BALTIC STRATIGRAPHIC ASSOCIATION

ABSTRACTS OF THE SECOND BALTIC STRATIGRAPHIC CONFERENCE

VILNIUS 9 - 14 May 1993

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LITHUANIAN GEOLOGICAL INSTITUTE
VILNIUS UNIVERSITY
GEOLOGICAL SURVEY OF LITHUANIA

ABSTRACTS OF THE SECOND BALTIC STRATIGRAPHIC CONFERENCE

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PREFACE

This edition presents the abstracts of the 2nd Baltic Stratigraphic Conference which was held in Vilnius 9-14 May 1993 under the aegis of the Baltic Stratigraphic Association. The purpose of Conference was the generalization of a new stratigraphic data touched in the East Baltic area and adjacent countries. Communications specifically analyse the current state of knowledge of the East Baltic biostratigraphy, lithostratigraphy and paleogeography as well as include reports touching the other regions of the East and Middle Europe.

Except the Abstracts other publications are devoted to the Conference, i.e.: * Catalogue of Vedian and Cambrian Stratotypes of the East Baltic Area. Compiled by Kaisa Mens // 1992, Tallinn; * Catalogue of Vendian - Devonian Stratotypes of Lithuania. Edited by J.Paškevičius // 1993, Vilnius; * Catalogue of Permian - Neogenė Stratotypes of Lithuania. Compiled by A.Grigelis and P.Suveizdis // 1993, Vilnius; * Catalogue of Quaternary Stratotypes of Latvia, Lithuania and Estonia. Edited by Ona Kondratienė // 1993, Vilnius; * Detali stratigrafija / Detailend Stratigraphy. Edited by J.Paškevičius and A.Grigelis // Lietuvos aukštųjų mokyklų mokslo darbai. Geologija. T. 14. 1993, Vilnius.

We have a hopeness these editions will stimulate further stratigraphic researches and will be useful for the whole complex of the geological works iniciating in the Baltic area and adjacent countries.

Editors

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PALEOECOLOGY OF PALEOGENE FOSSIL DINOFLAGELLATES

Study of phytoplankton in Paleogene of the Carpathians, the Crimea and Black Sea shore region, Northern Caucasus, Armenia and Eastern Precaspian makes possible some paleogeographical and paleoecological reconstructions

Paleocene epoch. At the studied area marine saline warmwater basin probably existed. In Late Paleocene in the Carpathians, Crimea, Northern Caucasus dinocyst complex differs a bit from the associations of Tethys region, and in Eastern Precaspian specific algocenosis was developing with predominance of Cerodinium and Deflandrea, known from Siberian Paleocene.

Eocene epoch. In Early Eocene warm marine basin predominated with development of Charlesdowniea, Dracodinium, Wetzeliella, excluding Eastern Precaspian with Deflandrea predominating. At the end of Early Eocene (level of NP13 zone) here is observed the influence of Tethys warm currents that resulted in "mixture" of warmwater and coldwater species of Wetzeliella, Charlesdowniea and Deflandrea. Middle Eocene algocenosis witnesses to warm marine shallow basin in the Crimea and Northern Ukraine, and presence of coldwater Rhombodinium in Carpathian sediments confirms the climatic zonation which was the most evident in Late Eocene. Predominance of Wetzeliella and Charlesdowniea over Rhombodinium, wide development of Phthanoperidinium, Areosphaeridium, Glophyrocysta are represented in Late Eocene sediments of Armenia.

Oligocene epoch. Formation of Paratethys led to the specific complexes which consist of one, two, rarely of three species. Such associations apparently may reflect the change of temperature and salt regimes. Coldwater monocomplexes with Rh. draco are established in Oligocene of the Carpathians, Black Sea shore region and Northern Caucasus. Wide development of W. gochtii and endemic nannoplankton (level of NP23 zone) witness to reduction of basin salinity in Eastern Paratethys.

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MIDDLE FAMENNIAN SUBSTAGE ON THE TERRITORY OF EASTERN EUROPE BY THE SPORES

According to the stratigraphic scheme the Famennian stage on the territory of Eastern Europe is divided into 3 substages. The Lebediansk, Optukhov and Plavsk Stages are referred to the middle Famennian in the central areas of the Russian Plate, and their analogues in other regions. By the palynological data the middle Famennian substage is considered to incorporate the ***Cornispora varicornata*** (CVa) Zone, which is composed of the Petrikov, Lebediansk and Optukhov Stages and their analogues. The Petrikov deposits are widespread in Eastern Europe. They can be identified in the most complete sections of the Famennian stage and possess individual paleontological and palynological features. The Plavsk deposits and their analogues have been assigned to the upper Famennian since they mark the beginning of a new concluding phase in the development of the Late Devonian vegetation.

New palynological data have been acquired recently as a result of the Famennian studies carried out in the stratoregional Franco-Belgian Basin (Ardennes), which change our common notion about the middle Famennian scope on the territory of Eastern Europe. The Famennian stage is divided in the stratoregion into 2 substages: lower (Fa 1a,b) and upper (Fa 2a-d). The base of the upper Famennian (Fa2a) is regarded to be the most important boundary. The ***Lagenoisporites immensus*** (Im) palynozone has been established in the lower portion of the upper Famennian section Esneux (Ardennes), which includes the lower Famennian Eletsk Stage. Taking into account the abovesaid, the middle Famennian of Eastern Europe should comprise the Eletsk, Lebediansk and Optukhov Stages in the central areas of the Russian Plate; Eletsk, Petrikov, Lebediansk and Oressk Stages in the Pripyat Depression; Kinashevsk, Maksakovsk and Adamov Formations in the Dnieper-Donets Depression; Eletsk and Ust-Pechora (without upper member) Stages in the Timano-Pechora Province; Eletsk, Lebediansk and lower part of the Zimovsk Stages in the Volga region near Volgograd; Kursask, Akmensk and Mursk Stages in the Baltic region. Over the entire territory of Eastern Europe the ***L. immensus*** (Im) and ***C. varcornata*** (CVa) palynozones are referred to the middle Famennian substage. Within the Famennian stratoregion (Ardennes) the lower part of the upper Famennian (Fa 2a,b) corresponds to the middle Famennian of Eastern Europe in case of its twosubstage division. By the conodont standard the middle Famennian conforms to the ***Pa. rhomboidea***, ***Pa. marginifera*** and, possibly, lower ***S. velifer*** Zones.

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MANY VERSIONS IN THE STRATIGRAPHIC CORRELATION AS A SIGNIFICANT PROBLEM OF THE LITHUANIAN QUATERNARY STUDIES

Lately stratigraphic correlation of Quaternary deposits was carried out on the basis of many facts, i.e. the results of a large complex of different ihnvestigations. The abundance of information doesn't help to increase reliability of stratigraphic correlation, but it creates preconditions to solve this problem in many versions. It is evident, for example, in the investigations of famous interglacial deposits in the rock exposures of Snaigupėlė (South Lithuania). Five boreholes were also bored through the whole cover of Quaternary deposits there. The pollen analysis and radiocarbon dating of interglacial deposits as well as granulometric, petrographic, mineralogic, chemical and paleomagnetic investigations of tills have been made. The results of all these investigations were taken as equivalents during the process of stratigraphic correlation. Five versions of correlation of Quaternary deposits in this area have been obtained.

Another example is the correlation of Quaternary deposits in the Eastern environs of Vilnius. The deposits of three different interglacials were distinguished in the core of boreholes according to the results of palynological investigations. So, the results of stratigraphic correlation of Quaternary deposits based on the palynological data differ from the results of stratigraphic correlation carried out on the basis of chemical analysis of tills using mathematical-statistical grouping methods.

We think that the problems of stratigraphic correlation of Quaternary deposits should be solved in several ways in parallels. It is necessary to carry out the critical analysis and to estimate the real limits of possibilities of those methods that are used for stratigraphic decomposition and correlation of Quaternary deposits. It is possible that mathematical models of glaciodynamic conditions for different age continental ice shields that had covered Lithuania and surrounding areas will help partly to solve problems of stratigraphic correlation as well. Besides, it is indispensable to search for more reliable methods of absolute geochronology suitable for Quaternary deposits.

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CONODONT STRATIGRAPHY OF THE ORDOVICIAN IN NORTHERN POLAND

The Ordovician deposits in northern Poland occupay an area between the Mazurian massif in the east, and the geosynclinal zone in the west.

In this territory, one can distinguish two confacies belts, that are known from Sweden. The first one is called the Scania confacies and prolongs to the western part of the syneclize (the Leba area), second one - Central Baltoscadian confacies which continues to the remaining part of the Polish part of the Peri-Baltic syneclize.

Within the Leba area the Ordovician deposits begin with dark-grey carbonate claystones with dispersed grains of glaucoite and inserts of grey-glauconitic limestone. Relatively rich fauna of Conodonts determines this interval as The ***Paltodus deltifer*** Zone (the Varangu stage). In the remaining part of the Peri-Baltic syneclie, from Gdansk to the Kętrzyn region, the Upper Hunnebergian is represented by glauconitites and grey-green limestones or by the Billingean brick-red limestones of the ***Oepikodus evae*** Zone.

The brick-red lithofacies of the Billingean passes up to the Volkhovian epoch, except the Leba area where the clayey graptolites lithofacies disappears and is replaced by grey pelitic carbonate ones with Conodonts of the ***Baltoniodus navis*** and ***Paroistodus originalis*** Zones.By the Kunda epoch the goethite ooids lithofacies becomes common and passes up to the next epochs: Aseri and Lasnamagi. On the basis of Conodonts are distinguished: the ***Amorphognathus variabilis*** and the ***Pygodus serrus*** Zones. However, in the central part of this territory some gaps below the ***Eoplacognathus lindstroemi*** and ***E.robustus*** Zones are noted.

At the begining of the ***Pygodus anserinus*** Zone (the Uhaku epoch) in the western part of the Peri-Baltic syneclize the ooid limestones disappeared, while the grapthilitic clayey are common. In the rest part of the syneclize the calcilutite type limestones are distributed. The ooid lithofacies so characteristic for the Volkhovian to Lasnamagi epoches disappeared or is limited to the central part of the syneclize where the carbonate lithofacies is reported from the Caradocian (the ***Amorphognathus tvaerensis*** Zone) stage. In the Upper Caradocian (the ***A.superbus*** Zone) and in the Lower Ashgillian (***A.ordovicicus*** Zone) the distribution of the clayey-marly lithofacies has comparatively widest horizontal extent. The end of the Ashgillian is characterized by a shallowing basin and greater predominance of sand deposits associated with movements of the Taconian orogeny.

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PLANT MACROFOSSIL ASSEMBLAGES IN THE PLEISTOCENE DEPOSITS OF LATVIA

Plant macrofossils have been examined in 39 profiles. The most detailed analysis of every layer has been done in interglacial dryland basin deposits of Pulvernieki (3 outcrops, 2 boreholes) and Felicianova (6 boreholes). In the marine bed of Ulmale macrofossils were found in 10 profiles. There are 243 names in the list of the Pleistocene seed flora of Latvia. The flora of Pulvernieki (120 forms) and Felicianova (89 forms) interglacials is the richest.

As a result of paleocarpological analysis plant macrofossil assemblages are determined in the profiles taking into consideration the ecological demands of plants, the variety of species, number of macrofossils and the lithological properties of the deposits that contain them. The formation of macrofossil assemblages is connected with the stages of the development of the basin, the climate and the vegetable kingdom. The plant macrofossil assemblage usually includes several palynozones. They help to specify the upper and the lower border of the interglacial deposits. The assemblages of interglacial climatic optimum contain characteristic thermophilie plants that are extinct, rare or that do not grow in Latvia at present. They allow to specify the age of deposits and the correlation of profiles.

Fragments of needles of ***Picea cf.omoricoides*** were found in the interglacial deposits of Židini (Gunz-Mindel).

The plant macrofossil assemblage typical to Pulvernieki (Mindel-Riss) interglacial contains ***Picea cf. orientalis, Larix sp., Spiraea cf.chamaedryfolia, Sambucus racemosa, Myrica cf.gale, Caulinia goretskyi, C. e gr.tenuissima, Caldesia parnassifolia, Carex paucifloroides, Scirpus atroviroides, Aracites interglacialis, Brasenia borysthenica var.nemenensis, Ranunculus sceleratoides, Aldrovanda cf.vesiculosa.***

The plant macrofossil assemblage typical to Felicianova (Riss-Wurm) interglacial contains ***Carpinus betulus, Acer sp., Tilia tomentosa, T.platyphyllos, Sambucus nigra, Caulinia flexilis, Scirpus Smithii, Brasenia holsatica.***

The tundra plant macrofossil assemblages are spread in the deposits formed at the end of the Latgale (Gunz), the Letiža (Mindel), the Baltic (Wurm) glacials and in the Baltic interstadial sediments. What concerns the structure of species they do not differ essentialy from each other. The best information is about flora at the end of the Baltic glacial (57 forms). Under the interglacial deposits of Pulvernieki in dryland basins some sediments have been determined from the end of the Letiža glacial with the following tundra plant macrofossils ***Dryas octopetala, Betula nana, Arctostaphylos uva-ursi, Potamogeton filiformis*** (Jaunškieri, Deseles Lejnieki, Uzvara) which are analogues of the Sudrabi beds (Seglinš V., 1987).

The deposits from the beginning of the Kurzeme (Riss) and the Baltic glacials are

characterized by tundra plant remain assemblages together with macrofossils of thermophilic plants that have been overflushed from sediments of the previous interglacial.

Marine beds of Jūrkalne formation from the beginning of the Kurzeme glacial contain the following plant macrofossils ***Salix polaris, S.herbacea, S.reticulata, Betula nana, Dryas octopetala, Selaginella helvetica, S.selaginoides, Sparganium hyperboreum***, with the plant macrofossils of the Pulvernieki interglacial ***Azolla interglacialica, Caulinia goretskyi, Carex paucifloroides, Bransenia borysthenica, Ranunculus sceleratoides, Larix sp., Salvinia natans, Zannichellia palustris, Elatine hydropiper, Carpinus betulus***.

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ON THE PROBLEM OF THE RHAETIAN STAGE

During last decade Rhaetian stage was abolished from time scale adopted for the geology of North America and also by the Stratigraphic Committee of previous USSR. In Lausanne (October, 1991) by decision of Subcommission on Triassic Stratigraphy Rhatian have been restored as independent stage of the Triassic system, but without designation of exact position of lower boundary.

There are there interpretations of Rhaetian: 1 - Rhaetian sensu lato, with the lower boundary at the base of ***Quinquepunctatus*** or ***Cordilleranum*** Zone; 2 - Rhaetian sensu stricto, with the lower boundary at the base of Choristoceras beds or ***Sturzenbaumi*** Zone; 3 - Rhaetian sensu medium, with the lower boundary at the base of ***Reticulatus*** Zone. Comparison of different interpretations of Rhaetian concerning three aspects - priority, faunal changes at the lower boundary and correlational capacity - shows that the third version is most valid., to last data of the Austrian geologists, the stratotype of Rhaetian stage - Koessen beds - is not older than ***Reticulatus*** Zone, and Hochlam Member of Koessen Formation and ***Reticulatus*** Zone are more or less synchronous. The analogues of ***Quinquepunctatus*** Zone in Koessen Formation according to conodont zonation are absent.

Most essential faunal changes at the lower boundary are observed before ***Reticulatus*** Zone. The renovation of ammonoids on all boundaries was equal and low, but main changes of brachiopod and bivalve assemblages occurred at the base of ***Reticulatus*** Zone. With the base of this zone is connected distinct renovation of the conodont assemblage (appearence of genus ***Misikelia***).

Rhaetian with the lower boundary at the base of ***Reticulatus*** Zone may be recognized in all regions of the whorld where are known topmost Triassic marine sediments - Northern Tethys, Perigondvanian Tethys, Circumpacific (includind oceanic facies) as well as Boreal and Notal regions.

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FINDS OF UPPER CAMBRIAN ACRITARCHS IN LATVIA

In Latvia the Cambrian and Ordovician contact zone is represented by a thin member of terrigenous rocks consisting, predominantly of weakly cemented sandstone with non-articulate brachiopod detritus. That the so-called "Obolus" sandstone has traditionally been considered to belong to Kallavere Formation (Pakerort regional stage), Lower Ordovician as core extraction in wells is insignificant thus yielding very little material to study. The only complete acritarch complex was found in Strenchi-8 borehole at the depth of 363 m in greenish clay "Obolus" sandstone layer (366.4-359.0 m) and seemed to support the dating of the sediments as the Lower Ordovician. Apart from new unnamed species it contained, according to the ideas prevailing previously, such Tremadoc forms as ***Stelliferidium, Cymatiogalea, Leiofusa, Veryhachium***, etc.

In 1973 Belgian scientist M.Vanguesten published information about 4 new acritarch genera discovered by him in Belgian upper middle Revinian, they were dated as Late Cambrian. Out of those ***Leiofusa stroumanense*** Vang. and ***Veryhachium dumontii*** Vang. are abundant in the "Obolus" complex from Strenchi-8 borehole. Detailed studies of acritarchs carried out in 1980 by F.Martin (East Newfoundland, Upper Cambrian and A.Volkova (East European platform, Upper Cambrian) made it possible to subdivide the acritarch complex and to correlate it with Scandinavian trilobite zones.

Taking into consideration these discoveries, the revision of the acritarchs from Strenchi-8 borehole has made it possible to state their age as Upper Cambrian and to correlate them with F.Martn's microflora A3a and A.Volkova's complex BK2 which correspond to the lower part of Upper Cambrian - the lower part of ***Parabolina spinulosa*** trilobite zone. A.Volkova has observed the BK2 complex in Petseru layers (SE Estonia) and, together with Estonian geologists, made a supposition that such deposits exist also in NE Latvia, including Strenchi-8 borehole. Later the BK2 complex was found in lower Julgaze formation, although that complex is somewhat different from Petseru. As in Strenchi-8 borehole acritarch complex ***Impluviculus multiangularis*** (N.Umn.) are abundant and it is nearest to Julgaze complex, it seems right ful correlate "Obolus" sandstone from Strenchi with the Julgaze Formation (Estonia).

The age relation between Petseru and Julgaze formations needs further investigations as it is not clear whether the differences in the BK2 acritarch complex in Petseru and Julgaze deposits are due to age alone. It is not known whether Latvian Upper Cambrian deposits correspond to Scandinavian ***Parabolina spinulosa*** trilobite Zone alone or the whole "Obolus" sandstone member correspond to that zone. That is why it is not clear where the borderline between the Ordovician and Cambrian is situated in Latvia, as well as the extent of Upper Cambrian deposits in the country.

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SOURCES OF ERRATIC, TRANSITIONAL AND LOCAL MATERIALS IN LITHUANIAN PLEISTOCENE TILLS AS LITHOSTRATIGRAPHIC CRITERIA

The stone counting methods of Lithuanian Pleistocene tills are based on determination of the source areas of the erratic, transitional and local materials. This permits conclusions regarding the directions of ice movement as well as the age of the tills to be reached (Fig.).

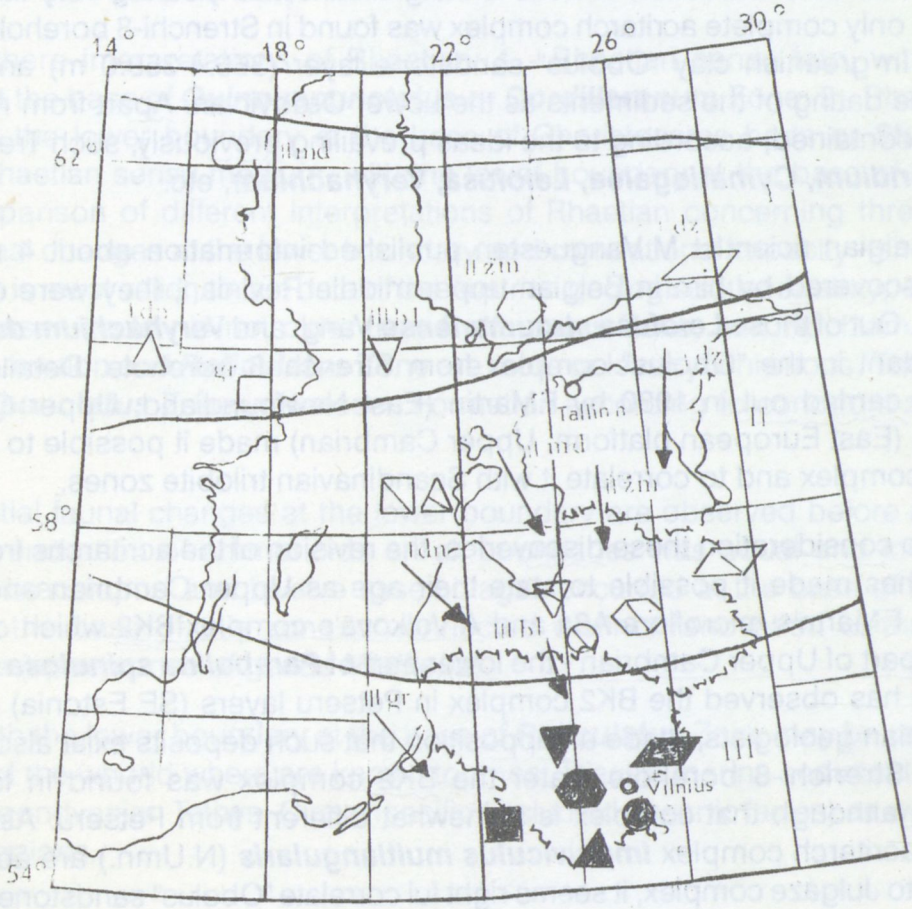

Fig. The areas of sources of Fennoscandian erratic (I), Baltic transitional (II) and Lithuanian local (III) materials in Dzūkija (Idz), Dainava (Idn), Žemaitija (IIžm), Medininkai (IIlmd), Grūda (IIIgr) and Baltija (IIIbl) tills of Lithuanian Pleistocene. The arrows show general directions of ice movements of diffrerent glaciations.

If used cautiously snd supported by biostratigraphic findings and geological mapping results, boulder or pebble statistics as sedimentary stratigraphic method can make a useful contribution to the solution of till lithostratigraphic questions. The eastern association of rocks was found in the Dzūkija and Žemaitija tills. The western association of debris established in the tills of Dainava and Grūda stages. In the Medininkai till crystalline rock boulders from North Sweden have been found. For Baltija till, the Aland rock fragments are common.

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EVOLUTION OF QUATERNARY STRATIGRAPHIC SCHEME OF LITHUANIA

The development of comprehension of Quaternary stratigraphy in Lithuania was directly related with general accumulation of palaeogeographic information concerning number of glaciations and interglacials in Alps and other parts of Europe. Names of interglacial and glacial periods in Lithuania were used the same as in stratigraphic schemes of Europe up to the middle of XX century.

The first Quaternary scheme with local Lithuanian appeliations of stratigraphic uits has been compiled in 1955. It was the first attempt to compile a common stratigraphic scheme for Baltic Republics and Byelorussia. Afterwards the ammount of stratigraphic data was continuously growing up as a result of extensive regional investigations and geological mapping, thus causing the necessity to compile a new stratigraphic scheme substantiated by data of Lithuanian investigators. Rather different and complex versions of stratigraphic subdivision of Quaternary of Lithuania were proposed by P.Vaitiekūnas (1960, 1965, 1967, 1969), V.Gudelis (1958, 1961, 1971), O.Kondratienė, A.Klimašauskas, A.Gaigalas, V.Čepulytė (1965).

The stratigraphic scheme obligatory for geological mapping of Quaternary has been approved by the State Board of Geology in 1961. The regional stratigraphic scheme of Baltic Republics has been accepted in Vilnius in 1970. According to climatic factor the horizons corresponding to glacial and interglacial periods were drawn. The Dzūkija, Dainava, Žeimena (with two subhorizons) and Nemunas (with two subhorizons and Turgeliai, Būtėnai, Merkinė interglacial horizons were stratigraphicaly established. This regional stratigraphic scheme was unified in 1976 and improved in 1983.

All stratigraphic units of Quaternary of Lithuania have property local names now. However the quantity and quality of data substatiating each of them are far from being equal. Ufortunately most of stratotype sections of interglacials in Lithuania, detected by pollen and spores data are not enough valid, because the conditions of occurrence of interglacial layers are not stratigraphicaly characteristic. Furthermore, the cooresponding geochronological equivalents are not revealed. The glacial formations are comparatively well grounded by regional correlations and large number of lithostratigraphic data.

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LOWER DEVONIAN VERTEBRATE ASSEMBLAGES IN SPITSBERGEN; THEIR RELATIONS WITH CIRCUM-ARCTIC AND NORTH EUROPEAN AREAS

Abundant vertebrate micro- and macro-remain assemblages occur throughout the whole Lower Devonian strata in Westspitsbergen. The content of various successive assemblages from the Red Bay and the Wood Bay formations is presented. These assemblages, dominated by ***Thelodonts, Acanthodians, Heterostracans, Placoderms*** and ***Chondrichthyans*** show a close similarity with the Lower Devonian series of Podolia, Severnaya Zemlya, and Lithuania. Some faunal components allow a further comparison with the Canadian Arctic and the North American cordilleran realm in Western USA. A tentative correlation chart is proposed between these areas, their possible paleobiogeographical relationships are explored.

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LITHOSTRATIGRAPHY AND GEOLOGICAL DEVELOPMENT OF THE JURASSIC - PALEOGENE BASINS OF LITHUANIA

After elevations during Middle and Late Triassic, continental regime and break in sedimentation, the marine basins became prevalent once again in the region of Lithuania and adjacent to her South Baltic area during Jurassic-Paleogene time. Sediments of these basins completed the formation of Late Permian (Early Kimmerian) Lithuanian-Polish (Peribaltic) syneclise which is pressed by its very deep submerged south-western edge to T-T zone on border of East European platform in North Eastern Poland and South Western Lithuania.

The Jurassic-Paleogene sequences are distinguished in this region by facial unsteadiness and different genesis. According to tradition in geology of Lithuania up to now the sections of subconhtinental sediments of these geological periods were subdivided into groups and formations, meanwhile sediments of marine genesis containing an abundant fauna - to biozones and stages.

With aim of applied geology, at first, the new stratigraphic concept of Jurassic-Paleogene of Lithuania is presented in this work where the complete lithostratigraphic subdivision is given to whole sequence. This subdivision is show in subjoined stratigraphic scheme. The old names of lithostratons are used completely, new ones are marked by asterisk.

The Jurassic-Paleogene sequences show the former different conditios of sedimentation in shelf basin when the change of facies was determined by change of sea level and the local environments of deposition of sediments and breaks in sedimentation were settled by interaction of eustasies and synsedimentary tectonic factors.

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GEOLOGICAL TIME IN POINT OF REGIONAL STRATIGRAPHY

An analysis of geological time in regional stratigraphy suggests a complete registration of geological time course in investigations of real geological sequences. Geological time may be expressed by physival material units and by some thickesses of rocks but also may be not expressed by them. However, due attention is not paid to analysis of geological time in regional stratigraphy.

The regional standart stratigraphical scale can be completed after investigation of concrete sections, their correlation, determination of stratigraphical hiatuses and carrying out the geological time analysis at last. Practically the regional standard scale is biochronological, i.e., zonal. Such a scale must be without omissions but it can reflect hiatuses longer than chron. Boundaries of zones which are distinguished by fauna groups conditionally independent from facies may be considered as isochronous in the whole paleobasin (within precision of methods). Such zones may be used for chronostratigraphical comparisons.

The geological time duration of zones is not defined by modern geochronometrical methods but it is calculated from duration of stage, series or system which is known from accepted geochronological scales. So, the duration of zones which form such a sratos conditionaly is aequal.

The duration of breaks in process of sedimentation is defined neither by biostratigraphical nor by some other methods if it is less than chron. The fixation of breaks either of different duration or different spreading is necessary in the scale of geological time in regional stratigraphy.

In the Baltic Region the biostratigraphical zones compared with standart chronozones are the most detail stratigraphical units with isochronical boundaries. These zones enable to subdivide sections into segments of time up to 1-2 mln. years in length. This time may be "filled" by sediments at different degrees, but when the formation of sediments lasts rather long interval of geological time that is why the possibility of finding or separating of zones in sequences is quite real. But very often the correlation of regional stages (formations) is impossible in whole basin of sedimetation.

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ACRITARCHS FROM THE LOWER - MIDDLE CAMBRIAN BOUNDARY IN THE BALTIC SEA REGION

Numerous acritarchs and cyanobacteria from the Central Baltic Proper, south-central Sweden, Bothnian Sea, and western Finland have yielded qualitative, quantitative, and diverse data. These data indicate a diverse development of the Lower/Middle Cambrian Boundary. A considerable break is indicated between the Lower Cambrian and the Middle Cambrian sequences in south-central Sweden and Bothnian Sea. The Gotska Sandon area is suggested to contain transitional beds. Quantitative frequencies and diversity data from the acritarch assemblages could be used to subdivide the boundary. However, the subdivision must be based primarily on the first occurrence of discreteacritarch genera and species. The influence of the Hawk Bay Regression Event is suggested to diminish towards the east.

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LOWER/MIDDLE CAMBRIAN FILE HAIDAR FORMATION IN THE CENTRAL BALTIC SEA, ALAND SEA, AND SOUTH-CENTRAL SWEDEN

It is suggested that the File Haidar Formation comprises the Lower and Middle Cambrian below the Alun Shale Formation. The time span includes the ***Holmia inusitata*** Zone to the ***Paradoxides paradoxissimus*** Stage. The File Haidar Formation occurs in South Central Sweden and the Baltic Sea area. The composition of the File Haidar Formation contrasts between the Central Baltic Sea area and South-Central Sweden. Differences also occur comparing with the Soderfjarden Formation in the Bothnian Sea Aera and on Aland Islands. The File Haidar Formation is comparable with parts of the Cambrian in the East Baltic Area. The Lower Cambrian part of the File Haidar Formation reflects the opening of the Iapetus Ocean. During the ***Holmia kjerulfi*** time a maximum transgression phase is indicated with a fast sea floor spreading rate. The Lower and Middle Cambrian transition is connected with a regression phase, not demonstrated in the East Baltic Area. The Middle Cambrian part indicates the presence of a subduction zone towards the west beginning during the ***Ptychagnostus praecurrens*** time. The subduction initiates the Middle Cambrian sedimentation in South-Central Sweden, on East European Platform, and along the Caledonian Mountain Range. At the same time sedimentation ceases in the Central Baltic Sea Area.

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UPPER PROTEROZOIC TO LOWER PALAEOZOIC SEDIMENTARY SEQUENCE IN THE ÅLAND SEA AND STOCKHOLM ARCHIPELAGO, SWEDEN

The sedimentary sequence in the Åland Sea and Stockholm Archipelago has been investigated by the aid of sedimentary erratics and marine seismic investigations. The Åland Sea is a basin structure possibly created by caldron subsidence in connection with raising raising rapakivi magma. The basin contains sedimentary bedrocks up to 1,700 m in thickness. The informal Soderarm formation comprises two units, i.e. reddish Middle Riphean (Jotnian) sandstones up to 1,200 m in thickness, and Upper Riphean/Lower Vendian coarse-grained sandstones with detritus from the surrounding Svecofennian Subprovince as well as from the underlying Middle Riphean sandstone. The unit is to 400 m in thickness. The Lower Palaeozoic, totalling 360 m, is represented by Lower Cambrian sandstones attributed to the File Haidar Formation. The Middle and Upper Cambrian is not verified, but could be present. The Ordovician comprises the Oeland, Viru and Harju Series. In the Upper Ordovician dolomitic Baltic limestone is present. Dolerite intrusions are supposed to have cut the sedimentary sequence at two occasions, i.e. during a time range comprising Middle Riphean (1.25 Ga) and, possibly as late as Late Palaeozoic. In the Stockholm Archipelago several local in situ occurrences of Ordovician limestone are indicated.

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SEQUENCES OF REGIONAL UNITS AS CONSTITUENT PARTS OF THE ORDOVICIAN CORRELATION CHARTS OF THE EAST EUROPEAN PLATFORM

The aim of this paper is to draw attention to the sequences of Ordovician regional chronostratigraphical units used in the correlation charts of the different regions of the East European Platform (of the Baltic basin) and to the problem what kind of units we need in practical geological studies. The most important regional chronostratigraphical units of these charts are stages. Each of them consists of contemporaneous formations and members, and the set of stages serves as a basis for different studies on the development of the depositional basin and its faunas. In the correlation charts considered here the term "stage" is used in the similar meaning of the British Ordovician stages.

Three main sequences of regional stages should be mentioned. They have been worked out the Scandinavian region (for Sweden and Norway separately), East Baltic and Russia (in the Moscow syneclise). The specifics of the geological history of different parts of the basin and also present geographical and adminitrative separation of the areas with Ordovician deposits is responsible for the differences in chronostratigraphical subdivisions. In some cases the stages of the different areas correspond to the same interval in terms of graptolite zones,in other cases their ranges are essentially different.

The stages established firstly in the outcrop area of Estonia and northwestern Russia (Ingerland) have been accepted in East Baltic, partly also in the Scandinavia and Russia. The Lower Ordovician Kunda Stage is a single chronostratigraphical unit recognized from Norway to Russia, in the limits of the whole basin. In the Swedish and Norwegian correlation charts the stages are not established yet for the whole Ordovician sequence and in some intervals the zonal schemes are used for the correlation of the formations.

Comparison of the different sets of stages shows that their application coincides roughly with the main confacies belts of the Baltic basin. IN the East Baltic deposits of two different facial zones are represented and conventionally stages of two sets should be used: in the northern East Baltic the stages with stratotypes in Estonia and Ingerland and in Central East Baltic the stages common with Scandinavia. Still, up to now in East Baltic only one Scandinavian stage - the Latorp Stage is accepted.

The plurality of the sets of the chronostratigraphical units may be useful in some aspects. However, it is difficult to use two different sets of stages in the case of continual succession of facies along the environmental gradient as it is known from East Baltic. An aspiration to unify the left side of the stratigraphical correlation charts cannot be formal, different possibilities should be analyzed.

The modified Ordovician correlation chart for Estonia will be presented.

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ON THE BOUNDARY STRATOTYPES OF THE ORDOVICIAN REGIONAL STAGES IN THE EAST BALTIC

In the East Baltic, a set of Ordovician regional stages consists of 18 units with stratotypes in the outcrop areas (16 in Estonia). The geographical name of the stratotype area or section serves as an etymon of the stage's name. The use of the stages in stratigraphical practice is traditional but not sufficiently formal.

For the progress in stratigraphy the establishing of the boundary stratotypes is actual. The suitable sections for the boundary stratotypes were analyzed for the stages of the Viru and Harju regional series. The direct use of possible characteristics to fix a boundary stratotype is complicated due the litho - and biofacial changes along the environmental gradient. The most authentic in the correlation of the sections of different facies belts are microfossils - chitinozoans, conodonts, to some extent ostracodes. Macrofossils and some lithological characteristics can be used indirectly.

The need for unambiguous understanding of the boundaries appears, for example, in the Idavere and Porkuni stages. The lower boundary of these stages is interpreted differently by different stratigraphers and the correlation of the corresponding deposits is complicated. In the type section the lower boundary of the Idavere Stage coincides with the lower boundary of the chitinozoans ***C.dalbyensis*** Zone identified in many sections in the East Baltic. Still, the boundary in the type section cannot be suggested for the boundary stratotype. It coincides with the significant gap in the sedimentation as follows from more complete sequences in South-East Estonia. A section in the Laeva region where the ***Cyathochitina aff. reticulifera*** Zone is considered as the oldest part of this stage should be suggested for the boundary stratotype of the Idavere Stage.

Unlike the Idavere Stage, the stratotype of the Porkuni Stage seems to be the most convenient section for the boundary stratotype, too. Up to now the discussions concern two stratigraphical units - the Roa Member and Taucionys Formation, which underlie the stratotype deposits of the Porkuni Stage. Both of these units are biostratigraphically closer to the Pirgu than to the Porkuni Stage. Therefore, the section in North Estonia should be preferred as the boundary stratotype of the Porkuni Stage.

The stability of the stages-level chronostratigraphical framework basing on the boundary stratotypes is extremely important in correlating the Ordovician over the East European Platform.

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PALYNOLOGICAL EVIDENCE OF THE COAL-BEARING SEDIMENT RHYTHM

In Middle Visean terrigenous-carbonate sequence, placed between two keybeds of limestones V_0 and V_2, opened by a number of boreholes in the northern part of Lviv-Volynian coal basin (Western Ukraine) the alternation of three palynocomplexes is found.

The first complex is densosporic with dominating ***Densosporites***, small content ***Lycospora, Calamospora, Punctatisporites***, spores of ferns; the second one is lycosporic (absence or a very small quantity ***Densosporites***, great number spores of arborescents placiolike, gerns and plants of family ***Calamitaceae***); associations are more hydrophilic and timed to transgressive parts of section. The third complex mainly Calamospora, Punctatisporites and spores of ferns is characteristic of regressive rhythm of sedimentation. In vertical section complexes of spores replace each other and repeat.

Natural vertical alternation of palynocomplexes reflects the rhythm structure of coal-bearing sediments and is the result of recurrence of paleogeographic and paleofacial conditions.

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FRASNIAN VERTEBRATE ASSEMBLAGES AND ZONATION OF THE EAST EUROPEAN PLATFORM

The Sargaevo Regional Substage (= R.S.) of the East European Platform is reliably belonged to the Frasnian (***asymmetricus*** conodont Zone). The Plavinas R.S. of the Main Devonian Field is corresponded to the most part of this interval. The suggested ***Bothriolepis cellulosa*** vertebrate Zone for the Snetnaya Gora and the Pskov beds of the Plavinas R.S. has wide geographic distribution on the platform. The species ***Grossilepis tuberculata*** extends to the Chudovo beds. As a rule, its ichthyofauna is very scarse and not clear. The assemblage of the ***Psammosteus megaloperyx*** Zone occurs from the Dubnik R.S. and the lower part of the Daugava R.S. of the Main Devonian Field. The upper limit of this species is the base of the Buregi beds of the Daugava R.S. The holotype of species ***Bothriolepis panderi*** has been described from the Snetnaya Gora-Pskov interval of the Syas River (Montsevo). The ichthyozones for the upper part of the Daugava R.S. (Buregi-Altovo beds), the Stipinai and the Amula R.S. are not established. The later ichthyozone of the Frasnian is the ***Psammosteus falcatus-Bothriolepis maxima*** Zone corresponded to the Snezha and the Pamushis R.S. This zone is widely distributed on the Main Devonian Field from Western Latvia to Vytegra.

The ***Bothriolepis cellulosa*** Zone occurs in the Uste Yarega Formation of the South Timan, the Uste Srednyaya beds of the Middle Timan, the lower part of the Sargaevo R.S. of Belorussia and others.

The assemblage of the ***Psammosteus megalopteryx*** Zone is discovered in the Semiluki R.S. of the Central Devonian Field, the Rassokha Formation of the North Timan.

The ***Psammosteus falcatus-Bothriolepis maxima*** Zone is found in the Petino and the Voronezh R.S. of the Central Devonian Field, the Vetlasyan and the Sirachoy formations of the South Timan and the Kamennyy Ruchey Formation of the Middle Timan.

Thus, the complete vertebrate zonation for the East European Thus, the complete vertebrate zonation for the East European Platform is not established, but some zones are distributed on the most part of the platform.

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PALUKNĖ MEMBER - A NEW LITHOSTRATIGRAPHIC UNIT OF THE LOWERMOST ORDOVICIAN OF LITHUANIA

A new lithostratigraphic unit - Paluknė Member - was established in the Lowermost Ordovician of the Paluknė-1 borehole in 1991. The site of the Paluknė-1 drilling is situated in the NW part of Lithuania, 8,9 km NE of Skuodas town, in the eastern part of the Krakė village. Tectonically this place belongs to the western part of Mažeikiai Ledge.

This unit, lies in the lowermost part of the Lower Ordovician and is only 0,5 m thick (depth interval 1855,1-1855,6 m). It consists of the dark grey almost black bituminous mudstone. Small mica flakes appear throughout and is rather abundant. Bedding is not very clear and is discernible because of horizontal lamination. Chemistry of the mudstone: CaO - 1,67%; MgO - 3,81%; SiO_2 - 61,44%; TiO_2 - 3,17%; Al_2O_3 - 14,67%; Fe_2O_3 - 5,92%. The organic carbon content is high: 5,29%.

The unit with distinct unconformity on the grey medium-grained quartzitic sandstone attributed to the Upper Cambrian (Salantai Member) and is unconformably overlain by the dark green glauconite sandstone of the Leetse Formation attributed to the lower-most part of the Arenig Stage. No faunal remains or microfossils have been found in Paluknė Member. But it has a very clear stratigraphic position and undoubtedly belongs to the Tremadoc Stage.

Paluknė Member is one and the only Tremadocian unit of Lithuania because the age of the underlying Salatai Member (Formation) or so called "Obolus Sandstone" is not Tremadoc, as is showed in the local stratigraphic scheme but is in fact the Upper Cambrian. That is proved by the abundand brachiopods Ugula ex gr. convexa Pander (by L.Popov: in E.Laškov et al., 1993).

The drillcore Paluknė-1 (in the above mentioned interval) is proposed as the stratotypic section for the Paluknė Member. According to E. Laškovas the same unit is established in the borehole Akmenė-71, interval 1610,7-1608,8 m (thickness 1,9 m). Its time-equivalents in Scandinavia and North Baltic Areas may be presented by the Dictyonema Shale or Ceratotype Shale.

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EOPLEISTOCENE OF BELARUS: BOUNDARIES, STRATIGRAPHY AND CORRELATION

At the 28th IGC (Washington) it was suggested to draw the lower boundary of the Quaternary at a level of 1,65 mln. yrs, somewhat above the top of the Olduvej palaeomagnetic episode. In Belarus this boundary was recognized in the Dvorets section on the top of the clayey member of the Lower - Dvorets Subformation. According to Z.Volok, this member includes two intervals of normal magnetization separated by an anomalous one. The palynoflora of this member reflects a transition from the optimum to a fall of temperature, and the seed flora corresponds to the Tiglian warm period.

Such a combination of palaeomagnetic and palaeobotanical data, with regard to the position in a section, permits to consider this clayey member as an analogue of the Tegelen and Olduvej. The boundary between the Quaternary and Tertiary in Belarus is traced by palaeocarpological and palynological materials in 13 sections. Deposits of the Eopleistocene (E.) are confined to an interval between the above boundary and the bottom of glacial formations of the Narev Glaciation. These deposits are represented for the most part by lake silts and clays, cover an area of ca 14 000 sq.km, and are confined to the Brest Depression, Belarusian Anteclise, to a lesser extent - Pripyat Trough. The E. includes the Brest Stage distinguished by N.A.Makhnach, Vseljub, Smorgon and Sivkov Formation described by G.I.Goretsky, Gomel, Yelnja and Brest Superstage from L.N.Voznjachuk's scheme, a part of the Bereza Group according to E.A.Levkov and A.F.Burlak.

The revision of results of principally palaeobotanical researches in 60 E. sequences and the materials collected by the author from 15 sequeces enabled her together with V.I.Nazarov to elaborate a detailed version of a stratigraphic scheme of the E. of Belarus and to correlate it with the general stratigraphic scale. The lower and upper units are distinguished in the E. of Belarus. The lower one includes the Gomel Superstage composed of the Vseljub cold and Yelnja warm Stage and Brest Superstage formed by the Varangian cold, Ruzhany warm Stage and that of Smorgon with a complicated climatic pattern. Palynoassociations from Artemisia-Poaceae to Pinus-Betula-Artemisia-Poaceae and macroremains of Selaginella selaginoides, Betula nana etc. are typical for the Vseljub, Varangian and Smorgon horizons. The Yelnja and Ruzhany Stage iclude a palynocomplex ***Quercus-Pinus-Betula-Alnus*** and remains of thermophilic ***Brasenia, Aracites, Stratiotes*** etc.

Correlation of the Eoeistocene of Belarus

Belarus Jakubovskaya,Nazarov 1992	**Lithuania Gaigalas, 1987**	**Netherlands Zagwijn, 1987**
Smorgon	Giliai	Glacial A--Linge
Ruzhany	Šilelis	Bavel s.s.
Varangian	Jundzikis	Menap
Yelnja	Šlavė	Waal
Vseljub	Šlavėnai	Eburon

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LOWER AND MIDDLE CAMBRIAN ACRITARCH-BASED BIOZONATION OF THE BALTIC SYNECLISE

The increasing use of the acritarch assemblages in the Cambrian stratigraphy of the East European Platform resulted in some local schemes of acritarch-based biozonation such as: East European Platform within the former USSR (Volkova et al., 1979, 1983; Jankauskas, 1991), Lublin Slope of one in Poland (Moczydlowska, 1991), Scandinavia (Vidal, 1981; Hagenfeldt, 1988, 1989; Eklund, 1990). But the coeval acritarch assemblages of mentioned areas can be directly compared because they all have been formed during deposition of the sedimentary rocks in the same epicontinental paleobasin. They provide a basis for the proposal of unified acritarch-based Lower and Middle Cambrian biozonation. The well-known "horizons" (regional stages) of the East European Platform are based generally on the acritarch evidence. They are in fact a biostratigraphic zones. Each of them includes an unrepeatable acritarch assemblages. Most of the acritarchs are presented by the long-ranging species. Therefore it is difficult to show the nominal - and index-taxa which are restricted to one "horizon". So only some of the "horizons" may be regarded as a range zones, the others are regarded as assemblage zones or concurrent range zones (Jankauskas, Lendzion, 1992).

Rovno and Lontova Stages regarded as ***Teophipolia lacerata*** ad accordingly ***Granomarginata prima*** Range Zones. First of them corresponds to ***Sabellidites*** faunal Zone, the second - to ***Platysolenites*** faunal Zone. The ***Baltisphaeridium cerinum*** Range Zone corresponds to both Dominopol (Talsy) and Lyuboml Stages and are subdivided into two assemblage zones. First of them recognized as ***B. cerinum - Skiagia compressa*** Assemblage Zone and is correlated with ***Schmidtiellus mickwitzi*** trilobite Zone. The other is absent in the Baltic Region but in Ukraine, Poland and Scandinavia may be recognized as ***B. cerinum - Skiagia ciliosa*** Assemblage Zone and is correlated with the ***Holmia inusitata*** trilobite Zone. The ***Estiastra minima - Micrhystridium dissimilare*** Assemblage Zone corresponds to lower part of the ***Holmia kjerulfi*** trilobite Zone and contains well-known Vergale acritarch Assemblage.

The ***Volkovia dentifera*** Range Zone, comprising the upper part of the Lower Cambrian deposits, is subdivided into two shorter ones. The ***Goniosphaeridium implicatum*** Assemblage Zone is correlated with the lower part of the ***H. kjerulfi*** Zone. Overlying ***Eliasum llaniscum - Multiplicisphaeridium dendroidem*** Concurrent-Range Zone is correlated with the ***Protolenus*** trilobite Zone.

The Middle Cambrian deposits are subdivided into two zones. The micrhystridium notatum - ***Lophosphaeridium*** variabile Assemblage Zone corresponds to ***E. oelandicus*** trilobite Zone and comprises Kybartai Formation and lower part of the Deimena Group. The ***Comasphaeridium strigosum - Timofeevia lancarae*** Concurrent Range Zone occupies the Paneriai Stage and is of the ***P. paradoxissimus*** in age.

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REVISION OF SOME CAMBRIAN ACRITARCH ASSEMBLAGES OF BELARUS

Two samples of the mudstone were obtained and microphytologically studied from the Cambrian deposits of Belarus. Both yielded rich and well - established acritarch assemblages which contradict with the official stratigraphic scheme of this country and previous publications.

Sample 1 (Locality 235): Borehole Skweriki-1 (Podlasie-Brest Depression), depth 636,1 m, Stavy Formation, 0,1 m below the top. One sample was attained and processed from the grey-coloured mudstone from the uppermost layers of mentioed formation. It yielded abunndant leiosphaerids and more or less abundant acritarch species, such as ***Skagia ciliosa*** (Volk.) type B, ***S. insigne*** (Fridr.), ***Goniosphaeridium implicatum*** (Fridr.), ***G. primarium*** (Jank.), ***Volkovia detifera*** (Volk.), ***V. flagellata*** (Jank.), ***Eliasum llaniscum*** Fomb., ***Annulum squamaceum*** (Mart.), ***Baltisphaeridium latviense*** Volk., ***Retisphaeridium howellii*** Mart., ***R. postii*** (Jank.), ***Cristallinnium ex gr. cambriense*** (Slav.), ***Lophosphaeridium truncatum*** Volk., ***Liepaina plana*** Jank. et Volk., ***Micrhystridium notatum*** Volk., ***M. obscurum*** Volk., ***Ovulum saccatum*** Jank. and numerous leiosphaerids. This assemblage is comparrable closely with those from the uppermost portion of the Lower Cambrian in different parts of the East European Platform and Scandinavia: the Rausvė Stage of the Baltic Syneclise, the ***Volkovia dentifera - Liepaina plana*** acritarch Zone of the Lublin Slope in SE Poland, the assemblage C of Sweden. All these biostratigraphic units are correlated with the ***Protolenus*** or ***Proampyx linnarssoni*** trilobite Zones of the Lower Cambrian strata. This seems to be not coordinated with the official opinion that Stavy Formation is of Middle Cambrian age.

Sample 2 (Locality 237). Borehole 68 (Olginiany) depth 194-192 m (Northern Belarus), Buiki Formation. Acritarch assemblage contains ***Timofeevia lancarae*** (Cr. et Dier), ***T. phosphoritica*** Vang., ***Cristallinium cambriense*** (Slav.), ***Micrhystridium confusum*** (Jank.), ***Tasmanites bobrowskae*** Waz., ***Ovulum saccatum*** Jank. and leiosphaerids. For the first time this assemblage was recovered by the author in 1983 and presented to Dr.L. Piskun. A bit later she published this material (Kembrij Belorussii, 1985, pl.12), but wrongly interpreted as belonging to lowermost Middle Cambrian (***E. oelandicus*** trilobite Zone). This assemblage seems to belong to younger strata of the Middle Cambrian - to the ***P. paradoxissimus*** trilobite Zone, because such species as ***T. lancarae*** and ***T. phosphoritica*** are nowhere in the world kown below the bottom of mentioned zone.

These micropaleontological data can more exactly show the geological age of the above mentioned formations.

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PANERIAI FORMATION OF THE EASTERN LITHUANIA, TECTONIC POSITION AND PALEOENVIRONMENT

Paneriai Formation with the maximum preserved thickness of about 20 m is located in the eastern part of Lithuania (Vilnius area) and partly extends to the northern Belarus (=Buiki Formation). This unit is developed in the isolated paleodepression and consists of grey massively bedded mudstone with irregulary interstratified layers of fine-grained white quartzitic sandstone. The mudstone grades laterally into white sandstone, therefore all section of this formation may consist generally of sandstone. The formation rests unconformably either o the lowermost Lower Cambrian (Baltic Group) or on white sandstone of the Lakajai Formation (uppermost Lower Cambrian) and underlies the Lower Ordovician deposits. This formation has been established as Middle Cambrian by its rich acritarch assemblage. It contains such characteristic species as ***Timofeevia lancarae*** (Cr., Deez), ***T. phosphoritica*** Vang., ***Cristallinium cambrience*** (Slav.), ***Eliasum llaniscum*** Fomb., ***Micrhystridium confusum*** (Jank.). No faunal remains are found in these strata. Litostratigraphically and paleontologically Paneriai Formation is comparable to the Genčiai Member of the western Lithuania and to the Veselovo Formation of the Kaliningrad District.

It is interesting to note that the Paneriai Formation lies in the Baikalian structural plan but belongs to Caledonian structural stage. The Vendian "Complex" and Baltic Group form a single megacycle of sedimentation, which occur in the Moscow Syneclise, Orsha Depression and southwestern slope of the East European Platform. The Cambrian, Ordovician and Silurian deposits forming a Caledonian structural stage are distributed generally in the Baltic syneclise and some adjacent areas. Only Paneriai Formation belonging to Middle Cambrian is developed within the area where the Vendion and Baltic deposits are distributed.

As a rule the geographical distribution of litostratigraphic units within the platformian cover is controled generally by the tectonic factors. Equally with the traditional tectonic structures in the Baltic region also there are established the seismic - tectonic zones (lineaments) with the features of a horizontal movements (Suveizdis, Vorobjov, 1991). They are long-living structures which have controlled the facies and thicknesses within the paleobasins. Some of them limit the geographic distribution of the Paneriai Formation. They seem to be very active during the Baikalian time and later, in the middle Middle Cambrian, after the period of the relative tectonic calmness, new movements along the lineaments probable caused the momentary renewal of the Baikalian structural plan of the platform.

The Paneriai Formation as well as coeval strata in the Moscow Syneclise have been deposited just in this paleoenvironmental stage which can be regarded as the paroxysm of the Baikalian - type movements during the Caledonian tectogenesis.

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ON SUBDIVISION AND CORRELATION OF LATE-GLACIAL AND HOLOCENE DEPOSITS ON THE TERRITORY OF LITHUANIA AND THE BALTIC SEA BY POLLEN AND DIATOM ANALYSIS DATA

On the basis of pollen and diatom analysis data, the author compiled the stratigraphic scheme for Lithuania's continental and marine deposits. The marine stratigraphy is based not only on coastal studies but also on the data from Central and SE Baltic Chronozones (climatic periods) serve as base units. There are twelve pollen zones and diatom complexes for continental and marine deposits separately.

In order to study the stratigraphy of lake and bog deposits by pollen data, we have analyzed the data from six various physical geographical parts of Lithuania. Rather prominent differences depending on environmental conditions were observed. Some characteristic features for pollen data in Lithuania have been determined: high values of ***Pinus*** pollen (the highest peak in Allerod); quantities of ***Betula*** are low; distinct, often double maximum of ***Picea*** in Late Holocene; not very high values of broad - leaved trees during Atlantic: the earliest possible signals of an anthropogenic effect are fixed approximately of the Atlantic - Subboreal transition; in the second half of Subboreal cereal pollen meanings increased.

Based on diatom data the Lithuanian Late - Glacial and Holocene lacustrine deposits can be divided into six zones (diatomic complexes). The lowest zone corresponds to Late - Glacial. Diatom flora is rich in benthic species and epiphytes. The second diatm zone comprises the Preboreal, and lower part of Boreal is noted by significant decrease in quantity of diatoms. The third zone (upper part of Boreal, Atlantic and lower part of Subboreal) shows a considerable increase in quantity of diatoms, especially planktonic ones, the zone is nonhomogenous. In the fourth zone (Subboreal) diatom quantity declines, benthos and epiphytes prevail in most lakes. The fifth diatom zone corresponds to the Subatlantic - increase in total quantity, mainly planktonic forms. The characteristic feature of sixth zone is flourishing of diatoms connected with human impact on the lakes.

We have some stratigraphical problems to be solved in Lithuania: to mark out and characterize the Bolling layers; to separate Preboreal and Boreal, especially when distinctly predominant Pinus or established hiatus in Early Holocene sediments occur, in various parts of Lithuania there is nonsynchronous culmination of some taxa, subdivision of Late Holocene; to detail diatom complexes of Late - Glacial and the third zone. The investigations showed and continental deposits it is important to use data on concentration of pollen in the deposits, diatom data are very useful. By diatom data it is possible to distinguish Baltic Ice Lake, Yoldia Sea, Ancylus Lake, Littorina Sea and Postlittorina Sea stages.

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BASE LEGENDS OF THE GEOLOGICAL MAPS (SCALE 1:50,000) OF ESTONIA, LATVIA AND LITHUANIA

The base legend of the bedrock map and the base legend to the map of the Quaternary deposits has been composed separately for Estonia, Latvia and Lithuania. Legends have been compiled using mainly the instruction of the geoloigical mapping (1986), the recommendations to the compilation of the Baltic geological maps (1981), the Baltic (1977) and East European Platform (1983-90) stratigraphic schemes and the experience received from the mapping of the Estonian, Latvian and Lithuanian areas.

The stratigraphic units of the large-scale geological mapping are as follows: complex (basement), group, formation and, mainly, subformation, bed and member. Inside the stratigraphic units of the Quaternary deposits there are distinguished genetical types and, if possible, also their facies and varieties. The conventional signs of mineral resources, lithological, geomorphological and other symbols were composed.

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SILURIAN BIO-EVENTS AND EVENT-STRATIGRAPHY

In the history of Silurian biota and/or ecosystem as a whole no "big" catastrophes occurred like the one at the Ordovician - Silurian boundary. Yet, it was not a quiet period either. There were established 15 more orė less remarkable bio-events, among others the most severe extinction of conodonts and acritarchs in the very beginning of the Wenlock (Treviken Event), the Great Crisis or Lundgreni Event among graptolites in the Homeria and the middle Ludfordian Event comprising many lineages of vertebrates, graptolites, conodonts and corals.

Most remarkable diversity rises of the Silurian biota were in the late Rhuddanian, in the Telychian and in the early Gorstian.

Both extinctions and originations were in good correlation with the global sea-level curve, but the effect has to be interpreted as an integrated process like suggested by Jeppsson.

The Baltic Silurian provides good examples (data) for tracing bio-events of differet ranks.

In general, the biostratigraphy is a kind of event-stratigraphy as the appearance or disappearance of a species or another taxon within an evolutionary lineage or an exotic one in a section is a bio-event. Consequently, many zonal units based on the occurrences of a taxon (or taxons) are the lowest-level event-stratigraphic units. Event levels can serve well for the correlation and as a criterion for defining the boundaries.

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PALYNOLOGICAL CHARACTERISTICS OF MARINE PLEISTOCENE DEPOSITS IN LATVIA

From 1986 to 1988 the Geological Survey of Latvia carried out a boring near Pavilosta and Ulmale boreholes in wich Quaternary marine deposits have been extablish and investigated by geologists V.Seglinš and S.Murniece. The 5 most representatives sections; Akmenrags, Sudrabi, Ozoli, Srante, Ulmale, have been palynologically investigated and correlated with stratotyphial sections and are in good agreement. The palynological investigations shows, that observed pollen complexes reflectjs three different spread vegetations;

1) On basis of all investigated sections extablished grey silt and clay, the Sudrabi layers (by V.Seglinš) of Late Glancial of Letiža (Elster) containing I pollen complex of periglacial vegetation with high frequencies ***Pinus, Betula nana*** and herbaceous pollen, within ***Artemisia*** and ***Chenopodioaceae*** dominate. ***Ephedra, Hippophae*** and ***Selaginella*** selaginoides are present. Redeposited pre-Quaternary spores and pollen have been observed; ***Taxodium, Sequia, Ilex, Ostrya, Eucomnia, Rhus, Nyssa, Carya, Cyathes***.

2) The marine silt (Akmenraga Formation by V.Seglinš 1988) above the Sudravi layers have been sedimentated during warm and wet Ulmaleian (Holsteinian) interglacial. The following pollen complexes are distinguished:

II - ***Pinus, Betula, Increase Alnus, Picea, Corylus, Quercetum mixtum***. Appear ***Abies*** and ***Carpinus***.

III - Maxima of ***Picea, Quercetum mixtum, Carpinus, Alnus, Abies, Corylus, Picea*** sect. ***Omorica*** and ***Pinus*** sect. ***Strobus*** are present. Climatic optimum.

IV - ***Pinus, Picea***. Decrease ***Quercetum mixtum, Carpinus, Alnus, Corylus***. ***Abies, Picea*** sect. ***Omorica*** and ***Pinus*** sect. ***Strobus*** are present.

V - ***Pinus***. Values outhers pollen and spores are insignificant. Most of the pollen have a poor preservation.

3) Silt and clay in upper part of sections (Jūrkalnes Formation) contents polle complexes:

VI - ***Pinus, Betula, Alnus***, Increase herbs and redeposited ***Quercetum mixtum*** pollen.

VII - ***Pinus, Betula nana*** + ***Betula humilis, Alnaster, Artemisia, Chenopodiaceae, Sphagnales. Hippophae, Ephedra, Helianthenum, Botrychium boreale, Lycopodium alpinum*** are present. The pollen and spores composition is indicative of periglacial conditions. The age of it is under discussion.

In Latvia the marine Eemian deposits occur in the eastern part of Gulf of Riga have been

established and investigated by geologists V.Juškevics and O.Stiebrinš from Geological Survey of Latvia in 1989. By author oneself have been carried out palynological investigations for borehole 21. The following pollen complexes have been distinguished;

1) Saalian (Kurzemes) Late glacial pollen and spores have been observed in grey clay. Pollen complex Ia,b-***Pinus, Betula nana*** and herbs; ***Artemisia*** and ***Chenopodiaceae*** dominate. Pollen ***Ephedra, Hippophae, Helianthenum*** and ***Dryas*** are present.

2) The Eemian pollen spectra commence with decrease of herbs pollen, ***Betula nana*** disapears. Pollen spectra can be devaid in following complexes and compare with pollen assemblages zones at the Prangli site (E_).

II - ***Pinus*** (E1 + E2).

III - Maxima of ***Alnus, Corylus, Quercus, Ulmus, Tilia, Carpinus*** (E3 + E4 + E5 + E6). This pollen complex derive in detail is not reasonable, because spectra of climatic optimum is very pressed (55 cm).

IV - ***Picea***. All thermophilous trees decrease considerably. ***Abies*** is present (E7).

V - ***Pinus*** and ***Betula*** sect. ***Albae***. ***Picea*** and ***Abies*** are present (E8).

VI - ***Pinus, Betula, Alnus***.

3) Silt underlying by brown till 3 m thick layer (Weichselian, Baltic) with insignificant amount pollen. Till are covered by brown clay, which contents pollen spectra comprising high frequencies of ***Betula nana, Alnaster***, herbaceous pollen characteristic of periglacial vegetation. The pollen and spore spectra from the borehole 21 shows a long continuous vegetational development starting with the Saalian (Kurzemes) Late Glacial continuing through the Eemian Iterglacial and ending with Weichselian (Baltic) Glacial Middle-Weichselian periglacial.

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CORRELATION OF THE KAZANIAN OF THE SOUTH - WEST SUBTIMAN AND ZECHSTEIN OF THE BALTIC ON BIVALVES

Kazanian Stage in the south-west of the Timan Ridge is represented by the Chevyu Formation (Lower Kazanian) and the Vesljana Formation (Upper Kazanian). They contain numerous bivalves. Their main locations are confined to the middle and upper layers of the Chevyu and lower layers of the Vesljana formations. The auther has identified bivalves from the Kazanian developed in the areas Vym, Koin, Kedva, Chevyu, Elva-Vym and Pytyryu rivers. More then 70 species and 3 subspecies belonging to 30 genera has been defined in total from these areas. In complexes of the bivalves representatives (from 4 to 8 species) of the genera ***Schizodus, Stutchburia, Aviculopecten, Pseudomonotis, Pseudobakewellia, Edmondia, Nuculana*** prevail.

In the Zechstein of the Baltic area bivalves are the most wide sread and numerous among fossils, and their associations are mainly confined to the carbonate deposits of the Naujoji Akmene and Žalgiris formations. It has been recognized 37 species (4 subspecieds), belonging to 20 genera. Among them the species ***Pseudobakewellia, Schizodus*** prevail. On the base of seimilarities in taxonomic composition and the distribution of the bivalves complexes the correlation of some intervals of the sections of the Kazanian and Zechsthein could be carried out.

The Chevya Formation corresponds to the Naujoji Akmene one on the base of the common species - ***Nuculana*** (***Phestia***) ***speluncaria*** (Gein), ***Solemya*** (***Janeia***) ***biarmica*** Vern., ***Pseudobakewellia ceratophagaeformis*** Noinsk., ***P.antiquaeformis*** Noinsk., ***Obliquipecten sericeus*** (Vern.), ***Streblopteria pussila*** (Schloth.), ***Palaeolima*** (***Elimata***) ***permiana*** (King), ***Permophorus costatus*** (Brown), ***P.simplex*** (Keys.), ***Stutehburia pallasi*** (Vern.), ***S.tschernyschewi*** (Lich.), ***Sanguinolites bicarinatus*** Keys., ***Dyasmya elegans*** (King). The Vesljana Formation basing on the association of bivalves ***Liebea septifer*** King, ***L.squamosa*** (Sow.), ***Schizodus truncatus*** King, ***Sch.schlotheimi*** (Gein), ***Sch.obscurus*** Sow., ***Oriocrassatella plana*** (Golowk.), ***Wilkingia***? ***aff.lunulata*** (Gein.) could be correllated (conventionaly) with the Žalgiris Formation. In this association five former species are also known in Naujoji Akmene Formation, while Liebea squamosa (Sow.) is spread in the overling deposits of the Galindai Formation of the Baltic. The described common taxa of the Kazanian Stage and Zechstein in the bivalves complexes prove the suggestion that two of these communities of fauna were connected through the Arctic Sea. Spreading and interpenetration of bivalves of the Kazanian Sea could occur through the Kanin and very short time through Vym straits.

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UPPER PALEOENE FACIES SETTING IN NORTHEAST POLAND AND ITS CONTROL OF AMBER DISTRIBUTION

Summary - thickness and thickness - relation maps prepared on a base of than 3000 borehole profiles show an architecture of the Northeast Poland Late Paleocene basin infilling. Besides basin and barrier - lagoon sedimentary series two major deltaic bodies may be reconstructed along the northern and south - eastern basin frames. The first of them is a part of large Sambian delta, which extend has been confirmed just formerly i North Poland to the North of Gdansk. This great delta developed to the South in the result of activity of great river located along the recent axis of the Botnic Bay. The second, not so large deltaic structure, drained area of the recent Upper Bug and Upper Dniester river basins and developed to the Norh - West.

Amber concentrations ***in situ*** have been found in both those areas: in two regions belonging to the Sambian delta (Chlapowo - Koscierzyna and Lidzbark Warminski) and in large longitudinal area between Lukow and Lubartow towns.

Primary amber concentrations belong to silty - sandy sediments of the Polczyn Sandy - Silty Member belonging to the Lower Mosina Formation (Uppermost Eocene). This is a stratigraphical equivalent of the amber - bearing "blue earth" on the Sambia Peninsula belonging to the Prussia Formation.

Origin of amber concentrations was controlled by sedimentary development of delta plain and delta slope and the amber hydrodynamic equivalent was responsible for its accumulation inside delta - plain distributary channels and on a delta slope together with aleuritic/fine psammitic quartz grains. Therefore, amber concentrations are usually closely related to fine - grained clastic sequences.

Two economical amber deposits, not especially rich, are known in described area. One of them, Chlapowo, is located to the North of Gdansk. The second one, Gorka Lubartowska, is situated inside the Southeast delta structure. This last area is particularly interesting from the point of view of occurrence of economic amber deposits, because the Polczyn Member sediments are placed there under very thin Quaternary cover.

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PRECAMBRIAN COMPLEXES OF LITHUANIA AS INDICATORS OF THE RIFTING

The main geological unit of the Archaean-Early Proterozoic crust of southern Lithuania is Dzūkija greenstone belt. The metamagmatic sequence of this greenstone belt is composed of mafic andultramafic rocks sometimes with komatiitic-like and tholeiitic affinities and was emplaced at about 2.5 Ga ago. The uprising of a mantle diapir initiated the breaking of the preexisting sialic crust and induced the formation of the greenstones in a proto-oceanic rift geodynamic environment. We consider that imbricated thrusts are the main structural feature of greenstone belt.

The volcano-sedimentary supracrustal Vidmantai complex is part of the western Lithuanian Precambrian basement, which was formed by extensive mantle-derived crustal growth during the Early Proterozoic. The rocks ranging from medium-and high-K tholeiitic dacites to high-Ti shoshonites resemble those of present-day mature volcanic arcs or arcs or at active continental margins. The high-Ti shoshonites may mark the existence of temporal or local extensional environments. This is in agreement with the models assigning the Svecofennian province to convergent plate margin environments.

The basalts and lamprophyres were found almost in the each drill hole of South and West Lithuania. The dyke swarm includes tholeiitic continental basalts and kersantites, which clearly suggest a continental rift setting. Our results suggest that the Trans-Lithuanian dyke swarm represent a failed attempt at the Early Riphean break up theA:PR thick continental crust, which was continued a little later by formation the Veiviržėnai volcano-sedimentery sequence in the graben-synclines.

We assume also the existence of the fourth extentional crust regime marked by signs probably of the Vendian basaltoid volcanism of the Volynian suite (580-620 Ma) expressed by the Merkys sequence in southern Lithuania and similar formation in the Vidmantai-I drill hole in western Lithuania. But these formations additional special investigations.

This regularity seems to be carried general characteristic. Rifts are frequently regenerated with respect to tectonic and magmatic activity. A nearby example is provided by the Permian Oslo graben, which was partly controlled by Late Precambrian rifting (Ramberg et al. 1978). The Late Precambrian Reelfoot (Mississippi embayment) rift was active in the Mesozoic time and is today the site of seismic activity (Keller et al. 1983).

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FIRST FIND OF THE VOLYNIAN GROUP VOLCANICS IN LITHUANIA

Remnants of a sequence composed by volcano-clastic rocks likely of the Vendian Volynian Group and their leading channels as thin fractures were discovered in the Vidmantai-I drill hole, Western Lithuania. The layer has a thickness about 0.6 m and overlies the strongly metamorphosed and deformed A: PR basements at the depth 2,113.2 - 2,113.8 m. The contact between them is very sharp. The sequence is overlapped by the Cambrian and is not undergone by regional metamorphism. The volcano-clastic rocks consist of rare fragments of basaltic and andesite---basaltic lavas and abundant fragments of the acid effusives. The cement mass represents a fine-grained greenstone---altered tuff consisting of chlorite, serpentine, palagonite(?) and ore minerals with relics of a glass. The composition of tuffs varies from basaltic to andesitic with tholeitic affinity. The layer possesses a zonal structure. The cement mass has a wide-spread occurence at the lower part of layer. The fragments of a lavas predominate in the upper part, in which a cement fills up only the pore space.

A leading channels as some thin fractures were revealed at the depth 2,115.3 m and 2,133.2 m. They are composed of dense dark green rock representing devitrified glass in a thin sections. X-ray study revealed chlorite, serpentine, palagonite(?) and ore minerals. The chemical composition of this rock more nearly corresponds to the Fe-hypersthene this apparently agrees with composition of a remnant liquid of the differentiated tholeitic basaltic magma. This is a characteristic feature of the trappean formation. There exists flow structure in this rock. The wall rocks reveal contact action in the vicinity of the vicinity of the fractures fitrst of all as replacement of the hypersthene by chlorite-serpentine aggregate and appearance of the Fe-oxides.

The volcanics discovered in the Vidmantai-I drill hole described above quite differ from those of the Trans-Lithuanian dyke swarm and the Veivirženai sequence by mineralogical and chemical composition and a relics of the glass. They also differ from the rocks of the Merkys not only by the composition and structure but also by their genesis.

The pre-Cambrian unmetamorphized volcanogenic formation of the Vidmantai-I drill hole as a remnant of the layer and thin fractures most likely represents analogue of the Vendian Volynian Group, taking into account their similar composition, structure and stratigraphical position. It is discovered in Lithuania for the first time. Beyond doubt its locality is not restricte only by the drill hole mentioned above.

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LITHOSTRATIGRAPHICAL SUBDIVISION OF THE ARUKÜLA REGIONAL STAGE

In 1981 the Aruküla Regional Stage was divided by H.Viiding into two parts, the upper - Viljandi and the lower - Mòra members. More recent and revised lithological and mineralogical data have permitted to distinguish three cycles. The basal part of the cycles is represented by relatively coarse-grained arenaceous rocks of a mature mineralogical composition, the upper part, however, contains very fine-grained sandstone, siltstone and mudstone. These cycles are observable in all sections of the Baltic and Leningrad District, corresponding thus to evolutionary stages of the area and serving as a basis for the distinction of three members in the Arukula Regional Stage.

The lower, Viljandi Member (thickness in Estonia 15-25 m) is mostly represented by reddish-brown very fine to fine-grained sandstone with violet shades. Very thin bedding, silty and domeritic interbeds are characteristic.

The middle, Kureküla Member (15-45 m) is dominated by the yellowish reddish-brown cross-bedded sanstone interbedded with silstone, particularly in the upper part of the section. The sandstone is characterized by white patches and interbeds with irregular dolomite-cemented lenses. Siltstone is mottled, commonly broken up into polygonal pieces.

The upper, Tarvastu Member (18-41 m) is mostly represented by reddish-brown and yellowish-brown fine-grained cross-bedded sandstone with clay interbeds in the upper part of the section. Irregular cementation and relatively poor sorting of the terrigenous matter are characteristic.

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QUATERNARY DEPOSITS STRUCTURE AND GROUNDWATER QUALITY IN LITHUANIA

Groundwater occurring in the inter - or undermorainic sandy layers can be named semiconfined becaude this water is very closely interrelated. The quality of semiconfined groundwater is rather variable and depends upon the quality of shallow (unconfined) groundwater. In its turn the quality of last one is more and more dependent upon human impact. In a case when technogenic load is constant, shallow groundwater in clayey deposits is more polluted than in sandy ones. The main pollutants of groundwater there are nitrggen compounds (nitrates, nitrites, ammonia) and unidentified organics characterised by permanganate oxidation. Pollutants from shallow groundwater spread into semiconfined groundwater only where hydraulic premises of semiconfined groundwater contamination exists. These premises are as follows: *hydraulic pressure decreasing with deph (downward filtration); *aquitards absence or local presence in geological profile.

The regularities of occurence of contaminated semiconfined grounwater in Lithuania manifests itself locally and on regional scale. Increased amounts of nitrates, ammonia and organics in the recharge areas of semiconfined groundwater (Baltija and Žemaitija highlands) and decreased amounts in the discharge areas (Middle Lithuanian Plain) are fixed. A close correspondence of groundwater chemistry to the structure of the geological profile is ascertained: in poorly isolated semiconfined aquifers the nitrates accumulate and in better confined ones the ammonia dominates.

An interesting local regularity is also noticed: the plumes of contaminated semiconfined groundwater do not exatly conform with the source of pollution and are somehow moved downstream by groundwater flow.

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STRATIGRAPHY AND GEOLOGICAL STRUCTURE OF MORAINES IN THE MARGINAL ZONE OF THE OLD GLACIAL ACCUMULATION AREA

The Byelorussian Ridge with the big Minsk and Oshmyany heights in its central part is one of few regions in the marginal zone of the old glacial accumulation area of Europe, where moraines of the Lower, Middle and Upper Pleistocene glaciations show classical evidences. There are detailed stratigraphic classifications of the Lower and Middle Pleisticene within the Minsk and Oshmyany heights; the entomofauna, micro- and macroflora were studied in all the stratigraphic levels in the area of these heights. For the above reasons this region is very important for understanding conditions of the relief units formation in the marginal zone of old Pleistocene glaciations of Europe. We have established the following succession of stratigraphic bedding of morainic horizons

Three morainic horizons separated by deposits of the watershed paleolakes of the Korchevo (Cromer 1) and Belovezhian (Cromer 2,3) interglacials are distinguished in the Lower Pleistocene strata of the Minsk and Oshmyany heights. The oldest morainic horizon coorresponds to the Narev (Dorst) glaciation; the middle one - to the Yaselda (Cromerian) and the third - to the Berezina glaciation. The moraine of the Narev glaciation was discovered only in the deepest narrow glacial gullies and was deposited as a moraine of subglacial metling. In some places the Narev moraine covers also remnants slightly affected by glacial exaration. Now such remnants are the socles of the Minsk and Oshmyany heights. The Narev age of the oldest moraine is determined in several sites south-westwards of Minsk, where the Narev moraine is overlain by the Korchevo iterglacial deposits (the borehole Dubentsy).

The second glaciation within the heights resulted in the origin of the Yaselda moraine. The Belovezhian interglacial deposits discovered in the moraine roof cause us to consider it of the pre-Berezina age. The Yaselda moraine is the ground one too, though it is more thick and shows numerous glaciotectonic deformations. It covers the botomm of glacial gullies and is found in the watershed areas westwards of Minsk and Oshmyany. The Berezina glacial deposits occur in the stratigraphic interval between the Belovezhian and Alexandrian (Holsteinian) interglacial horizons. There are two stages of glacial deposits in the Berezina horizon. The Lower stage is mainly formed by the ground moraine, the upper one by push end moraines. Southwards, the end moraines are replaced by outwash deposits.

These data can indicate the post-maximal Berezina glacial stage of the epoch of the Berezina glacier disintegration. There are at least three more morainic horizons separated by one horizon of limno-deluvial sandy loams and clays above the Alexandriya interglacial deposits in Middle Pleistocene strata. The taiga and tundra-steppe periglacial spore-pollen floras originate from limnic deposits. The lower morainic horizon corresponds to the maximum stage of the Dnieper glaciation (Saalian Ice Age), but two upper ones correspond to the Minsk and Oshmyany stages (Warthian). Deposits of the ground

moraine and fluvioglacial rocks are associated with the maximum advance of the glacier, and the Minsk and Oshmyany stadial ice motions formed push end moraines, which are responsible for the structure and isolation of the Minsk and Oshmyany heights.

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ON THE QUATERNARY STRATIGRAPHY OF THE BALTIC REGION

The unified schemes of the Baltic region Quaternary stratigraphy (of 1977 and 1986) were made following the requirements of the USSR Stratigraphic Code (1977). Little attention was given in this code to the specific character of the Quaternary paleogeographical conditions. Here the same standards are applied both to the Quaternary and to the more ancient geological periods. Thus, the stratigraphic classification contains a lot of formalities (even muddle). A most conspicuous thing is that there is a discrepancy among the ranks of stratigraphic subdivisions: in some cases a different rank is given to the same geological stage, while in other cases, quite contrary, the same rank is attatched to different stages. Such discrepancy might be avoided if clearly formulated principles of distinguishing main stratigraphic units were available. In our opinion, the time interval corresponding to glaciation and interglaciation should be classified as the main unit of the Quaternary stratigraphy. It is out of such correlated units that Quaternary stratigraphic classification of the Baltic region should be composed of.

There is a lot of vagneness in the field of correlation. It is particularly difficult to correlate the units corresponding to glaciations. This may be explained by a variable lithological composition and by indistinct differences of lithological criteria among separate units. Some of the above problems might be avoided if we had area stratotypes studied applying the same methods. Up to now, however, we even have no clear definition of the area stratotype. A different understanding of the latter leads to a different stratigraphic interpretation.

The absence of absolute age dates in another obstacle to correlation. Only some sequences dated by radiocarbon method and some efforts to apply the luminescent method are available. There are no data of paleomagnetic studies either. The fauna of mammals has been of little interest. There are few data on mollusk fauna, ostracodes and diatoms. The poverty of the above data makes it impossible to solve the problem concerning the interglacial stratigraphic situation of Snaigupėlė, thus giving trouble in classifying the Early Pleistocene sediment in more detail.

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STRATIGRAPHY OF EARLY PLEISTOCENE OF LITHUANIA

Early Pleistocene corresponds to interval of the geochronological scale between 0.73-1.8 million years. The deposits of the Early Pleistocene are known only in the Eastern Lithuania. These deposits are of continental origin and presented mostly by silt and fine sand. The presence of dispersed organic material and redeposited remnants of plants is a characteristic feature of sediments of the Early Pleistocene. Clay, gyttja and silty peat can be detected comparatively rare. The lithological composition indicates that the deposits of the Early Pleistocene have been formed mostly in shallow lakes. Different types of lacustrine facies can be revealed. The sediments which can be considered as alluvium are established only in very few cases. General thickness of the Early Pleistocene deposits in Lithuania varies from 1 to 20 and more metres.

The significant difficulties exist in respect to detailed stratigraphic subdividion of the Early Pleistocene. This interval of the Quaternary system is usualy identified as Daumantai Formation. These deposits can be observed in the exposures of the Šventoji river valley, but the majority of samples explored are picked from cores of boreholes located in the environs of Vilnius. The clastic deposits generaly are poor in pollen and spores, and the sections ivestigated are rather fragmentic.

According to the pollen data available the climate changes were quite significant. It was detected that several different types of vegetation formations existed during the Early Pleistocene. The coniferous polydominating forests were replaced by medium climate sparse forests, which afterwards have been changed into steppe and finally into tundra. The problematic periods with cold climate close to such of glaciations can be revealed in the Early Pleistocene too.

The lithostratigraphic indicators (local associations of minerals and data of analysis of sequences of facies) provides significant additional information for stratigrapic subdividion of the Early Pleistocen.

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CAMBRIAN BIOSTRATIGRAPHY AND PALEOGEOGRAPHY OF THE BALTIC BASIN

The contemporary structural plan of the Baltic basin in the Cambrian has been formed in the result of the tectonic movements of the Baikal and the Caledonic complex. These were performed by two large sedimentary complexes possessing the nature of the volcanic-terrigenic (Wend-Lower Cambrian) and terrigenic (Lower and Middle Cambrian) formations. As to the lithological signs as well as paleontological characteristics the Cambrian deposits are divided into the following unit: Subholmia, Holmia, Protolenus and Paradoxides biostratigrafical zones. In Subholmia Zone the following brachiopods are found - Lingulella nathorsti, Westonia elongatus, Acrothelle bellapunctata; in Holmia and Protolenus biozones - Mobergella holsti, Westonia finlandensis; in Paradoxides Zone - Lingulella agnostorum, L.ferruginea, L.perattenuata, L.desiderata. In the Upper Cambrian - Obolus apollinis, Ob.apollinis maximus, Ob.ingricus, Ob.celatus.

The Cambrian brachiopods lived most probably in the litoral zone to the depths of 80 - 100 m. Sand-aleuritic rocks contain some trilobites, cephalopods annelides and acritarchs. The analysis of the brachiopods, trilobites and annelides fauna shows a connection between Cambrian Baltic basin and European Atlantic zoogeographical province and is very important for determination of the age of burrs and reconstruction of paleogeography. The available paleontological material and the lithological analysis of the Lower, Middle and Upper Cambrian biostratigraphie complex made it possible to ascertain the sedimentation areas and development of tectonical periods. In the Baltic basin the Cambrian deposits are spread over a large territory reaching thickness up to 250 m. They consist of sandstones, aleurolites and clays which were formed in marine and near-shore conditions.

The paleogeographical situation of the Baltic syneclise in the Cambrian was essentially the same as in the East at a rather small distance from the coast boundary of the epicontinental reservoir where the sea deposits of Baltic Group appear at the surface. The difference in absolute measurements of the regions of assessement and those of depositing is comparatively insignificant. In Northern part this resulted in the Baltic Shield and in South-eastern this resulted in the Sarmatic Shield. In Eastern regions of the Baltic syneclise the Middle Cambrian layers are rather low thin and without a great diversity in composition.

The contemporary position of the ridge of the Middle Cambrian in the Baltic syneclise varies greatly in regard to different regions. In the East in the Vilnius region the ridge of these deposits was opened at 193 m; in the direction of the West near Jurbarkas the deposits were opened at 1404 m; in the Gargždai region tectonic zones are as deep as 1900-1980 m. South-Western regions of the Baltic syneclise could be characterized as those deepest submerged, this fact being the positive indicator of the presence of oil. Paleogeographic reconstructions of the deposits of oil formations took place in the regions of beaches and coastal ,littoral of shallow regressive reservoir of the sea.

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UPPER CAMBRIAN DEPOSITS OF THE KALININGRAD DISTRICT

Due to limited distribution, the Upper Cambrian of the Kaliningrad District is recognized only in some boreholes and has a maximum thickness of 1.5 m. A.Kaplan et al. (1972) were the first to describe them in borehole Ladushkino-I (depth 2451,8-2452 m). It was a thin layer of limestone (20 cm) with the trilobites ***Homagnostus*** and brachiopods ***Orusia lenticularis*** (Wahl.) and ***Acrothele***(?). This unit have been attributed to the Upper Cambrian ***O.lenticularis - P.spinulosa*** Zone and named as "Ladushkino Formation".

Second locality of the Upper Cambrian is established by L.Laškova in the borehole Yuzhno-Primorskaya-2 in the interval of 2,621-2,621.4 m. M.Korobov (1985) examined this core material and stated here the presence of the trilobites ***Agnostus pisiformis*** (Wahl.). This is the nominal-taxa of the lowermost Upper Cambrian trilobite zone in Scandinavia. No microfossils have been found in the limestone.

The interval studied is represented by a dark limestone. The lower and upper contacts of this unit are unconformably developed with a sharp boundaries: dark limestone rests on the eroded light Middle Cambrian sandstone (Deimena Group) and with profound unconformity overlain by the bright green glauconitic sandstone of the Leetse Stage (Lower Ordovician). This unit is divided into two parts. The lower part comprises two layers of grey sandy limestones (2-2.5 cm) with black carbonic limestones (12 cm) between them. Small floating rock fragments (1-1.2 cm) of light sandstone and black mudstone are located in the sandy limestone. The rounded grains of the detrital transparent quartz also present here. The upper part consists of a black massive medium-crystalline limestone (24 cm). The lenses and interbeds of a grey coarse-crystalline limestone occur sporadically. Black opaque organic matter is developed in the pores between the crystalls of calcite and adds the color to rocks. The aggregates of the coarse-crystalline calcite occuring sporadically seems belong to faunal remains. They were recrystallised during the stage of catagenesis. Coarse-crystalline grey limestone is developed by the primary light-brown clayey material, separated relics of which remained between the coarse colorless crystalls of calcite.

The limestones described litologically differ from those in the borehole Ladushkino-I but are similar with the Upper Cambrian deposits of the Baltic Depression in Poland. The lower part of the Y-Primorskaya section is coeval with the sandy-carbonate complex of Poland, which is correlated with the ***Agnostus pisiformis*** Zone of Sweden. The upper part of the unit investigated may be correlated with the carbonate complex of Poland and the ***Homagnostus obesus - Parabolina spinulosa*** level of Sweden. So the unit of limestone in the borehole Y-Primorskaya-2 contains the strata which are older then one in the borehole Ladushkino-I.

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"OBOLUS" SANDSTONE IN THE SOUTHEASTERN PART OF THE BALTIC REGION

The "Obolus" Sandstone is developed almost over the entire Baltic Syneclise (Lithuania and Kaliningrad District) and partly on the northern slope of the Mazury-Byelorussian Anteclise (eastern Lithuania). Due to the characteristic lithologic feature and the presence of numerous phosphatic brachiopods this unit is easily recognized in the all investigated sequences. Unit reaches a thickness of 0,1 to 0,5 m with a maximum of 5 m; sometimes they lack. It lies unconformably on the eroded surface of the Deimena Group, which is of Middle Cambrian age (***E.oelandieus*** Stage) and unconformably covered by the Lower Ordovician (Latorp Stage). The unit consists generally of a medium-grained quartzitic sandstone occasionally interbeded with siltstones, fine-grained sandstones and rarely conglomerates. The color is grey to light grey. The mineralogical composition is simple. Monocrystalline quartz dominates in the sandstones (79-90%). Feldspar is restricted by the siltstones (20-40%). Small fragments of shells are present everywhere. The cementing minerals consist of dolomite, phosphate, gyps, quartz, clay, and calcite.

For the first time the "Obolus" Sandstone was recovered in this area in the borehole Prienai-3 in 1953. Numerous brachiopods established, T.Alichova attributed to "***Obolus apollinis*** Eichwald". Because this species shows the earliest Ordovician age, "***Obolus***" Sandstone have been established as Lower Ordovician (Pakerort Stage). V.Korkutis (1971) described many specimens of brachiopods from this unit in the Baltic Region as "***Obolus apollinis***". In the official stratigraphic scheme this unit is named as the Salantai Formation and is attributed to the Tremadoc Stage.

However recently L.Popov (Sankt-Petersburg) examined core material with brachiopods from some boreholes of Lithuania and interpreted them as ***Ungula ex gr. convexa*** Pander (Gorainiai-1, depth 2008 m; Kuliai-1, 2158.1-58.9 m). According to L.Popov this species as well as genera ***Ungula*** are Upper Cambrian in age and proves the correlation with the ***Leptoplastus*** and ***Peltura*** Zones of ***Olenus*** Stage in Scandinavia. Additionaly genera ***Ungula*** are established also in the boreholes Vėlaičiai-2 (1920 m), Vėlaičiai-3 (1875,3 m), Pajūrys-1 (1920,6 m), Šilgaliai-1 (2044,3-45,9 m), Genčiai-4 (1967-68 m), Darius-1 (2047,5-51,7), Pakalnė-1 (1856,4 m) and others. So in the light of new faunal data the mentioned unit in the investigated sequences in fact belongs to the Upper Cambrian.

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NEW FINDS OF THE CAMBRIAN FAUNAL REMAINS IN WESTERN LITHUANIA

Some new localities of the well-preserved and stratigraphically useful faunal remains in the Lower and Middle Cambrian core material of western Lithuania have been established. New paleontological data have been based partly of samples obtained earlier in the course of previous works (Sakalauskas), but generally on samples collected during some last years (Jankauskas, Lendzion). All specimens were examined and identified by K.Lendzion. Because the finds of the identifiable faunal remains in this region are very rare and do not permit the introduction of the traditional faunal zones, these new finds are very important for local stratigraphy and faunal control of the acritarch-based biozonation. List of the faunal remains recovered (borehole, depth, m): Trilobite. Lower Cambrian, Gegė Formation, Vergale Stage: ***Holmia sp***. (Darius-1, 2144 m); ***Proampyx sularponsis*** Alberg (Klaipėda-1, 2281,9 m); ***Proampyx sp***. (Klaipėda-1, 2278,9 m); ***Olenellidae*** (Klaipėda-1, 2278,5 m, Gargždai-4, 2129,9-2133,4 m, Usėnai-4, 2120,3 m, Traubai-1, 2217,5 m). Middle Cambrian, Kybartai Formation (Horizon=Stage); ***Ellipsocephalus cf. polytomus*** Linnarsson (Gargždai-3,2232 m). Other faunal remains. Lower Cambrian, Gegė Formation, Vergale Stage: ***Lükatiella sp***. (Klaipėda-1, 2278,5 m, 2278,7 m, Stumbrės-1, 2103,7 m); ***Torellella sp***. (Viduklė-62, 1650-1650,9 m; Genčiai-4 (1980 m).

The material studied here comes from the Gegė and Kybartai formations which are represented by the alternation of quartzitic sandstones, siltstones and mudstones. The rocks include very rare and generally fragmentary specimens of fauna.

The trilobite species ***Proampyx sularponsis*** is restricted to the upper part of ***Holmia kjerulfi*** Zone in Skandinavia. The presence of this index fossil in the upper Vergale of Lithuania (see above) dates the acritarch assemblage which occur in this interval and is named by T.Jankauskas in 1992 as ***Goniosphaeridium implicatum*** Assemblage Zone (Jankauskas, Lendzion, 1992). This result is in agreement with the acritarch-based correlation (Hagenfeldt, 1989; Eklund, 1990; Moczydlowska, 1991). Other finds of the faunal remains do not contradict with the acritarch data and usefully enlarge the paleontological record of the Vergale Stage of Lithuania.

The trilobite species ***Ellipsocephalus polytomus*** is known only from the lower part of the Middle Cambrian strata in Scandinavia and Poland and shows the correlation with the ***Eccaparadoxides oelandicus*** trilobite Zone (Stage). So this find confirms the belonging of the Kybartai Formation to the lowermost Middle Cambrian strata.

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CLIMATOSTRATIGRAPHIC SCHEME OF THE PLEISTOCENE DEPOSITS IN ESTONIA WITH PROPOSAL FOR TERMINOLOGY AND CLASSIFICATION

Because of short duration (1.6 Ma) of the Quaternary period the evolution principle is not applicable in subdividing the Quaternary system, except for ascertainment of its lower boundary. The units series and stage, proposed by ICS 1989 are of higher rank than Quaternary system itself and not applicable. Subdivision into Pleistocene and Holocene series is also not precise because the latter is a part of the former only. Both terms, however, are deeply ingrained into practise and cannot be discarded. They should be used in formal sense only. The unit horizon is also of higher rank and the unit formation is lithological substantially.

A major characteristic of the Quaternary was the great variations in climate with the great impact on changes of vegetation, fauna, glaciers, oceans, deposits etc. Therefore the climatostratigraphical units are the main base for subdivision of Quaternary deposits, the boundaries of which, however, are timetransgressive. In Late-Weichselian and Holocene the chronostratigraphic units are used mainly, which boundaries are synchronous levels. The most important climatostratigraphic units of regional category are the glacials and interglacials (climatolites). One interglacial together with the following glacial constitute a climate cycle. The glacials are subdivided into stadials and interstadials (subclimatolites) being of local character mainly. In case of absence of the clear climatostratigraphical evidences the formal units: lower-, middle- and upper- of different ranks may be put into practice.

In Estonia two interglacial units: Holsteinian and Eemian exist, which are defined by stratotypes of allochthonous continental deposits at Karukula and by autochthonous marine deposits at Prangli, respectively. According to the pollen zones these sites are in good agreement with the other corresponding sites in the Baltic region. The boundaries of the Weichselian (Jarva) Glacial unit are everywhere defined from above by the autochthonous Holocene deposits and from below by the autochthonous Eemian deposits at Prangli site and in Otepaa Heights. Deposits of the Weichselian unit contain redeposited Eemian pollen constantly. The boundaries of the Saale (Ugandi) Glacial unit are defined from above by the autochthonous Eemian deposits at Prangli; from below it is not fixed by any autochthonous Holsteinian layers. The deposits of Saale unit contain redeposited Holsteinian pollen constantly. The Ugandi unit can be divided into two stadials with the intervening interstadial characterized by periglacial vegetation. The Jarva unit is divided into main Valgjarve stadial and preceding Magiste stadial with the inntervening Toravere Interstadial. The latter and Early-WeichselianHarimae Subclimatolite are characterized by periglacial vegetation. The Late-Weichselian is not discussed at present.

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NEW FLORA OF THE KORCHEVO INTERGLACIAL OF BELARUS

Several seed floras of the same age related to the Korchevo interglacial have been recently distinguished within the territory of Belarus. The Korchevo section near the town of Baranovichy was of high importance for the understanding of these floras, their rank and position in the Pleistocene. Numerous botanical researches carried out in this section have revealed some peculiar features characteristic of the Korchevo type floras. The study of the Korchevo floras is of major stratigraphic significance because of their position in the Pleistocene section and rare occurrence.

Two organogenic strata overlaid by several morainic horizons have been stripped at a high depth as a result of drilling a borehole N 7 near the village of Romanjuki in the central part of the Novogrudok upland. A rich seed flora icluding 66 fossil taxa was found in the lower stratum (depth 188.5-192.0 m) represented by humified sandy loams and loams. The presence of thermophilic plants from genera ***Salvinia, Caulinia, Stratiotes, Euryale, Nuphar, Aldrovanda, Trapa*** is an evidence of its interglacial aspect. A detailed study of the fossil flora has revealed a number of exots including extinct ***Azolla interglacialis, Potamogeton palaetrichoides, P.panormitanoides, P.perforatus, Stratiotes cf. goretskyi, Carex paucifloroides, Raunculus sceleratoides, Scirpus kreczetoviczii, Aldrovanda zussii*** etc. Besides the above species there are also usual herbaceous plants of aquatic, aquatic-boggy and land habitats from genera ***Scirpus, Ranunculus, Carex, Polygonum***. A small contribution of arboreal species (***Picea, Betula, Alnus***) should be noted too. The presence of a rare species ***Scirpus kreczetoviczii*** and a peculiar ***Aldrovanda zussii*** in this flora indicates its Korchevo age.

The flora examined shows the most thermophilic and exotic composition among all the Korchevo floras established earlier. Correlations of the Korchevo seed flora of Belarus with those from adjacent territories are assumed. The floras can correspond to the Iljinka Stage in Russia, Psashnysh Stage in Poland, and, probably, the Katler one in Latvia.

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NEOPLEISTOCENE STRATIGRAPHY IN THE AREA OF LOWER VISTULA RIVER BASIN

The area of the Lower Vistula River adjacent to the Peri-Baltic zone is characterized by the most complete sequence of Neopleistocene sediments in Poland. Their thickness here reaches about 200 m. This Neopleistocene complex is represented by marine and continental deposits.

The basic and marker stratigraphical horizon consists of deposits of the Lower Powisle sedimentary formation extending from the vicinity of Torun to Vistula River Bay. The above formation includes sediments from the close of the Middle Polish Glaciation to preglacial deposits of the Post-Emsian complex. The marine and continental deposits of the Eem Interglacial, play the main role and comprise the most significant Tychnowy marine horizon, formed during the biggest Pleistocene marine transgression in this area.

Above the Lower Powisle Formation lies an approximately 100 m thick glacial and inter-morainic complex. There are three basic till horizons in this complex which were formed during three separate inlandice advances and two extra till horizons formed due to phase invasions kown only from the northern part of this region. The main till horizons are separated by two large series of intermorainic deposits with single marine horizons in the northern part of the Peri-Baltic zone.

All this complex was earlier classified to the Vistulian Glaciation. Presently its lower part including the lowest main till horizon and the lower inter-morainic series is regarded as a separate Torun Glaciation and Krastudy Interglacial, while only the upper part comprising two upper till horizons separated by upper inter-morainic series belong to the Vistulian Glaciation.

The preglacial of the Torun Glaciation contains the Amersfoort-Brorup interstadials and, probably Odderade.

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LLANDOVERY-WENLOCK BOUNDARY AND THE IREVIKEN EVENT

The base of the Wenlock Series was defined in the Leasows section (Shropshire, Great Britain). Although in the type area no graptolites were recorded from the strata between 10 m below and 4-5 m above the Llandovery-Wenlock boundary, it has been assumed that the base of the ***C. centrifugus*** Biozone coincides with the base of the Wenlock Series.

The flowering of conodonts during the late Llandovery sealevel high stand was succeeded by the strongest in Silurian extinction of conodonts - ***amorphognathoides*** resp. the Ireviken Event. Actually, the Ireviken Event includes eight steps of extinctions named as Datum 1 - 8. In terms of the graptolite biozonation, this event is considered to range from within the ***M. spiralis*** Biozone, through the ***C. centrifugus*** (C. insectus) Biozone and, probably, into the ***C. murchisoni*** Biozone.

Detailed comparison of conodont successions in Ireviken-3 (Gotland) and Leasows sections has shown that the base of the Wenlock lies probably in the lower part (below Datum 3) of the Ireviken Event. According to L.Jeppsson, in the stratotype section the Llandovery-Wenlock boundary most likely correlates with the Datum 2 (or is very close to it) of the Ireviken Event. This assumption seems to be proved by the data from the Ūhesaare core (Estonia), where the lower boundary of the ***C. murchisoni*** Zone (at 345.8 m) lies just below the Datum 3 (the disappearance level of ***P. amorphognathoides*** - at 345.5 m). Unfortunately, as in the Leasows section, also in the Ohesaare core it is not possible to identify Data 1 and 2.

Datum 2 of the Ireviken Event may be easily recognized in the shelf sediments by the disappearance of ***Oz. polinclinata polinclinata*** but it is not identifiable in basinal sediments due to the lack of ***Oz. polinclinata polinclinata*** in these facies.

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VENDIAN AND CAMBRIAN DEPOSITS IN THE NORTHEASTERN LITHUANIA

The Vendian and Cambrian deposits are distributed over the entire east Lithuania. Recently six new boreholes were drilled in the Ignalina area. The Vendian rests immediately on the crystalline basement at the depth 703-755 m and reaches thickness of 137.9 to 161.7 m and is represented by the alternation of conglomerate, gravelite, arcose sandstone, siltstone and rarely clays. In stratigraphic ascending order the Vendian comprises the Merkys, Šalčia, Skynimai and Vilkiškiai formations. The Šalčia Formation is proposed for the first time; it occupies the stratigraphic interval of both Jašiūnai and Rudninkai Formations (of V.Sakalauskas) because they are characterized by similar lithologic features. The stratotype of Šalčia Formation is proposed in the borehole Vilkiškiai-68, in depth interval 506.4-416 m. No macro- or microfossils were found in this formation.

The overlying Baltic Group is subdivided into the two (Rudamina and Lontova) Formations and consists of finely dispersed clays interbedded with sandy and silty layers, which are irregulary distributed through the sequences. Maximum observed thickness of the Rudamina Formation is 48 m. The basal member of the Rudamina Formation rests with profound unconformity on the weathering crust of the Vendian and consists of a massive or lamina ted quartzitic sandstone (up to 13,7 m). The mineralogical composition differs from the Vendian Vilkiškiai Formation generally by the first appearance of glauconite. Additionaly the member yields small black fragments of ***Sabellidites cambriensis*** Yan. which occurs from the base of this unit. Microfossils are found in the overlying clays and contain generally leiosphaerids among which ***Teophipolia lacerata*** Kirj., ***Leiovalia striatella*** Pašk., ***Leiosphaeridia dehisca*** Pašk., ***Cochleatina rudaminica*** Pašk. Sabelliditids are very abundant in the Rudamina Formation and rare ***Platysolenites*** are known only in the upper part of it.

The conformably overlying Lontova Formation reaches thickness of 61 m and yields rare sabelliditids (in the lower part), hyoliths(?) (in the middle part) and ***Plalysolenites*** through all the sequence. Lontova Acritarch Assemblages (***G. prima*** Zone) occur from the base of the formation and include such species as ***Granomarginata prima*** Volk., ***G. squamacea*** Volk., ***Tasmanites tenellus*** Volk., ***Synsphaeridium sp.***, ***Leiosphaeridia minutissima*** (Naum.) Jank., ***L. crassa*** (Naum.) Jank., ***L. atava*** (Naum.) Jank., ***L. dehisca*** Pašk., also cyanobacterial filaments and problematic forms ***Cochleatina***.

The Lontova Formation is unconformably overlain by the formation of light quartzitic sandstones which do not exceed a thickness of 15 m. No faunal remains or acritarchs were found here, but most probably it should be correlated with the Paneriai Formation in Lithuania (***P. paradoxissimus*** Zone, Middle Cambrian).

Thin member (up to 0,25 m) of the grey quartzitic sandstone with brachiopods ***Ungula***(?) is regarded as the Upper Cambrian strata.

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GIVETIAN AND THE BASE OF THE FRASNIAN IN THE BALTIC AREA

For the time being the number and names of the Devonian series and stages have been established, the boundary stratotypes selected and boundaries defined (Ziegler, Klapper 1985; House 1988; Oliver, Chlupač 1991; Crick 1992). The stage boundaries are defined by conodont zones. Graptolite, ammonoid and dacryoconarid (tentaculite) zones have also been used for subdivision and correlation. The lower boundary of the Givetian is within the ***Polygnathus ensensis*** Zone at the first occurrence of ***P.hemiansatus***. The base of the Upper Devonian Series and Frasnian Stage is the base of the Lower ***P.asymmetricus*** conodont Zone defined by the first occurrence of ***Ancyrodella rotundiloba***. The Baltic upper Middle Devonian sequence consists mainly of vertebrate dominated terrigenous rocks and has not revealed conodonts or zonal invertebrates. The lower boundary of the Givetian is given according to the correlation with sections of the other subregions of the East European Platform and roughly coincides with the internationally accepted boundary (see Rzhonsnitskaya, Kulikova 1990). However, the position of the lower boundary of the Frasnian differs considerably on the whole platform. Three conodont zones, ***hermanni-cristatus***, ***disparilis*** and Lowermost ***asymmetricus*** are ascribed to the Frasnian. In the Baltic area the interval corresponding to these zones includes the Gauja and Amata stages. To avoid different dating of these units, the lower boundary of the Frasnian should be placed higher, at the base of the Plavinas Stage, i.e. at the base of the Snetnaya Gora Beds or b. This boundary was traditional in Baltic before the 50 s. The Snetnaya Gora Beds which carbonate rocks dominate in represent a rare unit containing fishes and articulated brachiopods, and conodonts.

The Abava Formation that is situated between the Burtnieki and Gauja stages is worth to be considered as a stage. It has yielded a specific fossil fish assemblage with ***Microbrachius*** and ***Watsonosteus*** of a very wide distribution (Scotland, France, Severnaya Zemlya, China). Thus, the Givetian in the Baltic area could include four stages: Burtnieki, Abava, Gauja and Amata.

References

Crick, R.E. (ed.). 1992. I.U.G.S. Subcommission on Devonian stratigraphy, Newsletter No 8: 29 pp.

House, M.R. 1988 International definition of Devonian System boundaries. Proc. Ussher Soc., 7: 41-46.

Oliver, W.A.Jr., Chlupač, I. 1991. Defining the Devonian: 1979-89. Lethaia, 24: 119-122.

Rzhonsnitskaya, M.A., Kulikova, V.F. (eds.). 1990. Decision of the Interdepartmental Regional Stratigraphical Meeting on the Middle and Upper Palaeozoic of the Russian Platform, Leningrad 1988. Devonian System. Leningrad (in Russian).

Ziegler, W., Klapper, G. 1985. Stages of the Devonian System. Episodes, 8: 104-109.

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STRATIGRAPHIC ASPECTS OF THE GLACIAL RELIEF STUDY

When using geomorphological methods for stratigraphic purposes, most attention is concentrated on the relief morphometry and correlation of marginal glacial complexes. To increase the reliability of similar constructions, computer assistance is required. So, interesting results were obtained within the territory of Belarus with the computer-aided analysis of the spatial differentiation of values of absolute height, depth and density of the Earth's surface dissection, steepness and length of slopes, quantity of "swells" and "swales", as well as characteristics of distribution of these values - standard deviation, kurtosis and asymmetry.

The complex of these features made it possible to carry out a computer-aided zoning of the territory and to distinguish within three glacial sheets zones of the relief, as is shown by reliably different statistic data. These zones include stadial relief lands, which are revealed from morphometric parameters. A detailed enough age zoning of the Earth's surface can be carried out as well with the analysis of distribution of obviously residual landforms, lake-glacial, lake-alluvial plains and dead ice formations. These data plotted on a map make it possible to reconstruct the structure of ice sheets and major stages, phases and oscillations of their evolution. Similar reconstructions give a reliable information, when studying the Earth's surface, however such approaches can be also used for analyzing buried landforms.

Investigations carried out as described above have shown that the evolution of major ice sheets within the territory of Belarus includes the following number of stages: Narev - 4, Berezina - 7, Dnieper - 6, Sozh - 5, and Poozerje - 4. Some stratigraphic conclusions from the studies of river valleys and associated erosion-balka systems are given. The relief of various ice sheets differs considerably in volumes of slope trains and degradation sheet values of "swell-and-ridge" topography calculated from these data. At the same time, it should be noted that it is rather difficult to assess the rank of stages distinguished by geomorphological signs only.

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CAMBRIAN OF THE EAST BALTIC AREA: IS IT READY FOR ACRITARCH-BASED ZONATION?

In the East Baltic area located near the northwestern margin of the East European Platform the Cambrian sequence is mostly represented by siliciclastic rocks of shallow-marine origin. In the area the sedimentary sequence is incomplete throughout the system, very rarely reaching 300 m in thickness. Characteristic are stratigraphical gaps, occurrence of weathering crusts, great changes in the taxonomic composition of fossil groups etc.

Due to different sedimentary environments, the number of fossils and their preservation state vary largely in the succession. Trilobites - the key-group for Cambrian biostratigraphical subdivision and global correlation are very sparse in the East Baltic area. The subdivision of siliciclastic deposits is based on acritarchs. Significant contribution on the stratigraphical range of acritarchs and their correlation potential has been made by S.Naumova, B.Timofeev, N.Volkova, T.Jankauskas, L.Paškevičienė, A.Fridrichsone and I.Paalits. Up to now, seven biostratigraphical units have been recognized in the Lower, three in the Middle and five in the Upper Cambrian of the Platform (Volkova, 1990; Jankauskas, 1992; Fridrichsone, 1992). The boundaries of these biostratigraphical units ("zones") are defined by the distribution of the corresponding acritarch assemblages. The presences of the assemblages, as a rule, coincide with the occurrence of argillaceous sediments.

Due to the various depositional conditions there are several gaps in the acritarch distribution that do not permit to trace exact boudaries between acritarch zones. Usually these boundaries are considered to coincide with the boundaries of the lithostratigraphical units.

References

Fridrichsone, A., Zabels, A. 1992. Acritarchs and stratigraphy of the Lower and Middle Cambrian boundary beds in western Latvia. In V.S.Sorokin (ed.): Paleontologiya i stratigrafiya fanerozoya Latvii i Baltiiskovo morya. Riga, "Zinatne", 110-119. (In Russian).

Jankauskas, T., Lendzion, K. 1992. Lower and Middle Cambrian acritarch-based biozonation of the Baltic Syneclise and adjacent areas (East European Platform). Prz. Geol., nr. 9 (473).519-524.

Volkova, N.A. 1990. Middle and Upper Cambrian acritarchs in the East European Platform. Moscow, "Nauka". 116p. (In Russian).

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NEW STUDY OF THE CRETACEOUS NANNOPLANKTON OF THE SOUTHEASTERN LITHUANIA AND BELARUS

A detailed study of the Cretaceous nanoplankton in South-East Lithuania and in the neighbouring Belarus areas made the nannoplankton zonation scheme more exact.

The main problem of the study was to explore the nannoplankton of the Coniacia Stage and to entitle Interzone, which was separated in the top of Lower Coniacian - Upper Coniacian. The sediments of Upper Turonian - Coniacian were explored in Druskininkai area (the boreholes Meilės Sala-275, Snaigupis-264), Drucminai-63 and the Upper Turonian of Vištytis-17. The top of the Upper Turonian is marked by the first appearance of Lucianorhabdus maleformis. This species is found in the all explored boreholes. Some time ago the Quadrum obscurum Zone was described for the top of Upper Turonian- the lower part of Lower Coniacian of the South-Eastern Lithuania. But Sissingh in 1977 and Perch-Nielsen in 1985 correlated this zone with Lower Campanian. Therefore we do not use the name Quadrum obscurum. This part of Cretaceous sequence (the top of the Upper Turonian-Coniacian) belongs to the Lucianorhabdus maleformis Zone. The lower boundary of the zone is marked by the first appearance of Micula concava. Nannnoplankton assemblage obtained from this unit is characterized by high species diversity: ***Eiffellithus turriseiffeli, E.eximius, Kamptnerius magnificus, Cretorhabdus crenulatus, Quadrum pyramidum, Q.obscurum, Watznaueria barnesae, Lithastrinus floralis*** etc. ***Lucianorhabdus maleformis*** Zone was determined for late Turonian to early Coniacian by Sissingh in 1977. The zone occupies the larger interval of South-East Lithuania, because we failed to find ***Marthasterites furcatus*** that is typical to the Coniacian.

We studied two localities in Gardin district of the Belarus, because there is no Upper Maastrichtian in South-East Lithuania. The nannoplankton assemblage that is found in the lower part of the locatity Solovji is the same as that of the Quadrum trifidum Zone in Lithuania. The age of this interval is Early Maastrichtian, based on planctonic and benthic foraminifers. The nannoplankton of the Qua***drum trifidum*** Zone is found in the upper part of the Grandichi locality too. The lower part of this locality is marked by the first appearance of Lithraphidites quadratus. This unit contains abundant nannofossils: ***Arkhangelskiella cymbiformis, A.specillata, Biscutum blacki, Watzaueria barnesae, Prediscosphaera cretacea, Cretorhabdus crenulatus, Micula staurophora, Broinsonia parca, Quadrum trifidum*** etc. We cannot draw the exact boundaries of Maastrichtian zones, because the section of Maastrichtian is not full. The ***Lithraphidites quadratus*** Zone is correlated with the Lower Maastrichtian

References

Perch-Nielsen, K. 1985. Mesozoic calcareous nannofossils. In Bolli, H. and all. Plancton stratigraphy: Cambridge, P. 329-426.

Sissingh, W. 1977. Biostratigraphy of Cretaceous calcareous nannoplankton. Geol.Mijnbouw, 56. P.37-50.

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CRETACEOUS SHARKS FROM LITHUANIA

Macro-remains are not abundant in the Cretaceous deposits of Lithuania. The Lower Cretaceous contain only the teeth of sharks; few bivalves and brachiopods were discovered in the Upper Cretaceous.

Main collections of sharks'teeth are from the rare outcrops. The separate teeth were found in the boreholes. The first occurrence of sharks is attached to Late Albian. The rich complex of sharks teeth was found in Vareikiai outcrop (Upper Albian, Jiesia Formation). Here Jiesia Formation consists of aleurites glauconite, sandy, non-carbonaceous. The sharks are represented by ***Polyacrodus grewingki, Gyropleurodus canaliculatus, G. upnikensis, Squalus appendiculatus, Squatina muelleri, Synechodus dispar, Paraorthacodus recurvus, Eostriatolamia subulata, Pseudoisurus tomosus, Cretolamna appendiculata, Eoanacorax dalinkevichiusi, Cretoparanamatodon primaevus.*** Typical for this outcropis large quantity of Lamniformes. Their teeth make about 60% of the total quantity of teeth. The teeth of families Squalidae and Squatinidae constitute 33%. The first representative of the family ***Anacoracidae - Eoanacorax dalinkevichiusi*** apperst there. The teeth are small, the cutting edges of the crown are smooth. The anterior teeth are similar to the dontaspididae: the lateral ones are asymmetrical, the cusps bent towards the rear. In J.Dalinkevičius collection picked up in 1930-34 in the same outcrop we found a lot of the same species. There is Paraisurus macrorhizus wich is typical to late Albian. The separate teeth were found in the Upper Albian deposits of two boreholes Nida-2k (Eostriatolamia subulata) and Meilės sala-275 (Eostriatolamia sp.).

Outcrops of Lower Cenomanian are absent and only teeth of Eostriatolamia subulata are found in the boreholes Kaunas-HES and Balskai.

Some teeth of sharks were found in Pamerkys outcrop. There the Upper Cenomanian is formed by sandy marls. The teeth belonging to the ***Ptychodontidae - Ptychodus mammilaris*** and ***Ptychodus decurrens*** appear at first. The family ***Anacoracidae*** is represented by ***Palaeoanacorax oblioquus***. Their teeth are bent towards the rear: the cutting edges of the crown are entire or finely serrated. There are a lot of teeth of ***Eostriatolamia subulata***. The teeth of ***Lamniformes*** make about 87%. J.Dalinkevičius found the species ***Squalus appendiculatus, Squatina muelleri*** and the same species in the outcrop. He also found the teeth of ***Palaeoanacorax obliquus, Paraorthacodus recurvus, Eostriatolamia subulata*** of the Upper Cenomanian deposits of Skirsnemunė.

Only tooth of ***Eostriatolamia subulata*** was discovered in the Lower Turonian (Kalvarija-3). Many teeth were found in the marls of the Upper Turonian in the same outcrop Pamerkys. There are ***Palaeoanacorax pamiricus, Ptychodus mammilaris, Eostriatolamia subulata***. All teeth of ***Palaeoanacorax pamiricus*** have the triangular crown; the cutting edges are clearly serrated.

Outcrops of the Coniacian-Maastrichtian are absent. Therefore, there was found only separate teeth from the borehole Druskininkai-1421: ***Eostriatolamia subulata*** from Coniacian and ***Anacorax pristodontus*** from Upper Maastrichtian.

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CENOZOIC SEQUENCE STRATIGRAPHIC SURFACES IN THE EASTERN NORTH SEA

A sequence stratigraphic scheme of the Cenozoic deposits in the eastern North Sea is established on the basis of seismic stratigraphy, log stratigraphy, and biostratigraphy. Twenty one depositional sequences are identified, and correlation to Danish onshore outcrops is carried out.

Sequence boundaries in the Oligocene and Neogene is identified by differences in seismic facies, onlap, toplap, and truncations. A strong seismic reflection within a concordant reflection pattern characterizes the boundaries in the Paleocene and Eocene in the Danish sector.

High gamma ray peaks, apparently caused by glauconite-rich sediments, probably represent a time interval of starved sedimentation. This interpretation is supported by the presence of a seismic downlap surface, and it may correspond to the maximum flooding surface.

The boundary between the sequences 1.1 and 1.2 is correlated with the Lista-Sele Formation boundary. It is recognized on log data as the base of an interval with higher gamma ray readings (the Sele Formation), and a continuous seismic reflection is present. It is time-equivalent with a hiatus known from the onshore areas around the North Sea.

The top of sequence 1.2, coinciding with the top of the Balder Formation (the volcanic main ash phase), is easily recognized on log data from all wells as high sonic velocities. On seismic data it is characterized by a strong nearly continnuous seismic reflection. Erosional truncation in the upper strata of sequence 1.2 is seen at the depocenter, north of the Danish sector. The upper boundary of sequence 1.2 is time-equivalent with an unconformity onshore Denmark.

Danish outcrops of the two boundaries show deep marine sediments, and no evidences of subaerial exposure is seen. Glauconite horizons occur immediately above the boundaries, indicating a period of very reduced sedimentation.

The base of sequence 4.1 (approximately at the Eocene-Oligocene boundary) marks the beginning of a period with a south- and southwestwards sediment transport direction. The boundary is identified on log data by an increase in gamma ray values and on seismic data by a transition from nearly concordant reflections to a sigmoidal progradational clinoform pattern.

The boundary between sequences 4.4 and 5.1 (latest Oligocene) is identified on seismic data by onlaps and truncations. It is characterized by a pronounced downward shift in

coastal onlap, and it correlates with an unconformity seen onshore Denmark above an open marine shelf deposit and below coastal and lagoonal deposits.

The base of sequence 7.1, which corresponds to the so-called "mid Miocene unconformity" is marked on log data by two distinct and high gamma ray peaks. The surface is characterized by a transition from a progradational seismic reflection pattern to a nearly aggradational pattern. Seismically, it is mainly seen as a downlap surface, but onlaps are present in the marginal areas.

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CLIMATIC VARIATIONS IN THE WESTERN PART OF SOUTHERN NORWAY DURING THE LAST 13.000 YEARS

A revised model of summer temperature change is presented for the studied area, based on different palynological and glacier/ snow-equilibrium studies. A range of summer temperature of about 7 C is found over the last 13.000 years, with a temperature 4.3 below that of the present day during Younger Dryas chronozone, and a minimum of 3 above in the Early Boreal. Within the Holocene period, the two main climatic deteriorations are registered at around 8.000 and 5.000 B.P.

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BRACHIOPOD ASSEMBLAGES ON THE WENLOCKIAN/LUDLOVIAN BOUNDARY OF THE PODLIASSIAN-BREST DEPRESSION

The occurrence of brachiopods on the Wenlockian/Ludlovian boundary has been studied in the eastern (Belorussian) part of the Podliassian-Brest Depression. It has been found out that ***Eoplectodonta duvalii*** (Dav.) - obvious dominant, ***Resserella canalis*** (Sow.), ***Ygerodiscus cornutus*** (Dav.), ***Atrypa lapworthi*** Alex., ***Dalejina hybrida*** (Sow.), ***Cyrtia exporrecta*** (Wahl.), ***Dolerorthis cf. rustica*** (Sow.), ***Platystrophia cf. jaanensis*** Rub., ***Hemitoechia undavensis*** Rub. prevail in shallow marine facies at the uppermost Wenlockian (borehole Malye Krasniki 1). In deeper marine facies (borehole Skveriki 1) ***Glassia obovata***(Sow.), ***Resserella sabrinae*** Bass., ***Leangella segmentum*** (Lind.), ***Ygerodiscus cornutus*** (Dav.), ***Antirhynchonella linguifera*** (Sow.), ***Dalejina hybrida*** (Sow.) have been ascertained to dominate in the late Wenlockian brachiopod assemblage, i.e. fauna composition greatly changes.

The Early Ludlovian assemblage has been studied in detail in the borehole Skveriki 1 and supplement with the data from other sections located within the same facial zone (shallow open shelf). ***Dicoelosia biloba*** (linn.), ***Aegiria grayae*** (Dav.), ***Atrypa sowerbyi*** Alex., ***Resserella canalis*** (Sow.), ***Cyrtia exporrecta*** (Wahl.), ***Isorthis elegantulina*** (Dav.) are prevalent species

Thus, it has been established that in the east of the Podliassian-Brest Depression significant renovation of brachiopod fauna takes place at the Wenlockian/Ludlovian boundary. Many of the mentioned species are however typical of Wenlockian and Ludlovian in Great Britain, Gotland Island, Baltic States Podolia, and in lesser degree in Barrandien. Hence, close biogeographical connections existed between the marine basins of the above regions belonging to the European Province during the Late Wenlockian and Early Ludlovian time.

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FIRST FIND OF THE TRILOBITES *HOLMIA* IN THE LOWER CAMBRIAN OF WESTERN LATVIA

Because the faunal remains are very rare in the Lower Cambrian of Baltic Syneclise, new finds of two trilobite fragments (by A.Murnieks) i the core of Grobinia PN-I boring (depth 1829,9 m) are important for the stratigraphy and throw distictly addiitional light on the comparison of the acritarch assemblages with the stanndard trilobite zones. The mentioned borehole is located inn west Latvia. The Cambrian sedimentary rocks generally overlie the crystalline basement and only partly the Vendian (Zura Formation). Its thickness ranges between 125 and 250 m. The sediment sequence of the borehole Grobinia PN-I is subdivided into four formations which connformably overlie each other. They are well known Ovishi (1920-1917,8 m), Ventava (1917,8-1937 m), Tebra (1837-1742 m), Deimena (1742-1658 m) Formations. Fragments of trilobites have been found in greenish-grey horizontally laminated mudstone of the Tebra Formation immediately above the characteristic horizon of the brown ferruginous sandstones. According to K.Lendzion these both fragments belong to the genera ***Holmia***.

Trilobites ***Holmia*** occur in the middle Lower Cambrian, in stratigraphic interval between the ***Platysolenites*** Zone and ***Proampyx linnarssoni*** Zone of Scandinavia (Alberg, 1984) and between ***Mobergella*** Zone and ***Protolenus*** Zone of Poland (Lendzion, 1983). This interval comprises three faunal zones: ***Schmidtiellus mickwitzi*** (et Mobergella), ***Holmia inusitata*** and ***Holmia kjerulfi***.

Acritarch assemblage investigated (by T.Jankauskas) in the trilobite-bearing strata shows that Stage or ***E. minima*** - ***M. dissimilare*** acritarch Assemblage Zone (Jankauskas, Lendzion, 1992). Deph interval investigated (1818-1830) contains acritarch species: ***Skiagia ciliosa*** (Volk.), ***Micrhystridium dissimilare*** Volk., ***M. lantatum*** Volk., ***M. spinosum*** Volk., ***Tasmanites volkovae*** Kirj., ***T. bobrowskae*** Waz., ***Retiphaeridium postii*** (Jank.), ***R. howellii*** Martin, ***Goniosphaeridium varium*** (Volk.), ***Estiastra minima*** Volk., ***Alliumella baltica*** Vand. and others.

Assemblage is easily to compare with similar aged ones from adjacent areas: Vergale Stage of the Latvia, Lithuania, Belarus and Ukraine, the ***Heliosphaeridium dissimilare - Skiagia ciliosa*** acritarch Zone of the southeastern Poland (Moczydlowska, 1991); the Superzone C (Moczydlowska, Vidal, 1986) or the Informal Assemblage 1 (Hagenfeldt, 1989) or the Assemblage B (Eklund, 1990) of Scandinavia.

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INFLUENCE OF CALCITE, DOLOMITE AND TERRIGENOUS MATERIAL QUANTITIES ON THE DISTRIBUTION OF BRACHIOPOD COMMUNITIES

The main aim of research performed was an attempt to make an evaluation of influence of calcite, dolomite and terrigenous material quantities on the distribution of Silurian brachiopod communities of Lithuania. For this purpose five boreholes, which represent all facial zones were selected. The brachiopod communities were distinguished in these sections and in the intervals of their distribution the limits (maximum and minimum) and averages of calcite, dolomite and terrigenous material quantities for each community were estimated. Strontium and barium quantities also were ascertained through the sections investigated. Distinguishing of brachiopod communities was made according to the quantities of specimens in the samples or according to the frequency of taxa in the lithologicaly homogenous intervals. Comparison and description of these methods see in Musteikis 1989.

It was established that calcite and dolomite quantities increase from offshore to onshore and from Llandoverian to Ludlovian, then decrease in the middle of Pridolian and increase again at the top of Pridolian. If suppose that increase of carbonate quantities reflects the overall shallowing of basin, it coincides very well with development of Silurian basin of Lithuania. It was also noticed that dolomite quantities increase in the basin part (B.A.4-5), then decrease onshore and increase to a cosiderable degree again in lagoon facies (B.A.1). Increase of dolomite quantities in B.A.2-3 which occurs just below or above primary dolomites of B.A.1 is interpreted here as secondary dolomitization. It was also confirmed by strontium and barium ratio.

The maximal diversity of brachiopod communities is in B.A.4 and at the boundary between B.A.3 and 4, where calcite quantities differ from 15 to 25%, dolomite - from 8 to 19% and terrigenous material - from 70 to 63%. The biggest number of brachiopod communities is established in B.A.4. The factors analyzed show very close values in the limits of distribution of distinguished here communities. Some communities are more sensitive to calcite while others to primary dolomite quantities. The restrictive factors, such as oxygen tenor, wave base, water turbidity and limpidity, have very noticeable influence on the brachiopod communities distribution under these circumstances.

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CORRELATION OF THE MIDDLE PLEISTOCENE INSECT COMPLEXES IN CENTRAL AND WESTERN EUROPE

The study of fossil insect complexes from numerous sites of Middle Pleistocene deposits in Belarus, Lithuania and central regions of the East European Platform gave a possibility of their correlation in the next succession: Aleksandriya (Butenai, Likhvin), Kopys, Grodno (Priniemanski), Dnieper (Ugandi) ones. The Aleksandrian complex includes the species inhabiting now near the sites of Matveev Rov, Gralevo, Neravai, Chekalin etc.: Cychrus caraboides, Patrobus excavatus, Notaris acridulus. But among these species the boreal ones (Epaphius rivularis, Notaris aethiops) are always present together with those inhabiting on coniferous trees and rare exotic beetles (Agonum holdhausi). Entomofauna with similar landscape climatic features were described in Great Britain (Nechels site, Hoxnian interglacial) (Shotton, Osborne, 1965) and Poland (Belchatow site, Mazovian interglacial) (Pawlowski, 1989). The Aleksandrian Stage is compared with the oxygen isotope stage 9.

In Kopys deposits the peryglacial fauna indicavite of treeless landscapes (Pelophila borealis, Diacheila arctica, Simplocaria picipes and others) was found. The Grodno insect complex was studied in the sites: Ruba, Matveev Rov, brh. 6520 Berezovka, brh. 52 Ushevichi. The complex includes both inhabitants of the Middle latitudes of Europe, and boreal species. It differs from the Aleksandrian and Muravian complexes by the absence of termophilic exots. The similar fauna was studied by R.Coope in the Avely site (Stanton Harcourt interglacial) in Great Britain. The Grodno Stage is correlated with the oxygen isotope stage 7.

For the Dnieper Stage 4 insect complexes were distinguished. The first of them was the arctic and typical tundra one with the steppe-mountain species which lived before the Dnieper glacier (Gralevo, brh. 7 Nevda, brh. 63 Sviridovichi, brh. 50 Verechye, brh. 7 Pugachki): Tachinus arcticus, Diacheila polita, Pterostichus pinguedineus, Coniocleonus ferrugineus and others. It was compared with faunas from the Brandon site (Wolstonian glaciation) in Great Britain as well as the Gora Kalvaria and Tazhinechi sites (Odra glaciation) in Poland.

The next complex was obtained from periglacial lake deposits occuring between two upper tills in the Roslavl district (brh. 248 Konachovka). It reflects interstadial conditions and includes arctic tundra species with interzonal ones. In the late glacial deposits the periglacial and interstadial complexes were found in the Loev and Timoshkovichy sites. The first of them includes the tundra and steppe-mountain species (Diacheila polita, Curtonotus alpinus, Cymindis vaporariorum and others). The second complex consists of the boreal coniferous forest species (Phthorophloeus spinulosus, Notaris aethiops) with the intrazonal ones.

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NEW DATA ON THE EOCENE BIOSTRATIGRAPHY OF SOUTH RUSSIA, CAUCASUS, MIDDLE ASIA AND CORRELATION WITH THE SYNCHRONOUS DEPOSITS IN THE BALTIC, POLAND, GERMANY, BELGIUM AND ENGLAND

On the South of Russia and in the limits of the Alpine Belt the marine Eocene deposits are widely spread. During the latest 25 years micropaleontologists of Russia, Ukraine, the Caucasus and Middle Asia states have elaborated the zonal schemes for the Eocene deposits according to nummulitids, planktonic and benthonic smaller foraminifers, calcareous nannoplankton, dinoflagellates, radiolarians, ostracodes and worked out the stratigraphic correlation with the zonal schemes adopted in Western Europe based on nummulitids, planktonic foraminifers and calcareous nannoplakton.

Within the Eocene and Oligocene of the Eurasia two provinces are distinguished with the various species of the nummulitids. The North nummulitic province includes South Russia, Ukraine, the most part of the Caucasus and Middle Asia, the South of Kazakhstan. It extends in the north-west direction trough Poland and Germany to Belgium and England. On the South Baltic shore in some boreholes the nummulites of the Upper Eocene (the called Latdorfian stage) have been discovered.

Two different similar species of nummulites: Nummulites concinnus Jarzeva, 1960 and Nummulites germanicus (Bornemann, 1860), connected phylogenetically by the transitional form - subspecies Nummulites concinnus robustus Jarzeva, 1960, were found in the Upper Eocene of the North nummulitic province. Phylogenetic connection and stratigraphic position of those two species allow to determine two zones: Nummulites concinnus and Nummulites germanicus in the upper half of the Upper Eocene of the North nummulitic province. The first can be correlated with the upper part of the Nummulites fabianii Zone and the second - with the Nummulites retiatus Zone and, probably, with the lower part of the Nummulites fichteli Zone of the Lower Oligocene of the South nummulitic province.

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MODERNIZED CORRELATION CHART OF THE EAST BALTIC SILURIAN

The first unified correlation chart of the East Baltic (Estonia, Latvia, Lithuania, Kaliningrad District) Silurian was elaborated in 1976 (published in 1978). A revised version was made in the course of the preparation of stratigraphical schemes of the East European Platform in 1984 (published in 1987).

A most remarkable peculiarity of the Silurian stratigraphic practice in the Baltic states (particularly in Estonia) has been a combined usage of litho- and cyclostratigraphical criteria for the definition of local lithostratigraphical units. This kind of approach was induced by very variable lithology of the most shallow-water carbonate rocks. Therefore, in some cases stratigraphical formations, characterized by cyclically alternating types of rocks, have been subdivided into "beds" representing cyclithes, whereas in other cases lithologically more homogenous formations (usually in deeper-water sequences) have been subdivided into "members", consisting of mainly one type of rock.

The most essential changes, introduced into the present project of the correlation chart of the East Baltic Silurian are as follows:

*The global standart, recommended by the Subcommission on Silurian stratigraphy of the I.U.G.S. was used.

*Four regional biozonal scales (by conodonts, chitinozoans, ostracodes and vertebrates) were added to the graptolite scale.

*Some regional stages were subdivided into substages (Raikkula, Adavere, Paadla, Kaugatuma).

*A considerable stratigraphical hiatus has been established in the outcrop area, cooresponding to the upper part of the Jaagarahu Regional Stage.

*In Central Estonia, including the vicinity of Adavere, the lower boundary of the Adavere Stage was replaced from the base of the Mohkula Beds to their top, therefore a neostratotype for the Adavere Stage should be chosen.

*Some new formations have been distinguished (Nurmekund, Anelema, Muhu etc.).

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COMMENTS ON THE STANDARD GLOBAL SILURIAN CHITINOZOA BIOZONATION

On the Prague meeting of the Subcommission on Silurian Stratigraphy (I.U.G.S.) on August, 1992, it was recommended to elaborate a standard Global Silurian Chitinozona biozonation, based on the present state of knowledge on chitinozoans. A project of the standard scheme was compiled by J.Verniers (Belgium), F.Paris (France), P.Dufka (Czech) and the author, applying certain criteria. Only well-defined easily recognizable and well-known species were used, also other characteristic species of the biozone were listed in order to recognize the biozone when the index species is missing. Some difficulties arose in case of chitinozoan biozones not coinciding fully in different regions. This is obviously related to the facies influence on the first occurrence of a taxon in different local sequences. In such cases the lower boundary of a global biozone was usually fixed by the earliest occurrence of a zonal species. Along with subuits in the standard Silurian chitinozoan biozonal scheme 18 biozones were distinguished, most of them were for the first time defined in the Baltic area.

As compared with the standard scheme, the East Baltic biozonation is more detailed (32 biozonal units). From the standard scheme the interzones were omitted and only the zonal species found on several palaeocontinents were used.

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ZONAL DIFFERENTIATION OF THE FRASNIAN-FAMENNIAN BOUNDARY DEPOSITS IN BELARUS BY THE PLANT SPORES

The Frasnian-Famennian boundary deposits occur in Belarus within the Pripyat Depression. They include the Evlanovo and Chernin Stage (***Cristatisporites deliquescens-Verrucosisporites evlanensis*** Zone), Domanovitchy Stage and Kuzmichevo Beds of the Zadon Stage (***Corbulispora vimineus-Geminospora vasjamica*** Zone). The deposits have been successively described by the ground plant spores. That makes it possible to undertake detailed differentiation and correlation with the same-age formations occurring in other regions of the East European Platform and Western Europe.

The ***Cristatisporites deliquescens-Verrucosisporites evlanensis*** Zone can be divided into three subzones. The ***Verrucosisporites evlanensis-Kedoesporis imperfectus*** Subzone (EI) corresponds to the Kustovniky and Anisimovo Beds of the Evlanovo Stage. The subzonal assemblage has been traced in the lower portion of the Evlanovo (central regions of the Platform), Bauska Beds of Latvia, in the lower portion of the Uchta Formation (Southern Timan). The ***Auroraspora speciosa-Cristatisporites deliquescens*** Subzone (SD) conforms to the Skolodin Beds of the Evlanovo Stage. By the palynological data it is comparable with the upper portion of the Eylanovo Stage (central regions of the Platform), Amula Stage of Latvia and middle portion of the Uchta Formation (Southern Timan). The ***Grandispora subsuta*** Subzone (Gs) has been found to correlate with the Chernin Stage of Belarus, Liven Stage of the Central Devonian Field, lower portion of the Eleja Stage (Baltic region). Its lower part corresponds to the uppermost sulphate sequence of the Uchta Formation.

The greatest changes in spore composition are observed along the upper boundary of the ***G.subsuta*** Subzone. These confines agree well with the Frasnian-Famennian boundary from the point of view of event stratigraphy, and can be distinctly traced in Eastern Europe. The correlation of the identified palynozones with those occurring in Western Europe shows that the evlanansis-imperfectus and speciosa-deliquescens subzones are comparable with subzones IVA-D established in the Upper Frasnian of France. By the spore composition and trends of the spore assemblage development the ***G.subsuta*** Subzone may be correlated to some extent with Subzone IVE at the basis of which the Frasnian boundary has been suggested in Western Europe.

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DISTINCTIVE FEATURES OF EARLY AND MIDDLE JURASSIC SPORE AND POLLEN COMPLEX OF THE PRE-CARPATHIAN FOREDEEP

The Lower and Middle Jurassic of the Precarpathian Foredeep represent rock terrigenous complex where Lower-Middle Jurassic Bortyatinskaya, Podoletskaya, Medynichskaya and Kochanovskaya formations and Middle Jurassio Javorovskaya formations are singled out. By palynologic data it was established that Kochanovskaja Formations bottom is the age analogue of Medynichskaya Formations. Determination of age boundaries of local stratigraphic sub-units is based on palynologic data, because other paleontologic objects are low informative, especially in the Lower Jurassic part.

The Hettangian-Sinemurian-Early Pliens bachian complex. At first it be given off rocks by M.I.Burova (1986) and have no analogy of Precarpathian Foredeep. In it genera Lycospora and Densoisporites prevail among widely spread species in Liasian. There are species of the genera Lycospora: ***L. salebrosaceae*** (Mal.) Schulz, ***L. gracilis*** Sem. and of the genera ***Densoisporites***: ***D. aff. irregularis*** Haeg. et Barss., ***D. aff. velatus*** Weyl. et Krieg. The pollen consist of small content ***Dissacites***, ***Cycadopites*** and others.

The Toarcian complex. In the first type complex genera ***Cycadopites*** and ***Ginkgocycadopites*** prevail with small quantity of Pteridophytes spores. In the complex genera ***Inaperturopollenites, Araucariaceae, Chasmatosporites*** take part too. The spores represent genera ***Cyathidites*** and ***Dipteridaceae*** and others. In the second type complex we find a variety of genera ***Osmundacidites, Stereisporites, Selaginella*** and abundance of ***Vitreisporites*** pollen. Common feature of the first and the second types of complexes is constant presence of spores ***Klukisporites variegatus*** Couper, ***Marattisporites scabratus*** Couper and ***Tripartina variabile*** Mal.

The Aalenian complex. There are maximum developed spores ***Klukisporites variegatus*** Couper, ***Duplexisporites anagrammensis*** (K.-M.) Schug. and ***Camptotriletes cerebriformis*** Naum. In the complex spores ***Camptotriletes triangulus*** Jarosch., ***Equisetites***, ***Neoraistrickia*** and ***Gleicheniidites*** appeared for the first time. The pollen of ***Perinopollenites*** and ***Cupressaceae-Taxodiaceae*** appeared for the first time too.

The Bajocian-Bathonian complex. In spores maximum part developed are species ***Neoraistrickia rotundiformis*** (K.-M.) Taras, genera ***Equisetites***, ***Gleicheniidites*** and ***Cyathidites***. The pollen of ***Perinopollenites, Sciadopityspollenites, Classopollis*** and other are numerous.

The Callovian complex. In this association pollen ***Classopollis*** is dominating among spores and pollen and dinoflagellates, acritarchs and foraminifers are also found.

These distinctive features enabled to establish the age of these complexes basing on their correlation with synchronous complexes of adjacent areas of Poland, Roumania, the Donbas, the Northern Caucasus and more remonte Pre-caspian area and Siberia.

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MIDDLE ORDOVICIAN ACRITARCHS FROM LITHUANIA AND KALININGRAD DISTRICT

Acritarchs are extremely abundant and diverse fossil group in the deposits of the Middle Ordovician in Lithuania and Kaliningrad district. There is one exception - the deposits of Aseri Regional Stage where no acritarchs have been found. G.Kjellstrom in 1976 also points out the absence of acritarchs in redcoloured Segerstad and Skarlov limestones. There are many species among the acritarchs of Middle Ordovician that have wide vertical distribution ranging over several series or systems. Such species are ***Baltisphaeridium longispinosum, B. hirsutoides, B. microspinosum, B. polyradiatum, Peteinosphaeridium nudum, P. trifurcatum, P. trifurcatum, Ordovicidium elegantulum, Goniosphaeridium conjunctum, G. mochtiensis, Dasydorus cirritus, Veryhachium trispinosum, V. trisulcum, V. lairdi*** and others. But within definite structural-facial areas the changes of quantitative proportions of such species may be used for characteristics of stratigraphical units. The spreading of other species is limited to deposits of one or two regional stages.

The greatest importance in characterizing the regional stages of the Llanvirnian and Llandeilian Series have new species of the genera ***Cymatiosphaera, Dictyotidium, Tasmanites***, as well as the appearance or disappearance on the definite levels of such species as ***Aremoricanium deflandrei, A. simplex, A. aff. decoratum, Baltisphaeridium digitiforme, B. bulbosum, Pterospermopsis tranvikensis, Goniosphaeridium cf. makrosphaericum, Pirea sp. A, Stelliferidium striatulum***. For the characteristics of regional stages of the Caradocian Series the following acritarchs are important: ***Aremoricanium decoratum, Orthosphaeridium vibrisiferum, O. insculptum, O. bispinosum, O. sp. 4***, as well as new species ***Dictyotidium*** and ***Veryhachium***. Besides, in the Keila and Oandu Regional Stages, a decrease in frequency and specific variety decrease for most of the videspread species of the genera ***Baltisphaeridium, Peteinosphaeridium, Goniosphaeridium, Veryhachium***, increase of quantity species of the genera ***Leiovalia, Navifusa*** and appearance of the species that are widely distributed in the Upper Ordovician has been observed.

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ACRITARCHS FROM THE UPPER ORDOVICIAN OF EAST LITHUANIA

Acritarchs have been investigated from Meilūnai, Svėdasai, Ukmergė and Taučionys Formations. Stratotypes of these units are defined in Svėdasai borehole, situated in East Lithuania. The lithology and biostratigraphy of Meilūnai, Svėdasai, Ukmergė, Taučionys formations and their relations with subdivisions of the regional stratigraphic scheme have been given by E.Laškov, J.Paškevičius and N.Sidaravičienė (1984).

In the rocks of the Meilūnai Formation, corresponding to the Vormsi Regional Stage, there are found ***Poikilofusa syrdenospermatella, Eupoikilofusa ctenista, Sylvanidium paucibrachium, Multiplicisphaeridium cf. molinum, M. digitatum, M. fisheri, M. irregulare, Orthosphaeridium insculptum, Lophosphaeridium edenense, L. leptomolgion,, Veryhachium haami, V. oklahomense, V. trispinosum, V. cuneidentatum, Baltisphaeridium hirsutoides, B. polyradiatum, B. longispinosum, B. microspinosum, Micrhystridium stellatum, Goniosphaeridium polygonale, G. conjunctum, Peteiosphaeridium nudum, P. trifurcatum longiradiatum*** and new species of the genera ***Lophosphaeridium, Navifusa, Orthosphaeridium*** and ***Veryhachium***.

Acritarch assemblage from the Svėdasai Formation corresponding to the Pirgu Regional Stage contains ***Orthosphaeridium chondrododora, O. rectangulare, Goniosphaeridium makrosphaericum***, new species of the genera ***Multiplicisphaeridium, Baltisphaeridium, Lophosphaerdium, Tasmanites*** and species having wide stratigraphical range: ***Baltisphaeridium hirsutoides, B. polyradiatum, B. longispinosum, B. microspinosum, Multiplicisphaeridium fisheri, M. digitatum, Micrhystridium stellatum, M. fragile, M. shinetonense, M. nannacanthum, Orthosphaeridium insculptum, Sylvanidium paucibrachium, Goniosphaeridium polygonale, G. conjunctum, Veryhachium oklahomense, V. cuneidentatum, Lophosphaeridium leptomolgion, Peteinosphaeridium nudum, P. trifurcatum longiradiatum***, and ***Ordovicidium elegantulum***.

Each of these assemblages in the Svėdasai sequence can be subdivided into two parts respectively.

Acritarch assemblage from the Ukmergė Formation corresponding to the Pirgu Regional Stage is characterized by presence of ***Veryhachium trispinosum, V. cuneidentatum, Baltisphaeridium hirsutoides, B. longispinosum, Goniosphaeridium conjunctum, Micrhystridium fragile, M. shinetonense, M. nannacanthum*** and new species of ***Lophosphaeridium*** and ***Multiplicisphaeridium***.

Acritarch assemblage from the Taučionys Formation contains the following forms: ***Goniosphaeridium oligospinosum, G. makrosphaericum, G. conjunctum, Orthosphaeridium rectangulare, Veryhachium cuneidentatum, Baltisphaeridium longispinosum, Micrhystridium fragile*** and new species of the genera ***Tasmanites***, ***Baltisphaeridium*** and ***Multiplicisphaeridium***.

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BIOZONAL STRATIGRAPHY AND CORRELATION

Biozonations of the archistratigraphic groups of fossils are the most detailed and exclusive biostratigraphical tool for local, regional and global correlation of different facies, also used for the research and geological mapping.

The general definition of a biozone (=biostratigraphical zone) is rather simple, but in practice quite a lot of different versions of it are in use. The letters are basing on the rate of evolution, phylogenesis of groups, concurrent distribution, replacements of taxa (species) in stratigraphic sequence, change of ecological associations, area of distribution and other characters. Using the above criteria, in the Baltic paleobasins most often range zones, phylozones, interval zones, cenozones and less often acmezones, ecozones etc. were established. Preference was given to planktic and nektic organisms. In the Cambrian there were established acritarch biozones, in the Ordovician and Silurian - graptolite, conodont, chitinozoan and vertebrate ones; in the Devonian - vertebrate zones, in the Jurassic - ammonoid and foraminiferal zones, in the Cretaceous - vertebrate and foraminiferal zones and the Paleogene - foraminiferal zones. These biozones are often global. Biozones and communities of benthic groups of organisms (corals, brachiopods, ostracodes, trilobites etc.) are usually limited to a restricted region (only occasionally having subglobal distribution), but for the study of a paleobasin these are of a serious interest.

One of the main tasks of the biozonal stratigraphy is integration of communities of different groups into biozonations and correlation of those of different facies. After detailed studies this kind of correlation was carried out in the Baltic Silurian proceeding from the following aspects:

*graptolites were used as a leading group for this integration and correlation, enlarged graptolite zones integrating several detailed biozones were employed;

*much attention has been paid to the detailed study of the transitional belt between the clayey facies with graptolites and carbonate facies with shelly fossils, and to establishing synchronous faunal assemblages or biozones in these facies;

*ascertaining distribution pattern of benthic groups in the carbonate facies;

*compiling biozonation and defining synchronous integrated faunal assemblages by facies belts;

*tracking lithological et al. markers by facies belts;

*establishing correlation ties between lithological complexes, integrated assemblages of fossils and biozones for the interpretation of geophysical logs;

Interpretation and integration of all biostratigraphical and lithological data to give reasons for chronostratigraphic levels (=niveaus) which could be traced over all facies belts and defining of chronozones in the scope of elarged graptolite zones.

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SUBSTANTIATION OF THE ORDOVICIAN STRATIGRAPHICAL SCHEME IN THE SOUTHEASTERN BALTIC AREA

The proposed stratigraphical scheme of the Ordovician in the SouthEast Baltic area is bound to the standard stratigraphic scale and is composed of regional (stages and biozones) and local (formations and members) schemes.

Local schemes are compiled for the following structural facies zones of the basin: Early Ordovician - Lithuanian-Belorusian and Lithuanian-Latvian shelf monoclines, Jelgava and Natanga intrashelf depressions; Middle and Late Ordovician - Central Lithuanian depression with its axial and marginal subzones, Jelgava and Natanga depressions and Lower Nemunas elevation. The structural facies zonation of the basin is based on the following criteria: *lithofacies composition in the section, *faunistic composition, *stratigraphical completeness of the section, and *thickness of deposits. New formations have been singled out (Laškovas, Paškevičius, 1992): Piliava, Žintai, Balga, Drugėnai and Karbai in the Natanga depresion; Drūkšiai, Dūkštas and Dysna in the Central Lithuanian depression; Keklys in the Jelgava depression; Gaidė in the Lithuanian-Byelorussian shelf monocline, and Gilija Superformation in the western part of the Lithuanian-Latvian shelf monocline

Local and regional stratigraphic units are compared with the standart stratographic scale according to the graptolite and conodont zones.

The Latorp Stage have graptolite zones of ***T. phylograptoides, D. balticus*** and ***Ph. densus***, and the Volkhov Stage have ***Ph. elongatus***. In the upper part of the Arenig Series, the zone of ***G. austrodentatus*** is singled out and compared with the trilobite zone of ***A. expansus*** in the lower part of the Kunda Stage. Graptolites in the Kunda-Lasnamagi Stages are rare, but the comparison with ***D. artus*** ("***bifidus***") and ***D. murchisoni*** of Llanvirn is possible. In all facies zones of the lower part of the ***G. teretiusculus*** zone, there are traces of ***G. linnarsoni***. The boundaries of ***G. teretiusculus*** and ***G. gracilis*** should be adjusted. In the volume of Idavere, Jochvi and Keila Stages, there is the zone of ***D. multidens*** of Caradoc singled out. The lower boundary zone of ***D. clingani*** and the foot of the Oandu Stage is based on the graptolite complex. The zones of ***D. clingani*** and ***P. linearis*** are compared with the Oandu-Vormsi Stages (Upper Caradoc-Lower Ashgill).

The following conodont zones have been determined: ***C. angulatus*** in Pakerort, ***P. proteus, O. lanceolatus*** in Latorp, ***P. originalis*** in Volkhov, ***A. planus*** in Kunda, ***E. foliaceus*** in Lasnamagi, ***H. serra*** in Uhaku, ***A. triangularis*** suecicus in Kukruse-Idavere, ***I. superba*** in Oandu, ***A. triangularis*** frognoeyensis in Rakvere-Nabala and ***ssp. nov.*** in Vormsi-Porkuni Stages, or ***A. ordovicicus*** in Upper part of Nabala-Porkuni Stages.

Rich brachiopod complexes have been studied in the Central Lithuanian depressio. They

enable correlation of local, regional or even interregional (Hirnantian complexes) stratigraphic units.

The results of Lithuanian ostracode investigation are published by N.Sidaravičienė (1976, 1992). Acritarchs are studied in the Middle and Upper Ordovician deposits (Paškevičienė, 1973-1992). Their complexes related to the Lasnamagi-Pirgu Stages are singled out. In total, 10 acritarch complexes have been singled out.

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TERTIARY OF NORTHERN POLAND

The Tertiary sediments in North Poland originated in the NE area of the large epiplatform of the Northwest European sedimentary basin. This basin widespreaded from the North Sea area through Germany and Poland to Lithuania and Belarus. Tertiary development of the sedimentary basin was closely related to eustatic sea-level oscillations and processes controlled by this mechanism. Position of that area in a marginal zone of the basin influenced vertical and lateral facies variability inside basin fill and origin of numerous sedimentary gaps. Paleogene sedimentation was dominated there by shallow-marine deposits and Neogene ones - by alluvial and delta-plain deposits. The Tertiary thickness is strongly differentiated i the result of complex morphology of the Quaternary bottom surface.

Fauna and flora remains, well-valued from stratigraphic point of view, occur inside the Tertiary sediments in North Poland and allow to make a good stratigraphical correlation with the equivalent sediments of neighboring countries.

Stratigraphical column of the North Poland Tertiary sequence starts with marine Paleocene deposits which overlie Campanian and Mastrichtian series. Terrestial and brackish sediments of Upper Paleocene and Lower Eocene occur locally on the described area only. On the contrary, marine Mid- and Upper Eocene sediments and brackish-marine Lower Eocene ones occur on large areas. Continental sediments including lignite seam represent Miocene deposits. Marine-brackish influx record may be observed in the western part of the studied area in the Lower and Mid-Miocene sedimentary series only. Clayey lacustrine deposits of the Poznan Formation lying above belong mostly to Upper Miocene, but their uppermost part may be Lower Pliocene in age, too. The Neogene top surface has been generally modelled by erosional processes.

Numerous mineral deposits (lignite, amber, material for ceramic and building industries) and also underground water reservoirs for municipal and industrial users occur inside the Tertiary North Poland sedimentary series.

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BIOGEOGRAPHY OF THE EARLY FAMENNIAN BASIS IN THE WEST OF THE EAST EUROPEAN PLATFORM BY BRACHIOPODS

The biogeography of the Early Famennian basis occurring in the west of the East European Platform has been analyzed on a basis of the brachiopod studies. The lowermost Famennian layers were deposited in isolated basins with disturbed water salinityš (for instance, Kuzmichevo Beds in the Pripyat Depression, Kruoja and Šiauliai Formations in the Baltic Syneclise), and practically do not contain brachiopod fossils. The first massive occurrence of brachiopods is confined to the beginning of the Tonezh (Zadon) transgression abundant ***Cyrtospirifer cf. archiaci*** (Murch.) = ? ***C. asiaticus*** Brice, ***Sinotectirostrum furssenkoi*** (Linn.), ***Brunnirhyncha tichomirovi*** (Ljasch.), ***B. sp. n***. 1 apper in the Pripyat and Dnieper-Donets Depressions. The first species is widespread in Europe, the second is endemic, the genus ***Brunnirhyncha*** is known, except for the above areas, only in Moravia.

Thus, a distinct biogeographic connection is observed in the Tonezh time between marine basins of Central Europe (Moravia, Krakow area in Poland) with the Pripyat and Dnieper-Donets Depressions, and further, possibly, with the Central Devonian Field. The Tonezh brachiopod fauna has not been found in the Baltic Syneclise and Lvov Depression. The Tonezh sea in the Pripyat and Dnieper-Donets Depressions turned into semilagoonal environment of the Tremlia and Visha time. A new marine transgression began in the Tourov (Eletsk) time. This transgression was accompanied with the appearance of new brachiopod fauna among which ***Ptychomaletoechia klaipedensis*** Žeiba, ***P. kurshica*** (Liep.), ***Ardiviscus naidovense*** Pushk. and others are especially important. They have been discovered in the Tourov Beds of the Pripyat Depression, Joniškis and Kursa Formations of the Baltic Syneclise, lower part of the "Zadon - Eletsk" of the Lvov Depression.

A stable biogeographic connection between these regions seems undoubtful in the Tourov time, whereas it was less accessible with the Central Devonian Field. Species ***Ptychomaletoechia sp.n***. 1 found both in the Lvov Depression and Moravia (Brno area), suggests connection between these regions. During the subsequent Drozdy time the established biogeographic connections were ruined. At that time rich, but endemic faunas developed in the Pripyar and Lvov Depressions. The richest brachiopod fauna existed in the Petrikov time in Pripjat Depression.

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NEW MODIFIED STRATIGRAPHICAL SCHEME OF THE QUATERNARY DEPOSITS

A new stratigraphical scheme of Quaternary deposits of the Baltic states and local schemes will be based on regional and local stratotypes. Biostratigraphic units are based on assemblage zones. As for interglacial periods, including Holocene, pollen assemblage zones are of particular importance in subdividing annd correlating deposits, but they cannot be regarded as chronostratigraphic units. Glacial and interglacial sediments cause problems in dating, because as a result of redeposition they may be in anomalous stratigraphic position. Therefore, several physical methods (14C, TL, palaeomagnetic remanence and magnetic suspectibility data a.o.) were used.

As in 1976, three more or less independent schemes should be accepted: general scheme and additional schemes for Holocene and Late-Glacial deposits. Due to the fact that the Quaternary continental stratigraphic sequences are generally incomplete and contain glacial erratics, all the above-mentioned three schemes have two parallel subdivisions: for continental and marine deposits. The latter are correlated with oxygen-isotope stages of oceanic deep-sea sediments. According to the recommendations of the Paris INQUA Congress in 1969, the Holocene/Pleistocene boundary will be probably accepted as 10,000 radiocarbon years, and the lower boundary of the Quaternary will be fixed according to international agreements. It means that the Eopleistocene deposits in the previous regional and local schemes should be replaced to the Lower Pleistocene, and the previous Lower Pleistocene deposits to the Middle Pleistocene.

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TRIASSIC OF THE DNNIESTER-PRUTH AREA

In the Dniester-Pruth area the Triassic deposits are spread in the near Danube part in grabens among the Paleozoic rocks.

The graben of the North Dobrudja by its east side gets to the left bank of the Danube. For the first time the psephytic red coloured rocks and limestones on the siliceous cement were revealed under limestones of the Cartal Formation. It distinguishes them from the similar Paleozoic rocks, which were attributed earlier to Lower Triassic. The apparent thickness of these rocks is 6 m. They lie on the pre-Cambrian shists and aleurolites with contrastive angular and stratigraphic unconformity. They are overlied by the rosylike, lilac and greenlike limestones with pebbles and the gritstone in basements. The Meandrospira pussila (Pantic) occurred in limestones which referred to the Anisic Stage fauna which is typical for the upper part of the Lower Triassic. The end of Triassic consists of dark and dark-grey limestones with interbeds of marl and aleurolite and numerous Daonella lommeli (Wisman) of Ladinian Stage. The sequence of both Lower and Middle Triassic of the left bank of Danube is analogous to the right bank section. The apparent thickness of these rocks is about 1000 m.

The Kilian graben is filled with the greyish limestone of Ladinian Stage. The apparent thickness of this limestone is about 800 m. No borehole passed through the Middle Triassic. By analogy to the graben in the Danube delta the Lower Triassic deposits are absent here. The Carnian flysh (Strumoc Formation) with the apparent thickness of about 1500 m lies on the Ladinian limestones. The dark argillite with limestone intercalations (the thickness being up 400 m) belong to the Norian age. The total apparent thickness is more than 3,000 m. The upper part of Triassic is presented by lagoon facies deposits (Hadzhiderskaya Formation) which are typical for the Mediterranean area. Apparent thickness of this series is more than 800 m. The Marazlein graben is filled with deposits of Marazleevskaya Formation whose thickness is 400 m. These deposits occur on Paleozoic directly.

During the Triassic and Early Jurassic time (Kimmerian folding) the vertical movements exceeding 4,000 m predominated. It permitted to accumulate and keep about 10,000 m of the Triassic rocks. The horizontal movements were insignificant, this being confirmed by horizontal bedding of rocks in separate blocks. The upthrust and steep angles are observed in the areas of the most active faults.

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IMPORTANCE OF JURASSIC AULACOMYELLIDAE FOR STRATIGRAPHY AND PALEOGEOGRAPHY

The representatives of the family ***Aulacomyellidae*** Ichikawa, 1958, are widely sread in the Jurassic of Thethys. Two groups of genera may be discerned. One of them contains Bositra, ***Silberlingia*** and ***Aulacomyella***, the other - ***Diotis, Posidonotis, Pseudodymotis*** and ***Didymotis***. The first group is known from the Jurassic of Thethys, whereas the second one from the Cretaeous.

The presence of ***Silberlingia sanctaanae*** (Smith) in the Lower Callovian of Crimea and of ***S.pamirica*** Romanov in the Lower Callovian of Pamir makes possible the correlation of these deposits and serves as an indication of the existence of free migration from the Atlantic basins (the Argentine-Chilian and Mexico-Cuban provinces) into the Mediterranean ones. With the Later Kimmeridgian transgression the fauna of the West and South Europe, East Africa and Arabia basins have migrated into the basins of the North part of Tethys. The innumerable Bositra somaliensis (Cox) and ***Aulacomyella problematica*** Furlani prove this. The first species are known from the Upper Kimmeridgian of Somalia (Dagany shists), Yemen, Dniester-Pruth area and Crimea; second from Somalia (Dagany shists), Yemen, Turkey, West Germany, Yugoslavia, Dniester-Pruth area and Crimea. The presence of these species in the Jurassic of areas around the Black Sea makes it possibile to determine the Upper Kimmeridgian age of the lower part of various colcured deposits (the Kongaz Formation) in the Dniester-Pruth area and the rocks near the village Zelenogorye in the Crimea Mountains. The appearance of a mass of representatives of genus ***Aulacomyella*** in the Upper Kimmeridge of Africa, Europe, America and Japan proves that parts of Tethys could freely communicate during all the Late Jurassic.

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TWO APPROACHES IN STRATIGRAPHY PROVIDE TWO CODES BUT THE SAME TERMS

Let us consider the last versions of the International Stratigraphic Guide (ISG) and the Russian Stratigraphic Code (RSC). They represent two modes of thinking in stratigraphy between which we must make a compiling our own code.

According to Isg, stratigraphic units can be formed by each character (lithologic, paleontologic, tectonic etc.) separately. Their temporal relationships can be shown by various scales, forming of them (or their parts) chronostratigraphic units. The first units are more or less objective, while the latter have interpretative content.

According to RSC, the main stratigraphic units, aimed at describing local, regional and global stages of geologic history, must be formed on the basis of all characters. The interpretative meaning of such units follows from these procedures.

Chronostratigraphic scale in the sense of ISG is correct if there are no gaps or overlaps between units making it up. Such continuity can be reached, indeed, if boundary stratotypes are used. Lithostratigraphic units or their analogues, being defined by interval stratotype, may have both overlaps and gaps in time and space.

The correctness of local, regional and global scales in the sense of RSC, i.e. the content of corresponding stratigraphic units, depends more on completeness of description of the stage of development than their formal boundaries. Consequently, each such unit has to be defined first of all by interval stratotype.

The above-mentioed principal differencies make it impossible to translate most of the stratigraphic terms correctly from Russian into English or vice versa. However, the actual use of the local (RSC) and lithostratigraphic (ISG) units in Baltic, especially according to the previous versions of the references, allows to translate "pachka" as "member", "svita" as "formation" and "serija" (partim) as "group".

As for the global standard we must accept the following categories of chronostratigraphic units: "system" (="sistema"), "series" (="otdel"), and "stage" (="gorizont").

Regional units are most disputable. If we want to see them as units of the regional scale (independent of the global one) then they must be defined (by boundary stratotype) as chronostratigraphic units and named as "(regional) series" (="otdel", but not "serija") and "(regional) stage" (="gorizont").

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BIOSTRATIGRAPHY OF NEOPLEISTOCENE IN SOUTH-EAST BELARUS

Results of palynological and diatom investigations of anciet lacustrine sediments stripped by the borehole 66 at the village of Boroviki and the borehole 87 near Svetlogorsk (Gomel region) testify to their formation during the Muravian (Mikulino, Eemian) Interglacial and the Early Poozerian (Early Valdaj, Early Weichselian) time.

The section of the borehole 87 is the key one of the Neopleistocene in the south-east of Belarus. Palynozones mr2-mr8 have been revealed in the interglacial stratum of this section (45,1-61,2 m). Two distinctly expressed Early Poozerian Interstadials (Surazh and Polotsk) correlated in all probability with the Brorup and Odderade Interstadials of north-western Europe and separated by stadial layers are represented in the Lower Poozerian deposits (20,2-45,1 m). They were subdivided into palynozones pz1-pz5.

In the section of the borehole 66 the accumulation of sediments at a depth of 35,0-55,5 m took place during the second half of the climatic optimum and the end of the Muravian Interglacial (mr5-mr8), at a depth of 24-35 m - during the first Early Poozerian Stadial of the last glaciation (pz1) and the Surazh Interstadial (pz2).

Each of the above-mentioned sections contains a rich diatom flora (more than 200 species and varieties), the Late Pleistocene age of which was determined in virtue of the extinct species absence and its modern aspect. Revealed diatom assemlages reflect different facies conditions of sedimentation. In the section of the borehole 87 a high frequency of planktonic species was established both in the Muravian Interglacial (***Stephanodiscus, Cyclotella*** and ***Aulacoseira***) and the Surazh (Brorup) Interstadial deposits of the Early Poozerian time (mainly ***Cyclotella*** taxa) evidencing a deep water character of the palaeobasin. The prevalence of bottom (***Navicula scutelloides, Amphora pediculus*** and others) and epiphytic diatoms (***Opephora martyi***, various ***Fragilaria***) is characteristic for the Early Stadial sediments of the Poozerian Glaciation and indicates the fossil lake shallowing.

The ecologo-systematic analysis of the diatom flora occurred in the section of the borehole 66 testifies to a comparatively high water level in the palaeobasin only during the Muravian Interglacial. At this time diverse planktonic species of Cyclotella belonged to the dominants. During the Early Poozerian time (pz1 and pz2) the sedimentation took place in a shallow fossil lake when bottom species and epiphytes (at the beginning ***Amphora pediculus, Navicula hungarica var. capitata, Cocconeis placentula et var. euglypta*** and others, later on ***Fragilaria brevistriata, F. construens*** with varieties) were abundant.

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BIOFACIAL ANALYSIS AND CEPHALOPODS IN THE ORDOVICIAN OF LITHUANIA

In the Ordovician, cephalopods represent important index group of fauna. They are most numerous in clayey-calcareous deposits from the Volkhov to Porkuni Regional stages including. Facial peculiarities of deposits and sizes of fossils testified that cephalopods lived in warm water of normal salinity and were related to the shallow parts of the epicontinental Ordovician Baltic Basin.

Transgression of the Lower Ordovician sea has caused deposition of nearshore sand formations. Rare hingeless brachiopods, conodonts and acritarchs are found here. After the next sea transgression (during Latorp), the invertebrate fauna including cephalopods appeared. Dolomite formations found sometimes in some intervals of the Lower Ordovician showed that water salinity was changing.

In the upper part of Lower Ordovician and the lower part of Middle Ordovician, cephalopods are often found, whereas during the upper half of Middle Ordovician they occur rarely. This seems to be related to the fact that in this region the conditions were unfavourable for living and burying of invertebrates. Accumulation of sediments occurred in the water of the shelf (often laminae of detrital limestones). In the middle part Middle Ordovician, fauna composition has changed considerably due to changes in environmental conditions. The remnants of fauna were washed out by waves and transported by currents from the initial sites of accumulation. In the Upper Ordovician remnants of cephalopods are very rare. At that time, with sea regression, lumpy limestones or sometimes dolomite rocks were formed in the shallow part of the shelf. With changing environment, some species of straight cephalopods disappeared, whereas quantities of those twisted or semitwisted increased.

Biofacial analysis of the Ordovician deposits and occurrence of well-preserved cephalopods allowed to assume that ***Cochlioceras avus*** Eichw., ***C. angustiseptum*** Bal. and ***Bactroceras sp***. were crawling, whereas ***Orthoceras centrale*** His., ***Rectanguloceras danckelmani*** (Rem.), ***Schroederoceras vesenbergense*** Bal. and ***Sch. angulatum*** (Saem.) were passively drifting. ***Paracyclendoceras cancellatum*** (Eichw.) and ***Narthecoceras*** should be attributed to the "planktonic" species. The rest cephalopod species seem to be active swimmers.

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CONODONT ZONES OF UPPER ORDOVICIAN IN LITHUANIA AND ADJACENT COUNTRIES

Morphologically characteristic flat and rapidly evolving conodont genus of Ambalodus Branson et Mehl is found in the Upper Ordovician (Rakvere-Porkuni Regional Stages). There are also scattered conical and complex elements of conodonts. Defining conodont zones, special attention is paid to the appearance of the index species in the section.

The conodonts of Upper Ordovician in the North Atlantic province (NE America, the British Isles and Scandinavia) make up the zone of a flat multielementary species of ***Amorphognathus ordovicus*** Branson et Mehl. It includes flat amorphognathiformous and ambalodiformous elements (form species are ***Ambalodus triangularis*** and ***Amorphognathus ordovicicus***).

The Late Ordovician conodonts in the North Atlantic province are studied better than those in Europe, and they are rather specific. All the species common for both areas have very wide vertical distribution in the deposits and cannot be applied as a basis for correlation. This is confirmed by the zone of ***Amorphognathus ordovicicus*** embracing the entire Upper Ordovician layer in the area studied. However, such an approach cannot be applied for the Upper Ordovician deposits in the South East Baltic area (Lithuania and Kaliningrad District). Firstly, remmants of the ***Amorphognathus*** specimens are rare and badly preserved. Moreover, ***A. ordovicicus*** was evolving during the entire Upper Ordovician. Secondly, the elements of ***Ambalodus*** are met frequently, and the changeability of ***Ambalodus triangularis*** Branson et Mehl is observed. Such a conclusion is based on statistical data, taking into account the fact that conodont elements of one animal should be found in the statistically significat samples together.

In the Upper Ordovician of the SE Baltic area, there are well-preserved ambalodiformous elements, and two conodont zones are singled out:

*the zone of Ambalodus triangularis frognoeyensis Hamar embraces the Rakvere and Nabala Stages. The index species and other conodont elements are well-observed in the sections;

*the zone of ***Ambalodus triangularis viirae ssp. nov.*** is defined in the Vormsi, Pirgu and Porkuni Stages (V. Viira has described it in her monograph published in 1974 as ***Ambalodus triangularis ssp. nov.***). The zone with the index species and other elements is well-observed in the sections studied, except for black argillite of the Fjacka Formation (Vormsi Stage).

Higher occur deposits of Lower and Middle Llandoveri (Lower Silurian) with the zones of ***Keislognathus truncialatus*** (Walliser) or ***Neospathognathus celloni*** (Walliser).

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MALACOFAUNA OF KORCHEVO AND STRATIGRAPHIC IMPORTANCE

Interglacial deposits recently discovered in a quarry of the brick-yard near the village of Korchevo (brest region) contain remains of the Tiraspol fauna of mammals, the oldest seed flora from the Pleistosene of Belarus, and original pollen complexes. These deposits have been recognized a stratotype of the oldest and, at the same time, a new Interglacial of Belarus. At present the Korchevo layers have been already found in several sites of Belarus. However, the Korchevo malacofauna was unknown till now.

In 1990-1992 we have studied a series of samples with remains of shells from different parts of dislocated rocks of the Korchevo section. It was turned out, that the composition of shells is uniform and associated with the same dark-grey gyttjaaccumulated during the Interglacial optimum. The malacofauna includes 32 taxa (3 land and 29 freshwater ones). Lake mollusks (stagnicolous) are most various and abundant. Most species are indifferent to the climate. Only Ponto-Caspian Valvata naticina Menke belongs to typical species of warm periods. ***Limax sp.***, ***Planorbarius corneus*** L., ***Lithoglyphus naticoides*** (Pfeiffer) form a complex of associated interglacial mollusks. Most probably the extinct ***Pisidium astartoides*** Sandberger, regional exot ***Lithoglyphus cf. piramidatus*** Moellendorf and ***Gyraulus albus*** (Muller), ***Lymnaea sp., Viviparus sp***. can be included in this group.

The age of Interglacial deposits from Korchevo is determined by the presence in mollusk assemblage of large amouts (till 25,6%) of eccentric lids (operculata) of ***Bithyania labiata*** Neumayr.

Thick-walled ***Bithynia*** and its eccentric lids are typical species of the Lower and Upper Eopleistocene of European part of Russia and the Ukraine. In Pleistocene deposits this species is found very seldom only on the left bank of river Saksagan near Pjatikhatka in the Ukraine and apparently in Berlin paludinian rocks. The shells and lidds of the species have not been found till now in the younger sediments of Byelovezha Interglacial including deposits of Cromerian complex (Cromer Forest Bed) in England, calcareus silts from Ferdynandov in Poland, Borky in Byelovezha, Roslavl deposits in the profiles Kiryly and Podrudnjansky, Muchkap deposits on the Don. So, only deposits of the Korchevo Interglacial of all the Pleistocene fall within the zone of existence of ***B. labiata*** Neumayr. Perhaps, the time of the species extinction is associated with the first Interglacial of the Pleistocene.

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STRATIGRAPHY OF THE UPPER PLEISTOCENE IN THE MARGINAL ZONE OF LAST GLACIATION, EASTERN LITHUANIA

Stratigraphic subdiviion of the Upper Pleistocene Nemunas (Weichselian) Formation is rather problematic in Lithuania. There are conflicting views in respect to the Early Nemunas (Varduva) cold period palaeogeography and stratigraphy. Few investigators consider that during this period Lithuania was covered completely by an extensive ice sheet, which formed tills and glaciofluvial deposits. Others suppose that the periglacial conditions with two interstadials (Jonionys I and Jonionys II) were existing in Lithuania during the Early Nemunas. The stratigraphy of the Middle Nemunas so far is not well grounded by valuable data too. Only few sections of the Middle Nemunas were known and investigated in Lithuania up to now.

The investigations of stratigraphy of the Upper Pleistocene were carried out in Eastern Lithuania. The datawere collected during geological mapping in zone of margin of the Late Nemunas glacial stage. The area explored is particulary favourable for solving some problems cocerning the Upper Pleistocene stratigraphy. Abundant sites with the Merkinė (Eemian) interglacial deposits of lacustrine origin were discovered. The composition, genesis and conditions of sediment formation covering the Merkinė interglacial layers were explored. Particular attention was devoted to sediments of palaeolakes. A large palaeolake of the Merkinė interglacial age was revealed in environs of Mickūnai (20 km to NE from Vilnius). This palaeolake is located inside of territory which was covered by the ice sheet of the Late Nemunas. Deposits of the Nemunas Formation overlaying those of the Merkinė Interglacial in this palaeobasin have been subdivided into the Early Nemunas (lacustrine, bogs and deliuvium sediments), the Middle Nemunas (lacustrine sediments) and the Late Nemunas (tills and aquaglacial deposits). This stratigraphic sequence is established in 20 boreholes in area of 200 square km and seems to be not casual. Outside the area of Late Nemunas glaciation the, Merkinė interglacial layers are covered by deposits with the same stratigraphic sequence: Early, Middle and Late Nemunas. Otherwise than for sections located inside the area of last glaciation, the Late Nemunas deposits are not of glacial origin. The till which can be attributed to the Early Nemunas period were not detected in any site. This fact indicates that periglacial conditions have existed in Lithuania during the Early Nemunas (Varduva, Early Weichselian).

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CORRELATION OF MIDDLE-UPPER EOCENE SEDIMENTS IN THE KIEV PREDNIEPER REGION BY DINOCYSTS AND NANNOPLANKTON

Dinocysts and nannoplankton were studied from the samples of sequences at the villages Stayki, Rzhishchev, Obuchov, Khalepia. Middle Eocene sediments are represented by Kiev Formation composed mainly of phosphorite sands, marls, calcareous clays and sandstones. There the following zones are singled out from the bottom: ***Areosphaeridium diktyoplocus*** Zone with rich complex of ***Phthanoperidinium echinatum, Areosphaeridium multicornutum, Wetzeliella articulata, W. ovalis, Spiniferites ramosus, Deflandrea phosphoritica, D. phosphoritica subsp. australis var. lata*** and nannoplankton zones - ***Nannotetrina fulgens*** (NP 15) and ***Discoaster tani nodifer*** (NP 16).

The ***Rhombodinium porosum*** Zone is in the upper part of the Kiev Formation - the lower part of the Obuchov Formation. Almost all the species of underlying zone are present, as well as C***harlesdowniea clathrata, Homotryblium floripes, Rottnestia borussica, Impagidinium dispertitum, Tasmanites*** and all the subspecies and varieties of ***Deflandrea phosphoritica*** and a large quantity of green algae g. ***Tasmanites***. The ***Discoaster saipanensis*** (NP 17) Zone is singled out here by nannoplankton. The Upper Eocene deposits are represented by the Obuchovian Formation (Naglinok). They are non- carbonate, more seldom carbonate, glauconite clay interbeds and sandstones. Here the impoverished association of ***Charlesdowniea clathrata angulosa*** Zone is singled out. Except the zonal here all the subspecies ***Deflandrea phosphoritica*** dominate, as well as ***Thalassiphora delicata, Hystrichokolpoma cinctum, Microdinium peticulatum, Wetzeliella articulata, W. ovalis, Pentadinium laticinctum, Tyttodiscus chondrotus, Tasmanites newtonii, Crassasphaera spp***. The quantity of green algae g. ***Tasmanites, Tyttodiscus noticeably*** increases. Complex of ***Isthmolithus recurvus*** (NP 19), ***Sphenolithus pseudoradians*** (NP 20) is singled out here by nannoplankton.

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PROBLEMS OF PLEISTOCENE CORRELATION IN EUROPEAN RUSSIA, BELARUS AND BALTIC STATES

In the Central areas of European Russia, four glacial horizons are reported from the Lower Pleistocene section (the lowermost part of the Brunhes paleomagnetic epoch); the dividing interglacial deposits contain fossils of small mammals, which belong to various evolutionary stages of the Tiraspol faunal complex. The most extensive are deposits of the Don glacial, horizon, which is the third one from below, as well as deposits of the preceding Sukromma (Late Ilyinka) and the next Roslavl (Muchkap) interglacial periods. In Belorus, their analogues are the Yaselda moraine, the Korcheva and Belovezh (Shklov) interglacial deposits, whereas in the Baltic states - the Dzūkija moraine and the interglacial deposits of the Židini section (the pre-Dzūkija deposits seem to be totally removed by subsequent exaration). The moraine of the last Early Pleistocene glaciation is also encountered everywhere (the Oka, Berezina, Dainava moraine).

The moraine of the pre-Don-Middle Ilyinka glaciation is confidently recognized in Central areas (Setun) and Belarus (Narev). The deposits of the first Early Pleistocene - Likov Glaciation (the Pokrovsk Stage) and the next (Early Ilyinka) interglacial period are reported at present from several sections only in the Central areas.

The data on marine and subaerial deposits testify to the fact that there were at least two (and, possibly, three) glaciations and as many interglacial periods in Middle Pleistocene. However, both in the Central areas, and in Belarus and the Baltic states, one can recognize confidently only the deposits belonging to the interglacial period in the beginning of the Middle Pleistocene (Likhvin, Alexandryisk, Butenai) and the glaciation that occurred by the end of the Middle Pleistocene. Neither in the Central areas, nor in Belarus, one encountered as yet the deposits of the first Middle Pleistocene glaciation (which seemed to have covered much smaller area than at the end of Middle Pleistocene) and the second Middle Pleistocene interglacial period. It is possible that the Žeimena moraine and the Snaigupėlė interglacial deposits of the Baltic states belong to this geologic time; however, their stratigraphic position is not quite clear.

The interglacial deposits of the beginning of Late Pleistocene (Mikulin, Muravin, Merkinė) and the moraines belonging to several stages (or phases) of the second half of the only Pleistocene glaciation (Valdai, Poozersk, Nemunas) are clearly recognized in all places. During the first half of this glaciation (Early Valdaian time), the glacier did not reach Belarus and the Central areas, and, most probably, the Baltic states either.

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POLLEN ZONES AND CHRONOSTRATIGRAPHY OF THE LATE GLACIAL DEPOSITS IN LATVIA

Late glacial time is a period when was going the processes of emancipate the territory of Latvia from the last glacier. Character peculiarity of this period are consist in that at the same time was formed as the accumulation wchich direct are conect with the ice scheet and as the accumulation which are formed outside influence the glacier. The first among of them is the glacial, the fluvioglacial and limnoglacial deposits and the second among of them is river lake, bog the deposits. The deposits which are belong to the first group was formed in the begin and the middle of Late glacial time. The deposits are belonging to the second group was formed principal in the end of Late glacial time.

The Late glacial deposits are contains the admixture of organic remains including pollen and spores, the part of which is redeposited. For the distinction in the composition of pollen spektra the palynomorphs which are synchronous to containing their sediments was realizated to corection on basic: 1) The comparison species composition in the macroscopic remains of plants with the pollen and spores composition. 2) The comparision pollen spectra in the autochthonous (peat) with the allochtonous (clay, sand) deposits the same age. 3) The comparision pollen composition of the Late glacial time in Latvia with the pollen complexes by autochtonous deposits of the Post glacial time in Arctic and Subarctic regions of northern Europe. Basic on this criterias the author consider that the primary in composition for pollen spektra of Late glacial deposits are the pollens ***Pinus, Betula sec.Albae, B.nana typ, Picea, Salix*** and secondary (redeposited) are the polleen ***Quercetum mixtum, Carpinus, Alnus, Corylus***. By paleogeografical estimate the pollen composition of Late glacial deposits the pollen ***Pinus*** are regard as index the climatic warmer and the pollens ***Betula, B.nana*** as index the climatic colder.

The analyses of macroremains the plants are indicate that the first appearance floristical elements of the forest on the periglacial regions in Latvia was been in Allerod. It is ***Picea, Pinus silvestris, Juniperus communis, Betula*** (***pubescens?***), ***B. humilis***.

For recognizing the pollen zones in the Late glacial deposits paremount importance have correlation between the pollen of trees and the pollen of herbs and also correlation between the pollen of Pinus and pollen of ***Betula, B.nana***. Pollenzones are believed to definite chronozones.

The deposits of Memele chronosone are constituete with varve clay; of Raunis chronozone - with the limnoglacial, the alluvial, the lake sediments; of Older Dryas chronozone - with moranic and alluvial sediments; of Bolling chronozone - with the limnoglacial sediments; of Middle Dryas chronozone - with the limnoglacial and and the lake sediments; of Allerod and also of Younger Dryas chronozone - with the alluvial, the lake, the bog sediments and with sediments of Baltic glacial Lake. For deposits of Raunis, Allerod, Younger Dryas chronozones have any the radiocarbon (14C) dates.

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COMPARATIVE ANALYSIS OF THE LATE GLACIAL DEPOSITS PALYNOSTRATIGRAPHY OF THE SOUTHEASTERN BALTIC AND BARENC SEA

According to palynostratigraphical investigation the Late glacial deposits in the Baltic and Barenc Sea have been accumulated synchronously and chiefly belongs to the two periods - Allerd and Younger Dryas.

Pollen and spores spectrum of the allerd and the Upper Dryas deposits in the Baltic and Barenc Sea have uniform character.

The higher content of the pollen herbs is registered in their common composition mainly by owing to Artemisia. ***Pinus*** and ***Betula pollens***, accompanied to thesome quantaties of the pollens ***Picea***, are represented in general in the pollen of trees.

Identification of allerd and Upper Dryas for Baltic region is realized in the following based palynological indications. The quantity of the pollen of herbs in Allerd pollen and spores spectrum is relatively decreased, the role of ***Pinus*** is rised at the trees pollen composition. There are maximum quantity of pollen herbs in the upper dryas spectrum, compared to the allerd. A position of the pollen ***Betula*** increases among trees, accompanied with pollen ***Pinus*** quantities decreases, which keeps itis dominating significance.

Disposition of the distinguishes between allerod and upper dryas spectrum in the Barenc Sea preserves such as Baltic region. Relatively diminishing amount of the herbs inherent in allerod spectrum. Position of the pollen ***Pinus*** and of the pollen ***Picea*** in some regions is increased in composition of tree of allerd spectrum. Upper Dryas spectrum are characterised with the most heightened quantity of the pollen of the herbs and among the pollen of tree with the decreasing of content of the conifer vegetation and with the largest importance of the pollen ***Betula***, which ordinary have occupied the dominanting meaning. Establishment uniformity in the change of the pollen spectrum composition allows to stratigraphicaly compare the deposits of basic subdivision Late glacial stage of the Baltic and Barenc Sea. Stratigraphical coordination of this appearance calles thenecessity of the special subdivision competence apportion apparently in class of subhorizon, which marks the upper part of glacial horizon of last glaciation.

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MIDDLE ORDOVICIAN (VIRUAN) CONODONT BIOSTRATIGRAPHY OF THE BLIŪDŽIAI-150 WELL, LITHUANIA

Over 50 samples collected from the Middle Ordovician carbonate sequence penetrated in the Bliūdžiai-150 well, Lithuania have produced numerous conodonts (several 10.000 of specimens). The conodont faunas provide new information regarding the correlation and the mutual relations between the Scandinavian, Baltic and the Polish carbonate successions.

The basal part (1390 to 1385 m) of the investigated interval (1390 to 1369 m) is indicative of the ***Eoplacognathus reclinatus*** Subzone of the ***Pygodus serra*** Zone. The strata above 1385 m in the well correlate with the upper part of the ***Pygodus serra*** Zone, the ***Pygodus anserinus*** Zone and the ***Amophognathus tvaerensis*** Zone. ***Eoplacognathus robustus, E. lindstroemi*** Subzones of the ***Pygodus serra*** Zone and ***Baltoniodus variabilis, B. gerdae*** and ***Baltoniodus alobatus*** Subzones of the ***Amorphognathus tvaerensis*** Zone are present suggesting that the succession investigated in the well is without significant breaks. Hence, the Lasnamagian (CIb), Uhaku (CIc), Kukruse (CII), Idavere (CIII) and perhaps part of Johvi (DI) Stages are represented in the well.

The conodont faunal succession in the Bliūdžiai-150 well is similar to the conodont faunal succession established in Central Sweden within the Central Confacies Belt and correlation to Central Sweden and its equivalents in Norway, Southern Estonia and Poland is precise.

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STRATIGRAPHICAL FEATURES OF THE PERMIAN AND TRIASSIC DEPOSITS OF THE BALTIC REGION

The deposits mentioned above spreaded in the Polish-Lithuanian trench which represents the NE ending of the anciet large Middle European sedimentation basin. Now the territory of this basin occupies some areas in the Kaliningrad District of Russia, Lithuania and Latvia and also corresponding regions in the Baltic Sea.

The Permian consist of two series: the Lower and the Upper. The first one is a stratigraphical anaqlogue of the Rotliegendes (Saxone), the latter one - equivalent of the Zechstein (from the Werra to the Leine cycles). The lower one is presented by terrigenous deposits up to 53 m thickness in which coarse arkose sandstones have a widespread occurrence. The upper strata (thickness up to 300 m) is composed by typical Zechstein formations. Their main lithological features reflect cyclic repetition of terrigenous and carbonaceous evaporitic deposits with rare finds of faunas (foraminifers, ostracods, brachiopods, seldom fish faunas, and also spores and pollen), (Suveizdis P., ed., 1978).

The Triassic are typical analogues of Middle European Buntsandstein mainly of its lower part. This formation in the Baltic area are composed by clays, aleurolites and sandstones with poor faunas (ostracodes, gastropods) and spores and pollen. Its thickness reaches up to 500 m. The stratigraphic units based on lithologic-geochemical features are difficult to correlate with other region (J.Kisnėrius, L.Saidakovsky, 1972). The problems neede to be solved in the regional aspect are as folows: *establishing paleontological features of the Permian international scale; *working out another correlatives, mainly for the Triassic deposits, and more detail subdivision of both systems.

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MINERALOSTRATIGRAPHY IN CORRELATION OF THE SOUTH-EASTERN BALTIC JURASSIC FORMATIONS

The Southrastern Baltic region includes the Kaliningrad District of Russia, Lithuania and southwestern part of Latvia. In this region almost whole section of the Jurassic is found, with exception of Hettangian, Sinemurian, Middle Bathonian and Upper Volgian. The most full section is found on the territory of Kaliningrad Distrit.

The Jurassic rocks contain the following clay minerals: kaolonite, illite, montmorillonite, chlorite and mixed-layered illite-montmorillonite. These minerals form asociations consisting of from two to five clay minerals each. Amounts of the first three minerals in associations vary very much, the amount of chlorite everywhere is very small, and mixed-layered minerals are rare. The most sensitive minerals to paleogeographical environments are kaolinite and montmorillonite. Thats why they were chosen for mineralostratigraphy and correlation purposes.

Continental and sbcontinental terrigenous deposits of the preMiddle Callovian formations (Neringa, Lava, Įsrutis, Liepona and Papilė) contain large amounts of kaolinite, the vertical variation of which is not very large within the bounds of one individual formation but differs in adjacent formations of the section. It enables to subdivide sections into formatios. The amounts of montmorillonite are comparatively small everywhere but differ in sediments of individual formations. The horizontal distribution of kaolinite and montmorillonite differs more, depending on paleogeographical environments in the basins of sedimentation.

Marine carbonate-terrigenous sediments of the Middle Callovian - Volgian stages contain lower amounts of kaolinite, especially, beginning with the Oxfordian sediments. Here vertical variation of kaolinite amounts depends on transgression and regression processes of sea and is significant. These increases and decreases of kaolinite may be traced horizontally. It enables to divide sections vertically into small simultaneous units which can be correlated with ammonite or foraminifer zones. This phenomenon may be applied for correlation of "barren" and containing fossils sediments.

The montmorillonite amount is increased in marine sediments, and its vertical and horizontal distribution and variation in sections may be applied for correlation too, especially, in the sections without kaolinite.

Average amounts of kaolinite and montmorillonite of individual stages, substages and formations may be used for correlation purposes too.

The best results are distinguished in mineralostratigraphy and correlation of the Middle and Upper Callovian sediments of South-East Baltic.

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SIGNIFICANCE OF THELODONTS (AGNATHA) IN CORRELATION OF THE SILURIAN AND EARLY DEVONIAN OF THE NORTHERN PART OF EURASIA

During a period after the 1st Baltic Stratigraphic Conference in 1976 attention to investigation of thelodonts, particularly, of their discrete scales strongly increased. Many new forms were found in the upper part of the Ordovician, Silurian and Devonian, their great significance for correlation of inequifacial deposits was proved.

Thelodonts are basis of zonal scale of vertebrates which was worked out for the Silurian and Lower Devonian (Karatajūtė-Talimaa, Marss).

A large new material of thelodonts accumulated by author extends correlative possibilities of this group of early vertebrates. The first information was received about oldest Late Ordovician (Ashgillian) thelodonts of the Timan-Pechora province (TPP). The distribution of thelodonts was ascertained in the Lower Silurian of the Siberian Platform, Tuva and in the Upper Llandovery - of Mongolia, in the Silurian and Lower Devonian of TPP and the Ural region, archipelago Severnaya Zemlya. There was received a first information about the Upper Silurian and Lower Devonian thelodonts from Novaya Zemlya.

Assemblages of the Lower Devonian thelodonts from Podolya ans Spitsbergen were supplemented by new forms.

The representatives of Kataporida are best for zonal subdivision of the Silurian and Thelodontida ones - for the Devonian.

The genus ***Loganellia*** is characteristic for the Lower Silurian. There are distinguished the following zones: ***L. sibirica*** - Lower and Middle Llandovery of Siberia; ***L. scotica*** - Upper Llandovery and Lower Wenlockian of Europe and Siberia; ***L. "taiti"*** and ***L. grossi*** - the middle part of Wenlockian in Europe.

Species with trunk scales which have longitudinal rows of thorns on their crowns are determined as new genus ***Paralogania***. There is distinguished the zone ***P. martinssoni*** - Upper Wenlockian and Lower Ludlovian.

Phlebolepidides are distributed in the Upper Silurian Zones: ***Phlebolepis elegans*** - the upper part of Ludlovian in Europe; ***Helenolepis obruchevi*** - Upper Ludlovian to Lowermost Pridolian in Tuva; ***H. navicularis*** - Pridolian in Tuva.

Genus ***Katoporus*** is characteristic for the Pridoli deposits in Europe. Zones: ***K. tricavus*** - lower (basic) part of Pridoli: ***K. timanicus*** - the upper part of Pridoli and ***L. lithuanicus*** - the uppermost part of Pridoli and the lowermost part of Lochkov (Baltic and TPP).

The appearance of genus ***Turinia*** coincides with the Silurian-Devonian boundary in all regions of Europe and Severnaya Zemlya. Zones: ***T. pagei*** - the lower (basic) part of

Lochkov; ***T. composita*** (***sp. nov.***) - the upper part of Lochkov. The following subzones may be marked out: ***Nikolivia gutta, N. balabayi-Apalolepis obruchevi*** and ***N. oervigi*** - ***A. brotzeni***.

Genus ***Amaltheolepis*** represents the Pragian Stage. Zones: ***A. baltica*** (Lithuania), ***A. sp. n***. (TPP and Spitsbergen). The zone ***A. winsnesi*** (Spitsbergen) and ***A. bystrovi*** (Severnaya Zemlya, Novaya Zemlya) represent the Emsian part of Lower Devonian.

The zone ***Skamolepis fragilis*** includes the Upper Emsian (Grey Hoek, Rezekne formations) - the Eifelian (Kernave Formation) - in Spitsbergen, Latvia, TPP, Moscow Syneclise.

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DROP STONES ON THE SEABOTTOM IN THE VICINITY OF THE ANTARCTIC PENINSULA

The raw material for the investigations presented from the autors are 83 samples from marine surface sediments around the northern part of the Antarctic Peninsula. They had been sampled in the years 1981 to 1986 durig several expeditions of the research vessels "Meteor", "Polarstern" and "Walther Herwing" D.Matthies investigated the fine grain fractions - clay and silt. A.Hofstetter the medium sized sand fraction, while W.Skeries studied the coarse fraction of rock detritus greater than 1 cm qualitative and quantitative in the course of geological, petrographical and geochemical studies.

In the fine grain fraction provinces with typical clay mineral compositions and different portions of detritic minerals can be distinguished. By petrographical means a (sub) surfical stratigraphy for one sediment core can be deduced. The heavy mineral assemblages in the sand fraction indicate five provinces. Beside the subordinate transport by deep sea currents the main contribution comes from drifting icebergs. Numerous facts indicate the East and Central Antarctica, as well as the Antarctic Peninsula and its related islands as being the area of delivery. The coarse detritus almost exclusively derived from melting icebergs. By the recostruction of the drifting paths for the icebergs some knowledge about the ice covered baserock from the delivery are could be deduced.

Several individual findings of the three investigators can be correlated and allow a more comprehensive interpretation: the accessoric, but distinct appearance of tourmaline, rutile and zircon in the heavy mineral assembly along the northwestern coast of the Antarctic Peninsula is in agreement with the occurence of acid volcanic rock pieces in the coarse grain fraction of the ice load detritus in this region. In the vicinity of the South Shetland islands chlorite appears in remarkable portions in the clay fraction in combination with leucoxene, sphene and olivine and pumice as well as pyroclastic rocks in the medium and coarse grain fractions, respetively. Amphiboles and amphibole-shists are dominant on the South Orkney Plateau. In the sediments of the northwestern Weddell Sea the heavy mineral phases red spinel, garnet, kyanite and sillimanite in connection with upgrade metamorphic rocks, especially granolitic gneisses, are more abundant.

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STRATIGRAPHY AND CORRELATION OF THE LOWER DEVONIAN IN THE PECHORA PLATE

The Lower Devonian in the northern part of the Pechora Plate are represented by the regressive series of the Lochkovian, Pragian and Emsian stages, which finish the Silurian-Early Devonian sedimentary cycle. The Lochkovian Stage is subdivided into the Ovinparma and Sotchemkyrta Stage. The former is corresponded to ***Icriodus woschmidti*** conodont Zone, ***Protathyris praecursor*** brachiopod Zone and ***Traquairaspis*** ichthyozone. In the West of the region (Northern Timan, Shapkina-Yur'yakha Swell) the Ovinparma Stage consists mainly of the continental and litoral silty-sandstone deposits with thickness to 340 m. In the northern and central parts of the Khorejver depression the Lower Devonian were washed away by pre-Frasnian or more earl erosion. In the rest of the areas the argillaceous-carbonate deposits are predominant. On the base of faunal complexes the Ovinparma Stage is correlated confidently with Borshchov Stage of the Podolia, Tom'-chumysh Stage of the Salair and Til Stage of the Baltic region.

The Sotchemkyrta Stage is represented by lagoon sediments - sedimentary dolomites, argillites with sparse stromatoporoids, tabulata, brachiopods, ostracodes and vertebrates. The complex of vertebrates (***Turinia pagei, Nikolivia elongata, Lepidaspis, Porolepis*** and oth.) is considered by V.N.Talimaa to be as the complex from the Stoni Stages of the Baltic region which is correlated with the Upper Gedinnian of the Ardenno-Reinish region and Upper Dittonian of England.

The overlying Philippchyukskij Stage, consists of Rybackij and Pristan' Beds. They are established along the northeastern borderlands of the Pechora Plate, in the Varandej - Adz'va structural zone and north of the Shapkina-Yur'yakha Swell. In the standard sections of the Urals, the dolomite-terrigenous rocks of Rybackij Beds contain sparse ostracodes, Early Devonian complex plant microfossils and vertebrates ***Amaltheolepis***? ***sp.nov., Rhinopteraspis sp., Radotonidae, Porolepis*** and other. On the base of these fossils the lower part of the Philippchyukskij Stage is correlated with Brecon of England and Pragian Stage of the Chechia. In the Baltic region the lower part of the Kemeri Stage (Viešvil Formatio) is corresponded to the Rybackij Beds.

The Pristan' Beds, consisting mainly of red terrigenous rocks with ***Amaltheolepis***? sp., acanthodians, paleoniscidae, elasmobrachia and ***Porolepis uralensis*** Obr. are correlated with the Saunoriai Formation (the Upper Kemeri of the Baltic region) and are dated as lower part of the Emsian Stage.

In the Pripolar Ural and the southern part of the Chernyshev Swell the Pristan' Beds underlying terrigenous alluvial deposits of the Syv'ju ("Takata") Formation with ***Lunaspididae (Wijdeaspis?), Porolepis***, plant fossils and spores of ***Retusotriletes absurdus*** Zone. They are correlated with Rezekne Stage of the Baltic region and the Daleje (Upper Emsian) of the Chechia. In the Polar Urals the Emsian Stage are represented by lagoon-marine carbonate deposits of the Vuchvozh and Vjazovaja Beds.

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BIOTIC CRISES IN THE HISTORY OF THE UPPER SILURIAN GRAPTOLOIDS

The history of the Upper Silurian graptoloids may be visualized as a series of four biotic crises (C_1-C_4; Urbanek 1970), followed in each case by a recovery leading to a rediversification at a decreasing scale. Hence, in general, graptoloidis behaved as a regressive group in the sense proposed by Muller (1961).

Scenarios of some biotic crises are relatively well-known (C_1 or "big crisis" of Jaeger, 1991; Koren, 1991) (C_2; Urbanek, 1966,1970), while the two remaining ones (C_3-C_2) were recognized oly preliminarily. Although each biotic crisis reveals some characters of its own, all of them displaya number of important common features. Thus the immediate result of the extinction associated with each biotic crisis was the appearance of relic assemblages of some persisting species. They exhibit a characteristic post-event syndrome, including namely (1) drastic reduction of diversity (decrease in number of species and in number of morphoecological types), combined frequently with (2) strongly increased numerical abundance of the surviving species and, in some cases, also with (3) a subnormal phenotype due to reduction of the colonies ("the Liliput effect"). The post-event syndrome may be considered a distinct effect of a disturbed environment, with conditions hostile to most species of the group and tolerable only for few (element (1) of the syndrome). They thus affected adversely the growth and size of the phenotype (element (3) of the syndrome), permitting nevertheless even dwarfed varieties of graptoloids to reproduce themselves to more than sufficient extent (elemet (2) of the syndrome).

Moreover, recent ecological and biogeographical data commonly show on inverse relation between diversity and abundance. The recorvery of the depauperate post-event assemblages implied (1) a process of indigenous speciation and (2) immigration. Thus, rediversification after C_1 (lungreni event) involved mostly an indigenous speciation with some share of immigration, while the recovery after C_2 (leintwardinensis-event) was achieved almost exclusively due to a moderate adaptive radiation from the relic assemblage, with a negligible role of immigrants. In contrast, C_3 at the base of the Pridoli series, feature a prevailing role of immigration, the same seems to be true for C_4 at the base of the Lochkovian. However, the category of immigration includes not only truly cryptic species but also the Lazarus taxa, that is representatives of the lineages which reappear after a longer absence from the known succesions. The significance of the reappearance of true monograptids (with hooked thecae) for the Upper Silurian faunas has been recognized by Bulman (1971, 1978). Recent studies reveal that true monograptids were absent from the marginal seas in the time-span from the end of the nilssoni Zone up to immediately below the parultimus Zone. They reappear to form a substantial element of the Pridolian fauna. Both the cryptic element and the Lazarus taxa seem indicative of a great role played by the pelagic realm of the ocean in the evolution of planktic graptolites. The Lazarus effect in the stratigraphic distribution of some graptoloid lineages provides certain evidence for the presence of an oceanic reservoir of the

graptolite faunas. Hence, our record concerning the near extinction of graptoloids during some of the biotic crises is systematically biased. The pelagic refugia of the graptolite fauna might be identified in the light of the recent planktological research as Central Water ranges, characteristic of the open ocean. They relate to persistent water masses, relatively isolated by systems of gyres. A profound restructuring of the oceanic regime due to climatic and geographic changes was needed each time to enable the reappearance of the locked oceanic element in the epicontinental seas.

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PALEOZOIC MICROFOSSILS FROM THE LAKE LAPPAJARVI IMPACT CRATER,WESTERN FINLAND

The meteorite impact crater of Lake Lappajarvi in western Finland has 150 years history of research. The first 100 years it has been interpreted as a volcano, since 1968 as a meteorite impact crater (Svensson 1968). The ^{40}Ar-^{39}Ar age of karnaite (= impact melt rock) is 77 Ma (Jessberger & Reimold 1981), which differs from the paleomagnetic age of ca. 200 Ma (Pesonen & Marcos 1990). In the drill hole on the eastern slope of the crater there is beneath the Quaternary tills 18 meters of lithified sediments of age ca. 1200 Ma (Uutela 1990).

The latest drill hole DH 304 has been drilled 3 km SW of the geometrical center of the crater. Mudstone at the depth of 32.60-35.20 m are overlain and uderlain by suevite and impact breccias, where a miscellaneous assemblage of acritarchs was found: ca. 95% are Cambrian, ca. 3% ordovician and ca. 2% trilete spores of unknown age.

References

Jessberger, E.K. & Reimold, W.U., 1980. A Late Cretaceous ^{40}Ar-^{39}Ar Age for the Lappajarvi Impact Crater, Finland. J. Geophys. 48(2), 57-59.

Pesonen, L.J. & Marcos, N., 1990. Paleomagnetism of the Lake Lappjarvi impact structure, Central-West Finland. In: Symposium on Fennoscandian Impact Structures, Espoo and Lappajarvi, Finland, May 29-31, 1990. Programme and Abstracts, ed. by L.J. Pesonen and H. Niemisara. Geological Survey of Finland, Espoo. p. 26.

Svesson, N.-B. 1968. Lake Lappajarvi, Central Finland: a possible meteorite impact structure. Nature 217, p.438.

Uutela, A. 1990. Proterozoic microfossils from the sedimentary rocks of the Lappajarvi impact crater. Bull. Geol. Soc. Finland 62, Part 2, 115-121.

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ONE PROBLEM OF MODERN STRATIGRPHY OF DEVONIAN IN THE EAST BALTIC

The discussion on the age of the Rezekne Formation seems to be contiued. Since L.Lyarskaja's (1974) and A.Kleesment et al. (1975) pioneering papers ad the resulting decisions taken in the Baltic stratigraphic schemes (1978), the Rezekne Formation was assigned to Eifelian as a lowermost unit of Middle Devonian. This conclusion was based on the research of ichthyofauna, yielding dominating acanthodians together with smaller numbers of psammosteids, cephalaspidids, crossopterygians, ptyctodontids, palaeoniscids, otolits and spores.

The recent contributions of E. Mark-Kurik with the review of overall distribution of Wijdeaspis and associated characteristic placoderms (buchanosteids, phlyctaeniids) as well as thelodont Skamolepis and acanthodians allowed her to suggest the Late Emsian age for Rezekne Formation.

Controversally to this point of view and basing primarily on acanthodian sequence we can present the following conclusions.

1) The use of Skamolepis fragilis as a species-index for the Rezekne Formation as it has been previously recorded, is perhaps a little chancy. We have found it even higher - in Late Eifelian, Mosolovo Regional Stage in the cetral parts of the East European Platform. So Skamolepis does not indicate the Emsian age.

2) The Early Devonian Emsian age of the Rezekne Formation canot be confirmed by acanthodians. Comparing acanthodian assemblages that are widespread in Baltic's Early and Middle Devonian, we would emphasize, that the Early Devonian phylogenetical stage is characterized by dominating of climatiids and ischnacanthids whereas the Middle Devonian - by acanthodids and diplacanthids. This important change in acanthodian development is taking place with the Rezekne Fm. all the Early Devonian acanthodian assemblages show an abudance of Nostolepis and Cheiracanthoides (5-11 species) in association with Gomphonchus and Poracanthodes (4-7 species) and smaller numbers of C***anadalepis, Endemolepis*** and ***Tareyacanthus*** (Climatiida) and ***Lietuvacanthus*** and ***Estopacanthus*** (Ischnacanthida). ***Acanthodids*** (***Acanthodes***?) and ***Markacanthus*** are represented only in a final assemblage of Early Devonian (***Gomphonchus tauragensis*** biozone corresponding to the Saunoriai Regional Substage. Beginning with Rezekne Formation, first appearance of the acanthodids dominating in all the next Middle Devonian assemblages is fixed: ***Acanthodes***? (4 species), ***Cheiracanthus*** (4 species) and diplacanthids: ***Diplacanthus*** (2 species), ***Rhadinacanthus*** and ***Ptychodictyon*** (represented by one species both). So the lower boundary of Rezekne Formation is the most clearly expressed and shows a high degree of renovation in acanthodian sequence. Even if E. Mark-Kurik's conclusion that "... a hiatus between the Kemeri and Rezekne Regional Stages has perhaps magnified their faunal differences..." seems reasoable, this does not contradict to all mentioed above. According to acanthodians, Rezekne Formation suggests to be attributed to Middle Devonian.

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CONODONTS AND DATINGS OF KERNAVĖ FORMATION IN THE EAST BALTIC

Sparce conodonts positioned at one narrow stratigraphic level only - the Kernavė Formation - have been met in East Baltic during research of the Early and Middle Devonian acanthodian zonal sequence. This conodont assemblage corresponds to the ***Nostolepis kernavensis*** acanthodian biozone.

The most common in assemblage is ***Icriodus struvei*** Wed. with localities in (core: depth, m) Grybėnai: 117.4 and 118.3, Utena 56p: 233.0 Šaravai: 308.4, Keručiai: 228.5, Vaišnoriškės: 155.9, Šabaldauskai: 185.0, Rimšėnai: 160.9, Baltupėnai: 703.8, Kaniūkai: 204.2 and 204.6, Kančiškės: 214.5 and Kunkojai: 554.3. Two more ***Icriodus - I.n. sp. E*** Wed. and ***I. sp. C*** enter into this assemblage in a few localities. ***Icriodus n. sp. E*** - Šaravai: 313.0, Keručiai: 228.5, Vaišoriškės: 155.9, Sabaldauskai: 185.0, Rimšėnai: 160.9 and Kančiškės: 214.5. ***Icriodus sp. C*** identified in Šaravai: 320.0 only.

Three representatives of ***Polygnathus - P. linguiformis linguiformis*** Hinde, ***P. linguiformis alveolus*** Wed. and ***P. parawebbi*** Chat. are found in Grybėnai: 117.4 and 118.3. The latter occurs in Keručiai: 228.5 accompanied with ***P. cf. costatus oblongus*** Wed. Kančiskės: 214.5 bears ***P. linguiformis alveolus*** Wed. and ***P. cf. linguiformis*** Hinde. The latter is also defined in Rimšėnai: 160.9 ***P. cf. xylus ensensis*** Ziegl. et Kl., the important species for dating, is fixed in one locality only - Vaišnoriškės: 155.9.

Two localities have yielded specimens of ***Coelocerodontus. C. klapperi*** Chat. and ***C. sp.*** are identified in Būtėnai: 196.0 and C. n. sp. A Chat. - in Beržai: 185.0. All specimens of ***Coelocerodontus*** are resembling closely those described by B. Chatterton (1974) from the Harrogate Fm. of British Columbia. Two more localities, Utena 56p: 233.0 and Rimšėnai: 160.9, are mentioned by incoming in this conodont assemblage of ***Ozarkodina cf. bidentata*** (Bisch. et Ziegl.).

On the basis of dominating ***Icriodus struvei*** Wed. accompanied with ***Polygnathus linguiformis linguiformis*** Hinde, ***P. linguiformis alveolus*** Wed., ***P. cf. costatus oblongus*** Wed., ***P. parawebbi*** Chat. and ***P. cf. xylus ensensis*** Ziegl. et Kl. and representatives of ***Coelocerodontus***, this conodont assemblage corresponds well with the ***Polygnathus parawebbi*** Beds (Mosolovo and Cherny Yar horizons) widespread on the East European Platform. The assemblage is correlated with the uppermost costatus-kockelianus and lower ensensis zones of the Eifelian conodot standard sequence.

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EXOTIC PLANTS FROM THE ALEXANDRIAN (MAZOVIAN, BUTENAI) FLORAS OF BELARUS, POLAND AND LITHUANIA

In 1970-1980 many new sites of the Alexandrian (Likhvini, Butenai) Interglacial floras were examined in Belarus and the adjacent regions of the Baltic States and Russia. It was found difficult to correlate these floras with the Mazovian ones of Poland, which within 1930-1950 were discovered and become subjects of complex investigations thanks to W.Szafer's works and activity and to the palaeobotanical school created by him. The foregoing allows to suppose that one of the main causes of this phenomeon were differences between the method used in the field and laboratory investigations by specialists from different palaeobotanical schools.

In this connection, the author together with Kazimiera Mamakova (W. Szafer's Institute of Botany, Krakow) undertook a revision of the coeval interglacial floras of Poland, Belarus and the Baltic States. In the composition of carpological Mazovian floras several taxa were discovered analogous to those described from the Alexandrian floras of Belarus as extinct or extra-European at present and are the most characteristic of that Interglacial. These taxa are the following: ***Aldrovanda dokturovskyi*** Dorof., ***Aracites interglacialis*** Wieliczk., ***Carex paucifloroides*** Wieliczk., ***Caulinia goretskyi*** Dorof., ***Brasenia borysthenica var. heterosperma*** Wieliczk., ***Nymphaea cinerea*** Wieliczk., ***Scirpus torreyi*** Olney. Most of them were found (but not all together) in different Middle-Pleistocene floras of the Baltic States, however such an interesting extinct species as Aracites interglacialis was not yet discovered there earlier.

Teh composition of the Butenai floras of Lithuania is very similar to that of the coeval floras of Belarus, but the Alexandrian floras are known from more numerous sites and are better studied, because the group of exotic plants there is the most impressive.

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CAMRIAN-ORDOVICIAN BOUNDARY IN ESTONIA

In the East Baltic the Cambrian-Ordovician boundary has been drawn at the base of the Pakerort Regional Stage. It was motivated by finds of the ***Dictyonema*** (=***Rhabdinopora) flabelliforme*** group of graptolites from this Stage.

In 1985 the International Working Group on the Cambrian-Ordovician Boundary (IWGCOB) decided to place the level below the apperance of the nematophorous graptolites. Three conodont zones have been considered to be potetial levels at which to redefine the Cambrian-Ordovician boundary - base of the ***Cordylodus proavus*** Zone, base of the ***C. intermedius*** Zone, and base of thye ***C. lindstromi*** Zone. In several sections, including Dayangcha, China and Naersnes, Norway, the level of graptolite appearance falls into the ***C. lindstromi*** Zone. The material obtained from Estonia shows that the co-occurrence of conodonts and graptolites differs from area to area due to facies conditions and for some unknown reasons (Kaljo, Viira, 1989). In the East Baltic the ***R. flabelliformis*** group makes its first appearance at different levels: in the top of the ***C. proavus*** Zone, in the ***C. intermedius*** Zone or at the level of the ***C. lindstromi*** Zone.

Detailed taxonomic study of early species of Cordylodus by Nicoll (1991) refines the species concept of ***C. lindstromi*** and defines a related new species ***C. prolindstromi***. Our task is to decide about the Nicoll's ew taxonomy and to see how the material compares with Estonian material.

In 1990 the IWGCOB made decision that "other fossil groups should be considered for definition of the Cambrian-Ordovician boundary". Landing (1993) made the proposal that "the lowest local occurrence of ***R. flabelliformis*** assemblage within an interval with lower Fauna B-aspect conodonts (=***C. lindstromi*** Zone - V.V.) provides a interregionally correlatable Cambrian-Ordovician boundary horizon".

In any case the Cambrian-Ordovician boundary falls into the Kallavere Formation and for that reason the lower boundary of Pakerort Stage - the oldest Ordovician Stage - must be redefined.

References

Kaljo, D,, Viira, V. 1989. Co-occurrences of conodonts and graptolites in the Estonian early Tremadoc. Proc. Estonian Acad.Sci. Geol., 38, 3, 97-100.

Landing, E. . Cambrian-Ordovician boundary in the Taconic allochthon, eastern New York, and its interregional correlation. J. Paleont., 67, 1.

Nicoll, R.S. 1991. Differentiation of Late Cambrian - Early Ordovician species of ***Cordylodus*** (conodomta) with biapical basal cavities. BMR Journal of Australian Geology & Geophysics, 12, 223-244.

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TREMADOCIAN ACRITARCHS OF ESTONIA

Three assemblages of acritarchs have been founded in the Tremadocian of Estonia. The oldest Lower Tremadocian assemblage is recovered from conodont zone ***Cordylodus proavus*** (sequences Vihula, Maardu-9, Suhkrumagi). ***Acanthodiacrodium angustum*** (Downie) Combaz, ***A.comptulum*** Rasul, ***Dasydiacrodium ornatum*** Combaz, ***Arbusculidium striatulum*** Volk. occur in this assemblage. The second Lower Tremadocian assemblage is recovered from conodont zones ***C.lidstroemi-C.angulatus/ C.rotundatus*** (outcrop near town Toila). ***Vulcanisphaera britannica*** Rasul, ***V.imparila*** Rasul, ***Baltisphaeridium setaceum*** (Tim.), ***Corollasphaeridium sp.*** have been found here for the first time. Acritarchs from zoes ***C.intermedius*** are not known at present. The Upper Tremadocian acritarch assemblage is present in the well Maardu-56. Characteristic species: ***Dasydiacrodium tremadocum*** (Gorka) emend. Tongiorgi, ***Aryballomorpha grootaertii*** (Martin) emend. Martin et Yin, ***Athabascaella penica*** Martin et Yin, ***A.playfordii*** Martin.

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CALCAREOUS NANNOFOSSIL STRATIGRAPHY - VARIOUS APPLICATIONS

Calcareous nannofossils are the minute remains (2 to some 25) of mariūne unicellular algae that first appear in the late Triassic, become rock-forming in the late Jurassic and are presently a major part of the phytoplankton in the oceans from the tropics to the polar seas.

They have been used biostratigrapcally for over three decades and we now have a reasonably well established sequence of zones from the Jurassic through the Quaternary. The length of these zones differs considerably from as short as 0.2 million years in parts of the Tertiary and the terminal Cretaceous and several million years in parts of the Jurassic and Cretaceous. The definition of the zones is mainly based on first or last occurrences, but more and more also includes quantitative characteristics such as a shortžlived strong increase or a given species. In very detailed investigations for oil companies for example in the Danian of the North Sea, also the evolutionary steps within a species or genus were used as marker events for a very fine subdivision.

Calcareous nannofossil biostratigraphy has thus developed into an important tool for correlation of marine sediments both in high and in low latitudes and between the two realms. It is also possibile to correlate sediments from shelf areas with those from the open seas.

The geographical and stratigraphical distribution of typically/mainly tethyan calcareous nannofossils in the Lower Cretaceous of the boreal realm (such as ***Conusphaera*** and some ***Nannoconus***) helps in the reconstruction of the changing paleogeography of the connections between the tethyan and boreal realms during the Early Cretaceous.

The increasing study of living coccolithophorids and the quantification of processes that lead to their accumulation on the sea floor will allow a better interpretation of our findings in the fossil assemblages. As we learn to understand the sequence of dominance of certain species over the seasons of a year in different environments, will be better able to interpret the meaning of such sequences in laminites of different ages.

Finally the use of calcareus nannofossil biostratigraphy in the study of medeival paitings from Norwegian Churches will be discussed.

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STRUCTURE OF LAGENOCHITINA (CHTINOZOA) FROM BALTIC REGION AND CHITINOZOAN BIOSTRATIGRAPHY

Chitinozoans of Lagenochitina Eisenack, 1931 from the Arenig of Baltic region have been observed with a SEM.

Normally specimens are flask-shaped with a neck which may have a collar. Their vesicles do not have either spines nor appendices on the surface. Most specimens display a basal callus or basal pore. The neck is provided with a prosome inside. This is the only inner structure of Lagenochitina vesicle. The prosome is a cylindrical plug which extends orally in the neck ad partly fills the internal cavity of the chitinozoan chamber. The most aboral portion of prosome forms skirt-shaped flange in accordance with the shape of the chamber. This flange is attached to the inner side of the vesicle wall. The prosome is seldom completely developed and its proximal disc-like structure (similar to operculum) is recognized in excellently preserved specimens only. Central part of the prosome shows a septate inner structure in a cross section. Two distinct layers compose the vesicle wall, of which the inner is thick, structurless or fine-multilayered. The external layer consists of delicate granules and may have granulate outer surface sculpture.

Fairly numerous vesicles displaying morphological anomalies have been discovered. They are interpreted as teratological cases of unknown origin. Aberrant vesicles have a strongly expanded outer layer of the wall and may form a large space within the double wall. This space extends from the mid-length of the neck up to the aboral end. The external layer in abnormal vescles have granulate and porous surface and might be easily folded, damaged or totally stripped of the wall. Specimens with inter-layer voids or with stripped of outer layer strongly vary in theirs shape and dimensions. All these parameters are very important in lagenochitinds taxonomy. The species of ***Lagenochitina***. (***L. baltica, L. esthonica, L. tumida, L. magnifica***) are good biostartigraphic indicators for Lower Ordovician beds (up to Ashgillian), and the two last species at least seems to be established on chitinozoans with aborally expanded vesicles.

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GLACIOTECTONICS AND STRATIGRAHPY OF THE INNER ZONE OF THE LAST PLEISTOCENE GLACIATION IN LATVIA

Glaciotectonic phenomena occur abundantly in Latvia. Sediment deformation structures created by active ice vary in scale. The large scale structures have morphological expression on the ground surface and consist of individual glaciotectonic landforms, whereas small scale deformations complicate the internal structure of these landforms. Glaciotectonic landforms are organized spatially, forming drumlin fields, uval moraines, flutings, and areas of ribbed, arcuated or disintegrated moraines. A gradual transition of glaciotectonic structures and landforms from a parallel to transverse orientation, to non-oriented forms, in the direction of ice movement, reflects spatial and temporal changes in the stress field, temperature conditions and fluid content in the ice-bedrock contact zone.

The composition and orientation of the fabric and the age of the material composing the glaciotectonic landforms are very variable and may be divided into four types:

* pre-Quaternary bedrock, consolidated to some extent; predominantly the Middle or Upper Devonian sandstone, aleurolites, shales, rarely carbonatic rocks;

* pre-existing Quaternary strata, usually unconsolidated and composed of various types of sediments, including the oldest till and interglacial material;

* contemporaneous material, including basal till and glacioaqueous sediments deposited and subsequently deformed during the Last glaciation;

* mixed material of the above mentioned types.

The age of glaciotectonic formation and the age of the deformed sediments are different concepts. Most of glacioaqueous sediments which compose positive landforms are still defined as Late Weichselian. Conclusions based on the results of kinetostratigraphical investigations of these sediments indicate possibly a of Middle Weichselian age (Lejasciems subage).

Processes of glacial erosion, sedimentation and deformation began and continued during the extension phase of the Last glaciation. Hovewer, these earliest glaciotectonic formations were destroyed by erosion and lateral compression during further glacier propagation when planation of the subglacial surface prevailed. The latest glaciotectonic structures and landforms were successively created during glacier reactivization and migration of the zone of glaciotectonic activity stretching from 80-120 km inside of the active and passive ice contact. Simultaneously, with the formation of glaciotectonic landforms, the continuous cover of basal till was disintegrated and stratified sequence of bedrock was in some cases dislocated. At the same time, deposition of basal till had been occuring upglacier, whereas glacioaqueous sediments were deposited downglacier of glaciotectonic zone. Therefore different processes of glacial activity occured

synchronously in different parts of inner zone. Interpretation of the above-described depositional and deformational chronology is difficult or even impossible without the use of kineto-stratigraphical methods.

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NEW TITHONIAN-BERRIASIAN SECTIONS IN THE SOUTHERN CRIMEA

A number of wells bored in the southeastern part of the Crimea Mountains and in the west of the Kerch peninsula have shown the presence of the Tithonian-Berriasian deposits. They are represented by interbedded limestones and marls, with interbeds of sandstones, argillites, limestone, breccia in the north which are replaced by reef limestones in the south. According to the stratigraphic plots of the Jurassic of the Crimea Mountains (1984, 1991) the southeastern region of it is related to the Sudak-Feodosia structural-facial zone where Tithonian-Berriasian Dvuyakornaya Formation is situated. By facial, lithological and microfaunistic characteristics this formation significantly differs from the deposits mentioned above. The section in the far southeast of the Crimea Mountains may be regarded as a new one not mentioned in the stratigraphic plots of the Crimea Mountains.

Microfauna from core of some wells the Aptian-Albian foraminifers were found in the Tithonian-Berriasian layers. Our investigations have shown that the studied section is stipulated by a thrust which happeed after to Albian. The overthrusted complex (allochthone) is built by the Upper tithonian and Berriasian rocks represented by the beyond-reef facies in the north and reef rocks in the south. The autochthone Tithonian - Berriasian formations are represented by the beyond-reef facies. The thrust happened from southward, and, taking into consideration minimum amplitude, the development of reef body took place not less than 3.5 km southwards from the Yuzhno-Vidnenskaya-1 well.

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ON UPPER FRASNIAN STRATIGRAPHY AND CORRELATION IN LITHUANIA

The Upper Frasnian deposits, quite common in Lithuania and related to the axial part of the Baltic syneclise, have some specific features, including intensive lithofacies zonation expressed by rhythmic bedding of the members of dolomite, dolomitic marl with clay interlayers, aleurolite and gypsum. Sedimentation occurred in the shallow lagoon-sea badins with unstable regime. In the dolomite deposits, remnants of articulated brachiopods, Lamellibranches and gastropods with rare conchostracan and lingulid remnants, as well as spore and fish fauna complexes are described in the adjacent substrata. According to the unified stratigraphical scheme of the East European Platform, the Upper Frasnian (73-168 m thick) is divided into the Pamūšis, Stipinai and Pakruojis formations, whereas the Kruoja Formation is attributed to the Lower Famennian.

Working out stratigraphical basis for mapping and correlation in the East Baltic area, there are several unsolved problems related to the thickness and rank of some stratons. For the first time in the Upper Frasnian sequence, the Viduklė Formation is defined (type section: borehole 91-Viduklė, 198-224 m). It is divided into the Daugėlaičiai and Stipinai Beds. Previously the Daugėlaičiai Beds were attributed to the upper part of the Pamūšis Formation. The stratotype (borehole 1-Daugėlaičiai, 158-171.0) is mainly represented by dolomitic marl deposits with violet and green-grey spots,rare clayey dolomite interlayers, and with dolomite at the basis. The upper boundary passes gradually into the overlying Stipinai Formation. The thickness ranges in 6-13 m. The Stipinai Formation corresponds to the description of V.Narbutas (1981).

The Pakruojis Formation is divided into three layers: Repšiai, Alsiai and Renava. The Renava deposits attribute to the newly singled out Formation of Šaukėnai in the stratotype section (borehole 107-Repšiai, 161.2-173.7 m) are composed of alternating calcareous dolomitic clay and dolomitic marl with calcareous dolomite interlayers. The upper boundary is clearly expressed lithologically. The thickness ranges in 8-12 m. The Alsiai Beds in the stratotype section (borehole 142-Alsiai, 84-94 m) are composed of interbedding dolomite marl and clayey dolomite, with gypsum interlayers in some places. Rarely there are also fish bone fragments and phyllopodium imprints; thickness is 7-14 m.

The Šaukėnai Formation singled out newly (stratotype section: borehole 89-Šaukėnai, 192.1-209 m) is divided into the Renava and Kruoja layers. The Renava deposits (stratotype section: borehole 25-Renava, 315-323 m) consist of calcareous dolomitic marl with high content of clay and clayey dolomite laminae in some places. The lower boundary corresponds to the interlayer of gypsous dolomite, whereas the upper one is permeative. The thickness ranges in 5-12 m. The Kruoja Layers correspond to the description of S.Žeiba (1987) with some corrections.

ANNEX

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BALTIC STRATIGRAPHIC ASSOCIATION

ABSTRACTS OF THE SECOND BALTIC STRATIGRAPHIC CONFERENCE

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