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Application of diatom analysis for the study of the history of the lakes of north-west USSR.

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in Istoriya Ozer; Trudy Vsesoyuznogo Simpoziuma....
Vilnius, 1970.

During late - and post-glacial times lakes played a leading role in the development of the landscape of the North-west European part of USSR. A variety of geographic circumstances created great variegation of natural conditions in lakes and determined the composition of their diatoms. The basic stages of the development of the diatom flora of lakes (Table I) are linked with general climatic changes.

At the end of subarctic times the lakes were inhabited by a cold-loving, poor-in-composition diatom flora. Sediments of this age are found in the base of lake deposits of Ladoga and Onega lakes (Abramova, Dayydova and Kvasov, 1967; Davydova, 1967) in a series of lakes of the Karelian isthmus - Krasnoye (Vishnevskaya, Davydova, 1967), Lopata, Glukhoye, Vuoksa (Malyasova, Spiridonova, 1965), in the ancient Ivinsk lake (Zhuze, 1939), in lakes of Lithuania - Kuvintas, Bebrukas, Il'gis and others (Kabailene, 1965), in lakes of the central zone of the European part of USSR - Somino (Kozyrenko, 1961), Ushchemerovo, Yaroslavsk District (Korde, 1956), B.* Medvezhe Moscow district (Zhuze, 1961), in the lake Tur and others of the Volynsk district (Oksiyuk, 1957).

The deepwater regions of large periglacial lakes of the North-west are inhabited by plankton diatoms of the genera Melosira and Cyclotella.

This flora is found in sediments of lakes Ladoga and Onega, and in deposits of the pelagial of Lake Krasnoye. On the bottom of the shallow parts of lakes Glukhoye, Ivinsk, Lopata, and in the littoral of Lake Krasnoye, in this time the cold-loving littoral diatoms developed. Characteristic of the flora of some late-glacial lakes of the Baltic area (Bebrukas) and the central zone of the USSR (Somino) appears to be the dominance in them of cold-loving diatoms of the genus Cyclotella, and the absence of Melosira islandica subsp. helvetica, so characteristic for oligotrophic lakes in the region of the Baltic shield. Lakes of medium depth (Il'gis) are inhabited

* presumably "Boloto" = swamp, marsh.

by Melosira arenaria, M.italica, Stephanodiscus astraea, Epithemia turgida. In shallow-water lakes (Zhuvintas, Ushchemerovo) dwell numerous littoral diatoms. To late-glacial times belongs, probably, the fossil flora from the sediments of the B. [Swamp?] Medvezhe of the lake near Moscow where are found the ancient cold-loving Melosira islandica, living at present only in the lakes of Iceland, M.baicalensis - typical diatom of the pelagial of Baikal, and Stephanodiscus binderanus. The exact age of this flora is not established, possibly it is older (inter-glacial?). The late-glacial stages of lake Tyr, Volynsk district, are characterized by cold-loving diatoms.

Thus, at the start of the Holocene in lakes of the European part of USSR in the severe conditions of the late-glacial the cold-loving diatom flora was formed, and certain regional differences in the composition of the dominant species were marked.

The diatom flora of the early Holocene - pre-boreal and boreal times-is known from the same points as that of the late-glacial, and also from the lakes of Karelia (Lak, 1963; Mälder, 1951), Nero Yaroslavsk district and Galichski Kostromst district (Korde, Ulomskii, 1959), It is similar in composition to the flora of the lake-glacial. The warming-up of the climate was expressed in the moderation of natural conditions in the lakes and the advance into northern lakes of diatoms of temperate latitudes, that led to the appearance of a great variety of the composition of the diatoms. In the Ladoga and Onega basins in the boreal epoch there continued to exist the deep lake basins with mass Melosira islandica subsp. helvetica, Stephanodiscus astraea and others. Similar is the composition of the dominant species of the indigenous deposits of the pelagial of lake Krasnoye. Among the mass forms are found Melosira granulata, M. distans var. alpigena, M.italica et subsp. subarctica, Cyclotella ocellata.

Characteristic features of the early stages of development of the diatom flora in lakes of Karelia are described by G.Ts. Lak (1963). Melosira islandica subsp. helvetica dominates in the boreal epoch and in the ancient Ivinsk lake, which at this time was united with Onega. The composition of the littoral diatoms from the Ivinsk basin and lakes of the Karelian isthmus is similar to the composition of diatoms of late-glacial times. However in Ivinsk lake at this time some of the ancient cold-loving species, such as Cocconeis disculus disappear, and in lakes Krasnoye and Glukhoye Melosira arenaria develops in mass.

In the Baltic area pre-boreal and boreal time was characterised by a certain dryness of climate that was accompanied by a shallowing and partial swamping of lakes. As a result of this the number of planktonic and benthic species was reduced (Bebrukas). A wide distribution of the inhabitants of the overgrowth was obtained.

The rich and varied-in-composition diatom flora of the early Holocene is found in sediments of lakes of the central zone of the European part of USSR - Somino, Ushchemerovo, Nero and Galichskoye, in which are discovered in mass various Cyclotella and numerous benthic diatoms (Fragilaria, Navicula, Cymbella, Gomphonema). In lakes of Volyn in the early Holocene is preserved a characteristic late-glacial complex of diatoms, but if originally diatoms were found singly in the deposits, then in the early Holocene they appear in great quantity.

Thus, in the complexes of diatoms of the early Holocene everywhere appears an evident succession from the earlier complexes.

The diatom flora of the middle Holocene is known from many lakes of the European part of USSR. In Atlantic time, with maximal warming-up of climate, there set in more favourable conditions for the settling of moderately warmth-loving diatoms in the water bodies of the central zone of the European part of USSR and the North-west. The diatom flora of the large lakes - Ladoga and Onega - is substantially enriched. In lake Krasnoye, Shot-lake and other lakes of Southern Karelia, both planktonic and numerous benthic diatoms attain mass development. Ivinsk lake in Atlantic times significantly filled up with deposits. In this the number of planktonic species is sharply reduced, there appear various Eunotia, Pinnularia, characteristic for strongly humified water-bodies. The lake is gradually transformed to a swamp. In water-bodies of the Baltic area and the central zone of USSR the diatom flora in Atlantic time is richer in composition. This stage is characterised by significant eutrophication of lakes. In some of these still dwell ancient species: Cyclotella ocellata, Opephora martyi. The epoch of warming-up climate led to a drying-up of Volynsk lake that was expressed in almost complete absence of diatoms in the deposits.

In sub-boreal time, when the climate is characterised by somewhat greater aridity by comparison with the preceding epoch, in water-bodies of Karelia marked changes in water-supply were absent, and therefore the composition of diatoms did not substantially change, whereas in the Baltic area (in the shallow lakes of Lithuania) stages in the drying-up and degradation of lakes are expressed more clearly. In deposits of sub-

boreal times here in mass is found in epiphytic flora of Epithemia. The shallowing and impoverishment of the diatom flora is recorded in shallow-water lakes of the central zone of USSR (Ushchemerovo, Somino), where the number of planktonic diatoms was reduced and the quantity of benthic species was increased. In the deeper lakes is preserved a diatom flora similar to the Atlantic. At the end of Atlantic and in sub-boreal time in rich diatom flora colonized numerous water-bodies of the Kol'sk peninsula, on the bottom of which diatomite was formed. (Poretskii, Zhuze, Sheshukova, 1934)

The middle Holocene is the time of the climatic optimum and the richest development of freshwater diatoms in lakes, the time of the farthest advance of many species to the north and the colonization by them of water-bodies of high latitudes.

In the late Holocene-in sub-Atlantic time-occurred a certain deterioration of climate. The diatom flora of sub-Atlantic time is identical with the modern and is better studied. It is known in the deposits of many lakes. In lakes of the Kol'sk peninsula there continue to accumulate layers of diatomite. The composition of diatoms in these has not changed from Atlantic to present times. The formation of diatomite occurs in a series of lakes also of more southerly latitude: in lakes of south Murmansk district, in northern and southern Karelia (Pel'sh, Chernov, 1939; Chernov, 1939). In the larger lakes in the south of Karelia the diatomite is formed from species of Fragilaria. In lakes of the Onega-White Sea watershed (Sheshukova, 1949), the sub-Atlantic diatom flora by its composition is characteristic for lakes of the margin of the Baltic shield. In the bottom deposits the dominating forms appear planktonic species of Melosira and numerous benthic species. In the late Holocene the diatom flora of Ladoga and Onega lakes did not undergo significant changes in the same way as the flora of the lakes of Karelia and the Onega-Ladoga isthmus.

In the Baltic area, sub-Atlantic time is characterized by a somewhat greater humidity of climate by comparison with sub-boreal, that was expressed by a raising of lake levels. The diatom flora of sub-Atlantic time is similar to the Atlantic, but the number of species of Cyclotella is reduced. Numerous epiphytes develop: Epithemia, Cymbella, Gomphonema. In the central zone of USSR in sub-Atlantic time the basins of certain lakes appear to a significant degree filled with deposits. There occurred the shallowing of lakes Somino and Ushchemerovo that involved in itself the disappearance of planktonic species and mass development of diatoms of the benthos. The composition of diatoms in lakes Nero and Galichskoye remains the same as in the middle Holocene. In Volyn there set in a period of

inundation and raising of lake levels, where benthic diatoms are established.

The modern diatom flora of lakes was formed as a result of a change of geographic circumstances during the period of continuous evolution of diatoms. More clear characteristics distinguish the lacustrine complexes of diatoms of the late-glacial and Atlantic times. The late-glacial is a time of significant impoverishment in the composition of the cold-loving diatom flora. In lakes on the margin of the Baltic shield the leading position was taken by northern species of Melosira and in the more southerly districts by species of Cyclotella and cold-loving benthic diatoms.

The epoch of the climatic optimum - Atlantic time - is the second characteristic stage in the development of diatoms, when the lacustrine diatom flora was distinguished by greater richness and variety, preserving in this its regional peculiarities. The composition of diatoms of the late Holocene is similar to the modern. In the late Holocene occurs a certain impoverishment of the diatom flora, combined with a deterioration of the climate. In the central zone small lacustrine basins are filled up with deposits and lakes pass into the dystrophic stage.

The character of the diatom population of lakes depends, thus, on geographic position and natural peculiarities, and besides this, the diatom flora in developing preserves in its composition many elements of preceding times.

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FIG. I

Объяснения к рис. I

I – Озера Литовской ССР (Бебрукас, Кувинтас, Ильгис и др.), 2 – озера Карельского перешейка (Красное, Лопата и др.), 3 – Ладожское озеро, 4 – озера Онего-Ладожского перешейка (Шот-озеро, Ивинское), 5 – Онежское озеро, 6 – озера Карельской АССР, 7 – озера Кольского полуострова, 8 – озера средней полосы Европейской части СССР (Сомино, Ущемерово, Неро, Галичское), 9 – озера Волынской области (Тур и др.)

1. – Lakes of Lithuanian SSR (Bebrukas, Kuvintas, Il'gis, etc).
2. – Lakes of the Karelian isthmus (Krasnoe, Lopata, etc.)
3 – Lake Ladoga. 4 – Lakes of the Onega – Ladoga isthmus (Shot-lake, Irinok), 5 – Lake Onega.
6 – Lakes of Karelian ASSR
7 – Lakes of Kol'sk peninsula.
8 – Lakes of central zone of European part of USSR (Somino, Ushchemerovo, Nero, Galichskoye.
9 – Lakes of Volynsk District (Tur, etc.)

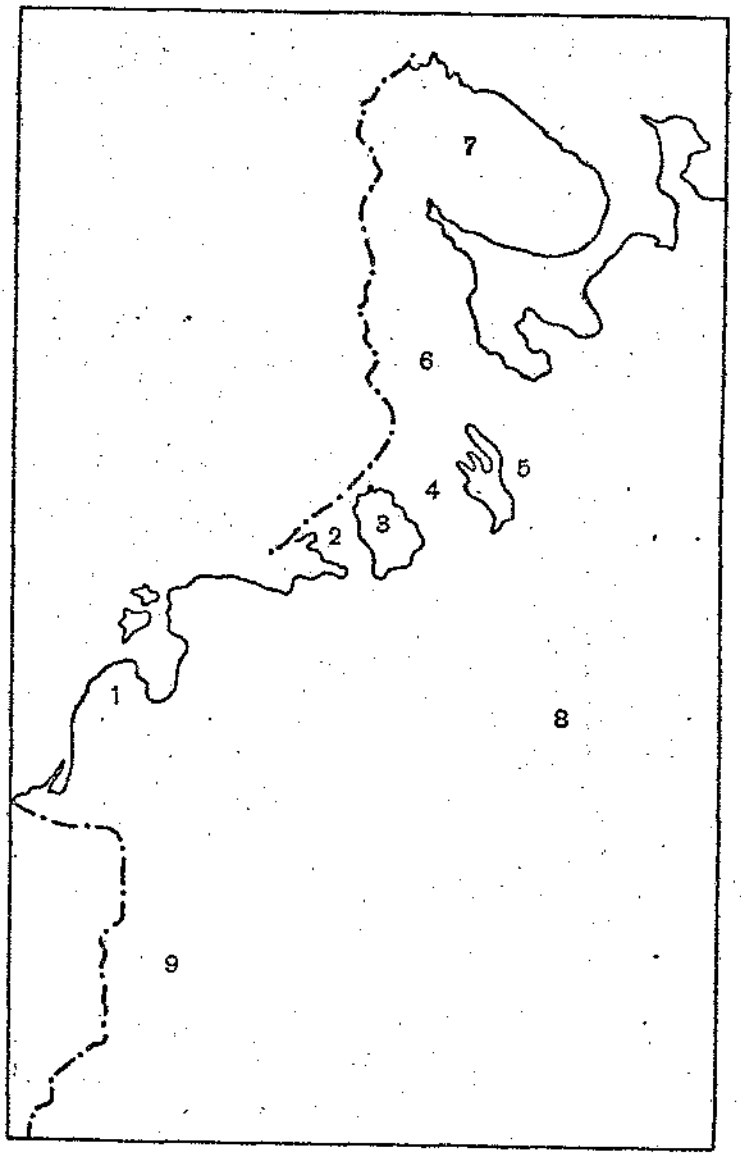

Fig. I Location of diatoms in sediments of lakes of N-W USSR

Рис. I. МЕСТОНАХОЖДЕНИЕ ДИАТОМОВЫХ В ОТЛОЖЕНИЯХ ОЗЕР СЕВЕРО-ЗАПАДА СССР

Характерные комплексы диатомей в
Characteristic complexes of diatoms in

Климатические периоды Climatic Period	Ладожское и Онежское озера (Абрамова, Давыдова, Квасов, 1967; Давыдова, 1967) Ladoga & Onega Lakes	Небольшие озера южной Карелии и Карельского перешейка (Виноградская, Давыдова, 1967; Малясова, Спиридонова, 1965; Кузе, 1939) Small lakes of S. Karelia & Karelian Isthmus
Субатлантический Sub-Atlantic	Melosira islandica subsp.helvetica O.Müll. M. distans var. alpigena Grun. M. italica (Ehr.) Kütz. Cyclotella comta (Ehr.) Kütz. C. vorticose A. Berg. Stephanodiscus astraea (Ehr.) Grun. Tabellaria fenestrata (Lyngb.) Kütz. T. flocculosa (Roth.) Kütz.	Melosira granulata (Ehr.) Ralfs. M. italica (Ehr.) Kütz. Tabellaria flocculosa (Roth.) Kütz. T. fenestrata (Lyngb.) Kütz. var.fenestrata T.fenestrata var.intermedia Grun. Fragilaria brevistriata Grun. F. construens (Ehr.) Grun. F. lapponica Grun. Eunotia faba (Ehr.) Grun. E. formica Ehr. E. pectinalis (Dillw.? Kütz.) Rabenh. E. praerupta Ehr. Navicula radiosa Kütz. Pinnularia gibba Ehr.
Субсубатлантический-субореальный Sub-Atlantic-boreal		Melosira islandica subsp. helvetica O. Müll. M. ambigua (Grun.) O. Müll. M granulata (Ehr.) Ralfs. M. italica (Ehr.) Kütz. Cyclotella bodanica Eulenst. C. comta (Ehr.) Kütz. C. quadriiuncta (Schrot.) Hust. Tabellaria flocculosa (Roth.) Kutz. Fragilaria lapponica Grun. F. construens (Ehr.) Grun. F. virescens Ralfs. Diploneis elliptica (Kütz.) Cl. D. finnica var. clevei (Font.) Hust. Pinnularia major (Kütz.) Cl. Gyrosigma acuminatum (Kütz.) Rabenh. Cymbella aspera (Ehr.) Cl.
Атлантический Atlantic	Melosira islandica subsp. helvetica O.Müll. M. distans var.alpigena Grun. M. italica (Ehr.) Kütz. var.italica M. italica subsp. subarctica O. Müll. Cyclotella comta (Ehr.) Kütz. C. vorticosa A. Berg. Stephanodiscus astraea (Ehr.) Grun. S. astraea var.minutulus (Kütz.)Grun. Tabellaria fenestrata (Lyngb.) Kütz. T. flocculosa (Roth.) Kütz.	

Таблица I

озерных отложений Северо-запада СССР
lake sediments of N-W USSR

Озера Литовской ССР (Кабайлене, 1965) Lakes of Lithuanian SSR	Озера средней полосы Европейской части СССР (Козяренко, 1961; Корде, 1956а, б; Кордэ, Уланский, 1959) Lakes of central zone of European part of USSR	Озера Волынской области (Оксиюк, 1957) Lakes of Volynsk Distr.
Melosira arenaria Moore Cyclotella comta (Ehr.) Kütz. var.comta C.comta var.oligactis (Ehr.) Grun. Fragilaria construens var. venter (Ehr.) Grun. Achnanthes clevei Grun. Navicula cari Ehr. N. pupula Kutz. Epithemia hyndmannii W. Sm.	Fragilaria brevistriata Grun. F. construens (Ehr.) Grun. Opephora martyi Héib. Stauroneis anceps Ehr. Navicula cuspidata Kütz. N. vulpina Kütz. Pinnularia major (Kütz.) Cl. Neidium iridis (Ehr.) Cl. Epithemia zebra (Ehr.) Kütz.	Tabellaria flocculosa (Roth.) Kütz. Fragilaria construens (Ehr.) Grun. F. pinnata Ehr. Stauroneis phoenicentron Ehr. Navicula radiosa Kütz. Cymbella cesatii (Rabenh.) Grun. C. turgida (Greg.) Cl.
Epithemia argus Kütz. E. turgida (Ehr.) Kütz. E. zebra (Ehr.) Kütz. Cymbella cistula (Hemp.) Grun. C. eherenbergii Kütz.	Melosira granulata (Ehr.) Ralfs. M. italica (Ehr.) Kütz. Cyclotella comta (Ehr.) Kütz. C. kuetzingiana Thw. Fragilaria construens (Ehr.) Grun. Cocconeis placentula Ehr. var. placentula C.placentula var. lineata (Ehr.) Cl. Navicula gastrum Ehr. N. scutelloides W.Sm. N. schoenfeldtii Hust. N. tuscula (Ehr.) Grun. N. vulpina Kütz. Amphora ovalis Kütz. var. ovalis A. ovalis var.libyca Ehr. Cymbella sequalis W.Sm. C. cistula (Hemp.) Grun. Gomphonema acuminatum Ehr. G. constrictum var. capitatum (Ehr.) Cl.	Усыхание озер, исчезновение диатомей Desiccation of lakes, disappearance of diatoms
Melosira arenaria Moore Cyclotella comta (Ehr.) Kütz. C. kuetzingiana Thw. Stephanodiscus astraea (Ehr.) Grun. Fragilaria construens (Ehr.) Grun. Opephora martyi Héib. Cocconeis disculus (Schum.) Cl. Navicula oblonga Kütz. N. scutelloides W. Sm. Amphora ovalis Kütz.		

Pra-Borea) – (Boreal) Преобореальный-бореальный	Melosira islandica subsp.helvetica O.Müll. Cyclotella comta (Ehr.) Kütz. C. kuetzingiana Thw. C. vorticosa A. Berg. Stephanodiscus astraea (Ehr.) Grun.	Melosira arenaria Moore M. islandica subsp. helvetica O. Müll. M. distans var. alpigena Grun. M. granulata (Ehr.) Ralfs. M. italica (Ehr.) Kütz. var. italica M. italica var. valida (Grun.) Hust. M. italica subsp. subarctica O. Müll. M. scabrosa Ostr. Cyclotella ocellata Pant. Eunotia clevei Grun. Diploneis domblittensis var. subconstricta A. Cl. Navicula fennoscandica A.Cl. Pinnularia nodosa Ehr.
Sub-Arctic Субарктический	Melosira islandica subsp.helvetica O.Müll. M. distans var. alpigena Grun. Cyclotella comta (Ehr.) Kütz. C. vorticosa A. Berg. Stephanodiscus astraea (Ehr.) Grun.	Melosira arenaria Moore Opephora martyi Héib. Fragilaria constricta Ehr. Cocconeis disculus (Schum.) Cl. Navicula scutelloides W.Sm. Campylodiscus noricus Ehr.

Synedra ulna (Nitzsch.) Ehr. Eunotia valida Hust. Pinnularia viridis (Nitzsch.) Ehr. Epithemia turgida (Ehr.) Kütz.	Cyclotella kuetzingiana Thw. C. meneghiniana Kütz. C. ocellata Pant. C. operculata (Ag.) Kütz. Melosira granulata (Ehr.) Ralfs M. italica (Ehr.) Kütz. M. ambigua (Grun.) O. Müll. Navicula scutelloides W. Sm.	Cyclotella kuetzingiana var. planetophora Fricke Achnanthes clevei Grun. Epicocconeis flexella Kütz. Navicula scutelloides W. Sm. Cymbella cesatii (Rabenh.) Grun. Campylodiscus noricus var.hibernicus (Ehr.) Grun.
Cyclotella comta (Ehr.) Kütz. C. kuetzingiana Thw. C. meneghiniana Kütz. C. ocellata Pant. Fragilaria construens (Ehr.) Grun. F. brevistriata Grun. Synedra ulna (Nitzsch.) Ehr. Navicula cari Ehr. N. oblonga Kutz. Gyrosigma attenuatum (Kütz.) Rabenh. Amphora ovalis Kütz.	Fragilaria construens (Ehr.) Grun. Stauroneis phoenicentron Ehr. Navicula amphibola Cl. Pinnularia distinguenda Cl. P. viridis var. intermedia Cl. Epithemia zebra (Ehr.) Kütz. Hantzschia amphioxys (Ehr.) Grun.	

Notice

Please note that these translations were produced to assist the scientific staff of the FBA (Freshwater Biological Association) in their research. These translations were done by scientific staff with relevant language skills and not by professional translators.