

## New Lower Callovian Ostracodes from the Kursk Region

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**Abstract**—Lower Callovian deposits (*subpatruus* and *koenigi* ammonite zones) in the Mikhailovskii Mine section (Central Russia, Kursk Region) yielded 13 ostracode species (two of them are new) belonging to ten genera. This ostracode assemblage corresponds to ostracode beds with *Praeschuleridea wartae*–*Pleurocythere kurskensis*. The stratigraphic range of these beds corresponds to three ammonite biohorizons: *Chamoussetia crobbyloides*, *Keplerites gowerianus gowerianus*, and *K. indigestus*. Three distinct ostracode assemblages have been defined in the section based on their taxonomy and occurrence pattern. Two new species, *Pleurocythere kurskensis* sp. nov. and *Pseudohutsonia wienholzae* sp. nov., are described.

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### INTRODUCTION

Jurassic and, particularly, Callovian ostracodes of the Kursk Region first came to knowledge 50 years ago. Preobrazhenskaya (1958) studied drilling core samples from the Kursk Region and samples from the right bank of the Don River (Voronezh Region). She was the first to subdivide Jurassic sediments in this area into the Bajocian, Bathonian–Callovian, Middle Callovian, Oxfordian, and Kimmeridgian stages and the Lower Volgian Substage. She published a short list of the most characteristic ostracodes for the Middle Callovian, Kimmeridgian, and Lower Volgian. Later, she examined ostracodes in the Kimmeridgian (2 species) and the lower Volgian (6 species) in the Kursk magnetic anomaly (KMA) area. Preobrazhenskaya (1961) pointed out that only foraminiferans occur in the Bajocian, Bathonian, Oxfordian, and Callovian in this region. In the next year Preobrazhenskaya (1962) reviewed stratigraphic occurrence of ostracodes in Jurassic deposits of KMA. She reported two species typical of the Bajocian–Bathonian, three species characteristic of the Middle Callovian, one species typical of the Lower Oxfordian, two species typical of the Kimmeridgian, and six species characteristic of the Lower Volgian Substage. No ostracodes were found in the Middle Oxfordian. In four years, Preobrazhenskaya (1966) published her major monograph “Stratigraphy of the Jurassic and the Lowermost Lower Cretaceous within the Territory of the Central Chernozem Region”. Here she for the first time presented figures of Jurassic ostracodes from the Bajocian–Bathonian, Middle Callovian, Oxfordian, Kimmeridgian, and Lower Volgian

of the Voronezh Antecline area. In the text, she gave abridged lists of ostracodes from the Middle Callovian and Lower Oxfordian replicated from the previous work. In the last work Preobrazhenskaya (1968) deals with the most common ostracode species of the KMA area, i.e., Jurassic ostracodes from the Middle Volgian *virgatus* Zone. Seemingly, no Lower Callovian ostracodes have been found.

Nevertheless, it is from the Kursk Region (KMA) that the Lower Callovian (*koenigi* Zone) ostracodes of Central Russia are known at present. Their association has been identified as beds with *Praeschuleridea wartae*–*Pleurocythere regularis* (Tesakova 2000, 2003). Because no ostracodes have been previously known from stratigraphically lower horizons, the present work is aimed at further investigation of Lower Callovian ostracodes in the KMA area from the underlying *subpatruus* Zone and their comparison with the previously defined ostracode-based beds. In addition, the distributional patterns of the taxonomy and abundance of ostracode are studied in the section.

This study, which deals with deposits of the upper part of the *subpatruus* Zone and the lower part of the *koenigi* Zone, supplements and extends the previous work (Tesakova, 2000, 2003).

### MATERIAL AND METHODS

The material includes 11 clay samples from the Fatezh Formation collected by Gulyaev in the Mikhailovskii open-pit mine (KMA) in 1999 with pre-

cise reference to the detailed ammonite scale<sup>1</sup> (Figs. 1, 2a). Each sample weighed about 0.5 kg.

Three samples (nos. 1 and 2 of the *elatmae* Zone, and no. 5 from the *subpatruus* Zone) did not yield ostracodes (Fig. 2a). Two samples from the upper part of the *subpatruus* Zone (nos. 3, 4) contain a diverse ostracode assemblage with 12 species belonging to ten genera. Samples nos. 6–11 come from the *koenigi* Zone. Its lower *gowerianus* Subzone (samples 6, 7) produced seven species belonging to six ostracode genera. The lower part of the middle *curtilobus* Subzone (samples 8, 9) yielded the least diverse association with only six species belonging to four genera. Ostracodes were not found in samples 10 and 11.

Because all samples represented poorly consolidated clays, ostracodes were extracted by sedimentation and rinsing with water. Prior to washing, the rock was dried, then soaked in hot water for some time, and then boiled with sodium bicarbonate. After washing, the residue was dried and separated into three fractions (>0.315 mm, 0.315–0.01 mm, and <0.01 mm). Fossils were picked only from the first two fractions. A total of 688 well- and exceptionally well-preserved specimens was collected. They belong to 13 species of 10 genera.

The quantitative data on all ostracodes studied are tabulated (Table 1) with indication of the number of complete carapaces (compl.), right (r.) and left (l.) valves, fragments (fragm.), as well as gender (♀, ♂) in case of pronounced sexual dimorphism in tests.

The collection is stored at the Department of Paleontology in the Geological Faculty of the Moscow State University, under no. 300.

SEM photographs were taken at the Laboratory of Electron Microscopy, Paleontological Institute, Russian Academy of Sciences (PIN). All of the species studied are illustrated in Plates 2 and 3.

#### Description of the Mikhailovskii Mine (KMA) section

Below is a description of the section in the Mikhailovskii open-pit mine, compiled by Gulyaev during the field seasons of 1998–1999.

The open-pit mine of the Mikhailovskii Mining Enterprise is located 3 km southeast of the town of Zheleznogorsk. The best section was exposed in its western wall, opposite the southern tip of the central basin. The sequence is described from the base to the top (Figs. 1, 2a) and is subdivided into zones based on ammonites.

The base of the section is formed by lacustrine-alluvial deposits of the Upper(?) Bathonian Arkinskaya Formation represented by a member of polymictic quartz sand with subordinate beds of carbonaceous clays. The following section occurs above the erosional unconformity:



Fig. 1. Schematic location of the Mikhailovskii Mine section (mining enterprise).

#### The *elatmae* Zone

Bed 1. Gray clay, with low sandy and carbonaceous content, with thin interbeds of reddish clayey sand, small nodules of phosphatized marl, rare pyrite concretions, and coalified wood fragments. The 0.2-m-thick basal conglomerate is composed of small quartz pebbles and grus, belemnite rostra oriented parallel to one another, shell fragments of ammonites, bivalves, and brachiopods cemented by pyrite. Fossils are preserved as compressed shells and marly and (rarely) pyrite casts. The bed contains ammonites of the *P. elatmae* biohorizon: *Paracadoceras elatmae* (Nikitin), “*Costacadoceras mundum* (Sasonov), *Macrocephalites prosekensis* Gulyaev and a variety of belemnites, bivalves, gastropods, and brachiopods. Ostracodes were not found. Thickness is 1.4–1.5 m.

#### The *subpatruus* Zone–*koenigi* Zone, *gowerianus* Subzone

Bed 2. Clay light gray with a greenish tinge, calcareous, with rare smaller phosphatized marl concretions and numerous bioturbations marked by pyrite. The boundary with the underlying layer is indistinct with obvious signs of erosion. This boundary is marked by small quartz and phosphorite pebbles and grus, abundant rolled and eroded belemnite rostra and shell detritus. A layer of septate flattened nodules of dense light gray marl (up to 1 m in diameter), which locally grades to 5–7 meters long up to 0.7 m thick lenses of the same marl, occurs in 1–1.5 m above the bed’s base. The bed contains numerous ammonites, belemnites, bivalves, gastropods, brachiopods, and extremely rare solitary corals.

The lower 2.6- to 2.7-m-thick layer of the bed contains the ammonite assemblage of the *Ch. crobyloides* biohorizon: *Chamoussetia crobyloides* (Quenstedt),

<sup>1</sup> Stratigraphic subdivision of the Lower Callovian is based on ammonites according to Gulyaev (2005).



**Table 1.** Numbers of ostracodes in studied sample

Sample no. Ostracodes studied	3	4	6	7	8	9
<i>Lophocythere scabra</i> Triebel	♀-18 r., 29 l. ♂-19 r., 11 l. 2 compl., 28 frag. =107	♀-21 r., 26 l. ♂-15 r., 2 l. 17 frag. =81	♀-3 r., 4 l. ♂-2 l. 11 frag. =20	♀-7 r., 8 l. ♂-5 r., 3 l. 9 frag. =32	♀-21 r., 24 l. ♂-37 r., 10 l. 2 compl., 18 frag. =112	♀-18 r., 20 l. ♂-12 r., 10 l. 10 compl., 8 frag. =78
<i>Eripleura prolongata</i> (Sharapova)	5 r., 5 l. 1 frag. =11	4 r., 3 l. =7	4 r., 1 l. 3 frag. =8	5 r., 1 frag. =6		1 r.
<i>Praeschuleridea wartae</i> Błaszyk	7 r., 6 l., 1 frag. =14			3 r., 1 l. =4	8 r., 7 l., 2 compl., 6 frag. =23	1 l., 2 r., 2 compl. =5
<i>Galliaecytheridea legitima</i> (Lüb.)	3 l.	1 l.		7 r., 8 l. =15		1 r.
<i>Neurocythere cruciata franconica</i> (Triebel)	1 r.	1 r., 1 frag. =2			6 r., 4 l. =10	
<i>Pleurocythere kurskensis</i> sp. nov.	♀-11 r., 23 l. ♂-17 r., 6 l. 8 frag. =65	♀-2 r., 6 l. >♂-3 r., 6 l. 3 frag. =20	♀-8 r., 6 l. ♂-8 r., 3 l. 3 frag. =28	♀-4 r., 2 l. ♂-2 r. =8		
<i>Pseudohutsonia wienholzae</i> sp. nov.	1 r., 1 l. =2	2 r., 2 l., 2 frag. =6	1 r., 1 frag. =2	1 r., 2 l. =3		
<i>Parariscus octoporalis</i> Błaszyk	1 l.			1 frag.		
<i>Neurocythere flexicosta flexicosta</i> (Triebel)	1 r., 1 l. =2	1 r.				
<i>Aphelocythere</i> aff. <i>hamata</i> Plumhoff	1 r., 1 l. =2					
<i>Procytherura reticulata</i> Brand	1 r.					
<i>Galliaecytheridea</i> aff. <i>spinosa</i> Kilenyi	2 r.	3 r. 1 compl. =5				
<i>Fastigatocythere interrupta directa</i> Wienholz					♀-9 r., 19 l. ♂-14 r., 3 l. 5 frag. =50	♀-2 r., 1 l. ♂-1 r. =4

*Pseudocadoceras* cf. / aff. *boreale* Buckman, *Keplerites* (*Gowericeras*) *gowerianus toricelli* (Oppel), *Toricellites approximatus* Buckman, *Parachoffatia* (?) sp., *Homoeoplanulites* (?) *lobatus* (Buckman). The ostracodes found here includes *Lophocythere scabra* Triebel, 1951, *Praeschuleridea wartae* Błaszyk, 1967, *Pleurocythere kurskensis* sp. nov., *Parariscus octoporalis* Błaszyk, 1967, *Neurocythere flexicosta flexicosta* (Triebel, 1951), *N. cruciata franconica* (Triebel, 1951), *Galliaecytheridea legitima* (Lübimova, 1955), *G.* aff. *spinosa* Kilenyi, 1969, *Eripleura prolongata* (Sharapova, 1939), *Procytherura reticulata* Brand, 1990, *Aphelocythere* aff. *hamata* Plumhoff, 1967, and *Pseudohutsonia wienholzae* sp. nov.

The layers overlying the lower layer contain ammonites of the *K. gowerianus gowerianus* biohorizon: *Chamoussetia chamousseti* (Orbigny), *Keplerites* (*Gowericeras*) *gowerianus gowerianus* (Sowerby), *Toricellites approximatus* Buckman, *Proplanulites*

(*Proplanulites*) *koenigi* (Sowerby), and *P. (P.) capistratus* Buckman. The ostracode assemblage occurring in this ammonite biohorizon is less diverse: *L. scabra*, *Pr. wartae*, *Pl. kurskensis*, *Par. octoporalis*, *G. legitima*, *E. prolongata*, and *Ps. wienholzae*.

Morphological and taxonomic boundary between ammonite assemblages is vague. Gradual changes in the characters of ammonites in phyletic lineages and changes in the proportions of their taxa occur within 1- to 1.5-m-thick interval. Thickness, 4.5–5 m.

#### *The koenigi* Zone, *curtilobus* Subzone

Bed 3. Clay somewhat darker than in bed 2, with numerous inclusions of yellowish sandy clay, pyritized bioturbations, and rare small calcareous-clayey phosphorites. Flattened concretions of light gray marl occur throughout the bed. The boundary with the underlying bed is irregular with clear signs of erosion. The bound-

ary is marked by small black phosphorite pebbles (including fragmentary ammonite casts of *Kepplerites* (*Gowericeras*), *Proplanulites* and *Chamoussetia*), rolled and eroded belemnite rostra and shell detritus. The bed contains abundant ammonites, belemnites, bivalves, gastropods, and brachiopods. The preservation of fossils is much as in bed 2. The lower two-thirds of the bed contain the ammonite assemblage of the *K. indigestus* biohorizon: *Kepplerites* (*Gowericeras*) *indigestus* Buckman, *Toricellites lahuseni* (Parona et Bonarelli), *Proplanulites* (*Proplanulites*) cf. *ferruginosus* Buckman, *P. (P.)* cf. *excentricus* Buckman. This interval yielded ostracodes *Fastigatocythere interrupta directa* Wienholz, 1967, *L. scabra*, *Pr. wartae*, *N. cruciata franconica*, *G. legitima*, and *E. prolongata*. Thickness, 16–19 m.

#### *Distribution of ostracodes over the section and its interpretation*

Three distinct assemblages are defined based on irregularities in the distribution of ostracodes over the section that show themselves both in taxonomy and in abundance (Fig. 2a).

The first assemblage occurs in sediments of the upper part of the *subpatruus* Zone (lower part of bed 2). This part of the section is richest in ostracodes. The twelve identified species include *Lophocythere scabra*, *Praeschuleridea wartae*, *Pleurocythere kurskensis*, *Parariscus octoporalis*, *Neurocythere flexicosta flexicosta*, *N. cruciata franconica*, *Galliaecytheridea legitima*, *G. aff. spinosa*, *Eripleura prolongata*, *Procytherura reticulata*, *Aphelocythere aff. hamata*, and *Pseudohutsonia wienholzae*. Four of them (*N. flexicosta flexicosta*, *A. aff. hamata*, *P. reticulata*, and *G. aff. spinosa*) are found only at this stratigraphic level. The most abundant are *L. scabra*, 55% of the ostracode specimens. In general, the ostracode assemblage is both diverse and abundant.

Up the section, the community gradually becomes poorer, retaining the composition inherited from the underlying sediments. Only seven ostracode species were found (assemblage 2) in the *gowerianus* Subzone of the *koenigi* Zone. The upper part of the assemblage range documents last occurrences of *Pl. kurskensis*, *Par. octoporalis*, and *P. wienholzae*. In addition, this level did not yield *N. cruciata franconica*, which reoccur higher up the section. Noteworthy is the overall reduction in the abundance of all species. In addition, the dominant species (*L. scabra*) constitutes slightly less than half of the total abundance.

The third assemblage occurs in the lower part of the *curtilobus* Subzone of the *koenigi* Zone and has an even lower diversity, with only six known species. This is a slight decrease compared to the second assemblage, but nearly twofold decrease in comparison with the first one. This level contains the first appearance of *Fastigatocythere interrupta directa* Wienholz, 1967, which

gradually replaces the former dominant. The total ostracode abundance of the third assemblage is markedly greater than that of the second, although it is lower than that of the first assemblage.

In general, the ostracode associations studied show a complex taxonomic structure and significant abundance that is typical of the mature, stable sublittoral communities. But the presence of a marked dominant species indicates instability of one or more environmental factors, which is common in shallow zones. Here, the basin's environment is more strongly affected by weather patterns, continental runoff, drift of organic matter, effects of wave hydrodynamics, etc. The dominant species *L. scabra* characterizes muddy grounds as indicated by the sculpture common to inhabitants of muddy biotopes. The characteristic features of this sculpture include a few broad flat ribs parallel to ventral edge, and thin flat vertical ribs tending to disintegrate into individual spines. This type of sediments accumulates under condition of inactive bottom hydrodynamics, and thus may indicate eutrophic oxygen depletion of bottom ooze and, possibly, bottom waters.

As inferred from the decrease in taxonomic diversity upward the section (from 12 species in the first assemblage to seven in the second, and six in the third), it is likely that the environmental conditions of benthic ostracode communities continuously deteriorated. In earlier works on Upper Jurassic ostracodes and ammonites of middle Russia (Tesakova and Rogov, 2004a, 2004b, 2005, 2006a, 2006b; Tesakova, 2008) these changes in ostracode assemblages were correlated with a basin undergoing deepening. Thus, a gradual deterioration of ostracode environment can be associated with progressive transgression and deepening of the marine basin, resulting in penetration of cold waters to the bottom levels, and, which is more likely, with the formation of disoxic and anoxic conditions in the bottom and ooze waters resulting from the progressive eutrophic stagnation.

In general, for the ostracodes studied we assume sublittoral conditions with very slow currents at the bottom and, as a consequence, widespread muddy grounds. The depth exceeded the depth of wave activity as shown by the absence of wave action signs. This conclusion agrees well with lithological and taphonomic observations including well-washed clay, pyritization, abundant bioturbation signs, mainly completely preserved shells, etc.

Particularly noteworthy is the behavior of the diversity and abundance curves of ostracode species. They change in the same direction at some levels of the section (samples 3, 4, 6, 7, 9) and in the opposite direction at the others (sample 8) (Fig. 2b). In the first case, slow and gradual environmental change caused coordinated changes in the diversity and abundance of ostracode community. In the second case, rapid environmental change strongly stressed the community that responded by a sharp decrease in the species diversity and an

abrupt increase in the abundance of buffer forms. It is this type of short-term event that occurred at the level of sample 8. The community structure decreased to four species, whereas the abundance of dominant species sharply increased. Notably, the level of sample 8 is directly above the short-term stratigraphic hiatus corresponding to the base of *K. indigestus* biohorizon of the *curtilobus* Subzone, *koenigi* Zone.

#### *Stratigraphic significance of ostracodes*

The ostracodes studied represent a relatively stratigraphically homogeneous association. Their complete stratigraphic ranges are inferred from the works of Sharapova, 1937, 1939; Mandelstam, 1949; Lüdimova, 1955, 1956; Pyatkova and Permyakova, 1978, Andreev et al., 1999; Triebel, 1951; Bizon, 1958; Lutze, 1960; Błaszyk, 1967; Wienholz, 1967; Bate, 1969; Whatley, 1970; Kaeffer et al., 1976; Hergreen et al., 1984; Dépêche, 1985; Bielecka et al., 1988; Brand, 1990; Witte and Lissenberg, 1994; Whatley et al., 2001; Tesakova, 2003, 2008.

The species *F. interrupta directa* and *N. cruciata franconica* are strictly Lower Callovian; *N. flexicosta flexicosta*, according to the literature, occurs throughout the Callovian; *L. scabra* appears in the Lower Callovian and also occurs in the Oxfordian; *Pr. wartae*, *Par. octoporalis*, and *P. reticulata* occur throughout the Bathonian and Callovian. Thus, these species co-occur only in the Lower Callovian. Two more species, *G. legitima* and *E. prolongata*, were previously known only starting from the Middle Callovian and ranging into the Oxfordian. In the Mikhailovskii Mine section, they occur in the upper part of the *subpatruus* Zone and at the lower part of the Lower Callovian *koenigi* Zone. Most likely, they just have not been found at this stratigraphic level before. *A. aff. hamata* was previously found only in the Upper Callovian of the Peski section in the Moscow Region. It apparently occurs throughout the Callovian. The stratigraphic range of the three remaining species, *Pleurocythere kurskensis*, *Pseudohutsonia wienholzae*, *Galliaecytheridea aff. spinosa*, cannot be established from the literature and they, for the time being, are considered characteristic of the Lower Callovian.

Ostracodes previously studied from the Lower Callovian of the Kursk Region, also from the Mikhailovskii Mine section, were assigned to ten species (*Lophocythere scabra*, *L. interrupta* Triebel, 1951, *Neurocythere cruciata cruciata* (Triebel, 1951), *N. flexicosta* (Triebel, 1951), *N. zmeinkensis* (Tesakova, 2003), *Praeschuleridea wartae*, *Parariscus octoporalis*, *Procytherura* sp., *Pleurocythere regularis* Triebel, 1951, and *P. juvenes* Lüdimova, 1956). This association defined beds with *Praeschuleridea wartae*–*Pleurocythere regularis* comprising deposits of the *koenigi* Zone (Tesakova, 2003).

In this paper, for some of the above cited forms a refined identification is given. *Lophocythere interrupta* is reidentified as *Fastigatocythere interrupta directa*; *Neurocythere cruciata cruciata*, as *Neurocythere cruciata franconica*; *N. flexicosta*, as *N. flexicosta flexicosta*; *Procytherura* sp. is redefined as *Procytherura reticulata* Brand. The form earlier called *Pleurocythere regularis* and utilized as an index species was misidentified (Tesakova, 2003). This form is described here as a new species *Pl. kurskensis*. Therefore, the earlier defined ostracode beds should now be referred to as *Pr. wartae*–*Pl. kurskensis*. In addition, the revision of the holotype of *Pleurocythere juvenes* Lüdimova, 1956 from the Lower Callovian deposits of the Dnieper-Donets Depression showed that it represents a larva of the *Pleurocythere* sp. In our case, *Pleurocythere juvenes* from the Tesakova, 2003 is a larva of *Pl. kurskensis*.

Thus, the comparison of the ostracode assemblages studied with the associations from *Pr. wartae*–*Pl. regularis* Beds shows their strong similarity. In particular, they share *Praeschuleridea wartae*, *Lophocythere scabra*, *F. interrupta directa*, *Neurocythere cruciata franconica*, *N. flexicosta flexicosta*, *Pleurocythere kurskensis*, *Parariscus octoporalis*, and *Procytherura reticulata*.

It should also be taken into account that the core of the Lower Callovian ostracode assemblage described above is formed by the most abundant species *L. scabra*, *Pr. wartae*, and *Pl. kurskensis*; this is fully consistent with data obtained previously for the *Pr. wartae*–*Pl. regularis* Beds (Tesakova, 2003).

It should be recalled that ostracodes from *Pr. wartae*–*Pl. kurskensis* Beds have been previously known only from the *koenigi* Zone (Tesakova, 2003). In the present study we report ostracodes from the beds underlying this zone, the uppermost part of the *subpatruus* Zone (*Ch. crobyloides* biohorizon) (Fig. 2a). Eight of the 12 species found here occur also in the overlying beds, in the *koenigi* Zone. Another two species (*N. flexicosta flexicosta*, *P. reticulata*) have been reported earlier from the *koenigi* Zone of this section (Tesakova, 2003). One species (*A. aff. hamata*) was known from the upper Callovian of the Moscow Region (Tesakova, 2003). Only *G. aff. spinosa* was found at this stratigraphic level. Thus, it is not possible to define the ostracode association from the *subpatruus* Zone as separate beds with ostracodes.

The available material was sufficient to clarify the taxonomic status of several forms, including one index species, and to expand the stratigraphic range of beds with *Pr. wartae*–*Pl. kurskensis* to include deposits of the upper *subpatruus* Zone. The range of ostracode beds corresponds to three ammonite biohorizons: *Chamoussetia crobyloides*, *Kepplerites gowerianus gowerianus*, and *K. indigestus*.

The faunal composition of the beds with *Pr. wartae*–*Pl. kurskensis* has been extended owing to the ostracode species *Galliaecytheridea legitima*, *G. aff. spi-*

## Explanation to Plate 2

**Figs. 1–4.** *Praeschuleridea wartae* Błaszcyk: sample 3, *subpatruus* Zone: (1) specimen, no. 300–3345, left valve, female, external view; (2) specimen, no. 300–3444, right valve, male, external view; (4) specimen, no. 300–3543, left valve, female, internal view; (3) specimen, no. 300–273, left valve, male, external view, sample 8, *koenigi* Zone, *curtilobus* Subzone.

**Fig. 5.** *Galliaecytheridea legitima* (Lübimova): specimen, no. 300–2056 left valve, female, lateral view, sample 4, *subpatruus* Zone.

**Figs. 6 and 7.** *Galliaecytheridea* aff. *spinosa* Kilenyi: sample 3, *subpatruus* Zone: (6) specimen, no. 300–16, right valve, female, lateral view; (7) specimen, no. 300–4638 right valve, male, lateral view.

**Figs. 8–11.** *Eripleura prolongata* (Sharapova): (8) specimen, no. 300–1561, left valve, female, lateral view, sample 6, *koenigi* Zone, *gowerianus* Subzone; (9) specimen, no. 300–3741, right valve, female, lateral view, sample 3, *subpatruus* Zone; (10) specimen, no. 300–2155, left valve, male, lateral view, sample 4, *subpatruus* Zone; (11) specimen, no. 300–2353 right valve, female, lateral view, sample 4, *subpatruus* Zone.

**Fig. 12.** *Aphelocythere* aff. *hamata* Plumhoff: specimen, no. 300–14, right valve, lateral view, sample 3, *subpatruus* Zone.

**Fig. 13.** *Parariscus octoporalis* Błaszcyk: specimen, no. 300–15, left valve, female, lateral view, sample 3, *subpatruus* Zone.

**Fig. 14.** *Procytherura reticulata* Brand: specimen, no. 300–1, right valve, male, lateral view, sample 3, *subpatruus* Zone.

**Figs. 15–18.** *Pseudohutsonia wienholzae* sp. nov.: sample 3, *subpatruus* Zone: (15) specimen, no. 300–762, right valve, female, lateral view; (16) specimen, no. 300–44, left valve, female, lateral view; sample 4, *subpatruus* Zone: (17) specimen, no. 300–31152, left valve, female, internal view; (18) holotype, no. 300–3246, right valve, female, lateral view.

*nosa*, *Eripleura prolongata*, *Aphelocythere* aff. *hamata*, and *Pseudohutsonia wienholzae*. The absence of *Neurocythere zmeinkensis* in the present Lower Callovian material from the Kursk Region is not surprising, because it used to be very rare according to earlier observations (Tesakova, 2003).

## SYSTEMATIC PALEONTOLOGY

The systematics of supraspecific taxa is according to Andreev et al. (1999).

The genus *Pleurocythere* is well known from the Middle Jurassic of Europe and has been repeatedly described in the literature. This is why instead of the full description we provide only synonymy and data on distribution, because the Lower and Middle Callovian pleurocytherids are restricted to the Kursk Region.

In contrast, descriptions of *Pseudohutsonia* and its few species are quite rare in the literature. Characters of the new species supplement the genus description. Therefore, this paper provides the description of this genus revised in the light of new data.

Order Podocopida

Suborder Cytherocopina

Superfamily Progonocytheracea Sylvester-Bradley, 1948

Family Pleurocytheridae Mandelstam, 1960

Genus *Pleurocythere* Triebel, 1951

*Pleurocythere kurskensis* Tesakova, sp. nov.

Plate 3, figs. 1–3, 5–8

*Pleurocythere regularis*: Tesakova, 2003, p. 204, pl. 15, figs. 6–9.

**Holotype.** Department of Paleontology of the Moscow State University (KPMGU) no. 300–2447, left valve of male, Russia, Kursk Region, KMA; Middle Jurassic, Lower Callovian *subpatruus* Zone.

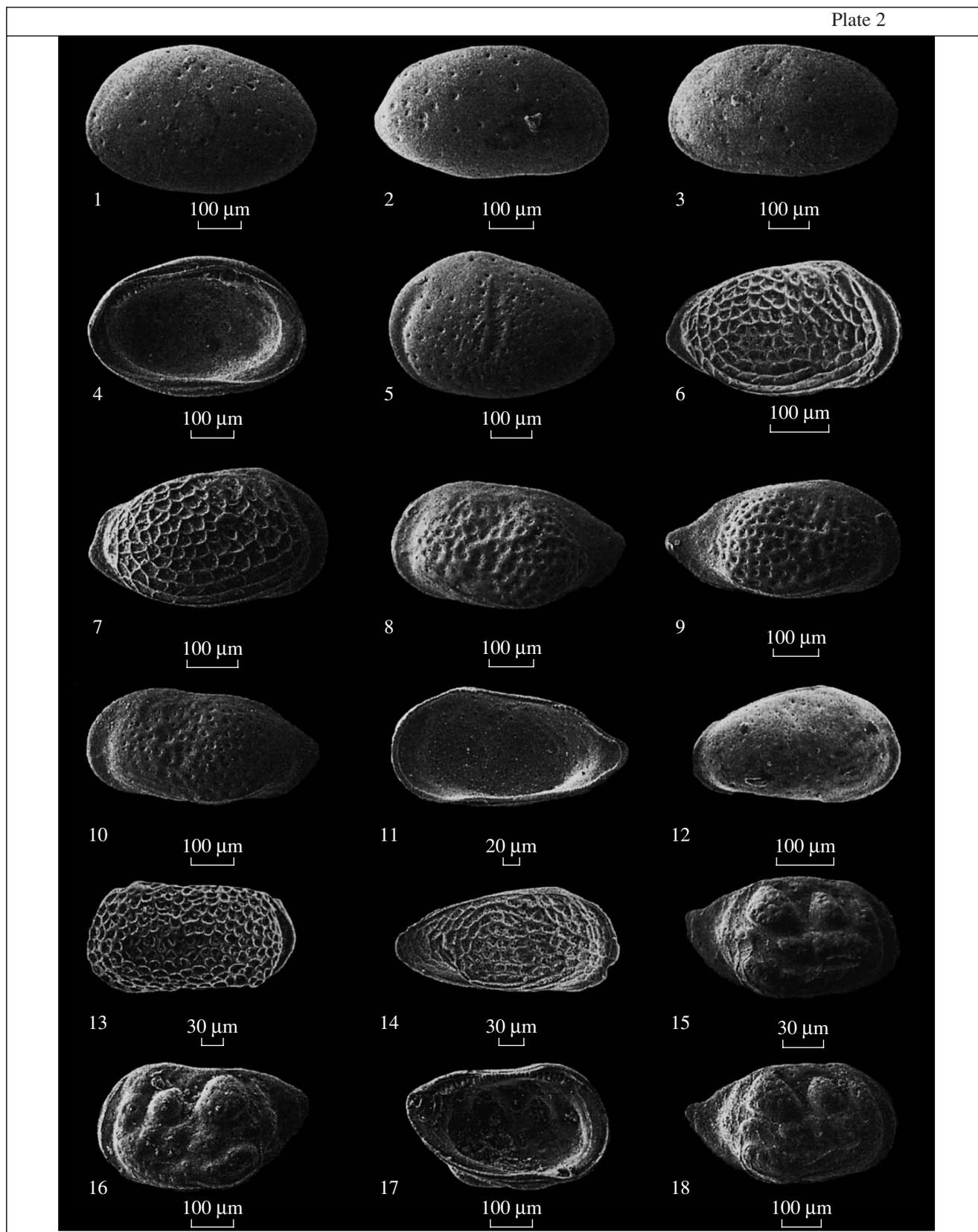
**Etymology.** From the city of Kursk.

**Description.** Carapace is medium sized, elongate, elongated oval, and moderately convex. Left valve

is larger than the right one; the overlap is mostly expressed at anterodorsal and posterodorsal edges. The test's anterior part is high, rounded, on right valves more dorsally truncated than in left valves. The flattened rear margin is lower than the anterior one. The posterior margin in right valves is rounded-rectangular, tilted toward the ventral side; it is more rounded and has a rounded-triangular shape in left valves. The dorsal edge is straight or slightly concave in the middle, tilted to the rear end of the carapace. In right valves it is connected with the posterior margin with a ledge; in left valves, more smoothly. The ventral margin is almost straight, not parallel to dorsal, slightly concave in the anterior third. The greatest length is in the midheight of the test. The greatest height is in the anterior third, and the greatest thickness, at the posterior third of the valve. The outer surface of the valve bears four distinct band-like longitudinal ribs. Middle and upper ventral ribs connect at the anterior margin of the test to form a single pointed short rib, reaching the front margin where it curves ventrally. The lower ventral rib is slightly shorter than the upper one. They connect at the front third of the valve. The dorsal rib, shortest of all, is parallel to the dorsal margin or convex. It deviates to the ventral side at the posterior margin and at the anterior third of the carapace. It connects with the medial edge to form a closed elongated loop. A short oblique rib reaching midlength of the anterior margin occurs in the upper part of the anterior part of the test. The entire outer surface of valves, except flattened parts of the front and rear ends and ribs, is covered with small rounded fossae. They are most conspicuous and are arranged in two faint horizontal rows between the dorsal and median ribs, the median and upper ventral ribs, and between the upper and lower ventral ribs. Depending on the development degree of pitted sculpture, the oblique rib can connect with the medial rib or remain separate. The posterior margin bears a small distinct tubercle.

Female valves are shorter and higher than in males.

Plate 2



## Explanation to Plate 3

**Figs. 1–3, 5–8.** *Pleurocythere kurskensis* sp. nov.: sample 3, *subpatruus* Zone: (1) specimen, no. 300–4033, right valve, female, lateral view; (2) specimen, no. 300–964, right valve, male, lateral view; (3) specimen, no. 300–43 left valve, female, dorsal view; (5) specimen, no. 300–863, left valve, female, lateral view; (6) specimen, no. 300–3939, left valve, male, internal view; (7) specimen, no. 300–4134, left larval valve, lateral view; (8) holotype, no. 300–2447, left valve, male, lateral view, sample 4, *subpatruus* Zone.

**Figs. 4, 9–11.** *Lophocythere scabra* Triebel: (4) specimen, no. 300–1957, complete valve, female, dorsal view, sample 9, *koenigi* Zone, *curtilobus* Subzone; (9) specimen, no. 300–2548, right valve, male, lateral view, sample 4, *subpatruus* Zone; sample 3, *subpatruus* Zone: (10) specimen, no. 300–1166, right valve, female, lateral view; (11) specimen, no. 300–1267, left valve, male, lateral view.

**Figs. 12–15.** *Fastigatocythere interrupta directa* Wienholz: sample 8, *koenigi* Zone, *curtilobus* Subzone: (12) specimen, no. 300–5029, right valve, male, lateral view; (13) specimen, no. 300–7, right valve, female, lateral view; (14) specimen, no. 300–6, left valve, male, lateral view; (15) specimen, no. 300–4, left valve, female, lateral view.

**Figs. 16 and 17.** *Neurocythere cruciata franconica* (Triebel): sample 8, *koenigi* Zone, *curtilobus* Subzone: (16) specimen, no. 300–4831, right valve, female, lateral view; (17) specimen, no. 300–8, left valve, female, lateral view.

**Figs. 18 and 19.** *Neurocythere flexicosta flexicosta* (Triebel): (18) specimen, no. 300–10, right valve, female, lateral view, sample 4, *subpatruus* Zone; (19) specimen, no. 300–11, right valve, female, lateral view, sample 3, *subpatruus* Zone.

Measurements, mm:	L	H	T
Holotype no. 300–2447	0.70	0.37	
Specimen no. 300–4033	0.54	0.3	
Specimen no. 300–964	0.63	0.29	
Specimen no. 300–43	0.65		0.17
Specimen no. 300–863	0.60	0.33	
Specimen no. 300–3939	0.67	0.35	
Specimen no. 300–4134	0.54	0.29	

**Variability.** Weakly expressed in pitted sculpture, presence or absence of connections between the oblique and median ribs and the shape of the posterior edge.

**Comparison.** The new species is most closely similar to *P. elliptica* Błaszcyk, 1967 from the Bathonian of Poland (Błaszcyk, 1967, p. 24, pl. 6, figs. 1–4, Fig. 5), from which it differs in the finely pitted biserial sculpture rather than four or three serial cellular sculpture in the intercostal surface. From *P. richteri* Triebel, 1951 from the Middle Jurassic of Germany (Triebel, 1951, p. 89, pl. 44, figs. 1–7) from the Upper Bajocian of Poland (Bielecka et al., 1988, p. 173, pl. 68, fig. 6) and Upper Bajocian of the Dnieper–Donetsk Depression (DDD) (Pyatkova and Permyakova, 1978, p. 150, pl. 65, figs. 5, 6) it is distinct in missing middle depression in the center of the valve, pitted sculpture (instead of smooth type in the compared species), loop-like dorsal ribs and the absence of short rib in anterodorsal part of the valve that connects to the medial oblique rib. From *P. impar* Triebel, 1951 from the Middle Jurassic of Germany (Triebel, 1951, p. 91, pl. 45, figs. 8–12) from the Upper Bajocian–Middle Bathonian of Poland (Błaszcyk, 1967, p. 24, pl. 5, figs. 4–7; Bielecka et al., 1988, p. 173, pl. 68, fig. 4) and the lower Bathonian of DDD (Pyatkova and Permyakova, 1978, p. 149, pl. 65, fig. 1), *P. regularis* Triebel, 1951 from the Middle Jurassic of Germany (Triebel, 1951, p. 92, pl. 45, figs. 13–16) and upper Bajocian–Middle Bathonian of Poland (Bielecka et al., 1988, p. 173, pl. 68, fig. 5), *P. connexa* Triebel, 1951 from the Middle Jurassic of

Germany (Triebel, 1951, p. 93, pl. 46, figs. 19–22), from the Upper Bajocian–Bathonian of Poland (Błaszcyk, 1967, p. 23, pl. 5, figs. 1–3; Bielecka et al., 1988, p. 173, pl. 68, fig. 3) and the upper Bajocian of DDV (Pyatkova and Permyakova, 1978, p. 149, pl. 64, fig. 4), *P. longicosta* Triebel, 1951 from the Middle Jurassic of Germany (Triebel, 1951, p. 93, pl. 46, figs. 23–25), and *P. favosa* Triebel, 1951 from the Middle Jurassic of Germany (Triebel, 1951, p. 93, pl. 46, figs. 19–22) it differs in finely pitted biserial, rather than the cellular three-four serial sculpture in the intercostal space, missing short rib connecting the oblique with medial ribs, and loop-like dorsal rib connected anteriorly with the median rib. In addition, it differs from *P. impar* and *P. favosa* in the well-pronounced dorsal rib in the left valves, from the *P. impar*, *P. longicosta*, *P. favosa*, and *P. regularis*, in the median and upper ventral ribs connecting at the anterior end into a short oblique rib; and from *P. longicosta*, in the middle rib that does not extend posteriorly to the rear margin.

**Remarks.** This species was previously found in the same section in *koenigi* and *jason* biozones and misidentified as *Pleurocythere regularis* Triebel (Tesakova, 2003). The mistake was found by Dr. Matthias Franz (Geological Survey of Freiburg, Germany) whom the authors sincerely thank.

**Material.** Eighty-five well-preserved valves and complete tests from the *subpatruus* biozone, and 103 valves and complete tests of good preservation from *koenigi* Zone, Lower Callovian; eight well-preserved valves from *jason* biozone, Middle Callovian; Mikhailovskii Mine section (KMA), Kursk Region.

#### Family Cytheruridae G. Müller, 1894

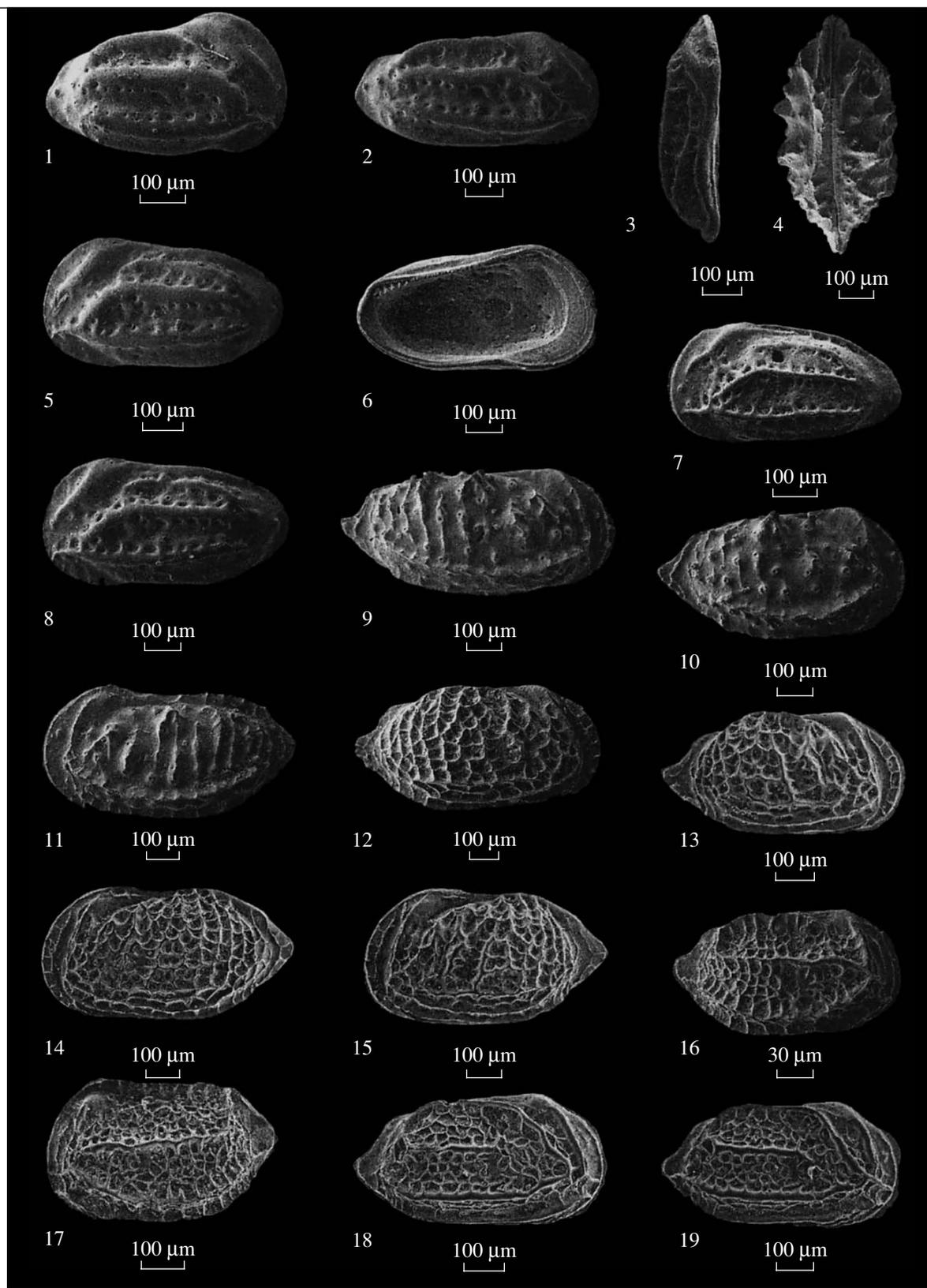
Subfamily Cytherurinae G. Müller, 1894

#### Genus *Pseudohutsonia* Wienholz, 1967

*Pseudohutsonia*: Wienholz, 1967, p. 35.

**Type species.** *Pseudohutsonia tuberosa* Wienholz, 1967, Middle Jurassic, Middle Callovian, *jason* and *castor et pollux* zones, north-eastern Germany.

Plate 3



**Diagnosis.** “Sexual dimorphism well developed, male carapace 1/6 longer than those of females. Anterior end broadly rounded, posterior end pointed at mid-height and forms caudal process. Ventral region convex, ascending to posterior end. Dorsal margin weakly convex at antero- and posterodorsal angles and weakly concave in the middle. Left valve larger than right valve. Sculpture tubercular; tubercles correspond to depressions on valve inner side. Thick bulge parallel to anterior and ventral margins, most prominent in middle part, expanding posteriorly and terminating in carapace posterior third. Largest tubercle above midheight, behind midlength. Second smaller tubercle in valve anterior part in variable positions, as common in different representatives of this genus. Another two or three small tubercles occasionally present between or below two main tubercles. Remaining valve surface covered with thin reticulation with better visible vertical elements.

Eye tubercle absent.

Adductor scar as straight vertical line composed of four oval imprints. Hinge antimerodont with two terminal crenulated teeth and crenulated groove in right valve”.

**Species composition.** Five species from the Middle–Upper Jurassic of Europe (Upper Bathonian–Oxfordian).

**Comparison.** From *Looneyella* Peck, 1951 from the Lower Cretaceous of North America (Howe et al., 1961, p. 329) and *Hutsonia* Swain, 1946 from the Jurassic of North America (Howe et al., 1961, p. 328), similar in carapace shape and tubercular sculpture, the genus differs in crenulated middle part of the hinge, and concave tubercles on the inner side of the valve, as well as significantly higher posterior margin. From *Otocythere* Triebel et Klingler, 1959 from the Lower–Middle Jurassic of Europe (Reyment et al., 1961, p. 297), similar in carapace shape and partly in sculpture, differs in short terminal teeth and a long middle part of the hinge. From the most similar in carapace shape and hinge structure *Pseudobythocythere* Mertens, 1956 from the Cretaceous of Germany (Nikolaeva and Andreev, 1999, p. 57; Sylvester-Bradley and Kesling, 1961, p. 268) the described genus differs in missing pronounced vertical depression and corresponding convexity on the inner surface of the valve.

*Pseudohutsonia wienholzae* Tesakova, sp. nov.

Plate 2, figs. 15–18

**Holotype.** KPMGU, specimen no. 300–3246, right valve, Russia, Kursk Region, KMA; Middle Jurassic, Lower Callovian *subpatruus* Zone.

**Etymology.** In honor of the micropaleontologist Eva Wienholz from Germany.

**Description.** Carapace is small, elongated oval, moderately convex. Left valve is slightly larger than the right valve; it covers most of anterodorsal and posterodorsal margins. The anterior margin is high, flattened,

archlike rounded, slightly truncated at the dorsal side, which is more pronounced in the right valve. The posterior margin is lower than the anterior one, also flattened, rounded-triangular in shape on the left valves, in right valve it is lower than in left ones and curves upward. Dorsal margin is straight or slightly concave in the middle of the left valve and connects smoothly with the posterior margin. In right valves, the dorsal margin is also straight or slightly convex and connects with the posterior margin with the small ledge. The ventral margin of both valves is straight, slightly concave in the front third, almost parallel to dorsal margin, slightly converge posteriorly along a smooth arch. The greatest length is at midheight of the carapace. The highest part, as well as the maximum thickness, is located in the posterior third of the valve. The entire anterior margin of the valve is contoured by a thickening running to the ventral side and ending posteroventrally with a slightly elongated large tubercle. The valve surface bears two more, similar large tubercles. The largest rounded-triangular one is located near the valve center in its posterodorsal portion. The second, smaller rounded tubercle is located at the same height anteriorly. The relief-forming tubercles correspond to a number of proportionally sized holes on the inner valve surface. Below major tubercles, at the valve midheight, there is a horizontal row of three smaller elongated tubercles tending to merge forming the second lateral thickening parallel to the ventral margin. A very small and rounded seventh tubercle is situated posteriorly in the posterior third of the valve as an extension of the lateral tubercle row. The entire outer surface of the valve, including tubercles, but excluding the flat anterior margin, is covered with a network of intersecting very thin ribs producing a scaly pattern. Inner spaces of these “scales” are convex on large tubercles and flat between them. The reticulate pattern is poorly expressed at the flattened posterior valve margin due to low height of ribs. Distinct rare large pores are mostly located on convex relief elements.

Measurements, mm:	L	H	T
Holotype no. 300–3246	0.53	0.30	
Specimen no. 300–762	0.46	0.26	
Specimen no. 300–44	0.46	0.28	
Specimen no. 300–3152	0.50	0.30	

**Variability.** Shape and size of large tubercles may be slightly variable. Smaller tubercles of the horizontal row occasionally merge forming a short horizontal thickening. Microsculpture elements, as fine surface riblets, may be indistinct, especially at the posterior margin.

**Comparison.** From the most similar *P. tuberosa* Wienholz, 1967 from the Middle Callovian *jason* and *castor et pollux* zones, northeastern Germany (Wienholz, 1967, p. 36, pl. 4, figs. 45–48a, pl. 5, figs. 48b, 51–52) and Middle Callovian of the Netherlands (Herngreen et al., 1983, pl. 4, fig. 10–12) the new species is distinct in the lack of a small dorsal convexity between

the anterior large tubercle and dorsocentral tubercles, the existence of three small tubercles (rather than one larger) below these tubercles, as well as in more coarsely reticulate microsculpture, do not forming vertical ribs at the posterior margin. From *P. prosopon* Whatley, Ballent, and Armitage, 2001 from the Lower Oxfordian of Scotland (Whatley, 1970, p. 351, pl. 15, figs. 15, 20, 21) and France (Bizon, 1958, p. 29, pl. 3, figs. 12–14, pl. 4, figs. 16, 17), Callovian of southern England (Whatley, Ballent, and Armitage, 2001, p. 156, pl. 6, figs. 1–9), and the Middle and Upper Callovian in the Netherlands (Herngreen et al., 1983, pl. 5, figs. 1–3; Witte et Lissenberg, 1994, p. 27, pl. 1, fig. 10) it differs in the lack of small dorsal convexity, in the presence of three small midvalve tubercles, in contrast to only one also small one in *P. prosopon*, and in weakly expressed reticulate microsculpture, compared to the well-developed cellular microsculpture in the latter form. From the Bathonian *P. subtilis* (Oertli, 1959) from France and England (Bate, 1969, p. 431, pl. 14, figs. 7, 8), in more coarsely reticulate microsculpture not forming vertical ribs posteriorly; in three, instead of a single, small tubercles in the horizontal row below the main tubercles; in location of the anterior main tubercle at the same level with the posterior one, instead of the lower position of the anterior tubercle in the compared species, and strongly posteriorly expanding ventral thickening.

**Remarks.** *Pseudohutsonia hebridica* Whatley, 1970 from the Upper Callovian–Lower Oxfordian of Scotland (Whatley, 1970, p. 349, pl. 15, fig. 5–10, 12–14, 16, 18) by the presence of a large central convexity and three subvertical ribs in the posterior part of the carapace should be attributed to the genus *Balowella* Wienholz, 1969 and is synonymous with *Balowella attendens* (Lübimova, 1955) from the Middle Callovian of the Ulyanovsk Region (Lübimova, 1955, p. 74, pl. 9, fig. 2) and the Upper Callovian of Moscow and Ryazan regions, Russia (Tesakova, 2003, p. 167, pl. 2, fig. 16–20).

**Material.** Eight well-preserved valves from the *subpatruus* Zone and five well-preserved valves from the *koenigi* Zone, Lower Callovian; Mikhailovskii Mine section (KMA), Kursk Region.

### CONCLUSIONS

The Lower Callovian section in the Mikhailovskii Mine yielded 13 ostracode species belonging to ten genera and representing a shallow marine sublittoral association. Three distinct assemblages are defined based on the distributional patterns of diversity and abundance along the section. The assemblages presumably correspond to phases of progressive transgression. The ostracodes studied correspond to the already known beds with *Praeschuleridea wartae*–*Pleurocythere regularis*. The redefinition as *Pl. kurskensis* sp. nov. of a species that was previously incorrectly assigned to *Pl. regularis*, leads to the change of the strati-

ton name as beds with *Pr. wartae*–*Pl. kurskensis*. The stratigraphical range of the beds was extended to include ostracodes of the upper *subpatruus* Zone, and five more species have been added to the taxonomic list. The beds with ostracodes correspond to the range of three ammonite biohorizons, *Chamoussetia croblyoides*, *Kepplerites gowerianus gowerianus*, and *K. indigestus*. Because no ostracodes were found in the lower *elatmae* Zone, and a stratigraphical break, corresponding to the four lower biohorizons of the *subpatruus* Zone, occurs between *P. elatmae* and *Ch. croblyoides* biohorizons, the lower boundary of these beds is still undefined.

Two new species of the Lower Callovian ostracodes, *Pleurocythere kurskensis* sp. nov. and *Pseudohutsonia wienholzae* sp. nov., were described.

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