

# Conodont-Based Stratigraphy of the Mosolovian Regional Stage (Eifelian, Middle Devonian) of the Voronezh Antecline

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**Abstract**—Conodonts from the deposits of the Mosolovian Regional Stage (Middle Devonian) of the Voronezh Antecline are studied on the basis of the data from six boreholes. Three assemblages are recognized. The index species of the lowermost assemblage is *Icriodus formosus* Naz. The index species of the middle assemblage are *I. formosus* Naz. and *Pseudobipennatus zieglerei* Kon. et Kim, as well as *I. arkonensis* Stauff. and *I. jejunos* Naz. This assemblage is the most diverse and is recognized in all boreholes. The deposits containing this assemblage correspond to the maximum of the Nara transgression. The upper assemblage is also recognized in all the studied boreholes. Its index species is *Ps. zieglerei* Kon. et Kim. The Mosolovian Regional Stage is assigned to the kockelianus Zone. The distribution diagrams of species in the most diverse middle assemblage support the hypothesis that, in the southeastern regions of the Voronezh antecline, the depth was greater than in its western part. The characteristic conodont species are shown in the plates.

**Keywords:** conodonts, Middle Devonian, Eifelian, Mosolovian Regional Stage, Voronezh Antecline

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## INTRODUCTION

Conodonts are known to be very important for the stratigraphy and correlation of the Paleozoic deposits of various facies. Despite recent studies (Aristov and Ovnatanova, 1985, 1990; Aristov, 1988; Nazarova, 1995, 1998; Kononova and Kim, 2005), conodonts of the Middle Devonian of the central regions of the Russian Platform, including the Voronezh Antecline, remain the least studied. The Devonian deposits here are widespread, but the Eifelian beds are only studied in boreholes. This study aims at supplementing the knowledge on the conodonts of the Mosolovian Regional Stage.

The Mosolovian Regional Stage (formation) is recognized by Lyashenko (1953) on the basis of brachiopods. Its stratotype is in the section of reference borehole 6 near the village of Mosolovo (Ryazan oblast) in the interval of 1107–1157 m (*Reshenie...*, 1990). Deposits of the Regional Stage are represented here by “gray and greenish gray limestones, to various extents argillaceous, massive, with thin beds of marl and calcareous clay” (Lyashenko, 1953). The Mosolovian Regional Stage lies conformably on the Klintsovian Regional Stage and is connected to it by a gradual transition. In the Voronezh Antecline, the Mosolovian deposits often lie directly on the Proterozoic rocks. In the marginal regions of the antecline, the thickness of the Regional Stage is 0–30 m, decreasing toward the central part (Rodionova et al., 1995).

The first data on the Eifelian conodonts of the Voronezh Antecline were obtained from sections in the central regions of the antecline (Aristov and Ovnatanova, 1985, 1990; Aristov, 1988), and later conodonts of this age were found in the northern and northwestern regions (Nazarova, 1995, 1998; Kononova and Kim, 2005). The Mosolovian Regional Stage has the most diverse conodont assemblage and is therefore the focus of this paper.

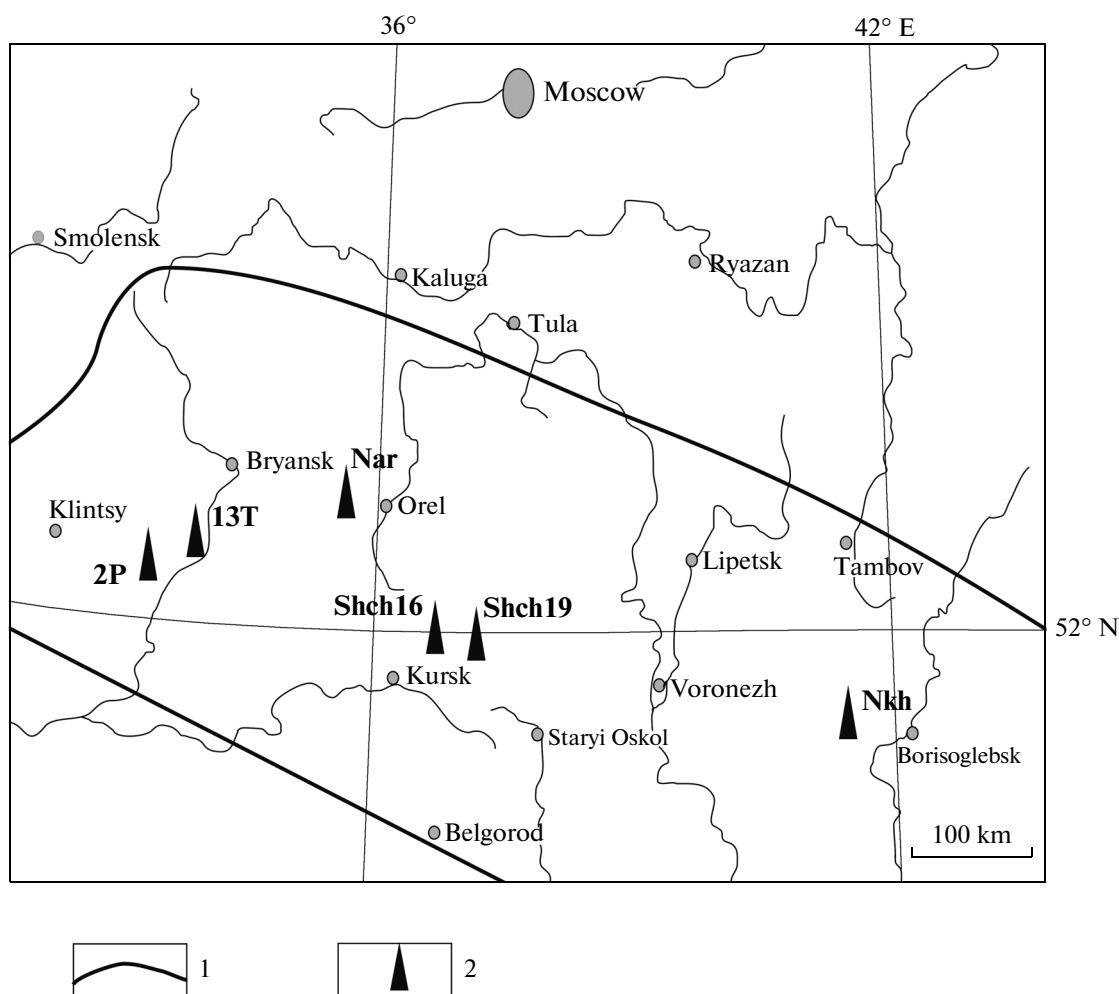
## MATERIAL

This paper is based on the conodont elements recognized from the Eifelian deposits in the boreholes in various parts of the Voronezh Antecline: Shchigry-16 (Nizhnekrasnoe), Shchigry-19 (Osinovka), Novokhoperskaya 8750/1; and also collections of conodonts from previously studied boreholes were used: Naryshkino 4177 Borehole, Prosvet 2P, and Trubchevsk 13T (Fig. 1). Altogether, 3329 specimens of conodont elements were collected. The characteristic species are depicted in plates (1–3). The collection is housed in the Department of Paleontology of the Faculty of Geology, Moscow State University (MGU), coll. no. 272.

## STRATIGRAPHY

### *Shchigry-16 Borehole (Nizhnekrasnoe)*

The Shchigry-16 Borehole (Nizhnekrasnoe) was drilled in the Kursk oblast 20 km west-northwest of the town of Shchigry (southwest region of the Voronezh



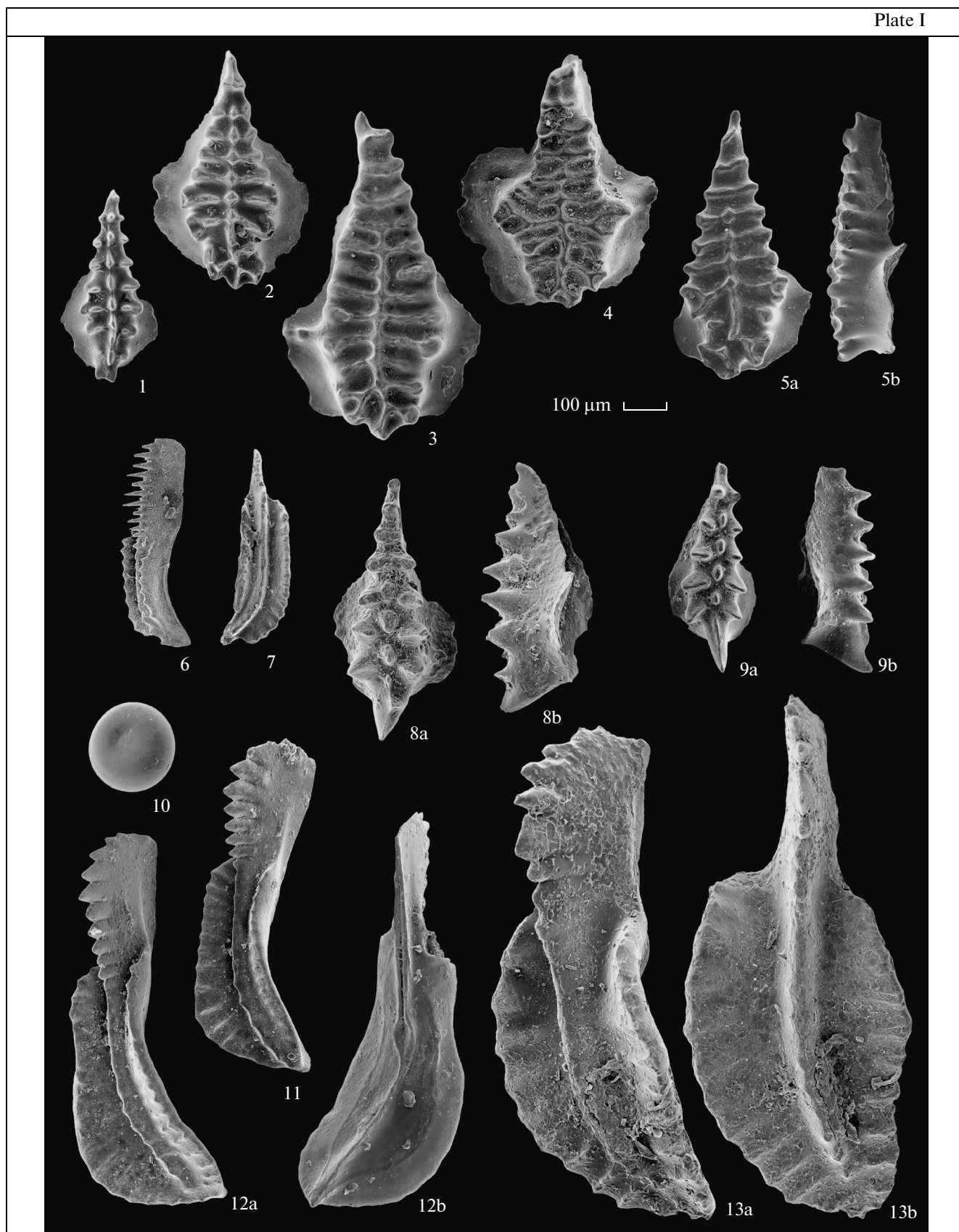
**Fig. 1.** Location of studied boreholes. (1) Borders of the Voronezh Anteclise; (2) boreholes: 2P—Prosvet 2P Borehole; 13T—Trubchevsk 13T Borehole; Nar—Naryshkino 4177 Borehole; ShCh16—Shchigry-16 Borehole; ShCh 19—Shchigry-19 Borehole; NKh—Novokhoperskaya 8750/1 Borehole.

Anteclise). The borehole goes down to the depth of 243.5 m. Devonian deposits 181 m thick are represented by carbonate-terrigenous rocks and lie over the crystalline basement and are overlain by Jurassic rocks. A.G. Olferiev originally stratified the deposits on the

basis of lithology, macrofauna (brachiopods identified by N.V. Oleneva), and a few samples containing conodonts (identified by L.I. Kononova). Detailed sampling from the borehole core was conducted in September 2006 by O.B. Bondarenko, R.A. Voinova, and

**Plate I.** Conodonts of Mosolovian Regional Stage; Eifelian Stage, Mosolovian Regional Stage; Voronezh Anteclise, Kursk oblast; in all cases  $\times 80$ . (1–5) *Icriodus formosus* Naz.: (1) specimen no. MGU 272/798, upper view, Shchigry-16 Borehole, interval 199.05–203.95 m, Sample SHCH-16/235; (2) specimen no. MGU 272/799, upper view, the same locality; (3) specimen no. MGU 272/800, upper view, the same locality; (4) specimen no. MGU 272/801, upper view, Shchigry-19 Borehole, interval 189.8–194.7 m, Sample SHCH-19/207; (5) specimen no. MGU 272/793, (5a) upper view, (5b) lateral view, Shchigry-19 Borehole, interval 194.7–199.6 m, Sample SHCH-19/213; (6, 7) *Ctenopolygnathus taljashenkoae* Kon. et Kim: (6) specimen no. MGU 272/816, lateral view, Shchigry-16 Borehole, interval 189.25–194.15 m, Sample SHCH-16/224; (7) specimen no. MGU 272/817, upper view, Shchigry-19 Borehole, interval 194.7–199.6 m, Sample SHCH-19/213; (8, 9) *Icriodus khalymbadzhai* Kon. et Kim: (8) specimen no. MGU 272/802, (8a) upper view, (8b) lateral view, Shchigry-16 Borehole, interval 199.05–203.95 m, Sample SHCH-16/237; (9) specimen no. MGU 272/803, (9a) upper view, (9b) lateral view, Shchigry-19 Borehole, interval 194.7–199.6 m, Sample SHCH-19/208; (10) “conodont pearls,” specimen no. MGU 272/772, cavity view, Shchigry-16 Borehole, interval 189.25–194.15 m, Sample SHCH-16/219; (11, 12) *Polygnathus parawebbi* Chatt. morphotype  $\alpha$ : (11) specimen no. MGU 272/818, upper view, Shchigry-19 Borehole, interval 194.7–199.6 m, Sample SHCH-19/209; (12) specimen no. MGU 272/819, (12a) upper view, (12b) bottom view, Shchigry-16 Borehole, interval 189.25–194.15 m, Sample SHCH-16/227; (13) *Linguipolygnathus oviformis* Kon. et Kim, specimen no. MGU 272/820, (13a) lateral view, (13b) upper view, Shchigry-16 Borehole, interval 189.25–194.15 m, Sample SHCH-16/224.

Plate I



L.I. Kononova (Department of Paleontology, Moscow State University).

The Mosolovian Regional Stage, about 20 m thick was determined by A.G. Olfieriev in an interval of depth of 184.5–204.15 m (Fig. 2). It conformably overlies a thick series of sandstone of the Klintsy Regional Stage (lacking faunistic remains) and is represented by limestone, mainly argillaceous, and clay, containing various fossils. This Regional Stage is unconformably overlain by siltstone of the Starooskolian Regional Stage with a few fossils. Altogether 39 samples were studied from this Regional Stage (including samples from A.G. Olfieriev's collection), with a mean weight of 0.3–0.5 kg, 36 of which yielded conodonts. In total, the collection contains 1109 specimens (Table 1). Some preliminary identifications of conodonts and brief data were published previously (Nazarova et al., 2010; Nazarova, 2011; Nazarova and Kononova, 2011, 2012).

Three conodont assemblages can be recognized in the Mosolovian Regional Stage (from bottom to top):

**Assemblage I** (interval 191.8–204.15 m) contains the icriodids *Icriodus formosus* Nazarova, *I. khalymbadzhai* Kononova et Kim, *I. lindensis* Weddige, *I. struvei* Weddige, and *Pelekysgnathus avriensis* Gagiev and the polygnathids *Ctenopolygnathus taljashenkoae* Kononova et Kim, *Linguipolygnathus oviformis* Kononova et Kim, *Polygnathus parawebbi* Chatterton (morphotypes  $\alpha$ ,  $\beta$ ,  $\gamma$ ), and also *Coelocerodontus* sp. All these species, apart from *Pel. avriensis*, continue up the section. It should be noted that no core was collected for the interval of the section of 195.0–199.0 m.

Icriodids dominate in number of specimens (about 60%); of these, *I. formosus* constitutes 38% of the total assemblage (Fig. 3). Specimens of polygnathids constitute 30%, including ramiform elements. Representatives of *Polygnathus parawebbi*  $\alpha$  (13%) dominate. The number of specimens of *Coelocerodontus* is quite high (about 10%).

The interval characterized by Assemblage I is composed of light gray and greenish gray limestone, unbedded, compact, micritic, argillaceous, and bioturbated. Apart from conodonts, the limestone contains sponge spicules, scolecondonts, ostracod shells, gastropods, tentaculites, articulate brachiopods, crinoid columnals, spines and ambulacral plates of echinoids, fish scales

and teeth, oogonia of charophytes, rarely foraminifers, corals (auloporids), bryozoans, and inarticulate brachiopods.

**Assemblage II** (interval 188.8–191.8 m) apart from conodonts, continuing from the lowermost assemblage, shows the appearance of icriodids *I. arkonensis* Stauffer, *I. gagievi* Kononova et Kim, *I. jejunos* Nazarova, *I. obliquus* Klug, and also *Pseudobipennatus ziegleri* Kononova et Kim and *Belodella* sp. The diversity of conodonts in this assemblage gradually increases and at a depth of 190.7 m reaches the maximum of 14 species.

Most of the assemblage is composed of the members of the genus *Coelocerodontus* (38%), while icriodids constitute only 35%, of these, *I. formosus* continues to prevail (27%) (Fig. 4). Polygnathids constitute only 17% of the assemblage, and 8% of these are *Pol. parawebbi*  $\alpha$ .

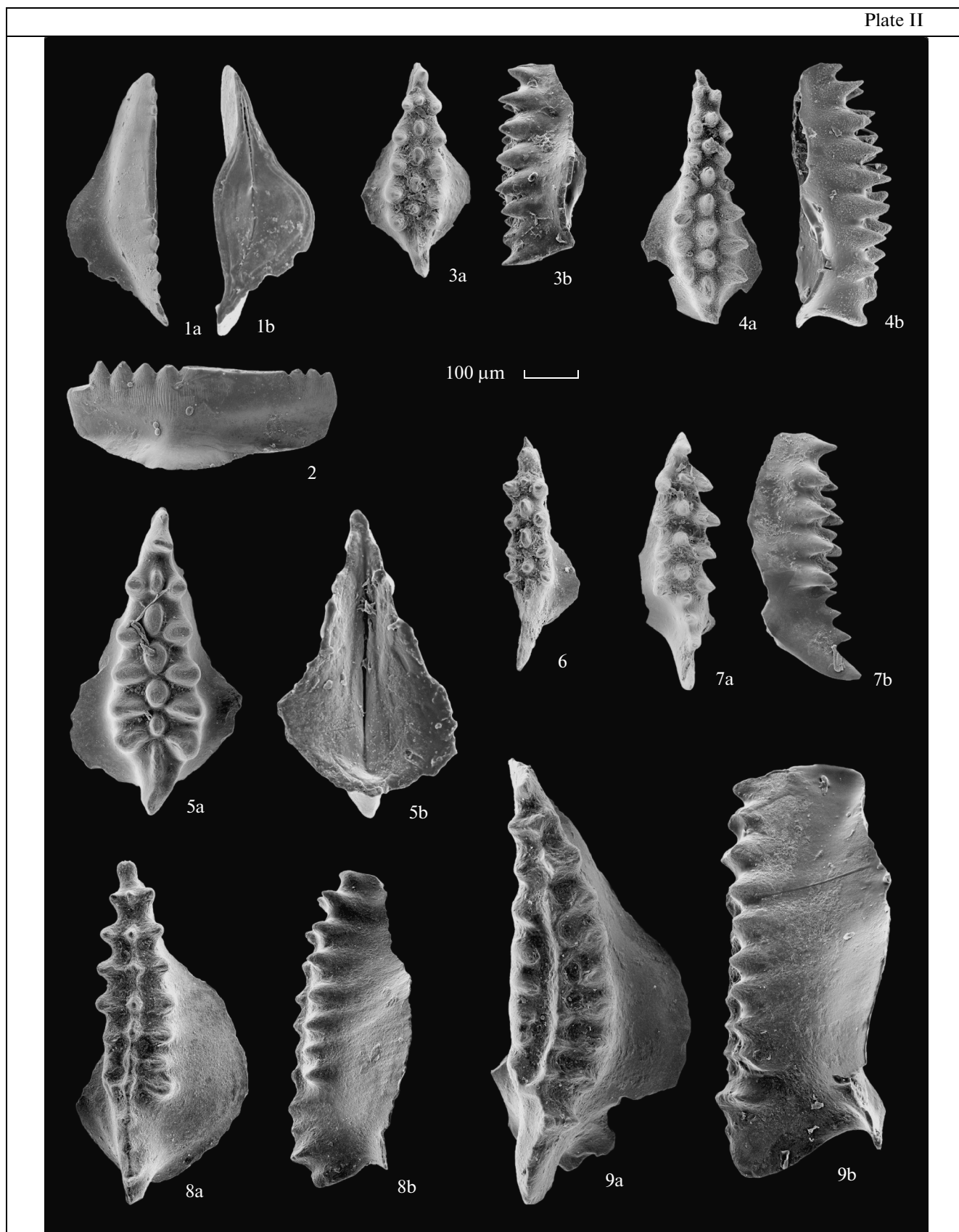
The interval containing the second assemblage is represented by light gray, unbedded, clastic limestone with a greenish gray calcareous-argillaceous matrix. Apart from conodonts, these beds contain sponge spicules, scolecodonts, ostracode shells, gastropods, tentaculites, articulate brachiopods, crinoid columnals, echinoid spines and ambulacral plates, holothurian sclerites, and fish scales and teeth; rarely encountered are foraminifers, corals (auloporids), and oogonia of charophytes.

**Assemblage III** (interval 184.5–188.8 m) contains the icriodids *Icriodus gagievi*, *I. khalymbadzhai*, *I. lindensis*, *Pelekysgnathus iris* Gagiev; polygnathids *Pol. parawebbi* (morphotypes  $\alpha$ ,  $\gamma$ ); and also *Ps. ziegleri*, *Coelocerodontus* sp. and singular, appearing for the first time, *Linguipolygnathus alveolus* (Weddige) and *Latericriodus latericrescens* Branson et Mehl. Previously, we assigned the interval of 184.5–188.8 m to the Chernovarian Regional Stage (Nazarova et al., 2010; Nazarova and Kononova, 2011).

Representatives of *Coelocerodontus* continue to be numerous and constitute 38% of the assemblage (Fig. 3). The proportion of icriodids decreases to 28%, with *I. lindensis* dominating among them, but its proportion does not exceed 4% of the assemblage. The number of coniform elements increases: from a few specimens in Assemblages I and II to 8% in Assemblage III. The number of polygnathids increases and

**Plate II.** Conodonts of the Mosolovian Regional Stage; Eifelian Stage, Mosolovian Regional Stage, Voronezh Anteclise, Kursk oblast; in all cases  $\times 100$ . (1, 2) *Pseudobipennatus ziegleri* Kon. et Kim: (1) specimen no. MGU 272/767, (1a) upper view, (1b) bottom view, Shchigry-16 Borehole, interval 189.25–194.15 m, Sample SHCH-16/222; (2) specimen no. MGU 272/770, lateral view, Shchigry-16 Borehole, interval 184.35–189.25 m, Sample SHCH-16/211; (3, 4) *Icriodus gagievi* Kon. et Kim: (3) specimen no. MGU 272/804, (3a) upper view, (3b) lateral view, Shchigry-16 Borehole, interval 184.35–189.25 m, Sample SHCH-16/206; (4) specimen no. MGU 272/805, (4a) upper view, (4b) lateral view, Shchigry-16 Borehole, interval 189.25–194.15 m, Sample SHCH-16/222; (5) *Icriodus struvei* Wedd., specimen no. MGU 272/806, (5a) upper view, (5b) bottom view, Shchigry-16 Borehole, interval 199.05–203.95 m, Sample SHCH-16/235; (6, 7) *Icriodus lindensis* Wedd.: (6) specimen no. MGU 272/807, upper view, Shchigry-16 Borehole, interval 184.35–189.25 m, Sample SHCH-16/214; (7) specimen no. MGU 272/808, (7a) upper view, (7b) lateral view, Shchigry-16 Borehole, interval 184.35–189.25 m, Sample SHCH-16/209; (8) *Icriodus regularicrescens* Bult., specimen no. MGU 272/809, (8a) upper view, (8b) lateral view, Shchigry-19 Borehole, interval 189.8–194.7 m, Sample SHCH-19/204; (9) *Icriodus arkonensis* Stauff., specimen no. MGU 272/810, (9a) upper view, (9b) lateral view, Shchigry-16 Borehole, interval 189.25–194.15 m, Sample SHCH-16/222.

Plate II



constitutes 29% (including ramiform elements), while *Pol. parawebbi*  $\alpha$  dominate (15% of assemblage).

The interval containing Assemblage III is composed in its lower part of light greenish gray, fine-grained massive, hard limestone, with stylolites and clay interbeds; in the upper part, it is composed of layers of light greenish gray mudstones with numerous gliding joints, with beds of limestone and siltstone. Apart from conodonts, they contain sponge spicules, scolecodonts, calcareous worm tubes, auloporid corals, ostracode shells, gastropods, articulate brachiopods, bryozoans, crinoid columnals, echinoid spines and ambulacral plates, fish scales and teeth, rarely tentaculites and inarticulate brachiopods, holothurian sclerites, and oogonia of charophytes. In the upper three samples (interval 184.5–185.5 m), fossils are represented solely by fish remains.

The deposits of the Mosolovian Regional Stage are overlain by siltstones of the Starooskolian Regional Stage lacking fossil remains and overlain by mudstones with lingulids and fish remains.

#### *Shchigry-19 Borehole (Osinovka)*

The Shchigry-19 Borehole (Osinovka) was drilled in Kursk oblast 10 km north of the town of Shchigry (southwestern regions of the Voronezh Anticline). The borehole was 206.0 m deep. The Devonian deposits, 147 m thick and represented by carbonate-terrigenous rocks, rest on the crystalline basement and are overlain by Jurassic rocks. The initial subdivision of these beds was conducted A.G. Olferiev on the basis of lithology, brachiopods (identified by N.V. Oleneva), and a few samples with conodonts (identified by L.I. Kononova). This borehole core was sampled in detail in 2006 by O.B. Bondarenko, R.A. Voinova, and L.I. Kononova (Department of Paleontology, Moscow State University).

The Mosolovian Regional Stage about 23.5 m thick was determined by Olferiev for the interval of 180.0–203.5 m deep. This Regional Stage lies conformably on the sandstones of the Klintsovian Regional Stage. A sample from the Klintsovian Regional Stage contained rare fish remains and scolecodonts. Beds of the Mosolovian Regional Stage are represented by limestone, mainly argillaceous, and clay, containing vari-

ous fossils. This Regional Stage is overlain unconformably by mudstone and clay of the Starooskolian Superhorizon with Givetian conodonts. From this Regional Stage, we studied 35 samples with average weight of 0.3–0.5 kg, 29 of which contained conodonts. Altogether, the collection contains 547 specimens (Table 2). Some preliminary identifications of conodonts from this borehole and brief conclusions were previously published (Nazarova and Kononova, 2012).

Here, as in the Shchigry-16 Borehole (Fig. 5), we recognize three assemblages (from bottom to top):

**Assemblage I** (interval 194.0–203.5 m) contains the icriodids *Icriodus formosus*, *I. gagievi*, *I. khalymbadzhai*, *I. lindensis*, *I. norfordi* Chatterton, *I. orri* Klapper et Barrick, *I. struvei*, and *Pel. iris* and polygnathids *Ct. taljashenkoae* and *Pol. parawebbi* (morphotype  $\alpha$ ), and also *Coelocerodontus* sp. These species, except *I. norfordi*, *I. orri*, and *I. struvei*, are traced up the section.

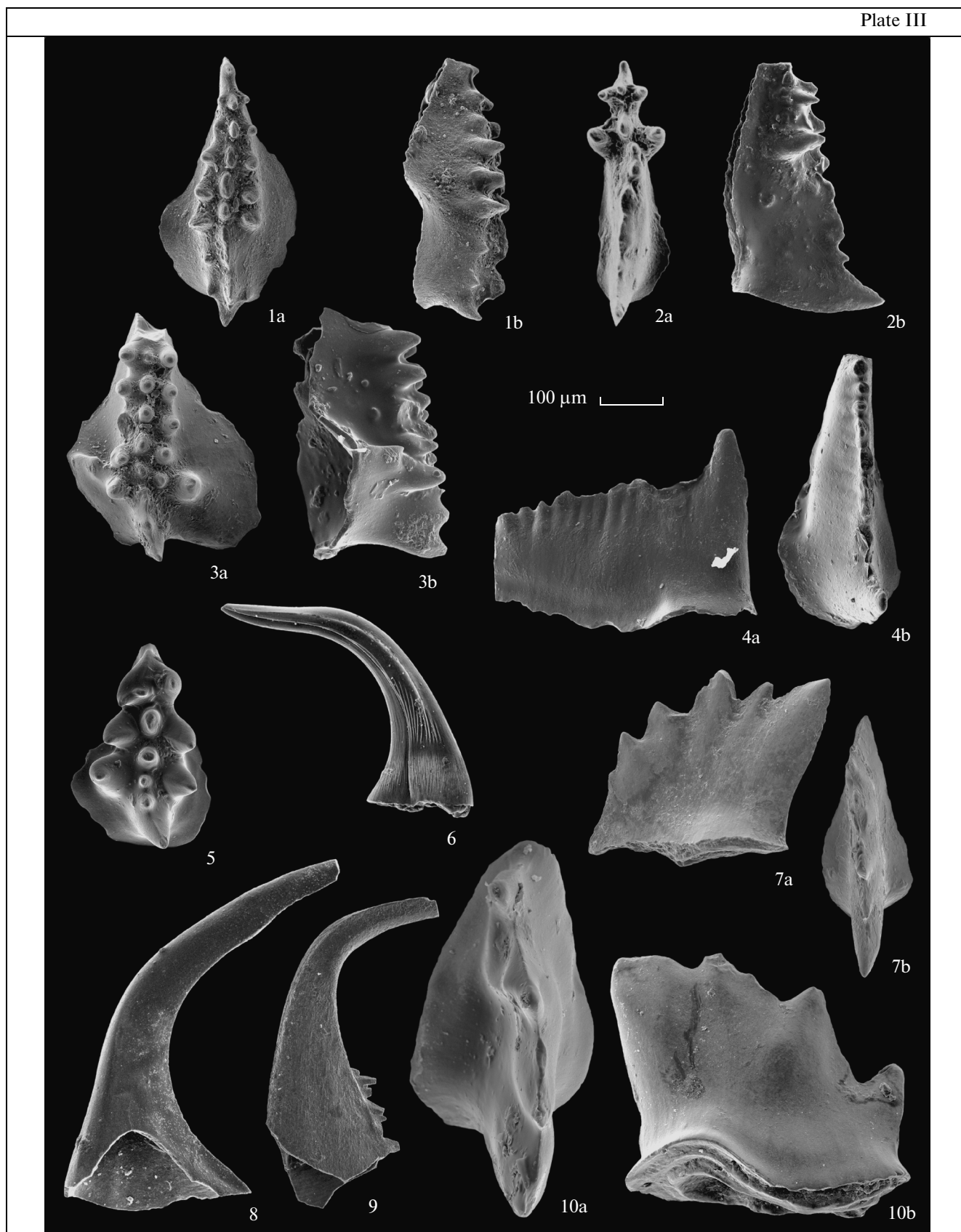
In number of specimens, icriodids significantly prevail (88% of the assemblage) (Fig. 3), of which *I. formosus* is the most abundant (43% of the assemblage). Polygnathids are not numerous (11%); of these, *Pol. parawebbi*  $\alpha$  is the most numerous (8%). Representatives of *Coelocerodontus* are few.

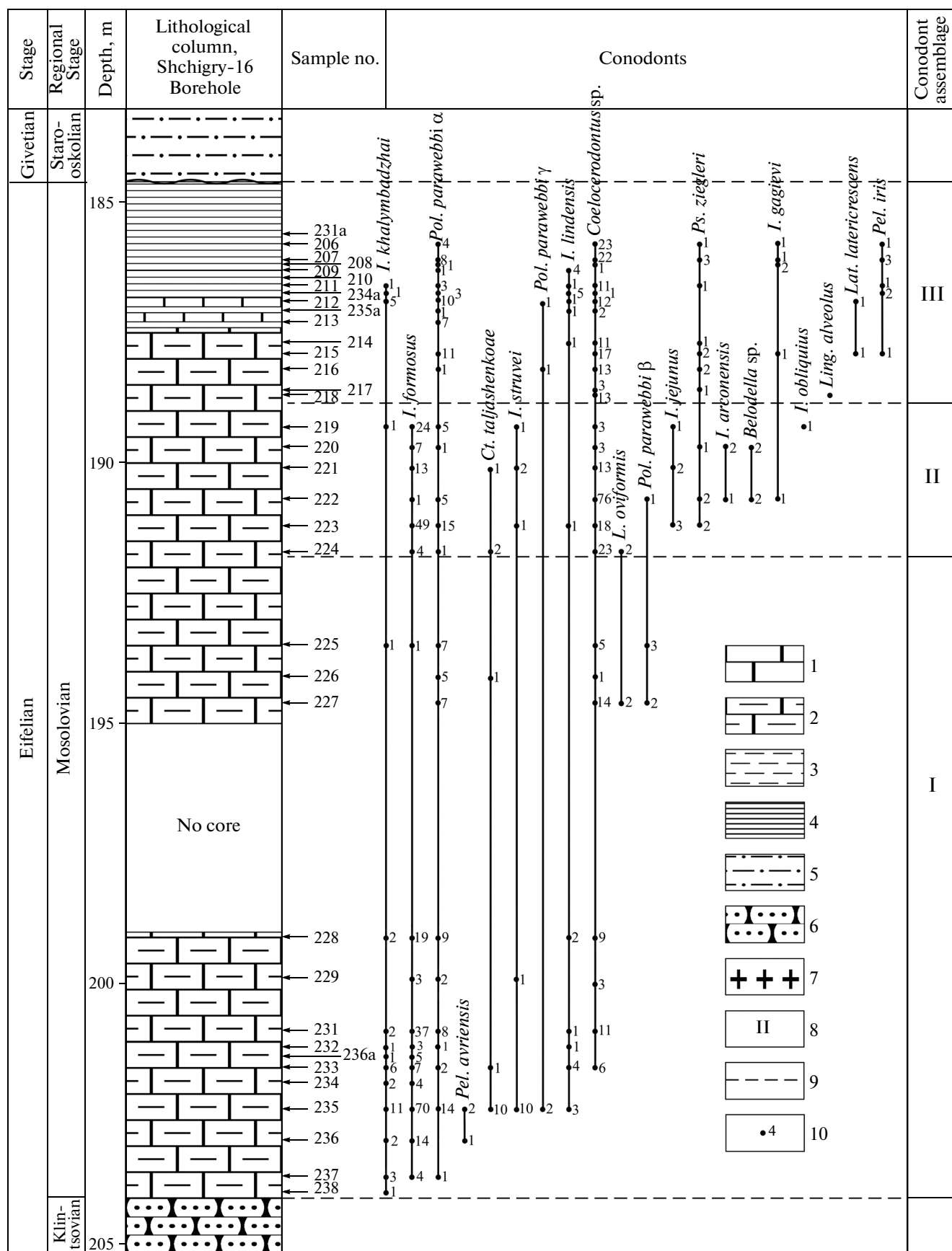
The interval containing Assemblage I is represented in the lower part by light greenish gray, platy mudstones, which up the section transit into alternating light gray hard limestone and greenish gray strongly argillaceous limestone, replaced higher in the section by a light gray, hard, massive limestone, with numerous stylolite sutures. Apart from conodonts, these beds contain scolecodonts, corals (especially in the upper part), ostracode shells, gastropods, articulate brachiopods, fish scales and teeth, and oogonia of charophytes, while less common are sponge spicules, foraminiferal shells, bivalves, tentaculites and lingulids, crinoid columnals, echinoid spines and ambulacral plates, and bryozoans.

**In Assemblage II** (interval 182.8–194.0 m), some of the species continue from the lower levels (*I. formosus*, *I. gagievi*, *I. khalymbadzhai*, *I. lindensis*, *Ct. taljashenkoae*, *Pol. parawebbi*  $\alpha$ , *Coelocerodontus* sp.), while *I. arkonensis*, *I. jejunos*, *I. regularicrescens* Bultynck, *Ps. zieglerei*, and *Belodella* sp. first appear at this level.

#### **Plate III.** Conodonts of the Mosolovian Regional Stage; Eifelian, Mosolovian Regional Stage, Voronezh Anticline; in all cases $\times 120$ .

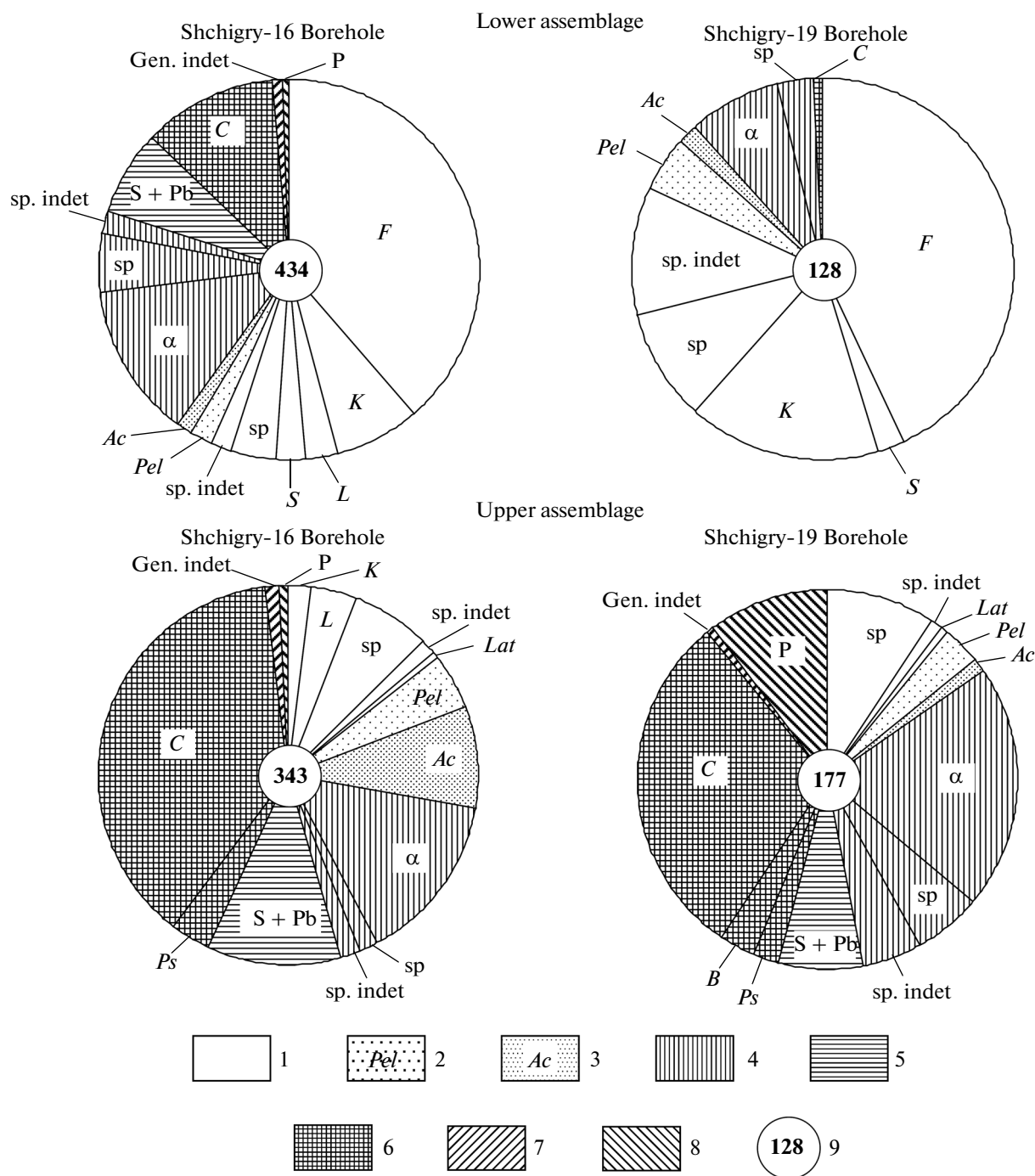
(1) *Icriodus jejunos* Naz., holotype no. MGU 272/750, (1a) upper view, (1b) lateral view, Kursk oblast, Shchigry-16 Borehole, interval 189.25–194.15 m, Sample SHCH-16/221; (2) *Icriodus obliquus* Klug, specimen no. MGU 272/570, (2a) upper view, (2b) lateral view, Orel oblast, Naryshkino 4177 Borehole, depth 344.4 m, Sample Nar-157; (3) *Latericriodus latericrescens* (Br. et Mehl), specimen no. MGU 272/812, (3a) upper view, (3b) lateral view, Shchigry-16 Borehole, interval 184.35–189.25 m, Sample SHCH-16/212; (4) *Pelekysgnathus* sp. F, specimen no. MGU 272/813, (4a) lateral view, (4b) upper view, Bryansk oblast, Prosvet 2P Borehole, depth 313.3, Sample 2P-66; (5) *Icriodus gordeevi* Kon. et Kim, specimen no. MGU 272/811, upper view, Orel oblast, Naryshkino 4177 Borehole, depth 334.9 m, Sample Nar-147; (6) *Coelocerodontus* sp., specimen no. MGU 272/821, lateral view, the same locality, depth 346.4 m, Sample Nar-161; (7) *Pelekysgnathus iris* Gag., specimen no. MGU 272/815, (7a) lateral view, (7b) upper view, Kursk oblast, Shchigry-16 Borehole, interval 184.35–189.25 m, Sample SHCH-16/211; (8) *Coelocerodontus* sp., specimen no. MGU 272/822, lateral view, Kursk oblast, Shchigry-19 Borehole, interval 180.0–184.9 m, Sample SHCH-19/190; (9) *Belodella* sp., specimen no. MGU 272/823, lateral view, the same locality, interval 189.8–194.7 m, Sample SHCH-19/203; (10) *Pelekysgnathus avriensis* Gag., specimen no. MGU 272/814, (10a) upper view, (10b) lateral view, Kursk oblast, Shchigry-16 Borehole, interval 199.05–203.95 m, Sample SHCH-16/235.







**Fig. 2.** Distribution of conodonts in the Mosolovian deposits studied in the Shchigry-16 Borehole. (1) Limestone; (2) argillaceous limestone; (3) mudstone; (4) clay; (5) siltstone; (6) sandstone; (7) crystalline basement; (8) Assemblage number; (9) boundaries of assemblages; (10) number of specimens in a sample.



**Fig. 3.** Diagrams of the number of specimens of the conodont species in Assemblages I and III in the Shchigry-16 and Shchigry-19 boreholes: (1) Representatives of *Icriodus* s. l.: *Ar*—*I. arkonensis*, *F*—*I. formosus*, *J*—*I. jejunos*, *K*—*I. khalymbadzhai*, *L*—*I. lindensis*, *O*—*I. obliquus*, *S*—*I. struvei*, sp—other icriodids (including juveniles), sp. indet—broken indeterminable icriodids, *Lat*—representatives of the genus *Latericriodus* s. s.; (2) representatives of the genus *Pelekysgnathus*; (3) coniform elements of icriodids; (4) representatives of polygnathids:  $\alpha$ —*Pol. parawebbi*  $\alpha$ , sp—other polygnathids, sp. indet—indeterminable polygnathids; (5) Pb and S elements of polygnathids (S + Pb); (6) representatives of other conodont genera: *Ps*—*Pseudobipennatus*, *B*—*Belodella*, *C*—*Coelocerosodontus*; (7) indeterminable fragments of conodont elements (Gen. indet); (8) “conodont pearl” (P); (9) number of conodont elements in an assemblage.

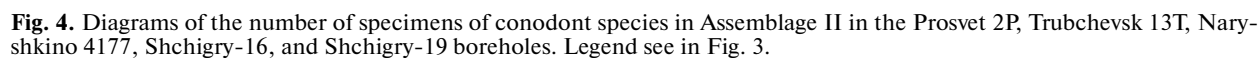
Table 1. Distribution of conodonts in the Mosolovian Regional Stage in the Shchigry-16 Borehole

Taxa	Sample nos.	238	237	236	235	234	233	236a	232	231	229	228	227	226	225	224	223	222	221	220	219
<i>I. arkonensis</i> Stauff.							1											1		2	
<i>I. formosus</i> Naz.			4	14	70	4	7	5	3	37	3	19			1	4	49	1	13	7	24
<i>I. gagievi</i> Kon. et Kim																		1			
<i>I. jejunus</i> Naz.																					
<i>I. khalymbadzhai</i> Kon. et Kim	1	3	2	11	2	6	4	1	1	2	2	2			1		3	2		1	1
<i>I. lindensis</i> Wedd.				3					1	2	2						1				1
<i>I. obliquus</i> Klug				10							1						1		2		1
<i>I. struvei</i> Wedd.								4					2		3	2					
<i>I. sp.</i>		1	1	3	2	1				3		1					3				
<i>I. sp. indet.</i>				2																1	
<i>Lat. latericrescens</i> Br. et Mehl																					
<i>Pel. avriensis</i> Gag.			1	2																	
<i>Pel. iris</i> Gagiev																					
<i>Pel. sp.</i>		1	1	1	2						1						1				
<i>Ct. taljaschenkoae</i> Kon. et Kim				10			1									2					
<i>Ling. oviformis</i> Kon. et Kim													2			2			1		
<i>Ling. alveolus</i> Wedd.																					
<i>Ling. sp. indet.</i>																					1
<i>Pol. parawebbi</i> α Chatt.		1	14	2					1	8	2	9	7	5	7	1	15	5		1	5
<i>Pol. parawebbi</i> β Chatt.													2		3			1			
<i>Pol. parawebbi</i> γ Chatt.				2								1								1	
<i>Pol. cf. parawebbi</i>																1					
<i>Pol. sp. indet.</i>			1	5	2																
<i>Ps. ziegleri</i> Kon. et Kim																	2	2		1	
<i>Belodella</i> sp.																	2	2		2	
<i>Coeloceros</i> sp.							6			11	3	9	14	1	5	23	18	76	13	3	3
Pb elements				2						3	1	1	1		3	1	5	2	2		1
S elements				1						7	3	2	5		3	2	1	6	4		2
Coniform elements							3	1						1	2		2		2		
Gen. et sp. indet.														1	3			3		1	
"Conodont pearls"															2		7	7			6
Total: 1134 specimens	1	10	19	136	6	37		11	6	73	13	47	33	9	33	38	108	107	39	19	46
Sample weight, kg	0.5	0.5	0.3	0.9	0.6	0.5		0.5	0.6	0.5	0.5	0.5	0.6	0.5	0.7	0.5	0.5	0.5	0.5	0.5	0.5

Table 1. (Contd.)

Taxa	Sample nos.	218	217	216	215	214	213	235a	212	234a	211	210	209	208	207	206	231a
<i>I. arkonensis</i> Stauff.																	
<i>I. formosus</i> Naz.																	
<i>I. gagievi</i> Kon. et Kim																	
<i>I. jejunos</i> Naz.																	
<i>I. khalymbadzhai</i> Kon. et Kim																	
<i>I. lindensis</i> Wedd.						1		1	1	5	1		4				
<i>I. obliquus</i> Klug																	
<i>I. struvei</i> Wedd.																	
<i>I. sp.</i>	5	4		2						3			4	2	1	2	
<i>I. sp. indet.</i>					1				1	1			2				
<i>Lat. latericrescens</i> Br. et Mehl				1					1								
<i>Pel. avriensis</i> Gag.																	
<i>Pel. iris</i> Gagiev				1					2	1	1				3	1	
<i>Pel. sp.</i>					1		1		2	1	1	1				1	
<i>Ct. taljaschenkoae</i> Kon. et Kim																	
<i>Ling. oviformis</i> Kon. et Kim	1																
<i>Ling. alveolus</i> Wedd.																	
<i>Ling. sp. indet.</i>																	
<i>Pol. parawebbi</i> α Chatt.				1	11		7	1	10	3	3		1	1	8	4	
<i>Pol. parawebbi</i> β Chatt.																	
<i>Pol. parawebbi</i> γ Chatt.				1	2	1			1								
<i>Pol. cf. parawebbi</i>						1											
<i>Pol. sp. indet.</i>	1	2	1										1				
<i>Ps. ziegleri</i> Kon. et Kim			1	2	2	1					1		1		3	1	
<i>Belodella</i> sp.																	
<i>Coelocerodontus</i> sp.	13	3	13	17	11			2	12	1	11			1	22	23	
Pb elements	2		3	3	3			1	2								2
S elements	2			4	3				4	2			6		1	1	
Coniform elements	2		1		2		7		3	8	2	1		1			2
Gen. et sp. indet.		1	1		1								1				
“Conodont pearls”				2												1	
Total: 1134 specimens	26	11	25	43	25		15	5	42	27	21	2	20	5	38	36	2
Sample weight, kg	0.7	0.3	0.7	0.5	0.25		0.3	0.5	0.5	0.5	0.5	0.3	0.3	0.5	0.5	0.5	0.5

Abbreviations here and below: *I.*—Icriodus, *Lat.*—Latericriodus, *Pel.*—Pelekysgnathus, *Ct.*—Ctenopolygnathus, *Ling.*—Linguipolygnathus, *Pol.*—Polygnathus, *Ps.*—Pseudobipennatus.



**Table 2.** Distribution of conodonts in the Mosolovian Regional Stage in the Shchigry-19 Borehole

Taxa	Sample nos.																				187	186	185	184	183
	216	214	213	211	210	209	208	207	206	205	204	203	202	201	200	199	198	196	195	194	193	191	190	189	
<i>I. arkonensis</i> Stauff.	3	3	11	5	2	29	2	15	14	8	11	8	3	1	1	1					1				
<i>I. formosus</i> Naz.															1	9					1				
<i>I. gagievi</i> Kon. et Kim			1					1						1				1		1					
<i>I. jejunus</i> Naz.	6	9				5	1	8	2	4		5					1				1				
<i>I. khalymbadzhai</i> Kon. et Kim											1														
<i>I. lindensis</i> Wedd.	1																						2		
<i>I. norfordi</i> Chatt.	2					1																			
<i>I. orri</i> Kl. et Barr.											1														
<i>I. regularicrescens</i> Bult.																									
<i>I. struvei</i> Wedd.	3	1																							
<i>I. sp.</i>	1		2	4														1			1				4 1 7
<i>I. sp. indet.</i>		1	5	3	1	4			1		1	1				1						2			
<i>Lat. cf. latericrescens</i> Br. et M.																						1			
<i>Pel. iris</i> Gag.			1	2	1																				3
<i>Pel. sp.</i>	1					1				1		1										1			1
<i>Ct. taljashenkoae</i> Kon. et Kim			2			1						1	1			1									
<i>Ling. sp.</i>																1									
<i>Pol. parawebbi</i> α Chatt.						10		1	6	4	9	20	1		10	5	1				1	3	5	5	24
<i>Pol. parawebbi</i> β Chatt.																						2	2		2
<i>Pol. parawebbi</i> γ Chatt.															1							1			
<i>Pol. sp.</i>				1												4	1						7		1 2
<i>Pol. sp. indet.</i>															1										2
<i>Ps. ziegleri</i> Kon. et Kim								1			1				1	1						4			
<i>Belodella</i> sp.											1	1						4				5			
<i>Coelocerodontus</i> sp.						1	1	8	1		13				2	8	5	1	3	3	3	27	10		16
Coniform elements	1															1								1	1
S elements									2		2	2	1		1	5	1	1	1	1	1	7	2		
Pb elements									2		5										1	4			
Gen. et sp. indet.									2			1			1		1		1	1		1			
“Conodont pearls”											5											16			2
Total: 570 specimens	17	5	32	15	4	50	6	34	24	23	26	63	4	3	6	42	9	10	5	6	9	3	82	24	1 1 57 1 8
Sample weight, kg	0.3	0.3	0.3	0.4	0.42	0.5	0.31	0.97	0.5	0.3	0.6	0.6	0.3	0.3	0.5	0.4	0.5	0.5	0.2	0.2	0.3	0.5	0.5	0.4	0.2 0.4 0.4 0.3 0.3

**Table 3.** Distribution of conodonts in the Mosolovian Regional Stage in the Novokhoperskaya 8750/1 Borehole

Taxa \ Sample nos.	578	577	576
<i>I. formosus</i> Naz.		2	
<i>I. norfordi</i> Chatt.		1	
<i>I. sp. indet.</i>		1	
<i>Ling. sp.</i>			1
<i>Pol. parawebbi</i> $\alpha$ Chatt.		6	
<i>Pol. sp. indet.</i>		1	
<i>Coelocerodontus</i> sp.	1	1	
Pb elements	1	1	
S elements	3	1	
Total: 20	5	14	1
Sample weight, kg	200	100	172

The percentage of icriodid specimens falls to 40%, and they are still dominated by *I. formosus* (25% of the assemblage) (Fig. 4). The number of polygnathids increases to 35% with clear dominance of *Pol. parawebbi*  $\alpha$  (22%). The number of *Coelocerodontus* representatives also increases (17%).

The interval containing Assemblage II is represented by light gray limestones with numerous stylolitic sutures. The lower part contains layers of corals, and the upper part contains thin layers of greenish gray laminated mudstones, containing organic detritus. Apart from conodonts, the rocks contain sponge spicules, scolecodonts, corals, foraminiferal shells, ostracodes, gastropods, tentaculites, articulate brachiopods, crinoid columnals, spines and ambulacral plates of echinoids, fish scales and teeth, and oogonia of charophytes, while calcareous worm tubes, bivalvian shells, lingulids, bryozoans, and holothurian sclerites are less common.

**Assemblage III** (interval 180.0–182.8 m) contains species continuing from the lower beds. These are *I. lindensis*, *Ps. ziegleri*, *Coelocerodontus* sp., and *Beldella* sp. Of polygnathids, apart from the continuing morphotype  $\alpha$  *Pol. parawebbi*, morphotypes  $\beta$  and  $\gamma$  known from the Shchigry-16 Borehole appear at this level. As in the Shchigry-16 Borehole, this assemblage contains the earliest *Lat. cf. latericrescens*. Polygnathids clearly dominate the assemblage compared to the synchronous level in the Shchigry-16 Borehole.

The number of icriodids becomes considerably lower (15% of the assemblage), and juvenile and broken specimens unidentifiable to species prevail (Fig. 3). The number of polygnathids increases to almost 40% (of these, about 20% are *Pol. parawebbi*  $\alpha$ ). The number of representatives of *Coelocerodontus* increases to 30%.

The interval containing Assemblage III is represented by gray limestone, in some interbeds strongly argillaceous, weak, with stylolitic sutures and thin layers of greenish gray, platy mudstones with organic debris. Apart from conodonts, these rocks contain scolecodonts, corals, ostracode shells, gastropods, articulate brachiopods, crinoid columnals, spines and ambulacral plates of echinoids, and fish scales and teeth; sponge spicules, calcareous worm tubes, tentaculites and lingulids, and holothurian sclerites are less common.

#### *Novokhoperskaya 8750/1 Borehole*

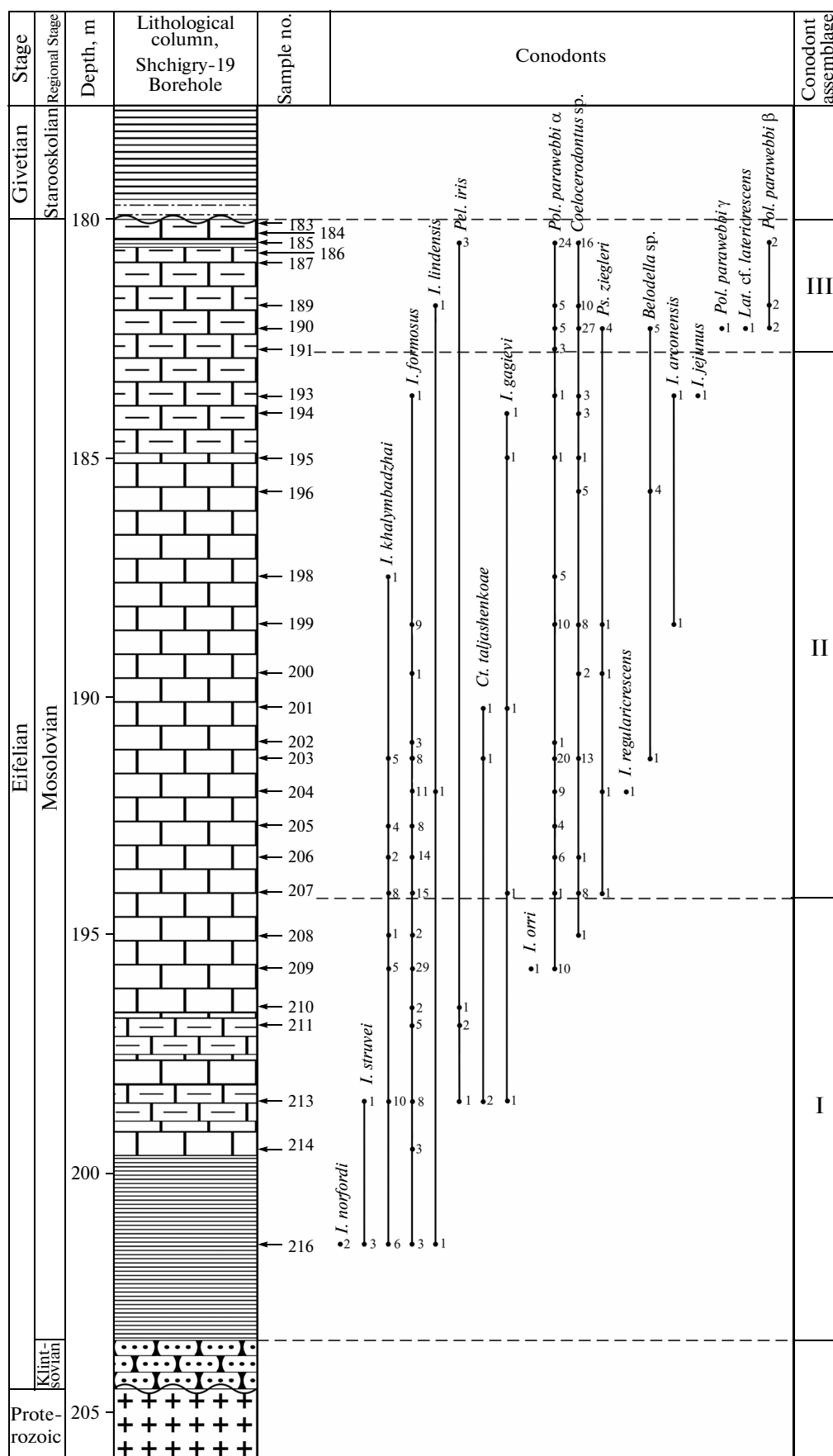
The Novokhoperskaya 8750/1 Borehole was drilled near the town of Novokhopersk of the Voronezh oblast (southeastern regions of the Voronezh Antecline). The borehole was drilled to a depth of 338.7 m and was discontinued in the sandstone of the Klintsovian Regional Stage. The Devonian beds are 286 m thick and are represented by carbonate-terrigenous rocks, overlain by Cretaceous terrigenous deposits. The detailed core sampling was conducted in 2003 by L.I. Kononova and underground students and students of the Department of Paleontology (MSU) E.M. Kirilishina, O.V. Komissarova, N.Yu. Nosko, and S.-E. Kim.

The Mosolovian Regional Stage is 30.3 m thick and was determined in the depth interval of 303.6–333.9 m on the basis of lithology (Fig. 6). It rests conformably on the quartz sandstone of the Klintsovian Regional Stage with rare plant remains. Deposits of the Mosolovian Regional Stage are represented mainly by limestone, which is conformably overlain by mudstone containing conodonts of Chernoyarian age.

We studied 24 samples from this Regional Stage with the mean weight 0.3–0.5 kg, but only three of these contain conodonts. The collection altogether contains 20 specimens of conodont elements (Table 3). In the lower part of the Regional Stage (interval 306.5–333.9 m), conodonts are not found. This interval is represented by limestone with rare organic remains, mainly scolecodonts and plants, while sponge spicules, ostracode shells and tentaculites, crinoid columnals, spines and ambulacral plates of echinoids, and charophytes are less common. Layers with brachiopods are observed in the upper part of the interval. No core was collected from the interval of 312.3–317.1 m.

The overlying beds contain conodonts, which can be correlated with Assemblages II and III from the Shchigry-16 and Shchigry-19 boreholes.

Fig. 5. Distribution of conodonts in the Mosolovian deposits studied in the Shchigry-19 Borehole. Legend see in Fig. 2.



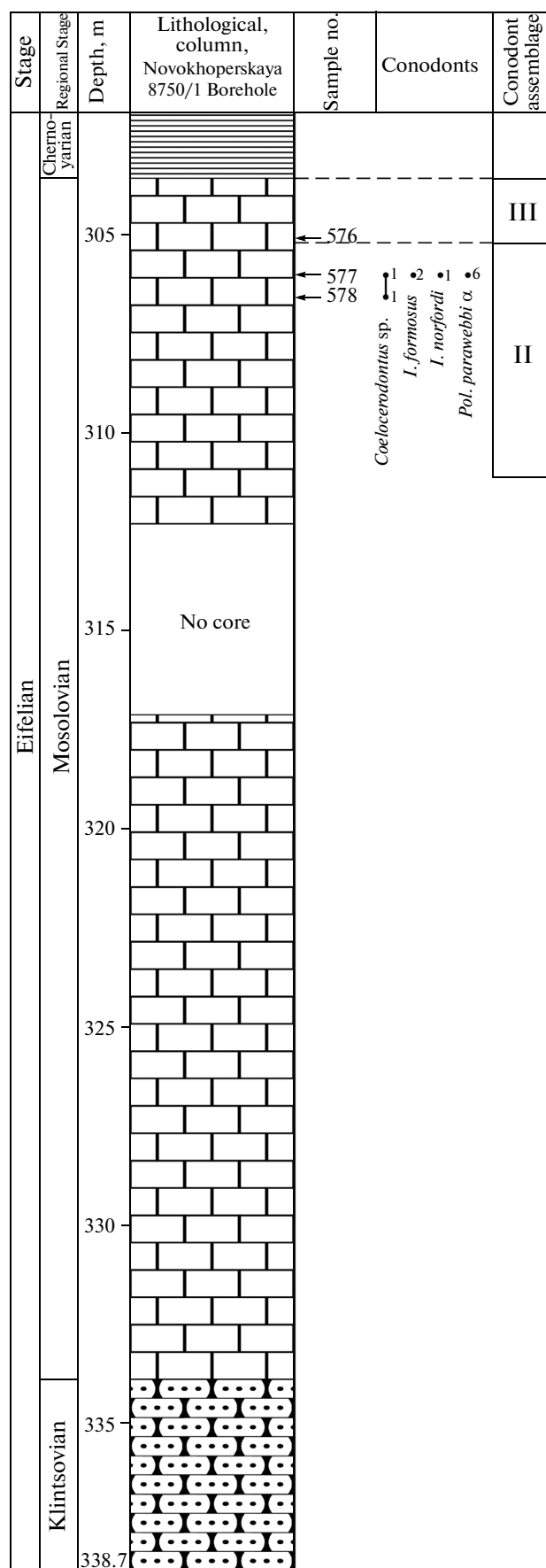


Fig. 6. Distribution of conodonts in the Mosolovian deposits studied in the Novokhoperskaya 8750/1 Borehole. Legend see in Fig. 2.

**Assemblage II** (interval 305.2–307.0 m) contains *I. formosus*, *Pol. parawebbi* α, *I. norfordi*, and *Coelocerosodontus* sp. Rocks hosting this assemblage are represented by limestone with brachiopods and fish remains. These beds also contain sponge spicules, scolecodonts, ostracode shells, gastropods and tentaculites, crinoid columnals, spines and ambulacral plates of echinoids, and oogonia of charophytes.

**Assemblage III** (interval 303.6–305.2 m) is considerably more impoverished and includes occasional *Pol. parawebbi* α and *Coelocerosodontus* sp. This interval is composed of limestone with sponge spicules, scolecodonts and crinoid columnals, less commonly conodonts, spines and ambulacral plates of echinoids, and plant remains.

#### ANALYSIS OF THE ASSEMBLAGES

The study of conodonts from the Shchigry-16 and Shchigry-19 boreholes showed that their distribution in the Mosolovian Regional Stage is uneven and three assemblages can be recognized. The first assemblage is characterized by the presence of *I. formosus* and general predominance of icriodids. The second assemblage shows the first appearance of characteristic species such as *Ps. ziegleri*, *I. arkonensis*, and *I. jejunos*. In the third assemblage, these species and *I. formosus* disappear, and only *Ps. ziegleri* remains. Apart from these species, all assemblages contain numerous other species. However, the above-listed species clearly mark the boundaries of the assemblages. In addition, they are readily identifiable and can be used as markers.

The reexamination of the collections from the Naryshkino 4177 (Orel oblast) (Fig. 7, Table 4) and Prosvet 2P (Fig. 8, Table 5) and Trubchevsk 13T (Fig. 9, Table 6) (Bryansk oblast) boreholes in the northwestern regions of the Voronezh Anteclise showed that similar assemblages can also be recognized in these boreholes, although they usually contain the second assemblage, whereas the first and third assemblages are considerably more impoverished and the thickness of the rocks containing these assemblages is low.

The data on the conodonts from the above boreholes were previously published (Nazarova, 1995, 1997, 1998; Kononova and Kim, 2001, 2005), but for this study, the entire collection was reexamined and the identifications of some species were updated.

The correlation of the boreholes is represented in Fig. 10. Terrigenous deposits of the Klintsovian Regional Stage, apart from the Shchigry-16 and Shchigry-19 boreholes, were studied in the Naryshkino 4177 and Prosvet 2P boreholes, but these did not contain any conodonts.



A few conodonts of Assemblage I were found in the marls in the interval of 348.3–353.3 m in the Naryshkino 4177 Borehole (*I. formosus*, *Pol. parawebbi*  $\alpha$ , *I. khalymbadzhai*, and *I. lindensis*) and in the limestones in the interval of 321.8–325.5 m in the Prosvet 2P Borehole (*I. lindensis*).

Conodonts of Assemblage II were found in all boreholes, and they are as diverse as in the Shchigry-16 and Shchigry-19 boreholes. Assemblage II was found in the Naryshkino 4177 Borehole in argillaceous limestones (interval 335.2–348.3 m), in the Prosvet 2P Borehole in limestones with argillaceous interbeds (interval 306.2–321.8 m), and in the Trubchevsk 13T Borehole in the limestones (interval 340.0–355.5 m). The number of species varies from 11 in the Trubchevsk 13T Borehole to 18 in the Naryshkino 4177 Borehole and 22 in the Prosvet 2P Borehole. In all boreholes, we found marker species of the second assemblage, including *I. formosus*, *Ps. zieglerei*, and *I. jejunos*. The Prosvet 2P and Naryshkino 4177 boreholes also contain *I. arkonensis*. The remaining accompanying species are distributed differently. All assemblages contain the polygnathids *Pol. parawebbi*  $\alpha$  and *Ct. taljashenkoae* and icriodids *I. khalymbadzhai* and *I. lindensis*, which in the Shchigry-16 and Shchigry-19 boreholes were found only at the level of Assemblage II. All boreholes also contained *I. obliquus* and *I. struvei*, which are absent at a synchronous level in the Shchigry-19 Borehole. Representatives of the genus *Pelekysgnathus* (*Pel. avriensis*, *Pel. iris*, and *Pel.* sp. F) are more common in the Prosvet 2P and Trubchevsk 13T boreholes than in the Shchigry-16 and Shchigry-19 boreholes.

Deposits of all boreholes are dominated by representatives of the genus *Icriodus*. They constitute from 35% in the Shchigry-16 Borehole to 60–75% in the Prosvet 2P and Trubchevsk 13T boreholes (Fig. 4). This suggests a shallow-water sedimentary setting. The species *I. formosus* is the most common (14–27% of the assemblage). This species is characteristic of both conodont Assemblages I and II of the Mosolovian Regional Stage, is readily identifiable because of its striking morphology, and therefore has a high stratigraphic and correlation potential for the Devonian deposits of the Voronezh Anteclise. *Pol. parawebbi*  $\alpha$  dominates among polygnathids in all boreholes (from 5% in the Trubchevsk 13T Borehole to 22% in the Shchigry-19 Borehole). In general, polygnathids are the most abundant and numerous in the Shchigry-19 and Naryshkino 4177 boreholes (35–45%). In the Shchigry-16 and Shchigry-19 boreholes, the assemblage is essentially composed of representatives of the genus *Coelocerodontus* (up to 38 and 19, respectively). In other boreholes, representatives of this species are only occasional.

The composition of the second conodont assemblage of the Mosolovian Regional Stage in the Trubchevsk 13T and Prosvet 2P boreholes are similar, which is not surprising because these boreholes are near each other. These sites were on the margin of the

Middle Devonian basin, which is supported by the facial interpretations of Rodionova et al. (1995). The similarity of the assemblages in the Naryshkino 4177 and Shchigry-19 boreholes is apparently related to the similar conditions, perhaps slightly deeper, which is suggested by more numerous polygnathids than in other boreholes.

The above description allows a reconstruction of the environment for some species of conodonts. *I. formosus*, the most common in all boreholes, most likely inhabited the surface water layers. The species *I. obliquus* and *I. jejunos* and representatives of the genus *Pelekysgnathus* were most likely demersal and coastal organisms because they are the most abundant in the Trubchevsk 13T and Prosvet 2P boreholes. Polygnathids (*I. arkonensis*) and representatives of the genus *Pseudobipennatus* inhabited greater depths because they are found in abundance in the Shchigry-19 and Naryshkino 4177 boreholes.

Assemblage III in the Naryshkino 4177 Borehole (clay, marl, and limestone in the interval of 330.8–335.2 m) is impoverished. It contains occasional *I. gagievi* and *I. gordeevi*. In the Prosvet 2P Borehole, this level (interval 305.0–306.2 m) is represented by clay and contains *I. obliquus*. In the Trubchevsk 13T Borehole, the corresponding interval (interval 335.8–340.0 m) is composed of clay and alternation of clay and limestone and contains occasional *I. lindensis*.

The above-considered conodont assemblages of the Mosolovian Regional Stage are characterized by many endemic species (*I. formosus*, *I. khalymbadzhai*, *I. gagievi*, *Ps. zieglerei*, and others), but also contain cosmopolitan species common in the Eifelian (*I. struvei*, *I. lindensis*, *I. arkonensis*, *I. regularicrescens*, and *Ling. alveolus*). The association of these species allows the assignment of the Mosolovian Regional Stage to the kockelianus Zone. This correlation was accepted previously (Aristov, 1988; Aristov and Ovnatanova, 1990; Nazarova, 1998; Kononova and Kim, 2005; Nazarova and Kononova, 2012).

In all boreholes above this interval containing conodonts of Assemblage III, there are deposits assigned to the Givetian Stage (Shchigry-16 and Shchigry-19 boreholes) or to the Chernoyarian Regional Stage of the Eifelian Stage (remaining boreholes). This is a sandy-argillaceous series with carbonate layers. In the Trubchevsk 13T, Prosvet 2P, Shchigry-16, and Shchigry-19 boreholes, this series is separated from the underlying beds by a clear hiatus. The assemblages of conodonts from the overlying beds in the Trubchevsk 13T, Shchigry-16, and Shchigry-19 boreholes do not share a single species in common with the assemblage from the underlying beds. The Prosvet 2P Borehole the overlying beds contained the Eifelian *Pol. parawebbi*. In the Naryshkino 4177 and Novokhoperskaya 8750/1 boreholes, the limestones of the Mosolovian Regional Stage are conformably overlain by the clay of the Chernoyarian Regional Stage. In the Novokhoperskaya 8750/1 Borehole, conodonts *I. steleki* Chatterton, a

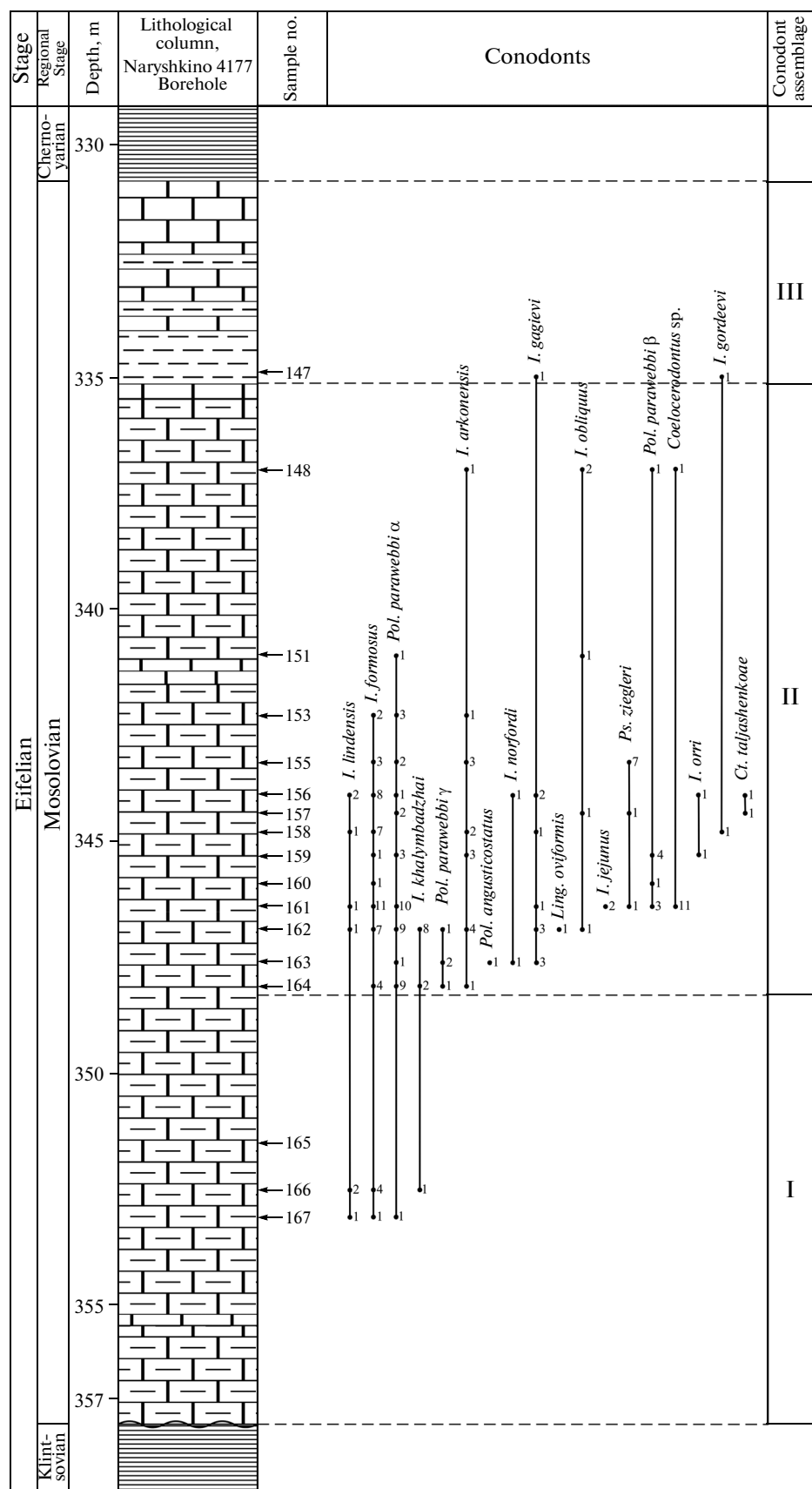
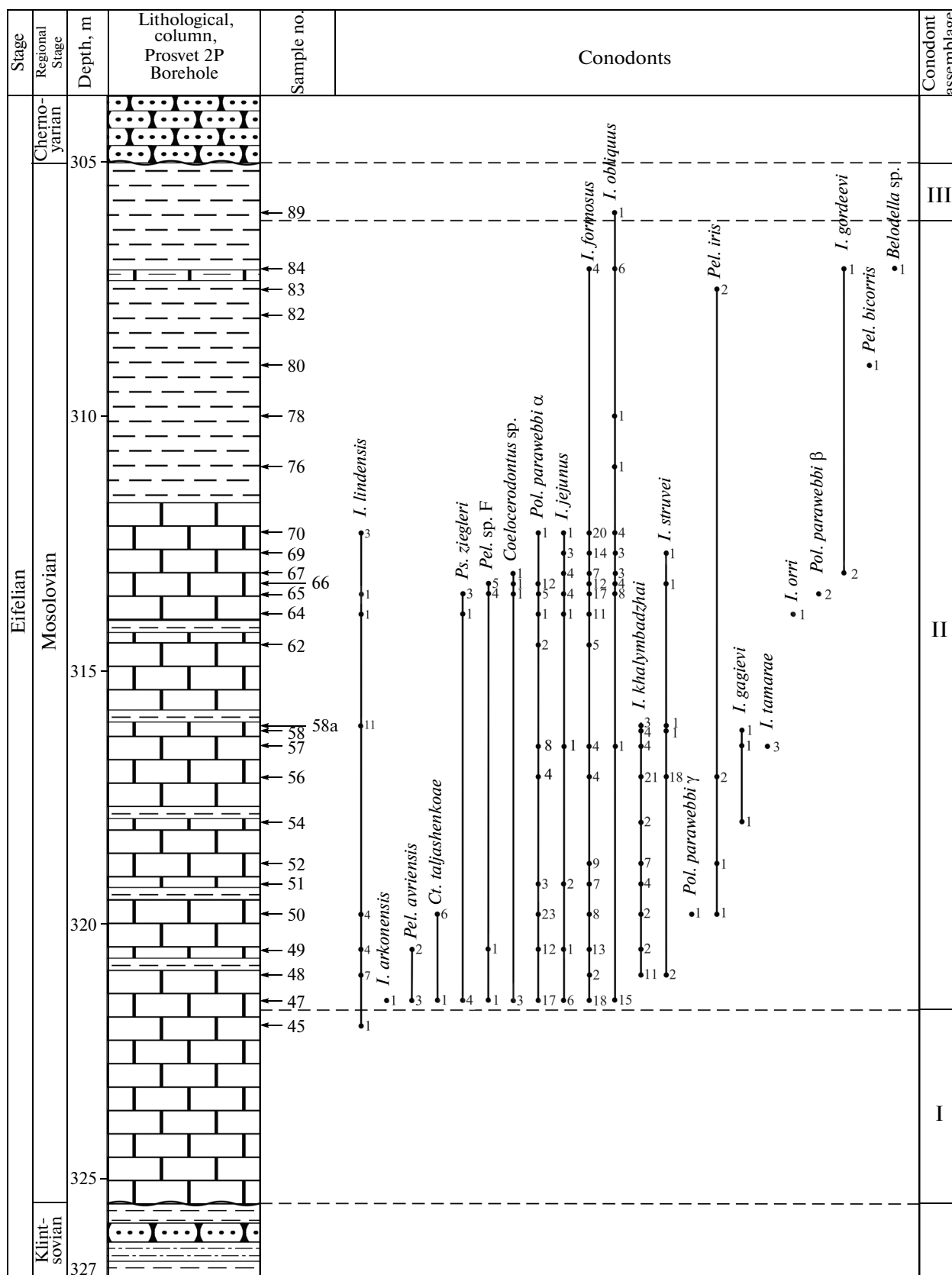


Fig. 7. Distribution of conodonts in the Mosolovian deposits studied in the Naryshkino 4177 Borehole. Legend see in Fig. 2.



**Fig. 8.** Distribution of conodonts in the Mosolovian deposits studied in the Prosvet 2P Borehole. Legend see in Fig. 2.

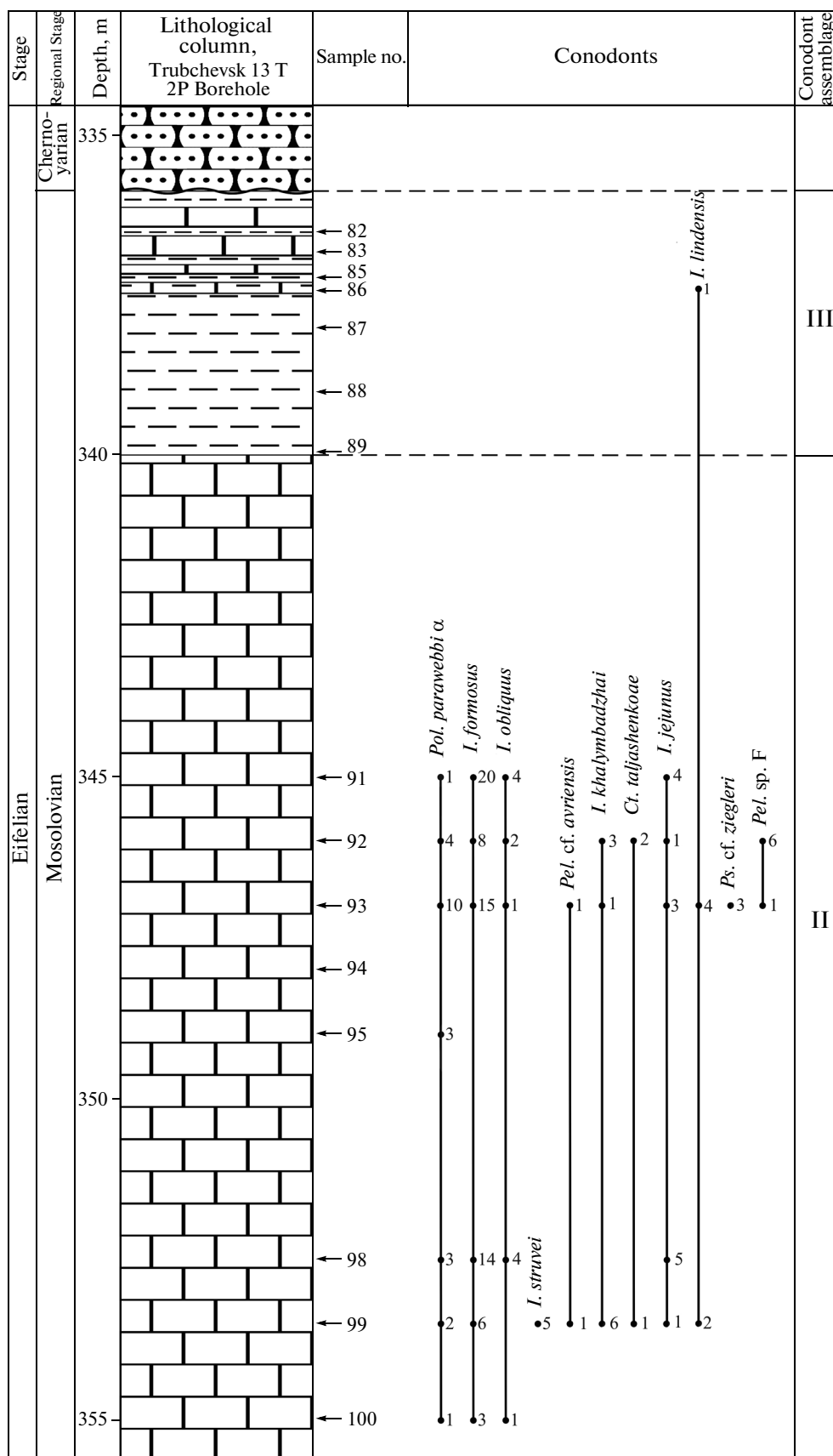


Fig. 9. Distribution of conodonts in the Mosolovian deposits studied in the Trubchevsk 13T Borehole. Legend see in Fig. 2.

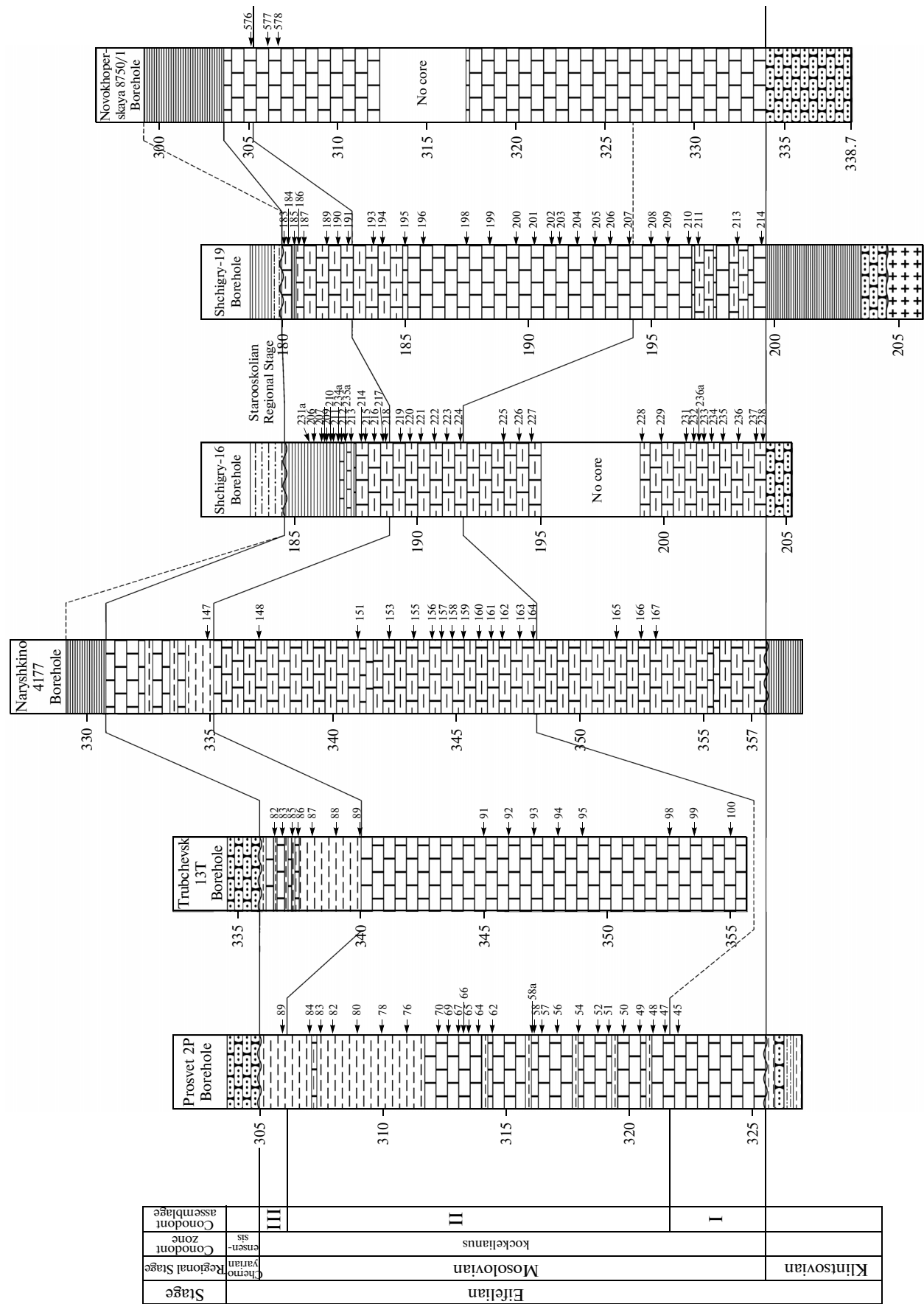


Fig. 10. Correlation scheme of the Mosolovian Regional Stage. Legend see in Fig. 2.

Table 4. Distribution of conodonts in the Mosolovian Regional Stage in the Naryshkino 4177 Borehole

Sample nos.		Taxa																				147	148
<i>I. arkonensis</i> Stauff. <i>I. formosus</i> Naz. <i>I. gagievi</i> Kon. et Kim <i>I. gordeevi</i> Kon. et Kim <i>I. jejunus</i> Naz.	167	166	165	164	163	162	161	160	159	158	157	156	155	153	151	1	1						
		1		4	3	4			3	2		8	3	1									
	1	4		4		7	11	1	1	7			3	2									
					3	3	1			1	2												
								2		1	1												
<i>I. khalymbadzhai</i> Kon. et Kim <i>I. lindensis</i> Wedd. <i>I. norfordi</i> Chatt. <i>I. obliquus</i> Klug <i>I. orri</i> Kl. et Barr.		1	2		8	1	1			1		2				2	1						
	1	2		1	1	1				1		1											
					1	1																	
											1	1											
									1														
<i>I. sp.</i> <i>I. sp. indet.</i> <i>Pel. sp.</i> <i>Pel. sp. indet.</i>	1	1	1	2	1	3			1	3	3	2				1	1						
							1			1													
				1		1																	
<i>Ct. taljashenkoae</i> Kon. et Kim <i>Ling. oviformis</i> Kon. et Kim <i>Ling. sp. indet.</i> <i>Pol. angusticostatus</i> Witt. <i>Pol. parawebbi</i> α Chatt.					1	1					1	1				1							
	1				1	9	10		3		2	1	2	3	1								
<i>Pol. parawebbi</i> β Chatt. <i>Pol. parawebbi</i> γ Chatt. <i>Pol. cf. parawebbi</i> Chatt. <i>Pol. sp. indet.</i>				1	2	1	3	1	4							1							
				5			4	1		1	1			1									
					1		3				1			1									
<i>Ps. zieglerei</i> Kon. et Kim <i>Coelocerodontus</i> sp.							1				1		7			1	2						
							11																
					1	1	2	1	1			2											
				8	3	2	5	2	4	2	5	2	3										
				2		2																	
Pb elements S elements Coniform elements Gen. et sp. indet. “Conodont pearls”		1				2	1	3	1		1					2	2						
						2	1																
Total: 300 specimens Sample weight, kg	4	9	3	38	14	44	60	8	20	19	17	18	19	11	2	8	6						
	0.6	0.7	0.3	1	0.5	0.5	0.7	0.9	0.9	0.5	0.5	0.8	1.4	0.9	0.5	0.5	0.9						

Table 5. Distribution of conodonts in the Mosolovian Regional Stage in the Prosvet 2P Borehole

Sample nos.		45	47	48	49	50	51	52	54	56	57	58	58a	62	64	65	66	67	69	70	76	78	80	82	83	84	89
Taxa																											
<i>I. arkonensis</i> Stauff. <i>I. formosus</i> Naz. <i>I. gagievi</i> Kon. et Kim <i>I. gordeevi</i> Kon. et Kim <i>I. jejunos</i> Naz.		1	18	2	13	8	7	9		4	4		5	11		17	12	7	14	20						4	
									1		1	1						2								1	
		6				2					1				1	4		4	3	1							
			11	2		2	4	7	2	21	4	4	3		1												
			7	4		4		5					11		1		1			3							
<i>I. khalymbadzhai</i> Kon. et Kim <i>I. lindensis</i> Wedd. <i>I. norfordi</i> Chatt. <i>I. obliquus</i> Klug <i>I. orri</i> Kl. et Barr.	1		2	1					1		1	1	1			8	4	3	3	4	1	1				6	
		15									1				1											1	
<i>I. struvei</i> Wedd. <i>I. tamaracae</i> Kon. et Kim <i>I. sp.</i> <i>I. sp. indet.</i> <i>Pel. avriensis</i> Gag.		2								18	3	1	1				1		1								
	1	2	10			1				16	12	1	5			3		9	2	2	1					3	
		8	6	1		2		6		13	22	2	12	1		2	2		5	12							
<i>Pel. avriensis</i> Gag. <i>Pel. bicorris</i> Gag. <i>Pel. iris</i> Gag. <i>Pel. sp. F</i> <i>Pel. sp.</i> <i>Pel. sp. indet.</i>																											
<i>Ct. taljaschenkoae</i> Kon. et Kim <i>Ling. sp. indet.</i> <i>Pol. parawebbi</i> α Chatt. <i>Pol. parawebbi</i> β Chatt. <i>Pol. parawebbi</i> γ Chatt.																											
<i>Pol. cf. parawebbi</i> Chatt. <i>Pol. sp.</i> <i>Pol. sp. indet.</i>																											
<i>Ps. zieglerei</i> Kon. et Kim <i>Belodella</i> sp. <i>Coeloceros</i> sp. Coniform elements Pb elements S elements Gen. et sp. indet. “Conodont pearls”																											
Total: 857 specimens Sample weight, kg		5	110	44	50	72	18	31	4	95	64	11	59	7	19	64	56	29	31	51	3	4	1	2	2	18	7
		0.7	0.5	0.9	0.3	0.5	0.3	0.7	0.5	0.5	0.5	0.6	0.5	0.6	0.5	0.6	0.5	0.7	0.6	0.5	0.4	0.4	0.5	0.4	0.5	0.3	0.5

Table 6. Distribution of conodonts in the Mosolovian Regional Stage in the Trubchevsk 13T Borehole

Taxa	Sample nos.										13T/87	13T/86	13T/85	13T/83	13T/82
	13T/100	13T/99	13T/98	13T/95	13T/94	13T/93	13T/92	13T/91	13T/89	13T/88					
<i>I. formosus</i> Naz.	3	6	14			15	8	20							
<i>I. jejunos</i> Naz.		1	5			3	1	4							
<i>I. khalymbadzhai</i> Kon. et Kim		6				1	3						1		
<i>I. lindensis</i> Wedd.		2				4					1				
<i>I. obliquus</i> Klug	1		4			1	2	4							
<i>I. struvei</i> Wedd.		5													
<i>I. sp.</i>	1	19	3			6	3	7	1			1			
<i>I. sp. indet.</i>	2	27	7			11	9	5				3	2		
<i>Pel. avriensis</i> Gag.		1				1									
<i>Pel. sp. F</i>						1	6								
<i>Pel. sp.</i>		3				1	6								
<i>Ct. taljaschenkoae</i> Kon. et Kim		2				2					1				
<i>Ling. sp.</i>															
<i>Pol. parawebbi</i> Chatt.	1	2	3	3		10	4	1							
<i>Pol. cf. parawebbi</i> Chatt.		2				2	3	2							
<i>Pol. sp. indet.</i>	3	4	8			16	4	3							
<i>Ps. zieglerei</i> Kon. et Kim						3									
Pb elements		2			1	2	1		1			2			
S elements		4	5	4		22	15	1				3			
Coniform elements	2	22	4	2		20	23	4				2		1	
Gen. et sp. indet.		5	9			15	8	1				1			
Total: 502 specimens	13	113	62	9	1	136	96	52	1	1	1	1	12	3	1
Sample weight, kg	0.6	0.4	0.8	0.3	0.4	0.5	0.4	0.5	0.3	0.2	0.5	0.5	0.5	0.4	0.2



characteristic taxon of the Chernoyarian Regional Stage, appear from the level of 300.1 m. In the Naryshkino 4177 Borehole, no conodonts were found in these beds. According to V.T. Umnova (personal communication), spore assemblages from the overlying clay and underlying limestone are different, and the spore assemblage from the clay more likely belongs to the Chernoyarian Regional Stage.

## CONCLUSIONS

The established ecologically related distribution patterns of conodonts correspond to the major historical events of a large sedimentary rhythm named the Nara Transgression by G.D. Rodionova and V.T. Umnova (Rodionova et al., 1995). It begins from the Klintsovian Regional Stage, the deposits of which do not contain conodonts in the region studied. The shallow-water deposits of the lower part of the Mosolovian Regional Stage with conodonts of Assemblage I correspond to the oncoming transgression. The transgression highstand corresponds to the carbonates containing the most diverse Assemblage II, dominated by polygnathids. In the third assemblage, the diversity of conodonts decreases, whereas the amount of terrigenous rocks increases, which indicates the uprising of the Voronezh Landmass to the south of the area studied and the northward progradation of the coastline. The basin became shallower in the Chernoyarian time. Deposits of this age are often absent from the successions; conodonts are rare and are usually represented by juveniles. The Chernoyarian Regional Stage marks the termination of the Nara Transgression. In the Starooskolian time, the region studied was on the borderline with the landmass, and coastal-marine sediments accumulated were interrupted by frequent gaps and erosion of previously deposited sediments.

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