MODELLING OF SPECIFIC AND SENSITIVE COASTAL AREAS OF THE BALTIC SEA

WORKSHOP
ENVIRONMENT IN THE NEVA BAY — KARELIAN ISTHMUS AREA, THROUGH TIME

ABSTRACTS

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OF THE NORFA NETWORK
MODELLING OF SPECIFIC AND SENSITIVE COASTAL AREAS
OF THE BALTIC SEA

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THE EVOLUTION OF FARMING IN LITHUANIA'S NEOLITHIC AND EARLY BRONZE AGE AND THE ARCHAEOBOTANICAL EVIDENCE

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This paper will review existing archaeological, osteological and paleobotanical data related to the transition to farming in the Neolithic and Early Bronze Age in Lithuania, and draw particular attention to present archaeobotanical research that incorporates a macrobotanical approach.

The archaeological sites of the Sventoji series, Daktariskes, Duonkalnis and Sarnele in western Lithuania, and the Kretuonas seriesand Narkunai in eastern Lithuania have been key sites used in creating a model of the evolution of farming in Lithuania for the Neolithic and Early Bronze Age. Research results from these sites suggest that agriculture developed earlier and faster in western Lithuania than it did in eastern Lithuania, though it was generally a very slow process.

The evidence for the evolution of agriculture in Lithuania to date is mostly from indirect evidence: isolated finds of seeds or their imprints on pottery, palynological data, the existence of farming tools. These data may provide us with a general view of economy and its evolution, however, the specific and chronological and geographical nature of the evolution remains fuzzy. Systematically collected on-site macrobotanical data from various sites complement the palynological and archaeological data and enable a more specific and thorough investigation of food production, preparation and distribution through time.

CHRONOLOGY OF VEGETATION AND PALEOCLIMATIC STAGES OF NORTHWESTERN RUSSIA DURING THE LATE GLACIAL AND HOLOCENE

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Until now, the climatic-geochronological division of the Holocene had been based on the recognition of climatic periods and phases using the Blytt-Sernander scheme. This relative scale has been linked with the absolute radiocarbon one only by means of ^{14}C dating of the border between climatic periods and phases identified in the "Ageroeds mosse" bog sediments. Later, similar, climatic-geochronological scales supported by ^{14}C dating were developed for many regions of Western Europe. The Holocene geochronological scale of norgthwestern Russia is also based on the Blytt-Sernander scheme but the climatic periods and phases identified here are not correlated well enough with the ^{14}C scale. This because of the shortage of Holocene sections investigated in detail by palinological and geochronological methods. This basis of our research project has been to study thoroughly the Holocene sediments in continuous sequences and to relate the pollen zones discovered to the climatic periods and phases, and to the ^{14}C time scale. Another reason has been to make a reconstruction of the Late Glacial and Holocene climatic parameters based on palinological and geochronological data.

We have studied six reference sections of bog and like sediments in the Leningrad and Novgorod provinces to develop a geochronological scale for vegetation and paleoclimatic changes in northwestern Russia during the Late Glacial and Holocene. Every 10-cm layer along the peat and gittja sections (4-8.5 m thick) was investigated palinologicallly and a great majority of them were dated by ^{14}C. Using the data obtained, standard palinological diagrams were plotted and reconstruction of vegetation history is made. The palinozones indicated on the diagrams were related to the climatic periods and subperiods (phases) of the Blytt-Sernander scheme. On the basis of 230 ^{14}C dates obtained, we derived the geochronology of climatic periods and phases, as well as the chronology for the appearance and areal distribution of forest-forming tree species. The upper-most peat layers were dated by using the "bomb effect". We compared the stages of Holocene vegetation and paleoclimatic changes discovered for the Leningrad and Novgorod provinces with the those obtained for Karelia, which we had studied earlier using the same methodological approach.

THE ANCIENT MEN AND ENVIRONMENT INTERACTION ON THE BASE OF THE PALEOGEOGRAPHIC RECONSTRUCTION OF THE SOUTHERN BANK OF LADOGA LAKE REGION

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All through the times environment influences very hard on the human being. On the another hand the men influences to the environment. These was mostly important in ancient period, particularly in the Middle Ages. The study of these processes could not only clear up the many obscure problems of the history but explain the role and significance of antropogen factor in different ecosistems.

The South bank of Ladoga lake is the region where unique situation exists. The problems might be solved there on the base of the materials of medieval settlements and grave - yards. Also we have here the interesting geological situation which exerted great influence upon setting system of the ancient collectives. The point is that all archaeological memorials place in the vast lowland which adjoin to Ladoga lake's shores from south and south-east sides. The north-western border of this region is the shore of Ladoga lake. From South, South-East and East this lowland is limiting by Vepse's Hills and Tikhvinskaya ridge which is the watershed between Baltic and Caspian basins. From West and South-West the border of this territory is the swamped low place which spread from Ladoga lake shore to the southern spurs of Tikhvinskaya ridge. The ancient memorials place on the banks of the four main rivers of this lowland : Sjas, Pasha, Oyat and Svir. But now after the archaeological investigations I can say that the ancient setting system was not so simple than it seems before. First of all there was one or two small settlements and two or three mound groups (in depend of quantity of the generations lived on that place) which was divided by uninhabited territories. Along the stream of every river we can count only 7 – 8 of such a accumulations of the memorials. Therefore the ancient population in Ladoga lake district was not so numerous during IX – XIII centuries. Also I can note that this ancient population lived only along river and never (with the exception of one case) in a territory between two rivers because were divided by considerable sampled spaces. This circumstance left its mark to the economy of this collectives. It was impossible to lead the significant agriculture activity. So, the most important work for this people was the hunter : the bag of the fur-skins which was rated highly on European and Asian markets.

Thus the environment influenced very much to the ancient collectives and very often determined the character of their activity. But this small report is the part of the possible investigations. Now the results of history, archaeological and paleogeographical researches are very hard to be compared. The reason of this situation is that this territory has not enough palinological examples from archaeological memorials and by the case of differences in dating methods of archaeological and paleogeographical researches. The burial customs in South – Eastern Ladoga lake district supposed to preserve the ancient peat in the burial mounds. This fact give possibility to receive the palinological samples. Moreover the big quantity of the peat-bogs in this district allow extend these possibilities. Because of archaeological monuments in this region are well known the chronology and there geographical diversity are well known too. So to get on a first stage not numerical series of samples by the excavations of the monuments which have been excavated before and correlation this samples from peat will make a possibility to extend the data base for exploration of the paleoecological system of this region and correct the present day methods of dating by the way of using together the radiocarbon dating, archaeological dating and palinilogical methods.

EXCURSION TO STARAYA LADOGA

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The visit of the "Zemlanoye gorodishe" ("Earth hillfort") of Staraya Ladoga. A lecture devoted to the ancient history of the settlement, the history of excavations for the period of 1909–1999. The visit of the fortress of Staraya Ladoga. A lecture devoted to the history of it construction. The main construction periods and their peculiarities. The traditions of Russian fortresses. The main archaeological monuments situated near Ladoga. The churches of Staraya Ladoga. The history and peculiarity of St.Georg cathedral.

The visit of the exhibition devoted to the archaeology and the history of the Ladoga district (Vorotnaya tower of the fortress). The lecture devoted to the main archaeological cultures and the main memorials situated near Ladoga their history and peculiarities. The visit of the exhibition of ethnological traditions of the North Russians (Dmitry Solonik church).

GLOBAL CLIMATIC EVENTS AND ENVIRONMENTAL CHANGES DURING THE LATE GLACIAL-HOLOCENE OVER THE LAST 18,000 YEARS

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The closer to the present time, the greater volume of paleoclimatic information for determining more precisely timing of climatic events and the improved accuracy of dating. This allows revealing a greater number of global climatic events for the last 17–18 thousand years than the preceding million years. In this case the most difficult aspect is analysing the information on the global scale and correlation of climatic events.

Suggested is detailed geochronological scale of global climatic events during the last 18,000 years. Based on summarized different proxy data (pollen, paleobotatic, ancient soils, lake level variations etc) for the four large regions of Russia: North-West (from Karelia to the Urals), West Siberia, the Central Siberia, North — east of Siberia and Chukotka were the major stages of climate and vegetation evolution in different latitudinal zones, These data were supplement by different proxy data for West Europe, Canada, USA, the norther part of Africa and Mediterranean region.

The analysis of these data allowed to reveal about 30 radiocarbon dated temperature variations duration from 100 to 1000–1200 years.

The climatic history of the Lateglacial — Holocene can be divided into three stages: 1) The Lateglacial time (16–10 ka B.P.) characterized by stable warming trend is accompanied by short (of 100–500 years) and drastic (by 2–3°C) changes in global temperature; 2) The Early and middle Holocene (10–5,5 ka B.P.), the time of warm and comparatively stable climate with the air temperature of 2–3°C above the modern at the high latitudes. Within this stage there are a few warm epochs: The Early Boreal (9–8.8 ka B.P.) with the northernmost spread of arboreal vegetation (up to the Arctic islands) in north-east of the former USSR, in Alaska and high latitudes of the Southern Hemisphere and the three Atlantic warmings (7.8–7.5, 6.9–6.5 and 6.2–5.3 ka B.P.).The last (6.2–5.5 ka B.P.)coincides with minimum area of land and mountain glaciation and highest (over the Holocene) of sea level (by 0.5–1.0 m above the modern); 3) The Late Holocene (the last 5,000 years) is characterized by cooling trend and increased climate instability.

The most considerable warming and cooling of the Late Glacial — Holocene are reflected in changing precipitation pattens and lake levels status in different latitudinal zones. With coolings, precipitation decreased and lake level dropped in subtropical and tropical latitudes and, vice versa, well expressed transgression were observed of the Caspian Sea and mid-latitudinal lakes.

Based on the different proxy data the climatic-reconstructions (seasonal air temperature near land surface and annual sums of precipitation, in departure from modern one) for the Atlantic warming (6–5 ka B.P.) and for the two cooling spells (the Younger Dryas, 10.8–10.5 ka B.P. and maximum of the Würmian glacial, 18–120 ka B.P.) are developed.

The presented empirical data can be used to assess the dynamics of natural biocenose productivity as well as carbon storage in terrestrial biota during global warmings and coolings over the last 18,000 years. Of the most interest is transition from the strong cooling spell (the Younger Dryas) to the Early Holocene warming. According to ice core data from Greenland (the Summit core) a 6° air temperature rise in the high latitudes occur over the 50 years, or may be, a shorter time interval. The reconstructions of climate for the two time intervals (the Younger Dryas cooling and the Early Holocene warming) could allow a number of most important problem:

- what was the response of vegetation and animal world to this fast climate changing in different latitudes of the Earth?
- how did the vegetation areas and zone change?
- how did the specias of compositions of flora and fauna (including the marine fauna) ones change?
- what was the response to this warming of large land fauna and ancient human being is?

EVOLUTION OF UNDERGROUND AND SURFACE WATERS CONTAMINATION OF THE NEVA DELTA DURING ST.PETERSBURG INFRASTRUCTURE DEVELOPMENT IN 18-20 CENTURIES

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The territory of contemporary Saint-Petersburg was developed long before the foundation of the city. So, the period before Peter I reign is considered to be the first stage of underground and surface waters contamination in the Neva delta. Still, there were settlements of Great Novgorod on this area in the 9-th century. By the end of 17-th century more then 40 settlements with Swedish, Finnish and Russian names have been located there, and the town Nienstadt (Nyen) was the largest one among them. Long before the period of Peter I reign sawing manufactures, brick production plants, shipbuilding (in Nienstadt town), fish utilization production had been developed on this territory.

Domestic, industrial, lumber, animal and other wastes were buried close to settlements. The type of contamination according to Swedish maps was characterized by the following term as «a soil mixed with a manure».

The second stage of the Neva delta contamination and that of adjacent area was resulted from the period of intensive building and growth of Saint-Petersburg, including initial stage of the city infrastructure and industry development (beginning of the 18-th – the first quarter of the 19-th century). During that period the sewage, domestic and municipal wastes were the principal contaminants of underground and surface waters.

Numerous declarations and laws on behalf of the throne concerning the city territory, environment and the state of canal-river waters hadn't been realized. Intensive pollution of the lands, soils, groundwater and river-canal system seemed to have acquired a regional scale.

By the middle of the 19-th – beginning of the 20-th century the composition of contamination compounds has been complicated due to concentration of the hazard plants and manufactures. Main units of above mentioned productions were located on the Neva river banks and it's tributaries (left bank of the Smolenka river, the mouth of the Fontanka river, the right bank of the Large Nevka river).

During all the period of Saint-Petersburg development the sewage, being large scaled, was a major source of the Neva delta underground and surface hydrosphere contamination due to absence and/or worse sewerage means and because of numerous uncontrolled storage of domestic wastes in the upper zone of soil sections.

Regular investigations and environmental monitoring of surface and groundwater states began in the first quarter of the 19-th century. As the Neva and small river waters were utilized for water supply the special department of water-system observation and inspection was formed in 1867.

The results of such investigations were published in the journal «Archives of medical jurisprudence». These data testified a high contamination level of surface and underground waters by compounds of nitrogen (ammonia, nitrites), sulfates, chlorides, organic components and some others.

A very high contamination of the Neva river waters was recorded during the time interval of the rising of water level (period of inundation), when the domestic and municipal waste leakage from cesspools and storage took place.

By the beginning of 19-th century the total number of cesspools in Saint-Petersburg has exceeded 40000. Epidemics of cholera, dysentery, typhus, typhoid fever and others gastric diseases started in Saint-Petersburg's districts, where the polluted ground and surface waters of small rivers were utilized by population.

Contemporary high pollution degree of upper aquifers, rivers and canals is explained by absence of perfect sewerage over 250 years after Saint-Petersburg foundation in 1703. The first regional sewerage system started to be exploited on the Vasilievsky island in 1935, but there were more than 80000 cesspools in Saint-Petersburg in 1950.

Present-day length of city sewerage system is 6000 kilometers while 900 kilometers of sewerage require total replacement and 2000 kilometers of it are in unfavourable state.

From the middle of the 20-th century underground and surface waters contamination by petroleum products has been regarded as one of significant problems. Oil hydrocarbons presence in the deep aquifers has been revealed. Water-saturated soil contamination by sewage and petroderivates causes the transformation of redox conditions in the soil sections. In this case the migration capacity of heavy metal increases greatly that and is followed by high-speed escape of heavy metals out of water-saturated soils to surface waters. Heavy metals transport in river water is realized on the mineral and organic particles, hence the bottom deposits of the Neva delta and the Nevskaya bay these pollutants accumulate.

Active biochemical autopurification processes within the underground space are determined by the following factors: a) existence of natural biocenosis in a peat and peating soils; b) microflora inrush from sewerage system; c) presence of organic contaminants (sewage and petroderivates) that are a nutrient for microorganisms. Intensive microbiological activity in the paleovalley of Saint-Petertsburg up to the depth of 120 meters was investigated by the authors of the present paper.

Autopurification of ground waters and soils has a negative influence on: 1) accumulation of bacterial cells and products of it's metabolism in soils; 2) agressive degree increase of ground waters and soils; 3) biochemical gas generation within water-saturated soil strata.

Thus unfavourable conditions in the Nevskaya bay has been a result of prolonged contamination of the territory, underground space and surface waters that had begun long before the foundation of Saint-Petersburg. The contamination of environment achieved it's peak in the second half of the 20-th century. Old-fashioned system of liquid municipal wastes refining and violation of hydrological regime of the Nevskaya bay by the dyke construction against inundation influence and escalate much on negative development of contamination process.

Observed reduction of autopurification processes certifies unreversible changes that take place in the underground space and hydrosphere.

THE LATE PLEISTOCENE-HOLOCENE HISTORY AND MODERN STATE OF THE LAKE LADOGA

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Lake Ladoga, the largest lake of the Europe, is situated at the South-Eastern boarder of the Baltic crystalline shield and the Russian plain. Its area is 17 677 square km, the maximum distance from North to South - 120 km, from West to East - 80 km. The mean depth is 51 m, maximum depth - 230 m The lake watershed includes the watersheds of Lake Onega, along the Svir River, Lake Ilmen along the Volkhov River and the Vuoksa-Saimaa system. The outflow of the Lake Ladoga to the Gulf of Finland is the Neva River.

The lake is oligotrophic stratified one, the total mineralization of water is 58 g / l, transparency varies from 2.3 to 4 m. During the spring increase and autumn decrease of the water temperature there is a phenomena of thermobar which divides the lake on two areas: thermoactive and thermoinert

The spring warming of the water surface of the lake and disappearance of the cool water with the temperature of +4 °C takes place at the beginning of July.

Studies of the Late Quaternary history of the Lake Ladoga started in the year 1932, when there was the first geological drilling at the SW part of the lake The depth of drilling was 30 m, two layers of till were drilled through but the beginning of glacial deposits have not been reached (Krasnov & Reineke, 1936). Eemian deposits were 4 m thick and contained of remains of marine mollusks and diatoms.

The ancient depression of Lake Ladoga was modified by glacial exaration and covered by glacial and fluvioglacial deposits during the deglaciation time.

According by seismic and geoacustic data the thickness of Quaternary deposits in the lake varies considerably. In the deepest northern part of the lake the total thickness of till and sediment deposits is 70 m. Its gradually decreases towards the shallower central and southern parts of the lake, and it is not more than 15 m near the southern shore of the lake.

According the newest data, the radiocarbon age of the varved clays obtained in the sediment core (60° 42'75" N, 32° 24'75"E) from the deep underwater valley with the depth of 78 m in south-eastern part of the lake the wood remains at the depth of 115 cm have the age 15 620±50 yr. BP. The preglacial basin appeared in the southern part of the lake earlier than the Luga stage of deglaciation, i. e. 14 000 yr. BP.

The maximum thickness of the Late Pleistocene varved clays deposited on the till of the Last Weichselian glaciation is 40 m at the northern parts of the lake. They are absent at the underwater steep slopes of islands in northern

part of the lake. On seismoacustic data three sequences of varved clays were identified, two of them have been sampled by sediment corers in the northern part of the lake. These two layers of varved clays represent sediments of the Baltic Ice Lake (BIL) when the glacier stayed at the Salpausselka morain ridges in Younger Dryas time (DR3). The sediments of the deep regions of the BIL, the varved clays, cover the extensive territories at the Neva River valley and at the Karelian Isthmus where the Lake Ladoga was connected with the Baltic. It was the single enormously great oligotrophic lake basin.

The second sediment layer of it consists of the grey clays with indistinct varved structure. The third layer consists of the grey clays with a varve thickness of 0.5-1 cm. It is covered by the microvarved clays where the varved thickness gradually decreases up to the 0.5 mm at the transition zone to the homogenous clays. This layer indicates the border between the Late Pleistocene and Holocene sediment cycles, when ice melting waters have not entered to the Lake Ladoga. It was the deep water large eastern bay of BIL.

The Holocene history of the lake depend of the rate of the isostatic uplift of the deglaciated territories. At the beginning of the Preboreal (BP, 10 000-9 000 yr. BP) the northern part of the Lake Ladoga was 50-60 m deeper than it is now, the water level decreased, the Lake Ladoga at the first time have been separated from the Baltic. The diatom frustules concentration in the homogenous clays of the central part of the lake was not more than 5 000 diatoms per gram of dry sediment while in nearshore bays it was to 360 000 at the end of Boreal (BO, 9 000-8 000 yr. BP). It demonstrate the increase of lake productivity mainly in nearshore areas. The Lake Ladoga has been connected with the Baltic again because of the uplift of its northern shores and increase of the water level. That time there was the Ancylus lake with typical «Arenaria» diatom flora along the whole great fresh water basin.

These two basins were separated again at the beginning of Atlantic (At, 8000-5 000 yr. BP) as a result of a continuous land uplift. The Lake Ladoga water level reached its lowest position along the Holocene time. The gradual increase of the lake ecosystem productivity during the AT climate optimum caused the formation of gyttja clays and silts which replaced the homogenous clays at the deep parts of the lake. It accompanied by the increase of diatom diversity and concentration in sediments to one million per gram in central part and to 4 millions - in sediments of the deepest part of the lake. All these data and the increase of the organic matter content demonstrate the increase of the lake ecosystem productivity.

The most interesting stage in the Lake Ladoga history is connected with the transition time between the AT and Subboreal (SB, 5 000-2 500 yr. BP), the time of the beginning of so-cold «Ladoga transgression», when the climate become more dry, but the lake water level started to increase. The slow increase of the water level at the southern shores, caused by the isostatic uplift of the northern part of the lake basin that time was accelerated by an inflow of water from the Lake Saimaa (Saarnisto, 1970) via the Vuoksa system. It was caused by the isostatic uplift of the central Finland, ceasing of the outflow to the West, to the Gulf of Bothnia and creation a new outflow via Vuoksa system. The inflow of Saimaa waters to Ladoga took place 5 000 years ago caused the increase of water level along the southern shores up to the altitude of 18 m (it is 14 m now). The lake flooded all nearshore lowlands and peat bogs. The sedimentation rate increased along the whole lake. The increase of the water level took place in the inner lakes and bays of the Valaam archipelago and changed diatom assemblages there (core 911, water depth -3 m, length 185 cm). The C-14 age of sediments of basal part of the core is 7310 ±1230 yr. BP, In the basal part benthic diatoms are dominants (*Ellerbeckia arenaria, Eunotia clevei*), in SB sediments dominants are represented by typical plankton of Lake Ladoga.

The final stage of the Ladoga transgression was the formation of the new outflow from the lake via the Neva River and a slow gradual regression of the lake during the Subatlantic (SA, 2500 up to now).

CONSERVATION OF COASTAL AREAS AND LOCAL AGENDA 21, A PILOT PROJECT FOR RUSSIA

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Primorsky district was selected as a pilot project for St.-Petersburg. This district has a great potential in the field of recreational resources and nature reserves network development. In the district a unique Yuntolovsky reserve and the Northern Recreation area are located.

Almost all-ecological problems typical for a big city are concentrated in Primorsky district. On the other hand, Primorsky district will be used as a model of the development of environmental protection strategies to be multiplied in other districts.

For 2 years I have been participating in this project as the secretary of the working group on Water Bodies. During that period our group collected and made an integrated analysis of available information about the current pollution level of the water bodies: the Dolgoe Lake, the Lakhtinsky Lake, including the Northern coastal area of the Neva Bay. The information was provided by Morzaschita Department of the City Administration, the Laboratory of Lakes and Reservoirs Studies of the State Hydrological Institute, and the Institute for Remote Sensing Methods (VNIIKAM).

The main objective of the work was a comprehensive evaluation the ecological status of the water bodies of Primorsky district based on the analysis of hydrochemical and hydrobiological data, numerical modelling, and to work out measures for sustainable nature use in the district.

Special attention in this work was given to the development of a Local Agenda 21 for the sustainable development of the city taking into account ecological factors, the nature conservation and environmental education.

The project resulted in the development of an integrated approach to the solution of environmental problems; measures for sustainable development were proposed. The current ecological status of Primorsky district was studied: the air and soil pollution was analysed, radiation pollution issues were studied.

Sources of every water body were identified. For the first time the environmental status of Primorsky district. Aerocosmic photos of the district were presented. For the first time uninvolved in the project: students, teachers, and pupils of ecological schools.

Members of the working group made presentations in schools and ecological conferences and exchanged opinions.

The first draft of the Local Agenda 21 for Primorsky district was published as a final result of the work. In the nearest future this document will be supplemented, edited and translated into English. This booklet will be given to the Primorsky district administration.

We do hope that measures and approaches. We proposed in our project will be implemented and contribute to the improvement of the ecological situation in the districts.

THE NEOLITHIC MATERIAL CULTURE AS THE TOOL OF HUMAN ADAPTATION TO ENVIRONMENTAL CHANGES (AS EXEMPLIFIED BY MATERIALS OF THE SERTEYKA VALLEY, THE WEST DVINA BASIN)

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Human adaptation for environmental changes is one of the driving force of cultural changes. There is an unique opportunity to investigate archaeological sites with different location and organisation which belonged to different archaeological cultures but at the same time are situated on the compact territory in the Serteyka valley. It allows to reveal a sequence of environmental changes in one microregion, to create a precise column of a sequence of archaeological sites and cultures and to find out precise correlation between natural and cultural changes.

In the Neolithic time environmental changes made the most effect on assemblage of stone and bone tools and on a choice of a place for organisation of ancient settlements as well.

It seems that changes of pottery depended more on a changes of fashion caused by contacts with neighbor tribes. Though the opportunity of such contacts frequently could be connected to an ecological conditions too.

The changes in a tool set can be caused by change of economic activity connected to an ecological situation and by changes of sources of raw material for tool making that is also connected to the geographical factors.

The organisation and placing of ancient settlements is more closely connected to an ecological situation. The change of settlements placing depends of a level of rivers, lakes and subsoil waters, of presence or absence of landscapes used in economic activity of ancient people.

ON THE TIMING OF THE ICE RECESSION FROM NW RUSSIA AND E ESTONIA

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An attempt is made on the basis of the revised Swedish Time Scale and direct correlation of the Swedish and Finnish clay varve chronologies (Strömberg, 1990), to date Markov's and Krasnov's (1930) chronologies for the southern Karelia, St.Petersburg area and Luga basin via Sauramo's chronology for Finland (Hang, 1997). It is proposed that the northern L.Onega area was deglaciated approximately between 13940 and 13140 varve years BP, St.Petersburg area between 12600 and 12520 varve years BP. Recent correlation of mean varve graphs for Neva and Luga late-glacial basins (Hang, 1999) allow to postulate simultaneous retreat of continental ice from St.Petersburg area and from the Luga basin. If this assumption is right, the Weichselian ice sheet would have retreated from the Pandivere/Neva ice marginal formations about 12500 varve years BP or even earlier if the proposed 300–1000 missing varves in the Swedish Time Scale will be considered.

Connection of the Neva, Luga and Peipsi proglacial lakes is an important point in understanding late-glacial early Holocene palaeogeography in the region. According to Markov, the beginning of the connection between Luga and Peipsi basins is not clear. At the same time many similar features in varve chronologies for the both basins point to the possibility of simultaneous accumulation of these deposits in one big proglacial body of water. Isolation of this lake from the Baltic Ice Lake took place at the water-level south of the Baltic Clint between 38–32 m a.s.l during the Preboreal Chronozone (Markov, 1955). Although, the Preboreal has been suggested as a low lake-level period in the evolution of the L.Peipsi. Recent investigation of the bottom deposits have demonstrated at least 6m probably 8m lower water-level than in present in the lake depression, timing of which is not clear jet. This low water-level period have definitely affected the whole palaeogeographical situation (river network, low growndwater level etc.) in the area and might have an importance in understanding the early colonization of the area.

SHORE DISPLACEMENT IN SE UPPLAND DURING EARLY LITORINA SEA, AS RECORDED BY DIATOMS IN ISOLATION BASINS

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In order to study the shore displacement in SE Uppland, c. 50 km north of Stockholm, investigations are carried out on sedimentary sequences sampled in basins, isolated from older stages of the Baltic Sea. The sediments are studied with respect to lithology, diatoms, and organic carbon. The isolation sequences are dated using the ^{14}C (AMS) method.

The altitudes, and thus the isolation ages, of the oldest basins makes the region suitable for studies of the maximum extension of the Litorina Sea. Also, the northern limit of the first Litorina transgression (L1) is studied. This transgressive phase has been recorded south of Stockholm, but due to a more intense isostatic rebound in the north, it has not yet been identified further north. At this date, there are diatomological and sedimentological indications of an interrupted isolation sequence in the sediments from Lake Hoven situated at 56 m a. s. l. This is interpreted to be the result of an early Litorina transgression.

WRITING A SCIENTIFIC PAPER FOR PUBLICATION

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The basic structure of a scientific paper that would be approved of, or even required, by the majority of journals is outlined. The format Abstract — Introduction - Materials and Methods — Results — Discussion and Conclusions' is evaluated step by step and both the points to be taken into consideration and the pitfalls which may be encountered are assessed.

Advice is given on the preparation of figures and tables, and the use and significance of different methods of illustrating results are compared. Other necessary aspects such as title, authors and their affiliations, key words, acknowledgements and references are reviewed. Practical points with respect to texts written in English are also touched on. The aim is to provide a package of guidelines which, if followed logically, enable a researcher to approach and complete the task of writing up results with confidence. By following some basic rules and considering the reader and the journal to which the text is to be submitted the task can be completed with the minimum of wasted time and the maximum possibility of success.

DIFFUSION OF MOLECULAR OXYGEN THROUGH WATER SURFACE IN THE PRESENCE OF OIL FILMS

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Pollution of water surfaces with oil-products is highly dangerous for the environment because apart from direct chemical contamination thin oil films form on the surface of water. Such films disturb the natural circulation of gases through the surface of water and hence may damage the ecology of water reservoirs. In this work, changes in the gas circulation have been investigated that occur in the presence of such films. All the experiments have been carried out by the methods of nuclear magnetic resonance (NMR), which allowed us to achieve the results unavailable via standard methods of investigation. In addition, the NMR methods perform non-penetrating and express analysis.

From NMR theory it follows that spectral line-width Dn of the hydrogen nuclei (protons) of water is a linear function of concentration of the dissolved paramagnetic:

$\Delta\nu=\Delta\nu_0+K_{re}N$,

where N - is the number of paramagnetic particles, $\Delta\nu_0$ - the line-width of water in the absence of any paramagnetic particles, K_{re} - the coefficient of relaxation efficiency. Molecules of oxygen are paramagnetic and hence any presence of these in water causes water spectral line broadening. Thus, it is possible to determine the quantity of oxygen present in water and to investigate the process of O_2 diffusion in different conditions. Concentration of the dissolved oxygen considering the above :

$C_{O_2}= \alpha(\Delta\nu-\Delta\nu_0)$,

where $\alpha=1/K_{re}$.

In this work, the dependence of spectral line-width of the hydrogen nuclei ^1H of water upon concentration of molecular oxygen in the water has been investigated. Investigation on the molecular level has been carried out of the processes of atmospheric oxygen circulation through the water surface in sea and fresh water in the presence of oil films on the surface in the temperature range from 0 to 35°C.

PROTECTION OF ST.PETERSBURG AGAINST FLOODS WITH UNCOMPLETED BARRIER: MATHIMATICAL MODEL STUDY

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The paper introduces the problem of flood protection for St.Petersburg (Russia) and presents results of a numerical model study of the possible water level heights in the city during catastrophic floods for the present uncompleted state of the St.Petersburg Flood Protection Barrier and also for the final design conditions, but with some of the gates in the Barrier open during floods. The propagation and transformation of long waves coming from the Baltic Sea into the Eastern Gulf of Finland and through the Barrier into Neva Bay were simulated with the integrated modelling system CARDINAL for two-dimensional depth averaged conditions. For the numerical experiments two historical floods were selected: the most catastrophic flood of 1824 and the flood of 1955, which is characterised by a rather high intensity of water level rise. One of the aims of the work was to estimate the possible decrease of water level heights in St.Petersburg and also maximal velocities in the existing Barrier gaps during catastrophic floods to see the effects of closing the water sluices which at present are already operational. The problem here is whether the closing will lead to a significant reduce of damage in the City or will mainly lead to erosion in the Barrier gaps and sliding of ground into the construction pits. In view of the cost of completion, for several variants of Barrier completion the accompanying water level height reductions in St.Petersburg were simulated, viz. constructing the main navigation passage in the Barrier without gates. In the paper the model results for the various Barrier variants in terms of their flood level reduction are presented, taking into account characteristic features like maximum level and speed of rise.

1. FLOODS IN ST.PETERSBURG

The City of St.Petersburg is located in the head of the shallow and narrow Neva Bay in the east extremity of the Gulf of Finland of the Baltic Sea (Figure 1). Due to this location, long waves generated by storm winds accompanying deep cyclones passing over the Baltic Sea region are increased several times and this may lead to floods in the City. The circumstance which aggravates suffering of the City from the floods is the west-east direction of the Gulf, i.e. the most dangerous for the west winds prevailing during storms. Flooding in the City start when the water level exceeds the alarm level of 160 cm relative to the zero of Kronshtadt sea gauge, i.e. close to 160 cm above Kronshtadt mean sea level. Floods with water height above 210 cm are referred to as very dangerous and above 300 cm as catastrophic ones. Since its founding in 1703 there were about 300 floods in St.Petersburg and among them three catastrophic ones: 321 cm (1777), 421 cm (1824) and 380 cm (1924). Very close to catastrophic was the 1955 flood with 293 cm. As floods lead to significant damages and loss of human life, St.Petersburg is in need of flood protection.

The construction of the first local dams was started in the Harbour after the flood of 1924. Towards the end of the 1920-ies the idea of hydrotechnical protection of the City was formed. In 1932 the Institute of Municipal Engineering presented a project design for a Flood Protection Barrier similar to the present one and based on a hundred years old design of P.P.Bazen. The death of S.M.Kirov, the City Leader in 1934 who actively supported the Barrier project and the Institute, however, the subsequent purges, the Second World War and the Blockade prevented the start of the construction. The project was revised only in the early 1960-ies, after the flood of 15 October 1955 and in connection with the development of a General Plan for the Growth of St.Petersburg. The decision to construct the Barrier was essentially influenced by five floods in 1977-78, although these were not extremely high. After 20 years

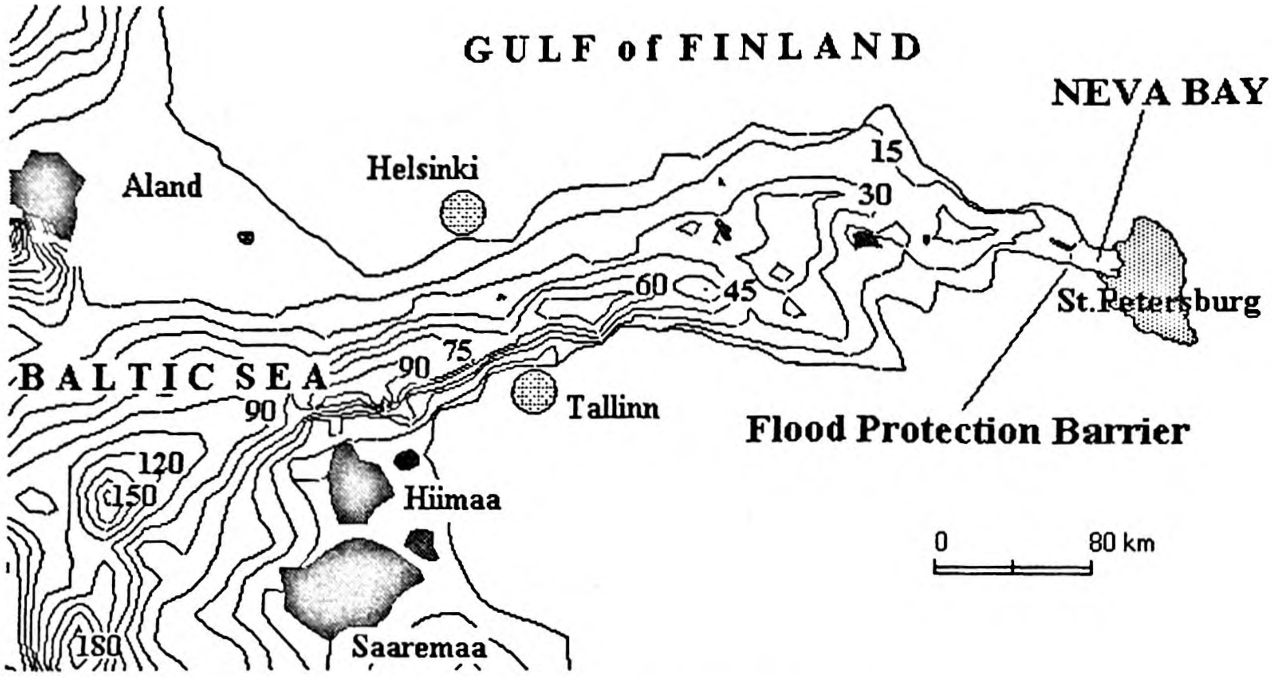

Figure 1. Depth isolines (m) in the Gulf of Finland and location of St.Petersburg Flood Protection Barrier.

of design studies, the construction was started in 1979 and it still continues at the present time. Since 1988 the construction has almost come to a standstill as it was long thought that the Barrier was the main cause of water pollution in the Bay. Now there is a decision of the Russian Government to complete the Barrier but due to lack of finances the construction is going on very slowly and it is unlikely to be completed during the next ten years.

2. OUTLINE OF THE PAPER

The paper presents the results of a numerical model study of the possible water level heights and height reduction in St.Petersburg during catastrophic floods for:

- the present uncompleted state of the Flood Protection Barrier;
- a completed Barrier but with some of its gates remaining open.

The Barrier design and its present state are described in Section 3. Section 4 describes the model aspects. Several pilot models of Neva Bay and the Eastern Gulf of Finland (EGF) have been developed with the integrated modelling system CARDINAL (Klevanny et al., 1991, 1995). A new, more detailed model *NBM3* for Neva Bay and the EGF is available now, and this model was used in the present study. Though CARDINAL has an option for 3D flow simulations, in this study the 2D depth averaged flow option was selected as it is assumed that 3D effects are negligible for long wave propagation in these rather shallow coastal waters. The models are described in Section 5.

For the numerical experiments two historic floods were selected: the most catastrophic flood of 18 November 1824 and the flood of 15 October 1955. Historically, the latter ranked 4 by water height but it had a rather high intensity of water level rise. Section 6 presents the modelling results of maximum water heights in St.Petersburg if comparable catastrophic floods would occur at present and how much their level may be decreased by closing the water sluices which at present are already operational. Attention was also given to the maximal velocities in the gaps as erosion on the uncompleted Barrier is of primary importance. Sliding of ground into construction pits and unprotected uncompleted metallic and reinforced concrete constructions will lead to very heavy consequences.

Section 7 deals with the results of numerical experiments for the design Barrier conditions when some of the gates remain open during floods. Reasons for an open Barrier may be a delay in receipt of the warning signal from the Hydrometeorological Service, unavailability of equipment or high intensity of water level rise. In adverse conditions about 2.5 h may be needed to close the main navigation passage. For example, during the flood of 20 December 1973 the intensity of water level rise was so high (up to 95 cm/h) that in 3 hours water level reached 240 cm. In line with this, and a cheaper option for Barrier completion, simulations are presented of possible water level height reduction in St.Petersburg for catastrophic floods and the main navigation passage in the Barrier not equipped with gates. Finally, in Section 8 the results are summarised and evaluated.

The result show that there is an urgent need for early flood forecasting and warning systems already now. After Barrier completion it will also serve to support the appropriate Barrier operation.

Part of the present work was performed within the framework of the Dutch-Russian project «Integrated Water Management in St.Petersburg Region» (The Netherlands Ministry of Economical Affairs, SENTER contract PSO 97/RF/3/5). The support of WL|Delft Hydraulics and especially of Dr. Herman Gerritsen is gratefully acknowledged.

3. THE ST.PETERSBURG FLOOD PROTECTION BARRIER

The Flood Protection Barrier crosses Neva Bay where the Bay meets the Gulf of Finland. The Barrier is 25.4 km long and it straddles Kotlin Island as it crosses Neva Bay (Figure 2a). The earth and rock fill embankment is divided into 11 dams which represent 91 % of the Barrier length. Two of them (D1 and D11) are connected with the south and the north coasts, another two (D4 and D6) are around Kotlin Island. Dam D5 crosses the Island. Between the embankment sections there are 6 water sluices each containing 10 - 12 elements approximately 24 metres wide, and 2 navigation passages. Water-sluices B1 and B2 are in the southern section of the Bay and water sluices B3 - B6 are in the northern section. During floods each water sluice will be closed with segment locks, 280 tons weight. Their closing takes 30 minutes. The Southern navigation passage C1 is designed for ocean ships with displacement below 100 thousand tons and will be 200 m wide and 16 m deep, containing two floating radial sector gates of 130 m radius each. It will operate the whole year. The Northern navigation passage C2 is intended for local and river vessels with displacement below 4 thousand tons and will be 110 m wide and 7 m deep with a single vertical lifting gate to operate in the ice-free period. The total cross section area of openings will be 9610 m^2. It is 3 times less than was the cross-section area in natural conditions but 50% higher than the cross-section area of the Neva Delta branches. The design height of the embankment will be 8 m above Baltic mean sea level, the width at the top is 30 m. A six-line highway will cross the water sluices on fixed bridges and cross C2 by a movable bridge.

Under C1 an underwater tunnel will be constructed. The feasibility study for the project was made by the Leningrad Branch of the «HYDROPROJECT» Institute.

In 1990, when the Barrier was approximately 60% completed, construction was halted because it was considered that the Barrier was the cause of the rapid deterioration of the water quality in the Bay. After public appeal to assess the situation, three commissions of experts were set up. Two of them concluded that the Barrier had a negligible impact on the Neva Bay. However, the third concluded that the Barrier should be dismantled. An International Commission co-ordinated by Delft Hydraulics was subsequently appointed. The International Commission stated that the Barrier produced localised ecological changes but that these changes could be mitigated by active ecological management. Now there is a resolution of the Russian Government to complete the Barrier but due to lack of finances the construction is going on very slowly and it is unlikely to be completed during the next ten years.

At present the Barrier has gaps which can not be closed in the case of a flood (Figure 2b). Except for a temporal gap in the northern section with width 167 m (TM D7) all gaps are in the southern section. They include a 940 m wide navigation passage, water sluices B1 and B2 and a temporal gap (TM D2) of 125 m width. The water sluices B3 - B6 in the northern section can be closed. The total cross sectional area of the openings in the Barrier is now 14932 m^2, of which 3720 m^2 or 25%, can be closed, while 11212 m^2 (75 %) will remain open during floods which will occur in the time before the Barrier construction has been completed.

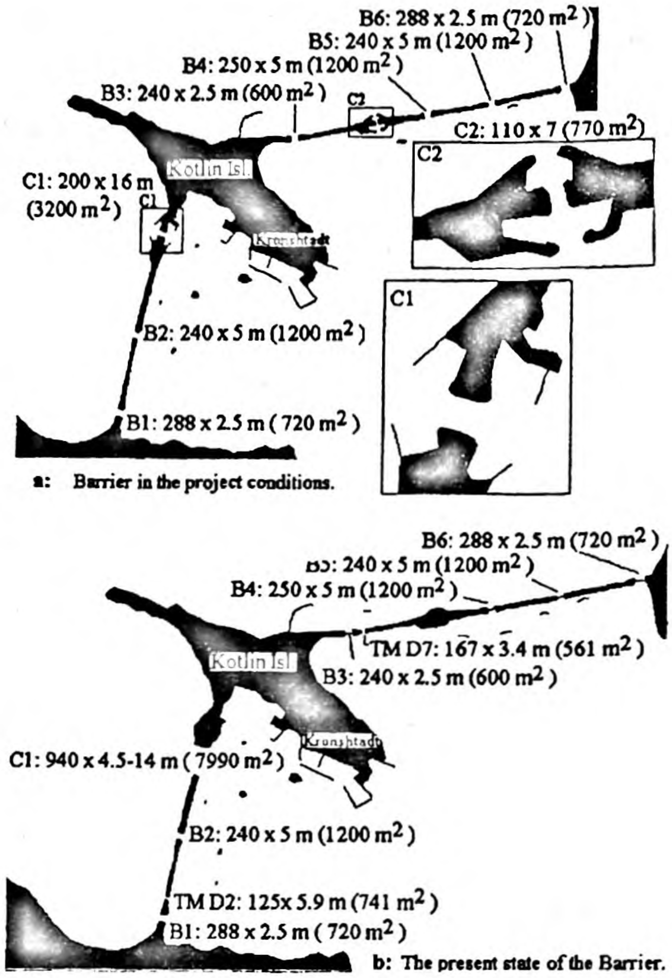

Figure 2: NBM3 model approximation of St.Petersburg Flood Protection Barrier. a: the design conditions; b: the present state (water sluices B3, B4, B5 and B6 can be closed).

3. OVERVIEW OF THE *CARDINAL* MODELLING SYSTEM

The CARDINAL is a user-friendly computer program for the simulation of long wave dynamics and dispersion of pollutants in any complicated area solving the depth-averaged shallow water equations for 2D conditions and 3D hydrostatic shallow water equations. Over the last years the package was fully updated and it now works under Windows-95 and has a standard graphical user interface. More then 90% of its code serves to provide a graphical user interface and graphical representation of results. The program is continually being revised to allow for greater ease and standardisation in use and at the same time for extending its functionality. Its interface includes convenient methods of input of an arbitrary water system geometry, bathymetry, open boundaries, wind field, possibility to translate text user input into an analytical expression for model coefficients, wide graphic support and other features.

In 2D conditions the shallow water equations are used

$$U_t + \left(\frac{U^2}{H}\right)_x + \left(\frac{UV}{H}\right)_y = fV - gH\varsigma_x - \frac{H}{\rho_0}\frac{\partial P_a}{\partial x} + \mu\Delta U + C_D\frac{\rho_a}{\rho_w}w_{(x)}\left|\overline{W}\right| - f_b\frac{U\left|\overline{V}\right|}{H^2},$$

$$V_t + \left(\frac{UV}{H}\right)_y + \left(\frac{V^2}{H}\right)_x = -fU - gH\varsigma_y - \frac{H}{\rho_0}\frac{\partial P_a}{\partial y} + \mu\Delta V + C_D\frac{\rho_a}{\rho_w}w_{(y)}\left|\overline{W}\right| - f_b\frac{V\left|\overline{V}\right|}{H^2},$$

$$\varsigma_t + U_x + V_y = 0,$$

where $U(x,y,t)$ and $V(x,y,t)$ are the Cartesian components of the flux $\underline{V}$ per unit width: $U = \int_{-h}^{\varsigma} u dz$, $V = \int_{-h}^{\varsigma} v dz$, $\mathrm{H} = \mathrm{h} + \varsigma$ is the total water depth, *z(x,y,t)* is the surface level, *h(x,y)* is the undisturbed depth, *u(x,y,t), v(x,y,t)* are the Cartesian components of velocity vector in directions *x* and *y*, respectively, axis *x* is directed to the west, *y* to the north, *f(y)* is the Coriolis parameter, $f = 2\Omega sin\phi$, is the latitude, Ω is the frequency of the Earth rotation, *g* is the acceleration of gravity, $P_a(x,y,t)$ is the atmospheric pressure, *m* is the horizontal eddy viscosity coefficient, Δ is the two-dimensional Laplacian, C_D is the wind drag coefficient, ρ_a is the air density, ρ_w is the water density, $\underline{W}$ is the wind velocity vector with components $w_{(x)}$ and $w_{(y)}$, and f_b is the bottom friction coefficient.

For solving these equations in an arbitrary water domain a transformation to curvilinear boundary-fitted co-ordinates $\xi = \xi(x, y)$, $\eta = \eta(x, y)$ is made. Along the lateral boundaries one of the co-ordinates is fixed and other is distributed arbitrary, but monotonously. Transformation to curvilinear co-ordinates makes it possible to increase considerably the accuracy of computations. The computational domain is mapped on a rectangle or on a system of rectangles. The curvilinear grid generated by solving a set of elliptical equations. A deficiency of using the Cartesian velocity components in curvilinear co-ordinates is the interpretation of zero normal component of velocity vector at solid lateral boundaries, which leads to a cumbersome averaging procedure. For the simplification of boundary conditions the contravariant components of velocity vector instead Cartesian ones are introduced. The transformed equations are solved with a semi-implicit numerical method (*Klevanny et al. 1994*) with a non restrictive stability condition. It should be noted that the numerical scheme used in the model becomes unstable when water velocities exceed the super critical values.

The CARDINAL modelling system is supplied with a graphical user interface and divided into separate windows. The "*Project*" window serves for selection of names of data files, saving them and printing results. The "*Area*" window serves to define boundaries of an area of computation and to generate the curvilinear grid for the area. In the "*Depth*" window it is possible: 1) to set up a rectangle grid for depth data input with further interpolation of depth values to the nodes of the curvilinear grid and 2) to assign depth values directly to the nodes of the curvilinear grid. Depth and domain boundary data may also be assimilated in the program from ASCII files. The "*Vertical*" window is used in three dimensional problems only. It is used to define the number of grid points in vertical direction and the selection of their distribution. The "*Open Boundaries*" window allows: 1) to define the locations of rivers along the area boundaries, time histories of their discharges and concentrations of pollutants in these rivers; 2) to define the locations of open boundaries with the prescribed time histories of water levels and concentrations of pollutants; 3) to define the locations of open boundaries through which disturbances may exit the area of computation. The "*Dynamics*" window allows to input some empirical coefficients and select the regime of computation, assign initial fields of flow and surface levels using analytical expressions or data values stored in files. In the "*Atmosphere*" window wind and pressure data may be defined in the form of the time series in arbitrary located weather stations, in the form of an analytical expression of co-ordinates and time or in the form of gridded ASCII files of fields produced as output from an atmospheric model. The "*Pollution*" window serves to define locations and powers of any number of point pollution sources and an initial pollution field. The "*Bottom*" window is used for 1) definition of an analytical expression for the bottom friction coefficient and 2) definition of variable bottom roughness, grain sizes and grain densities in different parts of the area of computation. In the "*Device*" window it is possible to select a number of points and regions for which time histories of surface levels, velocities, concentrations, volumes of pollution and discharges will be recorded during computations.

The possibility to use more and more powerful computers has led to the development of several models of Neva Bay and the EGF with more and more refined grids. The computational domain also expanded. The first model *NBM1*, which was developed for BESM-6 computers and was later transferred on an IBM AT-286 (*Klevanny et al., 1991*), had 2597 points (53 x 49). The eastern boundary of the computational domain was in the Neva mouth and the western one was along the cross-section Krasnaya Gorka - Privetninskoe. It was necessary to assign the distribution of the river discharge over the Neva River branches.

The computational domain in the second model *NBM2*, which was produced for an IBM AT-386, (*Klevanny et al., 1995*), includes the Neva Delta in the east and expanded to the cross-section Cape Shepelevo - Ozerki in the west. It was no longer necessary to assign the distribution of the discharge over the river branches. The *NBM2* model allows to include all gaps in the Barrier, some of the forts (i.e. small artificial islands) and underwater spill military lines constructed in the XVIII- XIX-th centuries from wooden piles and stones against foreign invaders. The grid in *NBM2* consists of 7425 (135 x 55) points. Each gap was represented by one computational point in which the velocity was calculated. Grid steps varied from 100 m in the gaps to 1500 m in the west. The time step was 60 sec. The *NBM2* and *NBM1* models were used mainly for the environmental impact assessment of the Barrier.

An even more detailed model of the Nave Bay and the EGF was needed, which could approximate the Barrier as an object with a certain width and a complex configuration, especially in the navigation gaps and which could approximate all forts, underwater military lines and fairways. The size of the Barrier elements which determine flood penetration are 5 orders smaller than the whole model area (1340 km^2). More powerful personal computers (an IBM Pentium-133 is used now) and working under Windows-95 gave the possibility to develop such a detailed model of Neva Bay and the EGF, *NBM3*. The grid consists of 32745 (185×177) points with grid lengths varying from 20 m in the Barrier gates to 1 km in the west. This grid approximates the Barrier as an object with complex configuration, especially in the navigation gaps. All forts, underwater military protective lines and fairways are included in the *NBM3* model. The model bathymetry and the grid around the C1 navigation passage is shown in Figure 3. The time step for modelling strong floods is restricted to 3-5 sec. This is the model used in the present study.

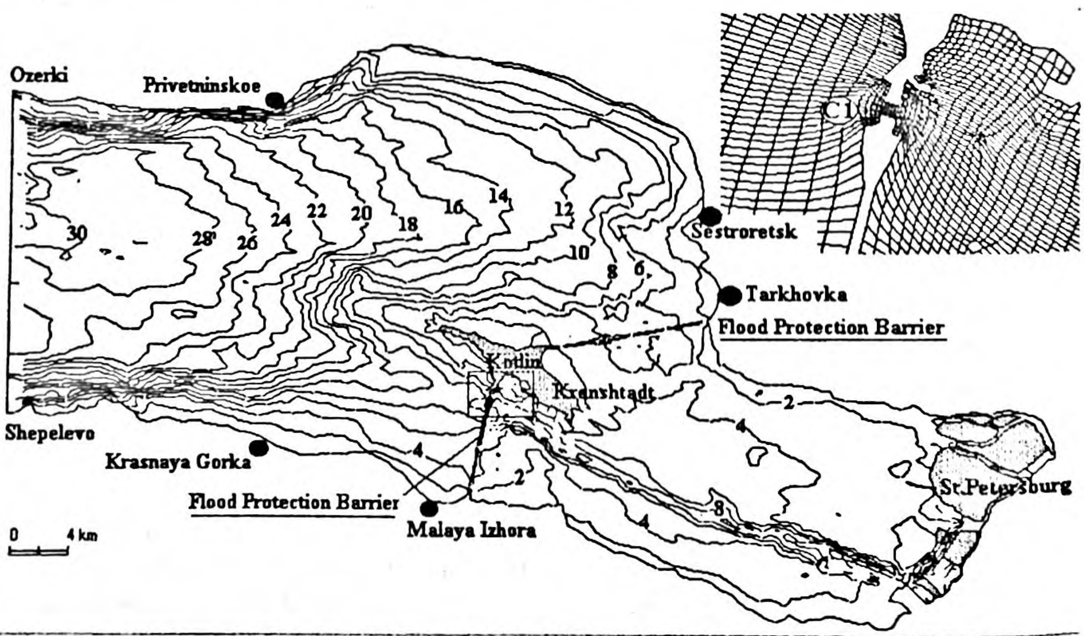

Figure 3. NBM3 bathymetry and the curvilinear grid fragment for the design state of the Barrier.

Table 1. Distribution of maximum discharges (m^3/s) among the Barrier gaps for the flood of 1955

	B1	TMD2	B2	C1	B3	TMD7	B4	B5	B6
Area, m^2/s	720	741	1200	7990	600	561	1200	1200	720
All is opened	3800	3800	4500	32000	3600	4200	8000	8000	5500
Partly closed	4120	4280	4900	35000	Closed	4300	Closed	Closed	Closed

6. POSSIBLE WATER HEIGHTS FOR THE PRESENT STATE OF THE BARRIER

For the simulations of flood waves coming into Neva Bay from the Baltic Sea uniform time histories of water levels were defined along the line Cape Shepelevo - Ozerki. As the catastrophic floods occurred before 1989, when the tide gauge in Shepelevo was installed, these time histories were defined based on data of St.Petersburg and Kronshtadt. According to measurements the difference in peak level between St.Petersburg and Shepelevo during 15 floods which occurred since 1989 was in the range 14 - 72 cm. During the flood of 15 October 1955 the maximum water level was 293 cm in St. Petersburg and 238 cm in Kronshtadt. For simulation of this flood the maximum water level rise in Shepelevo was defined equal to 230 cm and time history of water level in Shepelevo was defined as water level in St.Petersburg minus 63 cm. During the flood of 18 November 1824 water level in St.Petersburg increased on 421 cm. For the simulation of this flood the maximum water level in Shepelevo was defined equal to 370 cm and water level in Shepelevo was defined as water level in St.Petersburg minus 51 cm. This study concentrated on the influence of the Barrier in its different stages on the penetration of long waves in Neva Bay. Local wind fields in the Bay were therefore not included in the simulations. But in the final conclusions an additional increase of water height due to local winds in the Bay (it is about 50 - 80 cm) was taken into account. The bottom friction coefficient was set equal to 0.0026, the horizontal eddy viscosity coefficient was equal 60 m^2/s, the time step was 2-4 sec.

FLOOD COMPARABLE TO THE 1955 FLOOD FOR THE PRESENT BARRIER CONDITIONS WITH ALL GATES OPENED

The intensity of this flood was rather high: on average 58 cm per hour. Before the Barrier the simulated water level rise achieved 285 cm along the north coast near Tarkhovka - Sestroretsk and 260 cm along the south coast near Malaya Izhora. In Kronshtadt the simulated maximum water level was 175 cm and in St. Petersburg 208 cm (Figure 4). For this intensive water level rise the Barrier is the largest obstacle: the maximum level in St.Petersburg was 22 cm less then in Shepelevo. The distribution of maximum discharges among the Barrier gaps is shown in Table 1. The maximum cross-sectional aver-

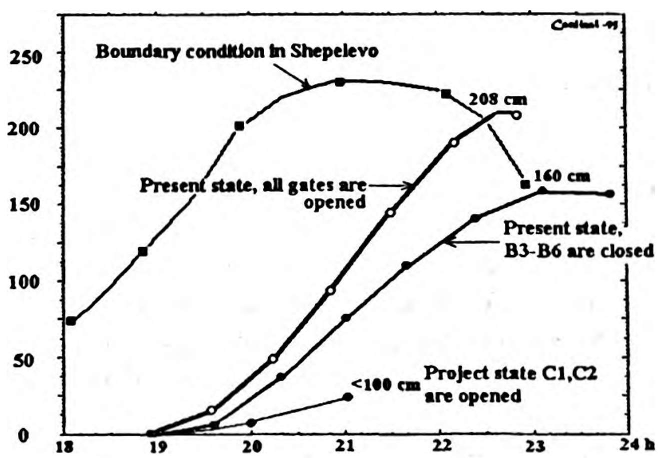

Figure 4. Time histories of water level in St.Petersburg for flood as 15 October 1955 for different situations on the Flood Protection Barrier (no wind in Neva Bay).

aged velocities were distributed as follows (from large to small ones): TM D7, B6, B4 and B5, B3, B1, C1 gap, B2 and minimum velocities were obtained in TM D2. Due to the large C1 gap velocities in the northern section exceeded velocities in the southern one. During penetration of long waves through the Barrier large eddies are formed on both sides of the jets coming through the gaps. Simulations showed that «craters» with a big water level drop are developed before the opened gaps. Maximum velocities (up to 6.2 m/s) are obtained for the south wall of the C1 gap where erosion can lead to large damage of the dam. Along the deeper north wall, velocities were up to 3 m/s.

FLOOD COMPARABLE TO THE 1955 FLOOD FOR THE PRESENT BARRIER CONDITIONS WITH B3 - B6 CLOSED

At present, the water sluices B3 - B6 in the northern section are operational and can be closed. The simulations for this partly closed situation have shown (Figure 4) that their closing gives a decrease of water level in St. Petersburg by 48 cm: from 208 to 160 cm, i.e. by 23%. For Kronshtadt the same water rise is found as in St.Petersburg, 160 cm, so the decrease here was 15 cm or 8%. This partial closing of the northern section led to insignificant additional increase of water level before the Barrier along the north and south coasts (near Tarkhovka -Sestroretsk from 285 to 290 cm and near Malaya Izhora from 260 to 270 cm). In all opened gaps the discharges are increased (Table 1), but the total maximum discharge decreased by 28%). As in the previous variant, maximum velocities were seen in TM D7. Minimum velocity were found for B2. The water level drop in the craters before the gaps was up to 80 cm. The maximum velocities in gap C1 increased to 7.4 m/s near its south wall and to 3.2 m/s along the north one.

FLOOD COMPARABLE TO THE 1824 FLOOD FOR THE PRESENT BARRIER CONDITIONS WITH ALL GATES OPENED

We consider now the results of the simulations of the flood comparable to the most catastrophic flood in St.Petersburg which occurred on 18 November 1824. The intensity of the water level raise in this case was not so high as during the flood of 1955: it was 35 cm/hour on average. Before the Barrier the water level reached 408 cm along the north coast near Tarkhovka - Sestroretsk and 395 cm along the south coast near Malaya Izhora. The simulated maximum water level was 368 cm in Kronshtadt and 401 cm in St. Petersburg (Figure 5). For this «slow» flood the water level in St.Petersburg exceeded the water level in Shepelevo by 31 cm, so for such floods the Barrier with all gates open is much less an obstacle than for «fast» floods with higher intensity such as the flood of 1955. The maximum cross-sectional averaged velocities are found in TM D7 and in B4 (about 4.5 m/s). Minimum peak velocities are seen in B2 and in TM D2 (about 2.5 m/s). Locally, the maximum velocities reached 5.5 m/s at the south wall of the C1 gap and 2.8 m/s along the north one.

FLOOD COMPARABLE TO THE 1824 FLOOD FOR THE PRESENT BARRIER CONDITIONS WITH B3 - B6 CLOSED

Closing of the north section (except for TM D7) led to an increase of water level before the Barrier along the north coast near Tarkhovka - Sestroretsk from 408 to 425 cm (4 %) and to some decrease of level near Malaya Izhora (from 396 to 390 cm). The simulated maximum water level in Kronshtadt was 324 cm (12% less). The closing of B3 - B6 decreased the levels in St. Petersburg for this flood by 15%: from 401 to 340 cm (Figure 5). So, the closing of the Barrier gates had a larger reducing effect for short period floods. As in the previous cases, maximum cross-sectional averaged velocities occur in TM D7, then in C1 gap, then in B1 and minimum velocities occur in TM D2 and in B2. Maximum velocities in TM D7 reached 5.24 m/s and maximum velocities in TM D2 reached 3.18 m/s. At the south wall of gap C1 velocities reached 7.4 m/s, and at the north one 3.3 m/s (Figure 6).

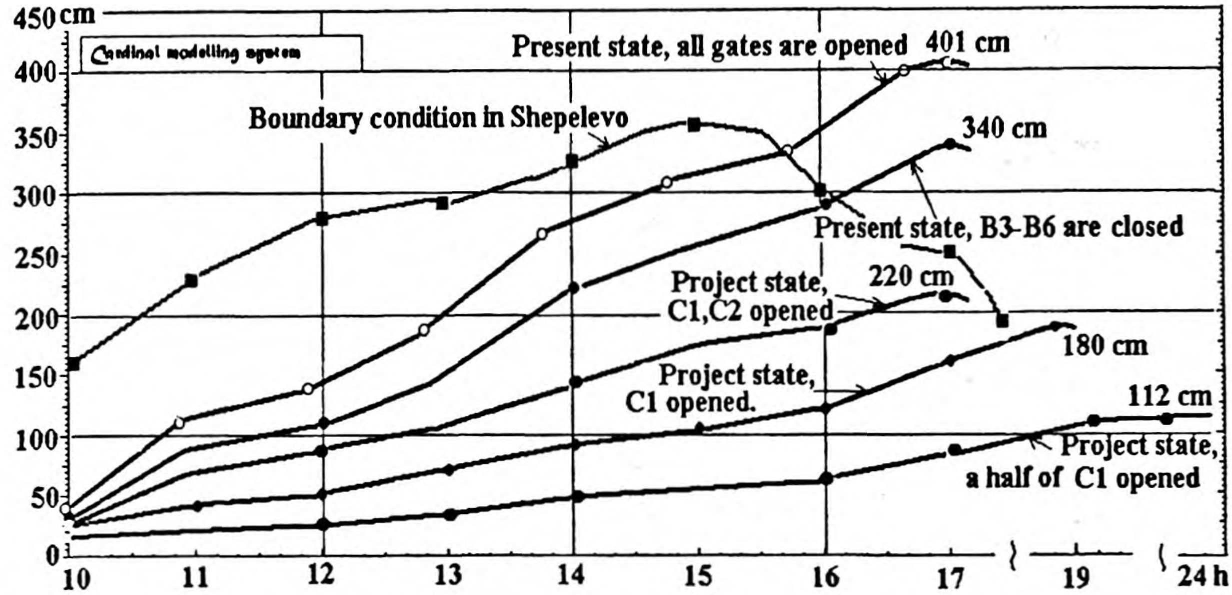

Figure 5. Time histories of water level in St.Petersburg for flood as 18 November 1824 for different situations of the Flood Protection Barrier (no wind in Neva Bay).

7. SIMULATION OF FLOODS FOR THE DESIGN STATE OF THE BARRIER

This section presents the possible water levels in the City and velocities in the navigation passages C1 and C2 for conditions when the Barrier is competed and all water sluices are closed but C1 and C2 (or C1 only) remain open during the whole flood period. Such a situation is possible in connection with delay in construction works in the navigation gaps, and it is also possible in accidental situations, when due to some reasons it is not possible to close the navigation passages in time.

FLOOD COMPARABLE TO THE 1955 FLOOD FOR THE COMPLETED BARRIER WITH OPEN C1 AND C2

A simulation was made until the moment of maximum velocity in C1 as it was already seen that maximum water levels in Kronshtadt and in St.Petersburg would be very small for this flood, i.e. below 1 m. As in the previous cases the maximum surface level (3 m) at this moment was obtained in the north section outside the Barrier between Tarkhovka and Sestroretsk. The water level difference across the Barrier at this moment was equal to 2.5 m. The cross-section averaged velocity was up to 5.9 m/s in C1 and up to 8.4 m/s in C2. It should be noted that the velocity in C2 practically reached a super critical value $u_{cr} = (gh)^{1/2}$ = 8.8 m/s (the analogue of the supersonic velocity in the aerodynamics). The super critical velocity for C1 would be12.5 m/s. The jets coming from C1 and C2 form eddies, so a reverse westward current was obtained near the north-west coast of Kotlin Island outside the Barrier (Figure 7). The main current comes into the Bay through C1 along the Sea Channel and then spreads to the north and to the south.

FLOOD COMPARABLE TO THE 1824 FLOOD FOR THE COMPLETED BARRIER WITH OPEN C1 AND C2

As in the previous cases the maximum levels were found along the coast Gorskaya - Sestroretsk. In Kronshtadt and in St.Petersburg maximum water levels were 210 and 220 cm, respectively (Figure 5). So, completion of the Barrier without installation of gates in C1 and C2 will reduce the water level for the most catastrophic flood by 43% in Kronshtadt and by 45% in St.Petersburg. The water level deference in the C1 «crater» was equal to 2.5 m and velocities reached 7 m/s. Even at a considerable distance from C1, velocities were higher then 4 m/s. Velocities in C2 reached the critical value (8.8 m/s for C2) and to continue the simulations it was necessary to increase the depths in C2 to 10 m, because, as it was

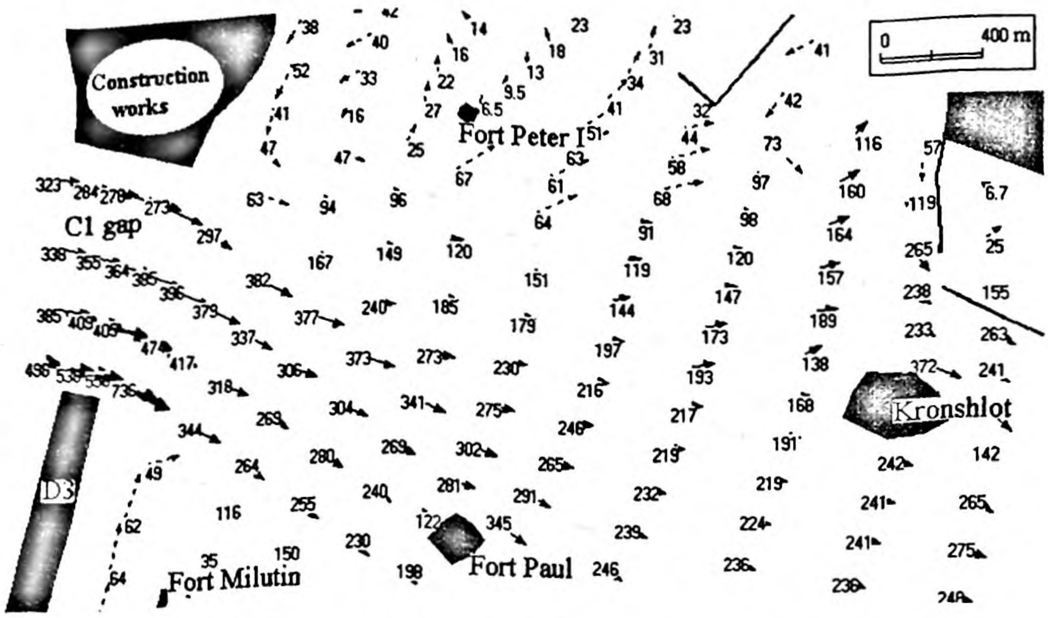

Figure 6. Present state of the Barrier. B3-B6 are closed. Velocity field (cm/s) at the moment of maximum discharge through gap C1

described in Section 4, the numerical scheme used in the model, becomes unstable when the velocity exceeds the super critical value.

FLOOD COMPARABLE TO THE 1824 FLOOD FOR THE COMPLETED BARRIER WITH OPEN AND HALF OPEN C1.

The simulation showed that with only C1 open the maximum water level height in St.Petersburg for the most catastrophic flood will be only 180 cm. The reduction of the water level in this case relative to

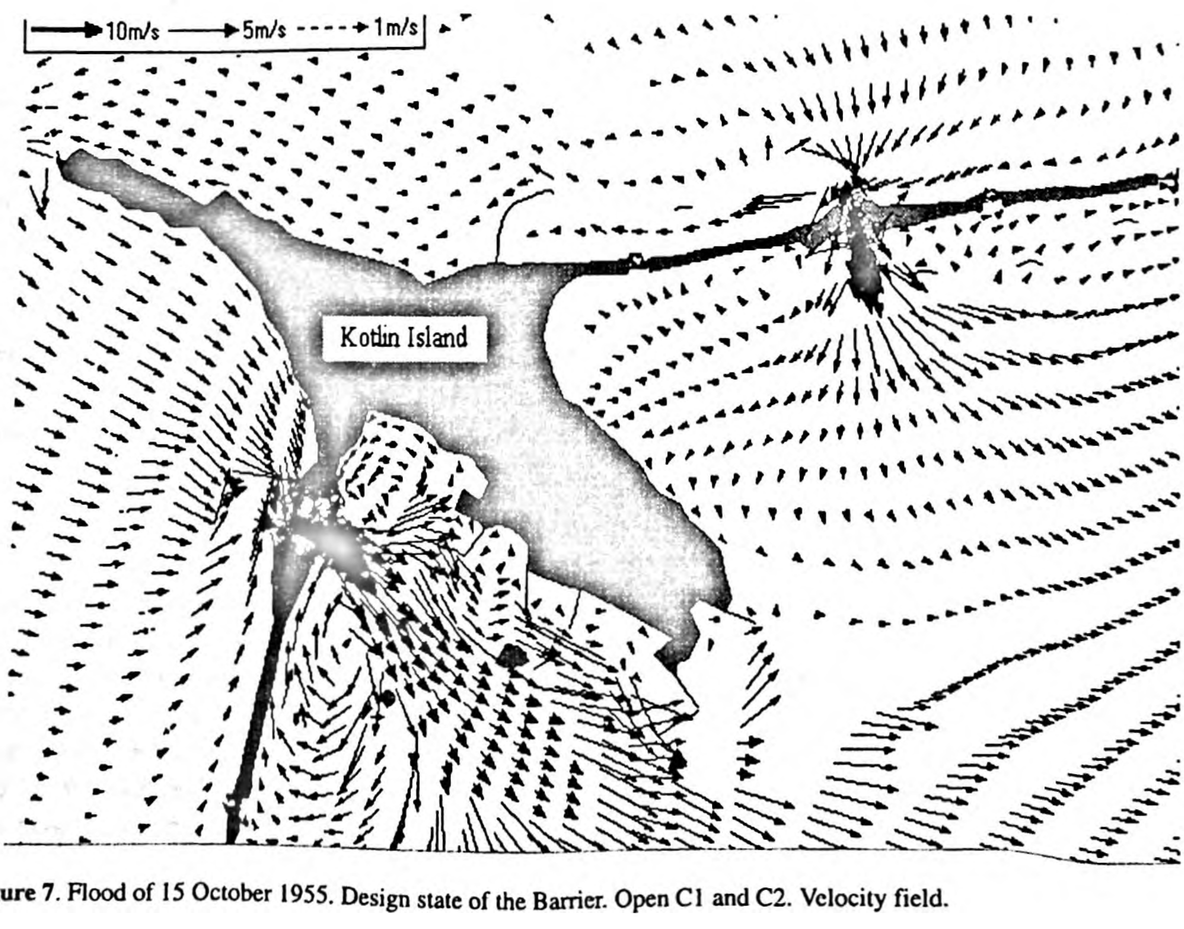

Figure 7. Flood of 15 October 1955. Design state of the Barrier. Open C1 and C2. Velocity field.

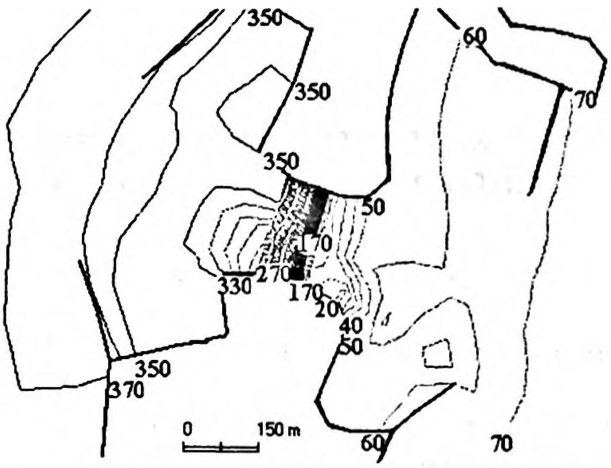

Figure 8. Flood of 18 November 1824 for the design Barrier conditions and C1 only half open. Isolines of water level (cm) near C1 at the moment of maximum velocities.

the present conditions with all gates open is 60 % (401 -180 cm). Local wind effects may increase this level to 230 - 260 cm. Such an in essence catastrophic flood will lead to strongly reduced damages in the City. Computations were also made for the case when C1 was only half open. In this case the water level rise was further reduced to 112 cm. Maximum velocities in the south half of gap C1 reached 7.2 m/s. The water level difference across gap C1 reached 3 m (Figure 8).

8. CONCLUSIONS

The results of mathematical model studies made with the CARDINAL modelling system have shown that for the present Barrier conditions the velocities during catastrophic floods can reach 7 m/s in open gates. These large velocities certainly will lead to erosion in TM D2 and D7, sliding of ground into the C1 navigation opening from walls around the foundation pit and dam D3. This erosion will increase if the sluice sections B3 - B6 would be closed as their closing will lead to 15-25 % increase of velocities in the remaining openings. It should be noted that sliding of ground from walls around the foundation pit may in a very short time lead to its destruction and into filling up of the navigation passage. For the completed Barrier with closed water sluices the velocity in the navigation passages, especially in C2 which has a sill depth of 7 m, may be higher than 8 m/s, so bottom erosion outside the concrete part of the passages will be a serious problem.

The Barrier in its present conditions with the C1 gap of 7990 m^2 and all gates open, is practically «transparent» for most floods but can reduce the ones with short periods such as the flood of 1955. Closing of B3 - B6 will lead to an additional reduction of the flood level by 15 - 23 % for floods with intensity of water level rise in the range 58 - 35 cm/h. A completed Barrier with all water sluices closed and open C1 and C2 with cross sectional area 3200 m^2 and 770 m^2, respectively, can defend St.Petersburg against most floods and can reduce (by 45 %) the most catastrophic ones. The completed Barrier with only C1 open can further reduce maximum water level height in St.Petersburg by 60 % relative to the present Barrier with all sluices open. Based on the present study a proposal has been made to revise the Barrier design and to complete the Barrier without the installation of the two floating radial sector gates each 130 m radius in navigation passage C1.

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SOME GIS METHODS IN ARCHAEOLOGY, PALAEOGEOGRAPHY AND SPATIAL PLANNING

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Use of the Geographical Information Systems, especially the spatial analysis tools in non-geographic research offers considerable benefits to scientists from e.g. archaeology and historical geology.

Spatial data can be most simply defined as information that describes the distribution of things upon the surface of the earth. In effect any information concerning the location, shape of, and relationships among, geographic features (Gillings et al., 1998). In archaeology, and in the studies of palaeoenvironments, scientists usually deal with a vast amount of spatial data. This data can be captured, stored and treated with the means of GIS.

In the following, we shall demonstrate some uses of GIS spatial analysis. Spatial analysis seeks to explain locational patterns of variables (such as human behaviour, ecological components, landscape features) and attempts to explain such patterns through spatial relationships (distance, shape, locational distribution).

1. Centres and peripheries on Saaremaa island during the Iron Age. Principles of spatial distribution of settlement centres (defined by Mägi-Lõugas, M., 1998) have been described, and natural environment preferences of settlements have been shown. It occurs that distances between ancient centres on Saaremaa converge to about 15 km. It is explained through resource base and landscape properties.

2. Simulation of the postglacial Baltic Sea shorelines on the island of Hiiumaa, West Estonian Archipelago. A GIS-based three-dimensional simulation of the postglacial emerging of the island of Hiiumaa was made according to shoreline (geomorphological) data. Taking into account uneven crustal movements, simulated contours of the island for the separate time slices of the Ancylus and Litorina transgressive periods as well as Ancylus regressive period of the Baltic have been presented.

3. Simulation of transport routes and consequent economic regions in the West Estonian archipelago. By modeling various situations with ferry lines and fixed connections (20 bridges or tunnels), the variations in time-space setting are analysed. Recent circumstances on the Estonian major islands (Saaremaa and Hiiumaa) is that these geographically closest areas are considerably distant in terms of time-space or cost-space.

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HYDROGEOLOGY OF THE AREA OF NEVA BAY

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Neva Bay is situated on the northern-eastern wing of the Moscow artesian basin at the conjugated zone of the Russian plate and Baltic crystalline shield. The rocks of Archeozoic-Lower Proterozoic crystalline base - gneiss, crystalline shale, granite – are deposited at the foot of a cut on the depth of 150-200 m. These rocks are crossed with a net of faults of northern-eastern, northern-western and latitudinal directions. Filling up with water of rock is insignificant and connected first of all to the weathering crust of crystalline rocks and fault zones.

Paleozoic sedimentary rocks are gradually dipping on the south-east with the angle of about 10 minutes (2.3 m on 1 km). They are bedding on the rocks of crystalline foundation. Gdov water-bearing horizon is connected to a fine-grained sandstone of Kotlin (Gdov) horizon of Vend ("Eocambrian") with a thickness of 80-95 m. At the natural conditions (before the intensive exploitation was started) piezometric crater of Gdov water-bearing horizon was laid higher that the daily surface, and the boreholes on the area of Prinev lowering and on the Island of Kotlin stream by themselves. The horizontal hydrochemical zones of Gdov water-bearing layer, reflected regional hydrochemical appropriateness, which are characteristic for the Moscow artesian basin, were revealed there. Salted water of chloride-sodium composition on the area of Saint-Petersburg at the northern-western direction is gradually changed to a fresh water; the isoline of 1 gram/liter of water mineralisation passes through Sestroretsk -Beloostrov – Pesochnaja – northern part of Neva Bay. On some areas water of Gdov horizon contain high concentration of radon, which is connected to the uranium ore occurance in the zone of weathering of crystalline foundation. The partly lifting of piezometric levels on 35-39m at the center of the city was happened as a result of cutting down of the volume of water taken away.

The regional waterproof is a thick layer (120-130 m) of laminate clays of Kotlin horizon of Vend, which are stretched under the most part of the Neva Bay. There are tunnels of metro at the central and northern parts of Saint Petersburg laid into this layer. Laminated clays are covered with Quaternary sediments on the northern bank of the Neva Bay, and with slightly water bearing sandstone of Lomonosov horizon of Lower Cambrian System, thickness of which do not exceed 10 m, on the southern bank. Fresh water of Lomonosov sandstone is using for supplying of some settlements. The horizon of blue clays of the thickness of 100-120m of Lower Cambrian System, which is bedded above, is a regional waterproof, stretched under water bearing horizon to the south of the Neva Bay. The blue clays are covered with water bearing layers of Cambrian and Ordovic with the total thickness of up to 25 m; the last one supplied with water some settlements of southern environments of Saint Petersburg. A thing layer (from 10 cm to 1 m) of Dictyonemea shales of Lower Ordovic beds at the upper part of this sandstone. A high radioactivity is characteristic for this layer, and as a result of this some small radon springs are formed to the west of Neva Bay (Lopukhinka).

Stretched under water bearing complex of carbonate sediments of Ordovic, which is representing by karst limestone and dolomite, is the main source of water supplying of settlements, which are situated to the south of Saint Petersburg. A glint with a height of from 30 to 60 m was formed along the outcrop of these dense rocks, which is stretched on 700 km (from lower Svir River to Tallin). There are many springs with output up to tens liter/minute. The thickness of carbonate layer on the edge of glint does not exceed 20-30 m, but gradually increases towards south-east and already on the area west of Gatchina reaches 120-140 m. The karst relief with many karst craters, narrow gullies, ravines, sparse net of surface water drains, small thickness of Quaternary sediments (often not more than 2-3 m) is characteristic for the area of developing of carbonate sediments of Ordovic. Favorable conditions for the infiltration of atmosphere sediments are creating in this area. Numerous cattle-breeding complexes and some industrial enterprises were the reason for considerable pollution of the underground waters with compounds of nitrogen, pesticides, metals. A drain of water-bearing horizon was carried out by the foot of glint, and further this water as small rivers and streams flows to the Neva Bay, intensifying its pollution from the side of southern bank.

Water-bearing complex of Quaternary sediments are representing by three horizons. The water-bearing horizon of ground water in sand and sandy loam of different genesis is using for water supplying of some small farms. On the area of the city the horizon in polluted and on the areas of "hydraulic windows" it is representing a danger for polluting of water-bearing horizon, which is based under Valdaj sandy loam moraine of upper intermoraine (Poljustrovo) water-bearing horizon. The water supplying of the settlements of Pesochnaja, Dibuny, Olgino, Lisij Nos, and also a well known Poljustrovo spring of chalybeate mineral water on the right bank of the Neva River is connected to the upper intermoraine water-bearing horizon, the thickness of which is 25-30 m on some areas. The lower intermoraine water-bearing horizon, which is using for drinking water supplying, is situated mostly in paleo-valleys, where the thickness of them increases up to 50-80 m, and coarse-granular and gravel sands are appearing in the composition of rocks. The depth of these buried cut-out sometimes reaches 110 m. Such a valleys are known on the areas of a mouth of River Smolenka, at Lisij Nos- Olgino – Staraja Derevnja, near settlements Zelenogorsk and Molodjezhnoe. There is a danger of pollution of the intermoraine water-bearing horizons under their intensive exploitation with waters of Neva Bay.

Thus, the state of the Neva Bay in connected very closely to the hydrogeological conditions and the state of underground water of the area. Conversely, the condition of underground water depends considerably of the situation in the area of water.

MEDICO-BIOLOGICAL MONITORING OF SESTRORETSK COASTAL LINE OF THE GULF OF FINNLAND

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The importance of hydrometeorological information of the environments of the coastal line of the Gulf of Finland is obvious, especially, considering its influence on the health of people. The requirements for receiving truth hydrometeorological information about the condition of coastal line of the Gulf of Finland are raising together with every year enhancing of the number of holiday-makers on the health resorts of the Northern-Western area. Complex medico-biological investigations are carrying out on the base of Bioclimatic Station of the sanatorium "Sestroretsk Kurort" for more than 15 years. They include the following parameters: temperature and humidity of the air, direction and speed of the wind, meteorological visibility, cloudiness, inflow of the ultraviolet (total and eritemic ones), thickness of the ozone layer of the atmosphere, density of the oxygen in the air. Besides, because of the order of the Krondshtadt observatory, the observations on the ice situation in the Gulf of Finland and on the levels of the highness of the water, are conducting. All the data obtaining are using for the organization of climatic medical treatment. Scientific-practical work is carrying out together with medical personal for revealing of the influence of not favorable atmosphere-electrical and other ecological factors on the heals of people.

Ecological situation of the area investigated is quite complicated and provokes substantiated anxiety in connection with unfinished construction of defensive and cleaning systems, and also because of the nearness of the atomic electrical power station.

The monitoring of the condition of the coastal line allow to let know beforehand of unfavorable natural phenomena and to take well-timed measures for decrease their harmful influence on the health of people.

GEOENVIRONMENTAL CONDITIONS OF UNDERGROUND SPACE IN THE SAINT-PETERSBURG HISTORICAL CENTER AND CONSERVATION PROBLEMS OF ARCHITECTURE MONUMENTS

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The historical center of St.-Petersburg is situated on the Littorine terrace with the lowest absolute marks up to 9 m. The main part of historical center is located on the several islands: Vasilevsky, Petrogradsky, Admiralty, Kazansky, Spassky, Bezimyany, Pokrovsky, and partly Aptekarsky. The main feature of underground space of the historical center of St.-Petersburg is existence of paleovalleys. It"s area can occupy up to 30 % of territory, and on Vasilevsky island up to 35%. Paleovalleys were formed to the direction of tectonic faults. The thickness of quaternary soft soils in the paleovalleys is increased as well as intensified underground waters contamination because such underground structure are considered as hollow flow. Agressivity water-saturated soil and ground water due to contamination increases to building materials, first of all, ancient construction. In the deep paleovalleys (Vasilevsky Isl.) the thickness of soft soils rises up to 120 m, and the contamination of underground waters is traced to depth more than 50 m. In the historical center, where there is concentration of industrial enterprises, the main contamination sources of underground space are leakage from sewerage system and petroleum products. Above all, it is necessary to specify the presence of domestic-municipal wastes that were stored since 17 centuries. The constant leakage from old and percolation sewerage in the historical center provokes decreasing of shear strength and deformation capacity of sand clay soils, as sorbtion of organic and microbiological component on the mineral particles of soils is observed. These sorbtion components form biofilms. Such film consists of alive and dead cells of microorganisms and products of it"s metabolism. The ground water contamination by petroleum products intensifies an microbiological processes in sand-soil strata as petroderivates are assimilated by natural and introduce biocenosis. In the historical center, mineralization of ground water can reach 4 g/l, the increase of chlorides and sulfate content as well as easy and difficulty oxidizing organic components is marked. The development and activity of microbiological processes within underground space of historical center has mosaic character. Nature of microbiological factor is very difficult, and it is caused by natural and techogenic conditions, as: a) degree of soil water saturation, b) despersity of soils, c) presence of natural and techogenic organic component, d) redox and pH state. Reduction conditions in the ground water of St.-Petersburg historical centre exist: value of Eh is reduced to –100mv and less.

Principal architectural complexes are located along coast of the Neva (within the zones limits paleovalley), for example the Ermitage, the Petropavlovsky fortress, the Aleksandro-Nevsky and Isaakievsky cathedrals, Admiralty. By the end of the 19th century the special investigations of soil properties and the bearing capacity of soil basis as will as it's transformation during the exploitation period were not carried out. As a rule the pressure of such heavy building weight on the soil base doesn't conform to the soil bearing capacity. It is possible with confidence to assert, now more than 80 % of St.-Petersburg architectural monuments are conditions of lack soils bearing capacity (for example, the Aleksandro-Nevsky, Isaakievsky and Kazansky cathedrals, the Kunstcamera, the New Ermitage building, the Petropavlovsky complex and others). Just this circumstance explains development of the settlements and deformations of these buildings during the long time. It is necessary to note, that the contamination of underground waters and soils causes the lime grout destruction, which were used for the foundation construction (New Ermitage). In many cases the wooden underground construction of old buildings are affected the action of the fungus various kinds. Such cultures are contained in the sewer. Therefore of the realization of complex investigations underground space of environmental state and the organization of ecological monitoring are necessary to realize. Such monitoring would permit to carry out the control and piloting of the architecture monument state as well as to take the adequate treatments.

THE USE OF DIATOMS ASSESS ENVIRONMENTAL CHANGE IN LAKE LADOGA AND LARGE LAKES IN FINLAND

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LAKE LADOGA

Lake Ladoga, the largest Jake in Europe, is a unique ecosystem and an important water resource for the several million people living in its vicinity, Eutrophication caused by various human activities has been noticed in Lake Ladoga since the early 1960s. We have analysed diatom stratigraphy and sediment chemistry in two 210Pb-dated sediment cores taken in the deep northern part of Lake Ladoga. In the lower part of the core taken near Valaam island (0-20 cm; 165 m water depth), the most abundant species are *Aulacoseira islandica, A. italica* and *Stephanodiscus cf. alpinus,* which have all declined in relative terms during this century. A peak *of Tabellaria floccu'losa* occurs around 1910 (7-8 cm). Since 1950 (above 5 cm) the planktonic flora has gradually become more diverse, with *Diatoma elongatum, Stephanodiscus minutulus* and *St. hantzschii* increasing towards the surface. Stratigraphic changes in the plankton diatoms are essentially similar in the core taken near Pitkaranta (0-33 cm; 55 m depth), even though the sites differ considerably with respect to nutrient inputs, sedimentation and thermal bar progression. A striking feature in both our cores is the presence of very small and thinly silicified frustules *of Stephanodiscus* spp. and *Cyclostephanos* spp. in the uppermost sediment representing post-1970 sedimentation. The stratigraphic evidence of eutrophication is clear. Transition of the diatom plankton from P-limitation to Si-limitation is indicated.

LAKE SAIMAA

In Finland we have studied Lake Sainiaa which is a large complex with several sub-basins. For paleolimnologiacal study we have taken short cores from three contrasting basins (Haukivesi. Paasivesi, Punivesi) of the lake. In sedimentary depositions of Haukivesi the industrial pollution history is clearly seen. The history includes change of brownish clay-gyttja into-black varved gyttja during the early 1950's. The central area of Paasivesi is an extreme of low sediment accumulation: only about 4 cm of sedimenting material since 1850. In lake Puruvesi. which is a clear water area, sedimenting has been faster but there has not been any great changes during the last 200-300 years.

THE SPECIFICITY OF THE MOST ANCENT PHASES OF AGRICULTURE OF EASTERN BALTIC AND NORTH-WESTERN RUSSIA (THE FLOOD-LAND MODEL OF AGRICULTURAL LANDSCAPES)

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The specificity of most ancient phases of agriculture and their dating is discussed in the present report on the basis of the author's field and palynological materials that were obtained for the following key areas and sites: 1. Kaliningrad region of Russia: Neolithic – Bronze age sites — Zedmar A and Zedmar D (non-published materials of the author and some data in publications: Dolukhanov et al., 1975; Timofeev, 1981); 2. Lithuania: Neolithic – Early Bronze age sites — Shwentoii (non-published materials on samples from excavations of R. Rimantene 1969); 3. Latvia: Neolithic – Early Bronze Age sites — Zvidze, Abora, Eini, Lagaza (data from monograph: Levkovskaya, 1987 and some author's non-published materials); 4. Novgorod region of Russia: Georgii settlement of IX (end)—X centuries, that was excavated by E.N. Nosov (author's non-published scanning electron microscope pollen materials from buried traces of plough; published materials palaeoethnolobotanist T. Lempiainen: Lempiainen, Levkovskaya, 1994 and specialist on seeds A. Alsleben: A. Alsleben, 1997); 5. Luga region of Russia: the pollen data on samples, that were taken from the soil under the burial ground Udrai 2 of XI–XII centuries. Excavations of Platonova N.I.

The specificity of regional patterns of all mentioned above areas is shown in the report. The conclusion about important role of flood-lands for ancient phases of agriculture is discussed.

According to the Dolukhanov data (1986) the most ancient agricultural landscapes were connected in the Europe (including the area of present researches) with loess plains and slopes of morene hills. Therefore the most ancient phase of agriculture P.M. Dolukhanov connected in the afforested areas with apperance of iron plough at Slavish tribes. According to this model the agriculture appeared at the east part of forest zone of Europe only about 800 years ago. The results of the present investigations show that the most ancient evidences of agriculture (pollen materials on Neolithic – Early Bronze age layers with battle axes, corded pottery and spherical amphors at Swentoii and Lubana sites that have dating about 4500 –4200 years B. P. By Rimantene, 1986; Loze, 1986; Levkovskaya, 1987; Loze, Kalnina, 1977) are connected with the ancient buried flood-lands of palaeo-Shwentoi river on the shore of Baltic see and Lubana lake. The last model was important for more late agricultural period as well that was studied at Novgorod area. According to E.N. Nosov (Nosov, 1997) the shores of lake Ilmen were the centre of appearance of early Slavish settlements at IX–X centuries. They were the most favourable places for the agriculture due to the existance of the large flood-lands of small rivers (like Verjashy and Raconuci rivers) and streams at this area. The Dolukhanov's model of agriculture means that only slash-burn cleaning could be used for the sowing in the forest zone areas. But researches of J.L. Krasnov (1971) shown that sowing existed at the west Europe not only at the slash-burn cleaning but even at treeles areas as well.

According to the data of botanists (Shennikov, 1950 and other) the most present meadows and open societies of forest zone of Europe have the anthropogenic origin, except of the flood-terraces meadows of rivers and lakes and swamps. The territory of the West-Europe was more remarkarable afforested in the past than now.

Hence the buried now flood-lands with rich soils and past natural meadows were the best places for ancient agriculture. The influence of the some regressions-transgressions on the dynamics of buried flood-terraces and ancient agriculture is discussed in the final part of the report.

THE GRANHAMMAR MAN - AN INTERDISCIPLINARY PROJECT CONCERNING A BRONZE AGE HOMICIDE VICTIM FROM EASTERN SWEDEN

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In june 1953 the remains of a Bronze Age man was discovered at the estate Granhammar, Uppland, ca 30 km NW of Stockholm, Sweden. The discovery was followed by a limited archaeological excavation, and a short archaeological and osteological report was published in 1959. Despite the publication, this remarkable finding has remained almost completely unknown to both professionals and the general public until this day. This is one of the reasons for the launching in 1998 of the project *The Granhammar Man.* A collaboration between experts on different fields — archeology, osteology, odontology, forensic medicine, DNA and diet studies — will hopefully give insights into the life and death of the Granhammar man, shred light upon his time and facilitate the use of the finding as a pedagogical object. Some preliminary results are presented.

MITIGATION OF FLOOD HAZARDS IN SAINT-PETERSBURG AREA

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St. Petersburg is situated in the end point of the largest water system which has a strategic value for the economic and social city development. The Neva river watershed system includes five large regions of Russia, Karelia, and some small areas in Byelorussia and Finland. The most specific feature of St. Petersburg environment is an abundance of the water sources, that occupy about the 10 % of its total territory.

Significant population growth and the extension of the city territory since 60's, as well as increasing of the industrial sector in the city economy without undertaking water protection measures have led to deterioration of the ecological situation in the Neva river and in the Neva Bay. Besides that, the most important problem — flood danger — existed from the moment of the city foundation and this problem is not decideds still. St. Petersburg has been built on the low coasts of the Neva delta and is open to the frequent floods. The city suffered more than three hundred floods since its foundation.

At present, the City of St.-Petersburg does not have an effective modern automatic flood warning system. The present flood level prediction and warning has a time window of about 6 hours only with perhaps a indication of a flood possibility several hours earlier. The forecasts are still made using regression techniques based on wind data and one upstream station (Tallinn), and not by dynamic modelling of the water motion.

Scientific researches of leading St. Petersburg institutes (Hydrology State Institute — GGI, Russian Institute of Hydrology and Meteorology — RGGMI, St.Petersburg branch of State Oceanography Institute — SPb. GOIN) testify that the deformation of the global, lately observed, hydrometeorologic factors increase the probability of the disasterous floods, which can take place according to the calculations at the end of this century or during the first three years of the next one. Floods frequency (23 % of all floods during 300 years of observation took place in the last fifteen years) has noticeably increased. For example, only in the October-November 1994 there were five floods, damage from the one of them has evaluated in 25 mlrd. rubles (for comparison, government has invested 19 mlrd. rubles in the construction of the defensive complex immediately the same year). The same year the Resolution of the Government was issued about the quick finishing the construction of the flood protection complex (FPC) by 2001.

The Netherlands and St Petersburg have the following common problems: location in mouths of great rivers, the watershed basin is located beyond the countries boundaries, stage by stage development of the water resources management system; construction of the port complexes; water resources are located in the artificially created and the natural landscapes; protection from sea floods. The Netherlands have brilliantly coped with the task of flood protection with environment protection measures. In April 1994 on III Annual meeting of managing staff of EBRD Delft Hydraulics company and «Morzachita» Administration have presented joint project — IWRM of the St Petersburg region.

Modeling system CARDINAL was developed in "Morzashchita", it reproduce the long wave fluctuations of the Baltic sea and can be used for the elaboration of short-term automatic flood forecasting.

The specialists of «Morzashchita» Administration and a number of other organizations in St. Peterburg have terminated together with the Netherlands side the first phase of IWRM project and work now on its continuation. Since 1998 per day the Netherlands firm "Delft Hydraulics" and " Morzashchita" Administration with Hydrometeorological department, Institute of Socio-economic problems and other organizations are working on the international project "Flood Warning System for the city St. Petersburg". One of the important parts of this project devoted to the mitigation of flood hazard and damage assessment with using GIS.

For the first time, such a GIS approach was used to prepare maps of geodetic heights (land level heights) for St.-Petersburg. These maps include detailed information on streets, housing blocks, and water ways such as rivers and canals, through which flood water can penetrate the city.

As a direct result of this, cartographic maps of scale 1: 7 000 for St.-Petersburg's low lying districts, influenced by floods, have been compiled and printed. These are the Admiralteisky, Vasileostrovsky and Central districts. Contours from 1.5 up to 6.5 m with 0.5 interval are presented on the maps, which give direct information which areas will be flooded for a given flood level.

As similar cartographic information was not available, and most (hard copy) charts in use were about 30 years old, these up-to-date maps are of a large practical interest for a wide range of customers. Amongst others these are the various city's organisations, departments and administrative bodies, the Civil Protection Agency (MChS). Special charts with the three flood levels used in flood response planning were transferred to MChS, which is now using these in their operational system, including a large scale training exercise which took place at the end of October 1998.

With the probability of floods in St. Petersburg being high, the development of possible losses assessment procedures is actual. The possibilities and perspectives of using different methods of assessment of flood losses for St. Petersburg were analysed taking into consideration the peculiarities of social and economic development in Russia.

THE HYDROLOGICAL PROBLEMS OF ST.PETERSBURG AND THE WAYS OF THEIR SOLUTION

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«Morzashchita» Administration Office of St.Petersburg. St.Petersburg. Russia

St. Petersburg is situated in the end point of the largest water system which has a strategic value for the economic and social city development. The Neva river watershed system includes five large regions of Russia, Karelia, and some small areas in Byelorussia and Finland. The most specific feature of St. Petersburg environment is an abundance of the water sources, that occupy about the 10 % of its total territory.

Significant population growth and the extension of the city territory since 60's, as well as increasing of the industrial sector in the city economy without undertaking water protection measures have led to deterioration of the ecological situation in the Neva river and in the Neva Bay. Besides that, the most important problem — flood danger — existed from the moment of the city foundation and this problem is not decideds still. St. Petersburg has been built on the low coasts of the Neva delta and is open to the frequent floods. The city suffered more than three hundred floods since its foundation.

Scientific researches of leading St. Petersburg institutes (Hydrology State Institute — GGI, Russian Institute of Hydrology and Meteorology — RGGMI, St.Petersburg branch of State Oceanography Institute — SPb. GOIN) testify that the deformation of the global, lately observed, hydrometeorologic factors increase the probability of the disasterous floods, which can take place according to the calculations at the end of this century or during the first three years of the next one. Floods frequency (23 % of all floods during 300 years of observation took place in the last fifteen years) has noticeably increased. Only in the october-november 1994 there were five floods, damage from the one of them has evaluated in 25 mlrd. rubles (for comparison, government has invested 19 mlrd. rubles in the construction of the defensive complex immediately the same year). The same year the Resolution of the Government was issued about the quick finishing the construction of the flood protection complex (FPC) by 2001.

Large work has been done by the expert commissions on the generalization of the numerous research material with the aim to evaluate the influence of FPC on the ecological condition in the Neva Bay and the eastern part of the Gulf of Finland. The most deep analysis of all available material has been executed by the International commission of experts, including specialists of six countries, in 1990. Special pilot studies have been performed, which have undoubtedly proved that FPC rendered smallest impact on the ecological situation in the Nevsky Bay in contrast with other factors like as untreated waste waters, liquidation waterlogged areas, etc. The international commission has noted the need in the water resources management: the Ladoga Lake — the River Neva — the Neva Bay — the eastern Gulf of Finland.

The Netherlands and St Petersburg have the following common problems: location in mouths of great rivers, the watershed basin is located beyond the countries boundaries, stage by stage development of the water resources management system; construction of the port complexes; water resources are located in the artificially created and the natural landscapes; protection from sea floods. The Netherlands have brilliantly coped with the task of flood protection with environment protection measures. The Russian delegation has visited the Netherlands and came to the conclusion that Dutch experience on the solution of the water problems is actual and is useful for our city.

St. Petersburg Region has not got yet a scientific-motivated approach to the complex using of water resources, the single concept of the water area rehabilitation is absent, water protection actions are not coordinated, the single system of water system monitoring does not develop.

As a result of the structural analysis of anthropogenic impact on the Neva Bay eleven types of affects have been named: a coastal building and infrastructure, recreation, agricultural activity, water-supply and water-drainage, undersea quarries and refulation, hydrotechnical constructions, navigation, rafting, fishing, contact with atmosphere. Understanding that is impossible to decide all these problems without the Integrated water resource management system of St.Petersburg region (IWRM), in April 1994 on III Annual conference of managing staff of EBRD Delft Hydraulics company and «Lenmorzachita» Administration have presented joint project — IWRM of the St Petersburg region. Experts of EBRD executed preliminary technico-economical study for the FPC project financing, and wrote in the environmental report (p.312): «Number of commissions, including International commission, recommended to create the single body which should take the responsibility for the water system environmental condition. This proposal was the basis of IWRM SPb project developed by Delpht Hydraulics and «Lenmorzashchita» Administration. Author of this report supports this proposal. There is a single way which it is necessary to follow in order to improve the ecological state of water reservoirs. It is important that any studies, which would be conducted in the future would reflect the integrated nature of this water system and adapt the existing approaches to their conditions».

At present there is sufficient potential in St. Petersburg for working on the joint project IWRM. Some steps in this direction are already made by «Lenmorzashchita» Administration.

To study the influence of the FPC shutters manoeuvring on the ecological condition of the Neva Bay «Lenmorzachita» together with Lenncompriroda has carried out the large-scale on site experiment in the period 14.10 — 6.11.1992. The study program included the following work: hydrometeorological and hydrological observations, analysis of the water quality upon many hydrochemical and bacteriological factors, hydrobiological and ichthyological studies, space observations; observations on the pollutant distribution from the city water purification plants by trassers; study of chemical and bacteriological composition of the stream sediments.

All possible monitoring equipment have been used: aerial photography, measuring of hydrophysical features by the instrumental methods along the ship route, stationary graphers of the water volume and the current speed, modern methods of the water quality analysis. Sixteen institutes and organizations have taken part in the experiment including: «Lenmorzachita», Lencompriroda, Vodocanal, NorthWestHydromet, City centre of the State sanitary-epidemiology control and others. It have been conducted four surveys with interval of 7 days: first — all water-passes of the north fold of FPC are opened (background condition), second — twenty two water-passed are opened, third - all forty four folds of water-passed are closed, and last expedition was during a week with open all water-passes. Water quality has noticeably improved during the second and third surveys. The results of the experiment have confirmed a possibility to influence purposively on the hydrological regime and on the changing of ecological situation of the Neva Bay water area and eastern part of the Gulf of Finland by means of manoeuvring of folds water-passed FPC.

In order to set up the continuous on site observations of the ecological condition in the Neva mouth, the Neva Bay and eastern part of the Gulf of Finland «Lenmorzashchita» 10 years ago became a client and a coordinator of those observations, conducted in cooperation with NWA Hydrometcommittee, State Centre of sanitary epidemiologic inspection, Military-Medical Academy, Lenhydroproject, Scientific-investigation centre «Aquatoria». Today it's a single constant observation station for the complex measurements of hydrochemical, sanitary-bacteriological, hydrological parameters. On the basis of the long-term observations the unique certified database on the Neva Bay has been created.

Database includes observations since 1968 for the 111 components, including: 18 hydrological parameters, 29 hydrochemical parameters, 55 hydrobiological parameters, 9 sanitary bacteriological parameters. At present about 1 mln measurements and several programs of data processing, visualization form the database. Short description of the database is given in «Environmental database for the Neva Bay». First International Conference «Ecology and Development of North-West Region of Russia», St. Petersburg 4—6 Oct. 1995. Tables of long-standing data on sources of pollution of the Neva Bay, Neva and its tributaries have been included in the database. On the basis of «Lenmorzashchita» database and patents of St. Petersburg Architectural Building University the joint project on the development and introducing the integral evaluations of the water quality is carried out. The final reports on all the studies connected with the complex of flood barrier and water quality in the Neva Bay and eastern part of the Gulf of Finland since 1969 till now are archived. All results obtained in this work have been put in computer in Russian and English.

Modeling system CARDINAL is developed, it has been approved in dozens projects as on the Neva-Ladoga water system, as well as on other objects. System has been submitted to international conferences. There is also positive recommendation on using the system CARDINAL as basis of project IWRM from the company Sir Alexandr Gibb & Partners (Great Britain), which carried out the EBRD project on the feasibility study on the completion of construction of the flood protection complex of St. Petersburg. Description of CARDINAL is published in the international scientific journals. System quidebooks for users in Russian and English are published. More than 90% of software system volume serves for ensuring an interface (dialogue) with the user. For the IWRM project the presence of the developed interface in the decision support system is a necessary condition. CARDINAL executes the calculation of the hydrodynamics conditions and spreading of the pollutants on the basis of method of curvilinear coordinates that allows to describe small-scale dissimilarities of morphometry of the Neva Bay in detail, simplify the model delta of the Neva river. The executed studies have shown that hydrodynamics model CARDINAL is capable along with the other tasks to reproduce the long wave fluctuations of the Baltic sea and can be used for the elaboration of short-term automatic flood forecasting. At present this model is jointed with DELWAQ bacterial contamination model.

The specialists of «Morzashchita» Administration and a number of other organizations in St. Peterburg have terminated together with the Netherlands side the first phase of IWRM project and work now on its continuation.

THE BALTIC SEA COAST A VARIETY OF GEOLOGICAL SETTINGS, LANDSCAPES, ENVIRONMENTS AND CULTURES

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The coastal landscapes of the Baltic Sea comprise geological settings from many periods: crystalline and sedimentary bedrock formations, glacial deposits and land-forms, and post-glacial and recent sediments. The isostatic and eustatic processes: land uplift, land subsidence, sea level changes, and the abrasion and accumulation of sediments have continued to form characteristic coasts around the Baltic. The anthropogenic factor has also left obvious traces during recent centuries.

The pioneers on the coasts, vegetation as well as people, have preferred certain environments, and these environments are changing, both in time and space, just as the preconditions and priorities for a living environment are changing depending on climate, culture and activities.

How much have the population and human activities influenced the development of coastal environments? How much have the changing coastal environments influenced cultural development ?

The answers necessary for understanding these integrated processes can be read in the environmental history of the coasts. This knowledge of past processes, changes and events is essential for studying the present and modelling future environments.

The importance of long-term as well as short-term studies in these areas and the need for such work is clearly underlined and justified. Interdisciplinary collaboration in the field of environmental history is also the main objective of the NorFA network «Environmental modelling of special and sensitive coastal areas of the Baltic Sea.»

THE BOREAL FOREST: UTILISATION OF RESOURCES FROM A PRODUCTION AND SETTLEMENT POINT OF VIEW

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Today the forest is the most important natural resource in Sweden as it is in many other northern countries. The growing forest is a renewable resource and its raw-material has great potential for further refinement. The bio-energy sector is one of the most interesting new fields of development. The forest also acts as a carbon-filter to lessen the diverse effects of the use of fossil fuel. It counteracts erosion and plays a big role in regulating the micro-hydraulic system of creeks and streams draining towards big rivers, lakes and ultimately to the sea.

The proper use of our economically most important and also, from an environmental protection point of view, most promising natural resource is of utmost importance. Knowledge of the history of the forest from the point of long-term natural changes as well as of developments sparked off by human societies may help plan for a sustainable development.

This paper presents recent work in the Värmland county, Sweden, where forest officers and archaeologists (and to some extent also quaternary geologists) work together since 1995 to build a data base regarding the utilisàtion of forest resources through time. Similar work has started in most other counties of Sweden during 1998.

One important lesson has been that the history of forest use will not be revealed, unless there is a combined effort by the humanities and the natural and applied sciences.

DISTRIBUTION OF ^{14}C IN NORTHWEST BELARUS NEAR THE OPERATING IGNALINA POWER PLANT

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INTRODUCTION

The accident at the Chemobyl Nuclear Power Plant (NPP) in Ukraine raised questions in Belarus concerning the reliability of operational cycles of the NPPs surrounding the territory of our country. Some answers can be obtained by studying the distribution of radiocarbon as one of the components of environmental radiocontamination.

Radiocarbon can be formed in the active zone of nuclear reactors of any type, where there are flows of neutrons, which interact with material of designs reactor with the coolant agent, moderator of nuclear fuel and impurities, available in them. The rate of ^{14}C formation in the fuel depends mainly on concentrations of nitrogen admixtures. The distinction of the Ignalina NPP reactor with boiling water under pressure as coolant (heat-carrier) and graphite as moderator is the presence of a great amount of nitrogen in an active zone used in a mixture with helium for cooling and a large mass of carbon in moderator. It results in a significant rate of ^{14}C generation that is approximately by an order of magnitude greater, than in reactors of other type. Radiocarbon formed in coolant and moderator is released partially or completely into the environment as gas-aerosols (complex) ,and from reactor fuel with radioactive waste.

As an object of research the area in northwestern Belarus was chosen where the Ignalina NPP (INPP), in Lithuania, is situated most closely to Belarus (55°37' *Longitude, N and 26°36' Latitude, E).* The INPP, located on lake Drisvyaty, is equipped with Chemobyl-type reactors; two units operate there.

METHODS

Radiocarbon concentrations were measured at some experimental sites selected on the basis of their location with respect to the nuclear plant. The INPP premises are distinguished in general by increased technogenic load on the landscape and by destruction of the soil-vegetation cover. Two canals designed for water intake for cooling the reactor and for dumping coolant into a reservoir extend from the NPP to Lake Drisvyaty, and thermal anomaly was recorded within the lake . A water-controlled area of Lake Naroch, a hydrological post in Belovezhskaya Pushcha, and (some sites in the Dokshitsy District of the Vitebsk Region (Berezinsky Reserve) and the Gorki and Dubrovno Districts of the Mogilev Region were chosen as control regions, presumably not exposed to the NPP influence .

RESULTS

As shown by the results of ^{14}C measurement, the region of Belarus contiguous with the Ignalina NPP is distinguished by an increase in ^{14}C concentrations in vegetation of up to 120-150% relative to the present level in undisturbed areas. Bulrush sampled near Castle Island in Lake Drisvyaty and two-year-old pine cones growing on the lakeside close to Pashevichi Village exhibit the maximum ^{14}C accumulation. Relatively high ^{14}C values were observed directly in water from Lake Drisvyaty, connected by canals with the Ignalina NPP. At the same time in water of "closed lake. Muysata not in all years of observation the influence NPP manifests itself. Concentrations ^{14}C vary from the current level (102%)

up to a comparatively increased one (132%). Similar radiocarbon contents (120-150%) are observed also in carbonate of mollusk shells - Anadonta Unio and Dreisena, selected along seaside of lakes. Excess radiocarbon, releasing as a result of Ignalina NPP revealed as well in the carbonate egg-shell of hens, whose food consisted of cereals nearly NPP.

The analysis of ^{14}C distribution in annual rings of trees as a whole characterize the tendency of ^{14}C distribution applicable to earlier periods of time (1979-1994) and is closely compared with determinations of ^{14}C concentrations in water of lake Drisvyaty, conducted by Banis. (1988). Radiocarbon concentrations in the lake varied over the period from 1978 to 1986 from 115 to 150% relative to the modern standard.

In comparison with 1994 values, our 1996 measurements showed a reduction in ^{14}C concentrations in plants. This phenomenon seems to be associated with the fact that in 1996 the Ignalina NPP was repeatedly subjected to preventive maintenance.

CONCLUSION

The carried out determinations of radiocarbon concentration in air, surface waters and vegetation are essentially the first oт[1] for Belarus area. They characterize both ^{14}C "background» concentrations - without penetration of technogenic radioisotope and ^{14}C concentrations values in the region adjoining to Ignalina NPP. Obvious variation in distribution of ^{14}C concentrations is associated with penetration of the «surplus» ^{14}C of nuclear power plant, working in the staff mode in the air space and surface water. The data obtained point to the necessity of radiocarbon inclusion in a complex of radioisotope monitoring.

IRON PRODUCTION DURING MEDEVIAL TIME THE VITTSJÖ AREA, SOUTHERN SWEDEN WITH RESPECT TO SOIL CHEMISTRY, GEOLOGY AND HYDROLOGY

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Several medevial iron production sites have been found in the Vittsjö area, Skåne, southernmost part of Sweden. Two of these sites, Brunkelstorp and Lehult, have been investigated regarding possible usage of local material for iron production, the formation of this material and the quantity of mined material. The methods used were chemical analyses of secondary formed iron compounds (crystalline, amorphous and organically bound), secondary formed crystalline manganese and in-organic phosphorous. The Quaternary geology and hydrogeology of the area around the sites have also been investigated.

The bedrock in the area, and thus Quaternary deposits, have a high content of magnetit. Due to weathering processes, iron(II)ions and iron bound to organic matter dissolve in the groundwater. In this form iron is transported through Quaternary deposits and later precipitated under aerobic conditions. Humic and fulvo acids play an important role in chemical weathering of the bedrock and Quaternary deposits.

In the southeastern part of the site Brunkelstorp a "red soil", rich in iron, was found. It contains 40-60% of secondary formed iron compounds. This soil is considered worth mining and if the southwestern part of the site have had the same concentration, about 1400-2000 m^3 soil could have been mined and between 3800 and 5500 kg solid iron may have been produced. One of the main reasons for the formation of the "red soil" in Brunkelstorp is the fluctuation of the groundwater table. When the water table rises, iron(II)ions follow the water to the top of the soil and when the water sink the environment will be aerobic. The iron(II)ions oxidize to iron(III)ions and precipitate as various secondary formed iron compounds.

In Lehult no material suitable for production of iron was found. Bog ore may have been used but no evidences for this was found. It is possible that bog ore was formed in the vicinity, but redeemed when the hydrogeology of the area was changed, i.e. through ditching.

CUMULATIVE VIEWSHED ANALYSES AND SPATIAL DISTRIBUTION OF STONE LABYRINTS IN SOUTHERN FINLAND

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Viewsed analysis can be used directly in archaeological research to address hypotheses related to site location on the basis of visibility. In this study, the viewshed was generated for seven stone labyrinths in SW Finland. It must be remembered, however, that the analysis has ignored contemporary vegetation, and shows only the possible significance of visible areas for the sites.

The stone labyrinths do not fall within each other's line-of-sight. The consistent non-intervisibility between stone labyrinths was probably the result of very careful siting procedures undertaken by local people. Stone labyrinths in this area were not positioned to attain maximum visual dominance. They were clearly oriented in certain direction, and the viewsheds do not overlap but only one or two small locations. In my opinion, the territorial landowner-ship was indicated by visual dominance of the stone labyrinths in this area.

BENTHIC ALGAE OF THE EASTERN PART OF THE GULF OF FINLAND AND ADJACENT FRESHWATERS

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It is well known that benthic algae play a major role in the organic matter production in shallow waters and can be an effective tool in water quality assessment. Yet, studies of the benthic algal vegetation are scant compared to that of phytoplankton in the Gulf of Finland and adjacent freshwaters.

My aim was to study species composition of the benthic algal communities in this area and to determine ecological preferences of algal species (mainly diatoms), which can be used in regional water quality asessment programs as well as in paleoecological reconstructions.

The sandy beaches dominating the northern coastine of the Gulf of Finland in its eastern part do not appear to provide favourable conditions for the development of benthic algae. Nevertheless, the high nutrient content of the water does promote extremely rich growth of filamentous green algae (mostly Cladophora glomerata), which reaches nuisance level in summer time. Two ecological groups of diatoms are the most abundant in the area: epiphytes on Cladophora and Potamogeton species , and epipsammic diatoms attached to the sand grains.

Study of a 100 rivers in the St.Petersburg area showed that water mineral content is the main ecological factor shaping their benthic algal communities. Soft-water rivers of the Karelian Istmus and hard-water rivers of the carbonate Izhora Uppland support contrasting communities of diatoms and green algae. On the other hand, some algal species, as for example, red alga Chantrasia chalybea are commonly found in the rivers of both regions. Most of the rivers were moderately polluted by organic material (BOD5 values 1.5–4.0 mg O_2/l), however those flowing through the city were often so heavily polluted by municipale and industrial waste, that no algae could be found there. Futher detailed ecological studies on benthic algae are needed to incorporate these organisms in regional programs of water quality monitoring.

VEGETATION, CLIMATE HISTORY AND HUMAN ACTIVITIES IN THE CENTRAL PART OF SRI LANKA (HORTON PLAINS) BASED ON POLLEN RECORDS COVERING THE LAST 7000 YEARS

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The Horton Plains nature reserve is the third and highest peneplain in the central mountainous part of Sri Lanka. Based on the pollen record from two mires in Horton Plains palaeoenvironmental changes for the last 7000 years (7 ka) are constructed. The time interval 7–6 ka was the warmest and driest period, resulting in a savanna forest with e.g. *Michelia* sp. The wettest and coldest period is recorded between 4–3 ka.

Since 6 ka, a montane forest with *e.g. Microtropis* sp., *Syzygium* sp. and *Rhododendron* sp. appeared in the area. Prehistoric man inhabited the Horton Plains during the period 6.7–4.1 ka. Slash and burn cultivation (*Hordeum* sp. and *Oryza* sp), forest clearance and grazing have been identified. Undefined activities and grazing followed between 4 and 3 ka. From this time onwards only a few human activities can be traced. Possibly, Horton Plains acted as one of the ancestral homelands for the cultivation of barley (*Hordeum*) and rice (*Oryza*) varieties.

STATE MONITORING OF SENSITIVE AREAS OF THE ESTONIAN COAST

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State monitoring in Estonia gained legal ground in 1993. The main purpose of the Estonian Environmental State Monitoring Programme is to monitor long-term and large-scale changes in the environment, to recognize the situations which require countermeasures and to identify the problems the solution of which calls for further complementary studies. In 1999 the Act of the State Monitoring, adopted by the Parliament, get into force. The decree of the Minister of the Environment of October 25, 1993, created the Monitoring Council, headed by the Chancellor of the Ministry. After the confirming of the projects, the Estonian Environment Information Centre concludes contracts with responsible institutions and responsible implementors, who should guarantee either alone or with sub-contractors the high quality collection, primary processing and preservation of the data.

The Estonian coastline is 3794 kilometres long. There are different coast types and various beaches of great touristic and recreational value. In many places, where the transport-geographical conditions are good, the narrow sections of sandy shore (Pirita, Kloogarand, Järve, Valgeranna, the northen coast of Lake Peipsi, Pärnu) are already suffering from a heavy load of visitors. Besides, during the last decades push ice and heavy storms have repeatedly caused catastrophic damage on Estonian beaches. In view of the above, good protection strategies are needed.

The HELCOM Recommendation 15/1 adopted by the Ministers of the Environment of the Baltic Sea States on March 8, 1994, addressed the protection of the coastal strip. The corresponding national plans were worked out and in 1995 a law on the protection of beaches and banks was adopted by the Estonian Parliament.

The protection of beaches is based on the coastal monitoring which was started in 1994. It includes 26 sites on the seashore, 8 sites on Lake Peipsi and 7 sites on Lake Võrtsjärv. Responsible institutions are the Estonian Geological Survey and the Institute of Geology at Tallinn Technical University, respectively. The main attention will be paid to the sensitive areas. In 1998, the compilation of cadastral register of the most typical coast types for the rational management of the coastal zone was started. In future, the cadastral units will cover the whole Estonian coast.

During the years under Soviet occupation, the coastal zone of the Republic was «well protected» by military forces of the former Soviet Union, who cut off people`s free access to the seaside. In the years to come, the ever growing number of tourists, the selling of land to the foreigners and careless construction of buildings close to the shore will cause severe environmental problems. We are afraid that as a result of the land and ownership reforms several semi-natural habitats, e.g. wooded, bottom-land and coastal meadows will perish gradually. An effective network for the protection of the ecosystems of wild flora and fauna should be built up according to the recommendations of the state monitoring and cadastral register. The environmental state monitoring is a long-lasting process. The results of the monitoring will constitute the main scientific base for political decisions to be passed by the state and local authorities. At the same, time the monitoring system must be flexible in order to evolve with the increase of knowledge.

PALAEOECOLOGICAL RESEARCH AT A MESOLITHIC COASTAL SITE IN SKÅNE, SOUTHERN SWEDEN

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The excavations of one of the largest Mesolithic settlements in Scandinavia, Tågerup in Skåne, have recently been carried out. The excavations are due to the construction work for the new railway between Landskrona and Kävlinge. The site is situated on a sandy hillock at the confluence of two relatively large streams. During the Atlantic period the hillock formed an approximately 800×300 metre large promontory, surrounded by narrow inlets from the sea on both sides. The fresh water of the streams was mixed with the salt water, forming optimal conditions for a Mesolithic population.

The excavation has revealed several settlement phases where the Middle Mesolithic «Kongemose culture» and the Late Mesolithic «Ertebölle culture» are the most prominent.

In the site were recorded immense layers of gyttja, a remainder that parts of the promontory was once under water. The post-glacial transgressions in the area usually cause a total restratification and destruction of old settlement structures, but in the case of Tågerup the situation is the reverse. A presumed quick rise in the sea level, in the calm inner parts of the inlet, covered earlier settlements and organic sediments accumulated on top of Kongemose settlements and refuse deposits. Consequently an oxygen-free environment was forming where all where many wooden and other plant materials were preserved in situ. The combination of calcareous sediments and oxygen-free environment has also helped to preserve the bone and antler material. Also the flint artefacts have preserved their lustrous black freshness. Especially conspicuous are the long, slender blades of high-quality flint that once were thrown out from the settlement.

The Late Mesolithic Ertebölle settlement is spatially and stratigraphically separated from the older periods. This phase is contemporary with the post-glacial transgression maximum. The major part of everyday activity was concentrated to the littoral. Although the refuse layers of this phase have been previously destroyed when the former railroad was constructed, the dwellings are preserved. At least four houses have been found. The houses are circular, about 8 metres across, or rectangular, about 15 metres long and 7 meters wide.

The most illustrious outcome from the excavations at Tågerup is a cemetery from the Kongemose period, the oldest known from north-western Europe. The graves are in all probability a small part of a larger cemetery extending outside the excavated area.

The palaeoecological analyses will be directed towards different aims. Plant macrofossil analyses are used to deepen the knowledge about plants and subsistence. The palaeoenvironment, where important aspects are vegetation development and sea-level changes, will be reconstructed with a combination of methods. Sediment analyses including parameters as molluscs, diatoms, chemistry and palaeomagnetism are important to understand the shore-displacement. Pollen and plant macrofossil analyses will be significant within reconstructions of plant communities. A group of palaeoecologists from several institutions has just started the immense analysis work, which will be published, in a separate volume dedicated only to environmental studies.

THE SUB-AQUATIC CULTURAL LAYER OFFSHORE THE VIKING AGE TOWN BIRKA, SOUTH-EASTERN SWEDEN

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In connection with the excavations of the cultural layers of the Viking Age town Birka 1990-1995, stratigraphical analyses of sediments accumulated offshore the town was carried out. From 90 corings in 11 sections, it was possible to map the distribution of a sub-aquatic cultural layer (the Birka Layer, BL) rich in organic material, *e.g.* mosses and fruitlets of hops, that has been dated to the Viking Age. By comparisons with underwater archaeological investigations, it is concluded that the BL is located to the west of the wooden rampart that protected the town. In the straight between Björkö and Adelsö southward currents dominate, resulting in an extension of the BL in that direction.

A general lithostratigraphic section consists of, from bottom upwards, glacial clay, gyttja clay, clayey silt, clay gyttja, Birka Layer and clay gyttja rich in charcoal and wood. The maximum thickness of the BL is 30 cm. Analysis of diatoms revealed that the BL was accumulated prior to the isolation of Lake Mälaren, *i.e.* saline water prevailed in the area during the Viking age. Phytoliths, especially a dendritic type, are frequent in the BL. Among pollen, high percentages of herbs indicate grazing and possibly cultivation. Magnetic susceptibility reveals low values in the Birka Layer, while it increases in the superimposed clay gyttja, rich in charcoal and wood. The increase is probably caused by a large input of highly magnetic particles formed by the frequent fires occurring in the town. These particles have during the last approx. 1000 years been transported by surface run-off to the sampling site.

At present there are two possible interpretations of the formation of the BL. The first involves man-made deposits of selected waste material in the water west of the wooden rampart. A second possibility implies that the BL is the remnant of the winter markets that were held on the ice. During those occasions, straw was put on the ice to keep dry. This could explain the large amount of phytoliths observed.

A strict deposition of the BL by surface run-off is excluded since the microfossil content does not correspond to what have been noted in the cultural layers. In these, diatoms, phytoliths and Chrysophyte stomatocysts occur in about the same proportions. This is not the case in the BL, where very few Chrysophyte stomatocysts were observed. Furthermore, the geographical distribution of the BL indicates that the wooden rampart should have acted as an obstacle.

RECULTIVATION OF ABANDONED QUARRIES OF GRAVEL AND SAND IN ESTONIA

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The area of unreclamated quarries of gravel and sand has increased in Estonia in the last decade. The abrupt decrease in mining at the end of the 1980's led to closing down of many open-cast pits. Today, most of these quarries have been out of use for seven or more years, and the overview on them is lost. To evaluate the situation, a case study in the Jõgeva county in central and the Võru county in southern Estonia was carried out. Altogether 60 quarries were examined. The mining area, situation of slopes, the level of ground-water, problems of hydrology, the occurrence and composition of waste products, the location of the quarry in regard to nature reserves, settlements and roads, the previous land use, and other aspects were examined.

The results revealed that 72% of the quarries were not covered by grass and trees and are in need of to reclamation. The area of unreclamated quarries covers 68 ha in the Jõgeva County and 40 ha in the Võru County. For levelling the quarries in the Jõgeva and Võru counties 76,000 mi and 123,000 mi of soil needs to be removed, respectively, at the cost of 500,000 kroons (35,000 USD) and 600,000 kroons (42,000 USD), respectively. The average area of the quarries is less than 2 ha in the Võru County and about 5.5 ha in the Jõgeva County. The small area of individual quarries leads to higher expenses on recultivation and often does not allow applying the methods used in large quarries.

Traditional recultivation works of quarries (levelling of the slopes, etc.) will be accompanied by several additional problems. Most acute of them are waste products dumped to the quarries by local people. Every fourth quarry in the Võru County contained a considerable amount of waste products, most often refuse and scrap metal, yet three quarries included waste products probably dangerous to groundwater (Pb accumulators, refrigerators, etc.). The problem in levelling the quarries is that in many cases mining has been done up to the border of the forest and no levelling ground has been left around the quarries; as a result, trees and stones keep constantly falling down the steep slopes. Yet, levelling the slopes according to the allowed norms of inclination requires cutting down the growing forest; quite often the soil removed before mining has lost its fertility. The timing of recultivation works has to be chosen carefully because swallows might be nesting in the slopes of old quarries.

Some abandoned quarries contain still some sand and gravel. The complete re-exploitation of this resource would essentially add to the resources of a county and allow postponing or avoiding spoiling new areas with mining. Most likely a large amount of the above-mentioned resource will not be exploited due to its low quality and restrictions set by nature reserves and landowners. Still, the accessibility and amount of the suitable material needs further research. Also, putting the above-mentioned resource with ecological, hydrogeological, land using etc. information on the large scale (1:50 000) environmental geology maps should be discussed.

THE NEVA BAY: GEOLOGICAL STRUCTURE AND HISTORY OF DEVELOPMENT IN PLEISTOCENE-HOLOCENE

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The Neva Bay is limited from east to a mouth of the Neva River, from west to the protective dam of St. Petersburg (from Gorskaja — island Kotlin — to Lomonosov). Length of a bay is about 25 km, greatest width - 15 km, area of a area of water - about 320 kms^2. It is characterised by small depths (on the average about 3m) and flat horizontal bottom surface.

The maximal depths in the Neva Bay are connected with a anthropogenic activity. The Marine channel has depths more than 11 m. all the way from St. Petersburg harbour to outside the Neva Bay. The extensive underwater sand-pits for mining sands for new urban territories building are placed in east part of water basin, along front of city. The depths them are various and make to 5–8m. More them 25% of the Neva bay bottom is transformed to a variable degree by the anthropogenic processes.

The geological structure of the Neva bay bottom is determined by presence of a bedrock basement, which is overlapped by a continuous cover of the Quaternary deposits. The crystalline basement is located on depths 140 — 210m and is gentle dipped on a south-east. The sedimentary rocks of a plate cover are submitted by the deposits of vendian complex (Kotlin set), levelling of the crystalline rocks roughness. The buried overdeepened valley revealing the roof of the Vendian rocks is placed along northern and in many respects predetermines the form of the Neva Bay. The origin of this valley is connected, most likely, to erosional processes, in particular by activity of glacial-melt waters.

The quaternary deposits within the limits of the Neva Bay are submitted, basically, formations of the last glacial-sedimentary cycle of the Late Pleistocene-Holocene age. The till of the Luga stage is the most ancient formations last glacial-sedimentary cycle (about 18000-20000 years ago). They are exposed directly on a bottom surface on the cross swell Lomonosov – Lisij Nos and along northern coast. The underwater exposures of till are fixed by congestions of boulders reserving a roof glacial deposits from further erosion.

The limno-glacial sediments overlap directly the till and are submitted mainly brown warves. Their thickness is 8–14m.

The Early Holocene sediments known as deposits of the Yoldia sea and of Ancilus lake. They are submitted weakcompacted grey fine clays with a organic and hydrotroilit. These clays are exposure on a bottom surface at the centre of the Neva lip, and both along northern southern coast. They are overlapped thin (some centimetres) layer of modern sediments.

The Middle and Late Holocene deposits are submitted by sand and silt, frequently containing the thin layers of peat or vegetative rests. The Litorina sediments is located in the basis of middle Holocene section. Their formation is connected with same transgression, captured all the Baltic Sea area, after its final connection to World ocean across Danish Straits. The youngest sediments in the Neva Bay are the muddy deposits of its more deep-water part, sandy-clay sediments, covering the bed underwater sandy-pits and small sandy bodies of wave accumulation in nearshore both northern and southern coast.

History of development of the Neva Bay began from the moment of deviation of glacier from the Luga marginal zone and occurrence of nearglacier lake. Now this age is defined approximately per 14000 years, since in clays overlapping till in Prinevsky lowland was determined palaeomagnetic excurs Heteborg. Their age is dated 12400 — 12700 years ago. (by A. Mörner).

The arisen local lakes quickly have merged in one large nearglacier lake or so-called «Ramsey Lake», which exits during the period in 11800 — 11900 years ago. The typical warves is accumulated in this lake. The thickbedded clays with a significant impurity silty and sandy material occurred in the bottom part of the section of limno-glacial deposits. The thickness of layers is decreasing upwards on a section and decreasing a impurity of sand. Such structure was caused by deviation of glacier edge and reduction of receipt in a gulf of the silty and sandy material.

In time of early Drias cold spell (12800 — 13000 years ago) the border of a glacier moves nearer again to area of water of the modern Neva Bay, however has not overlapped it. Apparently, the Neva Bay at this time was a part of big freezing for the long period a lake. The large «Baltic glacial lake» has arisen in middle Allered owing to deviation of glacier edge, which was by a prototype of modern Baltic. The border of a glacier was at this time in the central parts of the Karelian neck.

Baltic glacial lake has ended the existence on a boundary of Pleistocene and Holocene, about 10000 years ago. The first connection of the Baltic sea with World ocean through Middle Sweden lowland was happened In this period . It was responsible for sharp fall of a level of Baltic (almost on 20 meters).

The large fresh basin was in Preboreal time of Holocene (8-10 000 years ago). in area of a modern Neva Bay, in which is accumulated the clay deposits containing vivianit and sulphides. The new separation of Baltic from World ocean occurred in the beginning of boreal time because of decreasing of glacial loading. It has resulted in some increase of a level of water basin. But subsequent regression has caused drainage of the Neva Bay. The next history of development of the Neva Bay is connected to the beginning of the transgression of Litorina sea, which began owing to penetration of salt ocean waters through the Danish straits. The melt gulf has within the limits of a modern Neva Bay about 6000 years ago. Their east coastal line passed on the average current of the Neva River. Outlines of modern northern and southern coasts differed slightly from modern. The salinity and temperature of Litorina sea waters were a little bit above modern. The Neva Bay represented at this time shallow gulf of this sea. Litorina transgression was replaced a regression and about 4500 years the modern area of water of the Neva Bay again was drained. At this time river Pra-Tosna ran into the Gulf of Finland near island Kotlin.

Last stage of deposit accumulation in the Neva Bay connected to break of the Ladoga waters on ancient valleys Pra-Mga and Pra-Tosna in result Newladoga transgression. This event has taken place on last data about 2500-3000 years ago. The accumulation of muddy sediments in the deep-part of the Neva Bay began after the formation this channel, which river Neva is now. When the river Neva ran to Gulf of Finland, several erosion channels was formed in mouth, which into horizon of litorina sediments cut. Thus the psevdodelta of the river Neva was formed. The modern sediments are represented as a few little sandy bodies of dynamic accumulation.

Prospective route of excursion:

1. Area of Wood Park - the Litorina terrace and mouth of the ancient river, which has served as the reason of accident by the St.-Petersburg subway.
2. Area of Lachta flood - natural object Lachta flood, warehouses of sea sand mining with The Gulf of Finland bottom, panorama of a sea part of St.- Petersburg.
3. Station Gorskaja - the Litorina terrace with erosion scarp 8-9 meters
4. Dam with one - two by stops both discussion of a problem of floods and protection against them
5. Kronstadt (harbour, western extremity of island, architecture of military city, history of protection of St.-Petersburg). Excursion is finished by southern site of a dam - panorama of a southern coast, St.-Petersburg - main port of Russia, geological structure of a dam. (last item is possible at presence of the permission).

HOLOCENE LANDSCAPE EVOLUTION IN THE KARELIAN ISTHMUS AND LAKE LADOGA AREA

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Deglaciation took place in the Lake Ladoga basin after the Neva stage between 12500 and 11500 radiocarbon years ago. Following ice retreat high level local ice lakes occupied the southern lake basin before the formation of the high level Baltic Ice Lake. In the northern Ladoga area the elevation of the Baltic Ice Lake prior to its drainage 10200 BP is marked by shorelines at 70 -80 m above sea level. During the subsequent Yoldia Sea stage (10200 - 9500 BP) rapid regression of several tens of meters of the Baltic water body continued. During this period most dramatic changes in the landscape evolution took place when extensive areas emerged from the Baltic basin waters. The Lake Ladoga basin was in connection with the Yoldia Sea via Heinjoki, east of Vyborg. The elevation of the threshold is 15 m above the sea level whereas the present elevation of Lake Ladoga is 5 m a.s.l The Baltic and Ladoga basins were connected by an open strait or a river outlet in the Vyborg area during the Ancylus Lake and Litorina Sea stages of the Baltic until the origin of River Neva, the present outlet of Lake Ladoga since 3100 BP. This was the second remarkable event in the landscape evolution, when the water level in the Ladoga basin suddenly dropped by 12 metres. The Heinjoki threshold became dry immediately and vast areas of former lake bottom sediments became dry land suitable for farming. However, evidence of this early land use is still lacking.

Man has been present in the area since Early Holocene as shown by the famous fishing net from Antrea dated to 9200 BP (or 10000 calendar years ago). The Neolithic settlers wittnessed the outburst of Lake Sairnaa waters via River Vuoksi to Lake Ladoga which resulted in flooding of coastal dwellings 5000 BP. Since the origin of Neva the course and water level of River Vuoksi has continuously changed as the river has eroded its sediment filled bed. A dramatic event took place in the recent past in AD 1818 when a spring flood broke through a natural dam between Lake Suvanto and Lake Ladoga, the level of Suvanto dropped by several metres, and the River Taipaleenjoki was formed and became the principal new outlet of River Vuoksi.

SOIL MICROMORPHOLOGY AND SEDIMENT ANALYSIS AND IT'S CONTRIBUTION TO THE INTERPRETATION OF ARCHAEOLOGICAL SITES

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The soils and the sediments of archaeological sites are providing a context for the artefacts. They are a resource of essential information about stratigraphy, site formation processes and possible natural or artificial disturbances. The microscopic study of thin sections from soils makes it possible to describe and measure components, features and fabrics in undisturbed soils which cannot be seen with the naked eye. The method provides an important insight into many problems of for example; soil development, diagenesis, weathering, soil/plant interactions, and can be used for palaeo-environmental reconstructions.

The use of micromorphology is increasing in a number of disciplines, particularly in Soil Science, Quaternary geology, and Palaeoecology. It was not until the 1970–92s that the micromorphological analysis of soil thin sections was developed for general application in archaeological investigations. Today, soil micromorphology has become one of the established scientific techniques like analysis of macrofossils, charcoal, pollen, and bulk chemical, biological, and physical analysis.

Soil micromorphology is an essential part in a recently started project at the Museum of Archaeology, Stavanger, in collaboration with the Department of Soil and Water Sciences at the Agricultural University of Norway. The project will combine different geoarchaeological methods to obtain new information about prehistoric agriculture, and prehistoric use of the landscape southwestern Norway. The combination of the different geoarchaeological methods is especially expected to throw new light on methodical problems related to pollen analysis in mineral soils.

STONE AGE ARCHAEOLOGY IN INNER-ESTONIA, THE BASIN OF PÄRNU RIVER AND LAKE VÖRTSJÄRV

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Already the first archaeologists in Estonia were interested in stone age of inland. For example, in the second half of the 19th century the geologist and archaeologist Konstantin Grewingk investigated very thoroughly the Mesolithic settlement site of Kunda in North Estonia. The site was situated on a little island of ancient lake Kunda. Almost all the latter archaeologists have done most of their investigation in the sites of Inner-Estonia, too. Between the world wars and during the World War II Richard Indreko excavated at Kunda, in the surroundings of the ancient lake Vörtsjärv and at Tamula, South Estonia. His attention was also captured by the findings of Pärnu River. After the war Lembit Jaanits carried on the investigations of stone age settlement sites of inland, but his research was focused on upper stone age.

In 1960-1970 the investigation of middle stone age sites began again. The cause for that was probably the discovery of the oldest settlement site of Estonia, which is situated on the bank of Pärnu River. Research work was carried out again on the banks of Vörtsjärv lake and the rivers of Navesti and Narva. The collection book «Prehistory of Estonia», which was published in 1982, presents very systematically and thoroughly all the information about our prehistory, which had been gathered by that time. The archaeologists have not discovered or excavated any Mesolithic coastal sites of that time. However, some Neolithic coastal sites have been investigated on Saaremaa and on the coast of North Estonia. In the second half of the last decade big changes took place in this kind of research, but stone age archaeology of inland has been neglected because of lack of researchers.

At the beginning of 1990 the Chair of Archaeology at Tartu University was re-opened. Now new generation of archaeologists is growing up. This year the author of the lecture graduated from university. The theme of the graduation work was introduction of use wear analyses of stone tools. The second part was about comparing edge analyses of flint tools from Mesolithic Umbusi and from Neolithic Valma. Both sites are situated on shores of lake. In connection with the work during one-day landscape investigation some new Mesolithic sites were discovered on banks of the lake Vörtsjärv. It shows that despite of previous successful research it is possible to find something new about stone age of inland. It will be very interesting to carry out research on banks of rivers. This autumn the author of the lecture has planned to continue the studies at university already. In connection with the work at Museum of Pärnu the theme will concern stone age settlement on banks of lakes and rivers in south-west of Estonia. At the moment are work is just beginning and the purpose is to collect and study existing materials and set up work hypotheses.

ENVIRONMENTAL CHANGES DURING THE LATE PLEISTOCENE IN THE AREA OF THE LAST FENNOSCANDIAN ICE SHEET

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Environmental reconstructions are based on different methods and data which reflect environment of geological past. Sources of such data are: genetical, palaeobotanical and palaeontological studies of sediments, geomorphological reconstructions etc. Among all source of data the most important are those providing palaeoclimatic records. The Late Pleistocene comprises the last 130000 years and includes the Eemian Interglacial (130-117 ka BP) and the Weichselian period (12-117 ka PB) - the Last Interglacial/Glacial cycle. The Eemian Interglacial is rather well studied in Northern Europe and is characterised by wide extension of broad leaved forests. The extension in space and time of glacial advances especially during the Early and Middle Weichselian is a subject of different interpretations in Western Europe and Nordic countries.

Stratigraphic research performed in eastern Lithuania during the last decade has resulted in discovery of many new sections with Eemian and Weichselian nonglacial sediments. The Eemian-Weichselian sequences, located just outside the maximum limit of the Late Weichselian ice sheet, provide excellent possibilities to find continuous sedimentary and climatic records encompassing the whole Last Interglacial/Glacial cycle. The most complete sequences representing the Last Interglacial/Glacial cycle have been found so far in eastern Lithuania at the Jonionys, Medininkai, Mickunai sites. Very significant data for palaeoenvironmental reconstructions are available in Nordic countries as well. For instance, stratigraphic and in central part of the last glaciation (Norrbotten province, Northern Sweden) show a regular presence of non-glacial sediments, attributed to two Early Weichselian Interstadials - Peräpahjola and Tärendö) (Lagerbäck and Robertsson, 1988, 1996; Lagerbäck 1988a, 1988b). The unique section from Sokli (Finnish Lappland) show presence there of ice free intervals (interstadials) correlated with Brörup, Odderade and Oerel interstadials respectively (Helmens *et al* 1997).

The palaeogeographical transect (Fig.1) displays composite sequence of changes of palaeoenvironments, chronostratigraphic position of climatic events and their correlation with isotope stages, extension of the Fennoscandian ice sheet. The results of the studies show the presence of periglacial and interstadial palaeonvironments in Lithuania during Early and Middle Weichselian, since the end of the Eemian Interglacial. The regular presence of deposits representing two interstadials Jonionys 1 and Jonionys 2, correlated with Brörup and Odderade in NW Europe, has been revealed. The data obtained display the presence of at least four thermomers, separated by cryomers within the Middle Weichselian complex.

Due to time-transgressive palaeoclimatic events, a formal stratigraphic correlation between the central and peripheral parts of the latest glaciation is very complicated and problematic. The vegetational zonation along this transect ought be regarded as very tentative and is based mainly on data from the periphery (eastern Lithuania). The limited number of sites with a continuous stratigraphic record significantly complicates the construction of a time dependent model of stratigraphic events through the Late Pleistocene. The main problem to be solved is the geochronological framework of the Last Interglacial-Glacial cycle, which has not yet a sufficient base of continental records in the area of the Last Glaciation. Especially the time interval beyond 40 000-50 000 years B.P. is problematic due to absence of proper datings.

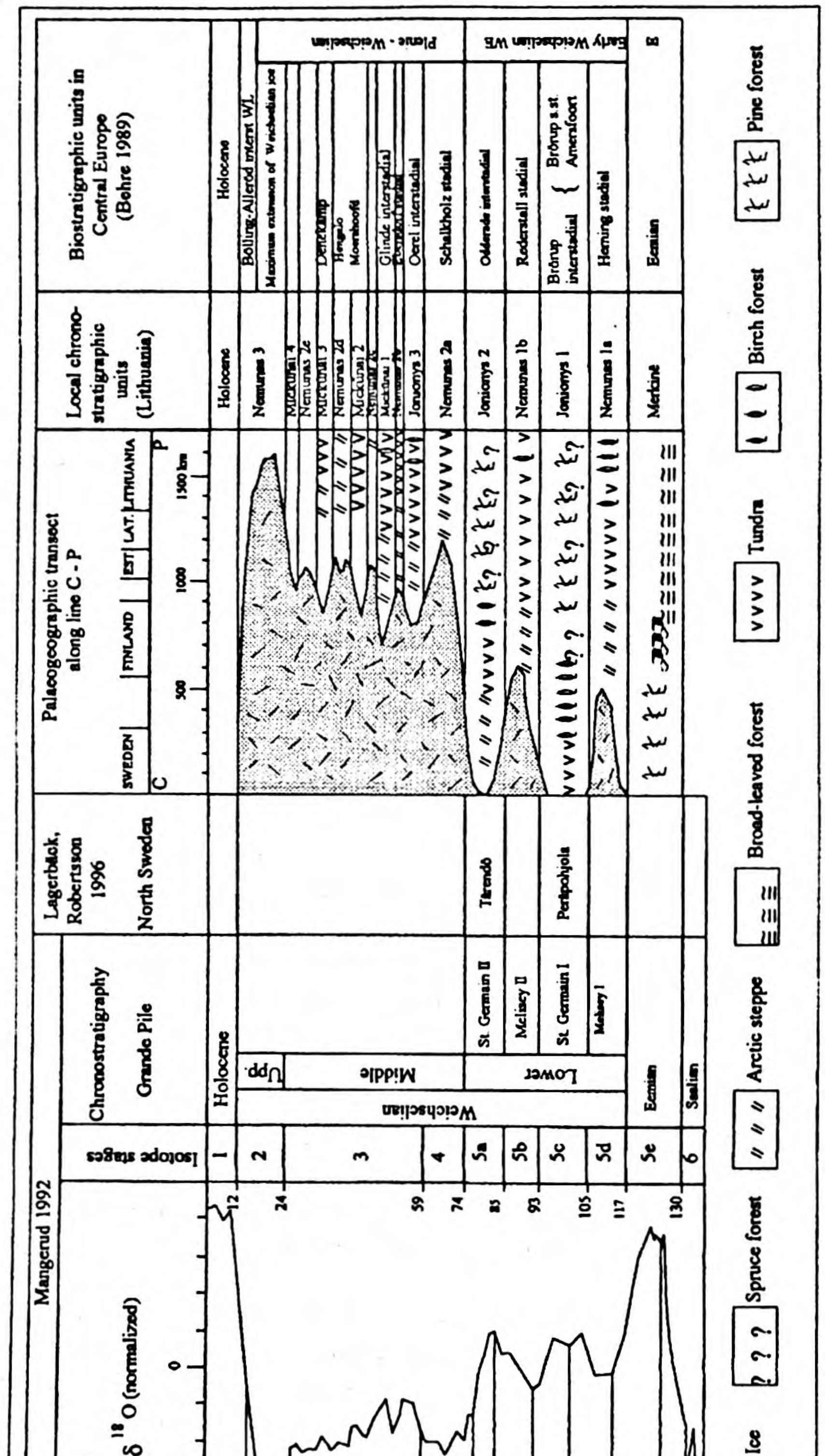

Fig. 1 Paleogeographic transect from Centre to Periphery of the Last Fennoscandian Ice Sheet

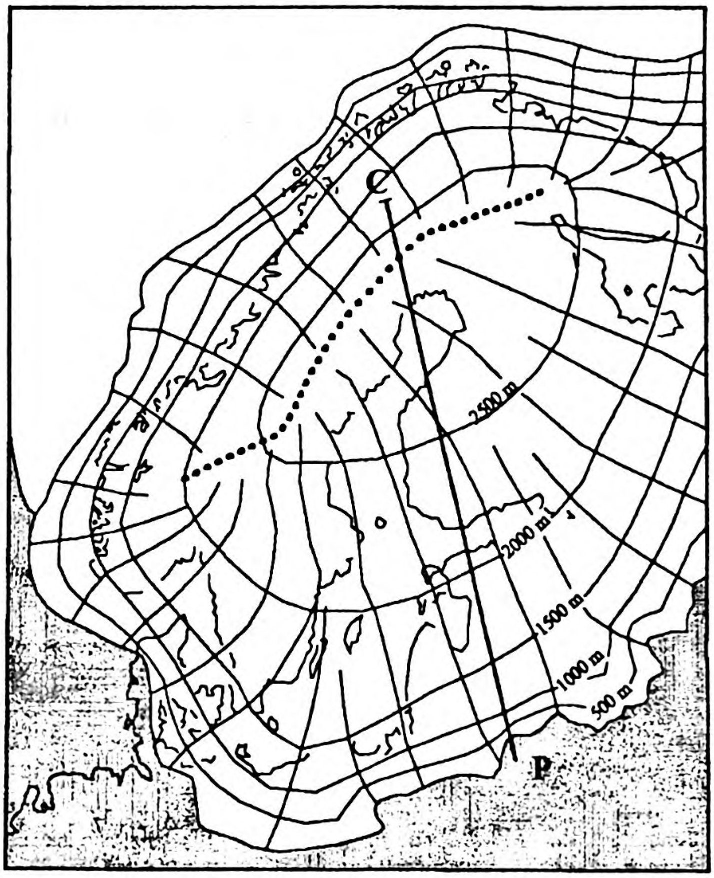

Fig. 2 The Last Fennoscandian Ice Sheet. Ice thickness, flow of Weichselian maximum (Ehlers 1992) and location of transect C – P

Nevertheless, the data already available allow to make conclusion of absence of Early-Middle Weichselian glacial deposits and presence of non-glacial conditions until the Late Weichselian in main part of the eastern Baltic area.

THE ENVIRONMENTAL CHANGES: THE GULF OF RIGA

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The Riga Gulf is geographically comparatively isolated sea area, which during the pass of thousands of years has sensitively reacted towards environmental changes in the Baltic Sea in general. Those changes in the partly closed basin are fixed and preserved much better as in most of the other places. This is the reason, why the Gulf of Riga in many aspects is successful reference area for the history of nature investigations in the Baltic Sea basin.

Since the Stone Age coasts of the bay are inhabited, but only during the last decades activities of man have caused an essential impact on environmental conditions in the bay. At present, this impact has been minimized because of economic recession and recent environmental actions, but revival of industrial processing economy should be balanced with the possibilities of gulf's ecosystems.

COMMON CHARACTERISTIC OF THE GULF OF RIGA

The Gulf of Riga is a relatively shallow water basin with a quite deep (about 50 m) central part and much shallower northern regions. The main water exchange takes place in winter through the Strait of Irbe. During a year, depending on hydro-metheorological conditions, about 25% of total water volume is exchanged.

The surface of the Gulf of Riga occupies 19 000 km^2, with a water volume of 430 km^3. The average discharge of Latvian rivers into the Gulf of Riga is about 29.1 km^3, in wet years it is up to 41,5 km^3 and in dry years about 17 km^3.

The Gulf of Riga is one of the most eutrophicated areas in the Baltic Sea. The annual primary production has been estimated to 4 million $t.year^{-1}$. This is about 290g C $m^2 year^{-1}$.

SEDIMENTS

Sediments in the Gulf area are stratified and by composition, color and organic remains easy can be stratified in several layers. Most of the area is covered with the Postlitorina Sea formations. There is *mud* spread deeper than 20- 25 m. It is weakly consolidated, fine disperse without admixture of coarser particles, saturated with water. On submarine slopes are presented *silt, silty sand* sediments. *Sandy* forms in the coastal zone from 3.5 to 7.5 m depth often contains interlayers enriched with heavy minerals, that have been formed as a result of action of waves.

GULF'S COASTS

The recent seacoast with beach and adjacent chain of dunes, in comparison with Litorina Sea mighty barrier beaches, is not more than some hundred meters wide belt. Therefore recent sea coast's contour lines are inherit from Litorina Sea time. Kolkasrags, Mersrags and Raganciema Capes are consisting mainly of Litorina Sea coast bars and bar-like dunes. The contour of the Gulf of Riga top is determined inside contour of the Litorina Sea accumulation forms - Jurmala Spit and barrier beach of the Garciems lagoon.

BOTTOM SEDIMENTS IN THE GULF OF RIGA

Thickness of the bottom sediments varies from 0.0 up to 20-30 cm, seldom more. The bottom sediments in the Gulf of Riga are terrigenous formations with prevailing of the clastic and clayey material. Huge areas of sea bottom are covered with relict sediments - by clays of periglacial basins, BIL, Yoldia Sea and Ancylus Lake. On the major part of the Central hollow mud sediments are saturated with gas, mainly hydrogen sulfide.

GEOCHEMICAL CHARACTERISTIC

Anomalies, related to *accumulation* areas of the potential metalliferous muds have wide distribution in the deepest part of the Gulf. There mean typical elements are: V, Mn, Ag, Zn, Cu, Mo, Ni, i.e. elements, actively sorbed by organic matter. Those anomalies have considerably areas of distribution and certainly are connected with the zones of intensive mud accumulation. *Technogenic* anomalies can be distinguishd in the S part of the Gulf of Riga (deltas of Daugava and Gauja rivers). They have been formed on the geochemical barrier "river-sea". They have a considerable displacement to the sea direction ("isolation" from coast). The most characteristical elements for those anomalies are Ag, Nb, Sr, V, P, and Ba.

CONDITIONS OF THE RECENT SEDIMENTATION IN THE GULF OF RIGA

Sedimentation in the Gulf of Riga is mainly subjecting according the common regularities of the sedimentation in the Baltic Sea. The Gulf of Riga is characteristic with considerable velocities of contemporary sedimentation (up to 1 cm in year), insignificant depths of the start of mud deposition, and also zonation distribution of the bottom sediments. The Gulf of Riga can be divided in 6 types of sedimentation conditions for the recent bottom sediments: constant intensive accumulation, constant temperate accumulation, transit or erosion- accumulation ("zero" accumulation), dynamic equilibrium or inconstant accumulation, accumulation in the river mouth areas, abrasion. Mentioned main sedimentation types have good correspondence to the results of bottom sediment pollution investigations. In general accumulation of the terrigenous materials in the Gulf of Riga is mainly related to the relief, which has been formed at the beginning of Holocene. Namely bottom topography is determined conditions of the sedimentation and be stipulated their zonation. Contemporary sedimentation continues the process, which started at beginning of the Yoldia Sea stage of the Baltic Sea development.

BOTTOM SEDIMENT'S POLLUTION

The main source of the pollution entering the Gulf of Riga is river flow and can be estimated to be approximately 30.7×10^6 m^3year^{-1}. Suspended particles coming from river flow (about 0.5×10^6 m^3year^{-1}) are sorbed in shelf of the pollution substances and accumulated in bottom sediments. Bottom sediment is not affected practically at the depth over 30 m by hydrodinamical processes. Therefore slow accumlation of suspended particles together with pollution substances takes place.

The first determination of pollution level of the bottom sediments by, HELCOM recomended, was carried out 1990–1991 in 6 components: *Corg.*, Pb, Cu, Zn, Cd and Hg. Its demonstrate limited human impact. Afterwards number of more studies was carried out with similar results.

The Gulf of Riga bottom sediments contain considerable amount of *Corg*, the content of *Corg*. have clear relations with dispersity of sediments. More content *Corg.* is observed in muddy sediments. The awerage content of *Corg.* in sandy sediments always is less than 1 %, in silty sediments 1–2.5 %, in muddy sediments - more than 3 %. Sediments are enriched mainly with terrigenous humus. *Corg.* gets into bottom sediments from chitin cover of benthos and vegetation cellulose as well. Amount of organic matter in the deepest part of the Gulf considerable exceeds the organic amount in the Baltic Sea, and also in the Azov, Caspian Sea and other productively water areas.The main area of increased *lead, cuper and zinc* content is in Southern and Western parts of the Gulf of Riga. Such areas are situated near the mouths of the biggest rivers - the Daugava, Lielupe and Gauja Rivers and are connected genetically with the outflows of these rivers. The area of high lead content borders with the Irbe Strait and, obviously, is related genetically with onshore current of the drift passing from the Baltic Sea into the Gulf of Riga.

Content of *cadmium* increased up to 0.6- 0.7 mg/g is found in lees that are located only in the Eastern and northern of parts of the Gulf. These are areas of clay deposits, obviously, sorbing this element. It is worth to pay attention to the anomaly of area, which lies near the mouths of the Daugava and Lielupe Rivers. The content of the cadmium here is small, however those are points of the pollution from river outflows. The local area with increased content of *mercury* lies near the mouths of the Rivers Daugava and Gauja only. So the analisis of distribution and content of studied pollutants shows, that the main areas of concentration of the heavy metals is related to the mouths of the largest rivers.

MODERN POLLUTION

About 7% of all freshwater draining into the Baltic Sea flows through the territory of Latvia. At the beginning of the 90ies this contributed more than 17% of the total nitrogen and up to 5% of the total phosphorous load discharged into the Baltic Sea. About 53% of water, discharged from the territory of Latvia into the Gulf of Riga, is transit watei from neighboring countries.

Modern pollution during the last decades were studied several times and correspondig monitoring is created. The newest data analysis support following conclusions:

The nutrient load in rivers 1991-1998 does not show significant trends, despite the dramatic decrease in fertilizer consumption. Probably this can be explained by the amounts of nutrients from previous years accumulated in the soil or in the sediments of the river basins.

Total winter phosphorus concentrations in the Gulf of Riga are still growing while nitrogen concentrations and phytoplancton biomass concentration in 1993-1996 were lower than in preceding years. However, the data basis is still not sufficient for trend analysis and conclusions.

Changes in marine species structure and biomass concentration, triggered by eutrofication are still going on: blue algae blooming, elevated concentration of colifom bacteria, zooplancton species shift and decreasing number of mollusk species.

Concentrations of dissolved heavy metals and oil hydrocarbons do not show any significant peculiarities.

PALEOBAY OF LADOGA - THE LAKE SUURI (HOLOCENE DYNAMICS OF ALGOFLORA)

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Limnology and plaeogeography researches carried out during the last years in Lake Ladoga area and on Karelian Isthmus have shown that the beginning of sedimentogenesis in the basin of the Lake Ladoga and on the boarder of the Karelian Isthmus dates from the time of disengage this region from glacial cover and flooded with thawed waters in late Dryas time. Therefore, the most lakes of the Karelian Isthmus north have similar stratigraphy of bottom sediments, analogous to the opened by coloumns in the basin of Lake Ladoga.

In lakes of north-west Lake Ladoga region, which genesis have connection with Lake Ladoga, usually a trinomial structure of bottom sediments is discovered. Grey-light-blue flaky clays, lay in the basis which above become grey-broun gomogeneous clays and then - organic silt. The layers of organic silt content the biggest guantity of agaflora remains. The composition of the remains reflect paleoecological conditions in these lakes from the time their isolation from pra-Ladoga to present day.

The change in sidemention conditions in little lakes is closely connected with the sharp changes of Lake Ladoga level depended on palaeoecological conditions. The results of diatom analyses showed that lake level changes in the past can switch to transition of water ecosistem from one trophical level to another.

Diatom complexes are important indicator of ecological conditions for water environment. As it is known, the ecological structure of diatoms changes in time reflecting change in ecosistem condition. Depth, flowage, limpidity of water, temperature, hydrochemical and lake level position are expressed in specific composition of diatoms .

In the table, which made on the basis of published research materials and up-to-date resuls achieved by the author after analysis of bottom sedimens coloumns, diatom complexes characteristic for different stages of the Holocene are shown.

Their comparison is given at the level of dominant and subdominant kinds in the lakes of different types: large oligotrophic Lake Ladoga; middle size evtrophic reservoir — Suuri Lake and small swamp distrophic-lake — Manti-Lampy. The algoflora these lakes can be considered as common succesion line, so as it have common origin.

Reservoirs chosen for comparative analysis represent generical development of united water geosistem. At a stage of lateglacial time they were united by integrated pra-reservoir, from which in postglacial time independent water objects separated. Lake Suuri is a palaeobay of Lake Ladoga, and Lake Manti-Lampy — ex-bay of Lake Suuri. The effect of isolation of Suuri and Manti-Lampy Lakes is brightly expressed not only in stratigraphy and litology of sediments, but also in changes of diatom complexes which these lakes contain. The isolation Lake Manti-Lampy from Lake Suuri was occur during sub-Atlantic period as the result of Lake Suuri level reduction on 2 metrs.

As our data show, diatom complexes changed during late- and postglacial period. It is reflected in domination of different kinds of diatoms during different stages of evolution of these lakes (Table).

As at present, in the past diatom complexes in lakes with different hydrological condition had their own special features, caused by differences in habitat of hydrobionts (depth, flowage, pH, turbidity at al.). These special features espesially distinctly displayed in the second half of the Holocene.

Therefore, modern diatom complexes of Lake Ladoga are characteristed by the dominance of *Aulacosira islandica ssp. helvetica, A. italica, Cyclotella comta, C. vorticosa, Asterionella formosa.* Unlike this in Suuri Lake, apart from *Aulacosira islandica* dominate: *Aulacosira distans var. alpigena, Cyclotella stelligera, Stephanodiscus astraea*, and in Manti-lampy besides with *Aulacosira islandica - Aulacosira distans var. lirata, Tabellaria fenestrata, Eunotia lunaris, Stauroneis anceps.*

It is important that in all investigated coloumns of bottom sediments the presence of number of typically Lake Ladoga species of diatoms was observed: *Aulacosira islandica ssp. helvetica, Cyclotella comta* both at the beginning of the Holocene, and at present. However, during lastglacial period (BO, All, Dr) integreted diatom flora which is characteristic of cold and deep water pool, prevailed in sediments of all lakes. During the Holocene diatom complexes underwent significant chages, and in coloumns of bottom sediments of different lakes specific kinds of diatoms are appeared.

At the beginning of postglacial time (Pb, BO) in Lake Ladoga and other lakes of the Karelian Istmuth some kinds of diatoms dissapeared (for example, *Navicula menisculus*), but north-alpine kinds, which are typical for cold-water oligotrophic reservoirs remain dominant. In that period of time specific composition of diatoms in Suuri and Manti-lampy lakes already differ from diatoms composition in the Lake Ladoga. By the middle of the Holocene (AT) in this diatom composition some special diatom complexes appear, this is probably caused by complete isolation of these reservoirs from Lake Ladoga. Alongside with the dominant *Cyclotella comta* new kinds related to genus *Diploneis, Achnantes, Cymbella, Epitemia* appear. At last by modern period in Suuri and Manti - lampy lakes form specific diatom complexes which are different from the complexes of Lake Ladoga. In Suuri Lake besides with mass diatoms, marked in table, appear: *Aulacosira distans var. lirata, Stephanodiscus astraea*, and in Lake Manti-lampy - *Aulacosira distans var. alpigena, Cyclotella stelligera, Eunotia sudetica.*

The marked special features in the composition of diatoms can be explaned by regression of Lake Ladoga in the late Holocene and complete isolation of Suuri and Manti-lampy lakes, which are smaller in size, from bigger reservoir, on account of their ecological conditions have changed. As a result of comparison of investigated complexes, we can to conclude that at present among the mass diatoms kinds which are characteristic of Lake Ladoga ecosystem continue are still present. The Lake Ladoga influence has caused the whole course of ecosistem evolution of Suuri and Manti-Lampy lakes, which had separated from Lake Ladoga. However, in modern sediments of these lakes specific kinds, which are not distributed in Lake Ladoga, alredy are founded. This circumstance is the indicator of radical changes in ecological conditions in isolated reservoirs and can point at development of evtrophication processes in these lakes.

Table

Comparison of grous mass diatoms in Ladoga, Suuri and Manti-lampi lakes

CHRONOLOGY	LAKES			BALTIC HISTORY
	LADOGA	SUURI	MANTI-LAMPY	
SA	*Aulacosira islandica, Aulacosira italica, Asterionella formosa*	*Aulacosira distans var. Cyclotella steligera, Eunotia pectinalis*	*Aulacosira distans var. lirata, Tabellaria fenestrata Eunotia lunaris*	**MODERN PERIOD**
SB	*Aulacosira islandica ssp. helvetica, Aulacosira distans, Stepha-nodiscus astraea*	*Aulacosira islandica ssp. helvetica, Aulacosira distans, Eunotia pectinalis var. undulata*	*Aulacosira islandica ssp. helvetica, Aulacosira distans, Frustulia rhomboides*	**POST-LITORINA PERIOD**
AT	*Aulacosira distans var. alpigena, Aulacosira italica, Cyclotella comta, Stepha-nodiscus astraea*	*Aulacosira distans var. alpigena, Aulacosira distans var. lirata, Paralia arenaria, Paralia scabrosa*	*Aulacosira distans var. alpigena, Aulacosira distans var. lirata, Pinnularia gibba, Stauroneis anceps*	**LITORINA SEA**
BO, PB	*Aulacosira islandica ssp. helvetica, Cyclotella comta, Stephano-discus astraea var.minutulus*	*Paralia arenaria, Paralia scabrosa, Eunotia clevei, Epitemia hyndmanii*	*Melosira ambiqua, Cyclotella stelligera, Tabellaria fenestrata, Eunotia pectinalis*	**ANCSIL LAKE**
DR, ALL, Bo	*Aulacosira islandica ssp. helvetica, Cyclotella comta, Stephanodiscus astraea, Eucocconeis laponica, Eunotia clevei, Frustulia rhomboides, Anomoconeis serians var. brachysira, Paralia scabrosa, Navicula menisculus*			**IOLD SEA**

SOCIETY AND ENVIRONMENT IN THE LATE PREHISTORIC EASTERN LATVIA

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Social archaeology as a specific trend of research within archaeology has been developed in the Western countries especially since the rise of so called processual archaeology in the 1960s-1970s. In their studies of this topic archaeologists concentrate their attention to such themes as social organisation and complexity, relationships among the people in both vertical (social and political hierarchies) and horizontal (kinship) dimensions, ways of interactions and influences among the societies of different stage and/or form of complexity, but, of course, the main accent is put on the explanations of social changes and transformations. Very often the ethno-archaeological and anthropological sources and theories have been applied to these studies, what culminated in the statement «archaeology as anthropology». Especially the anthropological theories of, for example, E.R.Service or M.Fried, were used to define and/or describe the prehistoric societies of the present Western countries.

During that time the scientific methodology was developed to explore the structures and organisation of society, so introducing the statistical, computing, etc., methods of the sciences into archaeology.

In the 1980s, by the formation of so called post-processual archaeology, the new topics have appeared on agenda, like archaeology of power, gender archaeology, critique of the concept of social evolution what which actually was the basis for previous researches. This quite historical approach to the archaeological remains is orientated more towards particularism and individualism, past and present relationships, cognitive, ideological and symbolic aspects of prehistory. The contemporary archaeology includes material culture studies and interpretative approach to societies, usually in the connection with the ideas of modern sociology and philosophy, emphasising their context in space and time, the search for individualism in prehistory. Anyway social archaeology seems to be an example of linking both practical field and theoretical parts of archaeology, at the same time connecting processual and post-processual approaches in archaeology.

It is proposed to analyse there the social organisation and social relations in the Eastern part of Latvia (nowadays Vidzeme, Latgale and Silija) during the second half of the Iron Age (the 7th -12th centuries). The 7th - 8th centuries were the turning point in Latvian Iron Age. The previous construction and organisation of society coming from the Bronze Age and finding itself in the crisis during the Early Iron Age, now was replaced by different model of society. The newly introduced social and political organisation reaches its peak of flourishing some centuries later, during the late 10th -11th centuries. It seems that the 12th century again was a period of social and political crisis in Latvia when the different ways of social development were sought in Latvia but which was interrupted by the Crusades and establishment of the new order in territories of present Latvia and Estonia. Thus there could be followed a circle of social development during the period under the question: the rise of new society in late Middle Iron Age, flourishing in the middle Late Iron Age and reaching its crisis towards the end of the 12th century.

The main source of information, as always about prehistoric periods, are archaeological remains: monuments and artefacts obtained in the course of archaeological excavations on settlements, hillforts and graveyards. There are about 1000 archaeological monuments in the territory of the Eastern Latvia what can be dated back to the late Middle and Late Iron Ages. The archaeological monuments of the region is quite well researched, the archaeological excavations have been carried out on almost 300 monuments.

Alongside with the archaeological material, the written sources also could help to highlight the social processes in the Eastern Latvia during the Late Iron Age. The first written historical sources in Latvia was created in the early 13th century. The main interest of them deserves Heinrici Chronicon written by contemporary clergyman during the 1220s. But it have to be remembered, the chronicle describes, and also very politically, just the situation in the early 13th century. And the retrospective use of it has some dangers of false interpretation of earlier stages of historical development.

The social construction of society namely social organisation is the problem around what the research usually is focused. The quantitative and qualitative differences of burial structures and grave goods, the distribution of burials within the graveyard, these are the important topics studied also before. The settlements and hillforts also hold within themselves the socio-symbolic meaning of social organisation. It is considered the location of houses and the inner spatial organisation of living-dwellings reflects social relationships between the inhabitants of houses as well as between the individuals from the same building.

Stratified, complex societies are often characterised by the site hierarchy. There very useful could be the theory of central places in conformity with what every centre has its hinterland which can be calculated mathematically on the basis of the spread of monuments. Thus every complex society needs to have the centre which usually can be related to the archaeological complexes - large and strong hillfort with ancient town/settlement, cult site, harbour/trading place, etc.

The site hierarchy and central places allows us to suggest the existence of some collective/individual power. The sources of power can be rooted in both warfare and violence and the control over the different resources, e.g., trade routes, raw material deposits. Collective power usually seeks to preserve traditional way of life often connected with the rituals, too, while the innovation is linked with the ambitious individuals. Presumable the relationships between the traditional and innovation have very great influence on the social (and political) dynamics. There is a number of models which are connected with the complex societies: segmentary societies, Big Man societies, chiefdoms and the early state. Of course, they are only labels but to create the general picture of social transformations in the Eastern Latvia during the prehistory it is necessary to find and to establish the archaeological correlates of them within Latvian material.

Much more difficult is to define the processes under which the ranking and hereditary status develop. Processual and functional analyses proposed that the changes leading to ranking most often were caused by population pressure. These researchers believed the societies behaviour must be adaptive. So Binford had argued that imbalances between society and its landscape induced adaptive change. The societies were thought to be static, and to be changed they required some kind of external pressure. In contemporary social archaeology it has been showed and proved the opposite view, that the egalitarian societies are exception and normally societies are ranked. A lot of variables under the influence of which the society more or less quickly become ranked are identified. The most important ones are resource base and large base population. The access to resources (mines, trade-routes, etc.) allows to some ambitious individuals to get and to establish the control over resources and to use them in their own interests. And, of course, of great importance is environmental condition which circumscribes people to live in a small area (like large villages).

THE HISTORICAL AND ARCHAEOLOGICAL RESEARCH OF THE WATER-WAYS AND NAVIGATION IN THE NORTH-WESTERN RUSSIA.

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The North-Western Russia, in case of its geographical position,was included into the political, economical and cultural processes of Baltic region. The remoteness of its main centres from the sea coast promoted the increasing of the role of the inner water-ways, connected with Baltic Sea (Fig. 1).

The investigations of the main north-western water-ways: 1. by the Volkhov, the Ladoga lake to the Neva river (Fig. 2); 2. by the Velikaya river to the Pskovskoye and the Chudskoe lakes and to the Narva river (Fig. 3); 3. by the Luga (Fig. 4); and the place of this ways in the system of the ancient russian communi cations is considered by Russian Historians since early 19th. Since that time the problems of the organization of the water-ways service and control-system are discussed in the historiography.

On the next stage started in the middle of our century, the archaeological and numismatic sources are often used for the solution of the problems of the waterways' exploitation. The aping, dating and systematisation of that sources allowed to make the partial reconstruction of the process of forming and functioning of the water-ways. The modelling of the communication on the medieval water-ways became the perspective trend in the modern science. It includes different types of vessels, even the copies of the medieval crafts. By this modelling we can determine the spied of the motion on the separate parts

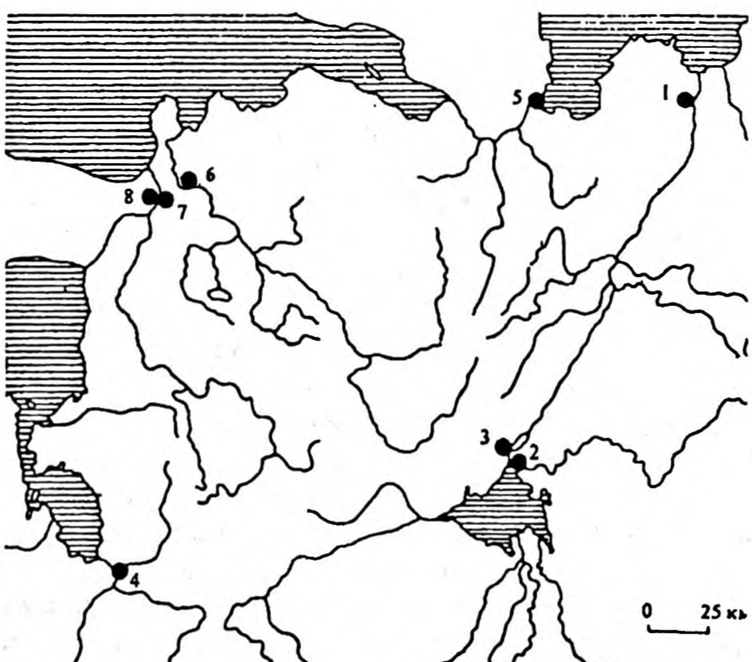

Fig. 1. The water systems connected the North-Western Russia with Baltic area and the city cetres on these ways. 1 - Staraya Ladoga, 2 - Ryurikovo gorodische, 3 - Novgorod, 4 - Pskov, 5 - Oreshek, 6 - Yamgorod, 7 - Ivangorod, 8 - Narva.

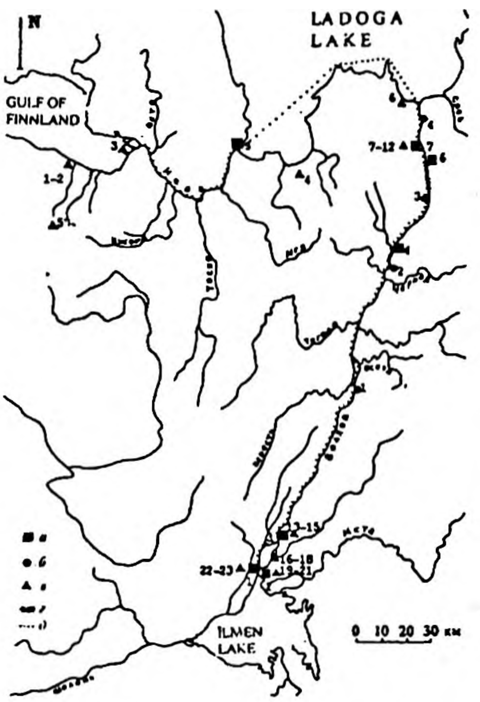

Fig. 2. The Volkhov–Ladoga–Neva way. a — fortress (1 — Novgorod, 2 — Ryurikovo gorodische, 3 — Kholopii gorodok, 4 — Gorodosche, 5 — Oreschek, 6 — Novye Duboviki, 7 — Ladoga); b — other places on the water way (1 — Gruzino, 2 - Pechva, 3 — Gostinopol,e, 4 — Issad); c — burieds of coins and objects (1,2 — Petrodvorez, Martyshkino, 3 — Basil islands, 4 — Putilovo, 5 — Gorki, 6 — Ladoga lake shore, 7–12 — Staraya Ladoga, 13–15 — Kholopii Gorodok, Khutynskii monastery, Dog's coffins, 16–18 — Kirillov monastery, Vylegi, 19–21 — Ryurikovo Gorodische, 22–23 — Novgorod); d — waterfall place; e — the route-marsh of water way.

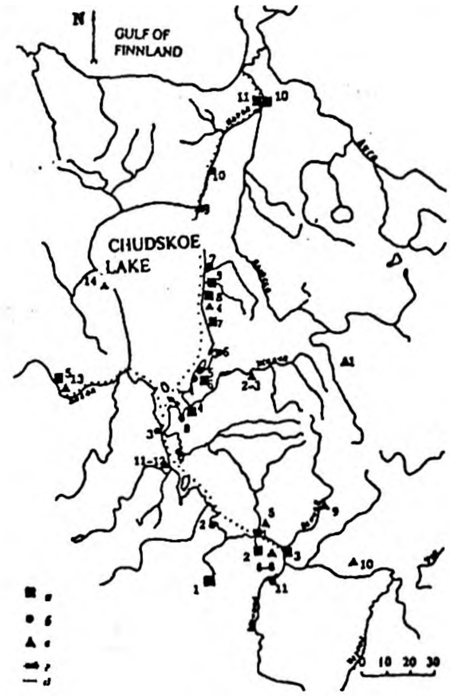

Fig. 3. The Pskov-Chudskoe-Narova way. a — fortress (1 — Izborsk, 2 — Kamno, 3 — Pskov, 4 — Kobyl'e gorodische, 5 — Yur'ev, 6 — Mda, 7 — Storozhinez, 8 — Gorodische, 9 — Gdov, 10 — Ivangorod, 11 — Narva); b — the other places on the water way (1 — Ust'e, 2 — Issad, 3 — Uzmen, 4 — Podolesch'e, 5 — Ostrovzy, 6 — Zalakhtov'e, 7 — Kalikhnovischna, 8 — Smolna, 9 — Skam'ya, 10 — Olgin cross, 11 — Vybuty); c — burieds (1 - Uzmino, 2 — Zabel'skoe, 3 — Polna, 4 — Ruch'i, 5 — Ust'e, 6–8 — Pskov districts, 9 — Molodi, 10 — Karamyshevo, 11–12 — Vyypsu, Pyapina, 13 — Yur'ev, 14 — Alatskivi); d — waterfall place; e — the route-marsh of water way.

of the way and also better undestand the intercommunication between the arrangement of the archaeological sites and the ancient system of navigation.

During the investigation of the documents of Novgorodian-Hanseatic league trade, allowed us to conclude that the combined cargo transportations had existed on the water-ways: the separate parts of this way were to be passed by different types of vessels. Taking as a basis the Scandinavian sagas and archaeological finds from Staraya Ladoga, Novgorod, Pskov, we supposed this system had been formed in the Viking age.

The north-western water-ways, according to the condition of navigation is divided into three main parts: two river and one lake part. The topographical arrangement of the archaeological sites on the shores of this water-way shows only the small rise of Volkhov's water-level during the Middle Ages.

The several periods in the exploitation of north-western water-ways can be distinguished, according to the archaeological and written sources.

So-called «archaic» period can be dated to the early Iron Age. At that period only local communications existed along the rivers-systems within the area of the archaeological cultures of that time. The sites of these cultures were discovered in the key-points of the river.

Russian-viking period continued since the middle of 8th to the end of 11th centuries. The archaeological sites of that time are concentrated in three zones of the water-way: this is, first of all, two large conglomerations of settlements in the Upper and Lower

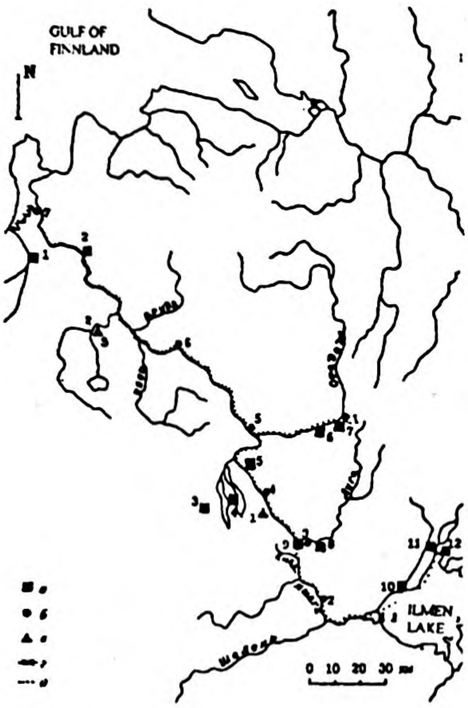

Fig. 4. The Luga's way. a — fortress (1 — Ivangorod, 2 — Yamgorod, 3 — Gorodez on the Luga, 4 — Petrovski pogost, 5 — Podgor'e, 6 — Nadbel'e, 7 — Kositskoe Gorodische, 8 — Peredol,skoe Gorodische, 9 — Gdov, 10 — Sergov, 11 — Novgorod, 12 — Ryurikovo Gorodische); b — the other places on the water way (1 — Yam-Tesovo, 2 — Medved, 3 — Bol'shoi Volk, 4 — Onezhizy, 5 — Zhel'zy, 6 — Lemovzha, 7 — Elkino); c — burieds (1 — Gerki, 2 — Lozhgolovo); d — waterfall place; e — the route-matsh of water way.

Volkhov, which were already formed in the 8 th - 10th centuries, and next, the zone near the Neva-river mouth, where many hoards of coins were found - it shows the existence of the trading sites in that area. At that period Volkhov - Ladoga - Neva water-way was the most important part of the transcontinental trade way from the North Europe to Arabian East and to Byzantium. The systems of organization of navigation and control were formed at all its length. Vikings, the inhabitants of Staraya Ladoga, did this work at the west part of the way (from the Neva mouth to the Lower Volkhov) and on Volkhov the local population did the same work. At the first part of the way merchants sailed on the Scandinavian sea-ships, then at the second part small keel-crafts and flat-bottomed ferry boats were used.

At this period the navigation by the Velikaya river to the Pskovskoye and the Chudskoye lakes and to the Narva river and its control were carried out by Slavs and Scandinavians,the inhabitants of the south shore of Pskovskoye lake and by Finns,settled on the shores of the Chudskoe lake and Narva river. During this period the water-way became a part of the ramified syste m of international trade communications. Pskovian period, that lasted from the middle 11^{th} to the end of the 12^{th} centuries, is characterised by the active colonisation of the south and east shores of Pskovskoye and Chudskoye Lakes and Upper Narva river by Russian population. At this time the forming of the system of navigation and control, based on the settlements at the key-points of the way also started. Pskovian-

During the next Novgorodian-Hanseatic league period (from 12^{th} to the beginning of 14^{th} centuries) Volkhov-Ladoga-Neva water-way gradually passed to the direct control of Novgorod. The Izhora tribe, being dependent from Novgorod, guarded the Neva part of the way. On the next stages, in the case of the enemy's penetration to the Ladoga Lake, the guard functions passed to the inhabitants of Staraya Ladoga and Novgorod. The active development of novgorodian navigation on the Baltic sea and trade with Gotland and Hanseatic league is connected with the beginning of this period (the 12 th century). The part of the water-way by the Ladoga and the Neva passed to the service's zone of Russian boatmen and pilots.

This period for way by the Velikaya river to the Pskovskoye and the Chudskoye lakes and to the Narva river continued from the middle of the 13^{th} to the end of the 15^{th} centuries, when this water-way was actively used for trade connections of Pskov and Novgorod with the countries of Baltic region. The struggle for the ownership of the way between Novgorod and Pskov on one side and German Order, Denmark and Sweden on another side finished by the demarcation of the Russian and Order's possessions in the region and by the creation of the double control system and of the service system on this water-way.

The Novgorodian period continued from the beginning of the 14^{th} to the end of the 15^{th} centuries. The foundation of Oreshek (1323), the demarcation of the Novgorodian and Swedish possessions (1324) and the colonization of the Neva shores by Russian population allowed Novgorod to strengthen the system of control in the west part of the way and to turn Neva region into the fleet base. It gaves to Russian craft-owners the possibility to service the parts of the trade ways, and in the war periods to carry out the navy operations in the Finnish Gulf.

During the first stage from the late 9^{th} - early 10^{th} to the 14^{th} centuries Luzhski way was used chiefly for inner communications between the large settlement's zones of Upper Volkhov on one side and Upper Luga and Middle Oredezh on another side. The beginning of the second stage was connected with the stimulation of the Novgorodian and Hanseatic league merchants' trade in Narva region and Lower Luga, with the new land ways, which were arisen near water-way, with the foundation of Narva etc. The foundation of Yamgorod in 1384 gave a possibility to the Novgorodians to organize the reliable control of the way on the Middle Luga. Probably in the 14^{th}-15^{th} centuries the system of communication was formed along the whole length of this river.

The natural conditions of the North-Western Russia: the shallow and rapid parts of the rivers, the rich forest resources contributed to the primary spreading on that territory the types of crafts, built with a dugout base and flat-bottomed boats. They could overcome all obstacles on water-ways and were easy to be made. During the Middle Ages the distinct tendency of the gradual colonization of the shores of the inner waterways can be traced. This process took place in the close connection with the process of forming and evolution of the navigation service system. As a result the forward bases of Russian crafts were transferred from the far districts of the region closely to the sea coast - to Oreshek, to the settlements on the Neva river, to Yamgorod and Ivangorod. The important prerequisites to develope Russian navigation on Baltic Sea were created.

DIATOMS IN ENVIRONMENTAL STUDIES

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Diatoms are unicellular algae. The cell walls are made of silica; these fossils are therefore often well preserved in sediments. Diatom taxonomy is based on the varied shapes and beautiful ornamentation of these walls. Diatoms are sensitive to many environmental variables and show a rapid response to water chemistry changes; they are therefore used as indicators of environmental changes such as salinity changes, acidification, eutrophication, and climatic changes. We can therefore f.i. interpret the past water quality of inland lakes from the study of the diatom content of lake sediments.

There is two basic methods used to establish the ecological tolerance of the diatoms for interpretation of environmental changes. One method is to use checklists, where established literature on ecological tolerances has been collected. The most common variables are coded in these lists. A more modern method is to use ordination to infer relations from data sets on diatom communities and their environment (canonical correspondence analysis).

The pre-industrial pH history of a lake in area of southern Norway that presently has heavy acid precipitation is elucidated on the basis of an 800-year history of its diatom assemblage. Diatom analysis of surface sediment samples from more than 20 lakes and the present water chemistry in these lakes is presented. This data set will serve as background information in interpreting the history of these lakes.

BALTIC LEVEL CHANGES RECORDED IN LAKE AND BOG SEDIMENTS OF THE KARELIAN ISTMUS IN THE LATE PLEISTOCENE-HOLOCENE TIME

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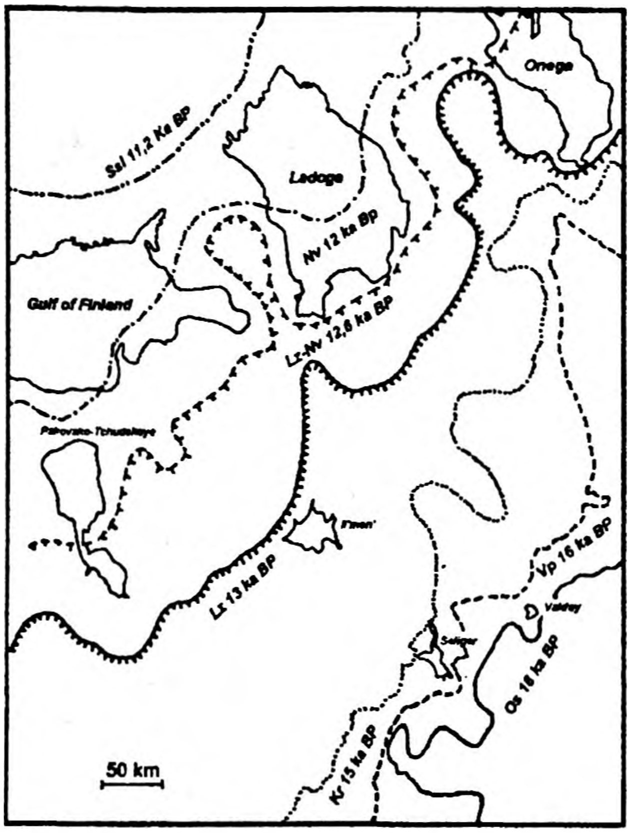
The Karelian Isthmus (60° to 61°N and 28° 30' to 31°E), which has a surface area of ca. 14,000 km^2, is located in North-Western Russia between the Gulf of Finland and Lake Ladoga. The southern border is the Neva River, and the northern part borders Finland. The territory of the Karelian Isthmus is drained by numerous rivers, of which River Vuoksi, the outlet of Lake Saimaa, one of the main tributaries of Lake Ladoga is the largest. The area, especially the northern part of it, is dominated by its more than 800 lakes which were formed since the last deglaciation. The central part of the Karelian Isthmus is an upland area with elevations above 100 m a.s.l. and a maximum elevation of 203 m a.s.l. Several terrace levels can be observed on its northern slopes at 180-140-120 m, 115-100-80 m, 70-40 m, 40-20 m and 20-0 m which reflect the presence of different water basins from ca 13, 000 yr. BP up to present. The southern slopes of the highland are formed by kame ridges with elevations of 45, 60 and 80 m a.s.l. In the southern part of the Isthmus, between the south-eastern part of the Gulf of Finland and the south-western shore of Lake Ladoga lies the Neva Lowland (15-25 m a.s.l.). This area is characterized by numerous terraces, which formed during the Holocene. The city of St.Petersburg is e.g. located at the mouth of the Neva River on the four lowermost terraces at 3-5 m, 10-13 m, 14-19 m and 25-30 m a.s.l.

The Karelian Isthmus is situated at the contact zone between the Baltic Crystalline Shield and the Russian plateau. The Precambrian crystalline basement is overlain by Cambrian sandstones and clays. In the central part of the highland, three horizons with glacial and interglacial sediments have been distinguished and attributed to the Dneprovskaya (Mindel), Moskovskaya (Riss) and Valday (Würm) stages of glaciation.

During the maximum of the Late Valday Glaciation (ca. 24,000 -18,000 BP) the NW Russian Plain down to 55°N was covered by ice. From ca. 15,000 yr. BP and onwards the ice retreated more rapidly, however, dead ice is supposed to have remained in these area until ca. 12,000 yr. BP. During the retreat several marginal deposits were formed the oldest of which are the Luga stage (ca. 13,000 yr. BP) and the Neva stage (ca. 12,000 yr. BP). The timing of ice recession and of the different ice margins stages is, however, not underpinned by sufficient radiocarbon dates. Following some researchers, the Luga stage is placed between 13,000-14,000 yr. BP and the Neva stage around 12,000 yr. BP, while others argue that both the Luga and Neva cold phases occurred before ca. 12,700 yr. BP. Based on a clay varve chronology, Markov and Krasnov (1930) could show, that almost the whole Neva Lowland from Ust-Tosno to Sestroretsk became deglaciated within a time period of 100-120 years. They also found that the ice recession to the north-west, in the direction of Viborg was ca. 350-400 meter per year. This rapid ice retreat is explained by a rapid rise of water level in the ice-dammed lake, which covered the Neva Lowland. During that time the ice sheet was divided into two tongues: the Ladoga tongue and the Gulf of Finland tongue. Markov and Krasnov suggested that this period should be regarded as the end of the Neva stage, which they placed around ca. 12,600 yr. BP.

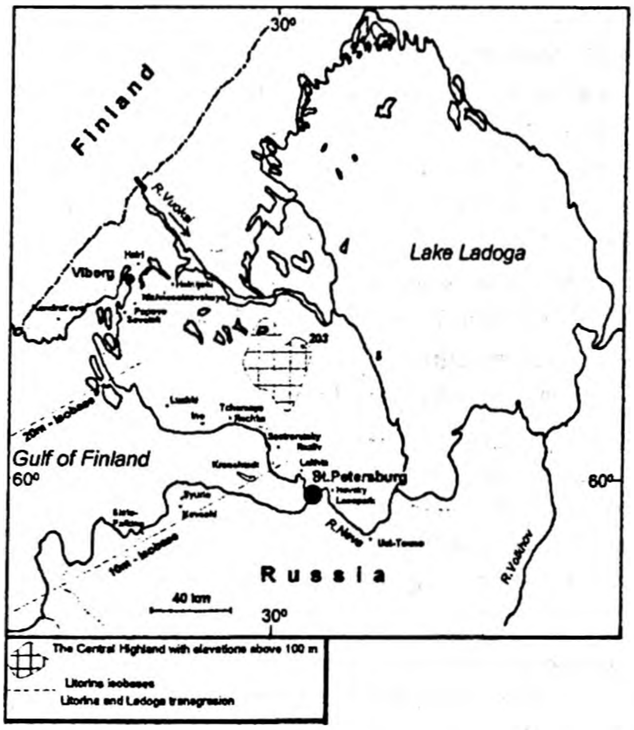
It is generally assumed that the central part of the Karelian Isthmus became deglaciated around ca. 13,000 yr. BP, while the active ice margin was still situated to the south of the Neva River valley. This led to the formation of an up-dammed glacial lake, between the southern ice margin and the Central Highland. Krasnov (1982) described this ice-marginal lake that existed in the Neva Lowland. A recent



^{14}C date obtained on wood from laminated sandy-silty clays in the SE part of Lake Ladoga shows the existence of this ice-dammed lake at 15,620±50 yr. BP (Davydova et al., 1996). During further deglaciation, at the time of the formation of the ice marginal zone Salpausselkä I, the higher parts of the Karelian Isthmus formed neither a large island in the Baltic Ice Lake nor a peninsula. It is possible that, the Neva Lowland (10-15 m a.s.l.) had been uplyered lower water level. On this plain, the Ust-Tosno peat-bog shows a continuous deposition of sediments since the Allerod (Lapin, 1939). The typical sediments of the Baltic Ice Lake basin are varved clays, which cover the lower parts of the Karelian Isthmus below ca. 50 m a.s.l. The highest coastline of the Baltic Ice Lake can be traced at ca. 50-60 m a.s.l. on the central part of the area and to 70-80 m a.s.l. in the northern part.

The final drainage of the BIL was ca 10,300 yr B.P. and the Yoldia Sea stage started. The terrace attributed to the Yoldia Sea stage, according to Hyyppä (1963) has an aititude of +18 m a.s.l. near Vyborg. The deposits of the Yoldia Sea have been found near Vyborg at heights ranging from -3.2 to +8 m a.s.l. (Vishnevskaya & Kleymenova, 1970) and near Veshevo (Heinijoki) in a section of the Nizhneosinovskoye Bog 18 km east of Vyborg at a heights from -+18,3 to 18,6 m, acording to Gey & Dzhinoridze (1995) and from +15.6 to 17 m a.s.l., according to Arslanov et al. (1996). In the section of the Aleksandrovskoe peat-bog, east of Sovetsk, the Yoldia sea deposits are situated at 0-4 m a.s.l. (Dolukhanov & Znamenskaya, 1965). In the section of the Lakhta peat-bog, the Yoldia Sea deposits is at depth of -10 to -6.5 m below sea level (Dzhinoridze & Kleymenova, 1965a). In the St.Petersburg the Yoldia Sea sediments have been found at depth of -18 to -10m below s.l. (Znamenskaya & Tcheremisinova, 1974).

At 9500 yr B.P. the Ancylus Lake transgression as a result of the tectonic uplift in the central Sweden has started. The accumulative terraces near Vyborg and Sovetsk with heights ranging from +15 to +26 m a.s.l. (Hyyppä, 1937; Dolukhanov & Znamenskaya, 1965; Vishnevskaya & Kleymenova, 1970) have been created. In the same place Hyyppä (1937) estimated the level of the Ancylus regression as a +17 m a.s.l. The radiocarbon-dating burried peat (8400±200 yr B.P.) marking the beginning of the Ancylus Lake stage has been openned in the area near Luzhki at +20 m a.s.l. (Dolukhanov & Znamenskaya, 1965). In a cross-section of the Tchernaya River, 7 km west of Zelenogorsk, deposits of the Ancylus Lake have been found at a height of +6.55 - +10 m a.s.l. (Znamenskaya, 1969). In the Lakhta peat-bog section, the Ancylus sediments are ca +6.5- +2.2 m a.s.l. (Dolukhanov & Kleymenova, 1965) and in



St.Petersburg ca -12 to 0 m below s.l. (Znamenskaya & Tcheremisina, 1974). According to Dolukhanov (1979) there was a single Ancylus transgression with maximum ca 8400 yr B.P. There are a lot of sites reflected the Ancylus regression. The layer of peat (+4.5 m a.s.l.) from the one of the Tchernaya River sections (VI) has been radiocarbon dated as follow: 8190±70 yr B.P. (TA-366; Znamenskaya et al., 1980). In the Lakhta peat-bog the gyttja has been dated to 8180±160 and 7490±90 (Dzhinoridze & Kleymenova, 1965a). On the southern side of the Gulf of Finland in the Kovashi lowland, peat underlying sandy clay at a height of 6.5 m have been radiocarbon dated to 7810±170, 7720±180 and 7840±60 yr B.P. and wood from the basal part of the peat has been radiocarbon dated to 8270±120 (Kessel & Punning, 1976) and 8060±70 yr B.P. (Serebryannyi, 1969). All the dates correspond to the period of the regression of the Ancylus Lake preceded the transgression of the Litorina Sea.

Between 8500 and 8000 years ago a connection between the Baltic and the Ocean was opened across the Danish straits. According to Berglund & Bjork (1994) at that time brackish water began to characterise the southern part of the Baltic that marks the beginning of the Litorina Sea. The 6 transgression have been distinguished by Berglund (1964; 1971; Berglund & Bjorck, 1994) in Blekinge, the southern Sweden: LI (6.4 m, 6600 BP), LII (6.7 m, 6100 BP), LIII (7.5 m, 5600 BP), LIV (7.6 m, 5300 BP), LV (5.7 m, 4700 BP), LVI (5.3 m, 3900 BP). Among the earliest studies with information on the shorelines of the Litorina Sea in the easternmost part of the Gulf of Finland are those by G. De Geer (1894), H. Berhell (1896) and J. Ailio (1915). According to Ailio, the brackish waters of the Litorina Sea found access into the Ladoga basin through a strait in the northern part of the Karelian Isthmus (threshold of Heinijoki, at 16 m a.s.l.), reaching a maximum level of 20-21 m in this area. Later, W. Ramsay (1920) summarized and discussed the results by these earlier authors and presented a system of isobases for the highest limit of the Littorina Sea around the Gulf of Finland, the southeastern end of the island of Kronshtadt, and Lisij Nos on northern coast of the Gulf. The 20-m isobase is about 80 km northwest of the 10-m isobase. Ramsay (1920) calculated that the isostatic gradient of the Littorina limit in this area is 1.3 m/10 km.

On the basis of morphological and lithostratigraphical studies curried out in southern Finland and the Karelian Isthmus, Hyyppä (1932, 1937) distinguished several Litorina transgressions (LI, LII, LIII). The waters of the Litorina Sea penetrated the Ladoga basin during the first and third transgression, the later being the cause of the Ladoga transgression.. The highest levels of the Littorina Sea were, according to Hyyppä, about +20 m near Viborg, +17 m near Sommee (Popovo) and +12-16 m in the area of Luzhki. In Kondrat'evo west of Vyborg and Hairi east of Vyborg the Littorina sediments represented by gyttja have been found at the depth 17.9-18.6 m a.s.l. and 15.6-16.8 m a.s.l. correspondingly (Kleymenova et al., 1988). Both gytties were overlaid by the peat layers which have been radiocarbon dated: 3430±60 (18.7 m a.s.l.) and 4610±150 (15.6 m a.s.l.). Kleymenova with co-authors (1988) assumed that there were 2 Litorina transgressive phases in the Hairi section and a single in the Kondrat'evo. The difference may be due to the fact that the site of Hairi is near the head of a long and narrow bay, while Kondrat'evo is more open to the sea. The record of Hairi might therefore be expected to be more sensitive to minor fluctuations in sea level and salinity. In the Privetninskoye (Ino) peat section (11 m a.s.l.), the burid peat under the Litorina gyttja has been radiocarbon dated to 5750±150 yr B.P. (Dolukhanov & Znamenskaya, 1965). In the region of the Tchernaya River section, where the Litorina maximum is estimated to be at 13 m a.s.l., four Litorina terraces (1.5, 4.0, 8.0-9.0 and 13.0-14.0 m) are distinguishable and 2 layers of the Litorina sediments - gyttja (from 7.8 to 9.1 m a.s.l.) with thin layers of peat in the lowermost and uppermost part of it and horizontal laminated sand (9.1-9.9 m a.s.l.) (Znamenskaya et al., 1980). The samples from peat layers (7.8 and 9.1 m a.s.l.) have been radiocarbon dated with difference results in the difference laboratories as follows: 7350±70 yr B.P. and 7140±170 yr B.P. ; 6705±110 yr B.P. and 6050±90 yr B.P. These radiocarbon dates show wide discrepancies, and hence the sequence can only be dated roughly to the second half of the Atlantic period.

A sample from the layer of buried peat underlying Litorina sediments in St.Petersburg has been radiocarbon dated to 6060±70 yr B.P. There are two Litorina terraces in the territory of St.Petersburg at 4-6 and 0-3 m a.s.l. The Litorina sediments (laminated clay abundant plant remains underlying organic gyttja) (from -1.65 to +1.15 m about the river level) have been found in the open section "Nevsky Lesopark", the right bank of the Neva River, 4 km southeast of St.Petersburg. The bulk radiocarbon datum from the gyttja (0.85-0.95 m about river level) is ca 5750±50 yr B.P. A layer of peat overlapping the gyttja has been radiocarbon dated as follows: 2980±70 yr B.P. in the basal part and 2600±90 yr B.P. in the upper part (Malakhovsky et al., 1989). The radiocarbon date on this peat is the youngerst date for a regressive sequence obtained from the eastern end of the Gulf of Finland (Table 1). On the southern side of the Gulf of Finland, in the Sista-Palkino area, the maximum Litorina transgression, according to Markov (1931), reached ca 8 m a.s.l. and in the region of Sosnovy Bor - ca 11 m a.s.l. The results of the extensive paleogeographical investigations by K.K.Markov (1931, 1934) of 22 stratigraphical sections of lake and mire deposits from surroundings of St.Petersburg and along the southern coast of the Gulf of Finland have demonstrated that at each site the Ancylus regression preceding the Litorina stage and was represented by peat horizons buried under Litorina sediments. The pollen spectra from the peat horizons were almost everywhere identical, characterised by "the start of the rising curves for the temperate deciduous trees and alder, an increase in birch and a drop in pine". The lowest position where these peat horizons were found was at -2.4 m below the present sea level. They are exceptionally rich in diatoms (often describable as diatomites), characterized by brackish-water assemblages with *Campylodiscus clypeus, C. echeneis, Nitzschia scalaris, Diploneis smithii* and *Navicula peregrina* as the dominant taxa. The percentage curves of the brackish-water taxa show a single maximum. In the upper parts of sections the brackish assemblages become mixed with fresh-water taxa. The maximal occurrence of the brackish-water diatoms coincides with the maximum of temperate deciduous trees and hazel and alder in the pollen diagrams. In St.Petersburg area, around the 10-m Litorina isobase, the Litorina sea reached its highest level of altitude contemporaneously with the highest level of salinity. After the culmination of the transgression, according to Markov, during the last 6000 years, a continuous regression of the relative sea level prevailed in this area.

THE STONE AGE SITES IN THE LENINGRAD OBLAST (REGION)

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Mesolithic. The earliest site known in the region is the famous Antrea-Korpilahti (Ozernoye) at Karelian Isthmus, studied in 1914 by S.Palsi (1920). The earliest in Europe remains of the fish-net were discovered together with bone-antler and stone tools. Fish-net is dated by C-14 9230±210 BP,uncal. (Hel-269) . The other Mesolithic site of Karelian Isthmus is Riukjarvi 6. Numerous finds of quartz artefacts were collected and very rare objects of flint and slate (Timofeev, in print).The materials are resembling the collections of Finnish Mesolithic. The finds of Kunda Mesolithic culture are known in the Southern and Western parts of the Leningrad region. Sokolok site of this culture was excavated in 1982-84 by the author (Timofeev, 1985,1987, 1993). The numerous bone and antler tools typical for the developed stage of Kunda culture were found and also objects of flint, quartz and slate. Some flints are originated from deposits situated in Upper Volga river basin area. The late Kunda finds are known in the Narva river basin (Moora, 1957) and in the southern coast of Ladoga lake.The sites of Leningrad region are the westernmost in the area of Kunda culture. The sites of other cultural attribution are found during the last decade in the eastern part of the region. The rich collections of flint artefacts came from the excavated sites of Listvenka group (Kosorukova-Kandakova, 1887), The blade-tools including some tanged points are characteristic for the inventory.

Early Neolithic. The sites of Narva culture are known mainly in the Southern part of the region. Syaberskaya III and Merevo II are excavated in 1980-s by the author (Timofeev, 1993). The same attribution has the part of the famous "collection of A.A.Inostrantzev" collected during the canal construction in the area situated close to the southern coast of Ladoga lake (Gurina, 1961, 1967). There is also Berezye site found in the modern river-bed of Volkhov river (Timofeev, 1985).The culture layer is embedded in the Ladoga deposits. Berezye gave the finds of Narva-type pottery and the Early Neolithic pottery of the other cultural attribution – of the Sperrings type. A number of sites of Sperrings culture in the Leningrad region are known in the Karelian Isthmus. Among them is Hayrinmaki site, well known to specialists. The site was situated close to Vyborg city and was studied in the beginning of our century. In the mid of the century the site was destroyed by the quarry. Sperrings-type finds are known as in the northern (Riukjarvi lake area and others) so in the southern parts of the Karelian Isthmus. The Hepojarvi site was excavated in the southern part (I.V.Vereschagina, unpublished). During the last decade the sites of Sperrings culture (Padan, Aschozero VII a.o.) were discovered in the eastern part of the Leningrad region (Gusentsova, Andreeva, 1994, 1996). At the same area was found also Zabelye site with materials related to more southern Valdai or Upper-Volgian cultures of Early Neolithic (Urban, 1996).

Middle-Late Neolithic. The sites of Comb-and-Pit pottery culture related to the Neolithic of Finland and Eastern Baltic area are known in the main part of the Leningrad region. The numerous sites were connected with the systems of the lakes at Karelian Isthmus (Palsi, 1920, Gurina, 1961, Timofeev, 1993). Some sites of the same cultutre are excavated in the Southern part of the region, in Luga district (Timofeev, 1993). The most important is Ust-Rybezhna I site at SE coast of the Ladoga lake, excavated in the large scale by N.N.Gurina (1961). The site Ustye could be mentioned excavated during last years by O.M.Tikhomirova. It is situated in Tichvin region, in the Eastern periphery of the Comb-and-Pit pottery culture. Two habitation layers were found embedded in clay deposits. The sites of Pit-and-Comb pottery culture with materials related to the materials of Neolithic of Karelia and also to the Neolithic assemblages of more southern regions of the Forest zone are situated mainly in the Eastern and North-eastern parts of the region. An important excavations were done there during the last years by T.M.Gusentzova and N.A.Andreeva (1996, 1998).

The sites of the later period (Early Metal Age or Bronze Age) are excavated mainly in N,NE and S parts of the region (Gurina, 1961, Timofeev, 1993). The fresh results of Shkurina Gorka site excavations (done by author , 1998) could be mentioned. The site is situated at the coast of Volkhov river, close to Volkhov city and is dated to the Late Bronze Age , about 3000 BP, uncal. The culture layer gave the rich faunal collection in which hunted animals and domesticates (mainly cattle and horse) are represented. The traces of Metal production and remains of limestone construction were found at this site.

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HOW TO PREPARE AND PRESENT A LECTURE

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The lecture should help students to prepare correctly a an oral presentation (lecture) at home and to present it in the best way during a congress or symposium.

1. How to prepare a lecture: consideration of the time schedule, composition and structure of the text, clarity of overheads and/or pertinent choice of slides, exercise of elocution.

2. How to present a lecture: importance of the physical presentation, preparation of the material, what to say and how to speak in the beginning, in the middle and at the end of a lecture.

This lecture will be illustrated with c. 20 slides showing simultaneously what to do and what to avoid.

PALAEOECOLOGY AND LAND USE HISTORY OF THE VALAMO ISLAND

Vuorela Irmeli

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The present-day shape of the Valamo Island was formed 3100 years ago when an archipelago of numerous small islands in Lake Ladoga were united by a 12-m lowering of the water level in connection with the opening of the Neva outlet. Several small ponds were isolated. Two profiles consisting of limnic material have been analysed in order to investigate local vegetational history and settlement history of the island which, according to the loss of archaeological finds, only covers this period.

One of the most prominent questions was wether agricultural activities preceded the foundation of the monastery of Valamo which, depending on various opinions, took place between AD 1160 and AD 1400. Pioneer results of pollen and charcoal analyses and ^{14}C determinations *show* some evidence of human activity as long ago as during the Pre-Roman Iron Age (500–0 BC). They also indicate that grazing in the area started in the Merovingian Period (AD 550/600–800) and cereal cultivation, most probably on the former lake bottom, in the 11th century, and in remote parts of the island in the late 13th century. Analysis on sediments deposited closer to the monastery are in progress.

In the topmost layers, sedimentological and pollen analytical results reflect the abandonment of the fields probably during the Swedish period in the 18th century and after the Second World War when field cultivation ceased and fields started to be used for grazing only.

PALEOGEOGRAPHICAL DEVELOPMENT OF THE SZCZECIN LAGOON DURING THE HOLOCENE IN THE LIGHT OF DIATOM ANALYSES

Witon Eva

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Two sediment cores from the Szczecin Lagoon were subject to diatom analyses. The cores were 120 cm (nr 16) and 530 cm (nr 3) long. The sediments were composed of gyttja and underlied by muds and sands with Cardium shells. Together 138 diatom taxa in core nr 16 and 319 taxa in core nr 3 were identified. The most abundant in both cores were benthic taxa. The proportion of planktonic taxa revealed gradual increase and then the decrease towards the core topmost part. With respect to salinity requirements, freshwater forms strongly predominated. Saline water inhabitants, mainly brackish-water forms constituted only a minor proportion and occurred as a small separate peaks. Marine diatoms were represented only by single valves 20.

The presence of marine bivalves indicate that the sedimentation started after the Littorina transgression level reached the Szczecin Logoon, i.e. ca. 7000 BP. The ratio between benthic and planktonic taxa indicate that the sediments in the lowermost part of the cores were deposited in shallow water conditions. Admixture of taxa representing the genus of Eunotia reveal that swampy conditions might have existed. Increasing contents of planktonic diatoms indicate gradual water level rise. A strong predominance of freshwater taxa with only a minor proportion of brackish-water forms shows that inflow of the Baltic Sea waters into the Szczecin Lagoon was rather weak. In the uppermost part of the cores studied there taxa indicative for anthropogenic pressure appear, these were Cyclotella meneghiniana and Stephanodiscus hantzschii.

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