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Paleogeography and Stratigraphy of Valdai (Würm) Loesses of the South-Western Part of the East-European Plain by Palynological Data

Paleogeografia i stratygrafia lessów waldajskich (würmskich) w południowo-zachodniej części Równiny Wschodnioeuropejskiej na podstawie danych palinologicznych

Палеогеография и стратиграфия валдайских (вюрмских) лёссов юго-запада Восточно-Европейской равнины по палинологическим данным

ABSTRACT

Valdai loess-soil series of the Russian Plain has been investigated by palynologists in about 40 sections. It was formed in the conditions of forest-steppe and steppe landscapes during considerable cooling. Horizons of loess accumulated under dry and cold, dry and comparatively warm (but colder than modern) conditions and formation of fossil soils took place under warm and comparatively wet, warm and dry, cold and relatively wet conditions. Now the middle Dniester is the most investigated region of East-European loess province in the view of detailed stratigraphy and paleogeography of the late Pleistocene. Here not less than seven interstadial fossil soils of the Valdai were determined.

Valdai loesses and loess-like sediments of the East-European Plain were studied by palynologists more than in 40 localities situated mainly in the valleys of the Dniester, Dnieper, Don and the coasts of the Black Sea and the Sea of Azov (Fig. 1). In spite of the difficulties of separation of pollen and spores from the loess and loess-like formations the representative data were obtained for the most of these localities. 26

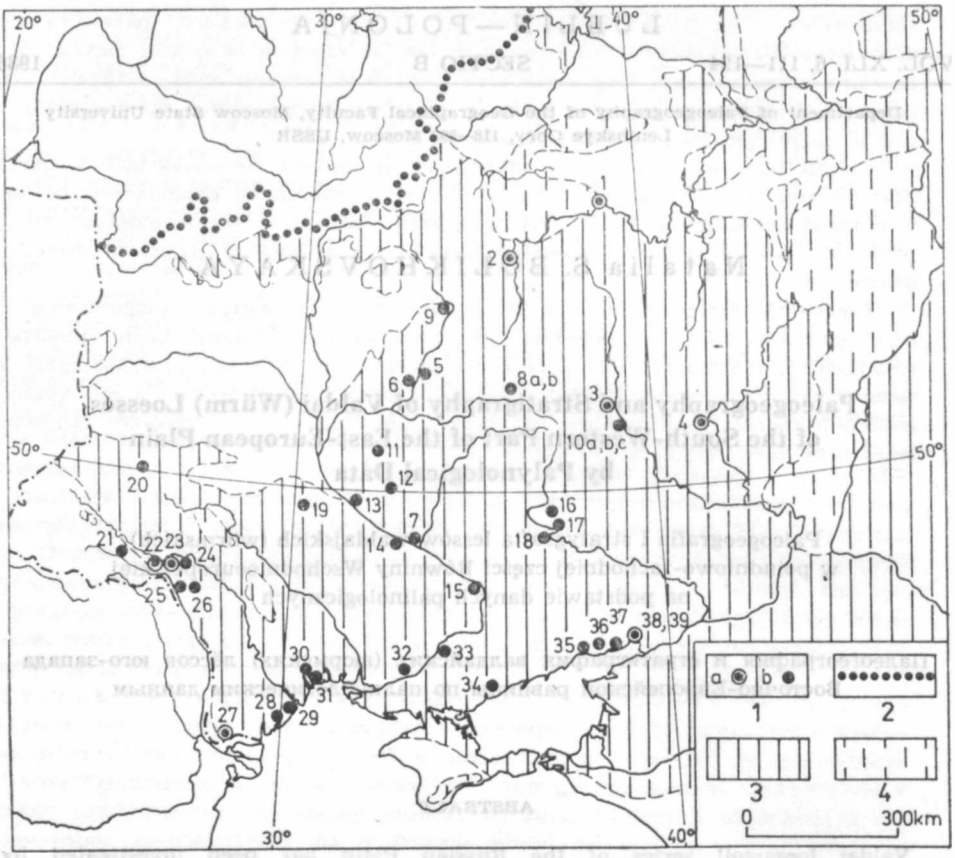

Fig. 1. Valdai loess-soil sequences of the East-European Plain investigated by palynological method

1 — a) sections studied by author, and b) sections studied by other palynologists; 2 — southern boundary of Valdai ice sheet of maximum stage; 3 — areas of distribution of loess cover of various thickness; 4 — sporadic distribution of loess (2—4 according to A. A. Velichko and T. A. Khalcheva 1982)

Sections: 1 — Kolomna, 2 — Chekalin, 3 — Strelitsa, 4 — Novokhopersk, 5 — Arapovichi, 6 — Mezin, 7 — Gunki, 8 — Golubitsa, 9 — Karachizh, 10 — Kostenki, 11 — Priluki, 12 — Vyazovok, 13 — Dobranichevka, 14 — Chigirin, 15 — Starye Kajdaki, 16 — Borshchovka, 17 — Levkovka, 18 — Zagorodnoe, 19 — Rozhki, 20 — Kremenets, 21 — Snyatin, 22 — Kishlyanskij Yar, 23 — Molodovo I, 24 — Korman, 25 — Avramen, 26 — Ketrish, 27 — Novaya Etuliya, 28 — Primorskoe, 29 — Budagskij liman, 30 — Kuyalnitskij liman, 31 — Kryzhanovka, 32 — Kamenka, 33 — Berislav, 34 — Mironovka, 35 — Rozhok, 36 — Zhdanov, 37 — Shirokino, 38 — Veselo-Voznesensk, 39 — Platovo

standard spore-and-pollen diagrams and 20 floristic diagrams were published, in a number of the revealed palynofloras the determination were made up to the species level and the detailed ecologic-phytocoe-

notic analysis was fulfilled. These data made a basis of reconstructions of the vegetation and climate of the extraglacial areas of the Russian Plain in the Valdai epoch of the late Pleistocene (A. T. Artyushenko 1970, A. T. Artyushenko et al. 1982, N. S. Bolikhovskaya 1976, 1983, Z. P. Gubonina 1975, V. P. Grichuk 1972, and many others). The attempts of cartographic synthesis of the palynological data were made. The last achievment in this field is a map of vegetation for the maximum stage of Valdai (Vistulian→Würm) glaciation of Europe made by V. P. Grichuk (1982).

Paleometeorologic parameters obtained by the arealogram or climatogram technique, informational analysis etc. permit to give a concrete expression to the climatic conditions of epochs of formation of loesses and fossil soils (L. G. Bezus'ko 1981, N. S. Bolikhovskaya 1981, Ye. Ye. Gurtovaya 1981, and others). A list of papers devoted to palynological study of the late Pleistocene loesses of the East-European Plain and their comprehensive paleogeographical interpretation is now very large. Analysis of the mentioned papers permits to conclude that the total series of the Valdai loess sediments was formed mainly under predominance of the forest-steppe and steppe landscapes on the background of significant climatic cooling. The loess and loess-like horizons were accumulated in dry and cold, dry and relatively warm (interstadial) conditions while the formation of separating them paleosols took place in warm and relatively humid, warm and dry, cold and relatively humid climates.

Reconstructions of structure of geographic zonality of the Eastern Europe and the total Northern Eurasia during Mikulino (Eemian) Interglacial and the main climatic minimum of Valdai epoch as well as a deep analysis of the main features of the environment of Russian Plain in the late Pleistocene are represented in papers of A. A. Velichko (1977, 1982b, 1985) and others. A development of this approach demands to pay attention that the dominating schemes of subdivision of the late Pleistocene periglacial formation of the European part of the USSR even in their latest versions (M. F. Veklich 1982, A. A. Velichko et al. 1984) are less detailed than the stratigraphic schemes of the glaciated areas. This is due to difficulty of obtaining of the detailed palynological (and another paleontological) information for every loess and paleosol horizon i.e. the data which should be so detailed to follow the evolution of the landscapes, the composition of flora, fauna etc. during individual cold and warm intervals and to be a basis of multimember climatostratigraphic subdivision of loesses.

In this relation the comprehensive study made under the leadership of I. K. Ivanova on the middle Dniester area seems to be interesting.

This area is now the most investigated one within the East-European loess province in the view of detailed stratigraphy and paleogeography of the late Pleistocene.

Valdai loess-like loams are outcropped here in the profile of terrace II of the Dniester river and its tributaries. The terrace is composed of alluvial sediments with the thickness up to 10 m and the mantle of loess-like deluvial and deluvial-proluvial formations with the thickness up to 25 m (I. K. Ivanova 1980, 1986). The well-known multilayer Paleolithic sites of the middle Dniester area are related to the loess mantle of the terrace II. The forest polygenetical soil lies in the base of the loess-like formations. According to the presence of pollen *Picea sect. Omorica, Pinus* cf. *cembra, Juglans regia, Carpinus betulus, Fagus sylvatica, Quercus robur, Q. petraea, Tilia platyphyllos, Corylus avellana* and other, high percentage of pollen of the broad-leaved species (36—51%), the sequence of its culminations and characteristic change of phases in the vegetation evolution and to other evidences, the basal soil belongs to Mikulino (Eemian) Interglacial. Not less than 7 intervals of the interstadial character correlated using the palynological data and ^{14}C-dating with interstadials of the north-east part of the Russian Plain, Middle and Western Europe have been observed inside the Valdai sediments of Korman, Moldova and Ketrosy sections (N. S. Bolikhovskaya 1981, N. S. Bolikhovskaya and G. A. Pashkevich 1982, G. A. Pashkevich 1977).

Let us consider climatic and phytocoentic features of cold and warm intervals using the I. K. Ivanova (1980, 1986) scheme (Fig. 2) of detailed stratigraphic classification of late Pleistocene and the results of palynological analysis.

Early Valdai cooling I (Pre-Amersfoort). During this cooling the broad-leaved forests predominating in climatic optimum of Mikulino Interglacial disappeared almost completely. Their place was occupied by coniferous mainly pine forests. Shrub. formations with *Betula fruticosa, Alnaster fruticosus* and *Juniperus* were widely distributed. Open areas occupied by steppe with grass and other herbs were predominant. Climate was cold and dry.

Early Valdai interstadial I (Amersfoort) correlated with Chermenino I Interstadial of the Russian Plain north-west and with Amersfoort, for which in the stratotype situated in the Eem valley, the Netherlands, 68,200 ±1000 and 67,500 ±1800/1400 y. BP dating were obtained (P. M. Grootes 1977) was characterized by the moderately warm conditions. The middle Dniester area was in the forest-steppe zone. Among the trees of forest areas localized to river valleys, gulchs and small flat-bottom valleys *Pinus sylvestris* predominated. The

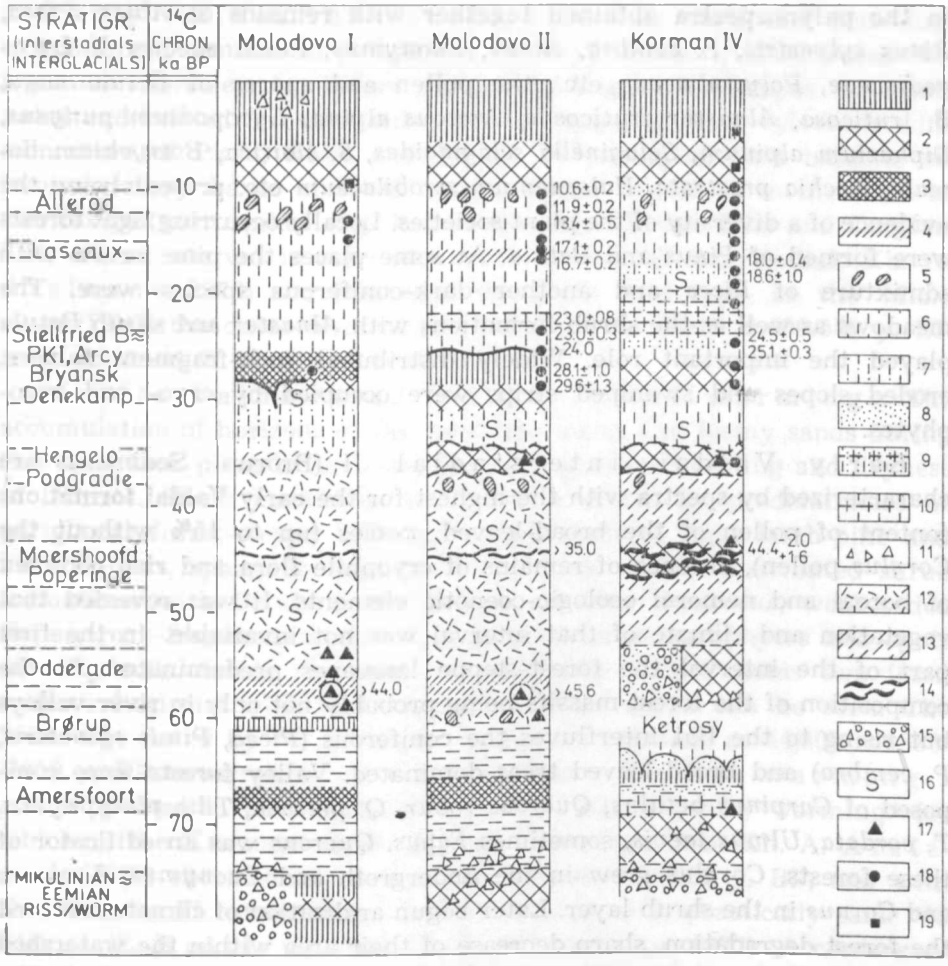

Fig. 2. Stratigraphical scheme of the late Pleistocene deposits of the middle Dniester region and geology of the Paleolithic

1 — humic horizons; 2 — brown loams; 3 — dark grey-brown loams; 4 — traces of gley; 5 — krotovinas; 6 — light loess-like loams; 7 — yellow sandy loams; 8 — sands; 9 — tundra type paleosol; 10 — yellowy-brown loams with tints of green; 11 — siliceous detritus; 12 — "particoloured" sequence; 13 — yellowy-brown loams with dark stains; 14 — "sooty" interlayer; 15 — alluvial sediments; 16 — traces of cryogenic deformations; 17 — the Mousterian artefacts; 18 — the late Paleolithic artefacts; 19 — the early Mesolithic artefacts

most favorable habitats were occupied by spruel-pine forests with admixture of *Carpinus*, *Quercus*, *Ulmus*, *Tilia* and *Acer*.

Early Valdai cooling II (Pre-Brörup). Period of the next, more significant that the first, cooling and continentalization of the climate was characterized by the periglacial forest-steppe landscapes.

In the palynospectra obtained together with remains of *Abies, Picea, Pinus sylvestris, P. cembra, Alnus, Euonymus*, forest species of *Lycopodiaceae, Polypodiaceae* etc., the pollen and spores of *Betula nana, B. fruticosa, Alnaster fruticosus, Arctous alpina, Lycopodium pungens, Diphazium alpinum, Selaginella selaginoides, S. sibirica, Botrychium boreale, Kochia prostrata, Halosnemum strobilaceum* etc. present being the evidence of a diversity of the plant societies. Locally occurring light forests were formed of *Pinus* and *Betula*. At some places the pine forests with admixture of *Picea* and another dark-coniferous species were. The meadows as well as the shrub formations with *Alnaster* and shrub *Betula* played the important role. Widely distributed rock-fragment taluses, eroded slopes and swamped strips were occupied by cryo- and xerophytes.

Early Valdai interstadial II (Brörup). Sediments are characterized by spectra with the highest for the early Valdai formations content of pollen of the broad-leaved species (up to 15% without the *Corylus* pollen), absence of remains of cryophile flora and rich complex of boreal and nemoral ecologic-coenotic elements. It was revealed that vegetation and climate of that interval was not invariable. In the first part of the interval the forest-steppe lanscapes predominated. In the composition of the forest massifs being probably not only in river valleys but rising to the flat interfluves the coniferous (*Picea, Pinus sylvestris, P. cembra*) and broad-leaved trees dominated. Valley forests were composed of *Carpinus betulus, Quercus robur, Q. petraea, Tilia platyphyllos, T. cordata, Ulmus laevis*, sometimes *Fagus*. *Quercus* was an edificator of these forests. *Corylus* grew in the undergroth and *Euonymus, Lonicera* and *Cornus* in the shrub layer. Later begun aridization of climate initiated the forest degradation, sharp decrease of their area within the watershed plateaus and almost everywhere predominance of steppe associations. The following phase with which the main cultural layer with remains of the Mousterian sites is related, is characterized by the appearance of cold-resistant species (*Selaginella selaginoides, Botrychium boreale*). The considered interstadial is correlated with Chermenino II Interstadial of the north-west and centre of the Russian Plain as well as with Brörup of the West-European schemes (from 64,400 ± 800 to 63,500 ± 1500/1200 y. BP) for which the most optimal in the early Würm phytocoenotic and climatic conditions occured.

Early Valdai cooling III. During this period at the territory of the middle Dniester area the forest-steppe with spots of light pine and birch forests, with the growth of *Betula fruticosa* and *Juniperus* in the undergrowth, *Selaginella selaginoides* and *Botrychium boreale* in the herb-and-low shrub layer predominated.

Early Valdai interstadial III was quite cool according to sporadical remains of pollen and spores of *Betula fruticosa* and *Botrychium boreale*. As before the forest-steppe landscapes predominated and limited forest massifs were composed of *Pinus sylvestris* with admixture of *Picea*, *Abies* and *Betula*. Palynological data indicate on two migratory waves of broad-leaved species expressed in the form of two insignificant spikes of pollen of *Quercus*, *Ulmus*, *Tilia* and *Corylus*. This warm interval is correlated with Ionönis II Interstadial (Kh. A. Arslanov 1976) and Odderade for which stratotype in the Miele river (FRG) the dates from 60,900 ±900/800 to 55,900 ±600/500 y. BP were obtained (P. M. Grootes 1977).

Middle Valdai cold intervals and warmings. The accumulation of horizons of the loess-like loams and loamy sands during this time took place in the conditions of significant cooling and dryness of climate. These conditions were characterized by predominance of periglacial forest-steppe landscapes with spots of light larch-pine and birch forests, sphagnum and hummock bogs, widely distributed shrub formations with *Betula fruticosa* and *Alnaster fruticosus*, weak-soded slopes, rock-fragment taluses with association of xerophytes and spots of salty soils. Inside the sequence of middle Valdai loams two fossil soils or horizons with the traces of soil formation can be seen. The lower one dated by ^{14}C technique in Korman section as 44,400 ±1630/1050 y. BP is correlated with the middle Valdai warming I and is seemed to be correlated with the "Krasnogorsky warming" for which in the Krasnaya Gorka section Gomel province Kh. A. Arslanov (1976) obtained the dates within 44,400—46,030 y. BP, and with the Moershoofd Interstadial, the Netherlands, with practically same ^{14}C datings (E. Kolstrup and T. A. Wijmstra 1977). According to complex of the data that time was characterized by temperatelly-warm climate, soil formation of the forest type with the podzolization features. Finds of wood and rind of coniferous trees, *Betula* and *Alnus*, as well as a composition of palynospectra permit to make a conclusion on the forest-steppe character of lanscapes of that interstadial and on wide distribution of spots of pine forests with insignificant admixture of *Quercus* and *Ulmus*. The Middle Valdai warming II being more significant than the previous one, was reflected in formation of the "Molodovsky" (according to I. K. Ivanova) fossil soil correlated with interstadial Hengelo (the Netherland) which age is approximately 39,000—37,000 y. BP (A. Leroi-Gourhan 1977). A significant extension of area of forests, in composition of which the role of *Quercus*, *Carpinus*, *Ulmus* and *Tilia* has been increased, is noted.

The main warm interval of Valdai time can be traced

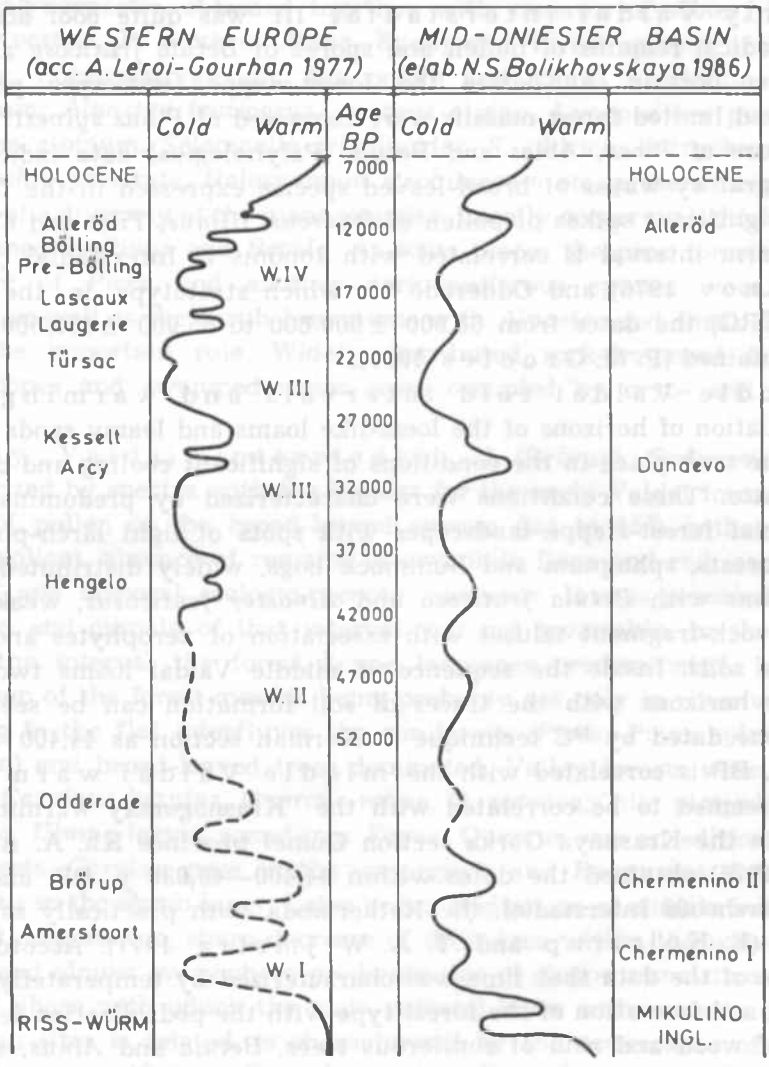

Fig. 3. Late Pleistocene paleoclimatic curves based on the palynological data

in Molodova I and V in the series composing (from the bottom) of the soil, having according the charcoals from cultural layer IX of Molodova V datings 29,650 ± 1320 and 28,100 ± 1000 y. BP, loam and gleying horizon. In Korman, in the "Dniester" (according to I. K. Ivanova) soil and overlying it loams and loamy-sandy layers which based on remains of charcoal are dated 24,500 ± 500 and 25,140 ± 350 y. BP. This warm interval is correlated with the complex interstadial Kesselt-Arcy (France), Denekamp (the Netherland from 28,860 ± 260 to 32,200 ± 500 y.

BP), Stillfried B (Austria 28,120 ± 200 and 27,990 ± 300 y. BP), Dunaevo Interstadial of the north-west of the Russian Plain (32,000—25,000 y. BP), and Brianskiy Interstadial supposed by A. A. Velichko (1982a, b) in periglacial areas of the European part of the USSR (from 29—30 to 23—24 ka BP). Although the middle Dniester area during that time was invariably in the forest-steppe zone a combination of palynological data gives evidences on complex character of this interval. In the first stage in the vegetation cover herbaceous phytocoenses dominated and in forests *Quercus* dominated (thermo-xerotical stage). Then the forest area increased and *Carpinus* became the edificator (thermo-hygrotical stage). Such nemoral elements of dendroflora as *Fagus* and *Tilia* played a significant role: total of pollen of broad-leaved tree species, not taking into account *Corylus* grains, was 22%. Flood-plain forests with *Alnus glutinosa* were widely distributed. Later the dryness increased and may be the climate cooling led to increase of percentage of birch-pine forests and steppe areas. *Ulmus* and *Salix* dominated in the composition of the flood-plain forests. During the terminal phase the territory under study became a field of expansion of boreal and tundra flora. In the meadow associations occupying large areas among other plants were *Botrychium boreale* and *Selaginella selaginoides*. Coniferous forests dominated among the forests formations. The last cold phase seems to correlate with those cold hyperzonal landscapes which were described by A. A. Velichko and T. D. Morozova (1969), Z. P. Gubonina (1975) and others for the epoch of formation of the Bryansk soil. Warm phases of the considered interval differ in maximum for Valdai epoch distribution of deciduous forests in the middle Dniester area. They can be correlated with a significant warming described by V. P. Grichuk (1972) according to results of study of the Bryansk soil of Arapovichi, Mezin and Gunki sections in the valley of the middle Dnieper. This warming was named as the second late Pleistocene interglacial. The problem of its rank as well as the problem of existence of two waves of warming in the interval 30—24 ka BP described in the sections of France, Belgium and others (A. Leroi-Gourhan 1977) are still unresolved.

Late Valdai cold interval I. To formations from this time are related loess-like loams in Molodova and Ketrosy as well as in Korman the doubled tundra soil ("Korman" according to I. K. Ivanova) and overlying it loams and sands which according to charcoals of the late-Paleolithic layer V have dating 18,000 ± 1000 and 18,560 ± 2000 y. BP. The most intensive wave of spreading of the arcto-alpine flora is related with this interval. Tree vegetation was presented by the birch-pine sparce growthes. Shrub bushwoods with *Betula nana*, *B. fruticosa*

and *Alnaster fruticosus* were abundant. Rock-fragment taluses with rare spots of *Artemisia, Arctous alpina, Arctostaphyllos uva-ursi, Diphazium alpina*, etc. were widely distributed. Swamp associations with *Betula nana, Cyperaceae, Rubus chamaemorus, Botrychium boreale* can be met at flood-plain of rivers, in the near-terrace depressions near the slope foots.

Late Valdai interstadials. The results of palynological study of overyling loess-like loams underlying the Holocene soil do not permit to obtain a characteristics of all late Valdai interstadials described for the northern Europe. I. K. Ivanova (1980) described two periods of warming when the role of brich-pine forests with *Quercus, Ulmus, Tilia* and *Corylus* became more significant. The first (16,000—17,000 y. BP) is correlated with Lascaux Interstadial, the second, with Alleröd. Both of them are expressed on the pollen-and--spores diagrams in the form of "spikes" of pollen of deciduous tree species on the background of stably "cold" spectra. The key feature of the Alleröd palynospectra is a predominance of grains of *Ulmus* among the pollen of deciduous tree species the content of which (except *Corylus*) is 10—20%. Together with other parameters this gives evidences the forests with admixture of broad-leaved trees were distributed only in gulches and river valleys.

Thus on the territory of the middle Dniester area the most warm were intervals correlated with three Valdai (Würm) interstadials: Chermenino II=Brörup, Dunaevo=Bryansk=Stillfried B=Kesselt-Arcy= =Denekamp and Alleröd. According to conception of A. Leroi--Gourhan (1977) the West-European interstadials in the order of decrease of warming degree can be arranged as follow: Brörup→Amersfoort→Alleröd→Odderade→Bölling→Kesselt-Arcy = Laugerie-Lascaux→ →Hengelo→Türsac. The last (as Bölling) has not been revealed yet in the sections of the south of the Russian Plain. In the light of the data obtained the similar sequence of interstadials for the middle Dniester area can be presented as follow: Stillfried B (Bryansk)→Alleröd→ →Brörup→Hengelo→Moershoofd → Amersfoort → Odderade = Lascaux. The post-Bryansk stage was the coldest, and the next in the amplitude of cooling was the period between Amersfoort and Brörup.

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STRESZCZENIE

Badania palinologiczne lessów i utworów lessopodobnych ze zlodowacenia wałdajskiego (Valdaian) na Równinie Wschodnioeuropejskiej wykonano dla około 40 stanowisk, położonych głównie w dolinach Dniestru, Dniepru i Donu oraz na pobrzeżu mórz Czarnego i Azowskiego. Pomimo trudności wydzielania pyłków i spor z warstw lessowych dla przeważającej części tych stanowisk uzyskano reprezentatywne dane. Opublikowano 26 standardowych diagramów palinologicznych i 20 wykresów florystycznych. Dla wielu stwierdzonych flor kopalnych wykonano oznaczenia (do gatunków wyłącznie) oraz przeprowadzono szczegółowe analizy ekologiczne. Obliczono parametry paleotermiczne pozwalające na określenie warunków klimatycznych okresów akumulacji lessów oraz rozwoju pedogenezy. Uzyskane materiały stanowiły podstawę do rekonstrukcji roślinności i klimatu ekstraglacjalnych regionów Równiny Wschodnioeuropejskiej w młodszym plejstocenie (A. T. Artyushenko 1970, L. G. Bezus'ko 1981, N. S. Bolikhovskaya 1976, 1981, 1983, V. P. Grichuk 1972, 1982, Z. P. Gubonina 1975, Ye. Ye. Gurtovaya 1981, G. A. Pashkevich 1977 i in.).

Wszystkie warstwy lessowych utworów wałdajskich powstały w warunkach krajobrazów leśno-stepowych i stepowych, w okresie znacznego ochłodzenia klimatu po ostatnim interglacjale (Mikulinian). Lessy, lessopodobne glinki i piaski pylaste akumulowane były w warunkach klimatu suchego i chłodnego lub suchego i względnie cieplejszego, a rozdzielające je gleby kopalne rozwijały się w klimacie ciepłym i względnie wilgotnym, ciepłym i suchym lub chłodnym i względnie wilgotnym.

Środkowe Naddniestrze jest obecnie najlepiej zbadanym obszarem lessowej prowincji wschodnioeuropejskiej pod względem paleogeografii i stratygrafii. Wśród wałdajskich utworów lessowych o miąższości do 20 m (Molodovo, Korman, Ketrosy) stwierdzono tam nie mniej niż 7 względnie ciepłych interwałów, o charakterze interstadialnym, które skorelowano na podstawie danych palinologicznych i dato-

wań metodą radiowęglową z interstadiałami północno-zachodniej części Równiny Wschodnioeuropejskiej oraz środkowej i zachodniej Europy. Najcieplejsze były interwały korelowane z trzema interstadiałami wałdajskimi: Chermino II=Brörup; Dunaevo=Bryansk=Stillfried B=Kesselt-Arcy=Denekamp; Alleröd. Siedem interstadiałów środkowego Naddniestrza można uszeregować według malejącego stopnia ocieplenia następująco: Stillfried B→Alleröd→Brörup→Hengelo→Moreshoofd→Amersfoort→Odderade=Lascaux. Najbardziej chłodny był okres następujący po interstadiale Bryansk=Stillfried B, a następny według stopnia ochłodzenia okres między interstadiałami Amersfoort i Brörup.

Dane palinologiczne dają podstawę do ustalania szczegółowej stratygrafii i międzyregionalnych korelacji profili lessów wałdajskich o małej miąższości lub nie zawierających poziomów gleb kopalnych wyrażonych w sensie morfologicznym.

РЕЗЮМЕ

Валдайские лёссы и лёссовидные отложения Русской равнины исследованы палинологическим методом примерно в 40 пунктах, большинство из которых приурочено к долинам Днестра, Днепра, Дона, побережью Черного и Азовского морей. Несмотря на трудности выделения пыльцы и спор из лёссово-почвенных толщ для подавляющего числа разрезов получены репрезентативные данные. Опубликовано 26 стандартных спорово-пыльцевых диаграмм и 20 флористических графиков. По ряду обнаруженных палинофлоров проведены определения до уровня видов и их детальный эколого-ценотический анализ. Подсчитаны палеометеорологические параметры, позволившие конкретизировать климатические условия эпох лёссо- и почвообразования. Эти материалы легли в основу реконструкций растительности и климата экстрагляциальных районов Русской равнины в валдайскую эпоху позднего плейстоцена (А. Т. Артюшенко 1970, Л. Г. Безусько 1981, Н. С. Болиховская 1976, 1981, 1983, В. П. Гричук 1972, 1982, З. П. Губонина 1975, Е. Е. Гуртовая 1981, Г. А. Пашкевич 1977 и др.).

Вся толща валдайских лёссовых пород образовалась при господстве лесостепных и степных ландшафтов на протяжении значительного послемикулинского похолодания климата. Горизонты лёссов, лёссовидных суглинков и супесей накапливались в сухих и холодных, в сухих и относительно теплых (интерстадиальных) условиях, а формирование разделяющих их палеопочв происходило в теплом и относительно влажном, в теплом и сухом, в холодном и относительно влажном климате.

В настоящее время самым изученным в плане детальной стратиграфии и палеогеографии регионом восточно-европейской лёссовой области является территория Среднего Приднестровья. Здесь внутри покрова валдайских лёссовидных образований мощностью до 20 м (Молодова, Кормань, Кетросы) зафиксировано не менее 7 относительно теплых интервалов интерстадиального характера, сопоставляемых по палинологическим данным (Н. С. Болиховская, Г. А. Пашкевич) и радиоуглеродным датировкам с интерстадиалами Северо-Запада Русской равнины, Средней и Западной Европы. Самыми теплыми были интервалы, сопоставляемые с тремя валдайскими (вюрмскими) интерстадиалами — II черменинским=брёрупом, дунаевским=брянским=штиллфридом Б=кессель-арси=денекампом и аллерёдом. По уменьшению степени потепления интерстадиалы Среднего Приднестровья распределяются следующим образом: штиллфрид Б→алле-

рёд→брёруп→хенгело→моерсхофд→амерсфорт→оддераде=ласко. Максимально холодным был период после брянского интерстадиала, а следующим по интенсивности похолодания в ряду холодных интервалов был отрезок между амерсфортом и брёрупом.

Использование палинологических данных позволяет осуществлять дробную стратификацию и межрегиональную корреляцию валдайских лёссов по разрезам, где они маломощны или не содержат морфологически выраженных горизонтов ископаемых почв.