GEOLOGICA BELGICA (2012) 15/4: 297-303

Dorlodotia Salée, 1920 (Rugosa), related and morphologically similar taxa in the Lower Carboniferous of Russia Ukraine

Maria R. HECKER

Borissiak Paleontological Institute, Russian Academy of Sciences, Profsoyuznaya Str., 123, Moscow, 117997, Russia; Department of Palaeontology, Royal Belgian Institute of Natural Sciences, Rue Vautier1000, Brussels, Belgium; hecker@paleo.ru, Maria.Hecker@skynet.be

ABSTRACT. Records of *Dorlodotia* Salée, 1920 in Russia and Ukraine include *Thysanophyllum vermiculare* Degtjarev, 1973 from the Moliniacian (?)-Livian of the Central Urals, *Dorlodotia briarti* Salée, 1920 and *D. fomitschevi* Zhizhina, 1978, possibly synonymous with it, both from the Moliniacian of the Donets Basin, *Pseudodorlodotia subkakimii* Vassilyuk, 1978 from the Warnantian of the same area and *Lonsdaleia sokolovi* Dobrolyubova, 1958 from the Brigantian of the Moscow Basin. *Protolonsdaleia tenuis* Zhizhina, 1978 from the Moliniacian of the Donets Basin, *Eolithostrotionella grechovkae* Degtjarev, 1973 from the upper Livian (?)-lower Warnantian of the South Urals, as well as *E. utkae* Degtjarev, 1973 and *Thysanophyllum druzhininae* Degtjarev, 1973 from the upper Moliniacian (?)-Livian of the Central Urals belong with *Ceriodotia* Denayer (2011). *Dorlodotia* and *Ceriodotia* are related genera and most probably belong to the family Axophyllidae Milne Edwards & Haime, 1851. *Eolithostrotionella* Zhizhina, 1956 is restricted to the Moliniacian of the Donets Basin and probably related to *Axoclisia* Semenoff-Tian-Chansky, 1974. *Eolithostrotionella cystosa* Zhizhina, 1960, *E. rotai* Zhizhina, 1960 and *E. lissitzini* Zhizhina, 1960 reported from higher intervals of the Donets Lower Carboniferous succession, are morphologically similar to *Ceriodotia*, but probably belong to a separate genus. Validity of the genera *Protolonsdaleia* Lissitzin, 1925 and *Sublonsdaleia* Lissitzin, 1925 should be discussed.

KEYWORDS: *Dorlodotia*, *Ceriodotia*, *Eolithostrotionella Protolonsdaleia*, *Sublonsdaleia* Dinantian, Russia, Ukraine.

1. Introduction

Fasciculate genus *Dorlodotia* Salée, 1920 is widely distributed in the Lower Carboniferous of Europe and Asia, comprises about forty species, most of them attributed to different genera, and is especially characteristic for the Moliniacian and Livian (Viséan). *Dorlodotia* is distinguished by typically fasciculate growth habit, major septa commonly dilated in tabularium, minor septa indistinct to poorly developed, inner wall commonly dilated, tabulae complete, conical to flat, dissepimentarium dominated by first order transeptal dissepiments. Axial structure is longitudinally discontinuous or lacking, typically represented by lath-like axial plate, sporadically by poorly defined primitive dibunophylloid axial column.

Cerioid genus *Ceriodotia* Denayer (2011) with the type species *C. bartinensis*, established on the material from the Livian of Northwestern Turkey, closely resembles *Dorlodotia* in having indistinct minor septa, major septa dilated in tabularium, dilated inner wall, complete, conical, tent-shaped or flat tabulae, dissepimentarium dominated by first order transeptal dissepiments, and axial structure typically represented by an axial plate, longitudinally discontinuous or lacking. Establishment of this genus allows clarifying the systematic position of few species from the Viséan of the Donets Basin and Urals, formerly attributed to the genera *Thysanophyllum* Nicholson & Thomson, 1876, *Protolonsdaleia* Lissitzyn, 1925 and *Eolithostrotionella* Zhizhina, 1956 (Degtyarev, 1973; Vasilyuk & Zhizhina, 1978).

The objectives of the present paper are: to specify occurrences of *Dorlodotia* and *Ceriodotia* in the Moscow Basin, Donets Basin and in the Urals; to discuss systematic position, range and evolution of *Dorlodotia*, as well as systematic position of *Eolithostrotionella* Zhizhina, 1956; and to describe a *Dorlodotia* species from the upper Warnantian (Brigantian) of the Moscow Basin attributed to the genus *Lonsdaleia* McCoy, 1849 by Dobrolyubova (1958).

Correlation of the Viséan-lowermost Serpukhovian of the Moscow and Donets Basins and selected areas of the Urals is summarized in the Tables 1 and 2. Regional subdivisions adopted herein are not considered as formally defined regional sub-stages and therefore are spelled without the ending "-ian".

2. Occurrences of *Dorlodotia* and *Ceriodotia* in the Lower Carboniferous of the Donets Basin, Moscow Basin and Urals

2.1. Occurrences of Dorlodotia

In the Donets Basin, *Dorlodotia* is reported from the Glubokaya

	Conil et al. (1990)		Poty et al. (2006)			Hecker (2001)	Moscow Basin Subdivisions after Makhlina et al. (1993)	Donets Basin Subdivisions after Poletaev et al. (1989)
SERP. →	Pendleian	Cf7		↑ MFZ 16	RC9 →	↑ IX	Protva ↑	Prokhorovka Sc
							Steshevo	Sb
							Tarusa	Samara Sa
VISEAN	Warnantian	Cf6 δ	Warnantian	MFZ 15	RC8	VIII	Venev	Mezha Vg
		Cf6 γ2		MFZ 14	RC7 β	VII	Mikhailov	
		Cf6 γ1					Aleksin	Donets Vf f_2
		Cf6 β					upper	f_1
		Cf6 α		MFZ 13	RC7 α		Tula middle	
	Livian	Cf5	Livian	MFZ 12	RC6	VI	lower	Styla Ve e_2
							hiatus	e_1
					RC5		Bobriki	*hiatus*
	Moliniacian	Cf4 γ-δ	Moliniacian	MFZ 11		V		Sukhaya Vd d_2
		Cf4 β		MFZ 10			*hiatus*	d_1
		Cf4 α_2		MFZ 9	RC4 β2	IV	upper Radaevka	Glubokaya Vc
		Cf4 α_1 ↓	Ivorian ↓	MFZ 8	RC4 β1 ↓	III ↓	*hiatus* ↓	Vb
								Dokuchaevsk Va

Table 1. Correlation of the Viséan and lowermost Serpukhovian of the Moscow and Donets Basins. Modified from Hecker (2001, 2002, 2009).

	Conil et al. (1990)		Poty et al. (2006)			Hecker (2001)	Urals Subdivisions modified from Antsygin et al. (1993)	
							Central Urals, western flank	South Urals, eastern flank
SERP. ↑	Pendleian	Cf7		↑ MFZ 16	RC9 →	↑ IX	Brazhka ↑	Khudolaz ↑
							Nizhnyaya Gubakha (Lenevka)	Suntur
							Ladeynaya	Bogdanovich Averino
VISEAN	Warnantian	Cf6 δ	Warnantian	MFZ 15	RC8	VIII	Gubashka	Kamensk-Ural'skiy
							Ust'ilim	
		Cf6 γ_2		MFZ 14	RC7 β	VII	Druzhinino	Uzunzyal
		Cf6 γ_1					Ilych	Ust'grekhovka
		Cf6 β		MFZ 13	RC7 α			
		Cf6 α						
	Livian	Cf5	Livian	MFZ 12	RC6	VI		
					RC5		Pester'ki	Burlya
								Obruchevka
	Moliniacian	Cf4 γ-δ	Moliniacian	MFZ 11		V		*Kos'va*
		Cf4 β		MFZ 10	β2			
		Cf4 α_2		MFZ 9		IV	*hiatus*	
↓		Cf4 α_1 ↓	Ivorian ↓	MFZ 8	RC4 ← β1	III ↓	Kos'va	
							Kizel ↓	*Kizel* ↓

Table 2. Correlation of the Viséan and lowermost Serpukhovian of selected areas of the Urals. Modified from Hecker (2001, 2002).

and Donets Formations (Vasilyuk, 1960; Vasilyuk & Zhizhina, 1978; Ogar, 2010) correlating with the Cf4α_2-γ, MFZ9-lower MFZ11 Foraminifera zones (Moliniacian) and Cf4 γ_2-lower Cf6δ, upper MFZ14-lower MFZ15 Foraminifera zones (Warnantian), respectively (Table 1). Records from the Glubokaya formation include *D. fomitschevi* Zhizhina *in* Vasilyuk & Zhizhina, 1978 (p. 27, pl. 1, figs 1a-c) (Vb Zone) and *D. pseudovermiculare* (McCoy, 1855) in the sense of Ogar (2010, fig. 6P) (Vb-Vc Zones), both species either synonymous with *D. briarti* or belonging to a morphologically similar species. From the Donets Formation is reported *Pseudodorlodotia subkakimii* Vasilyuk in Vasilyuk & Zhizhina, 1978 (p. 29, pl. 1, figs 1a-c) with corallites about 8 mm in diameter having 18-19 major septa, poorly developed minor septa, tabularium diameter 5-6 mm, longitudinally discontinuous axial plate connected to the counter septum, up to three locally developed radial lamellae, complete loosely packed tabulae, and dissepimentarium approaching in width one-third of corallite diameter, commonly composed of one row of large first order transeptal dissepiments.

Records of *Dorlodotia* in the Moscow Basin are from the Brigantian (Mikhailov horizon) and restricted to one species, *Lonsdaleia sokolovi* Dobrolyubova, 1958 (see chapter 4).

Dorlodotia also includes *Thysanophyllum vermiculare* Degtjarev, 1973 (p. 195, pl. 2, figs 2a-b) from the western flank of the Central Urals, which is restricted to the upper Pester'ki horizon correlating with the upper Moliniacian (?)-Livian (Table 2) and strongly resembles *Dorlodotia briarti*. The genus possibly also includes one species from the Serpukhovian (*Cravenoceras* Zone) of the Novaya Zemlya, *Thysanophyllum concavum* Gorsky, 1951, resembling *Pseudodorlodotia subkakimii*; *T. pseudovermiculare* in the sense of Gorsky (1951) most probably belongs to the same species.

2.2. Occurrences of Ceriodotia

Records of *Ceriodotia* in the Donets Basin are from the Vc-Vd Zones (Glubokaya-Sukhaya Formations) approximating to the Cf4β-δ, MFZ9-MFZ11 Foraminifera zones, Moliniacian (Table 1) and restricted to one species, *Protolonsdaleia tenuis* Zhizhina *in* Vasilyuk & Zhizhina, 1978, having corallites with diagonals 12-16 mm, 18-20 major septa, indistinct minor septa, tabularium 5-6 mm in diameter, longitudinally discontinuous axial structure represented by medial plate, few radial lamellae and locally developed irregular axial tabellae, abaxially declined tightly packed tabulae and wide dissepimentarium dominated by first order transeptal dissepiments (Vasilyuk & Zhizhina, 1978, p. 30, pl. 2, figs 1a-b).

In the Urals, records of the species belonging to *Ceriodotia* are by Degtjarev (1973) from the Zapadny Ural horizon. These are: *Eolithostrotionella grechovkae* Degtjarev, 1973 from the interval of the Viséan succession of the eastern flank of the South Urals now attributed to the upper part of the Ust'grekhovka horizon and correlating with the upper Livian (?)-Warnantian (Table 2), and *E. utkae* Degtjarev, 1973, *Thysanophyllum druzhininae* Degtjarev, 1973 and *T.* cf. *minus* Thomson, 1880 from the interval of the Viséan succession of the western flank of the Central Urals now attributed to the upper Pester'ki horizon correlating with the upper Moliniacian (?)-Livian (Table 2). Garan' et al. (1966), based on identifications of Degtjarev, also reported *Thysanophyllum* cf. *minus* near the lower limit of the Moliniacian (lower part of the Pester'ki horizon).

Eolithostrotionella grechovkae (Degtjarev, 1973, p. 193, pl. 1, fig. 2, pl. 2, figs 1a-b) shows close affinity to *Protolonsdaleia tenuis*, including in septal number (18-20) and tabularium diameter (5.5-7 mm), but has smaller corallites (diagonals 10-12 mm) with narrower dissepimentaria. Its axial structures are represented by thin to dilated medial plates with few discontinuous radial lamellae and locally developed irregular axial tabellae. *Eolithostrotionella utkae* (Degtjarev, 1973, p. 192, pl. 1, figs 1a-b) shows corallites with diagonals 10-15 mm, 22-25 major septa dilated in tabularium, indistinct minor septa, tabularium diameter 5.5-8 mm, dilated inner wall, and relatively narrow dissepimentarium attaining one-sixth to one-fifth of corallite diagonals and dominated by second order transeptal dissepiments. In longitudinal section, *E. utkae* resembles *Dorlodotia euxinensis* Denayer (2011) in having crowded tent-shaped steeply elevated tabulae and axial structure represented by thick axial plate with few radial lamellae. *Thysanophyllum druzhininae* (Degtjarev, 1973, p. 196, pl. 3, figs 1a-b, 2) has larger corallites with diagonals 15-20 mm, 22-25 thin major septa and indistinct minor septa, and wider tabularia (7-10 mm in diameter). Dissepimentaria, similarly to *Eolithostrotionella utkae*, are relatively narrow and dominated by first order transeptal dissepiments; axial structure is represented by thin axial lamella connected to the counter (?) septum; tabulae are subhorizontal to slightly sagging, irregularly spaced 0.3-2 mm apart. *Thysanophyllum* cf. *minus* in the sense of Degtjarev (1973, pl. 5, fig. 5) is probably synonymous with *T. druzhininae*.

In the aspect of axial structure and tabulae, *Eolithostrotionella utkae* resembles the very variable type species of the genus *Acrocyathus* d'Orbigny, 1849, *A. floriformis* d'Orbigny, 1849, characteristic of the St. Louis Limestone and correlative formations of the North American Mid-continent, which corresponds to the 13-14 Mamet Foraminifera Zones (Mamet, 1974), thus approximating to the Livian. Sando (1983) placed *Eolithostrotionella utkae* into *Acrocyathus* and attributed *Eolithostrotionella grechovkae*, although with a query, to the same genus. Hecker (2001) followed Sando in attributing these taxa to *Acrocyathus*. It is noteworthy, that variability pattern of *Ceriodotia* from the Urals involving axial structure, length

of septa and dissepimentarium strongly resembles that of *C. petalaxoides* Denayer (2011).

3. Discussion

3.1. Eolithostrotionella Zhizhina, 1956, Protolonsdaleia Lissitzin, 1925 and Sublonsdaleia Lissitzin, 1925

The cerioid genus *Eolithostrotionella* Zhizhina, 1956 with the type species *Lonsdaleia longisepta* Lissitzin, 1925 was established on the material from the Moliniacian of the Donets Basin. Four more species from the Lower Carboniferous of this area were attributed to *Eolithostrotionella* by Zhizhina (1960) and Vasilyuk (1960). These are: *E. zhizhinae* Vasilyuk, 1960 from the Molininiacian, as well as *E. cystosa* Zhizhina, 1960, *E. rotai* Zhizhina, 1960 and *E. lissitzini* Zhizhina, 1960 from higher levels of the Donets Lower Carboniferous succession.

Lonsdaleia longisepta Lissitzin, 1925 is restricted to the Vb-Vd Zones and distinguished by cerioid colonies with corallites having diagonals 15-20 mm, 24-32 thin septa of both orders, tabularium diameter 5-9 mm, and wide dissepimentarium dominated by transeptal dissepiments of various sizes in outer dissepimentarium and by regular interseptal dissepiments in inner dissepimentarium. Axial structures vary from longitudinally discontinuous thin axial plate commonly connected to the cardinal and counter septa, and few radial lamellae to poorly defined narrow axial column represented by slightly dilated medial plate connected to the cardinal and counter septa, 8-12 radial lamellae and locally developed irregular axial tabellae. Tabulae are abaxially declined, varying from complete tent-shaped to incomplete inflated; when axial tabellae present, periaxial tabellae abaxially declined, inflated (Zhizhina, 1956, p. 40, pl. 9, figs 1a-b; Vasilyuk, 1960, p. 112, pl. 30, figs 2, 2a).

Eolithostrotionella zhizhinae (Vasilyuk, 1960, p. 95, pl. 25, figs 1, 1a) is restricted to the Vc-Vd Zones. This species cannot be distinguished from *Protolonsdaleia mariupolensis* Lissitzin, 1925 as interpreted by Vasilyuk (1960, p. 107, pl. 25, figs 2, 2a-b) in corallite size, septal number, tabularium diameter, aspect of tabulae and other important diagnostic features. Both the holotype of *Eolithostrotionella zhizhinae* and the only described specimen attributed by Vasilyuk to *Protolonsdaleia mariupolensis* come from the same locality in the Vd Zone and show corallites with diagonals about 15 mm, 24-26 septa of both orders, minor septa reaching in tabularium one-fourth to one-third length of major septa, tabularium diameter 7-7.5 mm, longitudinally discontinuous axial plate, loosely spaced tabulae, tent-shaped when axial plate is present, and dissepimentarium reaching one-fourth corallite diagonal and dominated by first order transeptal dissepiments. The holotype of *Eolithostrotionella zhizhinae* shows locally contratingent minor septa, and the specimen of *Protolonsdaleia mariupolensis* sensu Vasilyuk shows few sporadically present radial lamellae.

To *Eolithostrotionella* also belongs *Protolonsdaleia intermedia* as interpreted by Vasilyuk & Zhizhina (1978, p. 30, pl. 2, figs 2a-b) (Vb-Vc Zones of the Donets Basin) [? = *Sublonsdaleia intermedia* Lissitzin, 1925]. It is distinguished by corallites having diagonals 11-17 mm, 19-24 septa of both orders, tabularia 5-6 mm in diameter, locally incomplete tent-shaped tabulae, axial structures varying from axial plate to poorly defined simple axial column composed of medial plate, few radial lamellae and longitudinally discontinuous irregular axial tabellae, and by dissepimentaria dominated by first order transeptal dissepiments.

Eolithostrotionella cystosa Zhizhina, 1960 (p. 250, pl. 61, figs 1a-b) and *E. rotai* Zhizhina, 1960 (p. 251, pl. 61, figs 2a-b), both from the Donets Formation (Warnantian), as well as *E. lissitzini* Zhizhina, 1960 (p.252, pl. 61, figs 3a-b) found in the Donets Formation and in the upper Serpukhovian (Arnsbergian, upper Zapal-Tyube and Voznesenka horizons) should be excluded from this genus. They resemble *Ceriodotia* in having major septa dilated in tabularium, minor septa indistinct to poorly developed, and dissepimentarium dominated by first order transeptal dissepiments. They differ from *Ceriodotia* in having incomplete tabulae; also, axial structure is less variable and represented by longitudinally continuous lath-like axial plate and locally developed radial plates.

Eolithostrotionella was considered as a subgenus of *Lithostrotion* Fleming, 1828 by Fomichev (1955), as a junior synonym of *Stelechophyllum* Tolmachev, 1933 by Dobrolyubova et al. (1966), Minato & Kato (1974), Hill (1981), and also by Sando (1983), who attributed the type species of *Eolithostrotionella* to the *Stelechophyllum microstylum* (White, 1880) species-group. The type species of *Eolithostrotionella*, however, shows close affinity to the solitary genus *Axoclisia* Semenoff-Tian-Chansky, 1974, established on material from the Lower Viséan of the Algerian Sahara in the aspect of septa, tabulae, dissepimentaria and axial structure, when fully developed. At least two *Axoclisia* species are present in the Moliniacian of the Donets Basin, *A. lissitzini* (Vasilyuk, 1960) in the Vb-Vd Zones and *A. brazhnikovae* (Vasilyuk, 1960) in the Vc Zone. *Eolithostrotionella* is most probably restricted to the Moliniacian of the Donets Basin, comprises three species, *E. longisepta, E. zhizhinae* and *Protolonsdaleia intermedia* as interpreted by Vasilyuk & Zhizhina (1978), and is most probably related to *Axoclisia*.

Both the genus *Protolonsdaleia* comprising three species, *P. carcinophyllosa, P. mariupolenis* and *P. ramulosa*, and the monospecific genus *Sublonsdaleia* were established by Lissitzin (1925) on the material from the Mariupol' Stage of the Donets Basin corresponding to the Vc-Vd Zones (Moliniacian). Lissitzin interpreted *Sublonsdaleia* as a genus close to *Thysanophyllum* (this generic name he applied to *Dorlodotia*), and defined it as a primitive lonsdaleoid genus lacking true axial column and possessing axial plate only. He considered *Protolonsdaleia*, distinguished by primitive axial column consisting of few irregular plates, as the genus transitional between *Sublonsdaleia* and *Lonsdaleia*. Vasilyuk (1960) accepted the genus *Protolonsdaleia*, and Vasilyuk & Zhizhina (1978) put *Sublonsdaleia* into the synonymy of *Protolonsdaleia*. Hill (1981) put *Protolonsdaleia* into the synonymy of *Actinocyathus* d'Orbigny, 1849; *Sublonsdaleia*, with a query, she put into the synonymy of *Thysanophyllum*. Sando (1983) considered both genera as possible junior synonyms of *Actinocyathus*. The original descriptions of the genera and illustrations are not adequate, the type species of *Protolonsdaleia* was not designated, and the figured types of both genera were never redescribed and are lost. Therefore, it is advisable to envisage submitting the case to the International Commission on Zoological Nomenclature.

3.2. Systematic position, range and evolution of Dorlodotia

Dorlodotia appeared during the "Avins event" (Latest Tournaisian, MFZ8 Foraminifera Zone, RC4β1 Rugose coral Biozone) (Poty, 2007) and, as indicated by the records of this genus in the Donets and Moscow Basins, ranged into the Warnantian.

Poty (2007) suggested that *Dorlodotia* evolved from a solitary caninoid coral that produced buds and developed a columella, and Denayer & Poty (2011) assumed that it evolved from *Corphalia* that could have originated from a solitary caninoid coral. Furthermore, they divided the genus *Dorlodotia* into two groups named "columellate *Dorlodotia*" and "acolumellate *Dorlodotia*", the former including *D. briarti* and evolving into *Ceriodotia*, and the other including *D. pseudovermiculare* and giving rise to *Dorlodotia* species from China lacking columella and distinguished by "the various development of lonsdaleoid dissepiments" (Denayer & Poty, 2011, p. 37).

Separation of *Dorlodotia* into two groups, depending on the development of a columella, each of them probably having different origin, does not agree with the data of Garwood (1912) and Smith (1916) on the presence of transitional forms between *Thysanophyllum pseudovermiculare* [= *Dorlodotia pseudovermiculare*] lacking axial structure and *Lonsdaleia praenuntia* Smith, 1916 distinguished by primitive and variable axial structure. Both species and transitional forms were recorded in NW England near the lower limit of the Viséan in the Upper C1-Lower C2 Zones correlating with the Cf4α_2 Foraminifera zone (Riley, 1993), thus approximating to the RC4β2 Biozone of Poty et al. (2006). *Lonsdaleia praenuntia* showing close affinity to *Dorlodotia pseudovermiculare* in having short major septa, indistinct minor septa and dissepimentarium dominated by first

order transeptal dissepiments, differs from it only in presence of longitudinally discontinuous loosely constructed poorly defined primitive dibunophylloid axial column composed of irregular medial lamella, few radial lamellae and conical axial tabellae. Presence of longitudinally discontinuous radial lamellae in *D. briarti* and *D. subkakimii* (Poty, 1975, 1981; Vasilyuk & Zhizhina, 1978), presence of longitudinally discontinuous radial lamellae and locally developed axial tabellae in *D. euxinensis* (Denayer, 2011) and, especially, high variability of axial structure detected in *Dorlodotia sokolovi* from the Moscow Basin (see chapter 4) suggest that *Lonsdaleia praenuntia* is also a *Dorlodotia* species distinguished by high variability of axial structure, possibly synonymous with *Dorlodotia pseudovermiculare*. Occasional presence in *Dorlodotia* of axial structure composed of medial plate, radial lamellae and axial tabellae, including at the early stage of evolution of the genus, could indicate that this genus belongs to the family Axophyllidae Milne Edwards & Haime, 1851.

As correctly suggested by Denayer (2011), *Ceriodotia* most probably evolved from *Dorlodotia*. It is noteworthy, that *Ceriodotia*, first reported from the Livian of Northwestern Turkey, shows earlier occurrence in the Donets Basin (Vc-Vd Zones). The Moliniacian age of this interval is confirmed by Foraminifera. *Eoparastaffella simplex* entering at the base of the Vb Zone defines the base of the Viséan, records of *Eoendothyranopsis donica* in the Vb-Vc Zones indicate the upper MFZ9 Zone, records of *Globoendothyra numerabilis* in the Vd_1 Subzone, records of *Uralodiscus rotundus* and of *Paraarchaediscus* in the Vd_2 Subzone indicate the13 Mamet Foraminifera Zone and the MFZ11 Zone, respectively (Hecker, 2002, 2009). The range of *Ceriodotia* on the western flank of the central Urals seems to be the closest to its range in Northwestern Turkey, whereas on the eastern flank of the South Urals this genus ranges into the lower Warnantian.

Near the limit of the early and late Warnantian in the Donets Basin, *Dorlodotia* could have evolved into a cerioid genus morphologically close to *Ceriodotia* and comprising *"Eolithostrotionella" cystosa, "E". rotai* and *"E". lissitzini*.

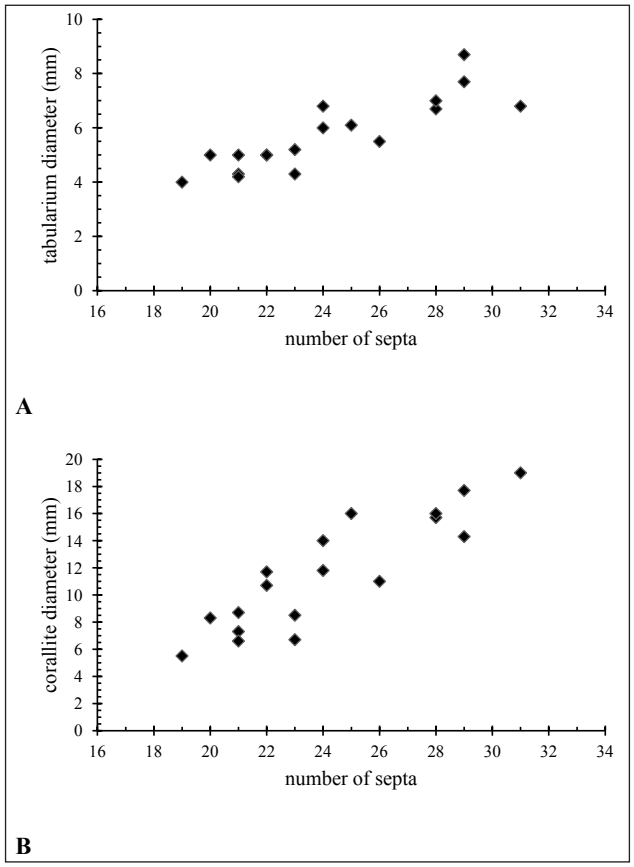

Figure 1. Statistical data of *Dorlodotia sokolovi*, specimen PIN 705/161, holotype. A: Ratio of the tabularium diameter to the number of major septa. B: Ratio of the corallite diameter to the number of major septa.

4. Systematic palaeontology

? Family Axophyllidae Milne Edwards & Haime, 1851

Genus *Dorlodotia* Salée, 1920

***Dorlodotia briarti* Salée, 1920 (p. 190, figs 5-6)**

Diagnosis. Fasciculate, with lateral increase; offsets arise in the outer dissepimentarium. Major septa typically withdrawn from the axis, commonly dilated in tabularium. Minor septa indistinct to poorly developed, commonly discontinuous longitudinally. Axial structure longitudinally discontinuous or lacking, typically a thickened axial plate, sporadically a simple dibunophylloid axial column comprising a medial plate, a few radial lamellae and irregularly conical axial tabellae. Tabulae typically complete, conical to flat. Dissepimentarium dominated by first order transeptal dissepiments, innermost series of interseptal dissepiments commonly dilated forming an inner wall (after Hill, 1981, emended).

Remarks. *Pseudodorlodotia* as originally defined (Minato, 1955) is considered herein as a junior synonym of *Dorlodotia*.

***Dorlodotia sokolovi* (Dobrolyubova, 1958)**
(Fig. 1, Pl. 1)

1958 *Lonsdaleia sokolovi* Dobrolyubova: p. 29, fig. 1, pl. 1, figs 1a-c.

Holotype. *Lonsdaleia sokolovi* Dobrolyubova, 1958. Specimen PIN 705/161, Borissiak Paleontological Institute, Russian Academy of Sciences, Moscow.

Type locality and horizon. Upper Mikhailov horizon, Brigantian, northwestern part of the Moscow Basin, Priksha River, 50-60 km N. of the town of Borovichi.

Material. Only the holotype.

Description. Corallites 7-18 mm in diameter, tabularia diameters 5-7.5 mm. Major septa 21-29 in number, dilated in tabularia, locally develop and thin in innermost dissepimentaria; their length in tabularium from half to two-thirds of its radius. Minor septa locally develop as ridges on inner wall. Axial structures lacking or varying from axial plate, thin to slightly dilated, to poorly defined axial column approximating one-fourth of tabularium diameter in width and composed of long, slightly to moderately dilated, straight to curved medial plate, one-two radial lamellae, irregularly conical steeply elevated axial tabellae spaced 0.4-0.6 mm apart. Periaxial tabellae subhorizontal, sagging or abaxially declined at angles of 10°-50°, spaced 0.25-1.55 mm apart. Periaxial cones composed of fused periaxial and axial tabellae may locally develop. Complete subhorizontal tabulae spaced 0.15-0.30 mm apart develop when axial structure is lacking. Width of dissepimentaria from one-fifth to one-third of corallite diameter. Dissepiments first order transeptal, locally second order transeptal in inner dissepimentaria, variously inflated, abaxially declined at angles of 30°-70°. Inner margins of innermost dissepiments vertically inclined and dilated forming thickened inner wall. Outer wall festooned, up to 0.4 mm thick.

Discussion. *Dorlodotia sokolovi* shows close affinity to *Dorlodotia subkakimii* in tabularium diameter, in aspect of dissepimentarium dominated by large first order transeptal dissepiments and in locally developed radial lamellae, but has bigger corallites with wider tabularia and a larger number of septa. The species is distinguished by high intracolonial variability involving axial structures and resembles in this aspect "*Lonsdaleia" praenuntia*, as it was emphasized by Dobrolyubova (1958).

Distribution. Only known by its holotype being from the upper Mikhailov horizon, Brigantian, north-western part of the Moscow Basin.

5. Conclusions

Fasciculate genus *Dorlodotia* is present in the Moliniacian (Glubokaya Formation) and Warnantian (Donets Formation) of the Donets Basin, in the upper Moliniacian (?)-Livian (upper Pester'ki horizon) of the western flank of the Central Urals and in the upper Warnantian (Brigantian, Mikhailov horizon) of the northwestern part of the Moscow Basin. *Lonsdaleia praenuntia* Smith, 1916 (lower Viséan, NW England) is also most probably a *Dorlodotia*. Cerioid genus *Ceriodotia* first reported from the Livian of Northwestern Turkey (Denayer, 2011) is present in the Moliniacian (Glubokaya Formation) of the Donets Basin, upper Moliniacian (?)-Livian (Pester'ki horizon) of the western flank of the Central Urals and in the upper Livian (?)-lower Warnantian (Ust'grekhovka horizon) of the eastern flank of the South Urals. Both genera probably belong to the family Axophyllidae.

Cerioid genus *Eolithostrotionella* is restricted to the Moliniacian (Glubokaya Formation) of the Donets Basin and is probably related to the solitary genus *Axoclisia*.

Eolithostrotionella cystosa Zhizhina, 1960 and *E. rotai* Zhizhina, 1960 (Warnantian, Donets Formation) of the Donets Basin, and *E. lissitzini* Zhizhina, 1960 (Warnantian, Donets Formation, Arnsbergian, upper Zapal-Tyube-Voznesenka horizons) are morphologically similar to *Ceriodotia,* but could belong to a separate genus ranging into the Serpukhovian.

6. Acknowledgements

The manuscript benefited from helpful and valuable comments of the reviewers, M. Aretz and J. Denayer.

7. References

Antsygin N. Ya., Popov, B.A. & Chuvachov B.I. (eds). Stratigraficheskie skhemy Urala (dokembriy, paleozoy). Mezhvedomstvenny Stratigraficheskiy Komitet Rossii, Roskomnedra, Ekaterinburg, 151 pp. [in Russian].

Conil, R., Groessens, E., Laloux, M., Poty, E. & Tourneur, F., 1990. Carboniferous guide Foraminifera, corals and conodonts in the Franco-Belgian and Campine Basins: their potential for widespread correlation. Courier Forschungsinstitut Senckenberg, 130, 15–30.

Degtjarev, D.D. 1973. Novye vidy korallov zapadnoural'skogo (uglenosnogo) gorizonta. Trudy Instituta geologii i geokhimii Ural'skogo Nauchnogo Tsentra AN SSSR, 82, 191-205. [in Russian].

Denayer, J., 2011. New *Dorlodotia* and related genera (Rugosa) from the Mississippian of Zonguldak and Bartin (Black Sea, Northwestern Turkey). Palaeontology, 54/6, 1435-1454.

Denayer, J. & Poty, E., 2011. Origin and evolution of *Dorlodotia* (Rugosa). In Aretz, M., Delculée, S., Denayer, J.& Poty, E. (eds.), Abstract volume of the 11th International Symposium on Fossil Cnidaria and Porifera, Liège. Kölner Forum für Geologie und Paläontologie, 19, 37-39.

Dobrolyubova, T.A., 1958. Nizhnekamennougol'nye kolonial'nye chetyrekhluchevye korally Russkoy platformy. Trudy Paleontologicheskogo Instituta AN SSSR, 70, 1-226 . [in Russian].

Dobrolyubova, T.A., Kabakovich, N.V. & Sayutina, T.A., 1966. Korally nizhnego karbona Kuznetskoy kotloviny. Trudy Paleontologicheskogo Instituta AN SSSR, 111, 1-198. [in Russian].

Fleming, J., 1828. A history of British animals. Bell & Bradfute, Edinburg, xxiii, 565 pp.

Fomichev, V.D., 1955. Tip Coelenterata. Kishechnopolostnye. In Khalfin L.L. (ed.), Atlas rukovodyashchikh form fauny i flory Zapadnoy Sibiri. Tom 1. Gosgeoltekhizdat, Moscow, 298-305. [in Russian].

Garan', I.M., Popova, Z.G. & Postoyalko, M.V. 1966. O karbonatnykh analogakh uglenosnoy tolshchi v yuzhnoy chasti basseyna r.Chusovoy na Srednem Urale. Trudy Permskogo politekhnicheskogo instituta, 23, 113 – 120. [in Russian].

Garwood E.J., 1912. The Lower Carboniferous succession in the North-West of England. Quarterly Journal of the Geological Society of London, 68, 449-586.

Gorskiy I.I., 1951. Kamennougol'nye i permskie korally Novoy Zemli. Trudy Nauchno-issledovatel'skogo instituta geoligii Arktiki, 32, 1-168. [in Russian].

Hecker, M., 2001. Lower Carboniferous (Dinantian and Serpukhovian) rugose coral zonation of the East European Platform and Urals, and correlation with Western Europe. Bulletin of the Tohoku University Museum, 1, 298–310.

Hecker, M., 2002. Correlation of the Dinantian of the East European Platform and Urals with the type area (Belgium). In Hills, L. V., Henderson, S. M. & Bamber, E. W. (eds), Carboniferous and Permian of the World. Canadian Society of Petroleum Geologists Memoirs, 19, 52–78.

Hecker, M. 2009. Major guide taxa for correlation of the Moscow and Donets Basins Dinantian successions with the type area (Belgium). In Puchkov, V. N. (ed.) Carboniferous type sections in Russia and Potential Global Stratotypes. Southern Urals Session. DizaynPoligrafServis, Ufa, 198–202.

Hill, D., 1981. Rugosa and Tabulata. In Teichert, C. (ed.), Treatise on Invertebrate Paleontology, part F, Coelenterata, 1-2. The Geological Survey of America, The University of Kansas, Boulder, Lawrence, xl, F1-F762 pp.

Lissitzin, K.I., 1925. Podrazdeleniya nizhnego karbona i ikh korallovo-brakhiopodovaya fauna. Izvestiya Donskogo politekhnicheskogo instituta, 9, 54-68. [in Russian].

Makhlina, M. Kh., Vdovenko, M.V., Alekseev, A. S., Byvsheva, T. V., Donakova, L. M., Zhulitova, V. E., Kononova L. I., Umnova, N. I. & Shik, E. M., 1993. Nizhniy karbon Moskovskoy sineklizy i Voronezhskoy anteklizy. Moskva, Nauka, 221 pp. [in Russian].

Mamet, B., 1974. Une zonation par foraminifères du Carbonifère Inférieur de la Téthys Occidentale. Compte rendu VII Congrès international de stratigraphie et de géologie du Carbonifère, 3, 391- 408.

McCoy, F., 1849: On some new genera and species of Palaeozoic corals and foraminifera. The Annals and Magazine of Natural History, 2, 3, 1–20, 119–136.

McCoy, F., 1855 In Sedgwick., A., A Synopsis of the Classification of the British Palaeozoic Rocks, by the Rev. Adam Sedgwick, with a systematic Description of the British Palaeozoic Fossils in the Geological Museum of the University of Cambridge, by Frederick McCoy. J.W. Parker & Son, London, Cambridge University Press, Cambridge, xcviii, 407-661 pp.

Milne-Edwards, H. & Haime, J., 1851. Monographie des Polypiers Fossiles des Terrains Paléozoïques. Archives du Muséum d'Histoire Naturelle, 5, 1-502.

Minato, M., 1955. Japanese Carboniferous and Permian corals. Hokkaido University, Faculty of Science Journal, ser. 4, Geology and Mineralogy, 4 (9-2), 1-202.

Minato, M. & Kato, M., 1974. Upper Carboniferous corals from the Nagaiwa Series, southern Kitakami Mountains, N. E. Japan. Hokkaido University, Faculty of Science Journal, ser. 4, Geology and Mineralogy, 16/2-3, 43-119.

Nicholson, H.A. & Thomson, J., 1876. Descriptions of some new or imperfectly understood forms of Palaeozoic corals (abstr.). Proceedings of the Royal Society of Edinburg, 9/95, 149-150.

Ogar, V.V., 2010. New data on the Carboniferous corals of the Donets Basin. In Kossovaya, O. & Somerville, I. (eds) Proceedings of the 10th International Symposium on Fossil Cnidaria and Porifera, Saint-Petersburg. Palaeoworld, 19, 284-293.

Orbigny, A.D., d', 1849. Note sur des polypiers fossiles. Paris, Victor Masson, 1-12.

Poletaev, V.I., Aizenverg, D.E. & Vdovenko, M.V., 1989. Unifitsirovannaya stratigrficheskaya skhema nizhnego karbona Dono-Dneprovskoy vpadiny. Izvestiya AN SSSR, seriya geologicheskaya, 1, 130–133. [in Russian].

Poty, E. 1975. Contribution à l'étude du genre *Dorlodotia* et sa répartition stratigraphique dans le Viséen du bord oriental du Bassin de Namur. Annales de la Société Géologique de Belgique, 98/1, 91-110.

Poty, E. 1981. Recherches sur les Tétracoralliaires et les Hétérocoralliaires du Viséen de la Belgique. Mededelingen Rijks Geologishe Dienst, 35/1, 1-61.

Poty, E., 2007. The Avins event: a remarkable worldwide spread of corals at the end of the Tournaisian (Lower Carboniferous). In Hubmann, B. & Piller, W. (eds). Proceedings of the 9th International Symposium on Fossil Cnidaria and Porifera, Gratz. Austrian Academy of Sciences, Schriftenreiche der Erdwissenschaftlichen Kommissionen, 17, 231-249.

Poty, E., Devuyst, F.-X. & Hance, L., 2006. Upper Devonian and Mississippian foraminiferal and rugose coral zonations of Belgium and Northern France: a tool for Eurasian correlations. Geological Magazine, 143, 829–857.

Riley, N.J. 1993. Dinantian (Lower Carboniferous) biostratigraphy and chronostratigraphy in the British Isles. Journal of the Geological Society of London, 150, 427-446.

Salée, A., 1920. Sur un genre nouveau de Tétracoralliaires (*Dorlodotia*) et la valeur stratigraphique des *Lithostrotion*. Annales de la Société scientifique de Bruxelles, 39/2, 145-154.

Sando, W.J., 1983. Revision of *Lithostrotionella* (Coelenterata, Rugosa) from the Carboniferous and Permian. Geological Survey Professional Paper, 1247, 1-52.

Semenoff-Tian-Chansky, P., 1974. Recherches sur les Tétracoralliaires du Carbonifère du Sahara occidental. Centre des Recherches sur les Zones arides, série: Géologie, 21, 1-316.

Smith, St., 1916. The genus *Lonsdaleia* and *Dibunophyllum rugosum* (McCoy). Quarterly Journal of the Geological Society of London, 71, 218-272.

Thomson, J., 1880. Contribution to our knowledge of the rugose corals from the Carboniferous Limestone of Scotland. Proceedings of the Royal Philosophical Society of Glasgow, 12, 225-261.

Tolmachev, I.P., 1933. New names for two genera of Carboniferous corals. Geological Magazine, 70/6, 287.

Vasilyuk, N. P., 1960. Nizhnekamennougol'nye korally Donetskogo basseyna. Trudy Instituta Geologicheskikh Nauk AN USSR (stratigrafiya, paleontologiya), 13, 1-179. [in Russian].

Vasilyuk, N.P. & Zhizhina, M.S., 1978. Novye dannye o nizhnekamennougol'nykh rugosakh Donetskogo basseyna (semeystva Lonsdaleiidae i Clisiophyllidae). Paleontologicheskiy sbornik, 15, 27-32. [in Russian].

White, C.A., 1880. Contributions to invertebrate paleontology No. 8: Fossils from the Carboniferous rocks of the Interior states. U.S. Geological and Geographical Survey of the Territories (Heyden), Annual Report 12/1, 155-171.

Zhizhina, M.S., 1956. Semeystvo Lithostrotionidae Grabau. In Kiparisova, L.D., Markovskiy, B.P. & Radchenko, G.P. (eds), Materialy po paleontologii. Novye semeystva i rody, novaya seriya. No 12. Gosgeoltekhizdat, Moscow, 39-41. [in Russian].

Zhizhina, M.S., 1960. Semeystvo Lithostrotionidae Grabau (1927) 1931. In Markovskiy, B.P. (ed.), Novye vidy drevnikh rasteniy i bespozvonochnykh SSSR. Chast' 1. Gosgeoltekhizdat, Moscow, 250-253. [in Russian].

Manuscript received 29.09.2011, accepted in revised form 08.05.2012, available on line 15.09.2012.

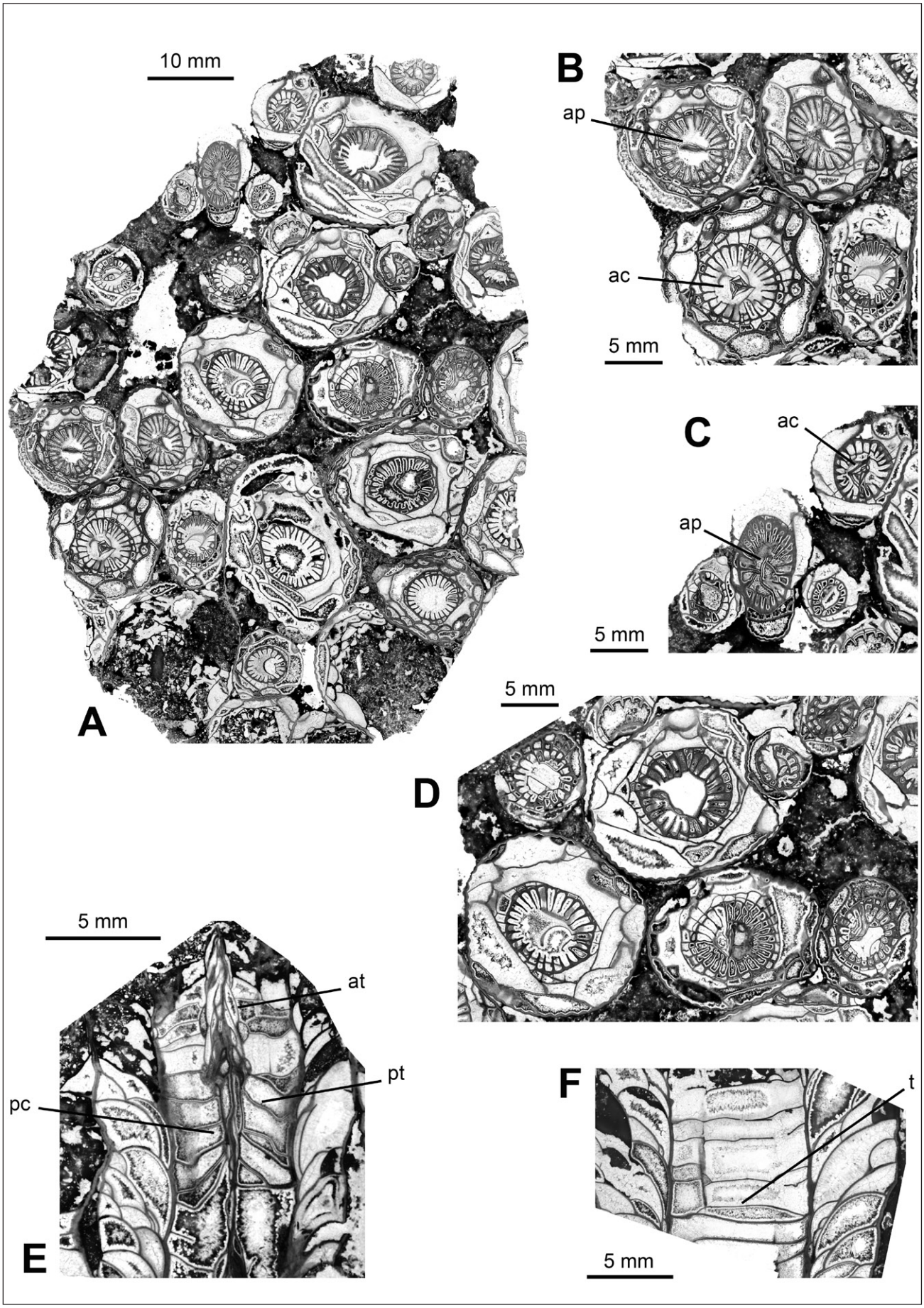

Plate 1. *Dorlodotia sokolovi* (Dobrolyubova, 1958), specimen PIN 705/161, holotype. A: Transverse section of the colony. B-D: Enlarged parts of the transverse section showing variability of axial structures. E: Longitudinal section of the corallite showing poorly defined axial column and periaxial cone on left side of column. F: Longitudinal section of the corallite lacking axial structure and showing subhorizontal tabulae; Dinantian, Brigantian, Mikhailov horizon, north-western part of the Moscow Basin, 50-60 km N. of the town of Borovichi. Legend: ac: axial column; ap: axial plate; at: axial tabella; pc: periaxial cone; pt: periaxial tabella; t: tabula.