ISSN 0031-0301, Paleontological Journal, 2010, Vol. 44, No. 6, pp. 622–631. © Pleiades Publishing, Ltd., 2010
Original Russian Text © V.V. Mitta, 2010, published in Paleontologicheskii Zhurnal, 2010, No. 6, pp. 25–33.

Late Volgian *Kachpurites* Spath (Craspeditidae, Ammonoidea) of the Russian Platform

V. V. Mitta

Borissiak Paleontological Institute, Russian Academy of Sciences, Profsoyuznaya ul. 123, Moscow, 117997 Russia
e-mail: mitta@paleo.ru

Received November 3, 2009

Abstract—Ammonites of the genus *Kachpurites* are characteristic of the lower part of the Upper Volgian Substage of the Russian Platform. *K. fulgens fulgens* (Trautschold), *K. fulgens tscheremkhensis* Mitta et al., *K. subfulgens* (Nikitin) are established in the *fulgens* zone. The genus *Kachpurites* also includes ammonites previously described as *Anivanovia mola* Kiselev. The holotype of *Volgidiscus singularis* Kiselev belongs to *K. mola*, wheras some of its paratypes belong to *Craspedites krylovi* Prigorovsky. The generic name *Anivanovia* Kiselev, 2003 is considered as a junior subjective synonym *Kachpurites* Spath, 1924. The beds with *Kachpurites mola* are in the basal part of the Upper Volgian *subditus* Zone. Species of the genus *Kachpurites* are described, and macro- and microconchs are established within the species.

Keywords: ammonites, Craspeditidae, *Kachpurites, Craspedites*, Upper Volgian, Russian Platform.

DOI: 10.1134/S0031030110060031

INTRODUCTION

The family Craspeditidae Spath, 1924 is one of the most widespread group of ammonites at the Jurassic–Cretaceous boundary in boreal and subboreal regions of the globe. In many regions, in the rocks of this age, craspeditids represent up to 100% of the taxonomic composition of ammonoids. This makes this family exceptionally important for biostratigraphy and correlation, as well as for studying ammonite evolution over a long period of time (from the Mid-Volgian to the end of the Ryazanian), mostly in monotaxonic assemblages. Members of this family are discussed in many papers. At the same time, most publications on Volgian craspeditids contain descriptions of new, or illustration of previously established species, without a taxonomic revision and a up-to-date analysis of stratigraphic distribution of taxa. The most recent monographic descriptions of Late Volgian Craspeditidae were published 40 years ago; Gerasimov (1969) on the Russian Platform and Shulgina (1969) on Siberia using Central Russian material. Both of these studies have retained their significance until today, but they have a considerable fault. Their authors considered dimorphism of ammonites (existence of macro- and microconchs) insufficiently or not at all, which resulted in mistakes in species identification. The later monographs, also considering Volgian craspeditids (Sasonova, 1971, 1977; Shulgina, 1985) resulted in an unjustified increase in the number of genera, mainly because of the splitting of *Craspedites*), without adding anything new to the understanding of the system of Craspeditidae.

Wright et al. (1996) in the new edition of *Treatise*... attempted the recognition of macro- and microconchs in Craspeditidae, which they understood as a subfamily of Polyptychitidae Wedekind, 1918, although this attempt cannot be considered as successful. The hypothesis that *Kachpurites* are microconchs of craspeditids is, as shown below, erroneous.

In different regions of the Boreal Realm, this family has (sometimes considerably) different generic composition during the Late Volgian and its equivalents. In the Russian Platform, the geographical center of origin of craspeditids (Mitta, 1993), members of this family belong to three genera *Craspedites* Pavlow, 1892, *Garniericeras* Spath, 1923, and *Kachpurites* Spath, 1924. Species of these genera are often indicated from other regions of the distribution of craspeditids, and ammonites typical for England, Greenland, and Siberia have been recorded from the Volgian Stage of the Russian Platform. These records are often based on material of insufficient preservation for positive identification, or even based on occasional records. However, such identifications are sometimes used for interregional biostratigraphic correlations, paleogeographical interpretations and understanding of connections between marine basins, of migration pathways, etc.

Kiselev (2003) described from the Rybinsk Reservoir (Rybinsk District, Yaroslavl Region) two new species of *Craspedites*. One of these was assigned to *Volgidiscus* [established by Casey (1973) as a subgenus in the genus *Subcraspedites*, based on English material], and another to a new genus *Anivanovia* (according to

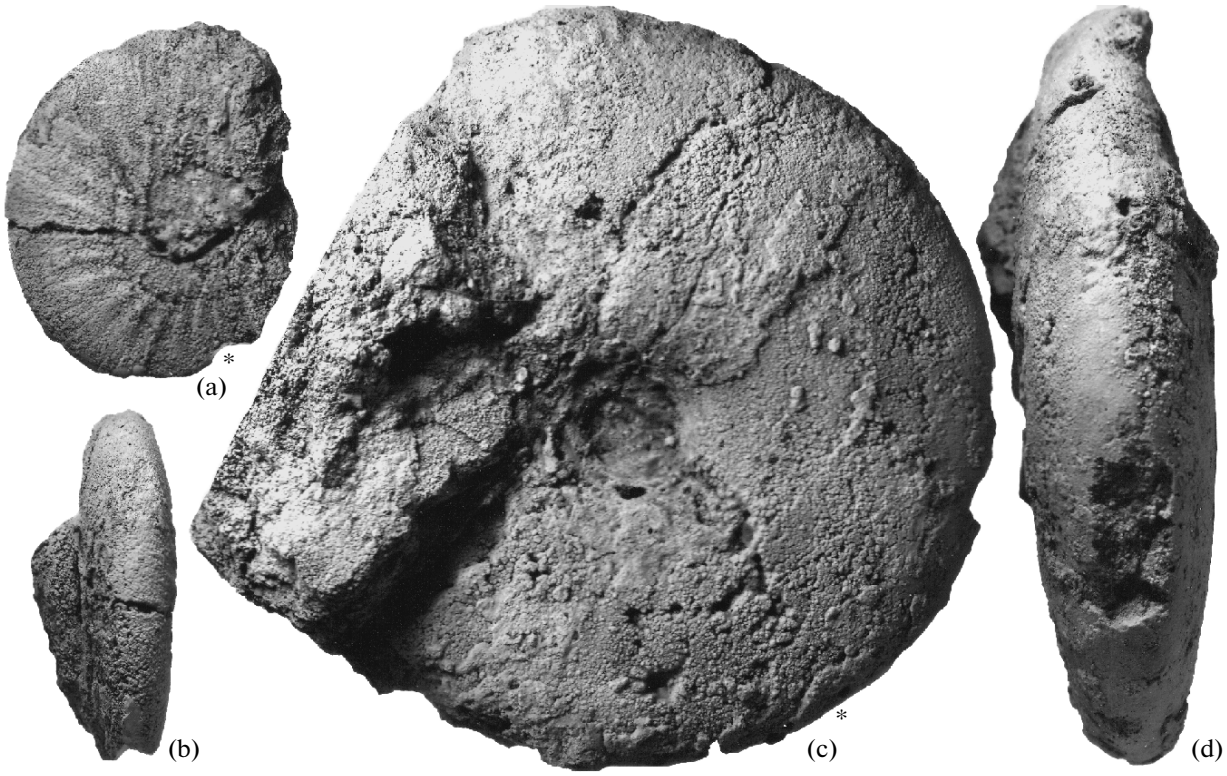


Fig. 1. *Kachpurites mola* (Kiselev), x 1: (a, b) specimen PIN, no. 3990/346, microconch: (a) lateral view; (b) ventral view; (c, d) specimen PIN, no. 3990/345, macroconch: (c) lateral view; (d) ventral view; Yaroslavl Region, bank of the Cheremukha River, near the village of Seltso-Voskresenskoe; Upper Volgian, beds with *Kachpurites mola*; collected by V.V. Mitta. Asterisk (*) shows the beginning of the body chamber.

Kiselev, also "genetically similar to *Subcraspedites"*). Kiselev based his new taxa on inner molds from a thin ferruginous sandstone bed, at the base of the sandy–gravelite series about 10 m thick, opened up by a small quarry on the Cheremukha River near the village of Seltso-Voskresenskoe. Since there were no fossils in the underlying and overlying beds and because the position of the series with new ammonoid records remained therefore uncertain, Kiselev recognized the series in question as "beds with fossils" (with *Volgidiscus singularis*). Taking into account the range of *Volgidiscus* at the top of the Jurassic of East England, the newly recognized unit was placed by Kiselev at the top of the Volgian, immediately below the Ryazanian, in the stratigraphic scale of European Russia. In the next few years some other workers followed Kiselev and accepted the presence of Beds with *Volgidiscus singularis* at the top of the Volgian Stage (Zakharov and Rogov, 2008; etc.), although originally this was a hypothesis rather than a proven fact.

In summer 2005, I organized a field trip to the Cheremukha River, and collected ammonites from the Seltso-Voskresenskoe locality, from the Beds with *Volgidiscus singularis*, including previously unrecorded representatives of Central Russian *Kachpurites* (Figs. 1, 2). A revision of this genus and some other members of the family Craspeditidae was necessary to resolve their taxonomy.

MATERIAL

The revision is based on my own collections of the last three decades in the Moscow Basin, and the upper and middle reaches of the Volga River (Upper and Middle Povolzhye). In addition, I examined material collected by previous workers in the last 150 years from currently unavailable localities housed in the Vernadsky State Geological Museum (GGM RAN) and Borissiak Paleontological Institute, Russian Academy of Sciences (PIN RAN). Collection no. 3990 is housed in PIN RAN, whereas other figured specimens are in GGM RAN.

RESULTS AND DISCUSSION

The genus *Kachpurites* is an early member of the family. A few species of this genus come from the lower zone of the Upper Volgian Substage of the Russian Platform and were seemingly well-studied. *Kachpurites fulgens* was first figured in the mid-19th century when Rouillier et al. (1849, p. 356, pl. K, fig. 85, pl. L, fig. 86) published a description of (ammonites *gigas* var. *junior* and var. *adulta* from the Khoroshovo section

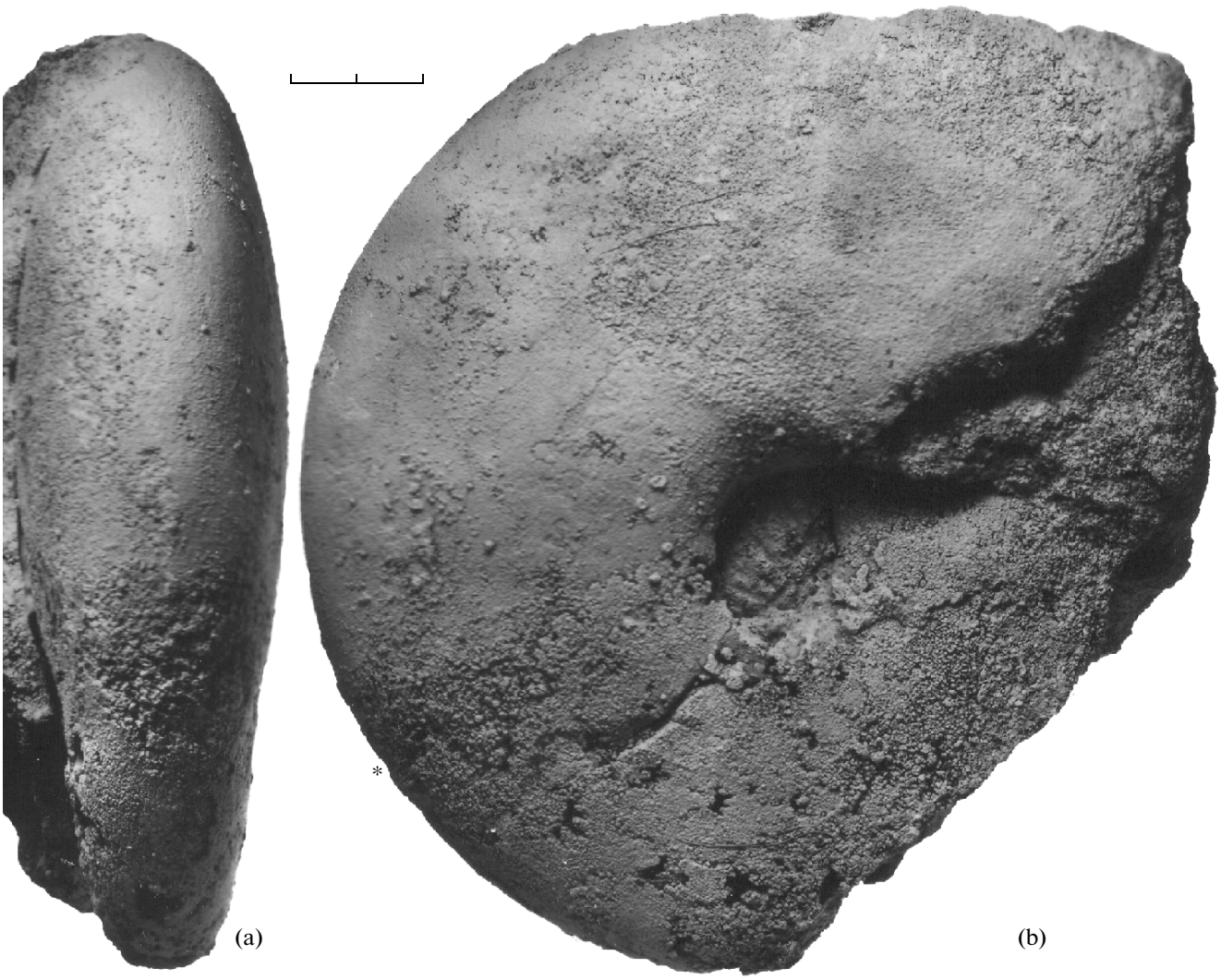


Fig. 2. *Kachpurites mola* (Kiselev), specimen PIN, no. 3990/343, macroconch: (a) lateral view, (b) ventral view; Yaroslavl Region, bank of the Cheremukha River, near the village of Seltso-Voskresenskoe; Upper Volgian, beds with *Kachpurites mola*; collected by V.V. Mitta. Scale bar 1 cm; asterisk (*) shows the beginning of the body chamber.

in Moscow. Later Trautschold (1858, text-fig. on p. 553) figured *Ammonites* sp. (see the figure reproduced in Mitta and Starodubtseva, 2002, pl. 1, fig. 8) from the section near the village of Kotelniki in the Moscow Region. Later Trautschold (1861, pl. VII, fig. 7) published a description of *Ammonites fulgens* sp. nov. from the Khoroshovo locality, including its varieties (var. *hybridus* (Trautschold 1861, pl. VII, fig. 9) and ?var. *triplicatus*). Later he described the latter as a separate species *A. fragilis* (Trautschold, 1866) (currently in *Craspedites*). Later beds with *fulgens* were considered as a separate unit (*Kachpurites fulgens* Zone), at the base of the Upper Volgian in its modern understanding.

Subsequent information on kachpuritids has mainly been obtained from the Jurassic beds of the Rybinsk Region (Yaroslavl Povolzhye). Nikitin (1881) described the genus *Neumayria* from the vicinity of the town of Rybinsk (village of Kamenik on the left bank of the Volga River), with the species *N. fulgens* (Trautsch.) and *N. subfulgens* Nik. The generic name was preoccupied, and in his next monograph Nikitin (1884) assigned these species to the genus *Oxynoticeras* Hyatt. Most kachpuritids figured by Gerasimov (1969) also come from the vicinity of Rybinsk.

Kachpurites fulgens tscheremkhensis and *K. sautenkovi* (Mitta et al., 1999) were described from the same region, from the Cheremukha River near the villages of Ivanovskoe and Popovskoe. In the opinion of Keupp (2000, p. 125), the elliptical uncoiling of the shell of the holotype of the latter resulted from pathological changes. Considering that *K. sautenkovi* was described based on a single specimen, Keupp's view seems justified.

Thus, the genus *Kachpurites* is interpreted as including *K. fulgens* (Trautschold), *K. fulgens tscher-*

emkhensis Mitta et al. and *K. subfulgens* (Nikitin). The generic name was proposed by Spath (1923, p. 307 (nom. nud.); Spath, 1924, p. 17). Spath (1947) attempted to typify *Kachpurites* based on the specimen figured by Nikitin (1881, pl. X, fig. 48). Wright et al. (1996) correctly noted that this specimen could not be a lectotype, as it was not a syntype, and proposed the illustrated specimen of *Ammonites fulgens* Trautschold, 1861, pl. VII, fig. 7. This proposal cannot be considered as the best solution because the location of the specimen figured by Trautschold is unknown and has possibly been lost. Dozens of topotypes of this species, similar and of similar preservation to the specimen figured by Trautschold are housed in the GGM RAN. Mitta and Starodubtseva (2002, pl. 2, fig. 3) figured one of these specimens (collected in the second half of the 19th century by an unknown collector). However, there is no particular need to designate a neotype because Trautschold figured a specimen of the species typical of the vicinity of Moscow.

In my understanding the genus *Kachpurites* is dimorphic, dimorphic pairs being recognized within the species. The macroconch phragmocone is up to 150 mm in diameter, and adult shells with a body chamber reached a diameter of 220 mm and over. The shells of macroconchs are compressed, with whorls of elliptical and oval cross section, and the umbilicus ranges from moderately wide to narrow. The ornamentation consists mainly of striated ribs, sometimes with long primary ribs. Microconchs show a considerably smaller adult shell size, and a wider umbilicus at a similar shell diameter, a much more pronounced original ornamentation—long primary ribs subdivided into 2–4 branches with mainly striated ribs in between. Gerasimov (1969) noted two morphs in *K. fulgens* and *K. subfulgens* (a smoother, and a more strongly ribbed), as possible evidence of sexual dimorphism, but he did not record differences in the size and shape of the shell. The body chamber of kachpuritids occupies from 3/4 to 7/8 of the whorl; the aperture is simple with a small expansion of the flanks and a small ventral projection. Shells of kachpuritids differ from craspeditids in more rounded whorl cross section and the presence of well-developed striated ornamentation. Crushed molds of kachpuritids, especially macroconchs, are hardly distinguished from similarly preserved macroconchs of the genus *Craspedites*.

Young shells (30–40 mm in diameter), are usually little distinguished in different species (see Pl. 2, fig. 4; Pl. 3, figs. 3, 4), although macroconchs have higher whorls and a narrow umbilicus (Pl. 3, fig. 5). Shells of such size and appearance are usual for Moscow and its vicinity; adult shells are here found rarely and are represented in the collections by fragments of body chamber, as phragmocone chambers unfilled with matrix are easily destroyed when removed from the sandy–clayey host rock.

Distinct dimorphism and species differences are observed at later ontogenetic stages. Microconchs of *K. fulgens fulgens* possess long, sparsely spaced primary ribs, alternating with numerous striated ribs (Pl. 2, fig. 1; see also Gerasimov, 1969, pl. XXXII, fig. 3). As the shell grows, the ornamentation is modified: some of the striated ribs disappear and some are transformed into filamentous secondary ribs, and the shell possesses strong, long primary ribs subdivided into three or four branches; with intercalating ribs developed between the fascicles (Pl. 2, fig. 2). The most strongly coarsely ribbed morphs (Pl. 2, fig. 3) have an unusual body chamber, at least seemingly, not typical of for *Kachpurites*. As a result, when only the body chamber is present, one of such specimens was identified by Gerasimov (1969, pl. XXXII, fig. 3) as *Subcraspedites* sp. Recently Kiselev and Rogov (2005, p. 138) assigned this illustration from Gerasimov's monograph to *Glottoptychinites* Buckman, 1923, a genus described from the Portlandian of England, like *Subcraspedites*. *Glottoptychinites* is characterized by large shells covered by coarse bipartite and simple ribs, which are very different from the ornamentation of craspeditids. The shell figured by Gerasimov shows sparsely spaced prominent but not coarse and less commonly bipartite ribs, with intercalating ribs in between—this is an extreme sparsely ribbed morph of the microconch of *Kachpurites fulgens* connected by transient forms with typical forms.

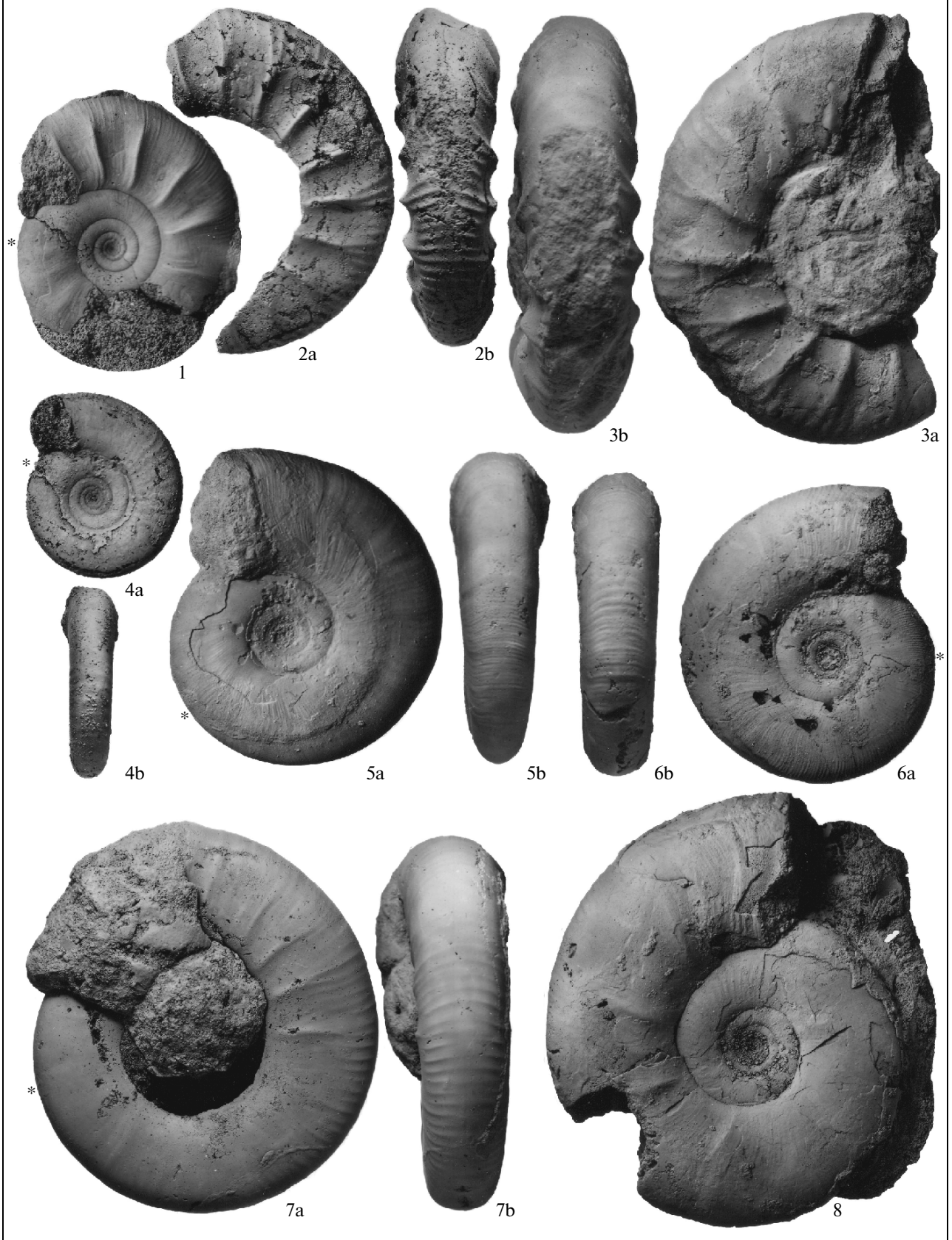
Microconchs of *K. fulgens tscheremkhensis* have less strongly developed ribbing–the stage of striated ribs is replaced in adults by a stage of long primary ribs with numerous intercalating filamentous ribs (Pl. 2, figs. 6, 7). Macroconchs of *K. fulgens* are distinguished by higher whorls with a moderately wide umbilicus. Molds are smooth (Pl. 3, fig. 5), whereas ornamentation on the shell is striated (Pl. 2, fig. 5), with sparsely spaced primary ribs developed in adults (Pl. 2, fig. 8).

Morphological differences of macro- and microconchs of *K. subfulgens* are observed from a diameter over 60 mm. The shells of macroconchs are larger, slightly more compressed, but their shape is generally very similar to that of macroconchs of *K. fulgens*. The umbilicus is moderately narrow in macroconchs (considerably widening on the body chamber) and moderately wide in microconchs. The ornamentation of macroconchs is striated, with sparsely spaced, weakly pronounced primary ribs, noticeable on the molds only in the umbilical region as elongate nodes. In microconchs, such nodes, which are curved orad, give rise to several weakly curved crescentic ribs in the lower third of the flanks of the body chamber, whereas the striated ornamentation persists.

As in *Craspedites*, differences between microconchs in different species of *Kachpurites* are much strongly pronounced than in macroconchs. This distinguishes Craspeditidae from most Jurassic ammonites, in which the rate of morphological changes in microconchs is lower than that in macroconchs.

The stratigraphic relationships of the taxa in question are not quite clear. I observed these ammonites

Plate 2



both separately from each other in different sections, and together, in more or less condensed beds, where the succession of species is difficult to inetpret. On the other hand, *K. subfulgens* is found in association with *Craspedites nekrassovi* Prigorovsky; the latter species being proposed as an index species of the upper subzone of the *fulgens* zone (Baraboshkin, 1999). The species *K. fulgens* when found separately from *K. subfulgens* is found in association with earlier *Craspedites* (*C. fragilis* and others); hence this species should be geochronologically older. Presumably, macroconchs of kachpuritids evolved toward increase in size, a more strongly compressed shell, a narrower umbilicus and smoothening of ornamentation.

Two ammonites of the family Craspeditidae are described from the vicinity of Rybinsk (Cheremukha River, near the village of Seltso-Voskresenskoe)—*Volgidiscus singularis* Kiselev (Kiselev, 2003, p. 60, pl. 26, figs. 1–8) and *Anivanovia mola* Kiselev (Kiselev, 2003, p. 61, pl. 26, figs. 9, 10; pl. 27, figs. 1–4). The genus *Anivanovia* Kiselev, represented by the type species only is characterized according to its author by a large shell of "macroconch kind", with compressed, high whorls and a rounded venter; The ornamentation is weak, and is smoothened completely in adults. "The genus *Subcraspedites* Spath is genetically close, possibly ancestral to the new genus" (Kiselev, 2003, p. 61). The description of the type species states that the intermediate whorls (50–70 mm) possess straight or slightly curved tripartite ribs with commonly developed intercalating ribs. The intercalation is developed in the mid-flank and above it.

This description is very similar to the morphology typical of *Kachpurites*, whereas illustrations in pl. 27, figs. 1–4, and pl. 26, fig. 9 (Kiselev, 2003) strongly resemble macroconchs of *Kachpurites subfulgens* differing only by more strongly compressed and involute whorls and hence a narrower umbilicus; these differences are only essential for delineation of species within the genus. Therefore I consider *Anivanovia* Kiselev, 2003 as a junior subjective synonym of *Kachpurites* Spath, 1924, and the species *Kachpurites mola* (Kiselev) to be a descendant of *K. subfulgens*.

The holotype of *Volgidiscus singularis* (Kiselev, 2003, pl. 26, figs. 4, 5) ("shell of microconch kind, medium-sized", suboval in cross section, with long primary ribs subdividing into three or four branches with intercalating ribs in between), is apparently a microconch of *Kachpurites mola*. One of the paratypes of "*Volgidiscus singularis*" (Kiselev, 2003, pl. 26, fig. 6), possessing bipartite and tripartite ribs, alternating with intercalating ribs can also be identified as *Kachpurites* cf. *mola*.

The other paratypes of *Volgidiscus singularis* are readily distinguished from the above specimens of the type series by much more densely spaced primary ribs and in general by a more pronounced ornamentation. Such shells are typical of *Craspedites krylovi* Prigorovsky, also described from the Jurassic in the Rybinsk Region. This species (Prigorovsky, 1907, p. 494, pl. X, fig. 11—holotype by monotypy) has not been redescribed. *C. krylovi* is distinguished from other *Graspedites*, mainly by bipartite and tripartite ribs, which are comparatively thin and evenly prominent along the entire whorls. Such ribs, judging from the description and figures, are observed among the paratypes of "*Volgidiscus singularis*" figured by Kiselev (2003) on pl. 26, figs. 1–3, 8. These ammonites are more similar to craspeditids than to *Volgidiscus*, and most likely belong to *Craspedites krylovi*. Small differences are readily explained by the intraspecific variability. In *Volgidiscus*, according to the author of the genus (Casey, 1973), the ribbing on the body chamber is smoothened in the upper flank and on the venter.

Text-fig. 3 shows photographs of the holotype of *Craspedites krylovi* found in a bed of "compact ferruginous sandstone in association with *Oxynot. catenulatum* Fisch., *Crasped. subditus* Traut." (Prigorovsky, 1907, p. 498) and its possible macroconch *C. subditus* (Trautschold), found by Prigorovsky loose, but composed of a similar variously grained ferruginous compact sandstone. These ammonites come from an outcrop which is currently flooded by the Rybinsk Lake on the left bank of the Volga River near the village of Kamenik upstream of Rybinsk. In the same paper Prigorovsky described more *Graspedites*, but from the

Explanation of Plate 2

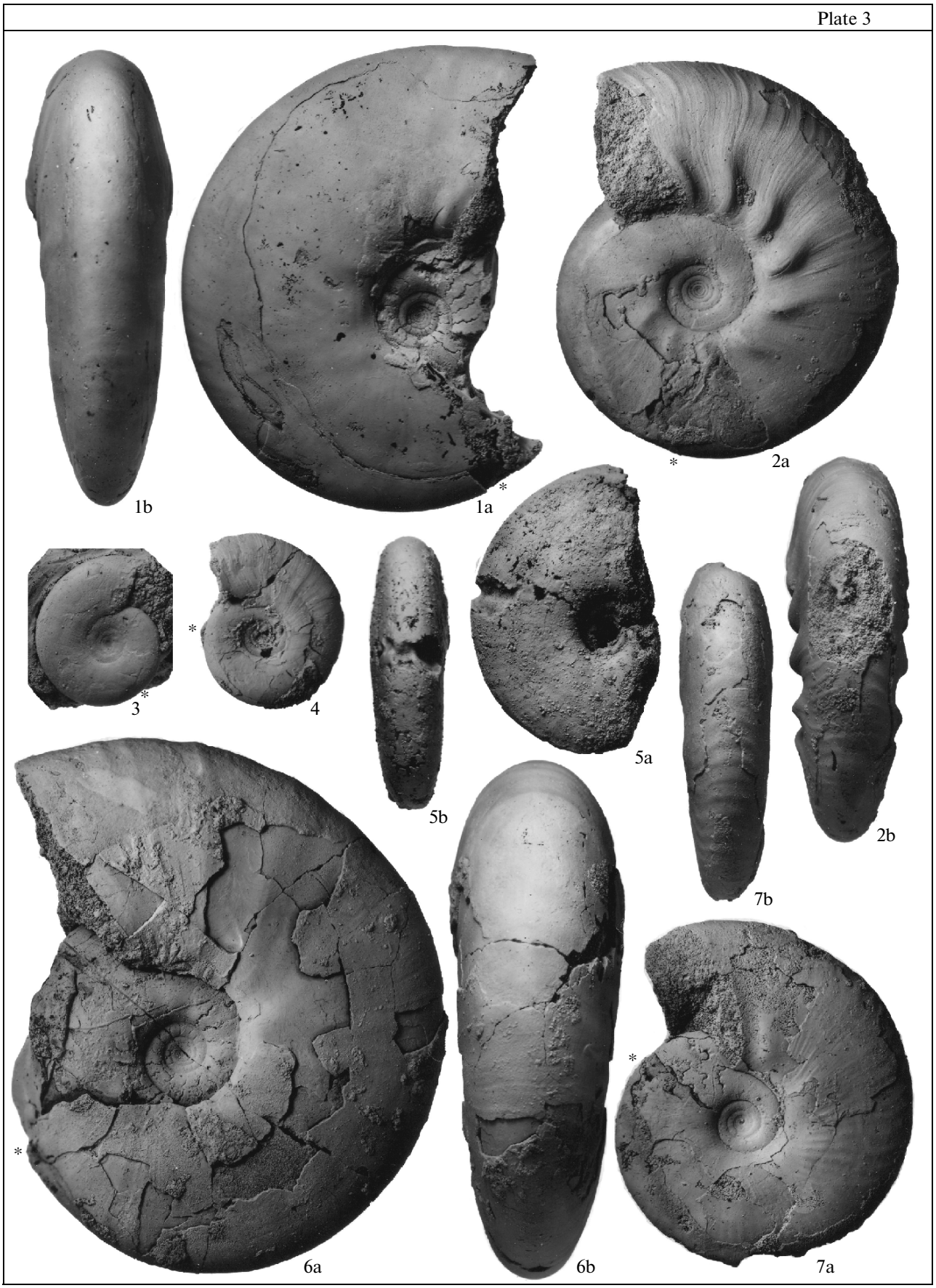
All figures are of natural size; asterisk (*) marks the beginning of the body chamber.

Figs. 1–4. *Kachpurites fulgens fulgens* (Trautschold): (1) plaster cast of the imprint of a microconch with a preserved beginning of the body chamber, lateral view, specimen GGM, no. II-98/264; (2) body chamber of a microconch, specimen PIN, no. 3990/342: (2a) lateral view, (2b) ventral view; (3) body chamber of a microconch, specimen PIN, no. 3990/341: (3a) lateral view, (3b) ventral view; (4) a shell with a complete body chamber and preserved aperture, specimen PIN, no. 3990/308: (4a) lateral view, (4b) ventral view.

Figs. 5–8. *Kachpurites fulgens tscheremkhensis* Mitta, I. Mikhailova et Sumin: (5) specimen GGM, no. II-98/284, macroconch with a preserved aperture: (5a) lateral view, (5b) ventral view; (6) specimen GGM, no. II-98/258, microconch with a preserved aperture: (6a) lateral view, (6b) ventral view; (7) holotype PIN, no. 3990/225, microconch with a preserved aperture: (7a) lateral view, (7b) ventral view; (8) specimen GGM, no. II-98/303, macroconch with a lifetime injury in the ventrolateral region, near the aperture, lateral view.

All from the *Kachpurites fulgens* Zone, Upper Volgian; (1, 5, 6, 8) Yaroslavl Region, Rybinsk District, bank of the Volga River, near the village of Kamenik, collected by M.M. Prigorovsky; (2, 4) Moscow Region, quarry of the Lopatin phosphorite mine, (3) Samara Region, Volga River near the village of Kashpir, (7) Yaroslavl Region, Cheremukha River, near the village of Popovskoe, collected by V.V. Mitta.

Plate 3



fulgens Zone—"from the sandstone bed with phosphate nodules, along with *Oxynoticeras fulgens* Traut.", including *Craspedites nekrassovi* Prigorovsky and *C. jugensis* Prigorovsky. The cited and figured specimens are housed in GGM RAN. In addition the same collection contains several drawers of material collected by the same author, from the same locality. The study of all these specimens showed that ammonites can be subdivided into two groups based on their preservation and matrix:

(1) Specimens with a preserved shell or with remains of nacre, in phosphorite sandstone nodules—*C. jugensis* Prigorovsky, *C. nekrassovi* Prigorovsky, *C. okensis* var. *crassa* Prigorovsky, *Kachpurites fulgens fulgens* (Trautschold), *K. fulgens tscheremkhensis* Mitta et al., *K. subfulgens* (Nikitin), *Garniericeras catenulatum* (Fischer); these ammonites are very similar in their preservation and taxonomic composition to ammonites from the *fulgens* Zone on the Cheremukha River near the villages of Ivanovskoe and Popovskoe.

(2) Specimens in reddish-brown, very variously grained sandstone are represented by molds and imprints, usually deformed or represented by fragments *Craspedites* cf. *nodiger* sensu Prigorovsky [=*C. subditus* Trautschold], *C. krylovi* Prigorovsky, *Kachpurites mola* (Kiselev), *Garniericeras* aff. *subclypeiforme* (Milachewitsch); in matrix and partly in taxonomic composition they resemble ammonites from the Cheremukha River near the village of Seltso-Voskresenskoe.

The series of variously grained sands, sandstones, and gravelites is not local but is more widespread than it was interpreted to be by Kiselev. Shchurovsky (1878) noted on the left bank of the Volga River upstream of Rybinsk outcrops of similar rocks in the region of the village of Kamenik. Later these and similar outcrops on the right bank of the Volga River (near villages of Krutets, Gorodok, and L'govets) were studied by Nikitin (1884). According to Nikitin, these sections contain "sands with dark phosphoritic nodules containing a vast quantity of excellently preserved ammonites... *Oxynoticeras fulgens* Trauts., *Olcostephanus subditoides* Nik., *Oxynoticeras subfulgens* Nik., *Olcostephanus fragilis* Trauts., *Olcostephanus okensis* d'Orb." (pp. 20, 21). These are overlain by a series of "hard red ferruginous sandstone" with *"Olcostephanus subditus* Trauts., *Oxynoticeras catenulatum* Fisch.", upward in the section replaced by yellow sand.

Gerasimov in 1934 had made the last description of the section near the village of Kamenik before it was flooded by the Rybinsk Lake. Gerasimov (1969, pp. 10–11) noted the presence of "yellowish–gray variously grained sand and loosely cemented sandstone (3–3.5 m) of the *Kachpurites fulgens* Zone with nodules of sandy phosphorite and many excellently preserved shells of *Kachpurites fulgens* (Traut.), *K. subfulgens* (Nik.), *Craspedites okensis* (d'Orb.), *C. nekrassovi* Prig., *C. fragilis* (Traut.), *C. krylovi* Prig., *Garniericeras catenulatum* (Fisch.), *C. interjectum* (Nik.). These rocks are overlain by the *Craspedites subditus* Zone with a total thickness of ca. 8 m mainly represented by brownish–yellow coarsely-grained sand with infrequent "pebbles of quartz up to 5–10 mm in diameter", in places strongly ferruginous, with several beds almost a meter thick of ferruginous sandstone. "The series contains throughout inner molds of *Craspedites subditus* (Traut.), *C. okensis* (d'Orb.), and *C. subditoides* (Nik.)". The record of *C. krylovi* from the *fulgens* Zone is apparently erroneous. Gerasimov (1969, p. 92) while describing *C.* cf. *krylovi* wrote: "I have in my possession only one insufficiently well preserved ammonite similar to the figure of *Craspedites krylovi* in Prigorovsky's paper", and records that this specimen comes from the outcrop near the village of Ivanovskoe of the Rybinsk Region (Cheremukha River). The plate shows two specimens, from an outcrop near the village of Ogarkovo on the Unzha River (Gerasimov, 1969, pl. XXXI, figs. 5, 6), which are readily distinguished from *C. krylovi* by their coarse ornamentation and wide whorls.

The lithology of the sections on the banks of the Volga River upstream of Rybinsk is completely identical to that of the Upper Volgian section on the Cheremukha River. The outcrops of sands and loose sandstones with numerous fossils of the *fulgens* Zone are well-known near the villages of Ivanovskoe and Popovskoe (for description see Mitta et al., 1999); ammonites are found in the sandy phosphorite nodules and are very well preserved, with a nacreous layer. Upstream of the river, near the village of Seltso-Vosk-

Explanation of Plate 3

All figures are of natural size; asterisk (*) marks the beginning of the body chamber.

Figs. 1, 2, 4, 6, 7. *Kachpurites subfulgens* (Nikitin): (1) specimen GGM, no. II-98/254, macroconch, body chamber with a plaster cast of inner whorls: (1a) lateral view, (1b) ventral view; (2) specimen GGM, no. II-98/260, microconch, body chamber with a plaster case of inner whorls: (2a) lateral view, (2b) ventral view; (4) specimen GGM, no. II-98/303a, lateral view; (6) specimen GGM, no. II-98/250, macroconch with an aperture broken off: (6a) lateral view, (6b) ventral view; (7) specimen GGM, no. II-98/249, macroconch an apertural edge partly preserved: (7a) lateral view, (7b) ventral view; Yaroslavl Region, Rybinsk District, left bank of the Volga River, near the village of Kamenik, collected by M.M. Prigorovsky.

Fig. 3. *Kachpurites fulgens tscheremkhensis* Mitta, I. Mikhailova et Sumin, paratype PIN, no. 3990/347, lateral view; Yaroslavl Region, Cheremukha River, near the village of Popovskoe, collected by V.V. Mitta.

Fig. 5. *Kachpurites fulgens fulgens* (Trautschold), macroconch, specimen PIN, no. 3990/306, phragmocone: (5a) lateral view, (5b) ventral view; Moscow Region, quarry of the Lopatin phosphorite mine, collected by V.V. Mitta.

All from the Volgian Stage, *Kachpurites fulgens* Zone.

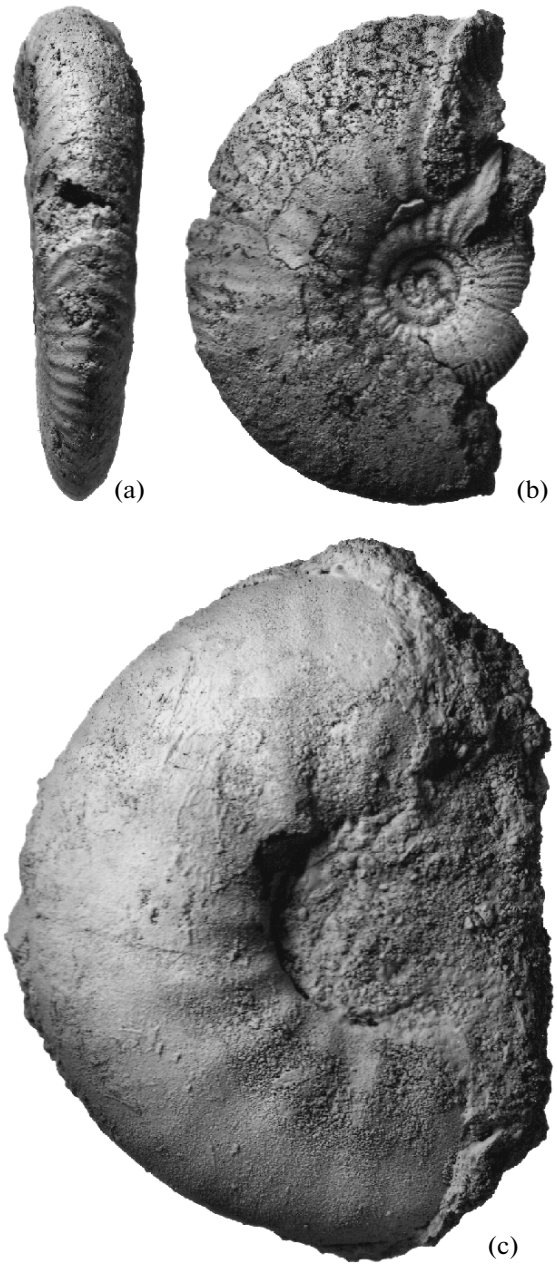


Fig. 3. Volgian *Craspedites*: (a, b) *C. krylovi* Prigorovsky, holotype GGM, no. VI-38/8, microconch, represented by a body chamber with an aperture and a plaster cast of inner whorls, ventral view and lateral view; (c) *C. subditus* (Trautschold), specimen GGM, no. VI-38/9, body chamber of a macroconch, lateral view [described by Prigorovsky (1907, p. 500) as *Craspedites* cf. *nodiger* Eichw.]. Yaroslavl Region, village of Kamenik on the Volga River; collected by M.M. Prigorovsky.

resenskoe, there are exposed "beds with *singularis*" represented by compact ferruginous sandstone, with inner molds of ammonites. Ferruginous sandstone from the Cheremukha River with "*Volgidiscus singularis* and *Anivanovia mola*" is a complete equivalent of a similar bed on the Volga River with *Craspedites subditus* and others. The discovery of specimens of *Kachpurites mola* in the collections of Prigorovsky from the outcrop near the village of Kamenik identical in rock matrix to the specimens from the section near the village of Seltso-Voskresenskoe is an additional piece of evidence.

Finally, all specimens figured as *Anivanovia mola* Kiselev, 2003, and the holotype of *Volgidiscus singularis* Kiselev, 2003, belong to the same species of *Kachpurites*—apparently the last representative of this genus. The specific name *singularis* has been used many times for various craspeditids (*Craspedites singularis* Schulgina, *Praetollia singularis* Alekseev). Therefore, under the First Reviser rule, I propose that this species is named *Kachpurites mola*. Some paratypes of "*Volgidiscus singularis*" are synonymised under *Craspedites krylovi* Prigorovsky,—species characterizing the lower horizons of the *subditus* Zone. Hence, beds with *Kachpurites mola* are also found in the basal part of the *subditus* Zone, and can be recognized as the lower faunal horizon of this zone.

ACKNOWLEDGMENTS

I was assisted in my field work on the Cheremukha River by A.V. Stupachenko (Moscow), and my friends from Germany O. Nagel (Radeberg), V. Pirkl (Gerlingen), S. Gräbenstein (Bodelshausen). I.A. Starodubtseva and M.N. Kandinov helped in examining the collections. Photographs are provided by V.T. Antonova (Paleontological Institute, Russian Academy of Sciences). T.B. Leonova made helpful comments on the manuscript. I am very grateful to all the above people. The study is supported by the Program of the Presidium of the Russian Academy of Sciences "Origin of the Biosphere and Evolution of Geobiological Systems", project "Geobiological events in the evolution of pelagic biota based on cephalopods and radiolarians."

REFERENCES

1. E. J. Baraboshkin, "Berriasian–Valanginian (Early Cretaceous) Seaways of the Russian Platform Basin and the Problem of Boreal/Tethyan Correlation," Geol. Carpath. **50** (1), 5–20 (1999).
2. R. Casey, "The Ammonite Succession at the Jurassic–Cretaceous Boundary in Eastern England," in *The Boreal Lower Cretaceous: Geol. J. Spec. Issue no. 5*, Ed. by R. Casey and P. F. Rawson (Seel House Press, Liverpool, 1973), pp. 193–266.
3. P. A. Gerasimov, *Upper Substage of the Volgian Stage of the Central Russian Platform* (Nauka, Moscow, 1969) [in Russian].
4. H. Keupp, *Ammoniten. Paläobiologische Erfolgsspiralen* (Stuttgart: Thorbecke Species, 2000).
5. D. N. Kiselev, "Sel'tso-Voskresenskoe," in *Atlas of Geological Monuments in the Yaroslavl Region* (Izd. Yarosl. Gos. Pedag. Univ., Yaroslavl, 2003), pp. 58–62 [in Russian].

6. D. N. Kiselev and M. A. Rogov, "Infrazonal Stratigraphy and Ammonites of the Middle-Upper Volgian Boundary Deposits of European Russia," in *Jurassic System of Russia: Problems of Stratigraphy and Paleogeography* (Geol. Inst. Ross. Akad. Nauk, Moscow, 2005), pp. 135–139 [in Russian].
7. V. V. Mitta, *Ammonites and Zonal Stratigraphy of the Middle Volgian Deposits of Central Russia* (Geoprognoz, Kiev, 1993) [in Russian].
8. V. V. Mitta, I. A. Michailova, and D. L. Sumin, "Unusual Volgian Scaphitoid Ammonites from Central Russia," Paleontol. Zh., No. 6, 13–17 (1999) [Paleontol. J. **33** (6), 13–17 (1999)].
9. V. V. Mitta and I. A. Starodubtseva, "Hermann Trautschold and His Contribution to the Study of the Jurassic of Central Russia," Vernadsky Mus.-Novit. **10**, 1–35 (2002).
10. S. N. Nikitin, "Jurassic Deposits between Rybinsk, Mologa, and Myshkin," in *Matherials for Geology of Russia* (Imp. S.-Peterb. Miner. Ob-vo, St. Petersburg, 1881), Vol. 10, pp. 201–331 [in Russian].
11. S. N. Nikitin, "General Geological Map of Russia. Sheet 56: Yaroslavl, Rostov, Kalyagin, Ves'egonsk," Tr. Geol. Kom. **1** (2), 1–153 (1884).
12. M. M. Prigorovsky, "New Data on Ammonites of Groups *Olcostephanus okensis* (*Craspedites* Pavl. et Lampl.) from Yaroslavl Province," Zap. S.-Peterb. Miner. Ob-va **44** (2), 483–506 (1907).
13. C. Rouillier, A. Vosinsky, and A. Fahrenkohl, "Études progressives sur la géologie de Moscou. Cinquième étude," Bull. Soc. Nat. Moscou **22** (2), 356–399 (1849).
14. I. G. Sazonova, "Berriasian and Lower Valanginian Ammonites of the Russian Platform," *Tr. Vses. Nauchno-Issled. Geol. Razved. Neft. Inst.*, (Moscow), Tr. VNIGNI **110**, 3–110 (1971).
15. I. G. Sazonova, "Ammonites of the Boundary Beds Jurassic and Cretaceous Systems of the Russian Platform," Tr. VNIGNI **185**, 1–97 (1977).
16. G. E. Shchurovsky, "Excursion to the Moscow, Kaluga, and Yaroslavl Provinces," Izv. Imp. Ob-va Lyubit. Estestvozn., Antropol. i Etnogr. **33** (2), 443–461 (1878).
17. I. I. Shulgina, *Boreal Basins at the Jurassic–Cretaceous Boundary* (Nedra, Leningrad, 1985) [in Russian].
18. L. F. Spath, "On Ammonites from New Zealand," Quart. J. Geol. Soc. Lond. **79**, 286–312 (1923).
19. L. F. Spath, "On the Blake Collection of Ammonites from Kachh, India," Mem. Geol. Surv. India, Paleontol. Indica, N. S. **9** (Mem. 1), 1–29 (1924).
20. L. F. Spath, "Additional Observations on the Invertebrates (Chiefly Ammonites) of the Jurassic and Cretaceous of East Greenland. 1. The *Hectoroceras* Fauna of S.W. Jameson-Land," Medd. Grønland. **132** (3), 1–69 (1947).
21. H. Trautschold, "Recherches géologiques aux environs de Moscou. Le grès de Katelniki," Bull. Soc. Nat. Moscou **31** (4), 546–560 (1858).
22. H. Trautschold, "Recherches géologiques aux environs de Moscou. Fossiles de Kharachovo et supplement," Bull. Soc. Nat. Moscou **34** (3), 267–276 (1861).
23. H. Trautschold, "Zur Fauna des Russischen Jura," Bull. Soc. Nat. Moscou **39** (1), 1–24 (1866).
24. C. W. Wright, J. H. Callomon, and M. K. Howarth, *Treatise on Invertebrate Paleontology, Pt L, Mollusca 4, Rev.*, Vol. 4: *Cretaceous Ammonoidea* (Geol. Soc. Am. and Univ. Kansas Press, Boulder–Lawrence, 1996).
25. V. A. Zakharov and M. A. Rogov, "The Upper Volgian Substage in Northeast Siberia (Nordvik Peninsula) and Its Panboreal Correlation Based on Ammonites," Stratigr. Geol. Korrelyatsiya **16** (4), 81–94 (2008) [Stratigr. Geol. Correlation **16** (4), 423–436 (2008)].