MILANKOVIC'S THEORY AS A BASE FOR EXPLANATION OF NATURAL ASPECTS OF CIVILIZATION DEVELOPMENT

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Abstract: Milutin Milanković's climate theory precisely describes the climatic conditions on the Earth over hundreds of thousands of years (during the Ice Age) and practically defines the real climatic framework for the survival of living beings. Climate oscillations have been successfully estimated by this theory, and modern measurement technologies, with the use of satellites and geological soundings, have confirmed its high accuracy. The calculations of the astronomical cycles of the Sun and the Earth, changes in the Earth's ecliptic, the inclination of the Earth's axis and its precession are related to the absorption of the Sun's radiation and its reflection. By connecting with geological processes and the spread of biota, we define the areas in which people could live in the Paleolithic, during the Mesolithic and Neolithic Periods until today. The author of this paper* added to this framework extensive studies of the ancient history of civilization, together which with Milanković's theory, indicates the need to redefine many attitudes in the study of ancient history, civilization, its origin, its characteristics, expansion and continuity to the present day.

Keywords: Climate change theory, Milanković's cycles, ice age, formation of civilization, spread of civilization

Сажетак: Климатска теорија Милутина Миланковића описује прецизно климатске услове на Земљи током више стотина хиљада година уназад (током периода ледених доба) и практично дефинише реални климатски оквир за живот живих бића. Климатске осцилације су успешно процењене овом теоријом, а модерне технологије мерења, уз примену сателита и геолошких сондирања, потврдиле су њену високу тачност. Повезивањем са геолошким процесима и ширењем биоте, дефинишу се простори у којима су људи могли живети у палеолиту, током мезолита и неолита и до данашњих дана. Укључивањем у анализе чињенице из бројних природних и егзактних наука, уз кориговање тумачења ранијих геолошких и археолошких анализа, добија се осетно измењена слика услова за настанак цивилизације и за њено касније ширење и континуитет. Аутор овог рада је на тај оквир надовезао обимне студија древне историје цивилизације, која заједно са Миланковићевом теоријом указује на потребу редефинисања многих ставова у изучавању древне историје цивилизације, њеног настанка, њених карактеристика, ширења и континуитета до данашњих дана.

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1. CLIMATE CONDITION CHANGES ON EARTH FROM THE PALEOLITHIC TO THE PRESENT

Milanković's theory of climate change shows that climatic processes are conditioned by the movement of the Earth around the Sun during long periods of time, but also that they are closely related to the heat exchange in the atmosphere, hydrosphere and lithosphere and connected with geological processes. Geological processes throughout the Earth's history have formed the layout of land and sea and the relief of land. These processes are very slow. The effects of volcanoes, earthquakes and tectonic movements of the earth's crust are more noticeable to human civilization than the geological changes, because their effect manifests itself in a drastic form. Larger tectonic disturbances can lead to the large parts of the coast sinking into the sea and to the opening and closing of sea passages. Volcanoes can cause major catastrophes with the explosions and lava flows, leading to the major climate change by emitting huge amounts of ash, smoke and toxic gases.

Such geological catastrophes have been recorded in historical documents in modern history (for example, the eruption of Krakatau volcano, the eruption of a volcano in Iceland, the eruption of Vesuvius, etc.), but during the period between the maximum of the last ice age and the appearance of the first civilizations, numerous tectonic changes played an important role as a initiator of population migration and knowledge exchange. These events are the most probable motif of myths and legends (myths about the Flood, about Atlantis, etc.). Many researches in the field of paleogeology, paleogeography, paleoclimatology, paleoecology, etc. show that behind these myths often real events are hidden, so their study can provide a significant progress in the study of historical processes.

Useful data on the history of flora and fauna are obtained by studying fossils of plant and animal origin. In this way, the outlines of the geological history of the Earth and paleobiology were reconstructed, and thus the real physical framework for human life and the emergence of civilization, as well as for the physical and technical feasibility of some historical processes. Many plant and animal species have become extinct in areas affected by climate change, and some have migrated or adapted to new conditions. A similar thing happened to people who were forced to move to more climatically favorable areas and to adapt to the new climatic conditions. This reflected on the racial characteristics of today's people, and new genetic researches show that genetic mutations have also been manifested.

Anthropologists have established the migration routes of people from Africa during the last 200,000 years, through Asia and Europe to Australia and America. These migrations have conditioned today's human races and the current distribution of the population. Most of these migration paths were confirmed by the findings of paleogeneticists, because the periods of stay in certain climatic conditions were reflected in genetic mutations. However, there are differences compared to the earlier opinion, which primarily refers to the white people, whose appearance about 40-45 millennia ago still remains insufficiently explained in terms of previously assumed migrations from Africa. At the end of the last Ice Age, there was a possibility for the migration of the paleolithic population from Northeast Asia to America, across the land at the site of today's Bering Strait and to its spread in America.

Milutin Milanković's model of climate change describes very well the regularity of the formation of the Ice Age period, which marks the last million years of the Earth's evolution. The last Ice Age had its maximum about 20,000 years ago, when the polar ice cap covered a significant part of Eurasia (Fig. 1. above left). During the Ice Age, large amounts of frozen water accumulated on land and caused ocean levels to fall, so that Asia and America were connected by land (Fig. 1, above right).). Figure 1 down shows the change in this level during the last 140,000 years, which is important for studying the Paleolithic period [4]. At the end of the Ice Age, the ocean level was 125 meters below todays.

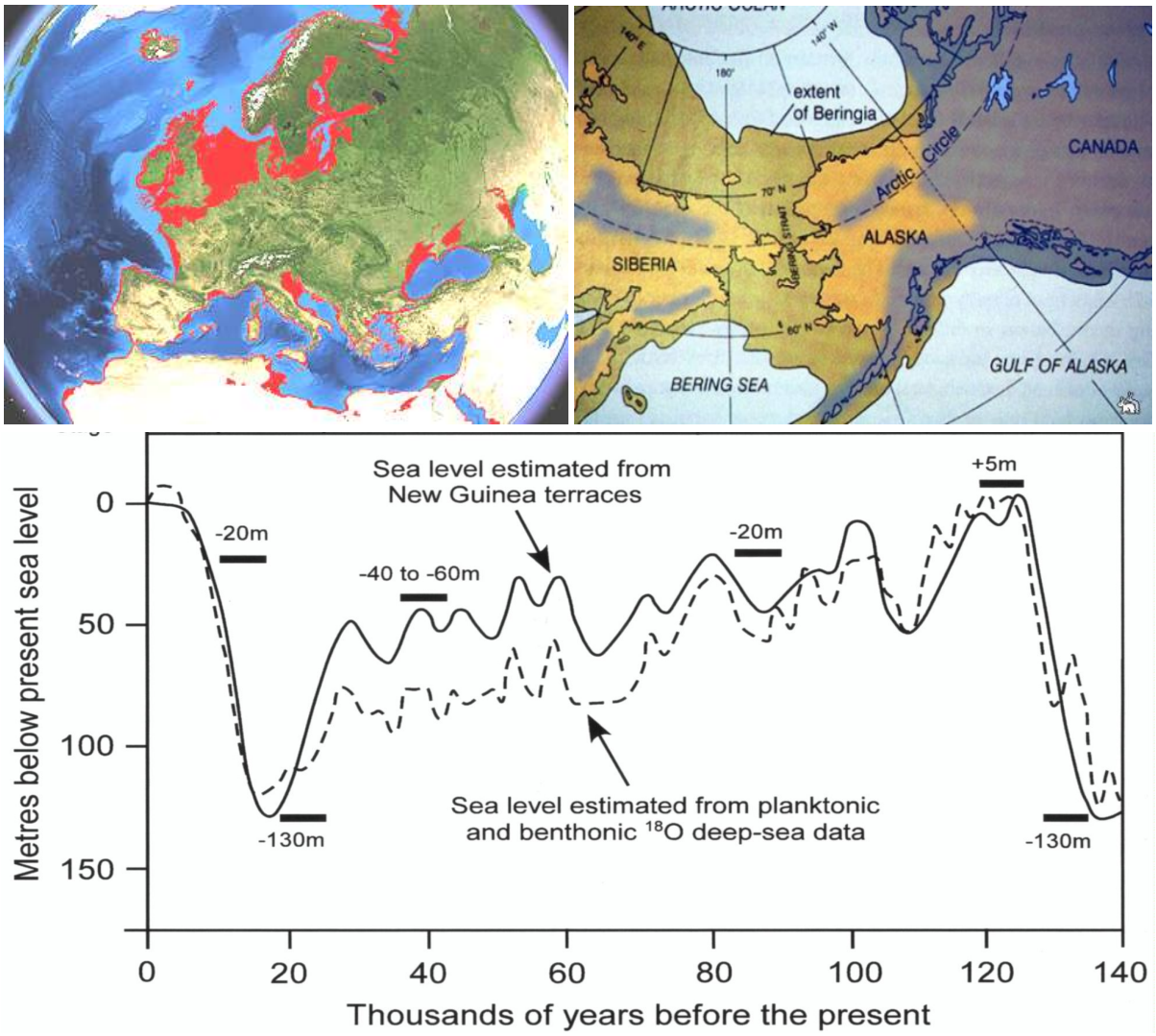

Figure 1. Europe (above left) and land connections between Eurasia and North America before the ice melts (above right), [21]; Changes in ocean levels during the last two ice ages and during warming to the present day (down, [4])

The last Ice Age, between 25,000 and 18,000 years before today, had the maximum distribution of ice caps on the northern hemisphere. This process compressed the European living space in the area south of the Alps, in the Danube region, and in the northern coast of the Black Sea. To the south, the zone was bounded by a hot desert [18,20]. In this way, a limited space for human survival is defined. Under the influence of climate change, wild animals and humans have moved in search of better living conditions. The paleolithic migrations can be estimated on the basis of a small number of available archaeological findings, on the basis of genetic analyzes, as well as on the basis of the analysis of natural and physical conditions of their feasibility.

With the end of the last ice age, about 18,000 years ago, the period of warming in Eurasia has begun. The recent paleoclimatic research gives the possibility to access the natural conditions for the development of flora and fauna in that period, and thus the natural conditions for human life. One such project provides the overview maps of plant cover for characteristic periods. The map of the distribution of the flora on Earth at the beginning of the warming period [1] shows huge zones of extreme deserts (icy in the north, hot in the south).

Favorable living conditions exist in the Middle East, in the so-called zone of the Fertile Crescent and in Europe, south of the Alps, in Pannonia and the Carpathians. The largest zone with a long period of multi-millennium stable conditions existed in the Danube valley and the Balkan Peninsula.

The warming after the end of the last Ice Age happened in several stages, with several oscillations of the mean annual temperature, including a short-term freezing 14,700 years ago (the so-called *Older Dryas*). The area of extreme desert narrowed during this period. The warming that follows (the *Alerod period*) brings heavy rainfall in the southern areas, as a result of which large rivers are directed to the north. There, barriers of thick ice deposits are formed and large glacial lakes are formed. The largest of them, the West Siberian – Manyensko Lake, was twice as big of today's Caspian Lake. During this period, most of northern Eurasia is poorly passable and there are no conditions for population migration, while the rivers west of the Urals drain water into the Black Sea and from there it flows in the Mediterranean.

In the period of cooling, about 11,000 years ago, before the beginning of the Holocene, there was a decrease in precipitation. This period of about 1,300 years was marked by a dry cold climate (*Younger Drias*). After this comes a long, stable period of warming and favorable conditions for human life - the period called Holocene. In the middle of this period, the so-called *Thermal Optimum*, the climate in the northern hemisphere was warmer than it is today. The research has shown that in Greenland the temperature rise was as much as 6˚C in the time around 8,200 years ago [6].

During the Holocene temperature optimum, 9,000-7,000 years ago, large tectonic and hydrological changes occurred, caused by climate change. Large lakes on the edges of the ice zone broke through the deposited moraines and the North Sea level began to rise. In the Holocene, the Baltic Sea level has several oscillatory changes, during which it transforms from a lake into the sea and vice versa [19]. In the further process, the southern water reservoirs (the Black Sea, Caspian and Aral Lakes) dry up and their level drops significantly. A detailed Russian pollen research has shown that the greatest warming of today's northern Russian coast and islands in the North Sea was in the so-called *Early Pre-boreal period* (from 11,000-9,000 until 8,500 years ago) [3]. In the inland, the warmest period was in the second half of the so-called *Atlantic period* 6,000 - 4,500 years ago, with a new warming in the period 3,500 - 1,000 years ago.

By analyzing the age of tree fossils, using the method of radioactive carbon, the areas of distribution of some characteristic tree species (birch, pine, spruce, larch) in the northern Eurasia during the Holocene were determined [7,10]. The movement of the distribution lines of these tree species to the north began 10,000 years ago, and during the period of 9,000-7,000 years ago they reached the present-day northern coast of Russia. In the period of 4,000-3,000 years ago, the impact of warmer water from the Atlantic is reduced and the cooling and the return of this line to today's positions starts. This shift was synchronized throughout the Russian North. When the maximum movement of the tree line to the north was reached, in the period 9,000-8,000 years ago, it was shifted in the whole of Russia more northerly than today, and the average July temperature of the northern Russian coast was 2.5 - 7˚ C higher than today.

During the Ice Ages, the oscillation of temperature and climatic conditions was very large, but the mean values at the planetary level remained weakly variable. As a result, large frosts in the north were accompanied by a large narrowing of tropical humid areas, the expansion of deserts, and a strong reduction in temperate climates. Therefore, at the end of the last Ice Age, the deserts in North Africa and the Arabian Peninsula were larger than today [2]. At the beginning of the melting and melting of glaciers, milder climatic conditions occur in the Sahara until the average temperature drops by 3-8º C. Between 16,000 and 6,000 years before the present, Sahara had a wetter climate. During this period, there are several lakes in

it, inhabited by crocodiles and hippos. Steppe hunters appear in that environment, as evidenced [22] by cave paintings from the period of 5,000 years BC. During this period, several milder oscillations of climatic conditions were recorded [23]. The drying processes in northern Africa began about 4,000 BC and accelerated rapidly after two millennia and spread to Western Sahara. In this process, Lake Chad was reduced from 200,000 km^2 to today's 8% of the area.

About 4,200 years ago, there was a new sudden change in the climate in the Sahara. The wet monsoon leaves this area and dries out abruptly. This drying was observed in the Mediterranean and in Mesopotamia. Measurements show during next 300 years five times higher level of concentration of dust deposited in the oceandust than today's level at the end of that period. The last two thousand years BC were followed by the constant drying of the Sahara and its final transformation into a desert around 1,500 BC. Climatic characteristics in North Africa changed considerably during the last Ice Age, but also after it. In warm periods, the northern hemisphere was warmer by 3-6˚ C than today [5]. During the climate optimum 9,000-4,000 years before today, Sahara had a wetter climate than today, due to monsoons blowing farther north, so that Lake Chad was 30-40 m deeper than it is today. The drying up of the Sahara began around 3,000 years BC. The conditions for agriculture originated around 9,000 BC. With further warming, the Iranian plateau became wetter and woodier and more suitable for life. T. G. Moore cites the results of some Americans scientists and Cavalli-Sforza, according to whom the wheat was cultivated in Southwest Asia between 8,000-7,000 BC, and the cattle in Sahara were raised 8,000 BC [5]. Recent archeological discoveries from Blagotin have shown that the wheat was grown in Morava Valley during the Starčevo culture, which brought this area to an approximate level of the so-called Fertile Crescent area.

The multidisciplinary research shows that the processes took place in the real physical world in the Neolithic, which led to great changes. The research into the mythology of ancient people and the search for evidence of the biblical Flood led to an important discovery about the flood of the North Black Sea coast and the precise location of that event in the VI millennium BC, based on the geological and paleo-oceanological findings. The theory of the geologists Walter Pitman and William Ryan from 1993, who determined that the event took place around 5,600. BC (according to later works, the period was moved to a slightly older past) [24], was confirmed in 1999 by Bob Ballard in an expedition organized by the National Geographic (this expedition discovered a sunken settlements on the Turkish coast at a depth of 95 meters, which shows that the level of the Black Sea was lower and that the rise in the levels led to the flooding of old settlements, [25]). A major tectonic disturbance led to the breakthrough of Dardanelles Sea and the former lake between the Dardanelles and the Bosphorus with a level at 120 m below the level of the Mediterranean Sea due to such a flood (20 km^3 of seawater per day) increased 2-3 times its size, and the previous outflow of its fresh water turned into a giant waterfall through the Bosphorus (intensity of about 200 Niagara Falls), by which the sea water from the Mediterranean flowed into the Black Sea. The level of the Black Sea rose at a rate of 15 cm per day and stabilized at more than 150 m above the previous one. The northern coast of the Black Sea has undergone drastic changes, because at its expense, the surface of the Black Sea has doubled and the Sea of Azov and the Crimean Peninsula have been created.

The population of the northern and western coasts, as well as the surviving population from the area between the Bosphorus and the Dardanelles, headed to its retreats along the rivers that flow into the Black Sea, carrying with them its previous knowledge and leading to the great perturbations of the previous population structure. The result was an intensified exchange of knowledge, which led to the emergence of new Neolithic cultures and formed a Proto-European community. This scenario of the flood of the Black Sea is a physical explanation of the process observed by linguists, on the basis of which at the end of the last

century they came to a consensus on the location of the ancient Indo-Europeans to Helm (the Balkans), the Danube, north of the Black Sea and Asia Minor. There are new linguistic results, but also the results of DNA analyzes of the ancient people, which speak in favor of such a theory.

Several additional recent geological investigations of this problem led to the correction of this theory and to the expansion of the time range in which the hydrogeological changes were analyzed. The most important conclusion is that this overflow of the Mediterranean into the Black Sea was preceded by an even more complex process 16,000-15,000 years ago, when large bodies of water of melted glaciers, which could not flow north, broke through the rivers to the present-day Black Sea, the Caspian and Aral Lakes and formed the *Novoexini Lake* [11].

2. THE NEST OF EUROPEAN AND WORLD CIVILIZATION WITHIN MILANKOVIĆ'S THEORY OF CLIMATE CHANGE

The ancient history today is mainly studied on the basis of some principles, mostly shaped more than 150 years ago by the historians of the Western European countries. According to such theories, it is generally believed that the civilization originated several millennia before Christ in Mesopotamia and then spread to the west and northwest. According to such an opinion, the most important achievements of Europe have been "imported", and today's population consists of nations created by the population migrations from the steppe-desert areas in the east. The languages and the nations were formed by the merging of diverse groups.

Such principles are the result of the ambitious political and national programs of these countries, which in previous centuries had achieved great power, on the basis of the conquest and exploitation of large colonial non-European colonies. The increased economic and political power has, quite naturally, produced a desire to better one's own history. These countries, that today lead the world in political, military, technological and economic terms, find themselves in areas that represented the real periphery of the early civilisation. After the collapse of the Western Roman Empire, some significant ancient history could only be appropriated from other people, by relativization and circumvention of facts, by target constructions, and even falsification. This is especially effectively directed against the historical past of the Slavic and Orthodox peoples, with maximum political and other pressures on Slavic historians, so that today's historical science in Europe mainly treats this largest European group of people as some kind of new people without ancient history and intruders in today's ethnic areas.

According to the logic of scientific research, ancient history must be studied taking into account the multidisciplinary combination of facts obtained from many scientific disciplines, because historical processes take place in the real physical world, in real physical spaces, and all activities during these processes represent real events in the real physical world. Therefore, all the rules of research in physical systems must apply, especially the conclusion about the limited speed of historical processes and the impossibility of discontinuous changes on a large scale and in a short time interval without extremely large releases of energy (major wars or natural disasters). By including Milanković's theory of climate change in this approach, the search for the "nest of civilization" acquired an exact character (instead of logical speculations based on insufficient data). Here are listed some of the most important conclusions of this consideration:

(1) Exploring the ancient world from the Upper Paleolithic to the New Age, one often deals with some of the popular legends. Milanković's theory clearly shows that during the previous million years some of them were not possible. Milanković's precise calculations do

not allow the possibility of the occurrence of mentioned processes, and their experimentally verified accuracy proves the correctness of such calculations. This conclusion applies to the following legends: (a) The change in the length of the year (280 to 365 days) over the last 20,000 years, due to the change in the Earth's orbit; (b) The replacing the orbit of Mars and Earth; (c) The disappearance of one of the planets of the solar system; (d) The existence and disappearance of the second Moon; (e) A drastic displacement of the earth's poles; (f) The disappearance of the great mainland - Atlantis.

(2) Some legends are possible within the framework of Milanković's theory, such as: (a) The legends of the flood (in many nations) - areas of large accumulations of melted ice in the period XV-VII millennium BC (The flood of the Black Sea in the VII millennium BC); (b) The legend of Hyperborea (a period of several thousand years in the Arctic zone).

(3) Some of the valid "historical truths" are too magnified in relation to the real natural framework defined by Milanković's theory: (a) The emergence of civilization in Mesopotamia before the 7th millennium BC (it had been a salt swamp until then); (b) Scandinavia as a possible ancestral home (until the 2nd millennium BC, it was mostly under ice); (c) The formation of civilization in the sparsely populated steppe and steppe-desert belt of Eurasia; (d) Priority of the “Fertile Crescent” (Nile-area of *Natufien culture*-Zagros) in search of the source of agriculture; (e) Large-scale ancient migrations; (f) Migration of steppe nomads in the field of farmers and easy changes of "qualifications".

(4) Possible areas for "nests of civilization" according to the framework defined by Milanković's theory of climate change would be: (a) Balkan Peninsula - the Northern Black Sea Coast - part of Asia Minor: continuous conditions during the last 40,000 years; (b) Fertile Crescent Zone as a source of agriculture: continuous conditions over the last 40,000 years - narrow zone, unfavorable environment; (c) Mesopotamia: only after the VII millennium BC; (d) Indus Valley - after the end of the V millennium BC; (e) The Nile-Sahara zone only until 6,000 BC and then a strong reduction to the narrow zone around the Nile; (f) Hyperborea - Arctic zone, before the VII millennium BC; (g) Atlantis - a smaller (now sunken) land somewhere in the Atlantic Ocean, or on the shores of the Black Sea - before the VII millennium BC.

3. REAL SUPPORTS FOR ANALYSIS OF ANCIENT HISTORY

According to the logic of scientific research, ancient history must be studied taking into account the multidisciplinary combination of facts obtained from many scientific disciplines, because the historical processes take place in the real physical world, on real physical spaces, and all activities during these processes represent real events in the real physical world. Therefore, all the rules of research in physical systems must apply, and above all the conclusion about the limited speed of historical processes and the impossibility of discontinuous changes on a large scale and in a short time interval without extremely large releases of energy (major wars, or natural disasters) must be taken into consideration.

During ancient times, as well as today, the appropriate natural and physical conditions were necessary for the realization of historical processes and for the events (population migrations, changes in population structure, wars, destructions and new constructions, new technologies, ethnogenesis, modifications of civilization characteristics). Determining these conditions is an important task in a serious research of ancient history, and this is usually a big problem, because of the connection with the sciences that are very different from the history greatly in terms of scientific methodology, and especially in terms of the knowledge needed to understand the facts offered by such sciences.

Here, the author of this paper presented favorable facts from his earlier studies of the ancient history of the European civilization (in which the methodology and results of several

natural and exact sciences are used) and connected them with the facts from Milanković's theory of climate change. This theory is a powerful tool that can be applied in the study of ancient history. Thanks to Milankovic's theory and his calculation of the parameters of the ancient climate over the past 20-30 millennia, an exact framework has been created for the study of the origin of the first civilization, its spread and development to this day [13]. The mutual connection of the results of Milanković's theory of climate change and several other natural and exact sciences, linguistics, mythology and ethnology, ancient historical writings and archaeological findings (which are most often ignored by historians, or misinterpreted and partial interpreted) gain their fuller meaning and the image of the ancient image becomes more precise [14].

The extensive research by the author of this paper arose from the desire to clarify the ancient history of Serbs, Slavs and other European nations as precisely as possible. In this sense, the results so far have clarified many obscure periods of the ancient history of the Serbs. The usual contradictions from historical studies have been eliminated and the basic contours of the thus formed image of the ancient world and the first Europe civilisation have been outlined. These results are confirmed by both linguists and geneticists. Extensive studies by the author of this paper [15,16,17] show that the European civilization originated in the Danube region and the Balkans during the Neolithic cultures of Lepenski vir, Starcevo and Vinca. It was the most densely populated area in Euro-Asia for several millennia after the maximum of the Ice Age and the warming period. It had the most favorable natural conditions for human life, with annual cycles and people oriented to agriculture. Thus, the cult of Mother Earth and the cult of the Sun arose, which formed the basis of all religions later. During the Neolithic, all civilizational characteristics were formed in this area: agriculture, mining, metallurgy, crafts, mythology, religion, social organization, language, literacy, oral epic poetry, ethnological characteristics (customs, costumes, ethno music, dance).

The first civilization has spread to large areas of Europe, Asia and the Mediterranean. The processes were accompanied by migrations from the Balkans to the southeast and migrations of nomadic people from the steppe regions to Europe (their migrations stimulated climate oscillations). The northern part of Europe became habitable only at the time of the establishment of climatic conditions similar to today's, so that the characteristics of civilization spread naturally to the north during the period from several millennia to the time of the first historically recorded states in Asia Minor, Mesopotamia and Egypt.

All this is confirmed by recent archaeological findings and linguistics. These studies by the author of this paper have shown that today's Serbs are the direct descendants of the ancient people of the first European civilization, created in the areas where Serbs still live today. The Serbs kept all essential civilizational characteristics of that original European civilization, by using the language that originated directly in this area and by using they the first alphabet formed in this area in the Neolithic period.

In recent years, the genetic DNA analysis has become extremely interesting for the study of history. Their commercialization has led to a huge number of analyzed samples of millions of today's people, on the basis of which one can get representations of the genetic structure of today's inhabitants of individual states and territories and genetic kinship between the nations. In recent years, a large number of samples from the burial remains of people from different historical periods have been analyzed, which has indicated significant opportunities for further research. In such research, the area where Serbs live has not been analyzed much, but it has been noticed that European genetic roots are the deepest in the Balkans.

The DNA analyzes have previously established that the genetic picture of Serbs in today's area does not correspond to the theory of the alleged immigration of Serbs from the area north of Pannonia in the 7th century. After several indications of the existence of such a need, at the end of 2016, the first results appeared (in spring of 2017 they became more

widely available), which refer to the genetic analyzes of the ancient population from archeological sites in the Djerdap Gorge in Mesolithic and early Neolithic times. The results obtained are extremely important, because they confirm the theories about the origin of the first European civilization at that time in the area of the Danube region and the Helm (Balkan) peninsula. These results, together with about 200 other results related to the area of Southeast Europe, have not been much analyzed by European researchers. It is now shown that the ancient inhabitants of the Djerdap Gorge, from which the chain of cultures Lepenski Vir - Starčevo - Vinča started, from which the first European civilization was formed, were from the same genetic chain [8]. Many theories of historians, especially ours, are definitely ripe for rejection, and the paths of more realistic studies are already being outlined. The latest results from 2020 show that this genetic picture of the population of this area existed in the area of today's Serbia even 4 millennia ago, at the time of the beginning of the Iron Age [12].

CONCLUSION

Milutin Milanković's theory of climate change is a powerful tool that can be used to research ancient history. It defines the parameters of the ancient climate during the past 20-30 millennia and defines the possible area of the origin of the first civilization („the nest of the civilization“), the area of its spread and the development to the present day. The mutual connection of the results of Milanković's theory of climate change and several other natural and exact sciences, linguistics, mythology and ethnology, ancient historical writings and archeological findings (which are most often ignored by historians, or misinterpreted and interpreted in isolation) gain their fuller meaning and the image of the ancient image becomes more precise. The author of this paper gives the basic facts from his earlier studies [13] of the ancient history of European civilization (which use the methodology and results of several natural and exact sciences), related to facts from Milanković's theory of climate change [14]. This connection of facts gave a large amount of evidence about the formation of the first European civilization during the Neolithic in the Danube region and the Balkans. Such conclusions [16,17] agree with numerous recent discoveries of archaeologists and linguists (for which many current theories of historians do not have an adequate explanation), and this is confirmed by recent DNA analyzes of burial remains of the ancient population of Djerdap Gorge and the Balkans and their genetic relationship to today's population of Serbia.

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