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New data on Carboniferous crinoids from the Moscow Region*

GEORGE V. MIRANTSEV[1,2] & SERGEY V. ROZHNOV[1]

[1] *A.A. Borissiak Paleontological Institute, Russian Academy of Sciences, Moscow, Russia*
[2] *Corresponding author, E-mail: gmirantsev@gmail.com*

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Abstract

Despite more than 150 years of study of crinoids from the Moscow Region there are numerous undescribed taxa from well-known localities as well as others from poorly known localities. In recent years, through the acquisition of new collections as well as new discoveries, the holdings of Carboniferous crinoids of the Paleontological Institute, Russian Academy of Science have been greatly increased. This has allowed a more detailed study of the faunas, which is in progress. Among the crinoids in the collection there are representatives of the family Pirasocrinidae Moore & Laudon, 1943, that are abundant in the Pennsylvanian of the USA, and previously unknown in the Carboniferous of the Moscow Region, as well as representatives of the genera *Allosocrinus* Strimple, 1949, *Cibolocrinus* Weller, 1909 and *Elibatocrinus* Moore, 1940, also previously unknown in the Moscow Region. There is also the first recognized Pennsylvanian member of the family Taxocrinidae Angelin, 1878. The stratigraphic distribution of the most common crinoids from the Carboniferous of the Moscow Region is compiled. The crinoid faunas that characterize the Upper Carboniferous Substages are described. They are represented by at least four crinoid faunas (Myachkovian, Khamovnikian, Dobryatinian and Noginskian) which are named respectively for the Substages name. The most typical crinoids of these faunas are mentioned, including undescribed forms. All previously described valid species of crinoids from the Carboniferous of the Moscow Region are listed.

Key words: Echinodermata, Crinoidea, Pirasocrinidae, Taxocrinidae, Russia, Palaeozoic

Introduction

Crinoids were typical members of the benthic communities in the Paleozoic. The isolated elements of their skeleton (stem fragments, thecal and arm ossicles) are rock-forming particles and can form so-called "crinoidal limestone". The highest generic richness and overall abundance of crinoids were during the Lower Carboniferous (Mississippian), which is also known as the "Age of Crinoids" (Kammer & Ausich 2006).

Crinoids are known in almost all Substages of the Upper Carboniferous (Pennsylvanian) deposits in the Moscow Region. Within these deposits there are layers which contain crinoids commonly with excellent preservation, including complete crowns with nearly complete stems. There are also colonies of crinoid crowns and stems. In the Lower Carboniferous deposits of the Moscow Region crinoids are usually rare and fragmentary, represented by disarticulated elements. This is in contrast to North America, where Pennsylvanian deposits contain few crinoids preserved complete with arms, unlike Mississippian localities (Ausich 1999).

Crinoids were first described from the Carboniferous of the Moscow Region by Johann Got-

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thelf (Grigorij Ivanovič) Fischer von Waldheim (1837) unfortunately, without any details (Alekseev 2001a). The first detailed works on crinoids were monographs and articles by Hermann A. Trautschold (1867, 1879, 1881, 1882), in which he described several new genera and species of crinoids, found in the vicinity of Myachkovo and Korobcheevo. These include *Poteriocrinus originarius* Trautschold, *P. multiplex* Trautschold, *Cromyocrinus simplex* Trautschold, *Synyphocrinus cornutus* Trautschold, *Forbesiocrinus incurvus* Trautschold, among others.

In 1898 Otto Jaekel assigned *F. incurvus* to *Synerocrinus* (Jaekel, 1898). In addition, Jaekel (1918) identified several new genera (*Dicromyocrinus*, *Moscovicrinus, Protencrinus* and *Ophiurocrinus*) on the basis of specimens from the vicinity of Moscow. Crinoids from the Carboniferous of the Moscow Basin were also studied by R.C. Moore, H.L. Strimple, J. Wright, F.B. Plummer, and other researchers.

The most significant contribution to the study of Carboniferous crinoids from the Moscow Region was made by Nikolaj N. Yakovlev. He distinguished several new taxa, including the first representative of the family *Acrocrinidae* (Yakovlev 1926), known outside North America, as well as the genus *Trautscholdicrinus* (Yakovlev, 1939).

A large monograph, dedicated to the Carboniferous and Permian crinoids and blastoids from the USSR was published by N.N. Yakovlev and A.P. Ivanov (1956). It includes a chapter about Carboniferous crinoids from the Moscow Region, which was based mostly on the collection of A.P. Ivanov. New crinoids such as *Synyphocrinus magnus* Yakovlev & Ivanov and *Miatshkovocrinus* (= *Dicromyocrinus*) *trautscholdi* (Yakovlev & Ivanov) were described therein.

It is worth noting that most of the specimens that were previously described from the collections of Trautschold, Ivanov and others from the vicinity of Myachkovo apparently came from a unit of "garnasha" (an alternation of shale, marl and dolomitic limestone) in a lower member of the Suvorovo Formation, Krevyakinian Substage, but not the Peski Formation, Myachkovian Substage, as previously thought (Alekseev 2001a).

Subsequently, the study of crinoids from the Moscow Region was continued by Yu.A. Arendt, S.V. Rozhnov, A.V. Stupachenko and A.D. Zubarev. A number of papers were devoted to a the description of a few new finds, as well as the redescription of previously described camerate crinoid (Arendt & Stupachenko 1984; Arendt 1995) as well as abnormalities in the radial symmetry (Rozhnov 1984; Arendt & Zubarev 1993; Arendt 1997). Some papers were devoted to the first discovery of crinoid calyces in the Lower Carboniferous deposits (Arendt 1962, 1981, 2002).

Study Area

Carboniferous deposits are widespread within the city limits of Moscow and nearby areas and are usually unconformably overlain by Jurassic sediments. Carboniferous rocks are mainly various dolomites, limestones, marls, and clays. Lower Carboniferous rocks are encountered mainly in the southern and south-western parts of the Moscow Syncline, a large depression in the sedimentary cover of the Precambrian East European craton. Upper Carboniferous sediments developed in most of the Moscow Syncline, and also at the Oka-Tsna Swell. During the Carboniferous the Moscow basin occupied a position approximately 10 to 20 degrees N of the paleoequator.

Cups of crinoids have been found in more than 20 locations in the Moscow Region, as well as in nearby areas (Fig. 1). Some of the locations and outcrops are no longer available for study due to reclamation of quarries. Numerous excellently preserved specimens were collected from the Moscow

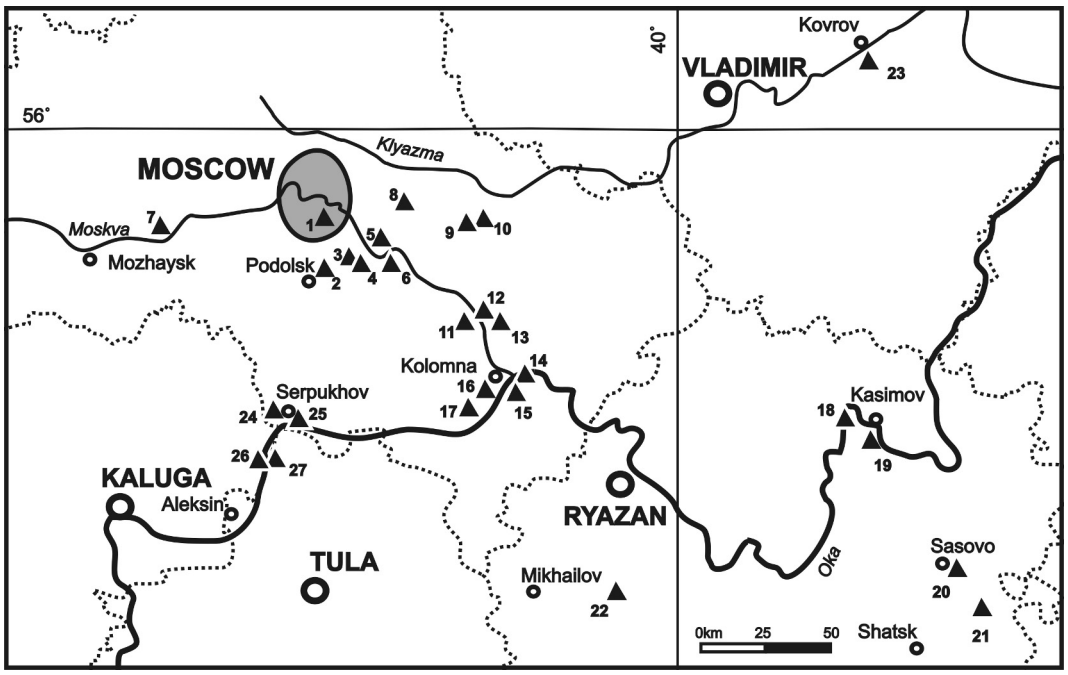

FIGURE 1. Map showing the most important Lower Carboniferous (24–27) and Upper Carboniferous localities (1–23) in the Moscow Basin from which crinoids have been collected (1—Moscow Subway dumps, 2—Podolsk, 3—Novlenskoe, 4—Domodedovo, 5—Myachkovo and Turaevo, 6—Zelenaya Sloboda, 7—Tuchkovo, 8—Rusavkino, 9—Gzhel, 10—Konyashino, 11—Afanasievo, 12—Shifernaya, 13—Peski, 14—Pirochi and Korobcheevo, 15—Schurovo, 16—Akatievo, 17—Gory, 18—Lashma, 19—Tashenka, 20—Maliy Studenets, 21—Yambirnoe, 22—Aljutovo, 23—Melekhovo, 24—Kalinovskie Vyselki, 25—Zaborie, 26—Ignatova Gora, 27—Mitino).

subway dumps during 1980–1990. Despite the material collected not being in-situ, the stratigraphical horizons of most of the specimens could be identified.

Materials

Crinoids for this study are the collections stored in the basement of the PIN RAS. The crinoids occur mostly as disarticulated skeletal elements from the Moscow Region, as well as in other nearby localities. However, diagnosis and classification of crinoids are based mainly on structural features of cups and crowns. Collections of Carboniferous crinoids of PIN RAS have been greatly increased in recent years, through the acquisition from private collectors as well as new discoveries of echinoderms from the Carboniferous of the Moscow Region. This has provided the basis for a more detailed study, which is ongoing.

Our preliminary data show that the collections contain more than 2000 specimens of cups and crowns of crinoids from the Moscow Region, of which there are at least 70 new species. At least 47 previously described valid species of crinoids are represented by complete or partial calices (Table 1). Most of them come from the Upper Carboniferous deposits; only 9 crinoid species are known from the Lower Carboniferous deposits.

Crinoid faunas of the upper part of Upper Carboniferous, with abundant crinoids, are still unstudied or poorly studied. The same is true of Lower Carboniferous crinoids, whose remains are rare.

Crinoids from the collections of the Paleontological Institute RAS are well preserved and much of the collections have been professionally prepared. For many genera there are growth stages in which

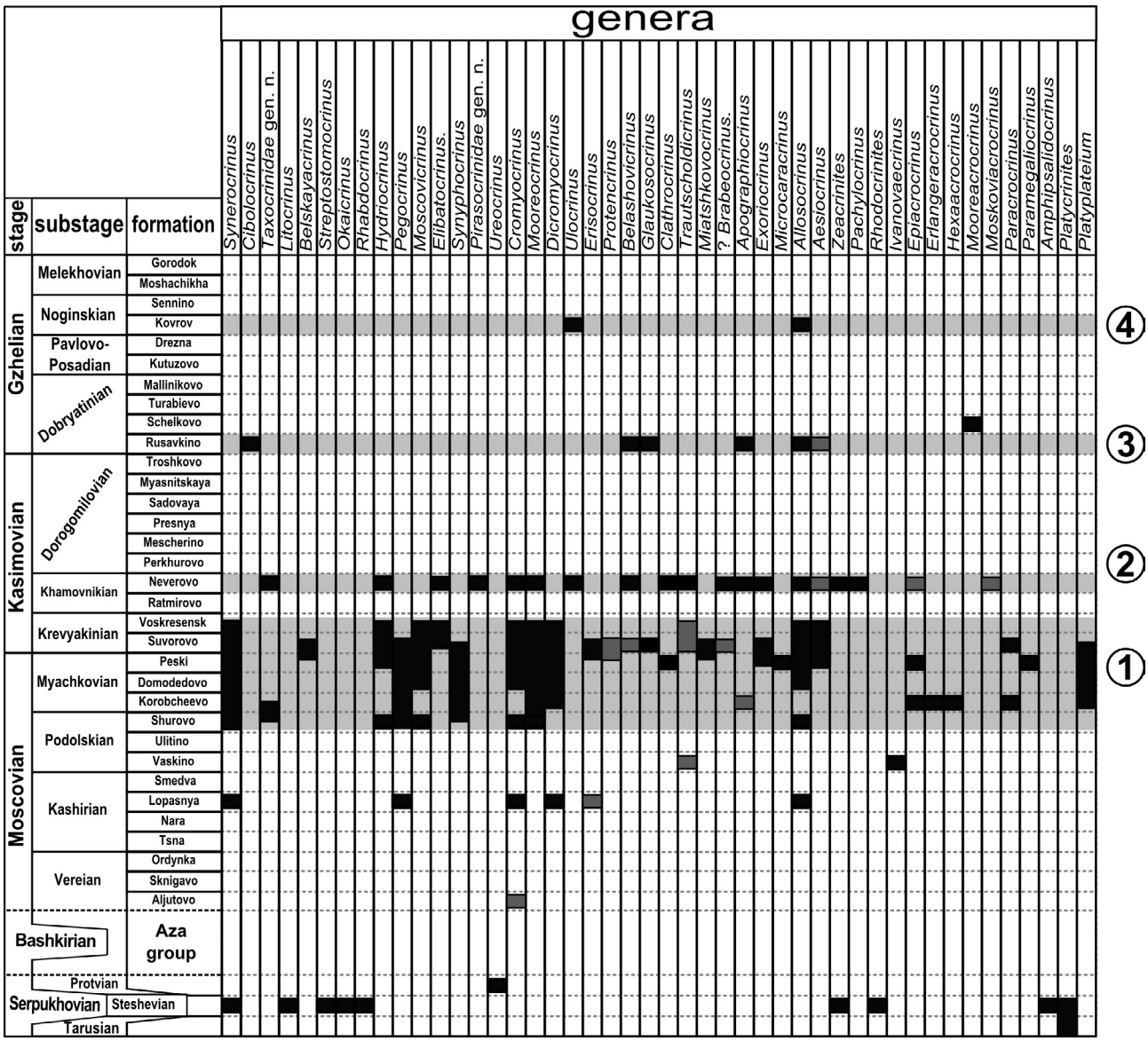

FIGURE 2. Distribution of the crinoid genera in the Carboniferous of the Moscow Syncline and the Oka-Tsna Swell (shown by black filled squares). Squares, filled by gray color indicate that the data need clarification; light gray area and the numbers indicate the Upper Carboniferous crinoid faunas described in the text (1—Myachkovian, 2—Khakovnikian, 3—Dobryatinian and 4—Noginskian).

it is possible to trace the change from juvenile to adult forms. There are a large number of aberrant specimens in these collections as well as specimens demonstrating crinoid-*Platyceras* interaction and different traces of parasites, such as *Phosphannulus* and *Schizoproboscina*.

Discussion

The systematic classification of crinoids adopted by Moore & Teichert (1978) with some modifications is followed herein.

In the Moscow Region there are representatives of all the known subclasses of Carboniferous crinoids: Camerata, Cladida, Disparida and Flexibilia. Most of the specimens belong to the most common late Paleozoic group Cladida, represented mostly by different members of the suborder

Dendrocrinida (Table 1). Cyathocrinitids are represented mostly by microcrinoids (Arendt 2002). Dendrocrinids are represented by different families, but particularly diverse cromyocrinids, scytalocrinids, cymbiocrinids and others (Table 1). There are also a number of undescribed cladid crinoids, including new species and genera.

The only known disparids from the Moscow Region are two species—*Litocrinus scoticus* (Wright) from the Steshevian Substage in Mitino and Ignatova Gora quarries and *Belskayacrinus turaevoensis* Arendt from the Suvorovo Formation, Krevyakinian Substage from Turaevo quarry (Fig. 2). The rarity of disparids may be explained by their size: their cups usually do not exceed a few millimeters.

Flexibles played a secondary role in Paleozoic crinoid faunas; they are rare in comparison with camerates and cladids. The finds of their crowns in the Moscow Region are also less frequent than those of cladids. For a long time, flexibles were represented only by one genus and species—*Synerocrinus incurvus*, which was known from the middle and lower part of the Upper Carboniferous of the Moscow Syncline, the Donbass (Yakovlev & Ivanov 1956) and the Oka-Tsna Swell. However, recently new specimens of *Synerocrinus* sp. from the Steshevian Substage of the Serpukhovian Stage have been described (Shmakov & Mirantsev 2010). There are also some specimens of a new taxon of the family Taxocrinidae in the collections of PIN RAS, which come from the Shurovo and Neverovo Formation of the Moscow Region (Podolskian and Khamovnichean Substages) and Korobcheevo Formation of the Oka-Tsna Swell (Myachkovian Substage). In the Dobryatinian Substage there have been finds of *Cibolocrinus* sp. (Mirantsev & Grishin 2010). So there are representatives of at least three different flexible families (Synerocrinidae, Taxocrinidae, Mespilocrinidae) in the Carboniferous of the Moscow Region.

Camerates are rare and mainly represented by different isolated thecae of acrocrinids (nine species), as well as stem fragments and plates of representatives of platycrinitids (*Platyplateium* sp., *Platycrinites* spp.). Camerate specimens from other families are extremely rare; however—there are several finds of three other different genera (*Ivanovaecrinus*, *Paramegaliocrinus*, *Rhodocrinites,* see Fig. 2).

In the Lower Carboniferous of the Moscow Region crinoids are known mainly from the Steshevian Substage of the Serpukhovian Stage (Fig. 2). In the older (Visean) deposits crinoid cups are unknown (Arendt 2002). Crinoid fragments occur at many levels in the Steshevian Substage and were found in different quarries in the Moscow, Tula and Kaluga Regions (Fig. 1). A few cups, as well as numerous fragments of stems and plates of *Rhabdocrinus vatagini* Arendt have been discovered in some quarries in rocks of this age. In addition a cup of a cromyocrinid, *Ureocrinus rozhnovi* Arendt, was found in rocks of the Protvian Substage of "Zaborie" quarry (Arendt 1981, 2002). However, despite the discovery of these crinoids, information is too incomplete to characterise the crinoid fauna of the Steshevian Substage.

The lower part of the Upper Carboniferous in the Moscow Region consists mainly of the Moscovian Stage. There are some crinoid finds in the Vereian Substage (Aljutovo locality). A single cup of *Cromyocrinus* sp. comes apparently, from this locality. Crinoids occur commonly in the Moscow Syncline and the Oka-Tsna Swell in the Kashirian. The most typical crinoids of this age are *Cromyocrinus simplex* Trautschold, *Dicromyocrinus subornatus* Yakovlev, *Pegocrinus* sp. and *S. incurvus*. There are some finds of colonies, which contains cups and crowns of *Dicromyocrinus subornatus*, in the Lopasnya Formation, Kashirian Substage, which show that these crinoids settled in colonies of more than 50 individuals with one dominant species.

In the Podolskian, in addition to the genera mentioned above (*Cromyocrinus*, *Allosocrinus*, *Pego-*

TABLE 1. Compiled list of all described Carboniferous crinoid species from the Moscow Syncline. Synonymies and doubtful species are not mentioned. Only forms that were described on the basis of partial or complete cups are mentioned.

Subclass Camerata Wachsmuth & Springer, 1885
- Order Diplobathrida Moore & Laudon, 1943
  - Family Rhodocrinitidae Roemer, 1855
    - *Rhodocrinites osipovae* Arendt, 2002
- Order Monobathrida Moore & Laudon, 1943
  - Family Dichocrinidae Miller, 1889
    - *Ivanovaecrinus carboniferus* (Yakovlev & Ivanov, 1956)
  - Family Acrocrinidae Wachsmuth & Springer, 1885
    - *Epiacrocrinus crassus* Arendt, 1995
    - *Epiacrocrinus* (?) *hexagonus* Arendt, 1995
    - *Epiacrocrinus pirogovae* Arendt, 1995
    - *Erlangeracrocrinus elongatus* Arendt, 1995
    - *Hexaacrocrinus drozdovae* Arendt, 1995
    - *Mooreacrocrinus gjelicus* Stupachenko & Arendt, 1976
    - *Moskoviacrocrinus grishini* Arendt, 1995
    - *Paracrocrinus mjatschkowensis* (Yakovlev, 1926)
    - *Paracrocrinus yakovlevi* Arendt & Stupachenko, 1983
  - Family Paragaracocrinidae Moore & Laudon, 1943
    - *Paramegaliocrinus erlangeri* Arendt, 1983
  - Family Platycrinitidae Miller, 1821
    - *Amphipsalidocrinus astrus* Arendt, 2002
    - *Platycrinites tenuiplatensis* Arendt, 2002

Subclass Disparida Moore & Laudon, 1943
- Family incertae sedis
  - *Belskayacrinus turaevoensis* Arendt, 1997
- Family Allagecrinidae Carpenter & Etheridge, 1881
  - *Litocrinus scoticus* (Wright, 1932)

Subclass Cladida Moore & Laudon, 1943
- Order Cyathocrinida Bather, 1899
  - Family Sycocrinitidae Lane, 1967
    - *Streptostomocrinus heckerae* Arendt, 2002
  - Family Lageniocrinidae Arendt, 1970
    - *Okaicrinus nodosus* Arendt, 2002
- Order Dendrocrinida Bather, 1899
  - Family Poteriocrinitidae Austin & Austin, 1842
    - *Rhabdocrinus vatagini* Arendt, 1962
  - Family Scytalocrinidae Moore & Laudon, 1943
    - *Hydriocrinus pusillus* Trautschold, 1867
    - *Ophiurocrinus originarius* (Trautschold, 1867)
    - *Pegocrinus bijugus* (Trautschold, 1867)
  - Family Blothrocrinidae Moore & Laudon, 1943
    - *Moscovicrinus multiplex* (Trautschold, 1867)
  - Family Anobasicrinidae Strimple, 1961
    - *Synyphocrinus cornutus* Trautschold, 1880
    - *Synyphocrinus magnus* Yakovlev & Ivanov, 1956
  - Family Pachylocrinidae Kirk, 1942
    - *Pachylocrinus baschmakowae* Yakovlev & Ivanov, 1956
    - *Pachylocrinus tenuiramosus* Yakovlev, 1939
  - Family Agassizocrinidae Miller, 1889
    - *Belashovicrinus gjelensis* Arendt & Zubarev, 1993
    - *Belashovicrinus medvedkaensis* Arendt & Zubarev, 1993
  - Family Decadocrinidae Bather, 1890
    - *Trautscholdicrinus miloradowitschi* Yakovlev, 1939
  - Family Cromyocrinidae Miller, 1889
    - *Cromyocrinus simplex* Trautschold, 1867
    - *Dicromyocrinus ornatus* (Trautschold, 1879)
    - *Dicromyocrinus subornatus* Yakovlev, 1956
    - *Mooreocrinus geminatus* (Trautschold, 1867)
    - *Ulocrinus grishini* Mirantsev & Rozhnov, 2011
    - *Ulocrinus karchevskyi* Mirantsev & Rozhnov, 2011
    - *Ulocrinus neverovoensis* Mirantsev & Rozhnov, 2011
    - *Ureocrinus rozhnovi* Arendt, 1981
  - Family Erisocrinidae Wachsmuth & Springer, 1886
    - *Erisocrinus cernuus* (Trautschold, 1867)
  - Family Protencrinidae Knapp, 1969
    - *Protencrinus moscoviensis* Jaekel, 1918
  - Family Galateacrinidae Knapp, 1969
    - *Miatschkovocrinus trautscholdi* (Yakovlev & Ivanov, 1956)
  - Family Cymbiocrinidae Strimple & Watkins, 1969
    - *Aesiocrinus ivanovi* Yakovlev, 1956
    - *Aesiocrinus patens* (Trautschold, 1869)
  - Family Staphylocrinidae Moore & Strimple, 1973
    - *Microcaracrinus pachypinnularis* (Yakovlev & Ivanov, 1956)
  - Family Zeacrinitidae Bassler & Moodey, 1943
    - *Zeacrinites heckeri* Arendt, 2002
    - *Zeacrinites schmitowi* (Yakovlev & Ivanov, 1956)

Subclass Flexibilia Zittel, 1895
- Order Taxocrinida Springer, 1913
  - Family Synerocrinidae Jaekel, 1918
    - *Synerocrinus incurvus* (Trautschold, 1867)

crinus, *Synerocrinus*, *etc.*), there is an additional genus, *Mooreocrinus* Wright & Strimple, that is widely distributed and is represented in the Moscow Region by the type species, *M. geminatus* (Trautschold). The most numerous crinoid specimens found in the Podolskian come from facies alternating in clay marls and detrital limestones of the Shurovo Formation, where crinoids are commonly badly preserved, being rounded and silificated.

The development of the benthic fauna continued in the Myachkovian. Deposits represent shallow-water sediments during regression in the initial phase of Korobcheevo time. Colonial corals, as well as foraminiferans formed coral-foraminiferal limestones during this period. Crinoids are represented mostly by *Pegocrinus*, *D. ornatus* (Trautschold) and also by columnals of *Platyplateium* sp. During Domodedovo and Peski times crinoids formed a typical Upper Carboniferous-Myachkovian faunal assemblage: cromyocrinids, other large (*Pegocrinus*, *Moscovicrinus*), and small cladids (*Hydriocrinus pusillus* Trautschold, *Miatshkovocrinus trautscholdi* (Yakovlev & Ivanov), *etc.*), flexible crinoids (*S. incurvus*) are typical. Cromyocrinids are represented by three different genera and species, *C. simplex*, *M. geminatus* and *Dicromyocrinus ornatus*, each occur in different facies and formations.

At the initial phase of the Krevyakinian Substage, during an extensive transgression represented by the Suvorovo Formation, the benthic fauna became more diverse and abundant (Alekseev 2001b). The composition of the crinoid fauna during this phase is not much different from that in the previous Myachkovian time. In particular, cromyocrinids are represented by the same three species, but their occurrences are much more common. A similar coeval "Myachkovian" type crinoid fauna is known in the Oka-Tsna Swell. There are few occurrences of erisocrinids and protencrinids, typical of North America faunas.

Fragments of crinoids have also been found in alternations of limestone and marl in the lower part of the Voskresensk Formation of the Kreviakino Substage and these have been mentioned in the literature. However, the discovery of a complete crinoid cup is unknown. Whole crinoids are rare in the lower part of the Khamovnikian Substage, Ratmirovo Formation, which is represented mainly by detrital limestones. The crinoid faunas were probably similar to the overlying faunas of the Neverovo Formation. A more detailed study of the Kreviakino and Khamovnikian Substages is to be made in the future.

At the top of Khamovnikian Substage, in the Neverovo Formation, the Myachkovian crinoid fauna was replaced by a new type the—termed here "Khamovnikian". This fauna was characterized by the appearance of representatives of new families (*e.g.*, Pirasocrinidae, Taxocrinidae) that are widespread in North America and were previously unknown (or were represented by isolated specimens) in the Moscow Region. It is worth noting that taxocrinids of this age from the Moscow Region are represented by a new genus and a species and are the youngest representatives of this family. In addition, some genera, such as *Pegocrinus*, *Moscovicrinus* and *Synerocrinus* that are typical of the underlying strata became extinct. The crinoid fauna of this age is very rich and contains many different new forms. Cromyocrinids are the dominant representatives among the large crinoids. *C. simplex* and *M. geminatus* continued to exist while there was an additional genus with two species, *Ulocrinus* Miller & Gurley, formerly known from coeval deposits of North America (Mirantsev & Rozhnov 2011). Typical crinoids of the Khamovnikian faunas include *Trautscholdicrinus miloradowitschi* Yakovlev & Ivanov, *Zeacrinites schmitowi* Yakovlev, *Pachylocrinus* spp. There are also some undescribed species including—of *Allosocrinus*, *Apographiocrinus*, *Elibatocrinus*, *etc.*

The occurrences of macrofauna in the Dorogomilovian Substage are rare, and the specimens are poorly preserved due to partial dissolution during secondary dolomitization of the rocks. In addition,

the exposures of beds of this Substage are rather limited and are found in small areas. Therefore, the crinoid faunas of the upper part of the Kasimovian Stage are still poorly studied. Crinoids were probably restricted or reduced in the Moscow Basin as a result of the regression in the Kasimovian.

The Gzhelian Stage is characterized by a significant regression, during which many areas became shoals or were emergent. This gave rise to the development of new benthic communities dominated by solitary rugose corals, bryozoans and fusulinids. In the Moscow Region the most discoveries of Gzhelian crinoids come from the tempestites facies (layers number 7 and 8 in Alekseev *et al.* 2009) of the Dobryatinian Substage at the stratotype section near the railway station "55 km". The specimens of the macrofauna in these layers are commonly rounded and silicified. A lot of crinoid cups and numerous plates of different crinoids were collected during the washing of material from the tempestites. This fauna is very different from that of the Khamovnikian and was heavily depleted, large forms were practically absent (the average size of crinoid cups from this complex is about 10 mm), and cromyocrinids have not been found. Most specimens (more than 100 cups, with many aberrant specimens) are cups of agassizocrinids—*Belashovicrinus gjelensis* Arendt & Zubarev, 1993. There are also specimens of undescribed species of *Aesiocrinus*, *Apographiocrinus*, *Glaukosocrinus*, *etc.* Several cups of the flexible crinoid *Cibolocrinus* have been recently described from coeval deposits from the Rusavkino quarry (Mirantsev & Grishin 2009).

Until recently, there was no information about crinoids from other parts of the Gzhelian Stage, younger than Dobryatinian Substage. However, recent discoveries in the Gzhelian deposits of the Vladimir Region of the Oka-Tsna Swell, has filled a gap in this study has provided important information about the crinod faunas of this age. Several layers, some of them containing echinoderm colonies with various crinoids (*Ulocrinus*, *Allosocrinus*), sea urchins, as well as complete skeletons of starfish and brittle stars, have been identified. This fauna is similar to that of the Khamovnikian, and it also occurs in a relatively deep water facies. A more detailed study of echinoderms from this locality is planned for the future.

These changes in the crinoid faunas are paralleled by changes in the other benthic macrofauna occurring throughout the Carboniferous. Most crinoids from the Carboniferous of the Moscow Basin lived in relatively shallow seas. Commonly fossils of other echinoderms, including sea urchins (mostly *Archaeocidaris* spp.), sea stars, rare brittle stars, and different brachiopods, bryozoans, solitary corals and mollusks are found in association with the crinoids.

Conclusions

Thus, the available crinoid collection includes a great diversity of taxa, including new species, especially in the Upper Carboniferous of the Moscow Basin. The Lower Carboniferous crinoid fauna is probably closely related to the coeval fauna in Scotland, wherein there are several common taxa. The Upper Carboniferous crinoid faunas were similar in general to the coeval crinoid faunas of the North America. Cromyocrinids, cymbiocrinids among others were very numerous and abundant as in Pennsylvanian formations of the Midcontinent reported by Pabian & Rushlau (2002) and the Rocky Mountains by Webster & Kues (2006). However, pirasocrinids and erisocrinaceans that are typical for Pennsylvanian faunas in North America are represented by rare isolated taxa which are usually restricted to certain formations. The crinoid faunas of the Moscow Basin are interesting because of the presence of new species, of unique finds with skeletal aberrations and of paleoecological (*e.g.*,

parasite) traces. These collections have a great interest and may more accurately track the evolution and the biodiversity of the Carboniferous crinoids of the European part of Russia, as well as identify and trace the relationship with crinoids from coeval formations in North America and elsewhere. It is planned to describe these collections in detail in the future.

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