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Ammonites of Tethyan Origin in the Ryazanian Stage of the Russian Platform: Genus *Riasanella* gen. nov.

V. V. Mitta

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

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Abstract—A new ammonite genus *Riasanella* is described from the Ryazanian Stage of the Russian Platform (type species *R. rausingi* sp. nov.). The new species *R. plana* sp. nov., *R. olorizi* sp. nov., and *R. riasanitoides* sp. nov. are described. These species come from the lower, strongly condensed beds of the *Riasanites rjasanensis* Zone of the Moscow Region. The upper subzone of this zone in the Ryazan Region contains specimens of *Riasanella*, identified in open nomenclature. The new genus is assigned to the family Himalayitidae; one of its species is a possible ancestor of *Riasanites* Spath.

Keywords: ammonites, Tethyan, Ryazanian Stage, Russian Platform, new genus.

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INTRODUCTION

The central part of the Russian Platform is one of the few regions on the Earth, where the basal Cretaceous beds contain ammonites of "boreal" and "Tethyan" origin. The first descriptions of these ammonites were published over 100 years ago (Nikitin, 1888; Bogoslovsky, 1896), but until now many taxa characterizing the Ryazanian Stage (equivalent of the Berriasian in central Russia) have not been studied. This is particularly important for the Moscow Region, because previous studies of Ryazanian ammonites including by Sazonova (1977) and Mesezhnikov (1979 and others), dealt mainly with material from the Oka River Basin in the Ryazan Region. Field materials, collected by the author of this paper showed that the richness and diversity of ammonites from the sections in the Moscow Region are no less than, and often exceed those from the type area. Sections in the Moscow Region contain taxa so far unknown from the Ryazanian of the Oka River Basin. Ammonites of boreal origin belong to the family Craspeditidae, and their stratigraphic succession and phylogeny in the Russian Platform are better studied than those of the Tethyan Neocomitidae and Himalayitidae. The comparison of the taxonomic composition of ammonites in the Ryazanian lower zone (*Riasanites rjasanensis*) showed that the basal beds of this zone in the Moscow basin contain earlier species of Craspeditidae compared to the assemblages of the Ryazan Region. Hence it has been suggested (Mitta and Bogomolov, 2008) that the *rjasanensis* Zone be subdivided into two subzones, the lower, *Riasanites rjasanensis*, and the upper, *Surites spasskensis*. Ammonites of Tethyan origin in the Moscow Region are restricted to the lower subzone (diverse assemblage), in the Ryazan Region the lower subzone is taxonomically impoverished, whereas the upper contains as rich assemblage of ammonites of Boreal and Tethyan origin. In the proceedings of various conferences and papers of mainly stratigraphic orientation (Mitta, 2004a, 2004b, 2005, 2006) I published definitions and illustrations of Ryazanian ammonites of Tethyan origin without description, an approach criticized by some of my colleagues (Sey and Kalacheva, 2005, 2008; Arkadiev et al., 2007). Therefore I began publishing papers with a comprehensive description of new material and, where necessary, with revisions of the data of previous workers. In my previous papers I considered ammonites of the genera *Riasanites* Spath (Mitta, 2008) and *Subalpinites* Mazenot (Mitta, 2009). In this paper I described species of the new genus *Riasanella*, which, judging from the shell morphology, is closely related to *Riasanites*.

All specimens described below from the Moscow Region come from the same locality at the base of the yellowish-gray, in places greenish-brown, phosphatized, clayey sandstone, 0.2–0.4 m thick, belonging to the *rjasanensis* Zone and Subzone. This overlies a thin (less than 0.05 m) bed of black unbedded compact sandstone with *Hectoroceras kochi* Spath (overlying Upper Volgian beds) and overlain by a bed of dark-gray and black sandy clay, 0.2–0.4 m thick, with *Surites spasskensis* (Nikitin).

The state of preservation of the material studied varies. Complete phosphatized molds with shell remains are rare; fragments are most frequently found, sometimes with a more or less complete imprint with a preserved nacreous layer, and cavities from dissolved molds are also common. In the case of molds, I suc-

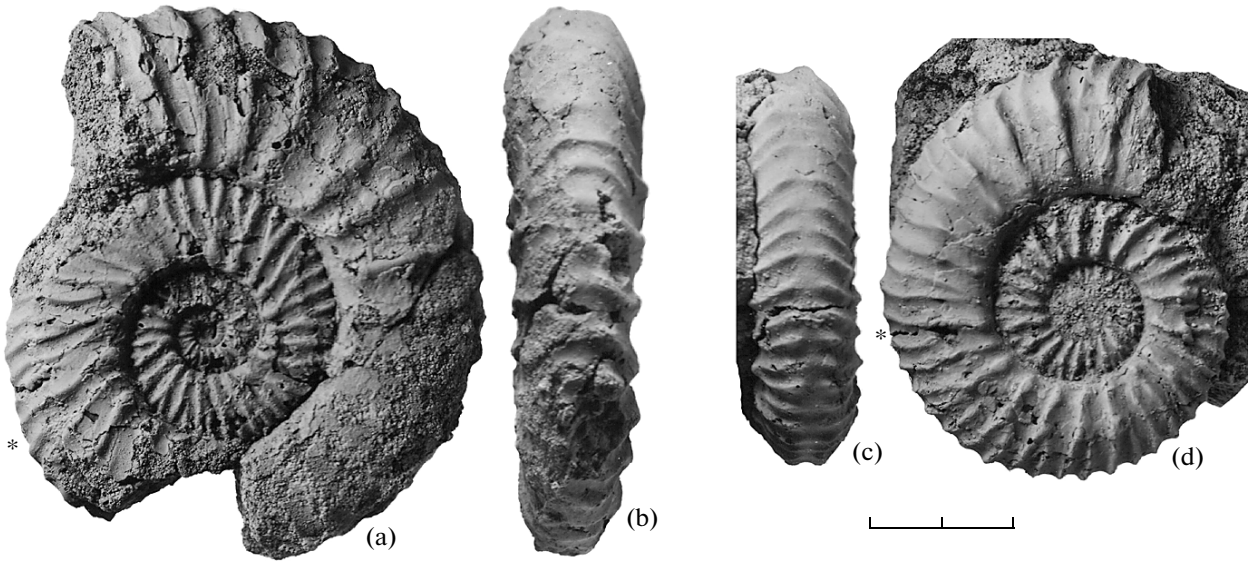


Fig. 1. *Riasanella olorizi* sp. nov.: (a, b) holotype no. 3990/396, macroconch: (a) lateral view, (b) ventral view; (c, d) specimen no. 3990/397, microconch, (c) ventral view, (d) lateral view. Coll. A.V. Stupachenko. The scale bar is 1 cm; the beginning of the body chamber is marked by an asterisk.

cessfully used a preparation technique common amongst amateur paleontologists in Germany: imprints or cavities are soaked in glue and filled with plaster or the "native" ground sandstone mixed with glue, whereas the counterpart of the imprint or external surfaces surrounding the cavity are carefully cleaned from the rock matrix. This is time consuming work, which requires a lot of patience, results in artificial "casts" covered from the outside by natural nacreous shell.

There are other difficulties in studying Ryazanian ammonites apart from the rarity of their fossils and the difficulties of preparation. There are often specimens with life-time injuries, which disrupt the normal development of the ornamentation. Plate 2, fig. 6 shows a specimen in which the life-time injury in the first third of the external whorl caused distortions in the development of the ornamentation on the venter of the succeeding portion of the whorl. The specimen in Pl. 2, fig 10 also shows a life-time injury in the first third of the external whorl, resulting in the ornamentation on of the flanks (Fig. 10c) differing considerably from the typical ornamentation for this species, which is represented on the opposite flank (Fig. 10a). In cases when a shell is incompletely preserved, when the place of injury was not preserved, or it is not known whether an injury was present at all, it is often difficult to identify a taxon with atypical ornamentation or shell shape.

The greatest difficulty in delineation of Tethyan origin in strongly condensed sediments of the *rjasanensis* Zone is in the recognition of macro- and microconchs of the same species. Specimens with a complete body chamber are extremely rare, and the preserved apertural margin is even more rarely found. Therefore, it is often necessary to make judgments based on differences in the shell size and coiling in shell with morphogenetically similar ornamentation, although in the absence of the shape of the aperture the conclusions may be erroneous. Unfortunately, only few specimens from our collection have a complete body chamber with a preserved aperture. Nevertheless, the new taxa proposed below are readily distinguished from one another and at the same time show a number of differences, primarily the cross section distinctly narrowing ventrad.

The earliest representatives of the new species are apparently *Riasanella olorizi* sp. nov. (Fig. 1) and *R. riasanitoides* sp. nov. (Fig. 2). The divergence of the former species probably resulted in the appearance of *R. rausingi* sp. nov. (Pl. 2) and *R. plana* sp. nov. (Pl. 3), which have the most similar inner whorls. A linear trend *R. olorizi* ⟶ *R. rausingi* ⟶ *R. plana* is also possible; the last member resulted from the disappearance of lateral nodes. There is a distinct trend toward decrease in the shell size, although the holotypes of *R. olorizi* and *R. plana* have similar sized phragmocones.

R. riasanitoides is very similar to the first *Riasanites*, i.e., *R. swistowianus* (Nikitin). Recent data suggest the following evolutionary lineage: *Riasanella riasanitoides* ⟶ *Riasanites swistowianus* ⟶ *R. rjasanensis* morph α ⟶ *R. rjasanensis* morph β. Later, a divergence probably led to the appearance of *R. rulevae* (="*Berriasella*" *rulevae* Mitta, 2007) and *R. maikopensis* Grigorieva, 1938. The latter species was described from the Northern Caucasus, but recently similar specimens were also found in the Oka River Basin (Fig. 3a), in the topmost *rjasanensis* Zone. The Northern Caucasus specimens of *R. maikopensis* examined (Figs. 3b, 3c) come from the *"Riasanites rjasanensis–Spiticeras cautleyi"* Subzone, or "lower

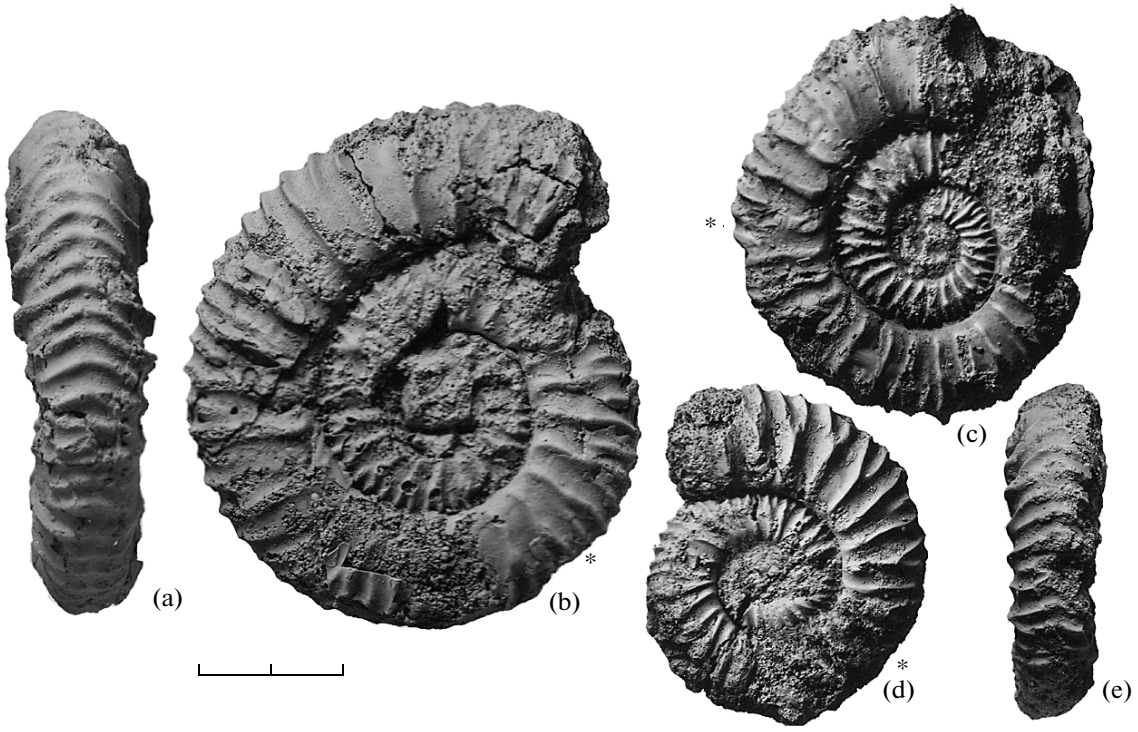


Fig. 2. *Riasanella riasanitoides* sp. nov.: (a, b) holotype no. 3990/395, macroconch with a complete body chamber, (a) ventral view, (b) lateral view; (c) specimen no. 3990/288, microconch lateral view; (d, e) specimen no. 3990/380, microconch, (d) lateral view, (e) ventral view. Coll. by V.V. Mitta and A.V. Stupachenko. The scale bar is 1 cm; the beginning of the body chamber is marked by an asterisk.

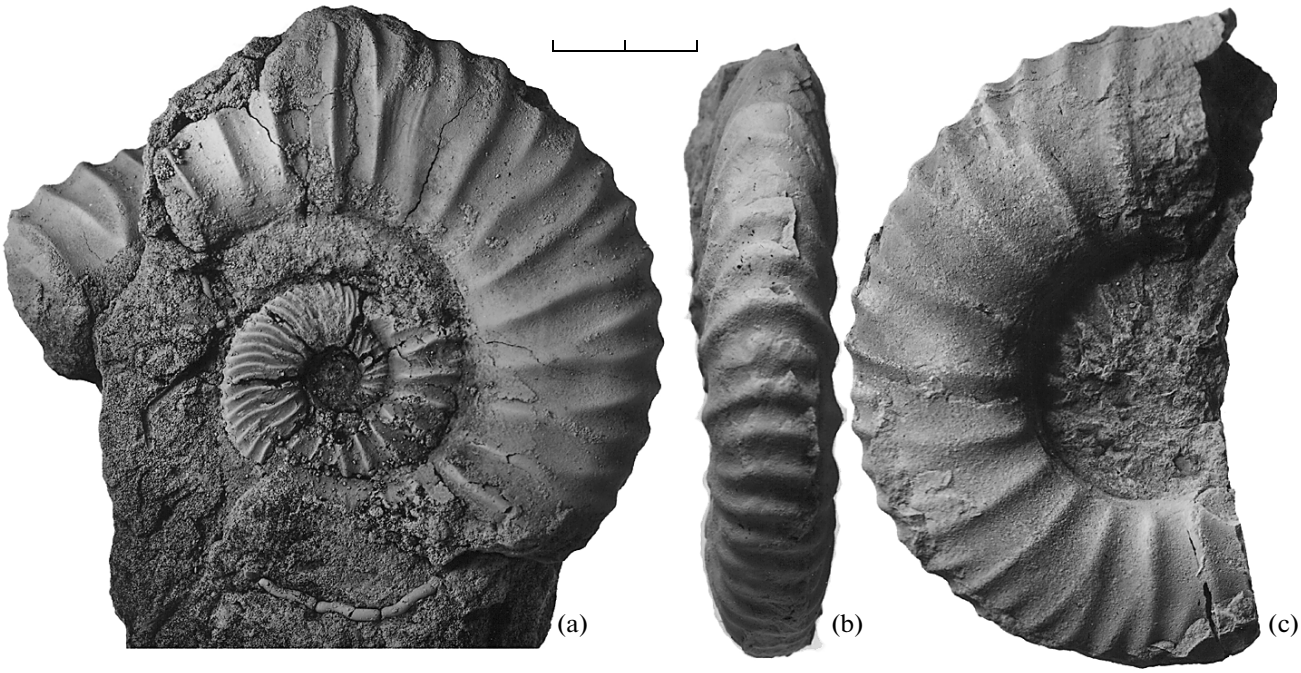
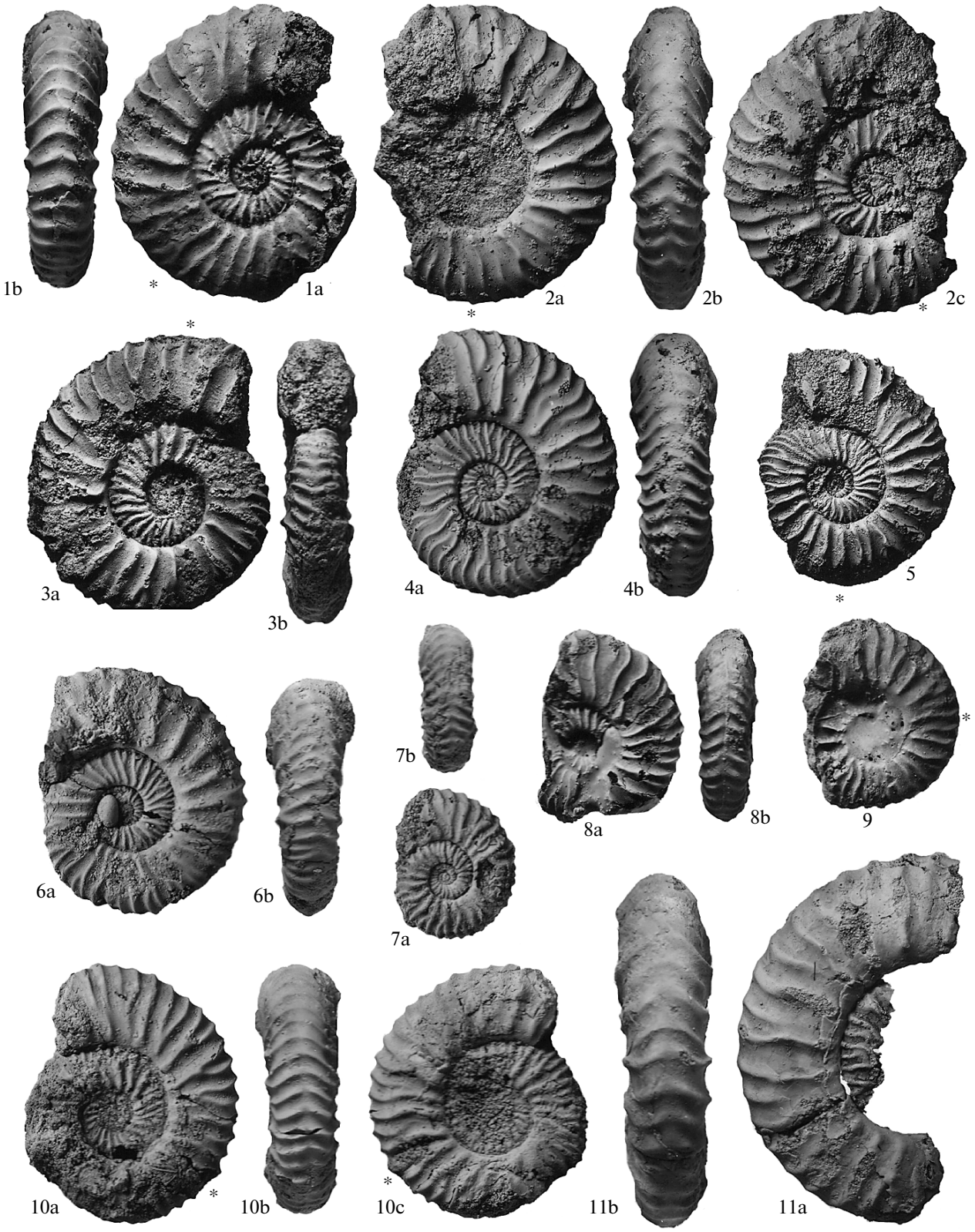


Fig. 3. *Riasanite*s: (a) *R.* aff. *maikopensis* Grigorieva, specimen no. 3990/402, lateral view; Ryazan Region, bank of the Oka River downstream of the village of Nikitino; *rjasanensis* Zone, *spasskensis* Subzone; coll. V.V. Mitta; (b, c) *R. maikopensis* Grigorieva, specimen no. 3990/403, (b) ventral view, (c) lateral view; Northern Osetia, the Urukh River downstream of the village of Chikol.; *boissieri* Zone, *rjasanensis–cautleyi* Subzone; coll. by S.K. Paraketsov and E.I. Iosifova. The scale bar is 1 cm.

Plate 2



Riasanites beds, according to Sey and Kalachova (1997, etc.). This suggests the correspondence of the "rjasanensis–cautleyi" Subzone of the Northern Caucasus not with the lower beds of the *rjasanensis* Zone of the Russian Platform, as suggested by Sey and Kalacheva but, with the topmost beds of the zone at best (Mitta, 2007).

The new taxa are described below.

SYSTEMATIC PALEONTOLOGY

Family Himalayitidae Spath, 1923

Genus *Riasanella* Mitta, gen. nov.

Etymology. From the genus *Riasanites*.

Type species. *Riasanella rausingi* sp. nov.

Diagnosis. Genus dimorphic. Dimorphic pairs recognized within the species. Shell small, with flattened whorls subtrapezoidal and suboval in cross section, with narrow, slightly flattened venter. Ornamentation may contribute to octagonal shape of cross section. Umbilicus wide or very wide. Umbilical wall low, with rounded or gently sloping shoulder. Body chamber in macroconchs occupying up to three-quarters of whorl. Aperture simple. Body chamber of microconchs occupying at least one-half of whorl. Aperture with lappets. Ornamentation consisting of curved bifurcating, simple, and intercalating ribs, lowering in middle of ventral side of phragmocone to form a groove. In umbilical region, on mid-flanks and on ventrolateral shoulder, ribs are occasionally raised to form crests and up to three rows of nodes. At the end of body chamber, ribs mainly simple and intercalating.

Species composition. Four new species.

Comparison. Some macroconch specimens of *Riasanella* have young whorls very similar to those of macroconchs of *Riasanites* both in shape and ornamentation. My collection also contains a few specimens of microconchs of *Riasanites* with phragmocones similar to those of *Riasanella*. Macroconchs and microconchs of these genera are similar in size to their counterparts, respectively. The new genus clearly differs from *Riasanites* in the cross section of adult whorls strongly converging ventrad, especially in the body chamber.

Remarks. The above similarity is explained by the phylogenetic closeness between *Riasanella* and *Riasanites*: the latter apparently descended from one of the *Riasanella* species (see below). These taxa differ from *Subalpinites*, *Pomeliceras*, and *Malbosiceras* (family Neocomitidae) occurring in the same assemblages in the generally smaller shell and considerably simpler suture (sutural ontogeny could not be studied because of poor preservation). These characters are also similar in other Himalayitidae (genus *Transcaspites*), occurring stratigraphically higher, in the upper part of the *rjasanensis* Zone in the Oka River basin (Ryazan Region).

All species of the genus described below come from the same locality in the Voskresensk District of the Moscow Region, from the lower part of the *Riasanites rjasanensis* Subzone (in the *Riasanites rjasanensis* Zone of the Ryazanian Stage). The section near the village of Nikitino on the Oka River (Spassk District of the Ryazan Region), in the *Surites spasskensis* Subzone of the *rjasanensis* Zone, contained several fragments that could also be assigned to this genus.

Riasanella rausingi Mitta, sp. nov.

Plate 2, figs. 1–11

Himalayitidae gen. et sp. nov.: Mitta, 2007, pl. 2, fig. 3.

Etymology. In honor of Academician Hans Rausing, whose foundation has regularly sponsored my fieldwork.

Holotype. PIN, no. 3990/264; Moscow Region, Lopatinskii phosphorite mine, quarry no. 12-2; Ryazanian, lower part of the *Riasanites rjasanensis* Zone.

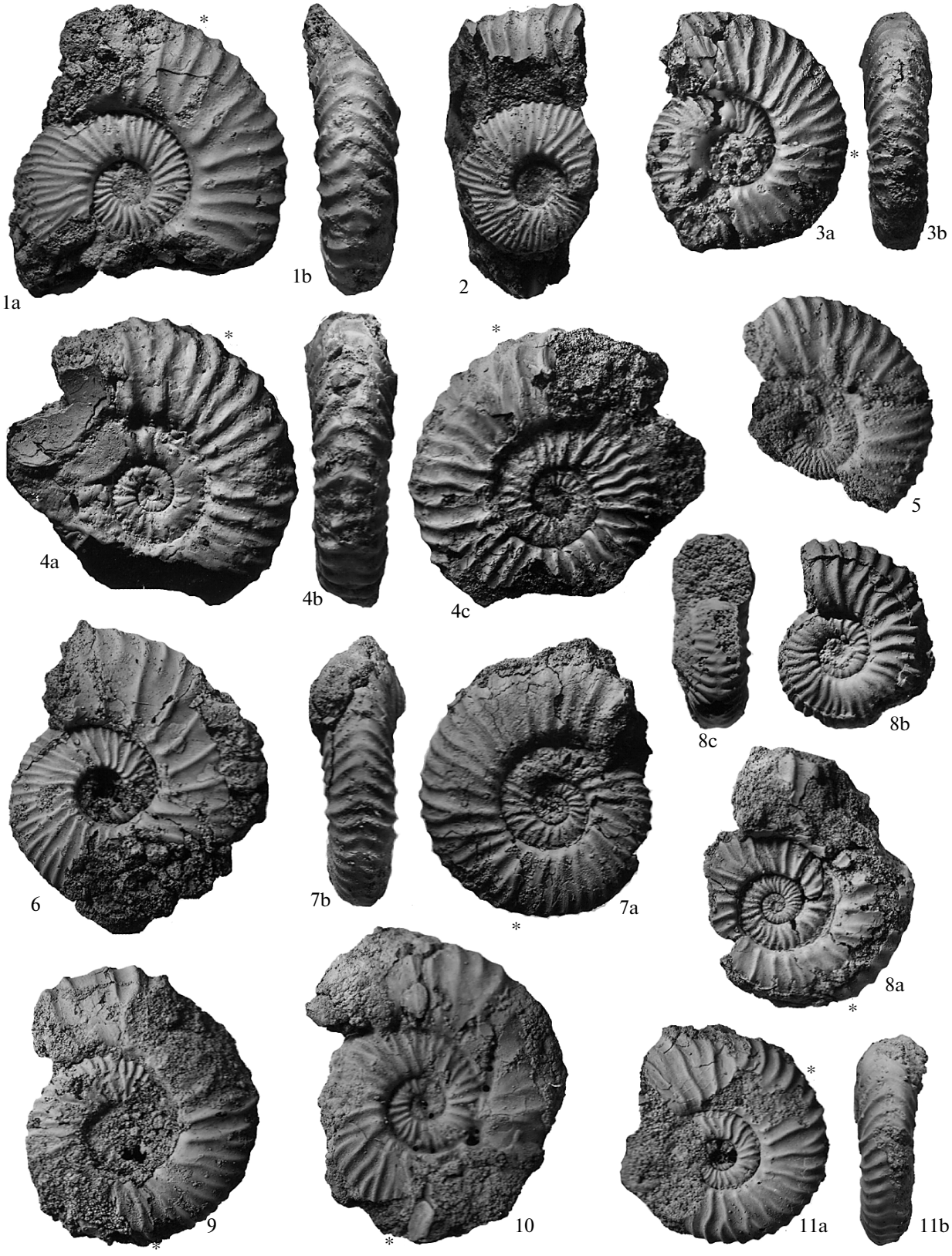
Description. Phragmocone of macroconchs reaches 45 mm in diameter, shell with a body chamber 65 mm; phragmocone of microconch up to 30 mm. The early whorls (Dm = 20–25 mm) moderately wide, with height the same as width or smaller. As the shell grows the whorls become flattened on the flanks highly trapezoid in cross-section with the maximum width in the umbilical region. The umbilicus is wide, umbilical shoulder rounded. The only specimen with a preserved aperture (Pl. 2, fig. 1) is apparently not fully mature (Dm = 48 mm, body chamber is less than 1/2 whorls); the aperture is simple, slightly expanding.

Explanation of Plate 2

All sizes are natural. The beginning of the body chamber is marked by an asterisk.

Figs. 1–11. *Riasanella rausingi* sp. nov.: (1) specimen no. 3990/348, macroconch with a preserved aperture: (1a) lateral view, (1b) ventral view; (2) specimen no. 3990/352, macroconch: (2a, 2c) lateral view, (2b) ventral view; (3) specimen no. 3990/350, macroconch: (3a) lateral view, (3b) apertural view; (4) holotype no. 3990/264, phragmocone of a macroconch: (4a) lateral view (4b) ventral view; (5) specimen no. 3990/353, microconch, lateral view; (6) specimen no. 3990/361, phragmocone of a macroconch with a life-time damage: (6a) lateral view, (6b) ventral view; (7) specimen no. 3990/360, juvenile: (7a) lateral view, (7b) ventral view; (8) specimen no. 3990/357, phragmocone of a macroconch: (8a) lateral view, (8b) ventral view; (9) specimen no. 3990/356, microconch, lateral view; (10) specimen no. 3990/359, macroconch with a life-time damage: (10a, 10c) lateral view, (10b) ventral view; (11) specimen no. 3990/355, body chamber of a macroconch with a fragment of the inner whorl: (11a) lateral view, (11b) ventral view; Moscow Region, Lopatinskii phosphorite mine, quarry no. 12-2; Ryazanian, lower part of the *Riasanites rjasanensis* Zone. Coll. V.V. Mitta and A.V. Stupachenko.

Plate 3



The ornamentation is represented mainly by bifurcating weakly curved ribs, irregularly forming crestlike bulges at the point of bifurcation. Simple and intercalating ribs are rare on the phragmocone. On the body chamber, some branches lose connection with the main ribs, to form intercalating and simple ribs.

Dimensions in mm and ratios:

Specimen no.	Dm	WH	WW	UW	WH/Dm	WW/Dm	UW/Dm
3990/355	63	19	15	30	0.3	0.24	0.48
3990/352	50	18	13	22	0.36	0.26	0.44
Holotype 3990/348	48	15	13	22	0.31	0.27	0.46
	36	13	11	15	0.36	0.3	0.42
3990/264	46	15	14	18	0.33	0.3	0.39
	36	13	11	13	0.36	0.3	0.36
3990/361	40	14	12	18	0.35	0.3	0.45
3990/360	25	8	9	11	0.32	0.36	0.44
	20	7	8	8	0.35	0.4	0.4

Variability is represented by the degree of development and frequency of crestlike bulges on the mid-flank. Microconchs (Pl. 2, figs. 5, 9) have a smaller size and more strongly evolute whorls at similar diameters.

Comparison with other species of the genus is below.

Material. Twenty one specimens from the type locality.

***Riasanella plana* Mitta, sp. nov.**

Plate 3, figs. 1–11

Etymology. From the Latin *planus* (flat).

Holotype. PIN RAN, no. 3990/358; Moscow Region, Lopatinskii phosphorite mine, quarry no. 12-2; Ryazanian, lower part of the *Riasanites rjasanensis* Zone.

Description. Phragmocone of macroconchs is up to 45-50 mm in diameter. Shell with body chamber – 60–65 mm and, possibly, more. In a single known microconch (Pl. 3, fig. 3), the phragmocone is 33 mm in diameter. The whorls are flattened, oval in cross-section, which is not becoming narrower towards the flattened venter. The umbilicus is wide; the umbilical wall is narrow, steep in early whorls and becoming more gently sloping at the end of the phragmocone and on the body chamber. To date, no specimens with a complete body chamber and aperture are known.

The ornamentation is represented by curved, simple and intercalating, more rarely bifurcating ribs. The umbilical portions of the ribs are crestlike very rarely and only slightly raised. The lateral crestlike bulges are also weakly developed and are mainly observed at the beginning of the last whorls.

Dimensions in mm and ratios:

Specimen no.	Dm	WH	WW	UW	WH/Dm	WW/Dm	UW/Dm
Holotype 3990/358	45	16	13	18	0.36	0.29	0.4
3990/351	42	14	12	16	0.33	0.29	0.38
3990/354	40	14	12	17	0.35	0.30	0.43
3990/366	40	14	12	16	0.35	0.3	0.4
3990/368	36	13	11	15	0.36	0.31	0.42
3990/368	36	12	12	16	0.33	0.33	0.44
3990/362	35	13	11	14	0.37	0.31	0.4

Explanation of Plate 3

All sizes except specially marked are natural. The beginning of the body chamber is marked by an asterisk.

Figs. 1–11. *Riasanella plana* sp. nov.: 1) holotype no. 3990/358, macroconch: (1a) lateral view, (1b) ventral view; (2) specimen no. 3990/349, phragmocone of a macroconch with a fragment of the body chamber, lateral view; (3) specimen no. 3990/351, microconch: (3a) lateral view, (3b) ventral view; (4) specimen no. 3990/354, macroconch: (4a, 4c) lateral view, (4b) ventral view; (5) specimen no. 3990/367, phragmocone of a macroconch, lateral view; (6) specimen no. 3990/365, phragmocone of a macroconch lateral view; (7) specimen no. 3990/366, macroconch: (7a) lateral view, (7b) ventral view; (8) specimen no. 3990/368, macroconch: (8a) lateral view, (8b) juvenile whorls, lateral view, ×2, (8c) apertural view, ×2; (9) specimen no. 3990/364, macroconch lateral view; (10) specimen no. 3990/363, macroconch lateral view; (11) specimen no. 3990/362, macroconch: (11a) lateral view, (11b) ventral view; Moscow Region, Lopatinskii phosphorite mine, quarry no. 12-2; Ryazanian, lower part of the *Riasanites rjasanensis* Zone. Coll. V.V. Mitta and A.V. Stupachenko.

Variability. The early whorls are the most variable. They are positioned similarly to those of *R. rausingi*, but are mainly more strongly flattened, and lacking crest-like bulges.

Comparison. This species differs from the type species of the genus (the most similar species) in the predominance of intercalating and singular ribs on the phragmocone, and weak development (or complete absence) of crest-like bulges.

Remarks. This species probably evolved from *R. olorizi* described below as a rest of divergence, but its evolution from the type species of the genus cannot be completely excluded.

Material. Nineteen specimens, including three specimens from the A.V. Stupachenko's collection; all from the type locality.

Riasanella olorizi Mitta, sp. nov.

Etymology. After Federico Oloriz (Granada, Spain), Jurassic ammonite and biostratigraphy specialist.

Holotype. PIN RAN, no. 3990/396; Moscow Region, Lopatinskii phosphorite mine, quarry no. 12-2; Ryazanian, lower part of the *Riasanites rjasanensis* Zone.

Description (Fig. 1). Phragmocone of macroconchs reaches 70 mm in diameter, shell with a complete body chamber up to 80-85 mm. Phragmocone of microconchs reaches 45 mm, and the complete shell 55 mm in diameter. The whorls are flattened, with an oval cross-section, narrowing towards the slightly flattened venter. The umbilicus is wide and (on the body chamber) very wide. The umbilical wall is narrow, with a rounded umbilical shoulder. The body chamber of macroconchs is up to 0.7 whorls; specimens with a preserved aperture are unknown. In the only specimen of a microconch with a partly preserved lateral auricle (Dm ca. 55 mm) the beginning of the body chamber is missing, hence its total length is unknown.

The ornamentation is represented by bifurcating, simple, and intercalating ribs. At Dm = 30–40 mm some ribs dichotomize in the umbilical region, and some near the mid-flank. The branches of the ribs are usually bent backward. Lateral bulges are frequently observed in the mid-flank. In microconchs, the ribs are crest-like and raised in the umbilical region. At the end of the phragmocone and on the body chamber, primary ribs are subradial, usually weakly bent, with distinct bulges in the umbilical regions and in the bifurcation point in the mid-flank. The branches are weakly crescent-like, bent orad. The ventrolateral shoulder possesses a node-like inflation, smoothening in macroconchs toward the end of the body chamber.

Dimensions in mm and ratios:

Specimen no.	Dm	WH	WW	UW	WH/Dm	WW/Dm	UW/Dm
Holotype 3990/396	74	22	17	37	0.3	0.23	0.5
	58	17	14	26	0.29	0.24	0.45
3990/398	72	22	18	33	0.31	0.25	0.46
3990/397	54	18	14	26	0.33	0.26	0.48
	43	13	12	19	0.3	0.28	0.44

Comparison. *R. olorizi* is readily distinguished from the above species by its large size. It also differs in the lesser number of simple and intercalating ribs at the same diameter, and by the more strongly developed (especially in adults) umbilical and lateral nodes.

Remarks. *R. olorizi* apparently gave rise to both the above species as a result of divergence or linear evolution.

Material. Ten specimens, including three specimens from A.V. Stupachenko's collection; all come from the type locality.

Riasanella riasanitoides Mitta, sp. nov.

Etymology. From similarity to *Riasanites* Spath.

Holotype. PIN RAN, no. 3990/395; Moscow Region, Lopatinskii phosphorite mine, quarry no. 12-2; Ryazanian, lower part of the *Riasanites rjasanensis* Zone.

Description (Fig. 2). Macroconchs reach 70 mm or more in diameter. The phragmocone is up to 60 mm. The phragmocone of microconchs may reach 45 mm. The whorls are flattened, with a maximum width in the lower third of the flanks. The umbilicus is wide to very wide, with a rounded shoulder. The body chamber of macroconchs is 0.7 whorls. The aperture is simple.

The ornamentation in the early whorls (Dm = 30–40 mm) is represented mainly by bifurcating ribs, raised crest-like in the mid-flank at the bifurcation point. Simple and intercalating ribs are rare at this stage. The ventrolateral bulges are weakly developed, especially on the body chamber. At the mid-flank, the ribs usually become lower and are occasionally (on the phragmocone) interrupted. The umbilical nodes are weakly developed, are usually present in the early whorls. By the end of the body chamber, the anterior branch loses connection with the primary rib, showing intercalation and simple ribs gently bent backwards.

Dimensions in mm and ratios:

Specimen no.	Dm	WH	WW	UW	WH/Dm	WW/Dm	UW/Dm
Holotype 3990/395	70	17	16	38	0.24	0.23	0.54
	59	16	14	28	0.27	0.24	0.47
3990/378	58	17	13	29	0.29	0.22	0.5
3990/288	50	13	12	25	0.26	0.24	0.5
3990/401	48	14	14	24	0.29	0.29	0.5
	38	11	10	18	0.29	0.26	0.47
3990/380	43	13	12	20	0.3	0.28	0.47
	33	11	10	14	0.33	0.3	0.42

Comparison. This species is distinguished from the most similar species, *R. olorizi*, by weak development of the umbilical nodes. The ornamentation of the early whorls (Dm = 30-40 mm) resembles that of *R. rausingi* differing by the regularly spaced lateral nodes.

Remarks. This species, judging from its ornamentation, is an immediate ancestor of *Riasanites*. Some microconchs of *Riasanites swistowianus* (Nikitin) have archaic ornamentation of the inner whorls with well developed lateral nodes (Mitta, 2008, pl. 6, fig. 4), similar to that in microconchs of *Riasanella riasanitoides* (Fig. 2c). However, judging from the shape of the cross-section with a narrow venter, the species described is assigned to *Riasanella*.

Material. Eighteen specimens, including one specimen from A.V. Stupachenko's collection; all come from the type locality.

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