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NEW FINDINGS OF CENOZOIC MARINE INVERTEBRATE FAUNA FROM THE WESTERN PART OF THE EAST-EUROPEAN PLAIN

New findings of marine faunal remains from Quaternary and possibly older Cenozoic strata from different regions of Belarus as well as of the European part of Russia are reported in the present article. Despite the prolonged discussion about the genesis of surficial deposits of the north-western part of the East European Plain, in Belarus the concept of continental and predominantly glacial origin of unconsolidated sediments of the upper part of the sedimentary cover is usually considered as firmly established and is not disputed in regional-geological literature. New paleontological evidence suggesting a marine nature of several kinds of these deposits was recently obtained. In some localities of varved and thin-bedded clays and silts, which are considered in the framework of the glacial theory as glacial-lacustrine, marine microfauna was discovered. The obtained results have the potential to become a basis for a revision of the common paleogeographic concept associating these sediments with Pleistocene glacial lakes. New findings of marine bivalve mollusks from surficial sandy and clayey sediments are also reported herein. They are represented by taxa widespread in the Pleistocene of Eastern Europe and some of them are typical mainly of the Black and Caspian Seas and their adjacent regions. Our study of the collected bivalve mollusks shows that Belarusian specimens are identical to those from other areas of the East European Plain. On the basis of the results reported below the authors suggest that several types of sedimentary accumulations, which are traditionally regarded as glacial, were in fact deposited in a marine setting.

Key words: Cenozoic; Pleistocene; marine invertebrates; Foraminifera; bivalve mollusks; varved deposits, surficial deposits; western part of the East European Plain.

Fig. 10. Table 3. Ref.: 53 titles.

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НОВЫЯ ЗНАХОДКІ ФАЎНЫ КАЙНАЗОЙСКІХ МАРСКІХ БЕСХРЫБЕТНЫХ НА ЗАХАДЗЕ УСХОДНЕ-ЕЎРАПЕЙСКАЙ РАЎНІНЫ

У артыкуле паведамляецца пра новыя знаходкі рэшткаў марской фаўны з чацвярцічных і, магчыма, больш старажытных кайназойскіх адкладаў з розных раёнаў Беларусі, а таксама еўрапейскай часткі Расіі. Нягледзячы на тое, што дыскусія пра паходжанне покрыўных адкладаў паўночна-заходняй часткі Усходне-Еўрапейскай раўніны адбываецца ўжо працяглы час, у Беларусі канцэпцыя кантынентальнага, пераважна ледавіковага, паходжання пясчана-глiністых утварэнняў верхняй часткі асадкавага чахла лічыцца бясспрэчнай і ў рэгіянальнай геалагічнай і палеанталагічнай літаратуры не абмяркоўваецца. Новыя палеанталагічныя сведчанні марской прыроды некаторых відаў паверхневых адкладаў дазваляюць крытычна паставіцца да гэтых поглядаў. У некалькіх месцазнаходжаннях стужкавых і тонкапластаватых глін і алеўрытаў, якія ў рамках ледавіковай тэорыі лічацца ледавікова-азёрнымі, выяўлена марская мікрафаўна. Атрыманыя вынікі могуць стаць адпраўной кропкай для рэвізіі агульнапрынятых палеагеаграфічных уяўленняў аб сувязі акумуляцыі падобных асадкаў

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з плейстацэнавымі ледавіковымі азёрамі. У артыкуле таксама прыведзены новыя знаходкі марскіх двухстворкавых малюскаў, прадстаўленых відамі, распаўсюджанымі ў плейстацэне і ў сучасную эпоху ва Усходняй Еўропе, у прыватнасці, у Чорным і Каспійскім морах і ў прылеглых да іх абласцях. Экзэмпляры малюскаў, знойдзеных у Беларусі, не адрозніваюцца ад знаходак з іншых раёнаў Усходне-Еўрапейскай раўніны. Асноўваючыся на гэтых матэрыялах, аўтары не выключаюць, што шэраг тыпаў адкладаў, што традыцыйна адносяцца да ледавіковых, на самой справе ўтвораны ў марскіх умовах.

Ключавыя словы: Кайназой; плейстацэн; марскія бесхрыбетныя; фарамініферы; двухстворкавыя малюскі; стужкавыя адклады; паверхневыя адклады; заходняя частка Усходне-Еўрапейскай раўніны.

Мал. 10. Табл. 3. Бібліягр.: 53 назвы.

Introduction. Previously there were only a few published reports about findings of marine faunal remains in surficial Late Cenozoic deposits of Belarus [1]. The *a priori* notion about their glacial redeposition from marine sediments has led to an extreme shortage of attention to such finds. Evidence of occurrence of marine invertebrates in Neogene and Pleistocene strata of other areas of the East European Plain, in particular in the European part of Russia, is quite common. Also sea mollusks and Foraminifers were found in clayey and sandy till-like deposits and in varved clays of Latvia [2; 3], ichnofossils were described from “glacial-lacustrine” varved clays of Lithuania [4] and marine mollusks were discovered in Quaternary varved clays of Ukraine [5].

In order to clarify data available on the origin of some types of sedimentary formations of Belarus, particularly of those which are regarded as glacial-lacustrine [6], the authors carried out micropaleontological examination of several depositional units of thin-bedded and varved clays and silts. Results of this examination are given below in the first part of the present paper. The second part covers a review of occurrences of Quaternary marine bivalve mollusks within the territory of Belarus. A redescription of several bivalve species is done on the basis of these materials as well as of collections from some other regions of the western part of the East-European Plain.

Material and methods. The micropaleontological methods employed were based on recommendations of a number of reference manuals: [7—9]. Micropaleontological sampling was carried out layerwise from exposures of the studied strata. A total of 20 rock samples were taken. Formation members of considerable thickness and a uniform lithological composition were sampled at their top and base, as well as at regular intervals throughout the entire thickness of the member. In the laboratory, the collected samples were exposed to short-term heating in a solution of sodium hydrocarbonate for their disintegration. After that the material was passed through a standard set of sieves with 1.0, 0.5 and 0.25 mm mesh openings. The fraction passing the 0.25 mm sieve was collected and subsequently decanted. After desiccation all the fractions were analyzed under a binocular microscope. Microfossils found in each of the studied samples were tentatively divided into the following groups:

1) Dominating (10 and more specimens of the same species),
2) Few (from 2 to 5 specimens of the same species),
3) Singular (a single specimen).

(7) Microfossils were depicted by means of scanning electron microscopy (SEM) and also under reflected light using the OGME P2 binocular microscope and the Sony DSC-H10 digital camera. The micropaleontological collection is kept by Yu. Zaika.

Collecting of bivalve mollusks was carried out from the surface of the ground, as well as in pits. The studied material includes 30 specimens, which are stored in private collections of the authors of the article (A. Krylov and Yu. Zaika), as well as that of the amateur paleontologist M. Supron (Grodna, Belarus), who shared his specimens for the present study.

Results and discussion. The following data include descriptions of Cenozoic sediments of Belarus containing the marine microfauna, as well as descriptions of marine bivalve mollusks collected both in Belarus and in the European part of Russia.

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Phylum FORAMINIFERA d'Orbigny, 1826, Phylum RADIOLARIA Müller, 1858,
other marine invertebrate microfauna

Geographic setting. For this survey micropaleontological sampling was carried out in several outcrops of thin-bedded and varved clays and silts, occurring in the central part of the Minsk Upland (sand pits near the town of Zaslauye) and in the northern part of the Polatsk Lowland (an outcrop on the Virynka river) (Figure 1). This kind of facies is traditionally regarded in the regional-geological literature as sediments of Pleistocene glacial lakes [10—12].

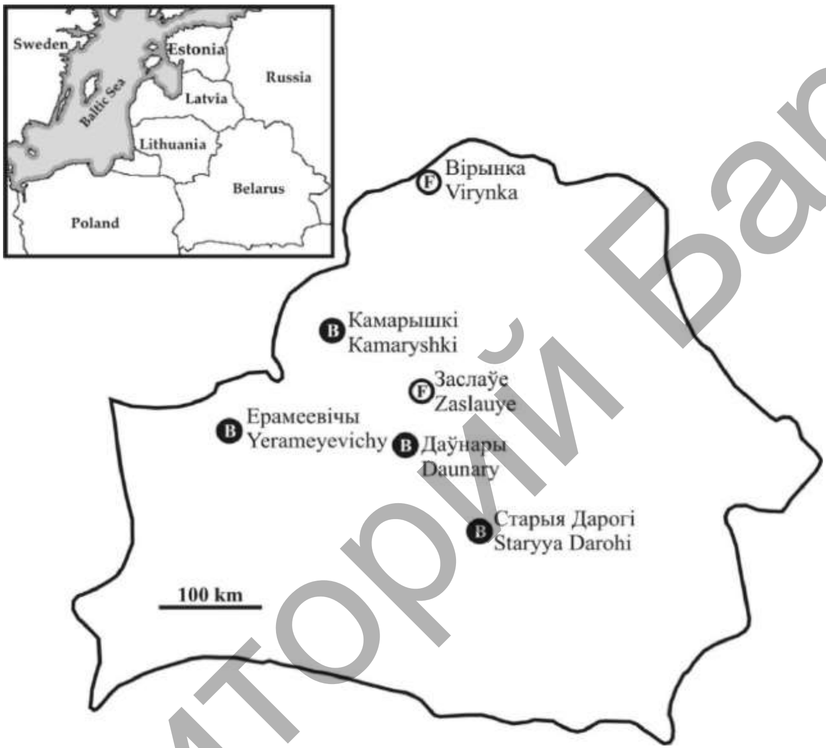

Figure 1. — Localities of marine fauna in surficial deposits in Belarus (as of 2017): ***F*** — Microfauna, ***B*** — Bivalve mollusks

Малюнак 1. — Месцазнаходжанні марской фаўны ў покрыўных адкладах Беларусі (на 2017 год) ***F*** — мікрафаўна, ***B*** — двухстворкавыя малюскі

Geological setting. ***The Zaslauye area*** (Figure 1) embodies a group of sand pits with the total area of about 2 km^2, occurring near the town of Zaslauye, in Minsk District. Mean altitudes of the surface of the territory are 230 to 244 m. In the pits several lenslike sedimentary bodies were revealed, up to 2.5 m of total thickness each, composed of varved clays and silts (Figures 2, *b*, *e*), as well as of carbonate thin- and micro-bedded clays. Prior to the beginning of quarrying, the top surfaces of these outcrops were probably covered with sands and topsoil of about 2.0 meters thickness at the most or probably even less. With the aim of describing these outcrops and for ascertaining their stratigraphic position, we prepared several sections by scraping the vertical surfaces to cleanly expose the bedding. These are referred to below as "clearings". It was observed that the varved silts and clays often pinch-out within a surrounding sand mass (Figure 2, *a*). Sometimes lateral replacement of varves with the sands or transgressive overlapping of the sands by varves with a basal gravel band is seen. These observations allow us to exclude any assumption that the silt and clay masses are allochtonous detached depositional units transported by a hypothetical glacier. Instead, their autochtonous occurrence is obvious. The enclosing horizontally layered sand member with interbeds of gravel and pebbles in turn cuts brown boulder clays.

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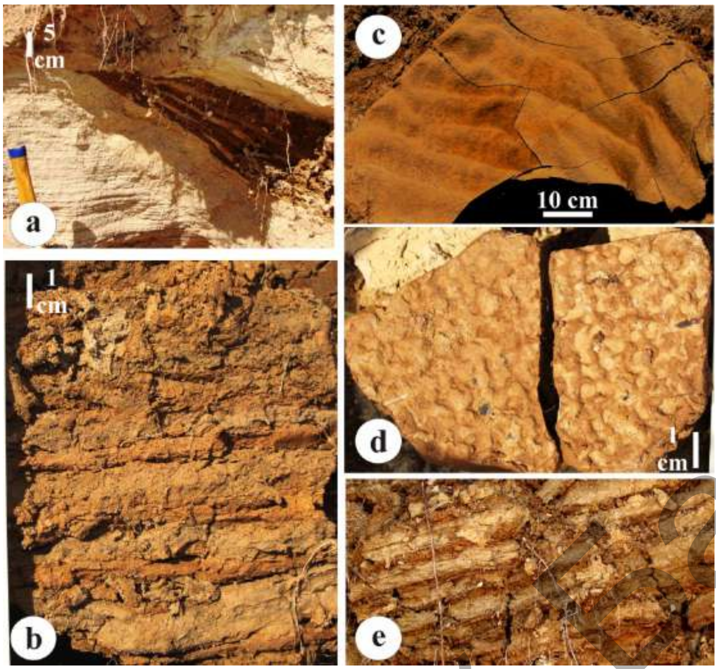

Figure 2. — Varve sediments of the Zaslauye area: *a* — varved clays and silts pinch-out into sand; ***b***, ***e*** — varved sediments (clearing no. 1, bed 2); ***c*** — ripple-marks onto bedding planes in clays; ***d*** — supposed rain print (print — to the left, counter-print — to the right) onto bedding planes in clays (clearing no. 1, bed 3)

Малюнак 2. — Стужкавыя адклады ўчастка «Заслаўе»: ***a*** — выкліньванне стужкавых глін і алеўрытаў ў пясках; ***b***, ***e*** — стужкавыя алеўрыты (расчыстка 1, слой 2); ***c*** — сляды хвалевай рабізны на паверхні напластавання гліны; ***d*** — верагодныя дажджавыя адбіткі (злева — дажджавая паверхня, справа — яе супрацьадбітак) на паверхні напластавання гліны (расчыстка 1, слой 3)

Some of bedding planes in clays show ripple marks (Figure 2, *c*) and supposedly rain prints (Figure 2, *d*).

Surficial varved deposits on the Minsk Upland are considered in Belarusian geological literature as glacial-lacustrine and are dated to the time of retreat of the Middle and Late Pleistocene glaciation [3; 13]. Sands and sandy loams in this region are referred to as glacial-fluvial and end-moraine deposits of the Middle Pleistocene Sozh Horizon [6].

Altogether six clearings of outcrops were prepared in the studied locality in which the whole thickness of clays and silts was uncovered. Of them, clearings No. 1 and 2 are sketched (Figure 3) and briefly described below.

In ***clearing No. 1*** the following layers were revealed from top to bottom.

1. Soil layer, underlain by sands of unknown thickness (the sands were partially removed during quarrying).

2. Varved sediments: rhythmic alteration of light-brown bands of clay and light-grey silts (Figures 2, *b*, *e*). Individual varves are about 1.0—1.5 cm thick, total thickness of the varved member is 50 cm.

A microfaunal association with foraminifers as a dominating group was revealed in the varved member. As identified by M. A. Alekseev (A. P. Karpinsky Russian Geological Research Institute (VSEGEI), St. Petersburg, Russia), *Biglobigerinella abberanta* (Neckaja) (Figures 6, *a*—*c*) and *Spiroplecta* sp. dominate among the foraminifers (Figures 6, *e*—*i*). N. Yu. Anikina (CMGL,

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Syktyvkar, Russia) notes that the *Spiroplecta* sp. may belong also to biserial representatives of *Guembelina* Egger. Given that *Biglobigerinella abberanta* (Neckaja) is often considered as a synonym of *Globigerinelloides asper* (Ehrenberg), the latest name will be used hereinafter in the text. In addition, solitary specimens of *Lagenammina* sp. (Figure 8, *a*) were collected. Other fauna is represented with solitary foraminifers (*Cibicides* sp. (Figures 6, *j—k*), *Globigerina* sp. (Figure 6, *d*)), Radiolarians *Dictyomitra rhadina* Foreman and *Dictyomitra* sp. (Figures 7, *b—c*), Ostracods (Figure 7, *d*), Chaetognathans (Figure 7, *f*), numerous sponge spicules (Figures 7, *e*, *g*) and various unidentified organic remains.

According to M. A. Alekseev (personal communication), foraminifers *Globigerinelloides asper* (Ehrenberg) (*Biglobigerinella abberanta* (Neckaja)) and representatives of *Spiroplecta* are widespread in the Upper Cretaceous, particularly, in the Maastrichtian. N. Yu. Anikina suggests that the Lower Paleogene age of the revealed microfauna is also possible. The above listed Radiolarians were reported from the Upper Cretaceous (Maastrichtian) — Lower Paleogene (Danian) boundary strata of the USA, Caribbean Sea and New Zealand [14].

3. Light-brown clay with 1-2 mm-thick silt bands. Some surfaces of discontinuity occur with rain marks (Figure 2, *d*). Total thickness of the bed is 25 cm. Organic microremains are represented by rare fragments of unknown systematic affiliation.

4. Brown clay with thin stringers of silt. Total thickness of the bed is about 25 cm.

5. Brown laminated clay with thin stringers of silt. Total thickness of the bed is 25 cm. Contains sparse remains of presumed agglutinated *Astrorhizata* (Figures 8, *c—b*) and few sponge spicules. A discontinuity surface with a rain print is encountered, analogous to the above described bed No. 3.

6. “Chocolate” clay with thin stringers of silt and fine sand. Total thickness of the bed is 25 cm. The upper part of the bed contains rare sponge spicules and organic remains of unknown systematic affiliation. The basal arenaceous part of the bed, which is underlain by sands, contains numerous sponge spicules, single foraminifers: *Cibicides* sp., *Globigerinelloides asper* (Ehrenberg) and *Spiroplecta* sp. (?*Guembelina* sp.), a few Radiolaria (*Dictyomitra* sp.) and problematic organic microremains.

7. Sand with gravel and clay inclusions consisting of clay identical to the one from the above bed No. 6. Exposed thickness is 30 cm.

Clearing No. 2 occurs approximately one kilometer from the clearing No. 1. The following strata were revealed from top to bottom.

1. Topsoil.

2. Horizontally-bedded sand with gravel inclusions, 25 cm thick.

3. Varved silt and fine sand with thin bands of clay and clayey silt. Total thickness is 25 cm. An association of microfauna revealed in this stratum is identical to the above-described association from the varved stratum in clearing No. 1. The following foraminifers dominate: *Globigerinelloides asper* (Ehrenberg) and *Spiroplecta* sp. (? *Guembelina* sp.). Among the latter there are numerous specimens incorporating organic debris into their shells (Figures 6, *h—i*). Also revealed are rare Radiolaria *Dictyomitra andersoni* (Campbell & Clark) (Figure 7, *a*), multiple sponge spicules and microremains of unidentified organisms. The above-mentioned radiolarian species was reported from the Maastrichtian-Danian boundary interval in the USA, Cyprus and New Zealand [14].

4. Brown clay with intercalations of silt, 20 cm thick.

5. Varved sediments: rhythmic alteration of bands of light-brown clay and light-grey silt. Varves significantly deformed, tentatively as a result of an immersed slump. Total thickness of the member is 50 cm. Numerous foraminifers with dominating *Globigerinelloides asper* (Ehrenberg) and *Spiroplecta* sp. (? *Guembelina* sp.), as well as a few Radiolaria were collected. Sponge spicules are multiple. As in bed No. 3, foraminifers *Spiroplecta* sp. (? *Guembelina* sp.) incorporate debris into their shells.

Below member No. 5 a massive clay bed was uncovered under a talus. The clay contains rare shells of *Globigerinelloides asper* (Ehrenberg) and organic microremains of unknown systematic affiliation.

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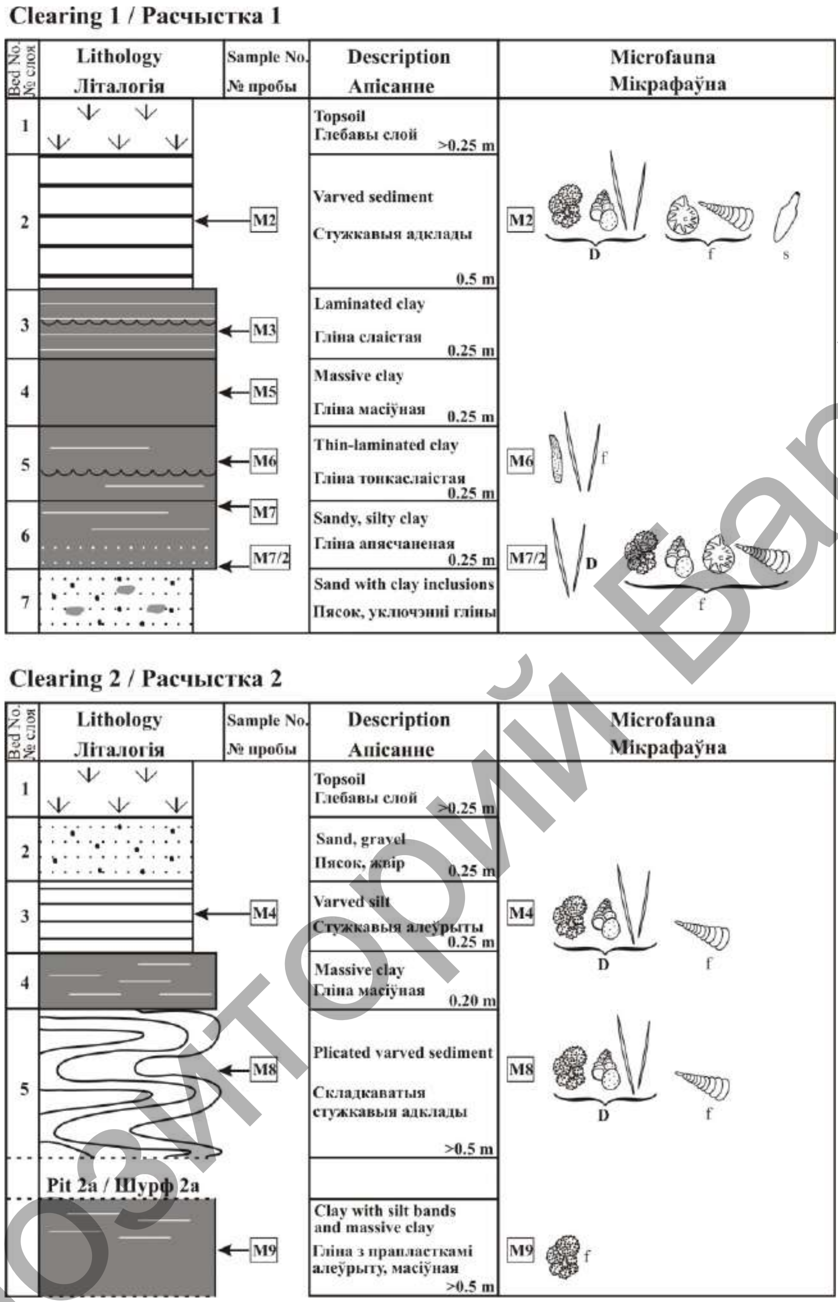

Figure 3. — Microfaunal association from varved sediments and clays of the Zaslauye area

Explanations:

M2 — sampling numbers and points; — rain print on bedding surface

Typical microfauna:

Globigerinelloides Spiroplecta Cibicides

Astrorhizata (?) *Radiolaria* *Lagenammina* Sponge spicules

D* —** dominating; ***f — few; ***s*** — singular

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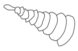
Continuation

Малюнак 3. Знаходжанне марской мікрафаўны ў стужкавых адкладах і глінах участка «Заслаўе».

Умоўныя абазначэнні:

M2 — кропкі адбору і нумары проб; ︶︶︶ — паверхні напластавання з адбіткамі дажджоў

Характэрная мікрафаўна:  *Globigerinelloides*  Spiroplecta  Cibicides

 праблематычныя рэшткі Astrorhizata (?)  *Radiolaria*  *Lagenammina*

 спікулы губак

D — дамінуючыя; ***f*** — малалікія; ***s*** — адзінкавыя

Discussion on deposits uncovered in the Zaslauye area.

1. Varved deposits and clays of the Zaslauye area contain an association of marine microfauna. Clear confinement to varved sediments is established for the following Foraminifers: *Globigerinelloides asper* (Ehrenberg), *Spiroplecta* sp. (? *Guembelina* sp.), *Cibicides* sp. and also for radiolarians and sponge spicules. In contrast to varved deposits, in massive, microlayered and laminated clays problematic tubular *Astrorhizata* occur almost solely, whereas other microfauna is absent or extremely scarce.

2. The age of the varved deposits of the Zaslauye area cannot be determined precisely on the basis of the above data. Using identifications of the collected foraminifers and radiolarians it would be allowable to date these sediments to the Maastrichtian (Upper Cretaceous) or Danian (Lower Paleogene). However, no other widespread Upper Cretaceous organisms, such as belemnitids or inoceramids, are found in the varves or in their underlying sands and sandy loams, which contradicts the idea of the Upper Cretaceous age of these deposits. Furthermore, Upper Cretaceous and Lower Paleogene sediments are known in Belarus at significantly lower hypsometrical levels in comparison to the above described succession [15]. Taking into account possible tectonic vertical movements, a hypothesis of an ancient pre-Quaternary age of these strata cannot be brushed aside, as it was previously suggested for many other high watersheds in the East-European Plain [16].

Alternatively, we cannot rule out that the varved deposits and clays of the Zaslauye area may have a complex origin. Varved silts might consist of the Upper Cretaceous or Lower Paleogene sediment redeposited from a short distance away, as indicated by the good preservation of fragile delicate Foraminifera, Radiolaria and sponge spicules. It should be noted that the nearest areas of occurrence of Maastrichtian and Danian strata are reported to be more than 200 km away from the Zaslauye area [15], whereas within the studied region they are considered to be eroded [17]. Tentatively, the primary source for the silt could be an outlying deposit of Maastrichtian or Danian sediments, which could have been tectonically raised above normal elevations of deposits of this age and subsequently washed away during the time of accumulation of the varved sediments described here.

If the assumption about the redeposition is correct, the varved sediments and clays may contain a heterochronous association of microfossils: palinological or diatom analysis may show a younger age for the clays. Examples of simultaneous occurrence of mixed assemblages of organic microremains are well known for various regions [18; 19]. Consequently, the time of formation of the whole complex of clays and varved deposits of the Zaslauye area is not clear so far.

3. Whatever the time and the way of their formation is, these deposits can hardly be regarded as glacial-lacustrine. A supposition about entrapping of microfauna into a glacier and its subsequent redeposition into a glacial lake entails the need to explain the selective burying of small-sized

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carbonate foraminifers, as well as radiolarians and sponge spicules almost exclusively into the varved sediments and silts, whereas in massive and laminated clays they are almost absent. In our opinion, a process of thawing-out and a subsequent transportation by the meltwater would lead to a general redeposition of light carbonate foraminifers and also radiolarians and spicules not only into the silts, but into the clays as well due to their high degree of buoyancy, which was obviously demonstrated during laboratory extraction of microfaunal specimens.

4. Ripple marks and rain prints, numerous silt intercalations and sandy clay intervals may indicate frequent depth oscillations and periodic short-duration unwatering episodes. In general, the studied outcrops show significant similarity with Late Cenozoic and recent littoral (watt) formations, accumulated in shallow coastal waters and separated from deeper waters by sand bars or banks [20].

The Virynka Section is confined to the northern part of the Polatsk Lowland and is situated in the mouth of the Virynka river, which is a right tributary of the Sarjanka river, 6 km to the north of the settlement of Sarja (Belarus, Verkhnyadzvinsk District). Clayey deposits were exposed here, supposedly at the first terrace above the floodplain. The absolute altitude of the terrace's surface is approximately 125 m. According to the map of Quaternary deposits of Belarus [6], subsurface clays occurring in this region belong to the Paazerje Horizon (Upper Pleistocene).

The studied outcrop is composed of horizontally laminated, thin-bedded and micro-layered clays covered by laminated sands. The following strata were revealed from top to bottom (Figure 4).

1. Topsoil.

2. Thin-layered yellowish-white sand with lenticles of pebbles and gravel of the Devonian dolostone exposed nearby. Thickness is about 1.5 m.

3. Thin bed of brown sandy clay, laterally replaced with clayey sand. Thickness about 5.0 cm. Contains scarce organic remains, among which are fragments of tubular agglutinated *Astrorhizata* foraminifers.

4. Thin-layered white and yellowish sand with intercalations of clayey sand and brown sandy loam. Thickness is 60 cm.

5**.** Light-brown carbonate horizontally laminated clay with interbeds of sandy clay and thin rhythmic silt microlayers. The total thickness is not known, the visible height of the stratum above the water's edge is 3.0 m. The upper part of this stratum, containing interbeds of silty and sandy material, contains numerous macroscopic organic tubules, presumably plant debris (Figure 5, *b*). Also found are multiple tubular agglutinated shells that unquestionably belong to the *Astrorhizata* class of foraminifers. Among them *Saccorhiza ramosa* (Brady), *Rhabdammina* sp. and *Hyperammina* sp. (Figures 5, *a*, *c*; 8, *h—j*) are identified. The first of the above-listed foraminifer species occurs from the Pleistocene until the present time. Tubular and ramose shells of *Astrorhizata* in this part of the member make up a mass accumulation. In spite of fragility they have exceptionally good preservation.

In other samples taken from the same member of clay but lower in the section only few organic remnants were collected, whose systematic affiliation is unclear.

Lateral relationships of the above-described clay depositional unit are obscure. Upstream along the Virynka river the clays are apparently replaced with sands which were uncovered by digging isolated pits. At water's edge inclusions of laminated clays, that are identical to clays from the above-described sequence, were found in the sand. Below the water's edge the clays are underlain by Upper Devonian dolostones.

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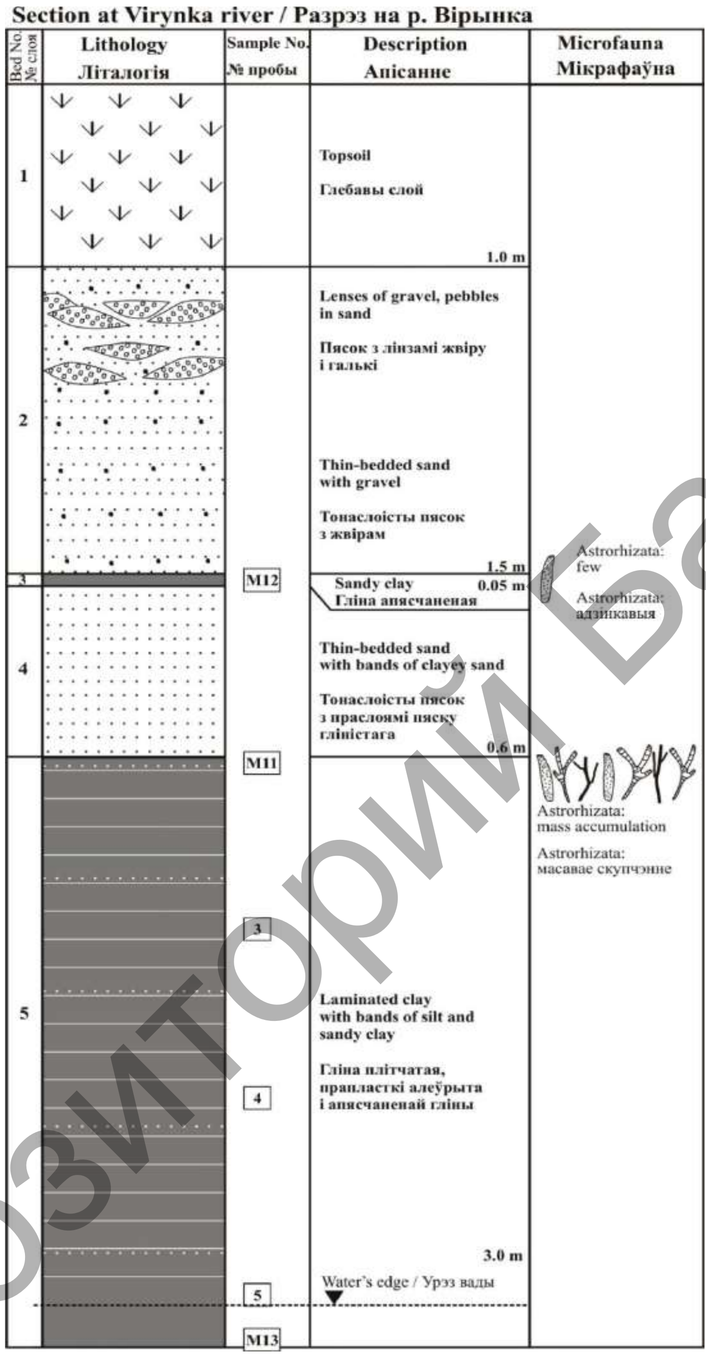
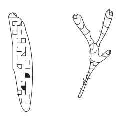
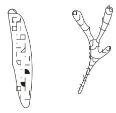


Figure 4. — Marine microfaunal association from clays of the Virynka section
Explanations:



— *Astrorhizata*
For other explanations see fig. 3

Малюнак 4. Знаходжанне марской мікрафаўны ў разрэзе на р. Вірынцы
Умоўныя абазначэнні:



— Фараміниферы *Astrorhizata*
Іншыя абазначэнні — *гл.* малюнак 3

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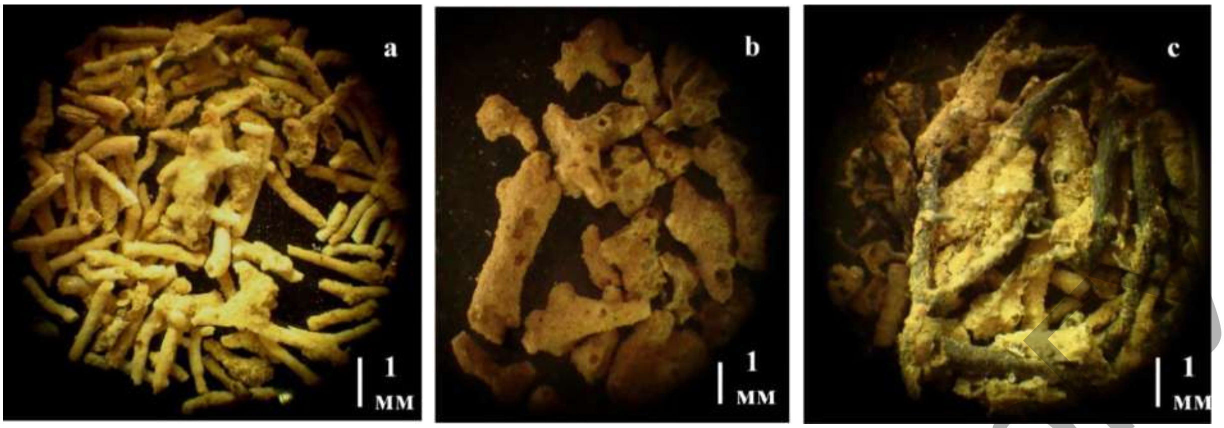

Figure 5. — Organic remains from the Virynka section (clays, sample M11):
a*, *b — tubular *Astrorhizata* foraminifers; ***c*** — organic tubules (probably plant debris)

Малюнак 5. — Арганічныя рэшткі з разрэза Вірынка (гліны, проба М11):
a*, *b — трубчатыя фарамініферы *Astrorhizata*; ***c*** — арганічныя трубчатыя рэшткі (верагодна, раслінны дэтрыт)

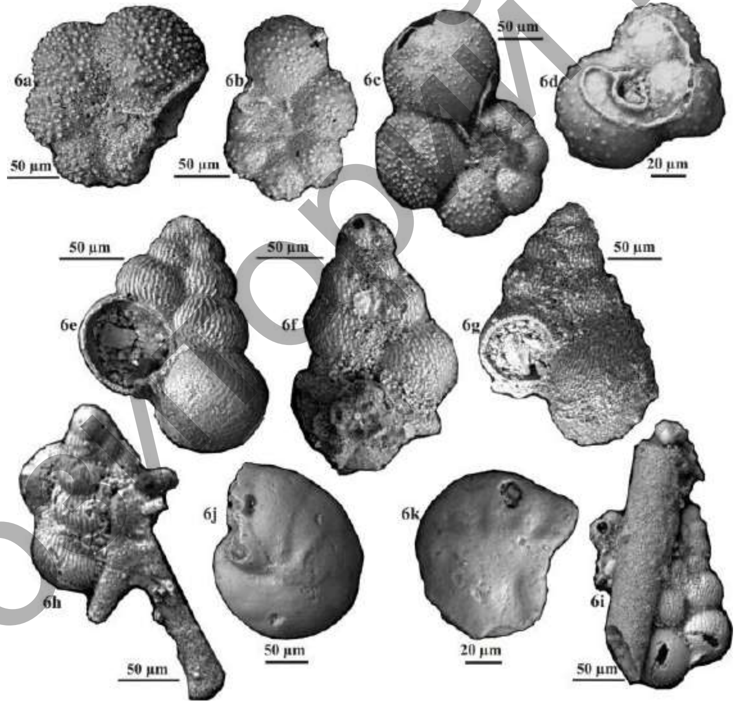

Figure 6. — Foraminifera from varved sediments of the Zaslauye area: ***a—c*** — *Globigerinelloides asper* (Ehrenberg) (***a—b*** — sample M2, **c** — sample M8); ***d*** — *Globigerina* sp. (sample M8); ***e—i*** — *Spiroplecta* sp. (***e*, *h*—*i*** — sample M8, ***g*** — sample M2, ***f*** — sample M4); ***j*—*k*** — *Cibicides* sp. (***j*** — sample M7-2, ***k*** — sample M2).

Малюнак 6. Фарамініферы са стужкавых адкладаў участка «Заслаўе»: ***a—c*** — *Globigerinelloides asper* (Ehrenberg) (***a—b*** — проба М2, ***c*** — проба М8); ***d*** — *Globigerina* sp. (проба М8); ***e—i*** — *Spiroplecta* sp. (***e*, *h*—*i*** — проба М8, ***g*** — проба М2, ***f*** — проба М4); ***j*—*k*** — *Cibicides* sp. (***j*** — проба М7-2, ***k*** — проба М2)

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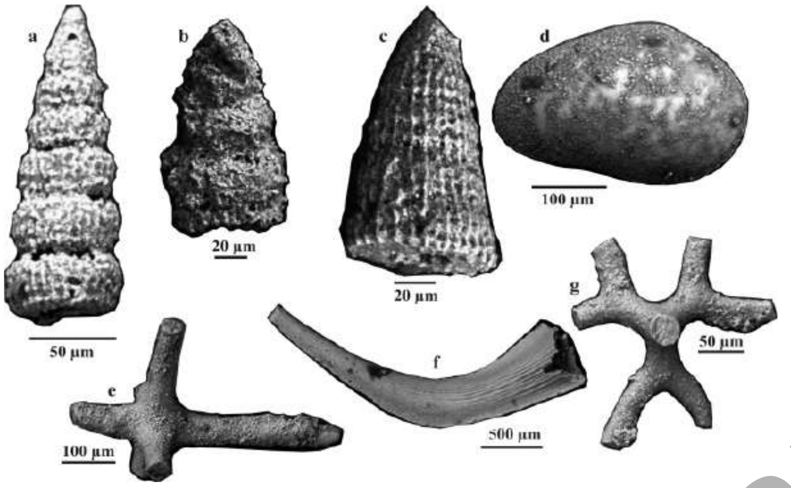

Figure 7. — Microfauna from varved sediments of the Zaslauye area: ***a*—*c* —** Radiolaria (**a** — *Dictyomitra andersoni* (Campbell et Clark) (sample M4), ***b*** — *Dictyomitra rhadina* Foreman (sample M2), ***c*** — *Dictyomitra* sp. (sample M2)); ***d*** — *Ostracoda* (sample M2); ***e*** — probable seizing jaw of *Chaetognatha* (?) (sample M2); **f**—***g*** — sponge spicules (sample M4)

Малюнак 7. — Мікрафаўна са стужкавых адкладаў участка «Заслаўе»: ***a*—*c*** — радыялярыі (***a*** — *Dictyomitra andersoni* (Campbell et Clark) (проба M4), ***b*** — *Dictyomitra rhadina* Foreman (проба M2), ***c*** — *Dictyomitra* sp. (проба M2); ***d*** — *Ostracoda* (проба M2); ***e*** — верагодна, хапальная шчацінка *Chaetognatha* (проба M2); ***f*—*g*** — спікулы губак (проба M4)

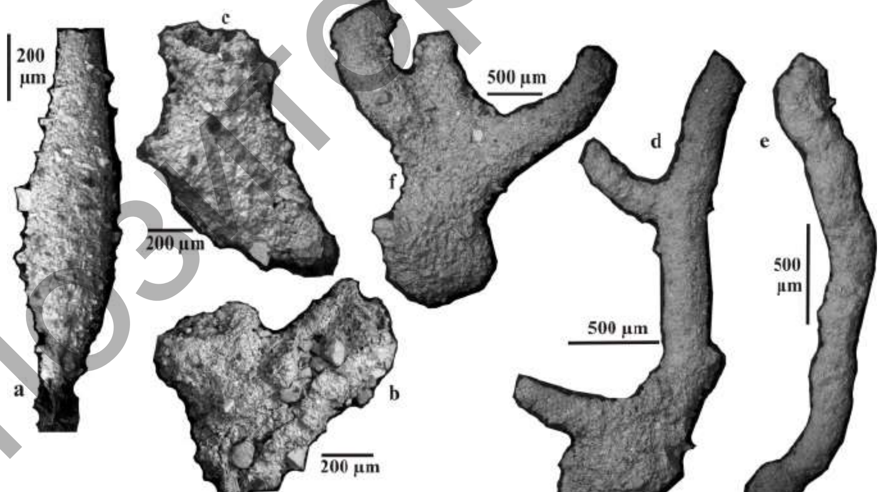

Figure 8. — *Astrorhizata* foraminifers from varved sediments and clays of the Zaslauye area and the Virynka Section. ***a*** — *Lagenammina* sp. (Zaslauye, varved silt, sample M2); ***b*—*c*** — *Astrorhiza* ? sp. (Zaslauye, clay, sample M6); ***d*, *f*** — *Saccorhiza ramosa* (Brady) (Virynka, clays, sample M11); ***e*** —*Hyperammina* sp. (Virynka, clays, sample M11)

Малюнак 8. — Фараміаніферы A*strorhizata* са стужкавых адкладаў і глін участка «Заслаўе» і разрэза «Вірынка». ***a*** — *Lagenammina* sp. (Заслаўе, стужкавыя алеўрыты, проба M2); ***b*—*c*** — *Astrorhiza* ? sp. (Заслаўе, гліны, проба M6); ***d*, *f*** — *Saccorhiza ramosa* (Brady), *Saccorhiza ramosa* (Brady) (Вірынка, гліны, проба M11); ***e*** — *Hyperammina* sp. (Вірынка, гліны, проба M11)

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Discussion of results of study of the Virynka Section

1. In contrast to the Zaslauye area, in the Virynka Section only a single interval containing marine microfauna is revealed represented exclusively by astrorhizids. Herewith, occurrence of a mass accumulation of tubular and ramose astrorhizids is notable because such a phenomenon is usual in recent cold-water seas and in abyssal oceanic zones [7; 21; 22].

Foraminifers are confined to the upper sandy part of the clay sequence, whereas in pure clays lower in the sequence they are not found. This denotes their facial relation to this interval and argues against the assumption of their redeposition from a melting glacier. An excellent preservation of fragile microfauna also contradicts the glacial supposition. In addition, it is hardly possible to explain the selective deposition of a separate layer enriched with tubular and ramose foraminifers in a glacial lake by means of melting out from the glacier whereas in other parts of the sequence they are almost completely absent. Therefore the evidence shows that the clays of the Virynka section are marine at least in the upper part of their sequence.

2. Taking into account a significant difference between altitudes of sediments of the Zaslauye area and the Virynka Section (about 230 and 125 meters respectively), it is possible to suggest their heterochrony. In view of unspecificity of astrorhizids for means of biostratigraphy, additional survey is required for ascertaining the age of this sequence. Occurrence of astrorhizid representatives, which are similar to some recent species, may indicate a comparatively young age of the enclosing sediments.

In addition to the above said, it should be noted that B. L. Afanasiev in 1967 reported his results of identification of conditions of clay and loam sedimentation of the Sarjanka river area based on the method of G. L. Stadnikov, which suggested their lagoonal nature [3]. In our opinion, the clays of the Virynka section probably have a more deep-water origin.

Phylum MOLLUSCA Linnaeus, 1758: Class BIVALVIA Linnaeus, 1758

Geological Setting. Five localities of marine Bivalve mollusks are known to the authors within the territory of Belarus as yet (Figure 1; table 1). According to the map of Quaternary deposits of Belarus, their enclosing rocks should be attributed to moraine, glacial-fluvial and glacial-lacustrine deposits [6].

T a b l e 1. — Localities and taxonomic composition of marine Bivalve mollusks in superficial sediments of Belarus (as of 2017)

Т а б л і ц а 1. — Месцазнаходжанні і таксанамічны склад марскіх двухстворкавых малюскаў з покрыўных адкладаў Беларусі (па стане на 2017 год)

Locality	Bivalve mollusk taxa	Source of data
1. Left bank of the river Strača (Myadzel District, Minsk Region)	*Arca* sp.	[1]
2. “Kamaryshki” Outcrop (Astravets District, Grodna Region)	*Arca* sp. *Leda* sp.	[1]
3. Field near the village of Yerameyevichy (Lida District, Grodna Region)	*Cerastoderma glaucum* Poiret	Reported for the first time, on the basis of a collection by M. J. Supron
4. Hill near the village of Daunary (Dzierzhynsk District, Minsk Region)	*Cerastoderma glaucum* Poiret	Reported for the first time, on the basis of a collection by Yu. U. Zaika
5. Excavation near the city of Staryya Darogi (Minsk Region)	*Didacna baeri* (Grimm)	Reported for the first time, on the basis of a collection by Yu. U. Zaika

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A short description of these localities is given below.

1. *Arca* sp. was reported from an outcrop of the “Valday morainic loam” (Paazerje Horizon, Upper Pleistocene) on the left bank of the Stracha river (Myadzel District) [1].

2. *Arca* sp. and *Leda* sp. in association with Anodonta and Diatomic algae (fresh-water and halophilic) were reported from varved silts and clays in the “Kamaryshki” exposure [1].

In the judgment of Vozniachuk and Kalechits [1], in the two above-mentioned localities marine mollusks were incorporated into periglacial or glacial-lacustrine deposits and were redeposited by melt water of a receding glacier. They had been entrained into the glacier beforehand during its passage through a sea basin. After melting, valves of the marine mollusks were deposited together with fresh-water species occurring in lakes into which glacial debris was moved by streams of melt water. Remains of fresh-water plants and also high hypsometrical occurrence of the enclosing deposits (140 m above sea level) are considered by Vozniachuk and Kalechits [1] as subsidiary evidence against their marine genesis.

In our opinion, the foregoing reasoning is not fully convincing for the following reasons.

1) High hypsometrical occurrence is not at variance with a marine origin of the sediment because the area could have undergone a tectonic rise. In addition, amplitudes of Late Cenozoic transgressions and regressions could amount to hundreds of meters [17].

2) Remains of terrestrial and fresh-water flora and fauna are not infrequent in sediments of contemporaneous seas, river deltas, lagoons and nearshore zones, where they are moved from continents by rivers and other active forces [23]. On the contrary, remains of marine organisms in fresh-water sediments are much rarer and are almost always emplaced by redeposition. Also terrestrial and fresh-water organisms can be embodied in marine sediments as a result of sea ingression into continental margins. In recent low-salinity and in brackish water some fresh-water organisms, including *Anodonta* bivalves, can coexist with marine invertebrates and even predominate over them [24]. Thus, combined occurrence of marine and fresh-water organisms can be explained without the assumption of their redeposition by glaciers.

3. Complete and fragmentary separated valves were collected on a surface of a loamy field near the village of Yerameyevichy (Lida District). Altitudes of the surface of this territory are 136 to 140 meters. Several specimens of *Cerastoderma glaucum* Poiret are identified among them (Figures 10, *a—d*).

4. Fragmentary separated valves of marine bivalve mollusks were collected on a hilltop in the vicinity of the village of Daunary (Dzierzhynsk District), at 210 meters above sea level. Mollusks were embedded in a surficial bed of light-grey loam, overlying sand and gravel deposits. The most fully preserved specimen is identified as *Cerastoderma glaucum* Poiret (Figures 10, *e—f*).

5. Remains of marine mollusks were collected within the northern outskirts of the city of Staryya Darogi (Minsk Region), on a site of a former forest bog and are confined to the upper boundary of “glacial-fluvial” sands, covered with peat and peat-containing sand. The altitude of the surface is 156 meters. Specimens collected are represented by separated fragments of valves, among which *Didacna baeri* (Grimm) is identified (Figures 9, *g—h*).

It is important to note that in many of the above-listed localities mollusks are confined to the surface or sub-surface bed, whose deposition, according to the glacialistic version, was caused by melt water of a receding glacier. In the outskirts of Yerameyevichy, Daŭnary and Staryya Darogi bivalves are found in the so called “after-Sož” deposits, which are correlated with the upper Middle or lower Upper Pleistocene [6].

Our supposition about a marine origin of the above-described sediments with remains of marine mollusks contradicts their interpretation as solely glacigenic. Correspondingly, we do not find the Middle Pleistocene age of these deposits to be obvious. More well-grounded conclusions about the age of these bivalve mollusks can be made only following study of additional collections, including absolute dating based on valve material.

The following redescriptions are provided by A. V. Krylov on the basis of new collections from Pleistocene of the East-European Plane, including new material from the territory of Belarus and from the European part of Russia.

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Family CARDIIDAE Lamarck, 1809
Didacna baeri (Grimm, 1877)
(Figure 9)

Didacna baeri Grimm, 1877, Plate 8, fig. 2, *a—c*, 3, *a—d*, p. 51—54 [25], *Didacna pseudocrassa* Pavlov, 1925, Plate VIII, fig. 124—125, p. 145 [29], *Didacna baeri-crassum* Pavlov, 1925, Plate VIII, fig. 130, p. 145 [26], *Didacna alibajramliensis* Gadzhiev, 1966: p. 37 [27], *Didacna baeri* Grimm: Gadzhiev, 1968, fig. 1—2, p. 76—77 [28], *Cerastoderma dombra* Krylov, Bolshyanov, Marquet, 2011 [29], fig. 5, *а—б*, 6, fig. 2, *а—б*, p. 4 (pars), *Didacna pseudocrassa* Krylov, Bolshyanov, Marquet, 2011, Fig. 6—1, *а—б* [29], *Didacna baeri* Kiyashko, 2013, photo 41, fig. 137, p. 347, 352— 353 [30]. Lectotype: Zoological Institute of Russian Academy of Sciences, № 1/44-1879, Left valve. Caspian Sea, station 132; 52°23′ east longitude 40°32′ north latitude, depth 36 m, collection of O. A. Grimm, 1876. Shell dimensions: length 24.9 mm, height 20.4 mm, inflation 15.9 mm. Established by B. M. Logvinenko and Ya. I. Starobogatov in 1967 [31].

Diagnosis. Shell trigonal to oval, valves thick, slightly asymmetric, with 40—45 radial comparatively narrow ribs. Umbo weakly protrudes above the shell. Keel moderately marked, with relatively slight bend. There is a triangular dilation near the cardinal tooth. Inner margin broad. Muscle scars small, approximated to the anterior end.

Description. Shell medium-sized, moderately convex, rounded-trigonal, slightly asymmetric, curved, thick-walled. Ribs 40—45 in number, radial, relatively narrow. There are 3—6 concentric growth lines. Shell color yellow, orange, white or grey. Valve height comprises 5/6 of its length. Umbo weakly protrudes forward relative to the adjoining vertex portion of valve, rounded, rounded-trigonal, asymmetric. Hinge heterodont. Left valve has small single cardinal tooth and two narrow triangular inner margins, right valve with two lateral teeth. There is a triangular dilation near the cardinal tooth. Umbonal apex wide. Muscle scars small, rounded-trigonal, shifted towards the anterior end of shell. Keel not sharp, well-developed, with relatively slight bend. Sub-keel area narrow. Pallial line continuous. Inner shell margin broad, widened in one direction and narrowing in another; there are 20 inner radial depressions, located under middle portions of largest radial ribs in shell center.

Collection numbers of the studied specimens and their dimensions are given in Table 2.

Table 2. — Morphometry of *Didacna baeri* (Grimm, 1877)

Таблiца 2. — Марфаметрыя *Didacna baeri* (Grimm, 1877)

Dimensions (in mm)	Specimens, their collection numbers				
	No. A-1 Russia, Rostov region, right valve	No. A-2 Russia, Tver' region, left valve	No. A-3 Russia, St.Petersburg region, Lukashi, right valve	No. A-4 Russia, Tver' region, Rogachevo, left valve	No. StD-1 Belarus, Minsk region, Staryya Darogi, left valve
Valve height	22,0	23,0	23,5	28,0	30,0
Valve length	—	31,0	—	34,0	—
Valve width	8,0	8,0	9,0	12,0	14,0
Cardinal teeth (or socket) length	2,0	2,0	—	2,5	—
Cardinal teeth (or socket) width	1,5	1,5	—	1,5	—
Anterior muscle scar length	—	7,0	7,0	—	—
Anterior muscle scar width	—	5,0	—	—	—
Posterior muscle scar length	8,0	8,0	—	9,0	10,0
Posterior muscle scar width	5,0	5,0	—	6,0	7,0
Inner margin width	5,0	5,5	6,0	7,5	8
Radial rib width (maximal)	2,0	2,0	—	3,0	3,0

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P. V. Kiyashko [30] reports the following maximal dimensions of adult specimens from the Caspian Sea: width — 40—50 mm, height — 30—40 mm, inflation — 25 mm. Some individuals have umbo protruding forward to a variable extent relative to its adjoining apical part of shell. Fossil specimens are characterized by comparatively smaller dimensions.

Comparison. Differs from *Didacna trigonoides* (Pallas, 1771) by having a more narrow shell with short and comparatively weakly convex umbo, larger muscle scars, less marked keel, trigonal dilation near the cardinal teeth, larger number of radial ribs and more thick shell. Main differences from *Didacna protracta* (Eichwald, 1829) are the following: more convex shell, short and weakly convex umbo, narrower inner margin, larger muscle scars, lesser keel bend, less marked keel, trigonal dilation near the cardinal teeth, lesser number of radial ribs and a thicker shell.

Mode of life. Inhabits shallow sea water and lagoons [27; 30]. Active, benthic; burrows into slimy and sandy bottom. Sestonophage. Shell coloration depends of the bottom color.

Figure 9. — *Didacna baeri* Grimm, 1877 from surficial deposits of the East European Plain: *a—b* — right valve, № A-1, precise locality unknown, Rostov region of Russia (external (***a***) and internal (***b***) side); ***c—d*** — left valve, № A-2, precise locality unknown, Tver' region of Russia (external (***c***) and internal (***d***) side); ***e—f*** — left valve, № A-4, Rogachevo, Tver' region of Russia (external (***e***) and internal (***f***) side); ***g—h*** — fragment of left valve, № StD-1/1, Staryya Darogi, Minsk region of Belarus (external (***g***) and internal (***h***) side); ***i—j*** — fragment of right valve, № A-3, Lukashi, St.Petersburg region of Russia (external (***i***) and internal (***j***) side)

Малюнак 9.— Рэшткі *Didacna baeri* Grimm, 1877 з покрыўных адкладаў Усходне-Еўрапейскай раўніны: *a—b* — правая створка, № А-1, дакладнае месцазнаходжанне невядома, Растоўская вобласць, Расія (вонкавы (***a***) і ўнутраны (***b***) бок); ***c—d*** — левая створка, №А-2, дакладнае месцазнаходжанне невядома, Цвярская вобласць, Расія (вонкавы (***c***) і ўнутраны (***d***) бок); ***e—f*** — левая створка, № А-4, Рагачова, Цвярская вобласць, Расія (вонкавы (***e***) і ўнутраны (***f***) бок); ***g—h*** — фрагмент левай створкі, № StD-1/1, Старыя Дарогі, Мінская вобласць, Беларусь (вонкавы (***g***) і ўнутраны (***h***) бок); ***i—j*** — фрагмент правай створкі, № А-3, Лукашы, Ленінградская вобласць, Расія (вонкавы (***i***) і ўнутраны (***j***) бок)

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Distribution. *Didacna baeri* (Grimm, 1877) is currently an endemic of the southern part of the Caspian Sea. According to T. M. Gadzhiev [27; 28], this species is widespread in southern and eastern parts of the Caspian Sea and is characterized by significant intraspecific variation. Occurs at depths from 7.5 to 50—60 m [25; 31], in salinities of 2.5—13.5‰.

Former geographic range includes the northern part of the Caspian Sea, near Dagestan (Holocene) and also the Black Sea Basin, which was a constituent part of the former Pontian-Caspian Basin, including Crimea (Tchaudin Formation, Lower Pleistocene), Caucasus and the Volga region (Samara Region), Western Kazakhstan; in addition it was reported from the Moscow area [32—34] and from the Tchaudin Formation of the Rostov region [35]. In the north-western part of the East-European Plain *D. baeri* (Grimm) was discovered in the St. Petersburg and Tver' regions of Russia: near the village of Lukashi (in a borehole, depth 14 m, and on a hilltop, 75 m above sea level) (Figures 9, *i—j*) and in a sand pit near the village of Rogachevo, 182 m above sea level (Figures 9, *e—f*) [29; 36]. Specimens from the pit near the village of Rogachevo were primarily identified as *Didacna pseudocrassa* Pavlov, 1925. Subsequent study of this extensive collection supported the conclusion that most of the material from that locality belongs to *D. baeri* (Grimm, 1877). In the locality of Lukashi other marine mollusks were found together with *D. baeri* (Grimm, 1877): *Cerastoderma glaucum* (Bruguiere, 1789), *Mytilus galloprovincialis* Lamarck, 1819, *Dreissena* cf. *bugensis* Andrussov, 1897. It is notable that horse remains belonging to *Equus latipes* Gromova, 1949 were also found in Lukashi. The above-described locality near the city of Staryya Darogi (Minsk Region, Belarus) is probably the most westward among localities of *D. baeri* (Grimm, 1877) known up to the present.

Remarks. In our opinion the depauperate fossil association of bivalve mollusks, which includes *D. baeri* (Grimm, 1877), may be indicative of desalinated lagoonal conditions. Bivalve species that tolerate desalination are not known in this association. *D. baeri* (Grimm, 1877) could also inhabit normal marine environments with salinity up to 40‰. This assumption is based on findings of this species on the territory of the Rostov Region in a mollusk association including some Black Sea species that are characteristic of habitats with normal salinity: *Venus gallina* Linnaeus, 1758; *Mytilus galloprovincialis* Lamarck, 1819; *Bittium reticulatum* (Costa, 1799), *Tritia reticulata* (Linnaeus, 1758) (unpublished data of A. V. Krylov).

Cerastoderma glaucum (Bruguiere, 1789)
(Figure 10)

Cardium glaucum Bruguiere, 1789: p. 22 [37], *Cardium glaucum*: Poiret, 1789: p. 12-14 [38], *Cardium lamarcki* Reeve, 1845: plate XVIII, fig. 1—8, p. 219 [39], *Cardium edule* var. *rusticum* Grimm, 1877: plate VI, fig. 1, p. 122 [25], *Cardium (Cerastoderma) edule lamarcki* Nevesskaya, 1965: plate VII, fig. 16—29, plate VIII, fig. 1—18, p. 163—175 [40], *Cerastoderma glaucum* Boyden, 1971: fig. 1, p. 307—310 [41], *Cerastoderma dombra* Krylov, Bolshyanov, Marquet, 2011: pictures 5, *a—b*, picture 6, fig. 2, *a—b*, p. 4 (pars) [29], *Cerastoderma glaucum* Kiyashko, 2013: photograph 39, picture 126, p. 301—343 [30]. Lectotype: The Natural History Museum, United Kingdom, Left valve, No. 196519, Devonshire County, Great Britain (Reeve, 1845). Established by P. D. Russell [42—44].

Diagnosis. Shell rounded-trigonal, asymmetric, valves moderately thick, with 25—30 comparatively narrow radial ribs. Keel weakly marked, with slight bend. Umbo sub-conical, highly convex, strongly protrudes above the shell. Muscle scars small.

Description. Shell small, highly convex, rounded-trigonal, asymmetric, curved, valves moderately thick, with 25—30 comparatively narrow radial ribs, in some specimens with 2—3 well-marked growth lines. Shell color white, pinkish, greenish or grey. Shell height almost equal to its length. Umbo sub-conical, strongly protrudes forward, shifted towards the anterior end of shell, rounded, rounded-trigonal, asymmetric. Hinge heterodont. Right valve has small single elongated cardinal tooth and two narrow triangular inner margins. Umbo rises above the cardinal tooth by 0.10—0.15 of total valve's width. Cardinal tooth of right valve is oval or rounded-trigonal in transverse section.

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Left valve with two lateral teeth. Hinge teeth thick or moderately thin. Umbonal apex wide. Keel not sharp, weak. Muscle scars small, rounded-trigonal, shifted towards the anterior end of shell. Sub-keel area narrow. Pallial line absent. Inner shell margin broad, widened in one direction and narrowing in another. There are 14—22 inner radial depressions, located under middle portions of largest radial ribs in shell center. Rounded granulated ribs with widely spaced transversal crests, which are well-marked near anterior and ventral aspects, and with conchiolin scales in central and posterior areas of valves. In central and sub-umbonal areas of inner side of valves, usually in young individuals, stripes reflecting outer ribs and grooves under radial ribs in posterior area may exist.

Collection numbers of the studied specimens and their dimensions are given in Table 3.

Table 3. — Morphometry of *Cerastoderma glaucum* (Brugierre, 1789)

Таблiца 3. — Марфаметрыя *Cerastoderma glaucum* (Brugierre, 1789)

Dimensions (in mm)	Specimens, their collection numbers				
	Belarus, Yerameye-vichy, right valve	№ Б-2 Russia, Rostov region, Yeisk,left valve	№ Б-3 Russia, St.Peters-burg region, Lukashi, left valve	№ Б-4 Russia, Rostov region, left valve	№ Б-5 Russia, Rostov region, Yeisk, right valve
Valve height	12,0	14,0	14,5	16,0	23,5
Valve length	12,0	15,0	15,0	18,0	24,0
Valve width	4,4	6,0	6,5	8,0	11,5
Cardinal teeth (or socket) length	0,1	0,4	0,5	0,6	1,0
Cardinal teeth (or socket) width	0,1	0,4	0,5	0,6	1,0
Anterior muscle scar length	0,5	0,5	0,5	0,6	1,0
Anterior muscle scar width	3,0	4,0	4,0	5,0	8,0
Posterior muscle scar length	2,0	2,0	2,0	2,5	4,0
Posterior muscle scar width	3,0	4,0	4,0	5,0	5,0
Inner margin width	1,5	2,0	2,0	2,5	3,5
Radial rib width (maximal)	1,0	1,5	1,5	1,7	2,5

After P. V. Kiyashko [30], length of shells in adult individuals from the Caspian Sea is up to 35 mm, height — up to 33 mm, inflation — up to 25—28 mm. According to L. A. Nevesskaya [40], length of shells from the Black Sea is up to 10.0—11.3 mm. Specimens from the Mediterranean and Atlantic reach 40—50 mm lengthwise. Fossil specimens are usually smaller than recent ones.

Comparison. Differs from *Cerastoderma edule* (Linnaeus, 1758) by the following: shell of *Cerastoderma glaucum* (Brugierre) is asymmetric on the left and on the right, more convex in its central part, with marked keel having right-angled bend on one side of a valve, large number of radial lobes, narrowed anterior vertex part of shell, absence of a longitudinal flattened wide lobe near the cardinal tooth, lesser angle between side lobes and depressions. Differs from *Cerastoderma rhomboides* (Lamarck, 1819) by umbo more protruding forward, less convex shell, shorter convexities on anterior side, wider cardinal tooth, narrow radial ribs and thinner valves.

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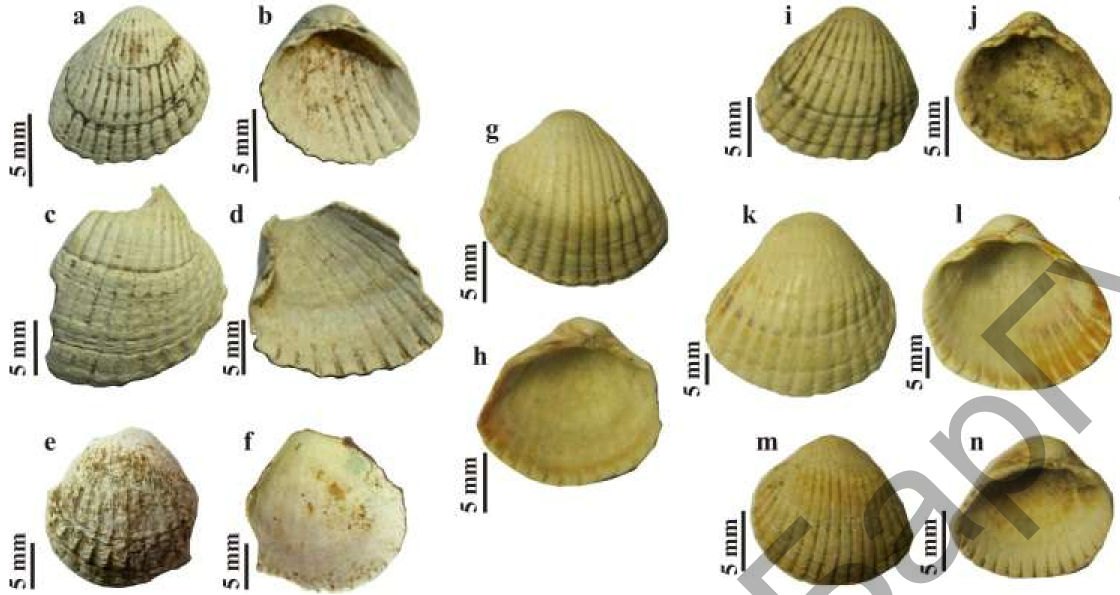

Figure 10. *Cerastoderma glaucum* (Bruguiere, 1789) from surficial deposits of the East European Plain: *a—b* — right valve, Yerameyevichy, Grodna region of Belarus (external (**a**) and internal (***b***) side); ***c—d*** — fragment of right valve, Yerameyevichy, Grodna region of Belarus (external (***c***) and internal (***d***) side); ***e—f*** — fragment of right valve, № Dr-1/1, Daŭnary, Minsk region of Belarus (external (**e**) and internal (***f***) side); ***g—h*** — left valve, № Б-2, outskirts of the city of Yeysk, Rostov region of Russia (external (***g***) and internal (***h***) side); ***i—j*** — right valve, precise locality unknown, Rostov region of Russia (external (***i***) and internal (***j***) side); ***k—l*** — right valve, № Б-5, outskirts of the city of Yejsk, Rostov region of Russia (external (***k***) and internal (***l***) side); ***m—n*** — left valve, № Б-3, Lukashi, St. Petersburg region of Russia (external (***m***) and internal (***n***) side).

Малюнак 10. Рэшткі *Cerastoderma glaucum* (Bruguiere, 1789) з покрыўных адкладаў Усходне-Еўрапейскай раўніны: *a—b* — правая створка, Ерамеевічы, Гродзенская вобласць, Беларусь (вонкавы (***a***) і ўнутраны (***b***) бок); ***c—d*** — фрагмент правай створкі, Ерамеевічы, Гродзенская вобласць, Беларусь (вонкавы (**c**) і ўнутраны (***d***) бок); ***e—f*** — фрагмент правай створкі, № Dr-1/1, Даўнары, Мінская вобласць, Беларусь (вонкавы (***e***) і ўнутраны (***f***) бок); ***g—h*** — левая створка, № Б-2, раён г. Ейск, Растоўская вобласць, Расія (вонкавы (***g***) і ўнутраны (***h***) бок); ***i—j*** — правая створка, дакладнае месцазнаходжанне невядома, Растоўская вобласць, Расія (вонкавы (**i**) і ўнутраны (**j**) бок); ***k—l*** — правая створка, № Б-5, раён г. Ейска, Растоўская вобласць, Расія (вонкавы (***k***) і ўнутраны (***l***) бок); ***m—n*** — левая створка, № Б-3, Лукашы, Ленінградская вобласць, Расія (вонкавы (***m***) і ўнутраны (***n***) бок)

Mode of life. Active, benthic; burrows into slimy and sandy bottom, exposing siphons and a portion of shell above the sea floor. Sestonophage and detritophage. Euryhaline inhabitant of shallow sea, lagoons and estuaries [40; 45].

Distribution. Occurs in the Baltic, North, Mediterranean, Black, Azov, Caspian and Aral Seas [45; 46]. In the Black and Azov Seas occurs in salinities of 2.5—40.0‰ at depths 0—12 m (single specimens — up to 70 m). Found in south-eastern part of the Caspian Sea at depths up to 50—60 m in salinities over 5.0‰. Along the eastern coast of the Caspian Sea, in its middle part, has only sporadic occurrence [27; 31].

Known in the North Sea beginning in the Lower Pleistocene. Later appears in the Irish, Celtic and Mediterranean Seas. In the Baltic Sea occurs from the Holocene and from there it was usually reported as *Cardium edule* Linnaeus. In the Caspian Sea occurs from the Pleistocene. Known in the Black Sea from the Lower Pleistocene until the present along its northern coast. In the early Eopleistocene — middle Neopleistocene (Lower to Middle Pleistocene) inhabited the former united

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Pontic-Caspian Basin (Crimea, Georgia, Rostov region). Recently fossil specimens have been found in the northwest East-European Plain: in the St.Petersburg and Tver' regions of Russia (Figures 10m—n), a hill near the village of Lukashi, 75 m above sea level) and a pit near the village of Rogachevo, 182 m above sea level. From the territory of Belarus is reported here for the first time: a hill near the village of Daunary, Minsk region (210 m above sea level) and a field near the village of Yerameyevichy, Grodna region (140 m above sea level).

General discussion of the results of the study of marine invertebrate findings

1. The present paper covers paleontological evidence of a marine nature of several kinds of surficial sediments including varved and thin-layered clayey and silty deposits, sands and sandy loams, which were previously interpreted as Pleistocene glacial-lacustrine, glacial-fluvial and other glacial accumulations. Marine microfauna is reported from two localities, in one of which the *in situ* occurrence seems to be undoubted and in the other redeposition from a short distance away is possible. For the latter an older pre-Quaternary age is not ruled out. In spite of the fact that varved facies and thin-bedded clays are widespread in recent seas [47; 48], a marine origin of their Cenozoic analogs was usually accepted as verisimilar only for recent maritime areas, whereas in the continental interior they were *a priori* considered to be almost exclusively glacial-lacustrine. The foregoing data suggest that there is a need to revise this postulate.

2. Especially valuable for ascertaining the Late Cenozoic paleogeography of the studied area are findings of marine bivalve mollusks. Although existing collections of marine bivalves form the territory of Belarus are scarce, available taxonomic identifications allow suggesting several suppositions. In particular, the presence of a widespread Quaternary and recent European bivalve species *Cerastoderma glaucum* (Brugierre) among the collected material might be evidence of a submergence of the studied area due to the Pliocene or Pleistocene Pontic-Caspian transgression from the south and the Northern (Arctic) transgression from the north, which could temporarily merge in Eastern Europe. There are a number of paleontological indications of former existence of this united basin which were obtained in various regions [17; 49; 50]. No less interesting is the discovery of subfossil remains of *Didacna baeri* (Grimm) in surficial beds of Belarus. This species is confined to the Caspian region and is known in Pleistocene and Holocene strata of several areas of the East European Plain. Taking into consideration the southern geographic confinement of this species, it is hardly possible to explain its occurrence in the studied region by transportation by hypothetical glaciers during their advancement from Scandinavia and from the north of Europe. Any assumptions about possible artificial delivery of shells of *Didacna baeri* (Grimm) by recent humans or by birds are not consistent with the occurrence of buried remains of *D. baeri* (Grimm), including in cores of drill holes. Also notable is the fact that this species is ordinarily found in small local deposits at slightly higher elevations, as revealed by A. V. Krylov in Russia's European part.

3. Absolute altitudes of localities of the marine bivalves collected in Belarus are 136—156 and 210 m, in the Tver' region of Russia — 180 m, in the St. Petersburg region of Russia — 75 m above sea level. The above-described varved and clay strata occur at altitudes of 125 m and 230—244 m. According to the geomorphological scheme by I. L. Kuzin [17], outcrops exposed at these altitudes, except for the St. Petersburg region, may not be only Pleistocene, but also Neogene and even older. Therefore, besides the revision of the generally adopted interpretation of the sedimentation setting of Upper Cenozoic varved, thin-layered clayey, silty and fine-sandy deposits, it is possible that the estimation of their geological age will also undergo reexamination. Taking into account that paleontological proofs of a pre-Quaternary age of some deposits heretofore considered to be Pleistocene were already reported earlier for several areas of Belarus [51], it cannot be excluded that more facts of the same kind may arise. The determination of a marine nature of the above-described sediments entails the need to reexamine all other surficial horizontally-bedded strata in this region by applying more advanced integrated micropaleontological methods.

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4. A comparative scarcity of findings of marine mollusks may be explained by the effect of dissolution of their shells and by other processes resulting in destruction of carbonate faunal remains, by analogy to processes taking place in recent northern seas [52, 53]. Indications of dissolution are clearly seen on many bivalve mollusk specimens available in our studied collection.

5. New data reported herein are not fully consistent with the prevailing idea about a glacial and glacial-lacustrine nature and in some cases with a Pleistocene age of the above-mentioned kinds of sedimentary accumulations. Further studies may result in a more clear understanding of the paleogeographic setting of the formation of surficial strata in Belarus and also of their correlation with neighboring as well as distant regions of the East-European Plain.

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Паведамляецца пра новыя знаходкі арганічных рэштказ з плейстацэнавых і, верагодна, больш старажытных кайназойскіх адкладаў Беларусі і Еўрапейскай часткі Расіі. Марская мікрафаўна (фараміміферы, радыяляры, губкі і іншыя групы) прыводзіцца са стужкавых адкладаў, а таксама з глін, якія ў рамках ледавіковай тэорыі трактуюцца як ледавікова-азёрныя. З покрыўных пясчана-глiністых адкладаў указаны марскія двухстворкавыя малюскі, прадстаўленыя відамі, пашыранымі ў адкладах плейстацэна Ўсходняй Еўропы. Іх пераважная прымеркаванасць да Чорнага і Каспійскага мораў дазваляе лічыць сумніўным магчымасць пераадкладання гэтага матэрыялу гіпатэтычнымі паўночнымі ледавікамі. На падставе атрыманых звестак аўтарамі зроблена выснова пра тое, што некаторыя тыпы адкладаў, якія традыцыйна лічацца ледавіковымі, у рэчаіснасці былі ўтвораны ў марскіх умовах, падчас познекайназойскай марской трансгрэсіі Паўночнага (Арктычнага) і Понта-Каспійскага басейнаў. Не выключаецца таксама і больш старажытны (неагенавы і палеагенавы) узрост часткі адкладаў, якія ў беларускай рэгіянальна-геалагічнай літаратуры лічацца плейстацэнавымі.

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