ISSN 0031-0301, Paleontological Journal, 2008, Vol. 42, No. 3, pp. 251–259. © Pleiades Publishing, Ltd., 2008.
Original Russian Text © V.V. Mitta, 2008, published in Paleontologicheskii Zhurnal, 2008, No. 3, pp. 30–37.

Ammonites of Tethyan Origin from the Ryazanian of the Russian Platform: Genus *Riasanites* Spath

V. V. Mitta

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

Received April 27, 2007

Abstract—The genus *Riasanites*, represented in Central Russia by two successive dimorphic species, is revised. *R. swistowianus* is found in the basal beds of the *rjasanensis* Zone. Its descendant *R. rjasanensis* is also found in this zone, but upwards in the section, including the beds with *Surites spasskensis* and *Externiceras solowaticum.* The representatives of *Riasanites* from the Crimea and Northern Caucasus are assigned to two species, *R. crassicostatus* and *R. maikopensis*, respectively. It is suggested that *Riasanites* evolved from Sub-Mediterranean Himalayatidae, which migrated from the Western Tethys via the Polish Passage into the Central Russian Basin, and from there to Mangyshlak, the Northern Caucasus, and the Crimea.

DOI: 10.1134/S0031030108030052

Key words: ammonites, genus *Riasanites*, Tethyan Region, Ryazanian, Russian Platform.

INTRODUCTION

Of the taxa of Tethyan origin that had migrated to the Central Russian Basin as a result of transgression at the Jurassic–Cretaceous boundary, the members of the genus *Riasanites* Spath were the first ammonites described from Central Russia. *Riasanites* and related ammonitids are very important both for Boreal-Tethyan correlations of the Jurassic–Cretaceous boundary beds, and for systematics of Perisphinctidae at one of the major stages of the evolution of this group. Nevertheless, the study of *Riasanites* in their type region has been restricted to three publications, two of which date from the end of the 19th century. This paper presents a revision of *Riasanites* of the Russian Platform based on the material from the Moscow and Ryazan regions.

HISTORICAL BACKGROUND

The history of studies of *Riasanites* and related ammonites formally began in 1883 when I.I. Lahusen listed the species "*Ammonites Rjasanensis* Wenetzky" among the fossils in the Ryazan region. He identified specimens from Wenetzky's (1868) collection in the Geological Cabinet of St. Petersburg University as belonging to *Rjasanensis*, which had been known to be characteristic of the so-called "*Aucella* Sandstone" of the Oka River basin (these specimens had labels with this name) (Lahusen, 1883, p. 6).

In the systematic part of his monograph Lahusen (1883, p. 69) first wrote "I do not give a characterization of this form, because I list here only all known forms from the *Aucella* Sandstone from the Ryazan Region, while a description of the new forms from this horizon will be given by S.N. Nikitin, as he specifically studied the forms from the *Aucella* beds of the Moscow Basin"[1] and then listed the localities for this species. Later, Nikitin (1888) listed three species of the *"Hoplites rjasanensis"* group from the Ryazan Region, under the names *H. rjasanensis* Lahusen, *H. subrjasanensis* sp. nov., and *H. swistowianus* sp. nov. Nikitin considered this horizon with ammonites (currently *Riasanites rjasanensis* Zone) to be equivalent to beds with *Perisphinctes virgatus* (= Middle Volgian Substage) in the Jurassic of the Moscow Basin. Krischtafowitsch (1892a, 1892b) in small papers attempted to explain the real position of this horizon (above the beds with *Craspedites nodiger*, i.e., the top of the Upper Volgian) based on the material from Moscow. However, after strong criticism from Nikitin he abandoned this subject. A few years later N.A. Bogoslowsky confirmed the accuracy of Krischtafowitsch's assumption when he discovered that the so-called Ryazanian Horizon (which he had recognized in the Oka River basin and which is currently a basal stage in the Cretaceous in the Boreal Region) overlies different horizons of the Jurassic, from the Oxfordian to Upper Volgian, inclusive. In the systematic part of his monograph, Bogoslowsky (1896) described and redescribed many ammonite taxa of both Boreal and Tethyan origin, including three of Nikitin's species presently assigned to the genus

[1] This citation is quoted here deliberately, because of the existing confusion regarding the name of the species *Riasanites rjasanensis.* Some workers attribute the authorship of the species to Wenetzky, some to Lahusen or Nikitin. Wenetzky is the author of the name "in coll.," while Lahusen was the first to publish this name, but as a "nomen nudum." According to the Code of Zoological Nomenclature, Nikitin is the author of the specific name *rjasanensis*, as he was the first to publish its description and illustrations.

Riasanites. After a long gap in the monographic studies of this group in the Russian Platform, Sasonova (1977) redescribed Nikitin's species and added a new species *Riasanites decorus* Sasonova to the list. Sasonova recognized a variation *R. rjasanensis* var. *maikopensis* described by Grigorieva (1938) from the Northern Caucasus as a separate species and later designated it (Sasonova and Sasonov, 1991) as the type species of a new genus *Subriasanites*. She also established a new genus *Prorjasanites*, which included two species, each based on a single specimen less than 30 mm in diameter. The above list covers all studies of *Riasanites* from Central Russia, except for the records in the lists of fossils in stratigraphic papers.

Ammonites identified as belonging to *Riasanites* have been recorded and/or described from various regions of the globe, from the Crimea, Mangyshlak, and Northern Caucasus to Saudi Arabia, Mexico, and Argentina. Most of these records are difficult to evaluate without seeing the collections. Therefore, I restrict this paper to the regions closest to the Russian Platform.

Undeniable representatives of *Riasanites* are described from Mangyshlak in the monograph *Berriasian of Mangyshlak* (Luppov et al., 1988). Only on one occasion (ammonites described as *Riasanites* ex gr. *subrjasanensis* (see Luppov et al., 1988, pl. 8, figs. 6, 8)) was the assignment to this genus incorrect. In the same paper Luppov described *R. bogoslowskii* Luppov sp. nov., based on "Hoplites sp. indeterm. E" previously described by Bogoslowsky (1896, pl. 6, fig. 6) as a holotype and on a similarly poorly preserved fragment from Mangyshlak as a paratype. The genus *Tauricoceras* Kvantaliani et Lyssenko (Kvantaliani and Lyssenko, 1979), described from the Berriasian of the Crimea was reassigned by Sey and Kalacheva (see Kolpenskaya et al., 2002) to *Riasanites*, because *T. crassicostatum*, the type species of the genus *Tauricoceras*, is very similar to coarsely ribbed macroconchs of *Riasanites*. The remaining three species of *Tauricoceras* were described by Kvantaliani and Lyssenko (1982) based on the total of five small specimens, which apparently mainly belong to microconchs. Unfortunately, the original descriptions lack information on the shape of the aperture and the length of the body chamber.

The species of *Riasanites* of the Northern Caucasus have recently been described by Sey and Kalacheva in the above-mentioned monograph on the Berriasian of the Northern Caucasus, containing also the synonymy of the Northern Caucasian species. Sey and Kalacheva included the following species in the genus *Riasanites*: *R. rjasanensis, R. swistowianus, R. subrjasanensis, ?R. decorus, R. angulicostatus*, and *R. proprius.* The species *R. angulicostatus* (Kvantaliani et Lyssenko, 1982) was originally established in the Crimea and assigned to *Tauricoceras*. The species *R. proprius* (Sacharov) was originally assigned to the genus *Cechiceras* Sacharov, 1982. All the above species, except *R. decorus*, were reexamined and redescribed by Sey and Kalacheva from the Northern Caucasus. It was suggested that *R. swistowianus* described by them based on two juvenile specimens less than 30 mm in diameter first appeared in the upper part of the stratigraphic range of *Riasanites*. The species *R. rjasanensis caucasicus* Khimshiashvili, 1976 was synonymized by Sey and Kalacheva with *R. rjasanensis.* The species *R. densicostatus* Khimshiashvili, 1976 was not discussed.

The above shows that the history of studies of *Riasanites* of the Russian Platform and adjacent regions is quite simple, and the number of known species is not large. Below the taxonomic position of this genus in the system of Ammonoidea. Spath (1923) proposed the name *Riasanites* gen. nov. for the "*Hoplites rjasanensis* (Lahusen) group," referring to an illustration by Bogoslowsky (1896, pl. 5, figs. 3, 4). This genus was assigned in both editions of *Treatise…* (Arkell, 1957; Wright et al., 1996) to the subfamily Berriasellinae Spath, 1922 (currently in the family Neocomitidae Salfeld, 1921). The taxonomy of this family is very uncertain, and in the opinion of some workers (Donovan et al., 1981) could even be considered as chaotic. The above-mentioned paper (Donovan et al., 1981) does not exclude a possibility that *Riasanites* evolved from the Boreal Dorsoplanitidae ("Pavloviinae"). The majority of workers assign *Riasanites* to Berriasellinae (Neocomitidae) and accept their Northern Caucasian origin.

MATERIAL

The revision of *Riasanites* in this paper is based on the present author's collection from the Moscow Region (Voskresensk District) and, to a lesser extent, Ryazan Region (Spassk, Mikhailov, and Ryzan Districts); the material was mainly collected in 2000–2006, but the first (although not systematic) collections were made in 1980. In addition, the collections housed in the museums of Moscow and St. Petersburg have been used, primarily the original material of Nikitin in the Mining Museum and of Bogoslowsky and Sasonova in the TsNIGR Museum (St. Petersburg).

The most important outcome of this revision is the reconstruction of the phylogeny of the members of *Riasanites*. All workers who have studied the *Riasanites rjasanensis* Zone stated that this zone in the Russian Platform is represented by strongly condensed sequences of small thickness. Therefore, it is virtually impossible to establish a succession of species in a single section, especially because it is known that ammonites of Tethyan origin are usually restricted to one layer, or even to part of a layer. Thus, Waagen's method, in its classical interpretation suggesting bed-by-bed collection in order to reveal actual phylogeny, is of little use in this particular case. The ontogenetic method of Hyatt (reconstruction of phylogeny based on ontogeny) is even less useful for reconstruction of such short phylogenetic lineages. Therefore, it became necessary to compare ammonoid assemblages in different sections, including analysis of common species in trenches more

than five meters apart. As material from various places and sections in the Moscow and Ryazan Regions accumulated, this approach produced results that were to some extent surprising. It was shown that different ammonites of Tethyan origin are found together with different ammonites of Boreal origin (Mitta, 2005, 2007).

The basal part of the *rjasanensis* Zone in quarry no. 12-2 of the Lopatino Mine (southeastern Moscow Region) contained numerous ammonites of Tethyan origin: *Riasanites swistowianus* (Nikitin), Himalayitidae (?) gen. et sp. nov., *Subalpinites* sp. nov., *S*. aff. *fauriensis* Mazenot, *Mazenoticeras* spp. (including *M*. cf. *urukhense* Kalacheva et Sey). Of ammonites of Boreal (Central Russian) origin, the most common are *Pseudocraspedites bogomolovi* Mitta and another species of Craspeditidae, previously unrecorded from the Russian Platform, very similar to the Late Volgian *Craspedites* and *Subcraspedites*. This occurrence also contained other ammonites (e.g., *Riasanites rjasanensis*), but these were represented by a small number of specimens.

The same interval of the section, examined in quarry no. 10, 5 km southeast of the one mentioned above, *Riasanites rjasanensis* (Nikitin) most commonly occurs in association with the Boreal *Praesurites nikitini* (Gerasimov) and *Pseudocraspedites bogomolovi* Mitta and, less commonly, together with the Tethyan *Subalpinites krischtafowitschi* Mitta, *Malbosiceras* sp., and *Mazenoticeras* sp. The ammonoid assemblage here is relatively impoverished (of other ammonites, rare *R. swistowianus* should be mentioned). The presence of *Praesurites* (genus intermediate between the Jurassic Craspeditidae and the Cretaceous Suritidae) suggest a younger age for this assemblage compared to the previously described. This is supported by *Subalpinites krischtafowitschi* that has a more advanced appearance compared to that of *Subalpinites* from quarry no. 12-2.

In the outcrops on the banks of the Oka River near the village of Nikitino in the Ryazan Region, *Riasanites rjasanensis* occurs together with numerous *Externiceras solowaticum* (Bogoslowsky) and similar forms, and with *Surites spasskensis* (Nikitin). The latter species is also found in the quarries of the Lopatino Mine, but upward of the section of *Riasanites*. *Riasanites rjasanensis* is represented there (in the Ryazan Region) by another, apparently younger morph than in the Moscow Region. This occurrence also contained other ammonites, not found in the Moscow Region *Transcaspiites transfigurabilis* (Bogoslowsky), *"Berriasella" rulevae* Mitta, and others (see Mitta, 2007).

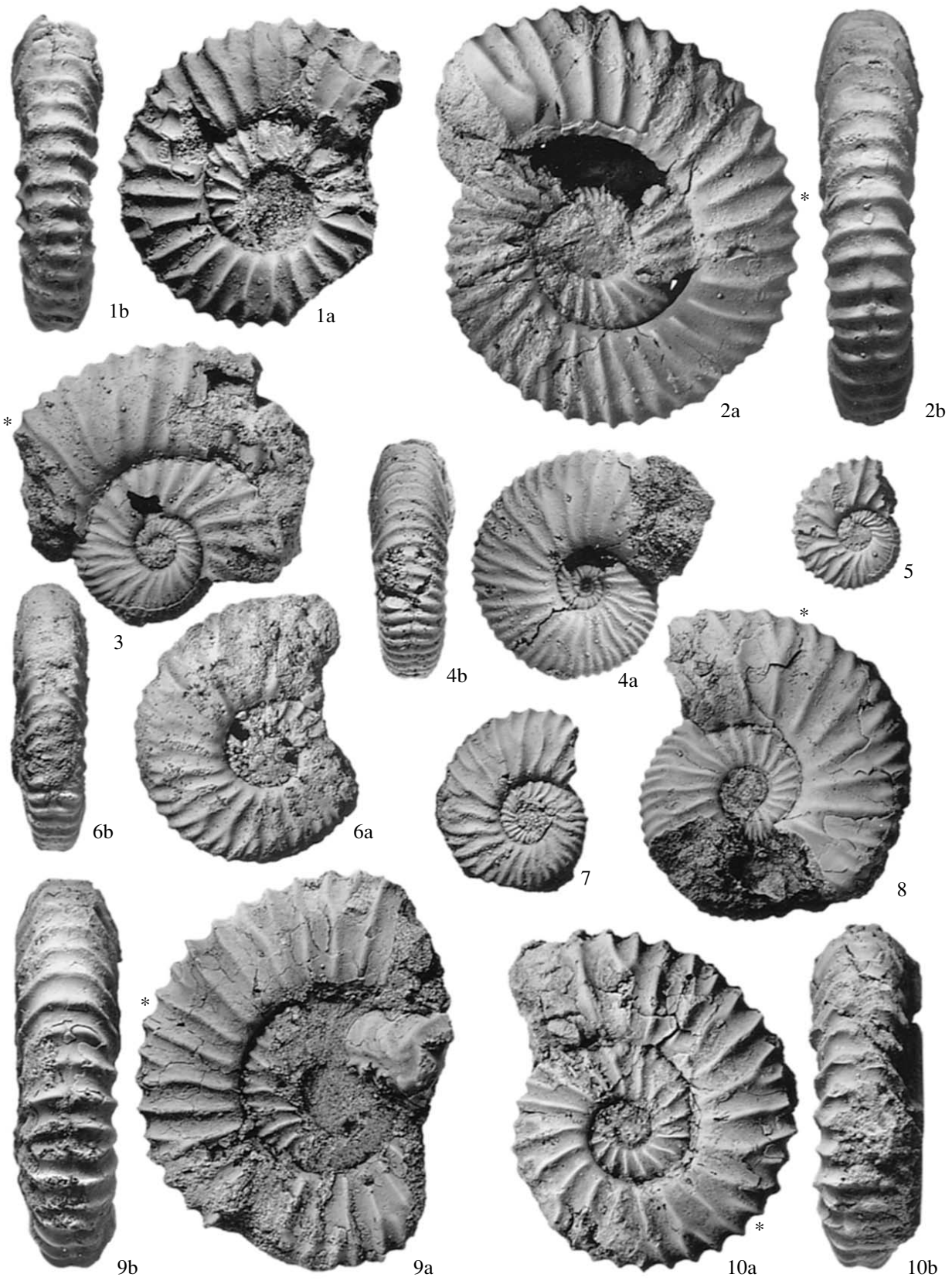
The data obtained from the above three localities are supported by data from other sections in the Moscow and Ryazan regions, as yet not studied as thoroughly. The above differences in the compositions of the ammonite assemblages cannot be explained by geographical factors, as all sections studied are situated within 200 km of one another. The only plausible explanation is the heterochrony of these assemblages. The chronology of these assemblages is chiefly based on the data from the ammonites of Boreal origin, because their taxonomy and phylogeny are far better studied compared to the Tethyan ammonites. The following succession of *Riasanites* has been revealed. *R. swistowianus* ⟶ *R. rjasanensis* morph α ⟶ *R. rjasanensis* morph β. The initial morph α of the latter species is characteristic of the Moscow Region, whereas the terminal morph (β) is typical of the type region in the Ryazan Region. In the outcrop near the village of Swistowo (type locality of *R. swistowianus*), geographically situated between the quarries of the Lopatino Mine and a group of outcrops in the area of villages Staraya Ryazan–Nikitino, both species are represented by morphotypes similar to those from the Moscow Region. A clear heterochronic condensation may be fixed in this outcrop.

It has been mentioned above that most workers consider *Riasanites* from Central Russia to have originated in the Northern Caucasus. Sasonova (1971, p. 6) wrote "here they (*Riasanites*—V.M.) are not members of the local fauna because they have no ancestors among ammonites that had inhabited the Volgian sea of the Russian Platform, they migrated to this basin from the northeastern regions of the Caucasus–Mangyshlak Basin." This opinion is shared by Sey and Kalacheva "It is unlikely that there is doubt that the Northern Caucasus is the center of distribution of these peculiar Berriasellinae, because in this region their geochronological range is the largest, the species diversity is the highest, and their genetic roots are the most likely" (Kolpenskaya et al., 2002, p. 30). However, the geochronological range, or, more precisely, the number of strata containing *Riasanites* in the Russian Platform may equal those in the Northern Caucasus (Mitta, 2006). The number of species described from different regions often depends on subjective factors (state of knowledge, view of a particular worker on the concept of species in paleontology, etc.). No real "genetic roots" of *Riasanites* are found in the Northern Caucasus or any other region. In my opinion, there are no reasons to conclude that *Riasanites* definitely originated in the Northern Caucasus.

It seems that Jeletzky (1984, p. 241) was the only scientist who had an opposite view. He suggested that *Riasanites* originated from the Oka River basin by evolving from the "Boreal *Pavlovia*-like perisphinctids", from where they spread to the Northern Caucasus and the Crimea via the Peri-Caspian and Mangyshlak, and to the west (Poland) via the Polish Passage. The weak point of this hypothesis is the absence of ancestors of *Riasanites* among the Boreal ammonites.

Presently, it is established that *R. swistowianus*, the earliest species of the genus *Riasanites*, appeared in Central Russia, and this species has not been positively recorded in any other regions. The shell morphology and ornamentation of *Riasanites* representatives indicate their "Tethyan origin." Apparently, the "Polish Passage" opened slightly earlier than was previously

Plate 5



suggested, and *Riasanites* are the first Tethyan ammonites to reach the Central Russian Basin from the Western Tethys. Judging from the absence of such forms in the Berriasian, these were direct descendants of Tithonian taxa.

Many researchers noted a striking morphological similarity between *Riasanites* and *Corongoceras* Spath from the family Himalayitidae (see photographs of *Corongoceras* Spath, originally described from the Upper Tithonian of Argentina in Parent, 2001, text-figs. 9A–9C). This similarity was a result of homeomorphy, rather than these ammonites being congeneric. In my opinion this is a case of heterochronic homeomorphy in closely related taxa, when similar shell and ornamentation repeat in the same phylogenetic lineage separated by generations of taxa. *Riasanites* is very different from synchronous Neocomitidae (*Subalpinites, Mazenoticeras*, etc.), connected by "intermediate" taxa. At the same time, *Riasanites* are most closely similar to the Late Tithonian Himalaytidae, for instance to the genus *Toucasiella*, ancestral to *Durangites* and *Protacanthodiscus* (Enay et al., 1998). Thus, based on ornamentation the assignment of *Riasanites* to the family Himalayitidae, rather than Neocomitidae, seems more reasonable. The sutures of Neocomitidae and Himalayitidae are poorly studied, and existing knowledge of sutural ontogeny is insufficient to make any inferences about the origin of *Riasanites*. The *Riasanites* species from Central Russia are described below.

SYSTEMATIC PALEONTOLOGY

Family Himalayitidae Spath, 1925

Genus *Riasanites* Spath, 1923

Riasanites: Spath, 1923, p. 306; Grigorieva, 1938, p. 93; Sasonova, 1977, p. 88; Kolpenskaya et al., 2002, p. 94.

Prorjasanites: Sasonova, 1977, c. 88.

Tauricoceras: Kvantaliani and Lyssenko, 1979, p. 629.

Subriasanites: Sasonova and Sasonov, 1991, p. 61.

Type species. *Hoplites rjasanensis* Nikitin, 1888; Ryazanian of the Russian Platform.

Diagnosis. Genus dimorphic. Dimorphic pairs recognized in species of genus. Shell small, compressed or of medium width. Whorl cross section subrectangular, with weakly convex flanks and flattened venter. Umbilicus wide. Umbilical wall short, with rounded or sloping shoulder. Body chamber in macroconchs up to three-quarters whorl. Aperture simple, with small expansion. Body chamber of microconchs at least one-half whorl, and its full length and shape unknown. Ornamentation of bipartite, simple, intercalating, less commonly tripartite, prominent ribs, decreasing on phragmocone up to the development of ventral groove.

Species composition. *R. rjasanensis* (Nikitin, 1888), *R. swistowianus* (Nikitin, 1888) (Russian Platform), *R. maikopensis* Grigorieva, 1938 (Northern Caucasus), and *R. crassicostatus* (Kvantaliani et Lyssenko, 1979) (Crimea).

Comparison. This genus is readily distinguished from simultaneously occurring genera *Mazenoticeras* and *Malbosiceras* by the rounded rectangular section of the adult whorls of macroconchs and ornamentation (ribs of *Riasanites* that are raised in the bifurcation point never become modified into hollow spines). The genus described differs from *Subalpinites*, in addition, in the more widely spaced ornamentation in young shells and in the more prominent ornamentation.

Remarks. Species from the Northern Caucasus are here assigned to one species *R. maikopensis* Grigorieva emend. Sasonova; holotype by monotypy—*R. rjasanensis* var. *maikopensis* in Grigorieva, 1938, pl. 1, fig. 2; refigured by Kolpenskaya et al., 2002, pl. 22, fig. 2. This species also includes macroconchs described by Kolpenskaya et al. (2002) as *R. rjasanensis*. Ammonites described from the Northern Caucasus as *R. angulicostatus* are partly inner whorls of the macroconchs of *R. maikopensis* and partly the microconchs of this species. Ammonites described from here as *R. proprius* (Sacharov) may belong to the extremely coarsely-ribbed form of microconch of this species. The proposal of Sasonova in Sasonova and Sasonov (1991) to recognize a separate genus *Subriasanites*, with the type species *Riasanites maikopensis* has not been accepted in the literature.

Apparently the Crimean specimens of *"Tauricoceras"* belong to one species of *Riasanites* (macro- and microconchs), which should be called *R. crassicostatus*, for reasons of priority.

Explanation of Plate 5

All figures are of natural size. Asterisk marks the beginning of the body chamber.

Figs. 1–4, 6–9. *Riasanites rjasanensis* (Nikitin): (1) specimen PIN, no. 3990/273 [M]: (1a) phragmocone, lateral view, (1b) ventral view; (2) specimen PIN, no. 3990/262 [M]: (2a) phragmocone, with partly preserved body chamber, lateral view, (2b) ventral view; (3) specimen PIN, no. 3990/274 [M], phragmocone with partly preserved body chamber, lateral view; (4) specimen PIN, no. 3990/275 [M]: (4a) phragmocone, lateral view, (4b) ventral view; (6) specimen PIN, no. 3990/277 [M]: (6a) phragmocone, lateral view, (6b) ventral view; (7) specimen PIN, no. 3990/278 [m], phragmocone, lateral view; (8) specimen PIN, no. 3990/279 [M], phragmocone with partly preserved body chamber, lateral view; (9) specimen PIN, no. 3990/280 [M]: (9a) phragmocone with partly preserved body chamber, lateral view, (9b) ventral view.

Figs. 5, 10. *Riasanites swistowianus* (Nikitin): (5) specimen PIN, no. 3990/276, topotype [m], phragmocone, lateral view; (10) specimen PIN, no. 3990/281, topotype [M], (10a) phragmocone, with partly preserved body chamber, lateral view, (10b) ventral view.

(1–4, 7) Moscow Region, Lopatino Phosphorite Mine: (1–3) quarry no. 10, (4) quarry no. 5, (7) quarry no. 12-2; rest are from the Ryazan Region, a gully near the village of Swistowo. All are from the Ryazanian, *rjasanensis* Zone.

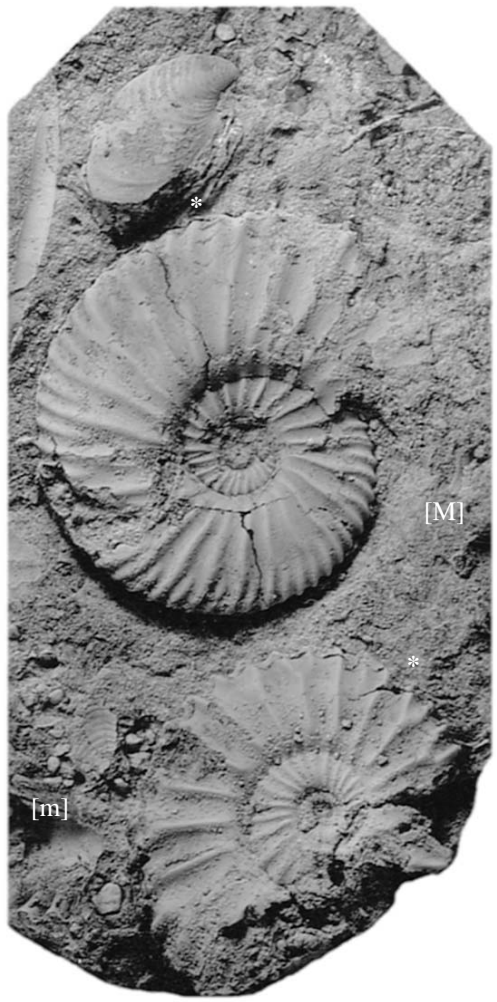


Fig. 1. Macro- and microconch of *Riasanites rjasanensis* (Nikitin) morph β, in the same piece of phosphorite sandstone, specimen PIN, no. 3990/294. Ryazan Region, bank of the Oka River downstream of the village of Nikitino; Ryazanian, *Riasanites rjasanensis* Zone, faunal assemblage with *Surites spasskensis.* The asterisk marks the beginning of the body chamber, ×0.9.

Occurrence. Ryazanian, *Riasanites rjasanensis* Zone of the Russian Platform; Berriasian of the Northern Caucasus, Crimea, and Mangyshlak.

***Riasanites rjasanensis* (Nikitin, 1888)**

Plate 5, figs. 1–4, 6–9

Hoplites rjasanensis: Nikitin, 1888, p. 91, pl. 1, fig. 1, 2; Bogoslowsky, 1896, p. 83, pl. 5, figs. 3, 5.

Hoplites subrjasanensis: Nikitin, 1888, p. 93, pl. 1, fig. 4 (?); Bogoslowsky, 1896, p. 87, pl. 5, fig. 6.

Riasanites rjasanensis: Sasonova, 1977, p. 85, pl. 18, figs. 1–3, pl. 19, figs. 1, 2, pl. 20, fig. 2; Mitta, 2007, pl. 2, fig. 1, pl. 3, figs. 3, 4.

Riasanites subrjasanensis: Sasonova, 1977, p. 86, pl. 18, fig. 4, pl. 19, figs. 5, 8, 9.

Riasanites sp.: Sasonova, 1977, pl. 20, fig. 6.

Prorjasanites plumatus: Sasonova, 1977, p. 88, pl. 19, fig. 3.

Prorjasanites vnigni: Sasonova, 1977, p. 88, pl. 20, fig. 4.

Lectotype. Mining Museum, St. Petersburg; specimen PIN, no. 1/81, figured by Nikitin, 1888, pl. 1, fig. 1; Ryazan Region, Staraya Ryazan village, Oka River; Ryazanian.

Description (Fig. 1). The shell is small, up to 80 mm in diameter. Younger whorls (up to 20–30 mm in diameter) are of medium width, quadrangular in cross section, with height slightly exceeding the width, and with a flattened venter. As the shell grows, the whorls become more compressed and quadrangular in cross section with almost parallel, flattened flanks and a flattened venter. The umbilicus is wide and open. The umbilical wall is convex or sloping. The total length of the body chamber and the shape of the aperture are unknown.

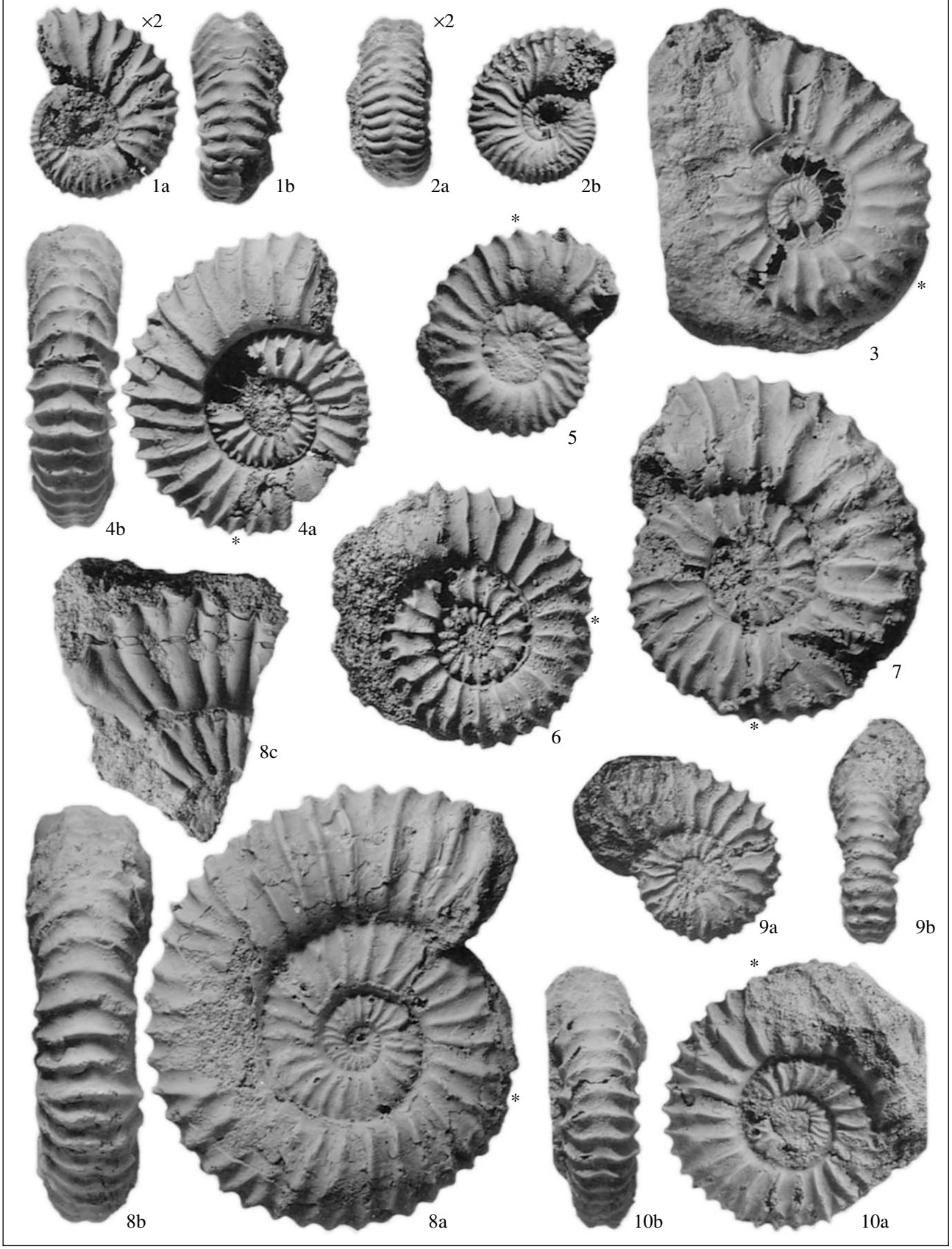
The ornamentation consists of well developed, bifurcating, simple, intercalating, and tripartite ribs. The ribs usually bifurcate in the upper third of the flanks. The anterior branches are subrectiradiate; the posterior branch is usually rursiradiate, especially strongly at early stages. The branching coefficient (ratio of the number of the secondary and primary ribs per half-whorl at the end of the phragmocone—beginning of the body chamber) is more than 1.6. In the mid-flanks of the early whorls, the ribs are interrupted, with a ventral groove formed. At the intermediate stages, the ribs become lower. On the body chamber, this lowering is either developed only slightly or completely absent.

Explanation of Plate 6

All figures are of natural size, except of specially marked. Asterisks mark the beginning of the body chamber.

Figs. 1–10. *Riasanites swistowianus* (Nikitin): (1) specimen PIN, no. 3990/282 [m]: (1a) juvenile whorls, lateral view, (1b) ventral view, ×2; (2) specimen PIN, no. 3990/283 [m]: (2a) juvenile whorls, lateral view, (2b) ventral view, ×2; (3) specimen PIN, no. 3990/284 [m], phragmocone with partly preserved body chamber lateral view; (4) specimen PIN, no. 3990/285 [m]: (4a) phragmocone with partly preserved body chamber lateral view, (4b) ventral view; (5) specimen PIN, no. 3990/286 [m], pathological specimen, phragmocone with an initial part of the body chamber, lateral view; (6) specimen PIN, no. 3990/263 [m], phragmocone with partly preserved body chamber lateral view; (7) specimen PIN, no. 3990/287 [M], phragmocone with an initial part of the body chamber lateral view; (8) specimen PIN, no. 3990/290 [M]: (8a) shell with a complete body chamber and preserved aperture, lateral view, (8b) ventral view; (8c) impression of the apertural part; (9) specimen PIN, no. 3990/289 [m]: (9a) phragmocone, lateral view, (9b) ventral view; (10) specimen PIN, no. 3990/291 [m]: (10a) phragmocone with a partly preserved body chamber, lateral view, (10b) ventral view. Moscow Region, Lopatino Phosphorite Mine; Ryazanian, *rjasanensis* Zone: (4, 6, 9) quarry no. 10, (10) quarry no. 11, rest quarry no. 12-2.

Plate 6



Dimensions in mm and ratios:

Specimen PIN, no.	Dm	WH	WW	UW	WH/Dm	WW/Dm	UW/Dm
3990/262	74	21	15	35	0.28	0.20	0.47
	59	18	13	28	0.31	0.22	0.47
3990/258	69	25	17	28	0.36	0.25	0.41
3990/273	55	18	15	24	0.33	0.27	0.44
3990/277	47	18	13	17	0.38	0.28	0.36
1/81, lectotype	46	16	13	17	0.35	0.28	0.36
	34	14	11	–	0.41	0.32	–
3990/277	32	12.5	9	10.5	0.39	0.28	0.33
3990/278	31	12	10	12	0.39	0.32	0.39

Variability. The species is dimorphic. Microconchs are smaller and (when of a similar size to macroconchs) differ in more strongly evolute shell and more prominent ribs. In the evolution of the species, the ornamentation of the early whorls becomes finer and more densely spaced (*"Prorjasanites"*), and generally a gradual increase of the branching coefficient in macroconchs, from 1.6 in the initial morph α to 2.4 in the terminal morph β. At the same time, later representatives of the species include morphs with wider whorls, mainly possessing simple and intercalating ribs.

Comparison. This species is distinguished from *R. swistowianus* by the more strongly flattened flanks, and ribs of equal height with high branching coefficient on the flanks. It differs from *R. maikopensis* in the smaller shell and the smaller umbilicus, and by the larger branching coefficient.

Remarks. The species "*Hoplites subrjasanensis*" (see the synonymy list) was described based on a small specimen, possibly belonging to the species under description. Two juvenile ammonites described by Sasonova (1977) as two new species of the genus *Prorjasanites* are most likely to belong to *R. rjasanensis* (to a terminal morph).

The specimens identified as *R. rjasanensis* and similar forms from the Berriasian of Mangyshlak (see Luppov et al., 1988) perhaps belong to a different species of this genus. No positive conclusion can be made based on the available material. The ammonite described as "*R.* ex gr. *subrjasanensis*" (Luppov et al., 1988, p. 132, pl. 13, fig. 6), does not belong to *Riasanites*.

Occurrence. Central Russia (Moscow, Ryazan, Yaroslavl, and Kirov regions, Republic of Chuvashia); Ryazanian.

Material. About 40 specimens from the quarries of the Lopatino Mine and several outcrops in the Oka River basin, near the villages of Kuz'minskoe, Nikitino, Staraya Ryazan, Swistowo, and the quarries of the plant "Mikhailovtsement."

Riasanites swistowianus (Nikitin, 1888)

Plate 5, figs. 5, 10; Plate. 6, figs. 1–10

Hoplites swistowianus: Nikitin, 1888, p. 93, pl. 1, figs. 5–8.

Riasanites swistowianus: Sasonova, 1977, p. 85, pl. 18, fig. 5, pl. 20, fig. 1(?); Mitta, 2007, pl. 2, fig. 2.

Riasanites rjasanensis: Gerasimov et al., 1962, pl. 9, fig. 1.

Riasanites decorus: Sasonova, 1977, p. 87, pl. 19, figs. 4, 7.

Euthymiceras sp. indet.: Mesezhnikov et al., 1979, pl. 1, figs. 1, 2.

Lectotype. Mining Museum, St. Petersburg, no. 5/81; figured by Nikitin, 1888, pl. 1, fig. 5; Ryazan Region, ravine near the Swistowo; Ryazanian.

Description. The shell is small, up to 80 mm in diameter. The juvenile whorls (up to 40–45 mm in diameter) are moderately wide, quadrangular in cross section with a height almost equal to their width. Later in ontogeny, the shell becomes more strongly flattened, with an oval section with weakly convex flanks and a weakly flattened venter. The umbilicus is wide. The umbilical wall is relatively short. The umbilical shoulder is rounded. The body chamber of the macroconchs occupies three-quarters of the whorl. The aperture is simple with a small expansion. No microconchs with a complete body chamber and aperture are known.

The ornamentation consists mainly of bipartite ribs and a smaller number of simple and intercalation ribs. The branching coefficient in adult whorls of the macroconchs is 1.3–1.5. Ribs branch in the mid-flanks. In the point of bifurcation, the primary ribs are raised as a sharp crest. The crestlike swellings are especially well pronounced in microconchs and in the intermediate stages of the macroconchs. On the body chamber of the macroconchs, the swellings become weaker and disappear towards the aperture, where simple ribs are mainly present. The ribs are also raised on the ventrolateral shoulder and become somewhat lower on the mid-venter.

Dimensions in mm and ratios:

Specimen PIN, no.	Dm	WH	WW	UW	WH/Dm	WW/Dm	UW/Dm
3990/290	77	23	21	37	0.30	0.27	0.48
	62	20	18	27	0.32	0.29	0.44
3990/280	68	22	17	32	0.32	0.25	0.47
3990/287	63	22	19	26	0.35	0.30	0.41
3990/281	58	18	15	26	0.31	0.26	0.45
	45	17	14	18	0.37	0.31	0.40
3990/263	46	14	13	23	0.30	0.28	0.50
3990/291	44	15	14	21	0.34	0.32	0.43
3990/289	30	12	9	13	0.40	0.30	0.43

Variability. Microconchs are distinguished by the smaller size and generally sharper ribs more strongly elevated in the bifurcation point. The species is highly variable in the shape of the cross section, umbilical width, and a degree of rib development.

Comparison. This species is distinguished from the type species in the less flattened shell, ribs raised in the bifurcation point, and in the lower branching coefficient. It differs from *R. crassicostatus* in the ribs raised in the bifurcation point.

Remarks. *R. decorus* Sasonova, in my opinion, belongs to the marginal coarsely ribbed morph of the species described.

O c c u r r e n c e. Central Russia (Moscow, Ryazan, and Kirov regions); Ryazanian.

M a t e r i a l. More than 80 specimens from the quarries of the Lopatino Mine and the outcrop near the village of Swistowo on the Pronya River.

ACKNOWLEDGMENTS

A.V. Stupachenko (Moscow) helped with field work and with preparation of fossils. T.B. Leonova (Paleontological Institute, Russian Academy of Sciences) and I.S. Barskov (Moscow University) provided valuable comments. The author is deeply grateful to all who helped in preparation of this paper.

The study is supported by the program of the Presidium of the Russian Academy of Sciences "Origin and Evolution of the Biosphere."

REFERENCES

1. W. J. Arkell, "Jurassic Ammonitina," in *Treatise on Invertebrate Paleontology, Part L, Mollusca* (New York–Lawrence, Kansas Univ. Press, 1957), pp. 232–344.
2. N. A. Bogoslowsky, "The Ryazanian Horizon: Fauna, Stratigraphical Relationships, and Probable Age of This Horizon," in *Materials for the Geology of Russia* (1897), Vol. 18, pp. 1–157.
3. D. T. Donovan, J. H. Callomon, and M. K. Howarth, "Classification of the Jurassic Ammonitina," in *Ammonoidea: Syst. Assoc. Spec. Pap., Vol. 18* (Acad. Press, London–New York., 1981), pp. 101–155.
4. R. Enay, M. Boughdiri, and G. Le Hegarat, "*Toucasiella* gen. nov., Himalayitidae (Ammonitina) nouveau du Tithonien supérieur: origine de Durangites," C. R. Acad. Sci. Paris. Sci. terre planètes **327**, 471–477 (1998).
5. P. A. Gerasimov, E. E. Migacheva, D. P. Naidin, and B. P. Sterlin, *Jurassic and Cretaceous Deposits of the Russian Platform* (Mosk. Univ., Moscow, 1962) [in Russian].
6. O. K. Grigorieva, "Lower Valanginian Ammonite Fauna from the Belaya River Basin on the Northern Slope of the Caucasus Mountains," in *Materials on Geology and Mineral Resources, Collection of Papers No. 1* (Azovo-Chernomorsk. Geol. Trest, Rostov-on-Don, 1937), pp. 83–122 [in Russian].
7. J. A. Jeletzky, "Jurassic–Cretaceous Boundary Beds of Western and Arctic Canada and the Problem of the Tithonian–Berriasian Stages in the Boreal Realm," Geol. Assoc. Canada Spec. Pap. **27**, 175–255 (1984).
8. N. G. Khimshiashvili, *Tithonian and Berriasian Ammonoids of the Caucasus* (Metsniereba, Tbilisi, 1976) [in Russian].
9. N. N. Kolpenskaya, E. V. Nikiforova, O. A. Sochevanova, et al., *The Berriasian of the Northern Caucasus Mountains (Urukhskii Section): Biochronology and Correlation of the Phanerozoic of the Natural-Gas and Oil Fields of Russia, Issue 2* (Vses. Nauchno-Issled. Geol. Razved. Inst., St. Petersburg, 2000) [in Russian].
10. N. O. Krischtafowitsch, "On Volgian Deposits in the Moscow Province," Zap. imp. S.-Peterb. Miner. O–va, Ser. 2, Part 29, 186–189 (1892a).
11. N. Krischtafowitsch, "Upper Tithonian Deposits of Central Russia," Vestn. Estestvozn., Nos. 1–9, 319–322 (1892b).
12. I. V. Kvantaliani and N. I. Lyssenko, "A New Berriasian Genus *Tauricoceras*," Soobshch. Akad. Nauk Gruz. SSR **93** (3), 629–632 (1979).
13. I. V. Kvantaliani and N. I. Lyssenko, "New Berriasian Ammonites of the Crimean Peninsula," Izv. Geol. O–va Gruzii **9** (1–2), 3–12 (1982).
14. I. Lahusen, "The Fauna of the Jurassic Formations of Ryazan Province," Tr. Geol. Kom. **1** (1), 1–94 (1883).
15. N. P. Luppov, T. N. Bogdanova, S. V. Lobacheva, et al., *Berriasian of Mangyshlak* (Nauka, Leningrad, 1988) [in Russian].
16. M. S. Mesezhnikov, V. A. Zakharov, N. I. Shul'gina, and S. N. Alekseev, "The Stratigraphy of the Ryazan Horizon on the Oka River," in *The Upper Jurassic and Its Boundary with the Cretaceous System* (Nauka, Novosibirsk, 1979), pp. 71–81 [in Russian].
17. V. V. Mitta, "New Data on the Age of the Ryazanian Stage Basal Layers," Stratigr. Geol. Korrelyatsiya **13** (5), 51–59 (2005) [Stratigr. Geol. Correlation **13** (5), 503–511 (2005)].
18. V. V. Mitta, "The Jurassic–Cretaceous Boundary: The Discussion Continues," in *Paleontology, Biostratigraphy, and Paleogeography of the Boreal Mesozoic: Materials for the Scientific Session Dedicated to V.N. Saks's 95th Birthday* (Geo, Novosibirsk, 2006), pp. 112–115 [in Russian].
19. V. V. Mitta, "Ammonite Assemblages from Basal Layers of the Ryazanian Stage (Lower Cretaceous) of Central Russia," Stratigr. Geol. Korrelyatsiya **15** (2), 80–92 (2007) [Stratigr. Geol. Correlation **15** (2), 185–192 (2007)].
20. S. N. Nikitin, "Traces of the Cretaceous Period in Central Russia," Tr. Geol. Kom. **5** (2), 1–205 (1888).
21. H. Parent, "The Middle Tithonian (Upper Jurassic) Ammonoid Fauna of Cañadón de los Alazanes, Southern Neuquén-Mendoza Basin, Argentina," Bol. Inst. Fisiogr. Geol. **71** (1–2), 19–38 (2001).
22. A. S. Sacharov, "A New Ammonitid Genus *Gechiceras* from the Upper Berriasian of the Northern Caucasus Mountains," Paleontol. Zh., No. 3, 132–136 (1982).
23. I. G. Sasonova, "The Berriasian and Lower Valanginian Ammonites of the Russian Platform," Tr. Vses. Nauchno-Issled. Inst. Nefti Geol. Razved., No. 110, 3–110 (1971).
24. I. G. Sasonova, "Ammonites of the Jurassic–Cretaceous Boundary Beds of the Russian Platform," Tr. Vses. Nauchno-Issled. Inst. Nefti Geol. Razved., No. 185, 1–97 (1977).
25. I. G. Sasonova and N. T. Sasonov, "The Stratigraphic Scheme of the Lower Cretaceous of the East European Platform (Russian Subboreal Province)," Byull. Mosk. O–va Ispyt. Prir. Otd. Geol. **66** (4), 49–63 (1991).
26. L. F. Spath, "On Ammonites from New Zealand," in C. T. Trechmann; "The Jurassic Rocks of New Zealand," Quart. J. Geol. Soc. London **79**, 286–312 (1923).
27. A. Wenetzky, "An Essay of the Geological Structures of the Southeastern Corner of the Moscow Basin," in *Proceedings of the 1st Congress of Russian Naturalists, Division of Mineralogy and Geology* (St. Petersburg, 1868), pp. 42–51 [in Russian].
28. C. W. Wright, J. H. Callomon, and M. K. Howarth, "Cretaceous Ammonoidea," in *Treatise on Invertebrate Paleontology, Part L, Mollusca 4, Revised* (Geol. Soc. Am. and Univ. Kansas Press, Boulder–Lawrence, 1996).