elements of the fishes from the Upper Frasnian Substage, Frasnian Stage, Upper Devonian. Scale bar 10  $\mu\text{m}$  for Figure 7b; 50  $\mu\text{m}$  for Figures 1b and 8; 100  $\mu\text{m}$  for Figures 1a, 2a, 2b, 3, 4, 5, 6, 7a and 9; 200  $\mu\text{m}$  for Figures 10 and 12; and 500  $\mu\text{m}$  for Figure 11

Figure 1 – *Devononchus* sp. Specimen №69/4-8e, depth of 302.0 m: a – scale in the oblique crown view,  $\times 100$ ; b – scaled-up scale in the crown view,  $\times 500$ ; Rechitsa Regional Stage. Figure 2 – *Devononchus* sp. Specimen №69/4-8d, depth of 302.0 m: a – scale in the oblique crown view,  $\times 100$ ; b – scale in the lateral view,  $\times 150$ ; Rechitsa Regional Stage. Figure 3 – *Cheiracanthidae* ? gen. indet. Specimen №69/6a-3c, depth of 307.0 m,  $\times 150$ , scale in the crown view, Rechitsa Regional Stage. Figure 4 – *Cheiracanthus* sp. Specimen №69/6a-3a, depth of 307.0 m,  $\times 160$ , scale in the crown view, Rechitsa Regional Stage. Figure 5 – *Cheiracanthus* sp. Specimen №69/6a-3e, depth of 307.0 m,  $\times 250$ , scale in the crown view, Rechitsa Regional Stage. Figure 6 – *Cheiracanthus* ? sp. Specimen №69/6a-3f, depth of 307.0 m,  $\times 150$ , ragged crown of the scale in the crown view, Rechitsa Regional Stage. Figure 7 – *Acanthodes* sp. Specimen №69/6a-3g, depth of 307.0 m: a – scale in the crown view,  $\times 200$ ; b – scaled-up scale in the crown view,  $\times 1000$ ; Rechitsa Regional Stage. Figure 8 – *Acanthodes* sp. Specimen №69/6a-3d, depth of 307.0 m,  $\times 300$ , scale in the crown view, Rechitsa Regional Stage. Figure 9 – *Acanthodes* sp. Specimen №69/6a-3b, depth of 307.0 m,  $\times 170$ , scale in the crown view, Rechitsa Regional Stage. Figure 10 – *Haplacanthus* sp. Specimen №69/4-8a, depth of 302.0 m,  $\times 75$ , cross section of the fin spine fragment, Rechitsa Regional Stage. Figure 11 – *Haplacanthus* sp. Specimen №69/4-8b, depth of 302.0 m,  $\times 50$ , fin spine fragment in the lateral view, Rechitsa Regional Stage. Figure 12 – *Acanthodes* ? sp. Specimen №69/5-7b, depth of 310.5 m,  $\times 70$ , scale in the crown view, Rechitsa Regional Stage





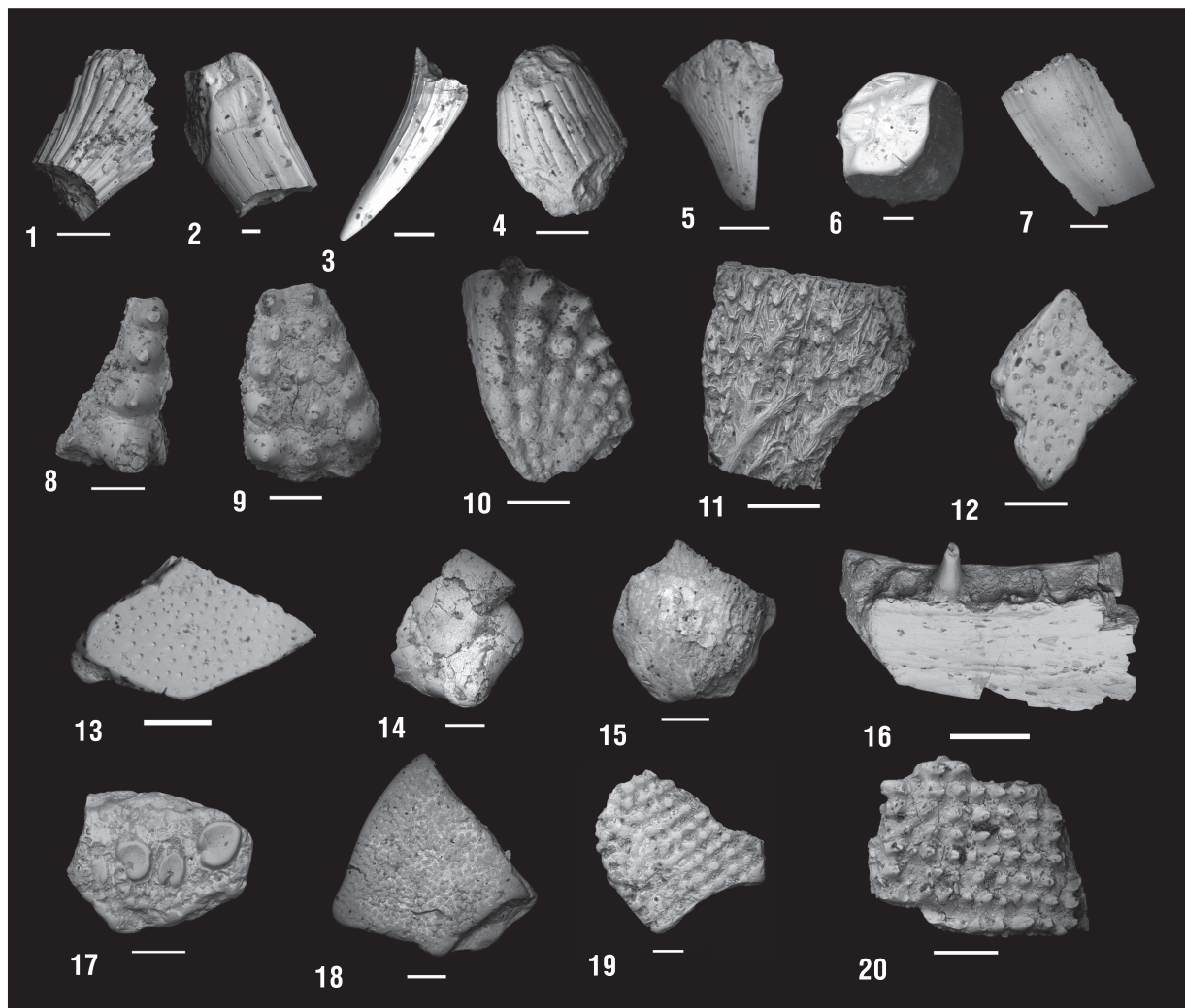
**Plate V. Acanthodian scales and fin spines from the Uvarovichi 94 borehole.** Skeletal elements of the fishes from the Upper Frasnian Substage, Frasnian Stage, Upper Devonian. Scale bar 50  $\mu$ m for Figures 1b, 2b and 5; 100  $\mu$ m for Figures 1a, 2a, 3 and 4; 200  $\mu$ m for Figures 6 and 7

Figure 1 – *Devononchus* sp. Specimen №69/4-24, depth of 302.0 m: a – scale in the crown view,  $\times 120$ ; b – an enlarged scale part in the crown view,  $\times 300$ ; Rechitsa Regional Stage. Figure 2 – *Devononchus* sp. Specimen №69/4-29, depth of 302.0 m: a – scale in crown view,  $\times 130$ ; b – an enlarged scale part in the crown view,  $\times 300$ ; Rechitsa Regional Stage. Figure 3 – *Devononchus* sp. Specimen №69/4-43, depth of 302.0 m,  $\times 150$ , scale in the lateral view, Rechitsa Regional Stage. Figure 4 – *Acanthodes* sp. Specimen №69/4-41, depth of 302.0 m,  $\times 130$ , scale in the crown view, Rechitsa Regional Stage. Figure 5 – *Acanthodes* sp. Specimen №69/5-24, depth of 310.5 m,  $\times 300$ , scale in the crown view, Rechitsa Regional Stage. Figure 6 – *Haplacanthus* sp. Specimen №69/4-39, depth of 302.0 m,  $\times 75$ , cross section of the fin spine fragment, Rechitsa Regional Stage. Figure 7 – *Acanthodes* ? sp. Specimen №69/4-23, depth of 302.0 m,  $\times 70$ , scale in the crown view, Rechitsa Regional Stage



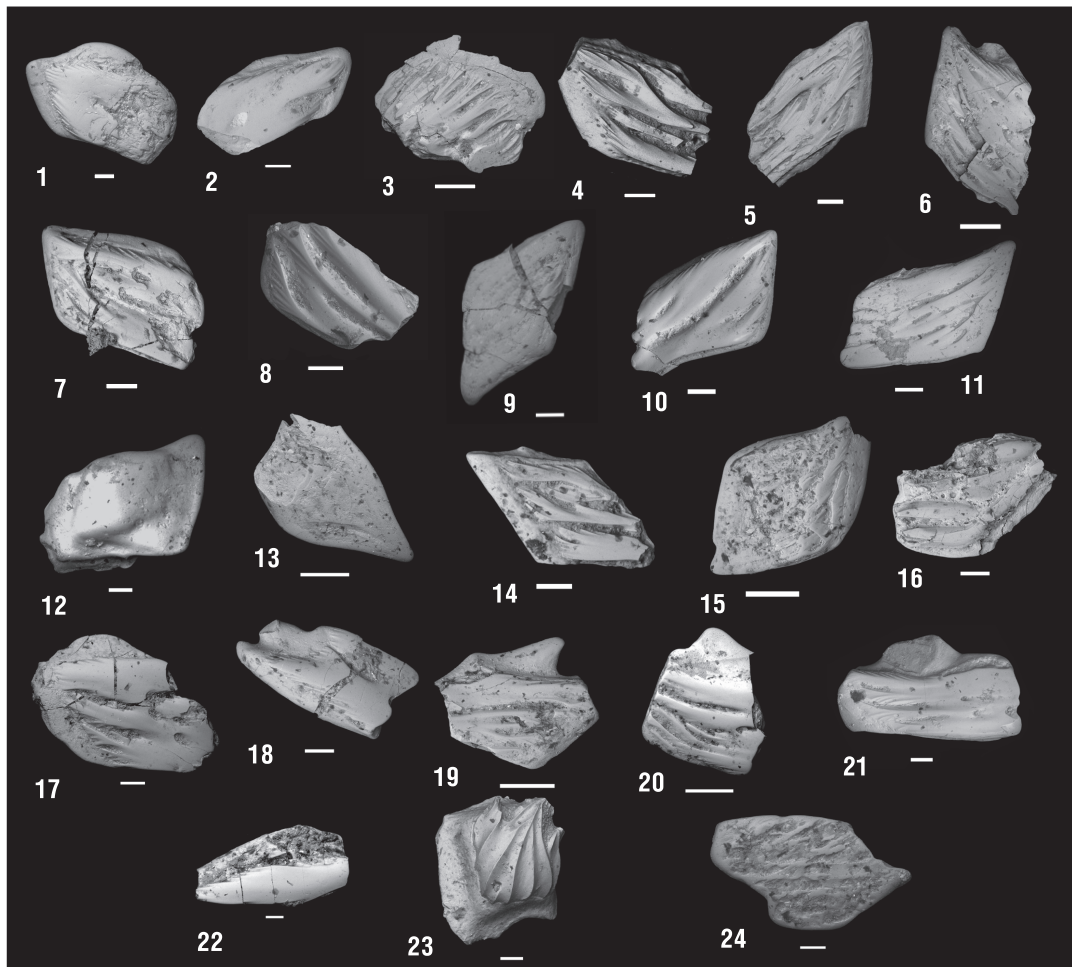
**Plate VI. Sarcopterygian scales and teeth from the Uvarovichi 94 borehole.** Skeletal elements of the fishes from the Upper Frasnian Substage, Frasnian Stage, Upper Devonian. Scale bar 100  $\mu$ m for Figures 1, 5, 14, 15, 16, 19 and 20; 200  $\mu$ m for Figures 2, 3, 6, 7, 10, 13, 17 and 18; and 500  $\mu$ m for Figures 4, 8, 9, 11, 12, 21 and 22

Figure 1 – Sarcopterygii indet. Specimen №69/4-4c, depth of 302.0 m,  $\times 150$ , tooth in the lateral view, Rechitsa Regional Stage. Figure 2 – *Strunius* sp. Specimen №69/4-4b, depth of 302.0 m,  $\times 80$ , tooth in the lateral view, Rechitsa Regional Stage. Figure 3 – *Strunius* sp. Specimen №69/4-4a, depth of 302.0 m,  $\times 80$ , tooth in the lateral view, Rechitsa Regional Stage. Figure 4 – Sarcopterygii indet. Specimen №69/5-1b, depth of 310.5 m,  $\times 40$ , tooth in the lateral view, Rechitsa Regional Stage. Figure 5 – *Strunius* sp. Specimen №69/6a-7a, depth of 307.0 m,  $\times 110$ , tooth in the lateral view, Rechitsa Regional Stage. Figure 6 – *Strunius* sp. Specimen №69/6a-7b, depth of 307.0 m,  $\times 60$ , tooth in the lateral view, Rechitsa Regional Stage. Figure 7 – Onychodontidae gen. indet. Specimen №69/6a-7c, depth of 307.0 m,  $\times 65$ , tooth in the lateral view, Rechitsa Regional Stage. Figure 8 – *Dipterus* sp. Specimen №69/4-6a, depth of 302.0 m,  $\times 30$ , prearticular tooth plate in the oblique top view, Rechitsa Regional Stage. Figure 9 – *Dipterus* sp. Specimen №69/4-6b, depth of 302.0 m,  $\times 45$ , prearticular tooth plate in the top view, Rechitsa Regional Stage. Figure 10 – Onychodontiformes ? indet. Specimen №69/4-3a, depth of 302.0 m,  $\times 80$ , scale fragment in the external view, Rechitsa Regional Stage. Figure 11 – Osteolepididae gen. indet. Specimen №69/5-2a, depth of 310.2 m,  $\times 30$ , scale fragment in the external view, Rechitsa Regional Stage. Figure 12 – Osteolepididae gen. indet. Specimen №69/5-12, depth of 310.5 m,  $\times 50$ , scale fragment in the external view, Rechitsa Regional Stage. Figure 13 – Osteolepididae gen. indet. Specimen №69/5-10, depth of 310.5 m,  $\times 60$ , scale fragment in the external view, Rechitsa Regional Stage. Figure 14 – *Strunius* sp. Specimen №69/4-31, depth of 302.0 m,  $\times 120$ , tooth in the lateral view, Rechitsa Regional Stage. Figure 15 – *Strunius* sp. Specimen №69/4-51, depth of 302.0 m,  $\times 100$ , tooth in the lateral view, Rechitsa Regional Stage. Figure 16 – *Strunius* sp. Specimen №69/4-52, depth of 302.0 m,  $\times 100$ , tooth in the lateral view, Rechitsa Regional Stage. Figure 17 – *Strunius* sp. Specimen №69/4-19, depth of 302.0 m,  $\times 90$ , tooth in the lateral view, Rechitsa Regional Stage. Figure 18 – *Strunius* sp. Specimen №69/4-32, depth of 302.0 m,  $\times 65$ , tooth in the lateral view, Rechitsa Regional Stage. Figure 19 – *Strunius* sp. Specimen №69/4-53, depth of 302.0 m,  $\times 120$ , tooth in the lateral view, Rechitsa Regional Stage. Figure 20 – *Strunius* sp. Specimen №69/4-54, depth of 302.0 m,  $\times 100$ , tooth in the lateral view, Rechitsa Regional Stage. Figure 21 – Sarcopterygii indet. Specimen №69/4-13, depth of 302.0 m,  $\times 50$ , tooth, Rechitsa Regional Stage. Figure 22 – Sarcopterygii indet. Specimen №69/4-34, depth of 302.0 m,  $\times 50$ , tooth in the lateral view, Rechitsa Regional Stage



**Plate VII. Osteichthyan scales, bones, teeth and jaw fragment from the Uvarovichi 94 borehole.** Skeletal elements of the fishes from the Upper Frasnian Substage, Frasnian Stage, Upper Devonian. Scale bar 100  $\mu$ m for Figure 2; 200  $\mu$ m for Figures 3, 6 and 19; 500  $\mu$ m for Figures 1, 4, 5, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18 and 20

Figure 1 – *Sarcopterygii* indet. Specimen №69/4-42, depth of 302.0 m,  $\times 50$ , tooth in the lateral view, Rechitsa Regional Stage. Figure 2 – *Sarcopterygii* indet. Specimen №69/4-48, depth of 302.0 m,  $\times 100$ , tooth in the lateral view, Rechitsa Regional Stage. Figure 3 – *Sarcopterygii* indet. Specimen №69/4-45, depth of 302.0 m,  $\times 85$ , tooth in the lateral view, Rechitsa Regional Stage. Figure 4 – *Rhipidistia* indet. Specimen №69/4-49, depth of 302.0 m,  $\times 50$ , tooth in the lateral view, Rechitsa Regional Stage. Figure 5 – *Sarcopterygii* indet. Specimen №69/4-11, depth of 302.0 m,  $\times 50$ , tooth in the lateral view, Rechitsa Regional Stage. Figure 6 – *Sarcopterygii* indet. Specimen №69/4-50, depth of 302.0 m,  $\times 80$ , tooth in the top view, Rechitsa Regional Stage. Figure 7 – *Sarcopterygii* indet. Specimen №69/4-40, depth of 302.0 m,  $\times 35$ , tooth, Rechitsa Regional Stage. Figure 8 – *Dipterus* sp. Specimen №69/4-15, depth of 302.0 m,  $\times 50$ , tooth plate fragment in the top view, Rechitsa Regional Stage. Figure 9 – *Dipterus* sp. Specimen №69/4-12, depth of 302.0 m,  $\times 43$ , tooth plate fragment in the top view, Rechitsa Regional Stage. Figure 10 – *Dipterus* sp. Specimen №69/4-16, depth of 302.0 m,  $\times 50$ , prearticular tooth plate in the top view, Rechitsa Regional Stage. Figure 11 – *Onychodontiformes* ? indet. Specimen №69/4-36, depth of 302.0 m,  $\times 50$ , scale fragment in the external view, Rechitsa Regional Stage. Figure 12 – *Sarcopterygii* indet. Specimen №69/5-11, depth of 310.5 m,  $\times 50$ , scale fragment in the external view, Rechitsa Regional Stage. Figure 13 – *Osteolepididae* gen. indet. Specimen №69/5-13, depth of 310.5 m,  $\times 45$ , scale fragment in the external view, Rechitsa Regional Stage. Figure 14 – *Sarcopterygii* indet. Specimen №69/5-7a, depth of 310.5 m,  $\times 40$ , scale fragment in the external view, Rechitsa Regional Stage. Figure 15 – *Sarcopterygii* indet. Specimen №69/5-7d, depth of 310.5 m,  $\times 45$ , scale fragment in the external view, Rechitsa Regional Stage. Figure 16 – *Onychodontiformes* indet. Specimen №69/6a-10, depth of 307.0 m,  $\times 50$ , jaw fragment in the lateral view, Rechitsa Regional Stage. Figure 17 – *Sarcopterygii* indet. Specimen №69/6a-9, depth of 307.0 m,  $\times 50$ , small fragment of an indefinable skeletal element in the external view, Rechitsa Regional Stage. Figure 18 – *Sarcopterygii* indet. Specimen №69/5-2c, depth of 310.2 m,  $\times 30$ , small fragment of an indefinable skeletal element in the external view, Rechitsa Regional Stage. Figure 19 – *Sarcopterygii* ? indet. Specimen №69/6a-1e, depth of 307.0 m,  $\times 70$ , scale fragment (?) in the external view, Rechitsa Regional Stage. Figure 20 – *Holoptychius* ? sp. Specimen №69/4-14, depth of 302.0 m,  $\times 50$ , scale fragment in the external view, Rechitsa Regional Stage



**Plate VIII. Osteichthyan scales and an indefinable bone fragment from the Uvarovichi 94 borehole.** Skeletal elements of the fishes from the Upper Frasnian Substage, Frasnian Stage, Upper Devonian. Scale bar 100  $\mu$ m for Figures 22 and 23; 200  $\mu$ m for Figures 1, 2, 4, 5, 7, 8, 9, 10, 12, 14, 16, 17, 18, 21 and 24; 500  $\mu$ m for Figures 3, 6 and 11; and 500  $\mu$ m for Figures 13, 15, 19 and 20

Figure 1 – *Moythomasia* sp. undet. Specimen №69/6a-1d, depth of 307.0 m,  $\times 60$ , scale in the external view, Rechitsa Regional Stage. Figure 2 – *Moythomasia* sp. undet. Specimen №69/6a-1a, depth of 307.0 m,  $\times 60$ , scale in the external view, Rechitsa Regional Stage. Figure 3 – *Moythomasia* sp. undet. Specimen №69/5-2d, depth of 310.2 m,  $\times 50$ , scale in the external view, Rechitsa Regional Stage. Figure 4 – *Moythomasia* sp. undet. Specimen №69/4-5a, depth of 302.0 m,  $\times 80$ , scale in the external view, Rechitsa Regional Stage. Figure 5 – *Moythomasia* sp. undet. Specimen №69/4-5b, depth of 302.0 m,  $\times 60$ , scale in the external view, Rechitsa Regional Stage. Figure 6 – *Moythomasia* sp. undet. Specimen №69/6a-4a, depth of 307.0 m,  $\times 35$ , scale in the external view, Rechitsa Regional Stage. Figure 7 – *Moythomasia* sp. undet. Specimen №69/5-7c, depth of 310.5 m,  $\times 70$ , scale in the external view, Rechitsa Regional Stage. Figure 8 – *Moythomasia* sp. undet. Specimen №69/6a-4g, depth of 307.0 m,  $\times 80$ , scale in the external view, Rechitsa Regional Stage. Figure 9 – Actinopterygii indet. Specimen №69/6a-1b, depth of 307.0 m,  $\times 55$ , scale in the external view, Rechitsa Regional Stage. Figure 10 – *Moythomasia* sp. undet. Specimen №69/6a-4c, depth of 307.0 m,  $\times 65$ , scale in external view, Rechitsa Regional Stage. Figure 11 – Actinopterygii indet. Specimen №69/5-3a, depth of 310.5 m,  $\times 27$ , scale in the external view, Rechitsa Regional Stage. Figure 12 – *Moythomasia* sp. undet. Specimen №69/6a-4b, depth of 307.0 m,  $\times 60$ , scale in the internal view, Rechitsa Regional Stage. Figure 13 – Actinopterygii indet. Specimen №69/5-14, depth of 310.5 m,  $\times 50$ , scale, Rechitsa Regional Stage. Figure 14 – *Moythomasia* sp. undet. Specimen №69/4-46, depth of 302.0 m,  $\times 65$ , scale in the external view, Rechitsa Regional Stage. Figure 15 – *Moythomasia* sp. undet. Specimen №69/5-18, depth of 310.5 m,  $\times 50$ , scale in the external view, Rechitsa Regional Stage. Figure 16 – *Moythomasia* sp. undet. Specimen №69/5-17, depth of 310.5 m,  $\times 70$ , scale in the external view, Rechitsa Regional Stage. Figure 17 – *Moythomasia* sp. undet. Specimen №69/5-22, depth of 310.5 m,  $\times 70$ , scale in the external view, Rechitsa Regional Stage. Figure 18 – *Moythomasia* sp. undet. Specimen №69/5-16, depth of 310.5 m,  $\times 60$ , scale fragment in the external view, Rechitsa Regional Stage. Figure 19 – *Moythomasia* sp. undet. Specimen №69/5-15, depth of 310.5 m,  $\times 50$ , scale in the external view, Rechitsa Regional Stage. Figure 20 – *Moythomasia* sp. undet. Specimen №69/5-21, depth of 310.5 m,  $\times 50$ , scale fragment in the external view, Rechitsa Regional Stage. Figure 21 – *Moythomasia* sp. undet. Specimen №69/6a-4d, depth of 307.0 m,  $\times 60$ , scale fragment in the external view, Rechitsa Regional Stage. Figure 22 – *Moythomasia* sp. undet. Specimen №69/5-20, depth of 310.5 m,  $\times 100$ , scale fragment in the external view, Rechitsa Regional Stage. Figure 23 – *Cheirolepis* sp. Specimen №69/4-8c, depth of 302.0 m,  $\times 100$ , scale in the oblique crown view, Rechitsa Regional Stage. Figure 24 – Osteichthyes indet. Specimen №69/6a-4f, depth of 307.0 m,  $\times 60$ , small fragment of an indefinable skeletal element in the external view, Rechitsa Regional Stage

The borehole exposed the whole thickness of the deposits of the **Semiluki Regional Stage** (depth of 310.5 – 344.5 m). The lithological, geophysical and palaeontological data available were used to subdivide these deposits into the Moiseyevka and Buinovichi Beds.

*The Moiseyevka Beds* (depth of 337.2 – 344.5 m) are represented by the light grey crystalline limestones, dark grey marls and clayey limestones with greenish-grey and black clay interbeds. Some large shells of the bivalves and gastropods, as well as the carbonate oolites were determined in the lower part of these beds. The acritarchs were also found in the deposits of these beds. In addition, the rocks contain abundant miospores that were used to justify these beds separation. The miospore assemblage established by V. Yu. Obukhovskaya [11] is represented by *Cristatisporites trivialis* (Naum.), *Geminospora semilucensa* (Naum.), *Archaeozonotriletes variabilis* Naum., *A. variabilis* Naum. var. *insignis* Senn., *Ancyrospora lacinosa* (Naum.), *Acanthotriletes crenatus* Naum., *A. polygamus* Naum., *Verrucosisporites* sp.

The overlying deposits of *the Buinovichi Beds* (depth of 310.5 – 337.2 m) are distinctly divided into three units.

The lower unit (depth of 326.5-337.2 m) is composed of the light grey, clayey, platy, sometimes, unclearly lumpy limestones with isolated grey clay interbeds (2–3 cm thick). The scolecodonts, brachiopods, acritarchs and miospores have been identified among the organic remains in this unit rocks. According to the definitions by V. Yu. Obukhovskaya [11] the latter are represented by *Geminospora semilucensa* (Naum.), *G. rugosa* (Naum.), *G. aurita* Archang., *Archaeozonotriletes variabilis* Naum., *A. variabilis* Naum. var. *insignis* Senn., *Sinuosisporis vermiculatus* (Medyanik), *Hystricosporites* sp.

The middle unit (depth of 318.0 – 326.5 m) is represented by clayey limestones, grey, platy marls, grey and dark grey clays with some few crystalline limestone intercalations. Numerous brachiopods only that had been buried in their lifetime were found in the bottom of this unit.

The upper unit (depth of 310.5 – 318.0 m) is composed of the brownish and light grey, crystalline, pseudobrecciated limestones. The brecciated limestone appearance is due to numerous differently oriented dark grey clay veins and interlayers. The brachiopods, bivalves, gastropods, corals, ichthyofauna remains and miospores were found in the rocks. According to V. Yu. Obukhovskaya [11], some single specimens of *Perotriletes* (?) cf. *multus* Medyanik in litt., *Convolutispora subtilis* Owens appear in the miospore associations of this part of the section along with the prevalence of the inherited species of *Geminospora semilucensa* (Naum.), *Archaeozonotriletes variabilis* Naum., *Cristatisporites trivialis* (Naum.), *Ancyrospora laciniosa* (Naum.).

The deposits of the **Rechitsa Regional Stage** (depth of 278.6 – 310.5 m) are represented by the interbedded variegated clays, greenish-grey marls, replaced by the clayey limestones with brown tuffaceous rock interbeds. The redeposited fragments of the light grey limestone of the Semiluki age with the ostracod valves, shells of gastropods, bivalves, brachiopods, segments of crinoids and rare ichthyofauna remains represented by the tubercle and tessera of *Psammosteus megalopteryx* (Trautschold) occur in the variegated clay bed in the bottom of this Regional Stage. The miospore assemblage of the studied stratigraphic interval includes the species typical of the Rechitsa Regional Stage with one distinctive feature that the miospores of the genus of *Archaeoperisaccus* predominates in the miospore association, which is also characteristic of the Petin deposits of the Voronezh Anticline [11]. The taxonomic composition of the vertebrates found in the rocks of the Rechitsa Regional Stage is quite diverse. The heterostracans are rather abundant there. These are represented by some separate psammosteid dentine tubercles of *Psammosteus* sp. 1, *P.* sp. 2, *P.* sp. 3, *P.* sp. 4, *P.* sp. indet., Psammosteidae gen. indet. and Psammosteoidi indet. The placoderms are not abundant. These are represented by indefinable plates of *Bothriolepis* sp., Placodermi indet., some small fragments of the plates from the pectoral fin of *Bothriolepis* sp. and *Antiarcha* indet. The acanthodians are taxonomically more diverse than the antiarchs, slightly more diverse than the psammosteids, but are less diverse than the sarcopterygians and actinopterygians. These are represented by the scales of *Acanthodes* sp., *A. ?* sp., *Cheiracanthus* sp., *C. ?* sp., Cheiracanthidae ? gen. indet., “*Acanthodes*” sp., *Devononchus* sp. and the fin spine fragments of *Haplacanthus* sp., *Acanthodii* gen. indet. The sarcopterygians occur rather often. These are represented by the tooth plates of *Dipterus* sp., *Dipnoi* indet., some discrete scales of Osteolepididae gen.

indet., *Glyptolepis* ? sp., *Holoptychius* ? sp., Onychodontiformes ? indet., Sarcopterygii indet., the teeth of *Strunius* sp., Onychodontidae gen. indet., Rhipidistia sp., Sarcopterygii indet. and one jaw fragment of an indefinable fish of Onychodontiformes indet. The actinopterygians are much less abundant than the sarcopterygians. These are represented by some isolated scales of *Cheirolepis* sp., *Moythomasia* sp. undet., Actinopterygii indet. and teeth of Actinopterygii indet. A small skeletal element discovered there was defined as Osteichthyes indet. because of its poor safety and fragmentation. In addition to the vertebrates and miospores, the ostracod valves, shells of bivalves, gastropods, tentaculites, brachiopods, crinoid segments, conodonts and carbonized plant remains were determined in the deposits of this Regional Stage.

Upward the section the deposits of the Rechitsa Regional Stage are overlain with a stratigraphic hiatus by the dark grey, fine and assorted, well-cemented sandstones and fine-grained, indistinctly laminated siltstones of the Jurassic System of the Mesozoic Erathem.

**Correlation of the Rechitsa Regional Stage.** The deposits of the Rechitsa Regional Stage of the Frasnian Stage of the Upper Devonian occurring in the territory of Belarus correspond to the *Bothriolepis maxima* zone of placoderms [8, 12]. The vertebrate assemblage established in the Uvarovichi 94 borehole together with the miospore evidences make it possible to correlate the Rechitsa deposits with both the same-name sediments developed within the country, and the synchronous deposits in the adjacent regions.

The Snezha Regional Stage is an age analogue of the Rechitsa Regional Stage of Belarus in the territory of the Main Devonian Field [6, 13]. The Rechitsa Regional Stage is correlated with the Petin Regional Stage within the central part of the East European Platform [6, 14, 15] and with the Upper Zolochev subformation – in the Volyn-Podolia territory [16]. As to the correlation of the Rechitsa deposits with the synchronous sediments of Western Europe, further studies are needed to make their correlation more accurate.

**Conclusions.** 1. The paper presents the data on the ichthyofauna of the Rechitsa age determined in the rocks of the Uvarovichi 94 borehole, as well as the information about all the known occurrences of the Rechitsa age vertebrates in the territory of Belarus.

2. The lithological description of the Rechitsa deposits from the Uvarovichi 94 borehole, as well as of their underlying and overlying sediments is given. The biostratigraphic characteristic of the rocks of the Rechitsa and Semiluki Regional Stages from the above borehole is presented.

3. The correlation of the Rechitsa deposits with the synchronous well-studied deposits in the territory of the Baltic States, Ukraine and Russia is performed.

4. The Rechitsa ichthyofauna data obtained from the Uvarovichi 94 borehole were used for the improvement of its systematic composition in the territory of Belarus.

5. Several vertebrate skeletal elements are demonstrated separately on the plates.

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