INQUA SEQS 2020

Conference Proceedings

Quaternary Stratigraphy – palaeoenvironment, sediments, palaeofauna and human migrations across Central Europe

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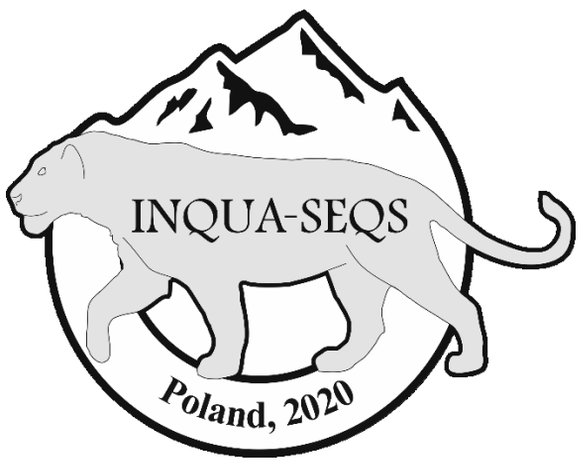

INQUA SEQS 2020

Conference Proceedings

Wrocław, Poland, 28th September 2020

Quaternary Stratigraphy – palaeoenvironment, sediments, palaeofauna and human migrations across Central Europe

International conference
dedicated to the 70th Birthday Anniversary of
prof. Adam Nadachowski

Uniwersytet Wrocławski

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Preface

In the year 2019, we decided to organize the 2020 SEQS-INQUA conference *"Quaternary Stratigraphy – palaeoenvironment, sediments, fauna and human migrations across Central Europe"*. The original idea was to offer a conference program with a plenary oral presentation at a venue located in the Śnieżnik Mountains (in the Sudetes) combined with field sessions in the Sudeten caves, the Giant Mountains (Karkonosze) and the Kraków-Częstochowa Upland. The year 2020 is also the year of the 70th birthday jubilee of our friend, mentor and former Head of the Department of Paleozoology at University of Wrocław – Professor Adam Nadachowski, who is an acknowledged specialist in the field of mammalian palaeontology studying Neogene and Quaternary faunas of rodents in particular. Therefore, we desired to dedicate this conference to him.

Unfortunately, the outbreak of the pandemic changed everything. Initially, postponing of the conference by one year was considered; however, after consulting the authorities of INQUA and the Section on European Quaternary Stratigraphy (SEQS), we decided to conduct the meeting this year in a virtual form and to stick to the previously agreed date. The aim is to organize the actual, 'real' meeting (including the field sessions) next year assuming that the travel restrictions are over.

The interest in the proposed form of the symposium exceeded our expectations. We face an uneasy challenge to fit all into the limited time frame dictated by the formula of remote on-line conferences. We present a volume with the conference program, abstracts of the presentations and a brief description of the scientific achievements of Professor Adam Nadachowski. We hope that our virtual conference will be an interesting introduction to the 'real' meeting that we all miss so much. We would like to invite you to visit the University of Wrocław and the interesting research sites in Poland next year.

In the name of Organizing Committee

Krzysztof Stefaniak

Organization

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Adam Nadachowski

Professor Adam Nadachowski, after graduating from the Jagiellonian University in 1973, started working at the Department of Systematic and Experimental Zoology, Polish Academy of Sciences, in Krakow, later transformed into the Institute of Systematics and Evolution of Animals. His scientific career is related to this institute, he was the head of the Department of Vertebrate Zoology, and also the Director of the Institute for three terms (11 years). In the years 2007-2018, he also worked at the University of Wrocław, where he was the head of the Department of Palaeozoology.

Adam Nadachowski is a student of Professor Kazimierz Kowalski, a theriologist and palaeontologist. He specialises in research of fossil Quaternary and Neogene rodents, important for the reconstruction of palaeoenvironment and the biostratigraphy of terrestrial sediments. Already in the first period of his activity, he published several works that have not lost their relevance until today. In 1982, he published a monograph on Late Pleistocene rodents of Poland with species reference to morphotype dentition analyses of voles. It was his doctoral dissertation. At that time, this work was of pioneering nature and made a significant contribution to the development of this speciality and is still relevant today; it is one of his best-cited publications (over 100 citations). In the following years, Adam Nadachowski revised and presented, for example, the systematics, the origin and evolution of snow voles - rodents of the genus Chionomys. This work, published in 1991, is also still cited.

However, most of his publications are collective works. From the very beginning of his scientific career, Adam Nadachowski focused on wide and close cooperation not only with biologists of various specialities but also with geologists, palaeogeographers and archaeologists. He made a valuable contribution to the interdisciplinary studies of many archaeological and paleontological sites and collected materials for its own research. The result is, for example, his work on the origin and history of extant rodent fauna in Poland based on fossil materials (published in 1989). At the same time, he was engaged in synthetic studies of fossil rodents of Ukraine. He published the Neogene (with Valentinen Nesin) and Pleistocene (with Leonid Rekovets) rodent fauna in English, which expanded the knowledge of this group of mammals from Ukraine among colleagues from Western countries. Cooperation with archaeologists has resulted in the participation in several spectacular discoveries. Excavation research conducted jointly with archaeologist Paweł Valde-Nowak in the Obłazowa Cave in the Carpathians led to the discovery of an original object made of a mammoth tusk, interpreted as the oldest boomerang in the world. This discovery, apart from the monograph co-authored by Adam Nadachowski, was published in Nature (in 1987). Another important discovery in recent years was the finding and description of the first in Poland tooth remains of Neanderthals from Stajnia Cave in the Polish Jura, together with a wide team from Wrocław University, Max Planck Institute for Evolutionary Anthropology in Leipzig and the University of Bologna.

In 2006, Adam Nadachowski, together with Robert Sommer, published an article on the so-called glacial refugia of mammals in Europe, pointing for the first time in the literature to the possibility of locating one of the Last Glacial Maximum refugia in the Carpathians. Later works by many researchers confirmed this assumption, which is also manifested by numerous citations of this publication (over 210 citations).

At the same time, he expanded his cooperation with molecular biologists, which started in 2004 with the publication on the phylogeny of the genus *Microtus*, based on the study of mitochondrial DNA, in *Molecular Phylogenetics and Evolution*. In this co-authorship, Adam Nadachowski was responsible for identifying the age of calibration points and the paleontological basis of *Microtus* evolution. Currently, it is the most cited publication of Adam Nadachowski (over 270 times).

In the last 15 years, Adam Nadachowski has become more interested in the use of radiocarbon dating of fossil remains to reconstruct the migration patterns and extinction of individual species of fauna under the influence of climate and environmental changes, especially in the Late Pleistocene. In 2011 and 2018, he published works with colleagues from his parent institutes in which he documents the rather unexpected phenomenon of the lack of mammoth remains throughout Europe in the time range from approximately 21 thousand years to approximately 19 thousand years, during LGM period. Another work in this series is the reconstruction of the migration of the saiga antelope in Europe in the Late Pleistocene on the basis of direct 14C dating.

The willingness and the ability to collaborate widely resulted in invitations of Adam Nadachowski to participate in large research projects, ending with the publication of books. Adam Nadachowski is the main author of two studies on the use of fauna resources by Palaeolithic hunter-gatherer communities in a book from 2015 edited by Maria Łanczont and Teresa Madeyska entitled "*Palaeolithic ecumene of the peri-and meta-Carpathian zone*". The second example is the authorship of two chapters on the reconstruction of the environment and changes in fauna in the volume on the Palaeolithic, which is part of a six-volume work edited by Przemysław Urbańczyk, entitled "*The PAST SOCIETIES. Polish lands form the first evidence of human presence to the Early Middle Ages*"(published in 2016).

In 2010, professor Piotr Węgleński, together with his team from the University of Warsaw and Adam Nadachowski with colleagues from Department of Paleozoology of Wrocław University, initiated cooperation between molecular biologists and palaeontologists, which resulted in the creation of a consortium called the "European Pleistocene Fauna Research Center", whose main goal is to use the research of ancient DNA, stable isotopes and morphology of mammals to reconstruct the history of species, migration and extinction. The consortium now operates less formally in the cooperation of 10 institutions: from the University of Warsaw, the University of Wrocław, the University of Toruń and several Polish Academy of Sciences institutes, and Adam Nadachowski currently coordinates its activities. In addition to the achievements of several publications in honoured journals, including for example Global Change Biology, Scientific Reports, Quaternary Science Reviews, Quaternary International, and others, the consortium organises every year conferences entitled "Species and genetic diversity of Pleistocene and Holocene mammal fauna in Eurasia".

Adam Nadachowski's international activity is evidenced not only by his publications but also by membership in Polish and international organisations, as well as participation in almost 100 local and international conferences.

In conclusion, it is worth emphasising that what distinguishes scientific and organisational activity of Adam Nadachowski is the ability to cooperate with representatives of various scientific disciplines, including in particular Earth Sciences and Prehistoric Archeology, as well as the ease with which he finds a common language with colleagues representing the most dynamically developing disciplines in biology - molecular biology and ecology. Adam Nadachowski is a naturalist in the full sense of the word. The most important, paradigmatic theory of biology is the theory of evolution, and this cannot be practised otherwise than by simultaneously reaching for molecular biology, ecology, palaeontology, geography and geology (Darwin himself did not know whether he was a biologist or a geologist, because he was a naturalist). The achievements of Adam Nadachowski are, therefore important because they do not belong to only one discipline. Characteristic of Adam Nadachowski's output is that although he is a biologist, his SCI counts most of his publications (64%) as Earth Sciences and Archaeology, but most of the citations are in biological works. They relate to very important topics - land biota changes due to climate change; works of Adam Nadachowski contribute to explaining the cause-and-effect relationships of such changes, and this is a very current topic in connection with today's climate change and the need to predict its effects.

Professor Adam Nadachowski is the author or co-author of nearly 300 publications, including 157 original articles in journals, 3 books and 14 chapters in books.

Krzysztof Stefaniak, September 2020

Professor Adam Nadachowski

I first met Adam Nadachowski in 1994 in Krakow, where he and his colleagues organised a conference in honour of his famous Teacher, Professor Kazimierz Kowalski. It included 101 participants from 26 countries and was dedicated to the Neogene and Quaternary mammals of the Palearctic. This conference was very excellent.

Professor Adam Nadachowski is an amazing, handsome, bright person, intelligent, highly educated, a famous scientist who brought up a worthy replacement. And very, very kind.
I am very grateful to him for accepting for publication my first article in English to the journal Acta Zoologica Cracoviensia.

Adam Nadachowski is very attentive, immediately noticed during a conference in France in 1995, brought an effective Polish medicine that immediately stopped my disease.
And every time I meet him with his charming wife somewhere at a conference I see him surrounded by young palaeontologists, cheerful, passionate about science.

Dear Professor Adam Nadachowski!

I sincerely congratulate You on Your wonderful anniversary and wish you many years of joy, harmony with the world and good health!

Warm wishes,
Fedora Khenzykhenova
P.S. Photo from conference in France (1995).

How I met and made friends with Adam Nadachowski

I met Adam, today Professor Adam Nadachowski, almost 50 years ago, when he appeared at the Institute of Systematic and Experimental Zoology of the Polish Academy of Sciences (at 17 Sławkowska street in Krakow), in 1973. I was associated with this institution since 1962 working as a second-year biology student of the Jagiellonian University on commissioned work, and from 1965 full-time job. It was in 1973 that I got a PhD in biology.

Of course, I do not remember what our first contacts were, but since Adam was hired by my husband, prof. K. Kowalski, who was then the head of the Institute, naturally I asked him about a new colleague. As far as I remember, my husband told me that he would like Adam to work on fossil rodents. He did work on them himself, but the materials were very rich and there were more and more of them. At that time, he was also writing papers on cave topics (including fossil bats), and apart from his scientific work, he also spent a lot of time managing the Institute. He did not want delay in elaboration of Polish fossil fauna.

As some of you may remember, my husband completed a team in the Department of Vertebrate Zoology of our Institute that could identify and describe every terrestrial fauna of vertebrates and molluscs dating from the Pliocene to modern times, both from Poland and Europe, and over time from older periods and areas beyond Europe.

It would be difficult for me to tell the history of our (Adam and me) acquaintance of fifty years in fifteen minutes. That is why I am going to tell you about our first trip abroad, which undoubtedly caused us to get to know each other better and make friends.

The intention of faunistic and possibly palaeontological research in the Institute outside Europe (e.g. in the Middle East) was promoted since the 1950s. For various reasons (including financial ones) the expedition did not took place and only much later appeared the possibilities of a currency-free exchange of scientists between the Academies of different countries, including Polish and Iraqi Academies.

I have been trying for a long time to go to Iraq, which is extremely interesting in terms of culture and nature. I wanted to visit Biological Research Centre in Baghdad and do some field trips. Unfortunately, my efforts did not bring results, because the Iraqi side did not want to allow a solitary woman, even married one, to come. They explained in their letters that there was no one who would take “care” of me, especially in the field. And only when I wrote that I would come with a colleague, did I receive the consent. Dr Abdul Khadim, who took his PhD in Bulgaria and came back to Iraq, helped as well, because he was familiar with foreign women and he undertook such a “suspicious care”. The colleague with whom I was supposed to appear at BRC was Adam Nadachowski.

During this trip, we also prepared the ground for the expedition of several colleagues of our Institute to Iraq in the following year, 1977. Both trips were full of troubles and smaller or larger adventures.

The biggest problem, as always, was the lack of money. It turned out that the four-year agreement between the Polish and Iraqi Academies was about to end, and the galloping inflation in Iraq meant that the previously negotiated daily rates did not even cover some of the expenses (hotel and food fees), not to mention any travel outside of Baghdad. Unfortunately, no one in the country had warned us about this situation. However, in order to make any field trip and at least partially implement the planned program, we started going to various institutions, including The BRC, The Polish embassy and The Ministry of Education of Iraq, asking for additional funds. It was not very pleasant, but it gave some results. Finally we visited the country from the northern Kurdistan to Basra situated in the south, with some scientific successes.

Unfortunately, the first walk around the capital was unlucky. We almost lost our camera, and we might even land in jail accused of espionage, because we unknowingly photographed an oriental-style building that turned out to be a government building. We were saved by a nice old man who, seeing the terrified foreigners, testified that we had not taken any pictures yet, which was obviously not true. On

the same day, it turned out that because we did not have enough funds for a hotel, we would be placed in student dormitories (male and female) on two distant ends of Baghdad.

The dormitories were poor, my room had no lock, and there were a few more students in Adam's room, including one seriously ill Turk. It irritated us a lot, because it could have been something contagious, and besides, we were far from each other. As you can guess I did not have access to Adam's dormitory, and Adam to mine.

As we could not afford restaurants we ate our meals on a park bench. There we also prepared presentations about activities of our Institute and our personal scientific interest, which we were asked to do.

Only after strenuous protests against this inconvenient situation, we were moved to a hotel. It was a poor, cheap hotel, though beautifully situated by the Tigris. Of course, there were no women in this hotel, both among the guests (bearded men in burnooses who came to the market to sell or buy donkeys and camels) and among the staff. So I was not surprised that a young woman in jeans had aroused widespread interest and dislike. The hotel rooms did not have bathrooms, so my every entrance to the shared bathroom in the corridor was embarrassing and required the help of Adam, who stood guard and would not let anyone in.

When we started going into the field, the problem was food. During the journeys by small bus belonging to BRC, we were accompanied by the aforementioned dr A. Khadim, the driver, technical worker who cooked for us and a nice Kurd, dr Khadim's assistant. We knew, of course, that in Iraq there were amoebas, tapeworms, and in the bends of the Tigris bilhartias, one of the hosts of fish. Very often, our cook bought these fish directly from fishermen by the river in picturesque palm groves, rinsed them in the river's water, and fried them briefly on sticks placed around the fire. Washed in the waters of Tigris and roasted briefly on the fire, they did not seem to be safe food, especially since the sewage of nearby villages ran into Tigris.

It was the same with drinking. One time we were served carrot juice. Muddy carrots were lying on the pavement, and before being pressed, they were rinsed in a bucket of water, not changed from the morning (and it was late afternoon). But it was not always possible to excuse yourself with stomach ache. You had to eat and drink something sometimes. Fortunately, we returned from this trip healthier then these fish we were served!

In Kurdistan, we had to have special permits to move and we watched stone fortifications and sandbags, remains of military outposts and machine gun positions. Despite these various problems, we managed to visit the incredibly numerous monuments and areas of Mesopotamia where the oldest civilizations in the world developed. They included 5000-year-old ziggurat, the ruins of the cities of the Assyrian empire (early second millennium BC), or the famous Babylon of Nabuchodonozzar II, from 605-562 BC. Hasmmurabi's Babylon (1792-1750 BC) lies deep under the groundwater today.

In the south we got to Shat el Arab where the Euphrates and Tigris merge into one channel. According to local beliefs the biblical Eden lies there. There is an old olive tree there and a large plaque informs about the land of Abraham and our forefather Adam. Obviously Adam asked for a photo under this plaque, though we were saying loudly that it was mistake. Of course, there was an apple tree on the Paradise, not olive. We also managed to visit incredibly picturesque swamps full of birds (pelicans, giant kingfishers, birds of prey), where people lived in houses made of reeds, moving by boats. Today, apparently, swamps do not exist. As it was area of malaria, so the swamps were drained and the people displaced.

Naturally, the main goal of the trips outside Baghdad was to learn about the modern mammal fauna of this part of the world. The trips resulted in finding two new species of mammals for Iraq, the bat *Myotis nattereri* and the dormouse rodent , *Eliomys melanurus*. In a separate publication, we summarized the knowledge about the modern mammal fauna of Iraq. Throughout our stay in Iraq, Adam was very helpful to me and supported me in situations that seemed hopeless. As those who know him know, he

is an excellent companion in the field, composed, cheerful, coping very well in difficult situations. And I am sure this over a month long trip to such a distant and exotic country in 1976 caused we are friends to these days.

The following year, 1977, the expedition of the Institute's workers took place. My husband and Adam's newly married wife, Ania Maryańska-Nadachowska, also participated in it. Wedding rings came with Adam from Iraq.

When I left with my family for Oran (Algeria) for 5 years (1979-1983), our contact were weaker. However my husband who was the promoter of Adam's doctoral dissertation corresponded with him all the time. Since he wrote in a few sentences what he was doing on a given day almost throughout all his adult life, reading this diary today I find quite frequent entries from the Oran period. He wrote for example: "copies of papers from Kraków sent by Nadachowski arrived", "I wrote a letter to Adam", "I got a letter from Adam", and more specifically on February 1, 1980 "Nadachowski's doctoral examination", February 3, 1980, Sunday "I read Nadachowski's work" and February 4, 1980 "Scientific Council of the Institute, defense of Nadachowski PhD and lunch at the Francuski Hotel"! We flew to Poland especially for that event because in other years we came only for summer holidays. When, much later, Adam became the director of the Institute he proposed me the head of the Department of Vertebrate Zoology. I was in the position for 3 terms from 1997-2007.

In recent years, we have traveled abroad several times and took parts in excavations. Our last "exotic" scientific trip was in 2006 to Buryatia on Lake Baikal. It was, however, a trip to conference, and so without improvisation, although not without adventures.

Barbara Rzebik-Kowalska

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Evolutionary and social parallelisms: 70th anniversary of prof. Adam Nadachowski

When starting a conversation about an honoured man, colleague and friend, it is necessary, above all, to know him well. And this is related to many years of cooperation, which historically and randomly took place between us for at least 40 years. From the point of view of our paleontological science, this is a concise term, and yet so long for our existence as Adam and Leonid. First, there was a remote acquaintance with publications and defence of doctoral dissertations at the very beginning of the 1980s, then the first and short personal acquaintance (tête-à-tête, probably in 1983) in Moscow on Kadeshevka with the famous palaeotheriologist Nina Semionovna Shevyreva, and from 1986 until this day we are proud of our acquaintance, successive cooperation and joint activities as colleagues, friends and researchers. On this wavy path and life events, caused by circumstantial factors and one's own "I", there was only one goal (perhaps treated as orthogenesis) to leave a deep or maximally possible trace in… science. And this is already part of the the history of micropalaeotheriology as a separate branch among the sciences about the diversity of life, it is a piece of history where we – researchers – are components of the system of the process of knowledge the essence of nature. We live and work at the turn of the 20th and 21st centuries, and this means that we are a small link in this history that we create today, complement and strengthen its foundation for the future in a constant dynamics of the process of cognition.

The beginnings of the science of small extinct mammals date back to the 19th century (I. Fischer von Waldheim, J. Kaup, R. Owen). At the turn of the nineteenth and twentieth centuries, such eminent scientists as F. Major, E. Newton, A. Nehring, L. Mehely, M. Hinton, T. Kormos, S. Schaub and others left their mark in science due to frequently cited publications. In the twentieth century, the authors of this story were no less famous researchers - paleotheriologists such as M. Kretzoi, D. Janossy, G. Brunner, F. Heller, B. Vinogradov, I. Gromov, A. Gureev, V. Topachevsky, K. Kowalski, A. Lungu, A. Maleeva, N. Schevyreva, V. Fahlbusch, G. Storch, L. Aleksandrova, who laid the foundations for the development of micropalaeotheriology. On this foundation of scientific palaeontological achievements, professor Adam Nadachowski was shaped, grew up professionally and enriched the science of small mammals in a wide range of contacts with colleagues who are now well-known active palaeoteriologists, e.g. J. Chaline, O. Fejfar, W. von Koenigswald, T. van Kolfschoten, J. Agusti, A. Agadjanian, V. Zazhigin, A. Markova, M. Erbajeva, G. Rabeder, W. Heinrich, L. Maul, I. Horacek, A. Tesakov.

This period and the scope of close cooperation mainly with the scientists from Europe, were carried out and documented in numerous publications of the professor and his co-authorship, which proves Adam's extraordinary ability to contact not only colleagues but also people in general and his ability to organise, direct and update scientific research. In science, it works almost as a natural selection, the professor selects the current research topics, leads the staff to the appropriate maturity, defines the research scope, their goals and perspectives, and adjusts modern research methods. All these individual qualities of Adam, combined with high professionalism, were useful and helped him in organising the functioning of the Institute of Systematics and Evolution of Animals of the Polish Academy of Sciences in Krakow, where he was a long-time director.

Performing these duties was a source and a good motivation in acquiring the organisational and scientific experience so necessary for every scientist, especially in our times of "fighting" for grants and financing priority research directions. At the same time, such a situation, on the one hand, limited Adam's time capacity to deal with scientific work, and on the other – expanded the possibilities of establishing international cooperation of the entire institute as a research unit. The director successfully used such opportunities in the interests of the Institute's research team. There were international grants, organised field works, research collections, international and national conferences conducted on the basis of the institute, in which the author of this article often participated, scientific internships, mostly for scientists from eastern countries, especially from Ukraine. All in all, these and other activities, along with the increase in the scientific publications of the entire team, significantly increased the level and

international authority of the institute in Krakow, which is still maintained today. This is due to its director Adam Nadachowski.

It was at this time that our cooperation with Adam reached its peak, which almost immediately gave its good result in the form of a scientific monograph on the Pleistocene voles in Ukraine (1995), published jointly in English. Later publications were separate articles, for example, on the evolution of biocenoses, and as of today common research topics concern DNA analysis of periglacial fauna species. Adam as a scientis is a demanding and meticulous experimenter, a good analyst, always has a strategic vision of research that will lead the reader or specialist to endless problematics – achievements today generate a new range of issues and research for the future.

To withstand such a scientific position in publications is a skill and a kind of art, inherent in Adam, but not every researcher. And it is worth adding to this characteristic a deep understanding of the scientific problem and its consequences after its resolution. These ideas can be "read" between the lines in almost all of Adam's papers. They are devoted to a wide range of research issues related to morphology and systematics, phylogenesis and the evolution of the late Cenozoic small mammals, historical faunistics, palaeoecology, biogeography and palaeogeography, taphonomy and stratigraphy. Many of them are presented in co-authorship, which proves his ability to cooperate in research teams. In 40 years of our cooperation, I learned about it myself that I can cooperate with Adam relatively easily and effectively, thanks to his deep professional knowledge and personal tolerance expressed primarily by a high level of intelligence.

As a palaeotheriologist, Adam turned out to be in the right place in his time, starting from his student days, his own interests and the selection of a research team under the guidance of his supervisor, Professor Kazimierz Kowalski. Such a successful combination – idea, dreams, fantasies of their fulfillment, the search for ways to implement them – is rare and gave favorable circumstances, mainly due to a team of colleagues. It was prevailed by the desire for self-realisation against the background of his internal potential possibilities, encoded deeply in the genes.

Faith in own strength, vision of a goal and a result, and also belief and patience are indicators of his personality as a researcher and cheef: director of the Institute and head of its scientific department, head of the Department of Palaeozoology at the University of Wrocław, coordinator of many grants, promotor of doctoral and master's theses, organisator of conferences and research teams. This list can be completed and filled with lots of concrete examples, data, events, activities. Behind all this is almost 50 years of creative life in the science of my colleague and friend, a world-famous scientist, professor Adam Nadachowski – a member of many scientific societies, editorial boards of various journals, a grant reviewer, monographs and publications. These merits are complemented by didactic activities and educating young talented scientists – the basis for creating their own palaeotherology school through doctoral studies, research internships, free-hand teaching, etc. For interested students at universities in Kraków and Wrocław, they were offered in more details through palaeontological topics in the form of optional subjects, seminars, workshops of scientific clubs, conference reports or discussions in a narrow circle.

The doctors of biological sciences Barbara Miękina, Katarzyna Ochman, Anna Lemanik, Paweł Socha are very grateful to their supervisor, professor Adam Nadachowski, for his help and for defining their life path. The habilitated doctors Piotr Wojtal, Krzysztof Stefaniak, Jarosław Wilczyński, Adrian Marciszak, and Tomasz Postawa are also grateful, and they also received consultative assistance from the professor during the preparation of the dissertations and the habilitation process. It can be stated unequivocally and generally that the scientific system works on the principles of the basic theory of systems, all its elements-components are closely related with each other by relations and functionality, all of us know each other in research fields, we contact, we cooperate to a varying degree, we form (if possible) our schools, develop fields of study, or create new ones. In such a system of developmental progress, it is normal to distinguish scientific leaders among whom we include prof. Adam Nadachowski. This is the recognition of his merits and authority among colleagues. In science, leaders do not choose, they grow by themselves.

Adam's and my scientific paths are parallel and similar: studies, defence, first publications and first monographs, similar scientific positions, active participation in excavations to collect research materials, many joint presentations at various conferences (Vienna, Rome, London, Moscow, Warsaw, Mikołajki, Prague, Kyiv, Weimar, Kerkrade, Brno, Kraków, Paris, Saint-Petersburg, etc.). Me and my colleagues from Kyiv, doctors of science Valentyn Nesin, Oleksandr Kovalchuk, Tatiana Krakhmalna, Yury Semenov, Galina Zerova, are always grateful to the professor for the support and for creating opportunities for us, Ukrainians, to participate in such events. In the early 1980s, it was a complicated matter – establishing international contacts. At the same time, I am also grateful for the opportunity to participate in post-conference excursions to the area, see and feel the famous or simply known in the world of scientists palaeontological sites and enjoy the stratotype sections (Villafranc, Wald Arno, Petrafita, Atapuerca, Merkur, Tuchorzyce, West Runton, Norfolk, cross-section of Vrik, Tegelen and Cromer exposures, Kadzielnia, Rębielice Królewskie, Wąże, Burgtonna, Mikulino, Tiraspol, Medzhybizh, and many others).

The result of such cooperation are publications prepared together with colleagues of two well-known research teams – Kyiv and Krakow. Perhaps the most cited among them are those published by Nesin and Nadachowski (2001) on the Late Neogene stratigraphy of Eastern Europe, Rekovets and Nadachowski (1995) on Pleistocene voles of Ukraine and the evolution of periglacial biocoenoses in the European fauna (1997), Rzebik-Kowalska and Nesin (2010), as well as Rzebik-Kowalska and Rekovets (2015, 2016), Rzebik-Kowalska and Topachevski (1997) about extinct insectivores of Europe, Nesin and Kowalski (1997) about Miocene dormouses of Ukraine, Szyndlar and Zerova (1990, 1992) about extinct snakes, Kovalchuk and Nadachowski with the participation of co-authors (2018, 2019, 2020) about extinct vertebrates (mainly fishes) of Europe. And that's not all. We participated in carrying out excavations in known sites of Poland (Kamyk, Żabia, Przemiłowice) and Ukraine (Medzhybizh, Grytsiv, Deremezna). We conducted mutual consultations on the improvement of museum exhibitions in nature museums in Kyiv and Krakow. In the 1990s, there was a practice of constant and mutual visits of specialists to our research units. Behind this is the great talent of prof. A. Nadachowski as a co-organiser of such activities.

Adam and his colleagues, palaeontologists from the vertebrate department, Henry Kubiak, Barbara Rzebik-Kowalska, Bronisław Woloszyn and Zbigniew Szyndlar, supported the ideas and desires of their director, prof. Kazimierz Kowalski, about the continuation of excavations in Starunia in the sub-Carpathian region of Ukraine. There were negotiations with the Academy of Sciences of Ukraine, but ... maybe in the future, I will be able to do it. And the chances of finding and obtaining other taphonomically unusual remains of a mammoth or woolly rhinoceros or other unique forms, quite significant. Only two things are needed - finances and organisation. The implementation of the plans for scientific cooperation at the same time defines new perspectives for joint activities, which today are aimed at researching fossil DNA, especially in the periglacial species of Europe and the related palaeoecological, historical-faunistic and phylogeographic problems. Existing fossil materials allow them to be either under development or waiting their turn.

Behind this characteristic of business and scientific activities in my deliberations, the jubilee – Adam as a man, colleague and friend – completely lost. Only his positive qualities allowed us to maintain our common, long-term cooperation and friendly relations, based on mutual kindness, understanding, help and unanimity. We talk and discuss not only business and scientific matters but also many other topics, especially socially relevant to us. Adam always comes into contact with people in current or thematic conversations, while he demonstrates his broad erudition, has in-depth knowledge and skillfully uses it even in unforeseen situations, he can quite tactfully and without offence comment or correct a colleague. And yet (this is a secret) he is a good husband and grandfather in his great family. I want to extend my best wishes to him and his family for the future on behalf of myself and my colleagues, mainly from Ukraine.

Leonid Rekovets

Wrocław University of Environmental and Life Sciences

Adam Nadachowski – the most important publications

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ABSTRACTS

PORTABLE OSL - FAST AND PROMISE LUMINESCENCE SIGNAL READING METHOD FOR SEDIMENTOLOGY AND ARCHAEOLOGY

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Keywords: *OSL, sediment accumulation, Blue LEDs*

During the past decade, a new method of rapid assessment of luminescence signals of bulk sediment samples was developed using the portable luminescence reader (Sanderson and Murphy, 2010). The reader measures bulk samples of sediment via Blue LEDs, the OSL signal of quartz, and RED LEDs, the IRSL signal of feldspar (k-rich) minerals. This method is useful for interpreting sedimentary and archaeological sections during fieldwork. It allows differentiation between gradual and rapid sedimentation rate, gaps in sediment accumulation and the source of the material.

The poster will show some recent preliminary results and insights from this new method.

GRAIN SIZE ANALYSES OF TERRIGENOUS LATE GLACIAL AND HOLOCENE DEPOSITS IN KARSTIC CAVE OF THE MIDDLE DNIESTER-PRUT AREA (UKRAINE)

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Keywords: *Late Glacial, terrigenous cave deposits, Dniester River*

The lithological study of terrigenous cave deposits (including grain-size analysis) has been carried out in two caves of the western Podillya-Bukovynian gypsum karst region of Western Ukraine. The Bukovynka cave is located on the IV terrace of the River Prut in the Chernivtsi region, and the Kryshtaleva cave is positioned on the plateau between the left tributaries of the Dniester River (the Ternopil region). Both cave were previously studied for palaenotology and palynology (Ridush, 2009, Gerasimenko et al. 2019; Avdieienko, 2018). The grain-size study has followed the 'pipette' technique of Kachinsky (1965). Gypsum (the product of decay of cave walls) was chemically removed from the sediments prior to the analyses. **Late Glacial.** The beginning of the Late Glacial (^{14}C 12 240±70 BP, 14.6-14.1 cal ka BP – the Bölling interstadial) in the Kryshtaleva Cave is marked by the prevailing of small silt fraction (40-43%) over coarse silt (23-27%). The next unit is represented by a dark-grey material of colluviated humic soils with a significant admixture of charcoal and burnt gypsum (a cultural layer without artifacts ?). The ^{14}C dates (11710±60, 11890±60 BP) enables its correlation with the Allerød interstadial. The deposits have the high content of clay fraction (30%) and the low content of coarse silt (13-28%). The overlying unit is lighter in colour and less sandy than the Allerød unit. At the same time, the sediments are clearly laminated, that indicates the intense development of colluvial processes. At the bottom of the Sukhy Chamber of the Bukovynka Cave, the sediments include 91% of sand that indicates their fluvial origin. An increase in the sand fraction indicates extensive runoff or development of fluvial processes in a cave, both formed when there is sufficient climate humidity. These deposits were formed during the Alleröd interstadial, as shown by ^{14}C date obtained from the *Ursus arctos* bones in the overlying layer, dated ^{14}C 10730±60 BP. This bed is a pale loam with a high content of large silt ('loess') particles (76%). Its formation occurred through the strong input into the cave of aeolian dust during the Younger Dryas stadial. It may indicate an increase in intensity and frequency of strong dust storms, responsible for loess accumulation on the surface. Climate was cold and dry. **Early Holocene.** The last unit in the section of the Kryshtaleva Cave if a dark humic heavy loam, strongly enriched in charcoal and marked by the lowest content of coarse silt particles in the section (only 6%). This indicates that loess accumulation was replaced on the surface by chernozem formation and clay weathering. **Middle Holocene** sediments are revealed in the Sukhy Chamber and have fluvial origin (they contain 90% of sand particles). Obviously, Early Holocene sediments were removed by erosion here. The maximum clay content (up to 47%) may correspond to the Atlantic optimum. The content of the 'loess fraction' dropped to half of its former level (27%). Judging from the weathering indices, the climate was warmer and wetter that nowadays. **Late Holocene.** The Late Holocene is established by the sharp increase in the proportion of coarse silt (78%) observed in the sediments of Bukovynka cave. This indicates an increase in aridity, which is also confirmed by the paleomagnetic marker (2800 BP), recorded in the deposits of the end of this interval. At the very top of the Bykovynka Cave sediments, the proportion of coarse silt reaches its maximum (76-87%) which might correspond to the dry and cool phase

of the Little Ice Age (700-200 yr BP). The interpretation of the data of grain-size analysis corresponds well to that derived from pollen and paleofauna data. Thus, we can regard an increase in large silt in cave deposits as an indicator of dust storms and dry climate, an increase in clay particles as evidence of intensification of soil weathering under more benign climate and the existence of more stable surfaces, and increase on sand as indicator of wet climate. The grain-size analysis in terrigenous cave deposits can be used in reconstructions of past environmental change together with the other proxies.

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A NEW LINEAGE OF THE TIAN SHAN VOLE (MICROTUS ILAEUS) IN THE LATE PLEISTOCENE OF EUROPE

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Keywords: *Microtus sp., Late Pleistocene*

Microtus is a widespread and species-rich genus which consists of at least 56 species identified, based on morphological and genetic differentiation. Grey voles (subgenus *Microtus*) are a complex of at least six closely related and partly cryptic species: *M. arvalis*, *M. obscurus*, *M. mystacinus*, *M. transcaspicus*, *M. kermanensis* and *M. ilaeus*. The range of grey voles extends from the Atlantic Ocean to the Altai Mountains but most of the species occur east from the Black Sea. Using the ancient DNA analyses of the Late Pleistocene specimens, we identified a new species of grey voles in Europe. Reconstructed phylogeny based on mitochondrial cytochrome *b* sequences showed that seven specimens from three caves Emine Bair Khosar (Crimea, Ukraine), Temnata - Prohodna Cave complex (Cave 16) and Bacho Kiro (both in Bulgaria) formed a sister lineage to the Tian Shan Vole (*Microtus ilaeus)*. The range of the latter is limited at present to Southern Kazachstan, Uzbekistan, Kyrgyzstan, Tajikistan, and Xinjiang (NW China), more than 2,000 – 3,000 km from the location of the studied specimens. The average divergence of cyt *b* sequences between the new European lineage and the extant Tian Shan Vole was 4.9%. The similar level of divergence was found between *M. arvalis* and *M. obscurus* as well as between the two main lineages of *M. mystacinus* (*M. rosiaemeridionalis* and *M. mystacinus* sensu stricto). However, we do not propose taxonomic changes in the *M. ilaeus* group. Further accumulation of genetic and morphological data will shed more light on the relationship and evolution of this divergent lineage. Basing on their stratigraphic position the new form occupied territories North and North-West of the Black Sea during MIS 3 and MIS 2. Most probably this vole was connected with damp habitats and lived in proximity to water, as its extant relative - *M. ilaeus*. The genetic record from the Emine Bair Khosar suggests that around Last Glacial Maximum this lineage was replaced by *M. obscurus*. Our discovery suggests that grey voles might have been more diversified in the past and underlines the utility of ancient DNA to decipher the evolutionary history of this species complex.

We dedicate this work to the late Jan Zima, an outstanding mammalogists and caryologist, who made the extant material of *Microtus ilaeus* available for genetic studies.

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CLIMATE AND ENVIRONMENT DURING THE EARLY HOLOCENE IN SĄSPÓW VALLEY (KRAKÓW-CZĘSTOCHOWA UPLAND, POLAND). PRELIMINARY DATA FROM SMALL VERTEBRATES AND MOLLUSCS

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Keywords*: small vertebrates, molluscs, early Holocene, Sąspów Valley, Poland*

The southern part of the Polish Jura is a karstic region rich in well-known archaeological sites. Several works on rodent remains were published by A. Nadachowski, contributing to make the Sąspów Valley one of the most important areas for the fossil microvertebrate studies in Central Europe. To renew the context related to human occupation during the Holocene in this area, molluscs, herpetofauna, and micromammals remains were analysed. The material was recently collected in Ciasna cave, Sąspowska Zachodnia cave, and in a new locality, Schronisko Małe Rockshelter. The sites' stratigraphies are composed by Late Pleistocene-early Holocene loess covered by Holocene humic horizons. They yield archaeological material that span between the Final Palaeolithic and the Early Iron Age.

Among small mammals, an assemblage characterized by high percentages of open environment related species (i.e. *Lasiopodomys gregalis*) and by *Alexandromys oeconomus*, is registered in the lower layer of Ciasna cave, dated to the Late Pleistocene-Holocene edge. This moment might be also identified in Schronisko Małe and Sąspowska Zachodnia lower layers, although the material is scarce. The assemblages were replaced in all the localities by ones characterized by a high percentage of *Clethrionomys glareolus* and *Microtus* (*Terricola*) *subterraneus*, together with glirids. In these horizons *Apodemus agrarius* is also present. The faunal shift is also visible in the rich herpetofauna assemblage of Ciasna cave where thermophilous taxa (as *Zamenis longissimus*) and to a lesser extent *Lissotriton* and *Lacerta agilis*, progressively appear throughout the sequence together with the withdrawal of *Vipera berus* and *Rana arvalis*. The most abundant and diverse mollusc assemblage occurs in Schronisko Małe. The lower layers, with abundant *Discus ruderatus* and *Semilimax kotulae*, may correspond with the Pleistocene-Holocene transition and/or the Early Holocene. Both species are replaced by *Discus rotundatus*, *Discus perspectivus*, *Ruthenica filograna* and other warmth-demanding species in the upper layers. Expansion of warmth-loving and forest species throughout the Holocene is also visible in Sąspowska Zachodnia and Ciasna cave.
Paleoclimate data show that in Sąspów Valley the beginning of the Holocene was characterized by a cold and dry climate followed by a rise of temperature and precipitations that reached the current values only during the deposition of the upper layers. The environment in the area evolved from open forests with presence of wetlands during the Late Palaeolithic-Early Mesolithic to closed forests during Neolithic times.

Our preliminary data on the palaeontological remains from Sąspów Valley caves confirm the faunal turnover registered in Southern Poland and gives new clues on the environment and climate changes at the edge of the Holocene Age.

UPPER PLEISTOCENE LOESS-PALAEOSOL SEQUENCES IN THE CENTRAL PART OF THE VOLYN' UPLAND (NW UKRAINE)

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Keywords: *Upper Pleistocene, Ukraine, loess-palaeosol sequnces*

The Upper Pleistocene loess-palaeosol record has been studied in 10 sections, which are situated on plateaux (Smykiv, Bakivtsi, Bryshchi), on palaeoslopes (Novyi Tik, Kolodezhi, Novostav, Kovban, Kostianets) and on high river terraces (Boremel, Shybyn). The stratigraphy of these loess-palaeosol sequences conforms with the Quaternary stratigraphical framework of Ukraine (Veklitch et al., 1993; modified by Gerasimenko, 2004; Matviishyna et al., 2010).

The Kaydaky unit (MIS 5e) usually is represented by Luvisol, Podzol and Retisol. At the Novyi Tik site, a Podzol in the palaeogully is replaced by a well-developed pedocomplex, which includes the following (from bottom to top): 1) Gleysol; 2) Retisol, with a high percentage of Carpinus and Ulmus pollen; 3) sand bed, with a dense network of frost fissures; 4) Luvisol, with a peak of Carpinus; 4) Entic Podzol, with steppe pollen in the subsoil and strongly dominant Pinus pollen in the soil.

The Tyasmyn unit (MIS 5d) occurs rarely as a sand bed (up to 0.6 m thick) and loess-like silt (up to 0.3 m), with ground wedges (up to 2 m deep). The Pryluky unit (MIS 5a-c) is represented by a polygenic Chernozem. In the majority of sections, several phases of pedogenesis have been revealed: 1) forest soils (Podzol, Albic Phaeozem), with pollen of broad-leaved trees; 2) Chernozem, with steppe pollen; 3) Cambisol, with forest-steppe pollen; 4) loess-like and sand beds, with ground wedges (up to 1.5 m deep); 5) Cambisol, with a well-expressed A horizon and forest-steppe pollen (Tilia pollen is present).

The Uday unit (MIS 4) is represented by a loess-like loam (up to 1.5 m thick) with a network of ground wedges (up to 2 m), and, in places, ice-wedge casts (up to 2 m). Its lower part is disturbed by solifluction. The Vytachiv unit (MIS 3) is usually represented by Gleysol, and, in places, Gleyic Cambisol. At the Kolodezhi and Kovban sites, the Vytachiv pedocomplex occurs. It includes these subunits (from bottom to top): 1) Gleysol, with boreal forest-steppe pollen including few pollen of Ulmus; 2) Gleyic Cambisol with southern-boreal forest pollen assemblages including some Carpinus, Quercus and Corylus; 3) a thin loess bed (up to 0.2 m); 4) Cambisol, with a maximum of pollen of Pinus and xerophytes.

The Bug unit (MIS 2) is represented by a thick loess unit (up to 5 m thick) disturbed in the lower part by solifluction. Ice-wedge casts (up to 2.5 m deep) open from its lower part. The Dofinivka unit occurs mainly as a Gleysol, in places, as Gleyic Cambisol. At Novyi Tik, two Dofinivka soils occur, separated by a thin loess bed. The lower soil is a Gleysol, with meadow-steppe pollen assemblages and few pollen grains of Tilia. The upper soil is Cambisol, with a high incidence of xerophytes pollen.

The Prychornomorya unit includes two loess subunits and an incipient Gleysol. The largest ice-wedge casts (up to 4 m deep) open from the Gleysol.

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RECENT CHALLENGES FOR BIOCHRONOLOGY AND BIOSTRATIGRAPHY IN THE NORTH OF THE WEST SIBERIAN PLAIN

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***Keywords**: Siberia, Quaternary deposits, biosphere*

Quaternary deposits serve as the basic source of evidence for the study of evolutionary history of modern Biosphere and all its components – from species to entire biomes. Reliability of the evidence is determined, among many other things, by our ability to distinguish between geological and biological properties of paleontological materials. Here, we outline the challenges for biologists arising from the unsolved geological problems in Quaternary stratigraphy and geochronology of Western Siberia. For the present, the most problematic questions discussed by Volkova (2009) remain principally the same: the debate on the time and extent of glaciations, inconsistence of the views on particular chronostratigraphic units, and the lack of absolute dating. Field expeditions undertaken during the last three years on the key sections in the lower reaches of the Ob' and Irtysh Rivers included in the ratified biostratigraphic scale of the West Siberian Plain have shown that there are some underestimated problems that have not been previously discussed.

- Poor repeatability of the studies on stratotype sections. Being confined to river banks, the stratotypes and type localities are subject to erosion by water, slope processes, and human transformation.
- Permanently increasing demand for absolute dating. Lithological similarity of fluvial deposits of different age and severe disruption caused by weathering, erosion and slope processes make it difficult to obtain repeated samples and impossible to extrapolate the results of absolute dating from one section to another.
- Reworked assemblages often comprise the unique paleontological materials so that the problem of reworking might not be solved by exclusion of disrupted sections from consideration. The need to improve our knowledge of the sources of biological variation in biochronologically important lineages in order to distinguish between geological and biological factors leading to the heterogeneity of fossil assemblages.
- The need to widen aDNA studies and to improve paleogeographic inferences from the patterns of genetic variation in extant biological species.

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ON THE CHARACTERIZATION OF QUATERNARY SCREE DEPOSITS IN THE FERGANA VALLEY – OBISHIR-I CASE STUDY (KYRGYZSTAN)

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Keywords: *Upper Pleistocene - Lower Holocene, Fergana Valley, Kyrgyzstan*

We present a study aimed at characterizing scree deposits discovered at the Obishir-I archaeological site (Upper Pleistocene – Lower Holocene). The site is located on the southern margin of the Fergana Valley (Kyrgyzstan), the latter being an intermountain basin renowned for its archaeological significance in Central Asia. The site was first excavated by U.I. Islamov in the 1960s and 70s (Kasymov, 1972; Islamov, 1972). Excavations were resumed in 2016 (Shnaider et al., 2017). Obishir-I is a site on a slope characterized by Quaternary scree deposits that onlap heavily fractured and karstified limestone (Lower Carboniferous). Strikingly, other Palaeolithic sites located in the vicinity have a similar geomorphological setting to this one (e.g. Obishir-V, Sel'Ungur). To gain a better understanding of the deposits described above, we applied a multi-aspect approach comprising the following key methods:

- identification of macro and micro sedimentary structures,
- analysis of the archaeological assemblage and its three-dimensional distribution,
- chronometric dating (luminescence).

We therefore purport to determine in detail the slope processes involved in the site formation and their age. We aim to evaluate the impact of these processes on the archaeological features so that we may deduce to what extent Obishir-I can be regarded as a reference for inferring correlations with similar scree deposits present at Palaeolithic archaeological sites in the micro-region.

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THE MAGDALENIAN CAMPSITE WROCŁAW – ŻERNIKI 25

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Keywords: *Magdalenian, Wrocław-Żerniki site, Late Glacial*

During the preventive excavations on ring road of Wrocław city in 2007 a new site Wrocław-Żerniki 25 was found, which had apparent features of the Magdalenian, but with some Hamburgian elements. However, the excavations had interdisciplinary character. There were made also geological and palaeoecological research showing primary situation as well as postdepositional site formation process.

The archaeological site Wrocław-Żerniki 25 (AZP 79-27-121) is in western part of the city, in the valley of Ślęza river (116,8 m a.s.l.). Recent river channel is about 150 m to the east from the site. The river flowed throughout Weichselian deposits forming 300 m wide and 5 m deep valley, filled up by Late Glacial river sands and loess deposits, covered later by Holocene clay. The artifacts were found just below recent humus layer, in dusty and clayish sediments with fine sand and gravel admixture.

According to RAMAC/GPR and the air photograph analysis, the site Wrocław-Żerniki 25 is located nearby buried oxbow-lake located on the western side of the site. The Magdalenian artifact concentration has oval shape, is 18 m long and 14 m wide. There were ca. 4500 flint artifacts, including 129 cores and 154 retouched tools, like end scrapers, burins, perforators, backed bladelets, truncations, shouldered points and the others. The main distinct features of the Magdalenian are fine blade technology and presence of several backed bladelets, which is not recognizable in the Hamburgian.

The artifacts were found in the sediment 40 cm thick, but they were mainly located in a layer 20 cm thick. In the center of lithic concentration was found a fireplace 122 cm long and 98 cm wide. On the western side of the fireplace was found concentration of the stone slabs (quartzite sandstone) 1 or 2 cm thick, which well refit into few bigger stone slabs. They are possibly remains of a floor in entrance zone of expected Magdalenian tent from a beach of oxbow-lake. Similar lithic concentrations are known from the Magdalenian sites in Eastern Germany, from Groitsch in Saxony. In Groitsch, comparable large lithic concentrations and numerous stone slabs were found. The new lithic concentration from Wrocław-Żerniki characterizes by relatively high number of cores comparing to small number of retouched tools. The most possibly disappeared tools were taken out of the campsite. The occurrence of some forms of retouched tools, like shouldered points may be seen as a feature of Magdalenian IV phase, which existed in Central Europe during Bølling interstadial (14.7–14 ka cal BP), that is somewhat younger than another new Magdalenian site in Dzierżysław near Głubczyce in Upper Silesia.

Wrocław-Żerniki is the first rich Magdalenian site filling up a gape between Magdalenian sites in South-Eastern Germany and Cracow-Częstochowa Upland in Central Poland. In addition to that, Wrocław-Żerniki is located in the southern part of Silesian Lowland, but still covered by loess, so close to Hamburgian sites in the northern part of Lower Silesia.

RODENT BIOSTRATIGRAPHY AND TENTATIVE CORRELATION FROM IBERIA TO SIBERIA

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Keywords: *rodent, biostratigraphy, Quaternary, Eurasia*

One more tentative correlation, based on quaternary biostratigraphy with rodents, seems a recurring and useless proposition. In the 1990, Reppenning, Fejfar and Heinrich proposed a correlation for the northern hemisphere using Arvicolinae rodents. After their impressive work few attempts have been made of such an ample geographical connexion. In recent decades, the discovery of numerous localities with fossils of hominins in association with lithic industry throughout Eurasia has reinforced the necessity of giving an age as accurate as possible for the archaeological—palaeontological sites. The effort of researchers to strengthen dating – biostratigraphic, paleomagnetic, radiometric – in numerous Eurasian sites has been remarkable. Given the new radiometric data, paleomagnetic and taxonomic revisions, it seems interesting updating and to put them in a single graph. This is the main objective of the present work, a tentative and practical correlation scheme based on the distribution of Arvicolinae rodents during the Quaternary. The novelty of the present work is the construction of a wide correlation scheme of different areas of Eurasia, from Iberia to Siberia.

As an example, the Early Pleistocene has different unit-names throughout Eurasia: the Siberian Units such as the Olyorian Age, defined by Sher. The Early Olyorian roughly corresponds to late Calabrian and/or late early Biharian, (Razdolian, Tamanian). The Late Olyorian is equivalent to late Biharian (Cromerian, Tiraspolian, Vyatkinian). In the Iberian Peninsula the faunal equivalents with arvicoline rodents are the biozones *Mimomys oswaldoreigi, Allophaiomys lavocati* and *Iberomys huescarensis*. The genus *Mimomys* and *Allophaiomys* are the only taxa in common, though not the species. The localities Kamyk, Zabia, Kielniki 3A, and Zalesiaki 1A in Poland are of similar age, sharing both genera. In Iberia, as well as in Poland, other European countries, the extinction of *Allophaiomys* and the apparition of *Microtus* is a good marker for the late Early Pleistocene (around the Jaramillo paleomagnetic subchron). In Siberia the first appearance data of *Microtus* in the Olyor section corresponds roughly with Jaramillo, and the speciation of the genus occurs after the Jaramillo age, as in Atapuerca (Spain) and Zuurland (The Netherlands). Also, the extinction of *Mimomys* seems to be pan European, at the beginning of the Middle Pleistocene, though *Mimomys*-based correlation with Siberian localities is not possible because the lack of *Mimomys* in the Beringian faunas.

The search for common taxa, not only of the Arvicolinae rodents, but of all the micro mammals, and the correlation throughout the continent, in well-dated localities will be developed in a more extensive work.

NEW DATA ON GLIRIDS (MAMMALIA: RODENTIA) FROM THE VILLAFRANCHIAN OF POLAND

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Keywords: *Glirid, Rodentia, Villafranchian, Poland*

Gliridae are a group of small rodents strongly associated with forested habitats. In Poland the group is known in the fossil record since the Miocene (Bełchatów locality) and five species constitute recent glirid fauna. Here we present a new Villafranchian material of Gliridae from Węże 2 locality (MN 16) and Żabia Cave (Biharian), respectively. The material from Węże 2 is much more abundant and includes one fragmentary mandible and 220 isolated teeth assigned to two dormouse species: *Glis minor* and *G. sackdillingensis*. The former precedes the latter in the fossil record and these two species do not usually co-occur. Węże 2 seems to be the only Polish site (and one of a very few in Europe) that documents such a co-occurrence. *G. minor* supposedly originated in Central Europe and migrated to Western and Southern Europe, where it apparently gave rise to *G. sackdillingensis*, which dispersed back to Central Europe. Both species lived in woodland environments and *G. sackdillingensis* is thought to be ancestral to the modern fat dormouse (*G. glis*). The Late Pliocene/Early Pleistocene spreading of *G. sackdillingensis* coincides with the decline of *G. minor*. Although both *G. minor* and *G. sackdillingensis* are present in Węże 2, the abundance of the former contrasts with the extreme scarcity of the latter. This site (together with Rębielice Królewskie 1 locality) may document the interval when *G. minor* was still dominant in the area.

The Early Pleistocene site of Żabia Cave records an early occurrence of the hazel dormouse (*Muscardinus avellanarius*), an extant species associated with shrubby-treed habitats. *M. avellanarius* is considered to be descended from *M. pliocaenicus*, known from Podlesice (MN 14), Węże 1 (MN 15), and Rębielice Królewskie 1 (MN 16). The glirid fauna of Żabia Cave is complemented by *Glis sackdillingensis* and *Glirulus pusillus* (a rare genus and species reported also from Podlesice (early Pliocene); *Glirulus* is nowadays represented by the relic species *G. japonicus* known exclusively from Japan).

The glirid fauna from Węże 2 and Żabia Cave may be seen as representing a transitional phase leading to the development of glirid assemblages typical of the Quaternary.

MOLLUSCS OF THE TYURKYAN HORIZON (BEGINNING OF THE MIDDLE PLEISTOCENE), A REGRESSIVE STAGE OF THE LATE APSHERON SEA (LOWER VOLGA AREA, RUSSIA)

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Keywords: *molluscs, Tyurkyan horizon, Middle Pleistocene*

In the Caspian region, according to the data of Vasiliev (1961), the Baku (Middle Pleistocene, ICC) and Apsheron (Early Pleistocene, ICC; =Calabrian Italian marine stages) deposits are sometimes associated with a gradual transition or with erosion. In a number of places between the marine Apsheron and Baku deposits, continental water and terrestrial formations are found (Pravoslavlev, 1908; Vasiliev, 1961, etc.). This intermediate series of deposits belongs to the Tyurkyan Formation (Fedorov, 1957; Vasiliev, 1961). According to the stratigraphic scheme of the Lower Volga region, the Tyurkyan deposits are identified as the horizon of the Lower Neopleistocene (lowermost part of the Middle Pleistocene of the International Chronostratigraphic chart), the lower boundary of which is established by the replacement of the Apsheron sands with dark gray Baku clays or sands (Postanovleniya..., 1999).

When studying the core of a number of boreholes (3 Erdnievsky, 5 Erdnievsky, 8 Erdnievsky, 1 Zamyany, 2 Kosika, 3 Lenino; 5 Seroglazovka; 1 Raigorod; 2 Chernyi Yar; 3 Zaimizshe; 4 Nikolskoe; 6 Kopanovka; 7 Astrakhan; 8 Ulan-Khol) on the territory of the Lower Volga, deposits were established with a freshwater complex of molluscs at depths of 128.4–160.5 m. In the lower part of these sediments, gray, fine and medium-grained sands can occur, higher – gray clays with brownish and greenish tints, with shells of freshwater molluscs and fragments of Cardiidae, sometimes dark gray to black clay with a fine lumpy texture (paleosol?) up to 1 m thick or gray clays, gradually turning into the Baku marine sediments. Sands at the base of the section may be absent. The lower and upper boundaries of the Tyurkyan deposits are sometimes unclear and are associated with the underlying and overlying deposits by a gradual transition. The thickness of the sediments is from 10 m to 38 m.

The age of the deposits is established by the stratigraphic position in the section between the Apsheron and Baku marine sediments, characterized by the dominant species of molluscs, and the presence of a complex of freshwater molluscs.

The malacological complex is represented by a few shells of 13 freshwater species from 10 genera. The complex contains brackish-water species in the form of fragments or juvenile shells. Species *Valvata piscinalis* (Müller, 1774), *Viviparus diluvianus* (Kunth, 1865), *Pisidium* cf. *supinum* (A. Schmidt, 1850), *P.* cf. *subtruncatum* (Malm, 1855), *P.* cf. *amnicum* (Müller, 1774), *Sphaerium rivicola* (Lamarck, 1818) and Unionidae indicate the formation of sediments in the river valley. Lymnaeidae testifies to a weak-flowing body of water (or backwaters along the banks of the river). The presence of some juvenile forms of brackish-water species suggests the proximity of the sea coastline (river delta, lagoons, estuaries).

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MAMMALS OF THE MIDDLE VALDAI, BRYNSK INTERSTADE (PERM PRE-URALS, RUSSIA)

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Keywords: *Urals Mts., Middle Valdai, rodents, small mammals*

On the northwestern slope of the Middle Urals, there are two karst caves with zoogenic deposits that contain very numerous bone remains of small mammals that lived in this area during the Middle Valdai (MIS 3). Sediments of Makhnevskaya-2 cave (59° 26′ 59.4′′ N; 57° 41′ 13.5′′ E) were formed at the end of the Bryansk Interstadial (24 811±426 IEMEG-1376; 24 760±200 GIN 14242). A similar composition of the fossil mammal fauna was found in the deposits of Dolgiy Kamen-3 Cave (59°31′16′′N; 57°41′42′′E, the right bank of the Yaiva river), located 7 km north-east of Makhnevskaya-2 cave. The species composition and structure of fossil faunas practically do not differ throughout the depth of the excavated sediments (~ 1 m). In Makhnevskaya-2 cave the bone materials is very abundant in the upper and middle parts of the sediments (> 50% - psephite fraction, ~ 30-35% - clay-silt fraction), there are few bones in the lower parts of the sediments (clay-silt fraction prevails).The bone material is very fragmented and is represented mainly by isolated teeth. Probably the investigated karst cavities were used by mammal predators as a temporary refuge. Bones and teeth of large mammals (mostly Mustelidae), bird bones, fish scales are found in these deposits in insignificant quantities. The quartz arrowhead was found in the upper layer of sediments of Makhnevskaya-2 cave.

The teeth of three rodent species (*Lasiopodomys gregalis, Dicrostonyx gulielmi, Lemmus sibiricus*) dominate among the remains of small mammals. The teeth of the tundra vole (*Alexandromys oeconomus*) are also numerous. The remains include teeth of *Arvicola amphibius, Microtus* cf. *middendorffii, Microtus agrestis, Craseomys rufocanus, Myodes rutilus, Myodes glareolus, Ochotona* sp., *Sorex tundrensis.* Teeth of *Cricetulus migratorius, Cricetus cricetus, Lagurus lagurus, Sicista* sp., *Citellus* sp., *Lepus* sp. and mandibles of bats are present in the sediments in very small quantities.

The first lower molars of the narrow-headed vole from the studied deposits differ from those from the Late Glacial and Holocene sediments from the sites of Perm Pre-Urals in a greater proportion of “primitive” morphotypes. Samples of the teeth (m1) of the tundra vole from Dolgiy Kamen-3 cave are characterized by a greater proportion of teeth of a complex structure in comparison with "geological younger" teeth of this specie from this territory.

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QUATERNARY INCISION LANDSCAPE DEVELOPMENT AND STRATIGRAPHY IN THE AREA OF LAKE ALTAUSEE (AUSTRIA)

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Keywords: *Lake Altausee, Austria, last glaciation*

Lake Altausee is situated in the Eastern Alps (Austria) about 714 m asl. and has a surface area of about 2.1 skm. The main water influx enters the lake via carstic passages from the 54 skm catchment area. The lake is situated in the area of the last glaciation in the Alps. An ice overload of maybe more then 1000 m was probably accumulated in the area of the later Holocene Lake Altausee. The process that created the lake depression is still in discussion. Glacial erosion is very probable but not proven.

In 2019 a high-resolution bathymetry map of Lake Altaussee was produced, providing a detailed 3D description of manifold subaqueous landforms, including the crater of the subaqueous carst well with at diameter of more than 70 m and a crater depth of more than 20 m. Furthermore, sub-bottom profiler echo sounder were used to acquire seismic reflection data (8 cm resolution/10 meters penetration), thus providing high resolution imaging of lake sedimentary infill.

Combining geomorphologic and hydrologic information of subaqueous carst wells with data of cave levels in the adjacent mountains will hopefully shed new light on the incision of the area and on longterm lake genesis. Comparable carst studies had been done in the past years in several parts of the Eastern Alps and provide helpful insights into Quaternary development and stratigraphy in the mountain belt.

Sediments in caves and cave levels are in most cases the only preserved evidence about former developments of local discharge system in Alpine valleys during the Quaternary. This longterm evolution places modern landscape features (like Lake Altausee) into an exciting story of general landscape development.

DENTAL CHARACTERS IN CRASEOMYS VOLES FROM THE LATE PLEISTOCENE AND HOLOCENE CAVE DEPOSIT OF THE RUSSIAN FAR EAST

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Keywords: *dental, Craseomys, Late Pleistocene, Holocene, small mammals*

Voles of the genus Craseomys are known from the Quaternary sites at least since the Late Pleistocene and as a common species in Holocene faunas in the Russian Far East (Kawamura, 1988, 1991; Omelko et al., 2020). During the excavation of Tetyukhinskaya cave (Middle Sikhote-Alin, 44°35′N, 135°36′E) a lot of bone remains of large and small mammals from the Late Pleistocene and Holocene complexes was found (Gasilin et al., 2013; Kosintsev et al., 2020). We studied the *Craseomys rufocanus* molars (N=4208) which were the most numerous among small mammals from six excavation pits of the cave. The taxonomical status of each individual was determined based on the morphotypic and morphometric characters of the third upper (M3) and first lower (m1) molars. Among the molars that were difficult to identify, there were some classified to ex gr. *C. rufocanus* and also the morphotypes that are characteristic to modern *C. rex* were found.

Throughout the entire depth of the cave filling the studied molars have different colors from very light to practically black. It was revealed that despite the number of molars from five color groups and their heterogeneity there are differences depending on the depth in all excavation pits ($H(16; N=4022)=111.17$, $p<0.05$). It can be assumed that very light molars belong to Holocene deposits, while dark and black ones belong to Late Pleistocene ones. It is consistent with the published AMS-dating and data of large mammal fauna (Gasilin et al., 2013; Kosintsev et al., 2020) as well as the finds of isolated molars of Mimomys (Borodin et al., 2018) from Tetyukhinskaya cave.

C. rufocanus molars were divided into groups according to the ontogenetic stages (Fominykh et al., 2010). It was found that the stages of m1 and M3 are equally distributed - most of the molars belonged to young specimens with still undeveloped roots (stage 4) or completely formed (stage 5) and old animals with the molar root length smaller than half of the molar height (stages 7 and 8). This may be due to the fact that the accumulation of vole remains in the cave took place at the same periods over a long period of time.

Occlusal surface of molars was analyzed using a morphotype ranking approach (according to Markova, 2014). An analysis of the occurrence of m1 complexity ranks showed that the fossil *C. rufocanus* are characterized by the m1 configuration with completely formed T6 and T7 prisms without reentrant angles, regardless of the depth of deposits and the color group. Among the reserve and rare ones, there are both more complex (with reentrant angles at T6-T7) and simpler variations (T7 is not or not completely formed). The complexity ranks of the fossil molars fall into the range of variability of modern *C. rufocanus* from the mainland of the Russian Far East ($H=0.28$, $p=0.59$).

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NEW STRATIGRAPHIC DATA FOR THE URAL REGION BASED ON THE RESULTS OF POLLEN ANALYSIS IN THE HOLOCENE

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Keywords: *pollen analysis, Holocene, Late Glacial, Urals*

The reliability of reconstructions of natural conditions in the Holocene and the accuracy of interregional correlations are necessary for understanding the processes of modern biomes and understanding human expansion in the Subarctic. Pollen data were obtained from the deposits of the Gorbunovsky horizon of the Polar (Utinoe Lake) and Severny (Troitskoe Lake) Urals. Undertake comparisons were made with data from literary sources Subpolar Ural (Lyapin river) (Antipina, Panova, 2016) and stratotype section (Gorbunovo peat bogs) (Khotinsky, 1977; Zaretskaya et al., 2014; Panova, Antipina, 2016).

The stratigraphic unity of all the studied sections is shown in the presence of regional particularities associated with the latitudinal gradient. Phase I, characterized by late glacial vegetation, is observed in all sections. Phase II with sparse larch-birch vegetation is also a common stage for all sections. Phase III with a predominance of pine is typical only for sections in the Middle and Northern Urals. In the subpolar and polar Urals, instead of pine forests, spruce-birch forests of park type are formed. Phase IV, dominated by spruce, is observed only in the stratotype section Gorbunovskoe peat bog. After the 8.2k cold event, phase V is observed in all sections, characterized by the dominance of spruce. Phase VI with forest small-leaved pine-birch and broad-leaved vegetation, final for the Gorbunov horizon, can be traced in the Northern and Subpolar Urals. In the polar Urals, at the beginning of the Meghalay Stage, the formation of peat deposits ceased, which is why phase VI was lost from the fossil record. Differences in the stratigraphy of sections from different regions are due to regional particularities and the stepwise distribution of some types of vegetation from south to north. Despite the presence of vertebrate and insect remains in the sediments, the main contribution to biostratigraphic and paleoreconstruction works is made by paleobotanical and, above all, pollen data. The most interesting are the peat deposits of the Gorbunovsky horizon (Stefanovsky, 2006), due to the abundance of factual material and the presence of many archaeological sites in this type of deposits (Zaretskaya et al., 2012).

The well represented sediments on the eastern slope along the Ural ridge provide an opportunity to reveal the latitudinal gradient against the background of global climate trends. And an increase in the number of sections from south to north, as well as in the east, will allow standardizing the stratification of the eastern slope of the Urals and western Siberia.

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POLLEN STUDIES OF KARST CAVES IN THE CRIMEAN YAILA AS A TOOL FOR RECONSTRUCTION OF THE ENVIRONMENT OF ANCIENT MAN

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Keywords: *Crimea, pollen, Mesolithic*

Pollen study of clastic deposits in the caves from the mountain meadow of Crimea (the Yaila) revealed multiple environmental changes during the Late Glacial and the Holocene. In the central Yaila (the Emine-Bair-Khosar Cave), during the Late Glacial (^{14}C 12,050±60, 10,490±170 BP), the extent of woodland was the same as now, but pine dominated over beech and hornbeam which spread is typical today. Birch grew, which does not occur at present. Among the herbal plants, the spread of *Ephedra distachya* was most typical, particularly during the DR-3. The DR-3 faunal complex shows the domination of steppe species (Ridush *et al*., 2013). The climate was cool (first, relatively humid, but at DR-3 much drier). At the beginning of the Holocene, the increase of broad-leaved trees and ferns, and the disappearance of *Betula* and *Ephedra* occurred.

In the west Yaila, vegetation changes were revealed in Shan-Koba Cave (the archaeological study by O. Yanevich). During the Middle Mesolithic (1100-9500 BP), herbs dominated, though woods existed (*Betula, Carpinus*, *Juniperus, Corylus, Sambucus, Euonymus, Viburnum*). During the Late Mesolithic (9500-8000 BP), oak-hornbeam woodland spread, with admixture of *Fagus* and *Acer*. Herbs and grasses grew in the meadows. Pollen from the Shpan-Koba Cave (the east Yaila) shows that during the Early Mesolithic herbal associations alternated with patches of birch-pine woods and juniper. During the Middle Mesolithic, woods spread more extensively and included few *Quercus* and *Carpinus.* The cool phases (at ^{14}C 9150±150 BP and during the Late Mesolithic, 8240±150 BP) were marked by the reduction of woods and the spread of juniper.

In the central Yaila, the first half of the Middle Holocene was marked by the maximum spread of *Carpinus betulus, Fagus sylvatica, Ulmus* sp. and mesophytic herbs. A warm and humid climate is indicated by the increase in magnetic susceptibility (Bondar, Ridush, 2015). In the east Yaila, hornbeam, oak, beech, elm and bushes (*Corylus, Cornus mas, Euonymus* and *Daphne*) spread. During the Late Neolithic (6000-5500 BP), the west Yaila (the Shan-Koba Cave) was dominated by herbal and grass associations, though woods (pine, hornbeam, elm and alder) occurred. A trend to aridification started then and peaked during the Subboreal, before 2800 BP. Woodland, dominated by oak instead of beech and hornbeam, was reduced, and xeric herbs spread.

After 2800 BP, the larger extent of woodland, with a smaller role for broad-leaved trees than today, marked the humid and cool Early Subatlantic, which was then replaced by a warm climate of the Roman and Medieval Periods. In the uppermost beds of the Emine-Bair-Khosar Cave, the strong reduction seen in trees (particularly broad-leaved taxa) and the domination of ferns might correspond either to the cool and wet 'Little Ice Age', or to intense human impact on the woods. The reduction in woods was followed by the strongest increase in run-off, which introduced sand particles in the cave deposits.

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THE LATE GLACIAL AND HOLOCENE CLIMATE CHANGES DERIVED FROM JÓZEFOWO PEAT-BOG NE POLAND

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Over 6 m long overgrown lake/peat bog sediments from Józefowo, N-E Poland were studied by means of various palaeoecological methods, e.g. pollen, plant macrofossil, and cladocera analyses. More over dendrochronology of fossil pine logs have been established as well as analyses of stable isotopes of C and N were performed. According to radiocarbon dating and pollen succession sedimentation of the biogenic deposis at Józefowo started in the Younger Dryas chronozone what is evidenced in the palaeovegetation succession and is supported by radiocarbon dating. At that time an open type of landscape dominated in the region under consideration. Very low amount of tree pollen, mainly *Pinus* and *Betula* suggest a scattered presence of trees in the area. Dry habitats were overrun by juniper thickets and steppe vegetation, while more wet ones by tundra with *Betula nana* and members of Cyperaceae family. According to a nearby long pollen succession at Woryty (Pawlikowski et al., 1982) succession from Józefowo started probably towards the very end of the Younger Dryas chronozone. Expansion of pine and birch forest followed by *Ulmus* and *Corylus* corresponds to the onset of the Holocene (Preboreal and Boreal chronozones) and reflects climate changes archived in the stable isotopes record. Mixed broadleaved forest communities with *Tilia*, *Quercus*, *Fraxinus*, and *Corylus* represent thermal optimum of the succession. Spread of *Carpinus* and *Fagus* marks the Subboreal chronozone. The following Subatlantic transformations of forest in NW Poland were depended on both the climate changes and human activities in the area. Basing on over 500 pine tree discs of waterlogged sub-fossil wood collected for dendrochronological studies 3 floating chronologies were established and they cover ca. 800 years. Their absolute dating by using matching technique revealed time interval between 700 BC – 100 AD. The pines that mark the individual chronologies display clearly noticeable growth and dying-off phases which are associated with hydrological changes. In drier periods, the peat-bog was colonized by pine trees, while in wetter intervals, trees were withdrawn. From the second century AD there was a forestless period of development of the peat-bog in Józefowo.

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THE EARLY- MIDDLE PLEISTOCENE TRANSITION IN THE MID-EUROPEAN FOSSIL RECORD: A SURVEY OF NEW DATA FROM CZECH REPUBLIC

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Keywords: *Early-Middle Pleistocene, Czech Republic, Quaternary environmental dynamics*

A series of fossiliferous sequences available in the Czech Republic illustrates the Early-Middle Pleistocene transition (EMPT), the utmost turning point of the Quaternary environmental dynamics, in particular details. Some of these sites (Stránská Skála, Koněprusy C718, Červený Kopec) were many times reported e.g. as type localities of several true index fossils of the EMPT (Macroneomys brachygnathus, Dicrostonyx simplicior, Campylaea capeki, Aegopis klemmi). Here we report results of recent excavations which essentially refine contextual and stratigraphical setting of the EMPT record in this country.

The updated faunal lists of the classical sites are supplemented with detailed survey of sedimentary and faunal history of site clusters in Koněprusy and Mladeč caves and in particular of a complicated sedimentary complex in Chlum near Srbsko representing a sequence of three glacial cycles including the Biharian/Toringian (Q2/Q3) boundary associated with the glacial stage between the upper cycles.

Biostratigraphic and magneto-stratigraphic correlation date the proper Q2/Q3 boundary to MIS 16. In faunal terms it was quite sharp and associated with considerable rearrangements in structure of communities and phenotypic patterns in more clades. Nevertheless also the preceding cycles (MIS 20-17 in Chlum, MIS 21 in Koněprusy) show specific differences including FADs of several apochoric elements (including index taxa of EMPT). The continuous sedimentation of MIS 20 - MIS 15 deposits infilling a river bank cliff 80m above the present river level in Chlum begun after onset of rapid drop of the erosion base associated with forming a deeply incised canyon-like valley.

Regarding the biostratigraphic dating of the local sequence of river terraces, it seems that about a half of total depth of canyon valleys (in Berounka and Vltava rivers) was eroded during a short period prior to Q2/Q3 boundary, MIS 22-18, i.e. prior to putative effects of deep and long glacial stages of the Middle Pleistocene cycles. This strongly supports a hypothesis that a radical activation of neoid tectonics terminating globally the Early Pleistocene with massive uplift of centers of northern continents (G.J. Kukla: K cycle break = MIS 22/23) might play a role of an ultimate driving force of the EMPT.

In central Europe the it resulted a.o. in: abrupt increase in declivity of surface water, disappearance of floodplains and marshy habitats, aridisation with expansion of a mosaic of dry open ground habitats.

The increasing relief dynamics and gamma diversity promoted range expansions of diverse apochoric elements – including humans, and supposedly disturbed homeostatic capacity of the Early Pleistocene communities by driving diverse adaptive rearrangements in particular community members, what finally terminated with divorcing them into chorologic groups of the glacial and the interglacial elements after the break of the first deep and long glacial stage at MIS 16.

RECORD OF CLIMATE AND PALAEOENVIRONMENT CHANGES IN THE FOSSIL EEMIAN LAKE IN ŻABIENIEC (CENTRAL POLAND)

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Keywords: *Eemian Interglacial, climate, palaeolakes, Poland*

Despite the good diagnosis of the Eemian Interglacial optimum in numerous sites in the European Plain, the problems of small-scale climate oscillations remain unresolved. The duration of the hornbeam phase, was very long, as we can judge on the basis of the calculations of varvs in the Bispingen core, it was 7,300 years (Lauterbach et al., 2012; Kupryjanowicz, Granoszewski 2018), hence the high probability of hiatus occurrence in this phase in the case of drop in water level.

However, the interpretation of pollen spectra in terms of the presence of sedimentation breaks is complicated, as their causes may vary. In view of such interpretation uncertainties, the discovery of many Eemian palaeolakes concentrated in a small area of Garwolin Plain (Central Poland) created a unique opportunity to detect small-scale climatic oscillations and environment changes in different phases of the Eemian interglacial.

One of the key sites in the Garwolin Plain is Żabieniec. Three Eemian palaeolakes with different thicknesses of interglacial sediments were discovered there, but still two small reservoirs have a record of all seven major phases (according to Mamakowa, 1989) of interglacial vegetation development. Gyttjas are very hard in places, which was described in the literature as interglacial bituminous shales (Łyczewska 1966). Apart from pollen also plant macroremains analysis was performed. In the period of the climatic optimum, there was a thermophilic water fern *Salvinia natans* and a number of macrophytes with high thermal requirements, such as *Najas minor* and *Najas marina* with the July temperature range of + 18°C (Aalbersberg, Litt 1998). The waters and surroundings of the reservoir were oligotrophied during the interglacial optimum. *Rhynchospora alba* appeared, which, along with *Scheuchzeria palustris*, occurs mainly in transitional fens and in moist depressions of raised bogs.

Correlation of lithostratigraphic and palaeobotanical records made it possible to resolve the problem whether changes in plant cover in individual Eemian phases constitute a natural vegetation succession. The lack of fundamental changes in temperature in the Eemian interglacial optimum was confirmed. Only a gradual disappearance of indicator taxa for warm and humid climate was observed as in other Eemian sites, both from Poland and Western Europe. However, the profiles from Żabieniec show a drop in the water level in the hornbeam phase (compare Kupryjanowicz 2008 and references therein). This decline even includes a fragment of the spruce-fir phase. It is most visible in the shallow palaeolakes. The comparison of profiles from Żabieniec with other profiles from the Garwolin Plain, allows for the conclusion that the hornbeam phase probably contains a sedimentation gap.

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PALAEOENVIRONMENT OF THE EXTINCT RHINO (*STEPHANORHINUS KIRCHBERGENSIS;* JÄGER, 1839) FROM GORZÓW WIELKOPOLSKI (W POLAND)

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Keywords: *rhino remains, Stephanorhinus kirchbergensis, interglacial, palaeolake sediments*

In palaeolake sediments in western Poland (near Gorzów Wielkopolski) almost complete rhino remains of a female Stephanorhinus kirchbergensis were found. Results of pollen and macrofossil analysis of 6 sediment samples directly adjacent to the jaw of the rhino show dominance of multi-species deciduous forests with dominance of Carpinus and Corylus as the rhinoceros' living environment. This species composition allows to determine the rhinoceros' lifetime on the end of the Middle Eemian Interglacial (E5 in MIS 5e) defined for the terrain of Poland as Carpinus-Corylus-Alnus R PAZ (E5), considered as the climatic optimum of this interglacial. In this level short-term breakdown of Carpinus and Corylus tree stands observed and the entry of Pinus along with numerous herbaceous vegetation and ferns, which indicates a climatic oscillation.

In macroremains the E5 phase provided fruits of Carpinus betulus and nuts of Corylus avellana, while in the lake, alongside other species characteristic of the climate optimum, such as Brasenia sp., and Trapa natans, Najas marina was ever more present. In the period of the climatic optimum the lake was characterised by an increased presence of rush vegetation, including Cladium mariscus, Typha sp. and Schoenoplectus lacustris. The percentage of remains of trees and peat plants, such as Eleocharis palustris and Carax pseudocyperus, is also increased at this level, which indicates gradual shallowing.

The remains of subfossil Cladocera identified in Gorzów profile were poorly preserved and the frequency of remains was quite low. Eight species of Cladocera were identified in the optimum period (R PAZ E5). Results of analysis suggest that the water level was low in this part of the lake. Four out of eight species were associated with the silty-sandy bottom (including Pleuroxus uncinatus, Monospilus dispar, Alona quadrangularis) and the remaining four with aquatic vegetation (Acroperus harpae, Alona affinis), there were no species from the deeper water zone. On the basis of indicator species, the state of water can be defined as meso-euthrophic (the presence of species such as Chydorus sphaericus, Leydigia leydigi, Monospilus, Pleuroxus) with a water pH of about 7 and a higher electrolyte concentration (Rybak and Błędzki, 2010).

NPP analysis (Non Pollen Palynomorphs) provided information that the reservoir during the life of the rhino was shallow, as indicated by the remains of Nympheids, Ceratophyllum, Sponge, and

algae, including Pediastrum. The presence of some saprophytes from this period is associated with the alder carr, which may have developed on the shores of an overgrown lake. The spores of coprophilic fungi confirm that the shore was relatively close and visited by animals. The presence of HdV-126 in the upper part of this level indicates the development of the red zone. Cyanobacteria indicate the eutrophic nature of water.

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LATE HOLOCENE MAMMALS FROM VORONIN GROTTO (MIDDLE URALS, RUSSIA)

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Keywords: *Mammal bone remains, Upper Holocene*

Mammal bone remains from Upper Holocene sediments at Voronin Grotto were studied. Voronin Grotto is located on the right bank of the Serga river (right tributary of the Ufa river, Kama river basin), on the outskirts of Mikhaylovsk town, Sverdlovsk region. Serga river valley lies in the southwest of Middle Urals, on a border between Krasnoufimsky insular forest-steppe and mountain taiga forest. The grotto is located in a limestone rock 2 m above the river and has a western exposition. The total area of the excavation square is 1.5 m^2. Sedimentary sequence contains 3 layers. Layer 1 is dark gray humus sandy loam with numerous small and middle-sized debris (thickness of 0.4 m). The layer contains a large amount of charcoal and recent anthropogenic garbage. Layer 2 is gray sandy loam with numerous small and middle-sized debris (total thickness is up to 0.35 m). It has brownish tinge in lower part. Layer 3 is light brown clay loam with large lumps (total thickness is up to 0.25 m). Total maximal thickness of the described deposits is 1 m. In layers 2 and 3, fragments of pottery were found dating from the 4th-5th centuries AD. Thus, sedimentation in the grotto took place in the Late Holocene time in the first half of the Subatlantic. Remains of mammals, fish and amphibians are numerous. In addition, rare bird bones and fragments of mollusc shells were found. Judging by the preservation and taxonomic composition of the osteological material, the remains of small vertebrates have been accumulated by a four-legged predator, possibly an otter or a mink. Most of the bone remains of large mammals is highly fragmented and not suitable for species identification. Identified mammal elements include 1367 bone remains of 28 taxa belonging to six orders, i.e., Eulipotyphla (*Talpa europaea*, *Neomys fodiens*, *Sorex araneus*, *S. caecutiens*, *S. isodon*, *S. minutus*), Chiroptera (Chiroptera indet.), Lagomorpha (*Ochotona pusilla*, *Lepus timidus*), Rodentia (*Pteromys volans*, *Sciurus vulgaris*, *Castor fiber*, *Sicista betulina*, *Apodemus agrarius*, *A. uralensis*, *Micromys minutus*, *Cricetus cricetus*, *Craseomys rufocanus*, *Myodes glareolus*, *M. rutilus*, *Arvicola amphibius*, *Alexandromys oeconomus*, *Microtus agrestis*, *M. arvalis*), Carnivora (*Vulpes vulpes*, *Mustela nivalis*, *Martes* sp.), and Cetartiodactyla (*Alces alces*). Most identified species currently inhabit Middle Urals and adjacent territories (Bolshakov et al., 2006) excepting steppe pika *O. pusilla*. Fragment of pika's dexter mandible, found at the border of layers 2 and 3, is no different in its preservation from the rest of the osteological material. Steppe pika was common in the Middle Urals during the Late Pleistocene and Early Holocene (Smirnov et al., 2016). The species is now disjunct from Voronin Grotto by approximately 200-300 km to the south and to the south-west. *O. pusilla* probably inhabited the area around grotto as a relic of the Late Pleistocene and Early Holocene faunas as early as 4th and 5th centuries AD. Thus, the pika lived in the Middle Urals in historical times, but later disappeared from here. This is consistent with our data from Nizhneirginsky Grotto (Izvarin et al., 2020).

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HUMAN ENVIRONMENT AND CLIMATE OF THE BAIKAL REGION DURING THE LATE PLEISTOCENE AND HOLOCENE

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Keywords: *Baikal region, palaeoenvironment, Late Pleistocene*

In the Fore-Baikal area periglacial, ecologically mixed small mammal faunas permit reconstruction of environments of the Palaeolithic time, as steppes, locally with tundra. The climate was cold-temperate and dry. During late-glacial time the landscapes gave way to meadow-steppe and forest-tundra-steppe, and in the early Holocene to the forest-steppe, the climate turning warmer and wetter. In the Trans-Baikal area, changes of palaeoenvironment and species composition of mammal faunas were not so drastic as in the Fore-Baikal.

Fauna from MIS 3 sites in the Near-Baikal (southwestern Baikal area) is similar to Trans-Baikal ones, lacking tundra species and dominated by indicators of dry steppe and arid climates. The southwestern Baikal is more similar to the Fore-Baikal area, both having a higher proportion of forest species than in Transbaikalian assemblages. The fauna distribution displays features of mosaic landscapes with distinctly identified zones: forest- and meadow-steppe along rivers, and dry steppe and semi-desert on south-facing slopes of mountains. The climate was milder than in the Trans-Baikal and warmer than in the Fore-Baikal area. Unfortunately, we not find Holocene fauna here.

THE PALAEO-ENVIRONMENTAL CONDITIONS AT LINGJING, A CHINESE MIDDLE PALAEOLITHIC SITE RICH IN FAUNAL AND HUMAN REMAINS

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Keywords: *Middle Palaeolithic, fauna remains, human remains, China*

Lingjing is an open-air archaic hominin site in northern China where, apart from two incomplete Human skulls, thousands of lithic artefacts as well as abundant, well-preserved mammalian remains with and OSL ages ranging between ≈105 ka and ≈125 ka. It has been excavated yearly since 2005. The mammalian faunal assemblage from the site is very diverse with 22 different taxa. Equids and a large bovid Bos primigenius dominate the fauna; the mortality profiles of these herbivores indicate hominin/human hunting. Detailed taphonomic analyses demonstrate that Lingjing is a kill-butchery site and not a base camp.

The OSL ages suggest deposition under interglacial conditions. However, the mammal fauna is, based on the presence of Coelodonta antiquitatis (Lingjing is located close to the most southern distribution of the woolly rhinoceros) as well as the absence of Macaca and Porcupine, not characteristic for an interglacial period. The Lingjing mammalian fauna belongs to the northern faunal associations that inhabit mainly open grassland with some mosaic forests. The fauna indicates semi-humid to semi-arid continental monsoon climate conditions with average temperatures slightly lower than that of today.

MAMMALIAN FAUNAS OF NORTHERN EURASIA IN THE MIS 5e

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Mammalian faunas of the MIS 5e period are numerous and well-studied in Western Europe (Markova, Puzachenko, 2018). The number of faunal localities dated to this period is much lower further to the east. In Eastern Europe there are fifteen known MIS 5e faunas (Markova, Puzachenko, 2018), in the Urals - four faunas (Smirnov, 1993; Fadeeva et al., 2020; Kosintsev et al., 2020), in Western Siberia - two faunas (Chlachula et al., 2003; Kosintsev, Vasiliev, 2009), in the Altai Mountains - three faunas (Kuzmin et al., 2017; Krivoshapkin et al., 2018; Agadzhanyan et al., 2019), and in Chukotka – one fauna (Agadzhanyan, 1980). Most of the faunas comprise less than 200 bone remains. There are no radiocarbon dates for almost all the faunas of Northern Eurasia. Faunas were assigned to MIS 5e period based on palynological data, species composition and their relative abundance, and morphological analysis of taxons. The faunas includes relatively few cold-tolerant species (lemmings, arctic fox, musk ox), relatively many insectivores (Erinaceus, Desmana, Talpa, Sorex, Crocidura, Neomys), species associated with tree, shrub vegetation (mice, forest voles, badgers, deers) and water reservoirs (beaver, water vole, tundra vole). The composition of the fauna includes forest species (squirrel, Himalayan bear) and relatively thermophilic species (bats, dormice, and porcupine). Among the small mammals presented only modern species. The ratio of tooth morphotypes in a number of species (Dicrostonyx, Microtus, Lasiopodomys Lagurus) is close to the ratio in their Holocene populations. The average value of the enamel differentiation coefficient (SDQ) in water vole teeth is less than 1.

The detailed investigation of faunas from localities which was previously dated to MIS 5e revealed that not all of them are correctly assigned to this period.

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PLEISTOCENE FRESHWATER FISH ASSEMBLAGES OF POLAND IN THE FOCUS OF PALAEOENVIRONMENTAL STUDIES

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Keywords: *Pleistocene, fish, Poland*

The Pleistocene is one of the youngest periods in the history of Earth as well as a time of dynamic environmental changes. Pleistocene glaciation cycles had repeatedly reshaped the fish fauna of Europe, which thus became a suitable model for studying the evolutionary dynamics under drastic environmental changes (Hewitt 1996; Taberlet et al. 1998). The formation of modern freshwater fish assemblages was influenced by the alterations of glacial and interglacial periods, as well as changes in the hydrographic network (Costedoat and Gilles, 2009).

Fish remains from the territory of Poland are mostly confined to interglacials covering a wide timespan from the late Early Pleistocene (Augustovian Interglacial, MIS 21-19) until the early Holocene. They represent 23 species belonging to 20 genera of eight families (Acipenseridae, Cyprinidae, Salmonidae, Lotidae, Esocidae, Gobiidae, Cottidae, and Percidae). Cyprinids were the most taxonomically diverse, followed by salmonids and percids. Other families were each represented by a single species. The most common components within the Pleistocene fish assemblages of Poland were the roach, rudd, bream, pike, and perch.

Detrended correspondence analysis and hierarchical cluster analysis showed a clear division of the studied assemblages into two groups: palaeolakes inhabited by diverse cyprinids, pike and perch, as well as cave sites comprising salmonids with an admixture of other groups indicating riverine environment. The natural burial in the alluvium is suggested for the first group of localities, while the second group indicates the accumulation of fish remains due to the hunting activity of raptors. Fish assemblages from the territory of Poland are taxonomically similar to those of Chibanian and Late Pleistocene age within Central and Eastern Europe.

Further development of the fish fauna was favoured by the formation of lakes in the Polish Lowland after melting of the Scandinavian Ice Sheet. Climate warming at the beginning of the Holocene led to the wide occurrence of species that require higher temperatures for spawning.

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THE LATEST CAVE HYENA SURVIVORS NORTH TO CARPATHIANS

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Keywords: *cave hyena, Crocuta crocuta spelaea , Carpathians, radiocarbon dates*

Cave hyena (*Crocuta crocuta spelaea*, Goldfuss, 1823) is one of iconic species of the Ice Age fauna. However, its extinction is still poorly understood. This is mostly because the species has not gained such attention of chronometric studies as, for example, a cave bear. According to Stuart & Lister (2014), only 104 radiocarbon dates were available for cave hyena remains from Europe by 2014, including only 15 from Central Europe. According to the current knowledge, cave hyenas disappeared north to Carpathians around 40 cal ky BP (Nadachowski et al. 2015).

Perspektywiczna Cave, situated in the central part of the Kraków-Częstochowa Upland (Poland), is a classic example of a fossil Late Pleistocene cave hyena den. Hyena-related sediments occur *in situ* in an upper chamber (layers 1-3) and in a form of colluvial packet in a lower chamber (layer 7c). These deposits are extremely rich in coprolites and crushed and/or digested fragments of bones. A taphocenosis consists of remains representing adult, senile and juvenile hyena individuals. Remains of prey belong to a number of large ungulates: reindeer, wooly rhino, steppe bison, giant deer, and mammoth. Moreover, the cave bear and cave hyena bones are also heavily gnawed.

Eight radiocarbon dates of hyena bones have been achieved for Perspektywiczna Cave. The dating revealed three phases of hyena occupation. The oldest one peaked around 43 cal ky BP, the second one around 40 cal ky BP, and the latest one around 30 cal ky BP. The youngest date 25,900 ± 300 BP (30,900–29,600 cal BP, 94.5% probability) points out the latest find of cave hyena north to Carpathians. This date was achieved for ulna excavated at the upper chamber. The bone exhibits morphology resembling cave hyenas, and its affinity to Hyenidae was confirmed by mtDNA analysis. Stable isotope analysis of bone collagen reveals that this latest hyena had similar diet as hyenas from the previous phases (data partially shown by Krajcarz et al. 2016). This suggests that the late population was not affected by ecological stress.

The discovery from Perspektywiczna Cave reveals that cave hyenas survived in the Kraków-Częstochowa Upland at least 10 thousand years longer than previously thought, i.e., until around 30 cal ky BP.

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ALLERØD SUBFOSSIL PINE TREES FROM KWIATKÓW SITE (CENTRAL POLAND). DENDROCHRONOLOGY AND MULTIPROXY ANALYSIS OF PEAT DEPOSITS

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Keywords: *dendrochronology, multiproxy analysis, peat deposits, Poland*

In Europe, north of the Alps, wood from the end of the last glaciation is known from few sites, among others Reichwalde near Cottbus (E Germany) and Warendorf near Muenster (N Germany). Another location with the remains of a postglacial "fossil forest" was found in the mining area of the KWB Adamów, near the village Kwiatków (N 52°05'59", E 18°40'52", 95.6 m a.s.l.). Fragments of trees in peat, at a depth of more than 2 m below the surface, were lifted in three excavations of 8 ares each. In total, more than 400 fragments of trunks, branches and roots of trees were excavated, much of which were in situ. More than 250 of the best preserved wood samples were subjected to the dendrochronological analysis, by measuring the annual increment widths. The vast majority of the trees were represented by young individuals between 40 and 60 years old. Trees older than 120-140 years were only a few. Pine trees were characterized by narrow-increments (average annual growth was 1 mm). Analysis of the growth rhythms of the trees studied indicates a variety of causes of their death; some have stopped growing a few years after the tree-ring reductions – most likely due to changes in weather conditions (humidity, temperature); others displayed no increment reductions and were most likely annihilated by extreme phenomena (floods, strong winds). Based on the best correlated dendrochronological curves of post-glaciation pines, an incremental standard of 265 years was compiled. This pattern exhibits a clear similarity to the chronology for Reichwalde (t=5.5) and slightly less convergence with chronology for Warendorf and the Danube basin.

For the period represented by the chronology, samples containing five consecutive annual increments were selected, from which α-cellulose was extracted for 14C AMS measurements with increased precision. The piece of the curve recording changes in 14C activity produced was attached to the official calibration curve with the method of adjusting the curves (wiggle-matching). The curve produced represents the period of 13821-13561 (±8) cal BP and thanks to samples covering shorter, 5-year time intervals, it presents a more accurate shape than the calibration curve used so far. For samples from the organic sediment profile with tree trunks, palynological analyses of the plant vestiges and geochemical analyses were performed, which allowed for reconstruction of the environmental conditions during the growth of dying the trees

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BIOSTRATIGRAPHY OF THE PLEISTOCENE OF UKRAINE ON THE BASIS OF ARVICOLIDAE

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Keywords: *biostratigraphy, Pleistocene, Ukraine, Arvicolidae*

Pleistocene biostratigraphy of the Ukraine on the basis of small mammals was established at the end of 20th century. The main biostratigraphic criteria used at that time were based on changes of faunal composition in time and percentage differences of tooth morphotypes in Arvicolidae. These criteria were at present supplemented by several indices e.g. SDQ, A/L, B/W, C/W and D/E, and sometimes SDQH, HH and M/L as well as details of enamel structure. The obtained numerical indices allowed to establish evolutionary changes for particular taxa of Arvicolidae in the Pleistocene. Directions and trends of morphological changes in time of particular phyletic lineages (Mimomys-Arvicola, Allophaiomys-Microtus with division to subgenera, Pliomys-Clethrionomys, Prolagurus-Lagurus) were analyzed. On the basis of old and new criteria and also taking into account cyclic climatic changes the chronological succession of more than 70 Pleistocene sites of Ukraine was described. Moreover, boundaries of different stratigraphic units were established, e.g. boundaries between faunistic complexes and correlation of particular assemblages. The correlation of continental and marine sediments of Pleistocene were also possible because some marine sediments in the Ukraine contain remains of Arvicolidae.

EFFECT OF INSOLATION VARIATIONS ON VEGETATION OF THE EURASIAN SUBARCTIC IN THE LATE PLEISTOCENE AND HOLOCENE

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Keywords: *climate, Late Pleistocene, Holocene, vegetation, Urals and West Siberia*

Variation of the insolation is one of the global factors which determine the Earth's climate. Multi-periodic variations of the insolation determine the cyclicity of the Earth's climate. The investigation aims to estimate the insolation variations influence on vegetations of the Urals and West Siberia subarctic during the Late Pleistocene and Holocene over 30 ka BP. The calculation of insolation in the Eurasian Subarctic for the Late Pleistocene and Holocene is carried out based on the solution La2004 for the Earth's long-period evolution orbit. We have estimated the insolation for the latitudes from 55° to 70° N. We have considered the mean monthly insolation over 30 ka BP. We have shown that the mean monthly insolation in July correlates with the dendrochronology data for the Yamal peninsula (the latitudes from 67.5° to 70° N) over 7.3 ka BP. We also analyzed short-period variations in dendrochronology data and the relationship between them and substantial volcanic eruptions (Volcanic Explosivity Index is five and more) over 7.3 ka BP. It is shown that within 1-2 years after a major eruption, the growth of wood decreases. We assess the insolation changes in the Eurasian subarctic under the influence of such a factor as the topography evolution. The surface topography was analyzed for the recent period (the Urals and West Siberia) and the Pliocene epoch (West Siberia). An assessment of the difference in the corresponding digital elevation models showed that the crust subsidence took place in West Siberia (the median value of the difference between the digital elevation models was 230.7 m above sea level). The intensity of erosion processes increased in a southerly direction.

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ROLE OF THE COMMON AND THE FIELD VOLE FOR CLIMATE AND LANDSCAPE RECOSNTRUCTIONS DURING THE LATE PLEISTOCENE IN IBERIA

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Keywords: *Microtus sp., Late Pleistocene, Iberian Peninsula*

Through his works done in the '80s Prof. Adam Nadachowski became the pioneer in the morphological identifications of the common vole (Microtus arvalis) and the field vole (Microtus agrestis). Considering their different environmental requirements, it is important to identify correctly these two vole species. Both species are indicative of open landscapes, but while the common vole indicates a more arid environment with a discontinuous ground coverture, the field vole is related to more humid conditions. Furthermore, their morphological traits are important to reconstruct the past climate and landscape. In this meeting dedicated to him we are going to present an update of these two vole species in the late Pleistocene of the Iberian Peninsula, focusing on their importance for the reconstruction of the climate and the environment of the past.

M. arvalis and M. agrestis are widely present in the subfossil record of the Iberian Peninsula during the Late Pleistocene (ca. 126-11.7 ka) and related to relatively cold and dry periods. The field vole is currently found in the northern Iberian Peninsula, in a strip that ranges from the Pyrenees to Galicia and northern Portugal. The common vole occurrence is signaled in the northern and central areas of the Peninsula, but not in the Atlantic region. Both species are absent in the Mediterranean region.

The presence of these two species outside of their present distribution range during the Late Pleistocene in some Iberian sites could be indicative in general of relatively cool climatic conditions. As examples M. arvalis and M. agrestis were identified in the Late Pleistocene of the sites such as Caldeirão or Lagar Velho, M. arvalis were identified in El Salt, Cova de les Cendres or Carigüela cave and M. agrestis were identified in Oliveira or Zafarraya cave.

Furthermore, analyzing morphological and morphometric characters in synchronic populations, it is possible to observe for example, that the Galician populations of the sites such as Cova Eirós and Valadavara-1 follow a different evolutionary trend than the rest of the northern peninsula, probably due to the influence of the Atlantic climate and its relative geographical isolation. Also, the differences in M. agrestis populations in Toll cave in relation to the other sites in northeastern Iberia, could be related to the particular environmental and climatic conditions that happened during the Last Glacial Maximum (LGM). Finally, the interglacial refugee conditions of some sites, as Colomera cave (Northeastern Iberia), might have caused the local M. arvalis population to be more similar to those of Galicia than to those of the rest on northern Iberia.

NON-ANALOGUE RODENT COMMUNITY IN CENTRAL ITALY DURING LATE PLEISTOCENE: THE CASE OF GROTTA DEL SAMBUCO

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Keywords: *Late Pleistocene, Rodent, Italy, Grotta del Sambuco*

Grotta del Sambuco is located in central Italy (Massa Marittima, GR) at a 20-km distance from the Tyrrhenian Sea, at 280 m ca. a.s.l. Since 2013, the excavations investigate the Pleistocene deposits and detected traces of human occupations in Stratigraphic Unit (US) 4, 5 and 6. These last two Units also yielded abundant small mammal material and a total of 3705 rests has been identified. US 6 has been dated at 28,125 - 27,404 years cal BP, corresponding to the end of Marine Isotope Stage (MIS) 3 – beginning of MIS 2 while US 5 is dated at 23,365 – 22,903 years cal BP, during MIS 2.

The small mammal assemblage is dominated by the Common vole Microtus arvalis in both Units (> 90%) but the number of species in US 6 is sensibly higher than in US 5 (14 vs 8).Remarkable is the occurrence in US 6 of the Narrow-headed Vole Lasiopodomys gregalis and the Southern Birch Mouse Sicista subtilis in association with the Mediterranean Water Shrew Neomys anomalus and the Western European Hedgehog Erinaceus europaeus.

The first two species are currently not present in Mediterranean Europe. They are cold and dry climate indicators and testify the presence of open and arid steppe environment in the immediate surrounding of the site. Nowadays it is not possible to find a species aggregation similar to that of US 6 of Grotta del Sambuco. This kind of non-analogue communities are frequent during Late Pleistocene in the Italian Peninsula, especially during MIS 3. The co-existence of these species in the western, nowadays Mediterranean region of the Italian Peninsula indicates a diversified environment, capable of supporting species with different ecological requirements and habits.

The presence of L. gregalis and S. subtilis at Grotta del Sambuco during late Pleistocene, and in particular before the LGM, also allowed us to reconsider the biogeographic regions that characterized the Italian Peninsula during the late Pleistocene. While the occurrence of rodent species related to the Eastern European biocenosis has been attested in the north-eastern area and the Po Plain since Middle Pleistocene, it was generally thought that they never cross the Apennines and never reached the Tyrrhenian coast. The small mammal assemblage from Grotta del Sambuco shows that the northern region appears to be more uniform than previously thought, and the Apennines a less formidable barrier.

TOPOCLIMATE DIVERSITY AND LOCAL PALEOENVIRONMENTS IN THE PERIODS OF HUNTER-GATHERER ACTIVITIES: A CASE STUDY OF TWO SITES FROM THE UPPER DNIESTER RIVER VALLEY (UKRAINE W)

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The part of the upper Dniester River valley, where the river ends its Subcarpathian reaches and flows in a deep narrow canyon into Podolia Plateau, was interesting for the hunter-gatherer communities. This is an area where numerous Middle and Upper Palaeolithic sites occur, among others Yezupil (Y) and Mariampil (M), located on both sides of the valley, 6 km away from each other. The main direction of the valley is NW-SE, but with many deviations caused by its meandering pattern. The valley slopes are divided by numerous Carpathian and Opillia tributaries, which reflect in a great variety of local relief and exposures. A set of Pleistocene terraces (II-V) occur in both sides of the valley, all with loess cover. Two above mentioned archaeological sites are related to III-II terraces of similar heights. Their subaerial sediment cover developed in the last interglacial-glacial cycle and is represented by similar sequences S1-L1-S0 but with different thicknesses (6 m and 17 m respectively). Multi-proxy analyses were provided in both sections (Bogucki et al., 2001; Komar et al., 2009; Łanczont et al., 2009, 2015).

The aim of our studies was to assess the impact of local factors on the environmental and topoclimate diversity not only in interglacial period but also in glacial time for which we rarely have the possibility of vegetation reconstruction. After the MISS 5e in both sites remained lessivé soil developed on loess (Y) or on the overbank deposits (M). Starting from the Weichselian, the rate of loess sedimentation and the pedogenic processes in both sites were different. The MIS 5d-a are represented by one chernozem horizon disturbed by solifluction processes (Y), and three thick chernozems separated by loess (M). Soils formed during MIS 3 are cambisols, in the first case weakly developed, in the second – much better. Local vegetation variation on the site surrounding depended on situation within the river valley as well as mesorelief and exposure. The plant cover reconstructed in both sites shows several common features during the 5e period, while greater differences are observed in the glacial time, particularly in the MIS 3. The Yezupil's surrounding were relatively cool due to exposition to NE. A quite low rate of loess accumulation results from two reasons: the location of the site on the long transit NW-SE section of the valley leading to the funneling of the air masses, especially in the case of the NW circulation; greater participation of slope processes in loess accumulation. Southern exposition of slopes and shelter from the north through the high ridge of the Opillia Upland made the place in Mariampil to be warmer than in Yezupil. Moreover, it is the area where the direction of the Dniester River valley changes, which could have been detrimental effect on the

palaeowind capacity and cause an increased aeolian sedimentation in this local trap. Palaeomagnetic studies (AMS) carried out in the Mariampil section indicate that southerly (local?) winds were prevalent during the loess accumulation (Pańczyk et al., 2020).

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THE SMALL MAMMALS FAUNA OF MIDDLE PLEISTOCENE OF THE PREDALTAI PLAIN

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Keywords: *small mammals, fauna, Middle Pleistocene, Siberia*

The south of Western Siberia is an important region for knowing the evolution of Siberian ecosystems over the Neogene and Quaternary periods. In this place are the complete fauna complexes of small and large mammals of the region that characterize all the main stages of the Late Cenozoic of Siberia. The least characterized from a faunistic point of view Quaternary sediments, it is sediments of Middle Pleistocene. In the south of Western Siberia, for the sediments of the Middle Pleistocene was described the Vyatkino complex of small mammals, which conform with the first half of the Middle Pleistocene. This complex also correlates with the Tirsapol fauna of Eastern Europe. The faunas that belong to the second half of the Middle Pleistocene in the south of Western Siberia are known in small numbers from the Tatarka and Kalmanka locality (Zazhigin, 1980). We discovered and studied two new geological sections containing the fauna of the second half of the Middle Pleistocene in the south of Western Siberia. The geographic area of material collection is the Pre-Altai plain, located between the Altai Mountains in the south and Salair Ridge in the east, northeast, and north. This is the southeastern outskirts of the West Siberian Plain. The material was collected from two geological sections: Solonovka (Peschanaya River) and Petropavlovsk (Anuy River). At the base of the Anuy (Solonovka) and Kolyvan (Petropavlovsk) Ridges there are alluvial sediments are containing numerous remains of small mammals and mollusks. From above sediments are overlain by loess-soil sediments (Zykin et al., 2017).

By now, the following species of small mammals have been identified: *Ochotona* sp., *Spermophilus* sp., *Allactaga* sp., *Ellobius* sp., *Cricetus cricetus*, *Myospalax* sp., *Clethrionomys rufocanus*, *Clethrionomys glareolus*, *Lagurus lagurus*, *Eolagurus* sp., *Dicrostonyx* sp., *Microtus (Stenocranius) gregalis*, *Microtus (Pallasiinus) oeconomus*. This faunal complex is younger than the Vyatkino faunal complex of the first half of the Middle Pleistocene. The upper boundary of the spreading of the fauna is clearly defined by the superior sediments of Suzun loess whose age correlated with MIS 6. In this way, we identified two new fauna locality of small mammals of the second half of the Middle Pleistocene in the south of Western Siberia.

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THE LATE VILLANYIAN SMALL MAMMAL FAUNA FROM RIVOLI VERONESE (VERONA, NORTHEASTERN ITALY)

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Keywords: *Late Villanyian, mammals, Rodentia, Italy*

Rivoli Veronese (Verona, NE Italy) is an exposed karst fissure in a limestone quarry. Described for the first time in 1994, it yielded an extremely high number of small mammal remains. Previous studies allowed to describe a new vole species, *Dinaromys allegranzii*, and gave a first characterization of the faunal assemblage.

The current systematic study led to the full description of the rich faunal assemblage, composed by 880 identified remains, divided in 26 taxa, 13 belonging to the order Rodentia, and 13 to Eulyphotyphla.

Rivoli Veronese attests the earliest occurrences in Europe of *Dinaromys* genus, *Sorex praealpinus*, *Pliomys* gr. *episcopalis*, and *Glis* cf. *sackdillingensis*. Among the *Mimomys* genus, *M. jota*, *M. tigliensis*, and a transitional form between *M. praepliocaenicus* and *M. pliocaenicus*, are documented. Some species, such as *Sorex* cf. *casimiri*, and *Villanyia exilis*, are reported in the Italian Peninsula for the first time

Nevertheless, a new species of *Talpa*, characterized by a very small size (close to those of Pliocene faunas in Central Europe), *Rhagapodemus* sp., and *Pliopetaurista* cf. *pliocaenica* attest the existence of at least three Pliocene relicts.

Based on our taxonomical and biometrical study, the fossil assemblage can be considered older than those from Tegelen, Senèze, Irchel, Kadzielnia 1, Zuurland 61-65m, and Weybourne Crag, which bear *M. pliocaenicus* and/or *Mimomys pitymyoides*, and younger than those from Stranzendorf C, D, and F, Zuurland 90-95m, Saint Vallier, and Norwich Crag, where *M. praepliocaenicus* and/or *Mimomys stenokorys* are documented. Therefore, the Rivoli Veronese small mammal assemblage is related to the early Late Villanyian.

This is a poor known period, documented only in few, less richer sites, i.e. Stranzendorf i, Zamkowa Dolna Cave A, Casablanca 1 lower level, Psekups, and Coste San Giacomo. Taking in account the palaeomagnetic and the radiometric records, these localities can be related to the interval between the Réunion I and the Olduvai subchrons, tentatively between 2.05 and 2.15 Ma. Therefore, considering its taxonomic composition, its biochronology, and its geographical position, the Rivoli Veronese assemblage is a reference for the Late Villanyian small mammal Age in Europe.

POŁUDNIOWA CAVE – FIRST MID-MIDDLE PLEISTOCENE SITE FROM STUDETY MTS (SILESIA, SW POLAND) AND THEIR BIOSTRATIGRAPHIC SIGNIFICANCE

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Keywords: *mid-Middle Pleistocene, Sudety Mts, Poland, Quaternary remains, bones*

Południowa cave (50°57'17"N 15°55'23"E; 620 m a.s.l. (German names *Kitzelhöhle, Kitzelloch, Kitzelberghöhle, Kitzelkirche, Teufelskeller*). The cave is already known more than 500 years. It was found during quarrying, and destroyed in 1970s. The cave was developed into an elongated, L-shaped corridor. The first research was organized there in 1904, however, complex excavations were carried out only in 1930s. Deposits are represented by a mixture of yellow clays, intercalations of quartz gravels, red clays of terra-rossa type and limestones covered by brown clays. It seems that at least three or even four different faunal assemblages were found there. The oldest faunal element is represented by the rodent *Baranomys loczyi*, being a single Pliocene find for Sudeten caves. Second fauna is dated back to mid-Middle Pleistocene, and consists of the following taxa: *Sorex* sp., *Rhinolophus* aff. *ferrumequinum*, *Glis glis*, *Mimomys* sp., *Pliomys coronalis*, *Lycaon lycaonoides*, *Canis mosbachensis*, *Ursus deningeri*, *Ursus arctos* ssp., *Martes vetus*, *Panthera spelaea fossilis*, *Homotherium latidens*, *Panthera gombaszoegensis*, *Acinonyx pardinensis intermedius*, *Capreolus* sp. The third assemblage is dated back to the Late Pleistocene (MIS 3), and contains the remains of *Glis glis*, *Arvicola* sp., *Canis lupus spealeus*, *Ursus spelaeus* ssp., *Martes martes*. Finally, the youngest fauna, dated as MIS 1, is represented by *Arvicola* sp., *Apodemus* sp., *Lepus* sp., *Cricetus cricetus*, *Ursus arctos arctos*, *Meles meles*, *Martes martes*, *Capreolus capreolus*.

Within the Middle Pleistocene Revolution (MRP), this site provides valuable data from the Sudety Mts, since in the locality presence of old forms like lycaon, jaguar or cheetah together with new arrivals like lion or brown bear were found. Especially interesting are possible relationships and impact of new species for the extinction of ancient carnivores.

THE HISTORY OF LIONS IN UKRAINE

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***Keywords**: Pleistocene, lion, Panthera spelaea, Panthera leo leo, Ukraine*

The Pleistocene lion *Panthera spelaea* (Goldfuss, 1810) constituted an important component of the Pleistocene ecosystem in Ukraine as one of the main carnivore since the Middle Pleistocene to the late Holocene, when it became extinct about 15–13 ka. Three forms of the Pleistocene ranked as chronosubspecies are commonly recognised. The Asiatic lion *Panthera leo leo* (Linnaeus, 1758), sometimes called also a European lion, inhabited Ukraine, similar like a part of the Balkan peninsula up to Hungary up to the late Neolithic period. It survived in open grasslands of eastern Ukraine until around the first century AD, even if some of these lions could be animals imported from other countries.

Among numerous, Ukrainian records we presented a unique find an intact skull of a dwarf lioness from Krysztaleva Szachta (Crystal cave) (western Ai-Petri Massif, southern Crimea). Morphology of the specimen clearly corresponded with the cave lion morphology: (1) strongly reduced, one-rooted P2; (2) morphology of P4: narrow with strongly convex buccaly posterior part crown, reduced protocone, large, rounded parastyle followed by minute preparastyle, metastyle longer than paracone; (3) proportions of lower dentition: p3 and p4 proportionally shorter and m1 proportionally longer; (4) p3 and p4 morphology: both with proportionally long and low protocone; (5) m1 morphology: narrow (width/length ratio far less than 50%), crown without zigzag enamel created by cingulum, strongly reduced talonide.

We suggested that those very small cave lions from southeast part of the Europe could represent a local population, similar to other small lions known from e.g. Beringia or Yakutia regions. We suggest that the presence of these small cave lions in south-eastern part of Europe, like lions from other populations characterized by smaller body size, e.g. from the Beringia should be treated as the local population, in which the size of the specimens could be affected by conditions climatic and environmental richness in large ungulates. Cave lion, like the modern African lion, and especially the Asian tiger, probably subject to the Bergmann rule, and individuals from the southern areas of coverage may be lower. However, it is not clear, since lions from Siberia were explicitly smaller than the lions in the area of Europe. The possible contact zone between the Pleistocene lion and the Asiatic lion are still unclear.

LATE GLACIAL AND EARLY HOLOCENE PALAEOENVIRONMENTAL CHANGES RECORDED IN LANDSLIDE FENS DEPOSITS IN THE POLISH QUTER WESTERN CARPATHIANS (SOUTHERN POLAND)

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Keywords: *fens, Beskid Makowski Mts., Late Glacial, thermophilous trees*

In the northern part of the Polish Outer Carpathians, the Beskid Makowski Mts., four landslides formed during the Late Glacial have been identified so far. The landslide fens formed within landslide depressions represent specific type of minerogenic mires filled down by organic-minerogenic deposit. Within the depositional sequences of these peats, palaeoenvironmental changes of the Late Glacial and the Holocene are recorded. The oldest of the studied fens started to form in the Oldest Dryas, the younger ones – in the Bolling (two peat bogs), Older Dryas and the Younger Dryas. In the sediments of the four landslide fens of the thickness varying from 4.5 m to 1.5 m, several logs were cored using the Instorf sampler. The laboratory study of the logs, reaching the deepest parts of the fens, included: palynological analysis, peat analysis (microscopic examination of organic deposits), grain-size (aerometric) analysis and content of minerogenic material (loss on ignition) analysis for 2.5 cm long intervals. Over 50 radiocarbon datings made in the studied logs (7–14 ones for each log), enable to date the horizons of lithological and pollen changes.

The loss on ignition curves show large variability of mineral inserts and illuvial horizons in peat deposits, which were formed owing to supply of minerogenic material to the peat bogs related to slope wash during the phases of an increase in precipitation (climate humidity growth). In the Late Glacial sequences of logs, mineral horizons were affected by periodic climate warmings resulting in the permafrost deterioration during the Bølling and the Allerød. However, the Allerød is bipartite in part of analyzed logs: the lower sections of Allerod (AL-1) sequences are usually represented by peat deposition, whereas in the upper parts of the logs (AL-2) numerous minerogenic (clay, silty clay) inserts confirm the climate humidity growth. In the Late Glacial sequence sections pollen of thermophilous trees, such as Corylus, Tilia, Quercus, Carpinus, as well as (typical for Subboreal Phase of the Holocene) Abies alba and Fagus sylvatica occur, which is probably related to the presence of refugium here.

During the termination of the Younger Dryas climate cooling, the gradual increase in the delivery of allochthonous material to peat bog is commonly observed. This process is finished by the deposition of clay and silty clay horizon. The lack of the depositional sequences of the upper Preboreal and the whole Atlantic Phase in the majority of logs is caused by the erosional removal of sediments during the climate humidity growth at the beginning of the Subboreal.

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BOG PINE DENDROCHRONOLOGY RELATED TO PEAT STRATIGRAPHY: PALAEOENVIRONMENTAL CHANGES REFLECTED IN PEATLAND DEPOSITS SINCE LATE GLACIAL, THE IMSZAR RAISED BOG CASE STUDY (NORTHERN POLAND)

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***Keywords**: dendrochronological analysis, Poland, Allerød interstadial*

Results of dendrochronological analysis of subfossil pine trees buried in peat deposits of the Imszar raised bog (NE Poland, Podlasie Region), were compared with multiproxy analysis of peat deposits (lithological, pollen and NPP, Cladocera, and macrofossils analyses). The beginning of peat sedentation (3.3 m thick) of the Imszar peatland was dated by 14C method at 12.7–12.4 ka cal. BP. However, in the light of palynological study, start of peat accumulation took place a little bit earlier - in the Allerød Interstadial.

Dendrochronological analysis of fallen stems of bog pine buried in peat indicates, that the pine tree populations grew in this peat bog in between ca 6832–6556 cal. BP. These dates also determine the time-range of the pine floating chronology of the Imszar peatland. Pine trees dying- off phases were dated at 6.64–6.47 ka cal BP. Apart numerous fallen trees excavated during the peat extraction, a horizon of vertical *in situ* tree trunks forming "died forest" was discovered: over one hundred, usually completely decomposed fragments of tree trunks ingrown to the ground, were exposed during peat exploitation. Single stems of these "death forest" horizon were dated at 5835–5606 ka cal. BP. Received dates determine the range of the next, younger pine dying-off phase. Similarly were dated tree trunks forming horizon in peat profile (ca 1.5 m below the ground) sampled during drilling the peat bog. All of the tree dying-off episodes are well correlated with phases of climate humidity growths and cooling in the Holocene.

The multi-proxy analysis of peat sediments and subfossil bog-pine trees are sensitive indicators of climate humidity fluctuations in the Polish territory during the Holocene.

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NON-ANALOGUE SMALL MAMMAL FAUNA FROM THE MOUSTERIAN SITE BETOVO (RUSSIA)

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There are several Late Palaeolithic sites situated in the Desna River basin and only few sites attributed to the Middle Palaeolithic. One of them is the well-known Betovo Mousterian site (Briansk province). This site was opened and investigated by L.M. Tarasov (1977). Dr. A.K. Ocherednoy excavated this site during the last years (2008). The numerous radiocarbon dates fall in the interval 28 500 – 36 000 yr ca. So, it is a contradiction between the relatively young dates and the Middle Palaeolithic culture.

The united list of small mammals of Betovo site (cultural layer 2):

Lagomorpha:
Ochotona pusilla Pallas (small or steppe pica) – 2
Lepus sp. (hare) – 1
Rodentia:
Marmota bobac Müller, 1776 (bobac marmot) – 2
Spermophilus sp. (ground squirrel) – 2
Dicrostonyx guilielmi Sanford, 1840 (collared lemming) – 461
Lemmus sibiricus (Kerr, 1792) (Siberian lemming) – 3
Eolagurus luteus (Eversmann, 1840) (yellow steppe lemming) – 12
Lagurus lagurus (Pallas, 1773) (steppe lemming) – 58
Lasiopodomys (Stenocranius) gregalis (Pallas, 1779) (narrow skull vole) – 112
Microtus sp. – 3 (vole)
Total - 657 identified bones.

All small mammal species from Betovo belong to tundra and steppe ones. The collared lemming, narrow-skull vole and steppe lemming dominate in the Betovo fauna. This fauna reflects the strong cooling, which caused the whole disappearance of the forest zone in the center of the Russian Plain and the distribution of the open cold tundra-steppe, so called the "mammoth steppe" which has no analogues in recent time. The similar reconstructions were received earlier by mammal materials from for the Desna R. basin and for the Russian Plain in a whole (Rekovets 1978; Markova et al. 2019). There are 28 species present in the modern fauna of small mammals of this region, most of which is distributed in the forest environments, but only 9 species of small mammals were found in Betovo. The low species diversity of Betovo small mammal fauna indicates the unfavorable conditions of environment, when only the several species dominated in the fauna.

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REVISION OF THE QUATERNARY HIPPOPOTAMUSES FROM ITALY

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Keywords: *Hippopotamus,* Italy, Pleistocene

The genus Hippopotamus dispersed from Africa to Europe during the Early Pleistocene and several hippopotamid remains were collected from different localities of Italy. Nevertheless some of these remains are fragmentary or lack a detailed stratigraphic and geographic data; in addition, the first and last occurrences of the different hippopotamids species are poorly understood. An update of the different Pleistocene Italian hippopotamuses is here reported in order to clarify their first and last occurrences during the Pleistocene and to investigate their chronology and distribution. Hippopotamids are recorded in at least 100 Italian fossiliferous localities. At present three different Pleistocene species are recognized: H. antiquus, H. amphibius and H. pentlandi. H. tiberinus, erected on material from La Maglianella, Rome, was considered a junior synonym of H. antiquus by some scholars. H. antiquus was dubitatively collected from localities ascribed to a time span from 2.1 to 1.8 Ma and recorded from different late Early and Middle Pleistocene deposits (at least till ca 0.5 Ma). H. antiquus was a little bit larger than H. amphibius and with a shorter neurocranial portion in respect to the extant species. In general, the skull of H. antiquus is slenderer and more elongated than the one of H. amphibius. According to some studies, the skull of H. antiquus resembles that of the African species H. gorgops.

The oldest record of H. amphibius in Italy is at present reported from the Middle Pleistocene deposits of the Tiber River, around 0.41 Ma, while the youngest record is from level G of Grotta Romanelli (Apulia, southern Italy), attributable to a time span between ca. 0.070 Ma and ca. 0.040 Ma. H. pentlandi was a dwarf species, typical of Sicily island. This species was 10-15% smaller than H. amphibius. The skulls collected from La Cannita Cave (Palermo, Sicily) displayed a more developed occipital region, a more enlarged mastoid process and a shorter dental row in respect to the continental species such as H. antiquus and H. amphibius. The orbits in H. pentlandi are more elevated than in H. amphibius. The mandible displayed a particularly low condyle, a character typical of the Sicilian dwarf species. H. pentlandi probably originated from H. amphibius which reached the island during a Middle Pleistocene sea level low-stand phase, probably during MIS 8 or MIS 6, and inhabited the Sicily until the early Late Pleistocene.

HOLOCENE ENVIRONMENTS IN THE SOUTHERN AND MIDDLE URALS: PALEOLIMNOLOGICAL PROXIES

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A multi-proxy paleolimnological study provided identification of main environmental changes in the Southern and Middle Urals. The study was based on pollen, diatom, and geochemical analysis of six sediment cores of the lakes located in the forest zone of the Southern and Middle Urals and forest-steppe zone of the Southern Urals. The forest lake pollen and geochemical records reflected the Lateglacial-Holocene transition 11.9-11.5 cal BP and other globally significant events: 11.2 ka, 8.2 ka, and 4.2 ka. Especially clear these events were observed in the Middle Urals lake pollen record.

The boundaries of the diatom and pollen zones were often not in accordance, as well as the diatom zones of different lakes, due to the fact that diatom assemblages could be affected not only by direct climate impact, but indirectly by changes in the catchment. Meanwhile, a diatom-inferred lake water electrical conductivity (EC) derived from lake sediments cores changed in accordance with the vegetation shifts, as reflected in the pollen records. The closest relationships were observed between EC and pollen abundance of herbs, *Pinus sylvestris* (for the forest-steppe lake) and *Picea* spp. (for the forest lakes). Forest lakes were marked by a declining trend in EC since the beginning of the Holocene (11.9–11.5 cal ka BP). An electrical conductivity of lake water was higher than present in the period between 6.5 and 3.8 cal ka BP in all studied lakes.

The climate events were the main direct or indirect drivers for the dynamics of the Southern and Middle Urals vegetation and lake ecosystems during almost the entire Holocene. Although different anthropogenic activities including copper metallurgy, settlements, and cattle breeding were developed since the Eneolithic, and the first metallurgical plants and administrative centers were constructed at the 17th century, the human impact was determined in lake records only since the beginning of the twentieth century. The pollen spectra of southern Urals lake sediments were marked by appearance of cultural cereals pollen and increase in birch pollen in sediments of lakes located near the Karabash copper smelter. Sediments of all studied lakes were characterized by higher concentrations of Cu, Zn, Pb, Bi, and Tl due to the metallurgical plants impact and the transboundary transfer of chalcophilic elements in the Urals. However, only diatom assemblages shift of Lake Ufimskoe provided the evidence for heavy metal loading impact. Diatoms of other lakes were indicative of eutrophication due to anthropogenic activities in the watershed. The climate changes of the last hundred years were not reflected in the lake diatom records because of the significant human impact on the lake ecosystems.

ON THE *MIMOMYS/ARVICOLA* BOUNDARY IN VARIOUS REGIONS OF EUROPE

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Keywords: *rodents, Mimomys, Arvicola,* Pleistocene

Mimomys and *Arvicola* (Mammalia, Rodentia, Arvicolidae) are two significant index fossils of the continental Pleistocene in Eurasia. An important biostratigraphic marker is the so-called *Mimomys/Arvicola* boundary, which was recognised in in large parts of Europe and some areas of Asia. It is positioned in the early Middle Pleistocene and was described in several comprehensive biostratigraphic studies by von Koenigswald, Fejfar, Heinrich, van Kolfschoten and others. This biostratigraphic demarcation is based on the replacement of *Mimomys savini* with rooted molars by the water vole *Arvicola* with rootless cheek teeth. Parallel to that the enamel thickness of the posterior enamel walls of the molars is gradually reduced, providing further biostratigraphic evidence. Most researchers assume that these modifications are not due to an immigration or displacement scenario but to an evolutionary transition within the water vole lineage (or parallel in several closely related water vole lineages). Three successive stages of this transition can be distinguished: Stage 1 (advanced *Mimomys savini*): Molars with clearly separated roots, rootless teeth only come from juvenile individuals. Stage 2 (primitive *Arvicola*): Predominantly rootless molars, only a few molars with beginning but never clearly separated roots. Stage 3 ("real" *Arvicola*): Exclusively rootless cheek teeth are present. The winning and use of these data requires, however, a larger amount of material, which is unfortunately not always available.

The establishment of the *Mimomys/Arvicola* boundary raises the question about the age of this border demarcation. To clarify whether the *Mimomys/Arvicola* boundary is the same everywhere or regional time-delayed, current data for the last occurrence (LOD) of *Mimomys* (stage 1) and the earliest occurrence (EOD) of Arvicola (stage 2 or 3) in Europe were compiled based on published age data by several authors (Rădulescu and Samson, 1993; Koenigswald and Van Kolfschoten, 1996; Roberts and Parfitt, 1999; Brunet-Lecomte and Paunesco, 2004; Cuenca-Bescós and García, 2007; Agadjanian, 2009; Hanquet and Desclaux, 2011; Markova and Puzachenko, 2016).

LOD M. savini – England: MIS 15; Spain: < 0.78 Ma, Germany: M. savini: MIS 17: Eastern European Russia: MIS 15.

EOD Arvicola – England: MIS 13; Southern France: > MIS 14; Spain: MIS 15; Germany: MIS 15; Italy: MIS 15; Romania: Prae-Elsterian; Eastern European Russia: MIS 13.

In summary, this preliminary compilation reveals that throughout Europe the *Mimomys-Arvicola* border appears to be consistently younger than MIS 17 and older than MIS 12 (Elsterian).

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BIŚNIK CAVE, SOUTHERN POLAND. SINGS OF A DEPOT AND WORKSHOP OF NATURALLY SHED CERVID ANTLERS?

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Keywords: *mammal taphonomy, skeletal part representation, bone modification, Late Pleistocene, Biśnik Cave, Poland*

The use of shed antler bases as soft hammers and retouches first appeared in the archaeological record in the Early Palaeolithic, around 500 ka (e.g., Boxgrove, UK: Wenban-Smith, 1989; Pitts and Roberts, 1997; Roberts and Parfitt, 1999; Pettit and White, 2012; Smith, 2013; Stout et al., 2014). This practice remained rare until the Late Palaeolithic when it became more common. An exceptionally high proportion of shed antlers from layer 7-5 of Biśnik Cave, Częstochowa Upland, which is referred to the MIS 3-4 transition, could have been accumulated by hominins as raw material and then employed as tools for crafting other tools or for being shaped into tools themselves. That they enjoyed special attention by humans is reflected by the fact that the shed antlers are the only specimens from Biśnik Cave's layer 7-5 to show human-derived damage; consistently, several flint tools display delicate striations on the working edges, suggestive of use for processing antler or wood (Cyrek et al. 2014). This, however, is not the only damage suffered by the antlers; most of them are also heavily gnawed and bit by carnivores, especially *Crocuta crocuta spelaea*, which evidently found them piled up in the cave and used them as nibbling bones. The spotted hyaenas cannot be held responsible for collecting the antlers; it is hardly credible that these opportunistic carnivores, at the top of the trophic pyramid, would spend time and efforts to collect large amounts of skeletal parts with so little nutritional value. We also exclude that spotted hyaenas needed to collect antlers to supplement their mineral intake: by being total consumers of vertebrate carcasses, their droppings consist almost entirely of mineral matter derived from bones (Matthews, 1939; Sutcliffe, 1970; Kruuk, 1972; Larkin et al., 2000). This reasoning inevitably leads to the conclusion that the blame for accumulating disproportionate numbers of shed antlers is to be placed on hominins. The alternating presence of hominins and hyaenas at Biśnik Cave is hinted at by taphonomic evidence. At the time when layer 7-5 was formed, the cave was used by many successive generations of animals. Taphonomic analysis indicates that the bone assemblage is the result of a time-averaged palimpsest of both biotic and episodic abiotic events, which include both animal and hominin frequentation, and eventual hydraulic winnowing, which purportedly removed a certain amount of the original specimens.

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CHARACTERIZATION OF THE PLIO-QUATERNARY RIVER-TERRACE SEQUENCES IN THE SOUTH – EASTERN ALPINE FORELAND (SLOVENIA) USING MORPHOSTRATIGRAPHY AND PROVENANCE ANALYSIS

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Keywords: *Pliocene-Quaternary sedimentary, Slovenia, river tarrace*

This study focuses on the Pliocene-Quaternary sedimentary evolution of the fluvial systems preserved in the terrace staircases in the intramontane basins of Slovenj Gradec, Nazarje, Velenje, Celje, Drava-Ptuj and Krško in the southeastern Alpine foreland, Slovenia. The main aim is to determine the morphostratigraphy of terraces with geomorphological analysis and to unravel provenance of the deposits using clast lithological analysis. Based on the spatial relationships between the individual landforms, the degree of landform preservation, the gradient of the landforms, the petrographic characteristics of deposits, the degree of weathering and pedogenesis, and published aged where available (Velenje and Krško Basins) low-, middle- and high-level terrace groups were constrained and tentatively attributed to Late Pleistocene, Middle Pleistocene and Plio-Early Pleistocene, respectively. The provenance analysis focused on the sediments of the Plio-Early Pleistocene terraces and included lithological and microfacies analysis of the clasts. The latter proved to be an excellent tool for determining provenance areas with high reliability. The main indicator lithologies which are metamorphic rocks from the Pohorje area, volcanic rocks of the Eisenkappel igneous zone and volcanic and volcaniclastic rocks of the Smrekovec volcanic complex. For the Slovenj Gradec, Nazarje, Velenje, Celje and Drava-Ptuj Basins, a local provenance with relatively short transport, and for the Krško Basin a distal provenance with longer transport was deduced. This is in accordance with the morphology of the clasts and the structure of the sediments, which in the distal Krško Basin show increased roundness and sorting.

Based on the provenance analysis, the paleodrainage in the Plio-Early Pleistocene was interpreted to correspond roughly to the present one, which is consistent with other observations from the Eastern Alps.

EEMIAN AND VISTULIAN PALAEOLAKE HORIZONS IN GORZÓW WIELKOPOLSKI (NW POLAND) ON THE BASIS OF ISOTOPIC AND GEOCHEMICAL DATA

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Keywords: *Eemian Interglacial, paleolake, sediment profile*

The newest succession from Gorzów Wielkopolski (NW Poland, central Europe) comprises 11-m long the lake-peatbog sequence accumulated from final phase of the Saalian glaciation through entire Eemian Interglacial to the Vistulian glaciation (Sobczyk et al., 2020). There are two thick layers (limnic cycles?) of lake deposits (gyttja and lake marl) divided by peat and mineral deposits layers accumulated in different times as well as different climatic conditions. In addition, almost complete skeleton of *Stephanorhinus kirchbergensis* and a single bone of fallow deer (*Dama dama*) were found in the site (Badura et al., 2017; Sobczyk et al., 2020). The Eemian-Vistulian age of the lake-bog sediments was determined based on the palynological results (Sobczyk et al., 2020). We present the results of the main stable isotopic and geochemical studies of these deposits.

We focus on the comparison of the features of two lake layers in relation to the climatic changes and environmental conditions. We discuss whether it was a one reservoir with continued accumulation or the two separate lakes. The values of oxygen and carbon stable isotopes from carbonates change from -10.7‰ to -4.9‰ (for $\delta^{18}O_{carb}$) and between -4.1‰ and 12.0‰ (for $\delta^{13}C_{carb}$). The greatest variations occur in the bottom and in the top of sediment profile and they are connected with the changing environmental conditions in the basin. Organic matter excavated from carbonate sediments, silty sands, and peat characterize by the changing values of $\delta^{13}C_{org}$ from -33.9‰ to -19.4‰, and by $\delta^{15}N$ values fluctuating between -2.5 and 6.4‰. The differences of carbon and nitrogen isotope values suggest different sources of organic matter accumulated in the studied basin and varying trophy of environment. The results of geochemical analyses show that both lakes were dominated by a slow accumulation of carbonates, which demonstrates their abundant ground supply. Only in the initial stages of lake development, some influence of the surface supply is visible, which is indicated by the increased content of lithophilous elements, especially potassium, along with some heavy metals closely correlated with this element (Cu and Zn). The mercury content is clearly related to the course of climate change reconstructed based on the results of palynological analyses (Sobczyk et al., 2020) and is the highest during cold periods. This is consistent with the results of the study by Martinez-Cortizas et al. (1999), as well as reports that in cold climate conditions, higher Hg concentrations are recorded in peatland plants (Olson et al., 2019).

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LITHOLOGY, STRATIGRAPHY AND PALAEOGEOGRAPHY OF THE UNIQUE LOESS-PALAEOSOL SEQUENCE AT ZADARIV IN THE OPILLIA UPLAND (W UKRAINE)

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New discovered loess section in Zadariv is located in the loess zone of the western part of Ukraine. The site is situated in the Zolota Lypa River valley on the area of the Opillia Upland, close to its eastern border. It is a sub-region distinguishing itself from the proper part of the Podolia Upland, based on clear differences of the relief. Podolia Upland is characterized by a well-developed structural relief, whereas erosive-denudative forms dominate in the Opillia region (Łanczont et al., 2015). The peculiarity of relief on the area of region are denudation surfaces developed at different heights up to 335 m a.s.l.

The Zadariv section reveals nearly 20 m a loess-palaeosol sequence surrounding the central part of the slope. The ages of this sequence are of the Upper to Middle Pleistocene (MIS 2-12). This is a unique site on the Opillia Upland because there are no loess sections with similar thickness and stratigraphic resolution. The section is complete and includes some loess units (L1-L5) and four palaeosols of the interglacial rank (S1-S4); a part of these deposits (L1-S2) were, tested in parallel at two points defined as Zadariv A and Zadariv B. Additionally, two large mammalian bones were found in Zadariv B section – in loess L1 and palaeosol S2-I. According to B.Ridush (pers. comm.), the bones represent proboscideans. OSL dating, chemical and grain size analyses in high resolution were performed for the whole sequence. On their basis a number of sedimentological indicators for palaeo-geographic interpretations were calculated. The main features of the sequence include the following: strong and numerous changes of grain-size records and low or no CaCO3, and high Fe2O3 contents, especially in palaeosol horizons.

The denudation area, on which Zadariv loess cover lies, refers to the fifth (Halych, see Łanczont et al., 2015) terrace level of the Dniester River, and the Zadariv loess-paleosol units correspond well to those ones in the Halych site. Indirectly, it dates to the MIS 15-13 stage of the formation of a under loess denudational surface in the Zadariv site. In both studied sections of the Zadariv site as well as the Halych site, is well-developed S2 pedocomplex (MIS 7), which can be a regional stratotype and can be used for interregional correlations. Moreover, the Zadariv site is interesting because of its importance in the discussion over the local conditions of differences in development of the S2-II palaeosol in the catenary system.

Detailed recognition of particular loess units in Zadariv site is at the initial research stage. We think that the results will give the opportunity to separate of the regional type of the Opillia loess and to reconstruct the stages of their forming in relation to Pleistocene's main stages of natural evolution in this region, and therefore the section can be considered a key loess profile for the Opillia Upland.

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LITHOLOGY OF L1 LOESS ON THE NORTHERN EDGE OF EUROPEAN LOESS IN THE UPPER DNIEPER RIVER BASIN

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High-resolution statistical analysis was carried out on the results of grain-size analyses of loess-palaeosol sequences available for studies at four geological sites situated in the Upper Dnieper River basin in northern Ukraine. The following sites, located in Pleistocene periglacial zone, were selected for analysis: Cherepyn, Korshiv, Lityn and Stayky. These sites belong to the group of key sections for this part of Europe (Pańczyk et al., 2020).

The subject of the study were loess-soil sequences from the last glaciation basically in the L1L2-L1S1-L1L1-S0 sequence system with a thickness of up to 10 meters. These sequences were sampled at an interval of 10 cm. Laser diffraction measurements were focused on detailed particle size analyses. On their basis, a number of statistical analyses were performed, including analyses of the share of individual fractions and subfractions, as well as sedimentological indicators, both the traditional ones, commonly used (i.e. average grain size index, median, standard deviation, curtosis, skewness – Folk and Ward, 1957) and the more modern ones, eminently dedicated to loess deposits (grain size index, U-ratio, end-members – Újvári et al., 2016; Varga et al., 2019). Additionally, the particular series of statistical analysis results of grain size distribution were presented as the heat maps – colourful models and highly attractive visually.

The results allow us to conclude, first of all, on the clear vertical variability of the tested sediments, which are both litho- and post-sedimentation. The "modern" methods of statistical analysis allowed to separate genetic features of sediments from each other, as well as to determine trends of changes. The research showed several similarities as well as distinct differences between adjacent loess samples. These features indicate, on many occasions, clear stratification of macroscopic sediments considered to be homogeneous. This, in turn, allows us to conclude about the variable sources of loess dust, as well as about the diagenic transformations and repeated recycling of the deposited material, mainly through aeolian processes.

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NEANDERTHAL REMAINS FROM STAJNIA CAVE IN THE LIGHT OF NEW SCIENTIFIC DATA

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Keywords: *Stajnia Cave, Poland, enamel, Neanderthal teeth*

In this study, we present and discuss the results of our detailed examination of the morphology of the two new hominin teeth (upper P4 and lower M3) discovered in Stajnia Cave, in Southern Poland, dated to over 46.4 cal BP. The performed analyses include the identification of the traits of the external morphology of their crowns and also the description of the traits concerning the morphology of the enamel-dentine junction surface of these teeth. Additionally, the data about the thickness of their crown enamel (Benazzi et al., 2014) was presented. The obtained results suggest a Neanderthal affinity of these new hominin remains. Additionally, the results of the performed analyses of mitochondrial DNA samples obtained from these teeth clearly support their taxonomic assessment and extend the sample of the Neanderthal teeth known from Stajnia Cave from three to five (Urbanowski et al. 2010; Dąbrowski et al., 2013; Nowaczewska et al., 2013,). The pattern of the subvertical grooves' expression observed in the crowns of the examined teeth was analysed in detail and discussed in the light of the hypotheses related to the causes of their occurrence (Villa & Giacobini, 2015). The presence of a toothpick groove in one of the examined teeth was diagnosed. The new data described in this study significantly enrich the current state of knowledge of morphological variation of Late-Pleistocene, East-European Neanderthal premolars and molars.

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PRELIMINARY MORPHOMETRIC COMPARISON OF MOLAR TEETH AND THEIR ENAMEL THICKNESS IN TWO BOVIDS, *BISON* AND *BOS*, BASED ON REMAINS FOUND IN POLISH CAVES

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An important component of Pleistocene fauna constituted two closely related bovids classified into subtribe Bovina and described traditionally under the genus *Bison* (HAMILTON-SMITH, 1827) and *Bos* (LINNAEUS, 1758). However, molecular studies proposed the inclusion of bison species into one genus *Bos*. The Pleistocene remains of these mammals from Eurasia are most often represented by *Bison bonasus*, *Bison priscus* and *Bos primigenius*. The big similarity between these two genera causes that it is difficult to recognize them in fragmentary or poorly preserved fossil material. Therefore, we decided to analyse subfossil and fossil molars of these bovids to recognize potential differences between them and identify probable changes over time. Our preliminary study included 55 molars collected from Biśnik Cave, Komarowa Cave, Łokietka Cave and Mamutowa Cave located in Poland. The teeth were found in layers dated to Marine isotope stages (MIS) from 1 to 6. In total, we took 44 measurement types including basic dimensions of the teeth and their parts, e.g. width, length, height, as well as distances between characteristic features on the occlusal surface, e.g. cusps and lophs. Moreover, we compared the teeth in terms of 8 enamel thickness measurements. We observed that teeth ascribed to *Bison* were on average larger in many measurements than those of *Bos*. The increase was on average 30% and up to 91%. However, the differences were not statistically significant due to poor sampling. Upper molars were on average 43% greater in 37 measurements than lower molars, which exceeded the former on average 23% in only 8 measurements. Twenty-six comparisons of these molar types turned put significant in statistical testing. The analyses also showed statistically significant positive correlations (up to 0.84) between some dental measurements and MIS stratigraphic time. It indicates that the teeth of these two bovids decreased in these features from the Pleistocene to the Holocene. The changes were likely related to changes in climatic and environmental conditions at the end of the Pleistocene, and were observed in other big mammal species too. Additional studies based on more rich material are necessary to verify these findings.

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QUATERNARY EUROASIAN WILD BOAR SUS SCROFA (LINNAEUS, 1758) FROM POLAND

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***Keywords**: wild boar, Sus scrofa, Quaternary fossil, Poland*

Suid remains are very rare found in the Quaternary sediments in Poland. In the Neogene the Suidae occurred during the Miocene; no representatives of the family were found in the Pliocene and Lower Pleistocene (Czyżewska 1989). The earliest known occurrence of Sus scrofa was the Middle Pleistocene site of the Kozi Grzbiet (Świętokrzyskie Mts) (MIS 17-19), with mandible remains of an adult individual. Somewhat more numerous remains of the species were found in cave localities from the late Middle Pleistocene MIS 9, 7 (Cave Biśnik), the Eemian Interglacial MIS 5e (caves Biśnik and Nietoperzowa), early Vistulian Glaciation MIS 5a-d (caves Biśnik, Nietoperzowa, Komarowa) and MIS 3 (caves Biśnik, Nietoperzowa, Komarowa, Niedźwiedzia). In the Holocene, besides the above-mentioned localities, the occurrence of the Eurasian wild boar was recorded in Cave Jasna Strzegowska and in open-air sites where it was among the most abundantly represented large mammals. Besides Cervus elaphus and Capreolus capreolus, the wild boar was the main game animal for the humans of that period. Remains of its domesticated form appear in the strata from the Neolithic upward (Nadachowski et al. 2015).

Morphometric analysis shows that the specimen from Kozi Grzbiet was of a size similar to that of the specimens from Untermassfeld (MIS 29) and Petralona (MIS 12-14), which were classified as Sus scrofa priscus (Faure and Guérin 1984, Guérin and Faure 1997, Tsoukala and Guérin 2016). Considering the chronological range of fossil subspecies of Sus scrofa, the specimen from Kozi Grzbiet can also be assigned to Sus scrofa priscus. The specimens from the late Middle Pleistocene, Upper Pleistocene and Holocene of Poland represent the nominate subspecies Sus scrofa scrofa (Faure and Guérin 1983, Fischer and Heinrich 1991, Hünermann 1965, 1975, 1977). The results of our analyses confirm the trend of decreasing size of species of the genus Sus, from Sus strozzii to Sus scrofa, and within the subspecies of Sus scrofa throughout the Pleistocene, while during the Holocene no significant differences were observed between populations of Sus scrofa scrofa either in time or in space.

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EARLY PLEISTOCENE RHINOCEROSES IN EURASIA AT THE TIME OF THE FIRST HUMAN DISPERSAL

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Keywords: *Early Pleistocene, rhinoceroses, Euroasia*

During the Early Pleistocene, the rhinoceroses were relatively well-distributed through Eurasia and were important elements of the past ecosystems. The diversity of the family Rhinocerotidae was indeed higher and the geographic distribution of the different species was wider than during the Holocene.

At least five species belonging to the genus Rhinoceros were documented in Southern Asia: Rhinoceros platyrhinus, R. sivalensis, R. fusuiensis, R. unicornis, and R. sondaicus. R. platyrhinus was only collected from the Siwalik Hills, as well as R. sivalensis. R. unicornis, and R. sondaicus occurred in several localities in South-East Asia during the Early Pleistocene, including localities with human evidences such as Yuanmou (China), whereas R. fusuiensis was only distributed in a few localities of South China. Anyway, a deep revision of the fossil material belonging to the genus Rhinoceros is still needed and several fossil records and species could be referred to R. unicornis or R. sondaicus. The status of R. sinensis, which is reported in some Homo-bearing localities of Asia, is matter of debate.

The genus Dicerorhinus occurred during the Pliocene-Early Pleistocene in Myanmar with D. gwebinensis and during the late Early Pleistocene in South China with D. sumatrensis. The two species are morphologically similar to each other.

In Central-Eastern Asia and in Europe, the family Rhinocerotidae was represented by three genera: Elasmotherium, Coelodonta and Stephanorhinus. Elasmotherium included three Early Pleistocene species, mainly documented in Central and Western Asia: E. peii, E. chaprovicum and E. caucasicum. All of them displayed very hypsodont teeth with complex enamel foldings, suggesting they were able to feed on very abrasive food.

The genus Coelodonta was represented only by one species, C. nihowanensis, which occurred in a few Early Pleistocene localities of China, some with evidences of human activities. Stephanorhinus was instead well-represented in Eurasia during the Early Pleistocene. The species S. yunchuchenensis, S. lantianensis (only documented at Gongwangling, an early human locality of China) and S. kirchbergensis occurred during the late Early Pleistocene in Eastern Asia. The so-called Etruscan rhino, S. etruscus, occurred in several Western European as well as in Greece, Georgia, and Israel during the Early Pleistocene. S. etruscus was reported in several localities where the presence of Homo was testified (e.g. Pirro Nord, ‘Ubeidiya, Atapuerca). The diachronic extinction of the Etruscan rhino could be probably related with the climatic deterioration at the end of the Early Pleistocene.

AN ATTEMPT TO ESTIMATE THE DENTAL AGE OF WHITE RHINOCEROS (*CERATOTHERIUM SIMUM*, BURCHELL 1817) BY MEANS OF ULTRASTRUCTURAL IMAGING TECHNIQUES AS A MODEL FOR FOSSIL REPRESENTATIVES OF THE RHINOCEROTIDAE FAMILY

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Keywords: *white rhinoceros, Ceratotherium simum, teeth, dental*

Structural analysis of teeth allows for the assessment of ontogenetic development of animals. One of the examined characteristics is the growth of dental tissue as an indicator of the individual animal's age at death. Such studies are carried out on fossil as well as on modern material. Existing studies on the subject, including those on the rhinoceros family, often use different research techniques and a different approach to the problem. This applies i.a. to the analyzed cross-sectional surfaces and the type of tooth tissue (cement, dentine). Thus, we present an attempt to determine the age of an animal on the example of dentine increment lines distribution analysis and cement in a white rhinoceros specimen for which its age is known. The object of analyses was a right premolar tooth (P3) from a mandible belonging to a 48-year-old white rhinoceros female (Ceratotherium simum, Burchell 1817), which died on March 22, 2016 in the Kiev Zoo, Ukraine. Photographic and radiological documentation of the mandible was made for the examined tooth. The characteristics of the tooth structure were determined, on the occlusal rubbing surface identified were areas and points of the anatomical constitution of the tooth crown. A histological evaluation was also carried out on the observed structures of dental tissues in occlusal, horizontal and longitudinal plane. The study was carried out with the use of hard grinds techniques and then observations in white, polarized and reflected light. X-ray and SEM had also been used, for analysis, in the subsequent stage, towards the distribution of annual growth lines of the mineralized dental tissues of cement and dentin, counted from the root canal center to the cheek surface of the tooth. Besides analyzing the number of growth lines, an attempt was also made to confirm the vegetation season in which the animal died, based on the cement growth lines. On the basis of observations of growth lines, it was found that they were visible on all analyzed planes, on dentine and on cement. On the cement the lines were sparse and they did not represent the known age of the animal. The most visible growth lines were observed on the dentin. Whereas on the occlusal plane these lines were few and unclear. On the longitudinal plane, both on the caudal and rostral roots these lines, although clearly visible, were much more numerous than expected due to the known age of the animal, as more than 50 were counted. On horizontal planes, for both roots, distinct growth lines were observed on dentin and their number 48 for both roots corresponded to the age of the animal. From the analysis of the color of the cement lines we presume, that the animal was regularly fed a diet that was not seasonally differentiated. However, from the X-ray examination we conclude that the animal did not suffer from periodontal diseases. These studies can be used to estimate the age at death of fossil rhinoceros representatives.

UPPER PLEISTOCENE FOSSIL BATS ASSEMBLAGE WITH NEW SPECIES REPORTS FROM NORTHERN ITALY

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Keywords: *bats, Northern Italy, Upper Pleistocene*

This paper presents the results of analyses of fossil bat remains collected in six caves located in Northern Italy. Palaeontological and archaeological investigations conducted over the last few decades have allowed us to recover bat bones dating to a time interval stretching from the Upper Pleistocene to the Holocene.The caves investigate are: Caverna degli Orsi, Covoli di Velo, Riparo Mezzena, Cava Salnova, Grotta Sopra Fontana Marella, Caverna Generosa.

The Caverna degli Orsi is located in the Trieste karst (360 m asl, northeast Italy): the bat bones come from levels dating from the Upper Pleistocene MIS 4-5 to the Holocene. Covoli di Velo (860-890 m asl) and Riparo Mezzena (250 m asl) are located in the Lessini Hills (northeast Italy): the bat bones come from levels dating from the Upper Pleistocene (MIS 3) to the Holocene for Covoli di Velo, and only from the Upper Pleistocene (MIS 3) for Riparo Mezzena. Cava Salnova (775 m asl), Grotta Sopra Fontana Marella (1040 m asl) and Caverna Generosa (1450 m asl) are located in northwestern Italy in the Lombardian Pre-Alps: the bat bones from these three caves in general date from the Upper Pleistocene (MIS3). However, in Caverna Generosa there are also Holocene levels with bat remains. Overall, 79% of the studied bat remains were recovered from levels dating to MIS3.

Fourteen species of bats have been identified. Four of these species are here reported for the first time for the Late Glacial period in northern Italy: Rhinolophus blasii, Myotis daubentonii, M. nattereri and Nyctalus leisleri. The other identified bat species are: Rhinolophus hipposideros, R. ferrumequinum, Myotis bechsteinii, M. cappacinii, M. dasycneme, M. emarginatus, M. myotis, M. blythii, N. noctula, Plecotus auritus and Miniopterus schreibersii.

The species of some of the bat remains could not be determined – we can say only that they belong to: M. cf. mystacinus, M. cf. nattereri, Myotis sp., Plecotus sp. and Chiroptera indet.The presence of M. dasycneme in the Holocene, not present today in Italy, suggests that parts of this region served as refugia during the Late Glacial period. The occurrence of R. blasii during the last interglacial in the Trieste karst area is interesting because the historical presence of this taxon in Italy is not currently confirmed, with only one historical report from the boundary between Italy and Slovenia.

The fossil bat assemblage suggests the presence during MIS 3 of open and mixed areas with a Mediterranean climate in northeast Italy, while forested environments and a temperate climate were seen in northwest Italy.

CLIMATE CHANGE AND NEANDERTHALS DISPERSAL DURING THE LAST GLACIAL IN CENTRAL EUROPE: NEW INSIGHTS FROM STAJNIA CAVE

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Keywords: *Pleistocene, Neanderthal, Stajnia Cave, Poland*

During the Pleistocene, climatic fluctuations and the development of the Scandinavian ice sheet in the Northern hemisphere caused demographic decline across the mid-latitude territories of Europe (Ehlers et al. 2011). Rather than tracking favourable habitats to the south, some studies support the hypothesis of local extinction of archaic humans living in periglacial environment, and of a subsequent repopulation from refuge areas after the climatic ameliorations (Hublin, Roebroeks 2009). Since late MIS 9, Neanderthals occupied the regions most affected by climatic changes, and the occupational hiatuses documented in North-Central Europe during the glacial cycles indicates recurrent episodes of recolonization (Goval, 2012). An important climatic change that altered the habitat of Neanderthals in the northern territories occurred during the Last Glacial when the forested environment of the Eemian shifted to open steppe habitats favouring the migration of cold adapted fauna (Kahlke, 1999). In response to these new environmental conditions, Neanderthals of Central-Eastern Europe modified their technical behaviours, and started to produce a wide range of asymmetric bifacial tools. This techno-complex is known as Micoquian, and is found from the Saône River to Poland and the Northern Caucasus (Jöris, 2006; Golovanova, 2015). Although this new technical behaviour expanded across most of the European periglacial regions, the production of bifacial tools persisted from MIS 5c to MIS 3 making unclear the role of glacial refugia in the processes of the technological continuity.

Here, we present the paleogenetic analysis of a Neanderthal molar S5000, found in a Micoquian context of Stajnia Cave (Poland). Our results demonstrate that the mtDNA genome of Stajnia S5000 dates to MIS 5 making the tooth the oldest Neanderthal specimen from Poland. Furthermore, S5000 has the fewest number of differences to mtDNA of Mezmaiskaya 1 Neanderthal from Northern Caucasus. The technological similarities between the Micoquian assemblages in Central and Eastern Europe, and mtDNA affinity between Poland and the Caucasus suggest a pattern of high mobility patterns across the European Plains. The Prut and Dniester rivers were probably used as the main corridors of dispersal facilitating seasonal forays to lower latitudes or vice versa. The persistence of the Micoquian techno-complex in South-Eastern Europe infers that this axis of mobility was also used at the beginning of MIS 3 when a Neanderthal population turnover occurred in the Northern Caucasus.

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PALAEOECOLOGICAL RECORD OF LONG EEAMIAN SERIES FROM KOZŁÓW (CENTRAL POLAND) WITH REFERENCES TO PALAEOCLIMATIC INTERPRETATIONS

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Keywords: *Eemian palaeolake, Kozłów site, Poland, plants*

Palaeobotanical and palaeoecological methods play a major role in climate reconstructions of previous interglacials as plants are very sensitive to changes of environmental conditions. Ongoing discussions on climate changes can be supported by detailed high resolution studies on Eemian Interglacial – the last interglacial without human impact on natural climate variability.

Newly found Eemian palaeolake deposits in the Garwolin Plain (Central Poland) provide excellent research material for this type of studies. The longest sequence was found in the Kozłów site where the thickness of the Eemian palaeolake series exceeded 6m. Two cores have been drilled from this site and investigated by palaeobotanical methods (pollen and plant macrofossil remains). Preliminary pollen investigation of the first core (signed KO) revealed full interglacial succession encompassing seven regional pollen assemblage zones (RPAZs) numbered E1-E7 from the bottom of the Eemian series to the top (Mamakowa, 1989). Plant macrofossils were scarce and supported the opinion of a great depth of the paleolake. More detailed palynostratigraphic investigations were performed on the second core (signed K2-19), in which Eemian deposits (at the depth2.50-8.80m) revealed extremely long E5 RPAZ (Carpinus phase). According to the new investigations of high resolution Eemian data from Poland (Kupryjanowicz and Granoszewski, 2018) the E5 RPAZ was divided into 5 subzones each of which was interpreted in terms of temperature and humidity climatic changes. The highest water level in the palaeolake was found in the E4/E5 RPAZ transition which agrees with earlier findings of Granoszewski (2003) and Kupryjanowicz (2008) and other Eemian sites referred to by Kupryjanowicz et al. (2018). Conclusions on vegetation and climate changes in the Eemian optimum in Central Poland, based on the Kozłów data confirm the east-west continentality climatic gradient. Pollen of plants – indicators of warm and humid climate (Ilex aquifolium, Buxus sempervirens) persisted longer up to the end of the Carpinus phase, while in the northern Podlasie their presence was observed up to the middle part of this phase (Kupryjanowicz et al., 2018).

Our study evidence that no drastic climatic change was observed during the Eemian optimum, although palaeobotanical results confirm changes in vegetation composition. Only part of them can be attributed to small-scale climate fluctuations. Evident was the drop of water level at the late part of the Carpinus phase (E5), which coincides with conclusions of Kupryjanowicz (2008) and Bińka and Nitychoruk (2003) from Poland, but also with the results of Börner et al. (2018) in northern Germany (Hinterste Mühle site), where during the hornbeam phase deposition of lacustrine sediments was replaced by peat accumulation.

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POLLEN BASED CLIMATE RECONSTRUCTION OF THE EEMIAN OPTIMUM: ŻABIENIEC – JAGODNE TRANSECT OF FOUR SITES (CENTRAL POLAND)

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The number of newly discovered Eemian palaeolakes in the Garwolin Plain (Central Poland) exceeds 20. From among them the longest lake sediment series are Żabieniec and Jagodne with six cores of biogenic deposits investigated by pollen analysis from both these sites. The studies revealed interglacial sequences with seven regional pollen assemblage zones (E1-E7 RPAZs) typical for the Eemian Interglacial (acc. to Mamakowa, 1989). Pollen data were transformed into the format suitable for the PPPbase software (Guiot, Goeury 1996) designed for pollen-based quantitative climate reconstructions by the modern analogue technique. The aim of our study was to estimate the range of climate variability during the Eemian optimum. The modern analogue technique with the use of the PPPbase software and plant indicator taxa method were applied to four high resolution pollen records from these palaeolakes to infer total annual precipitation, mean annual temperature and temperatures of the warmest and the coldest months. The method have already been used also for the Zdany and Łuków long pollen sequences of the Cromerian age from eastern Poland (Pidek, Poska 2013). The obtained results of the two methods created a coherent picture of climate changes. For the Eemian Interglacial in Europe several pollen-based climate reconstructions using the modern analogue approach were developed (Guiot et al., 1989; Cheddadi et al., 1998; Brewer et al., 2008).

The succession of Żabieniec and Jagodne starts with steppe-tundra communities and boreal forests, reflecting a cool, late glacial continental climate and develops into widespread riverine communities dominated by elm and oak trees, followed by hazel expansion in a very warm (at least 21°C in July), oceanic conditions (ca. 800 mm annual precipitation). The second part of the Eemian Interglacial characterized by hornbeam dominated forests was found to be warm, but less oceanic, which is in agreement with the scarcity of indicators of a humid climate at the decline of this phase. Our results are consistent also with opinions about high water level in the lakes during the hazel phase and at the beginning of the hornbeam phase followed by the drop of the water level in the second half of the hornbeam phase (Kupryjanowicz 2008 and references therein).

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GRAVETTIAN CAMP-SITE DOROSHIVTSY III (MIDDLE DNIESTER RIVER VALLEY, UKRAINE W) - "OLD" SITE AND NEW PROBLEMS

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Keywords: *Gravettian and Epigravettian, Middle Dniester River, bone remains, stone artifacts*

Dorishivtsy III site is one of a series of Gravettian and Epigravettian sites constituting an important settlement centre in the valley of the Middle Dniester River. Its numerous features (well-preserved loess sequence, the presence of several cultural layers, rich and diverse bone remains and stone artifacts, as well as art elements) make it a site with great scientific value.

The site was discovered in 1968 and then examined between 2006 and 2012. The synthetically recorded effects of this research as well as a few first results of OSL and 14-C dating were published (Kulakovska et al., 2012, 2015; Klasen et al., 2017; Haesaerts et al., 2019).

New investigations started in 2019. They covered another part of the site, bordering on SW with the former trench. The space, only a few meters away from the part of the site excavated so far, provided data that clearly shows a complex picture of the sequence compared to the previous works. In the new trench, the age of the sediment determined (OSL method) on the basis of 15 samples is between 20-34 ka. At this stage we examined lithology of sediments up to about 8 m. It is a sequence consisting of several loess and silty-sand packets with 5-25% carbonate content. The slope-type packets dominate and with the participation of periglacial structures, there is less massive loess. There are numerous thin soil horizons from the initial pedosediment (probably not stratigraphically significant, local) to tundra-gley (at the depth of 8 m) of ~29 ka. Distinguished horizons have variable thickness, are often discontinuous and the boundaries are usually sharp.

Several cultural layers were distinguished in the section. During the 2006-2012 study 7 of them were identified in a specific stratigraphic position. These layers provided inventories with a very clearly dominant layer 6 and a rich layer 3. In the part of the site currently under study, a clear decrease in the number of flint artefacts in all layers is observed. The almost complete lack of retouched tools is also surprising.

During the excavations in 2019, a total of 283 faunal remains belonging to at least 30 individuals was recorded. Bones are generally well preserved. We identified remains of reindeer, horse, mammoth, wolf, vulpine and crow. Layers 2 and 4 are the richest in terms of number of remains, of elements and of individuals. We identified impacts of fracturation on long bones of horses and reindeers linked to marrow removal. The density of remains is lower than previous excavated sector. Moreover, the representation of mammoth is higher than expected with individuals dead in situ, which status needs to be better understood.

The differences in the structure and frequency of both flint artifacts and animal bones observed between the 2006–2012 and 2019 excavations may indicate the functional diversity of the camp.

One of the most important problems of new research is the difficulty of synchronization of both sedimentological and cultural layers. It seems today that more than 7 cultural layers need to be separated within the area studied in 2019. The problem of their correlation with previous findings as well as the absolute dating of inventories is still open.

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UPPER PLEISTOCENE MOLLUSC FAUNA FROM THE CHANNEL ALLUVIUM AT THE BASE OF MULTI-LAYERED UPPER PALAEOLITHIC SITE DOROSHIVTSI 3 (MIDDLE DNIESTER AREA, UKRAINE)

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The Middle Dniester Valley is one of the reference areas in Ukraine and Eastern Europe for the state of preservation of terrace deposits and completeness of the stratigraphic sections. We try to study detailed the alluvium of lower terraces of the Middle Dniester, and the mollusc fauna of as an indicator of the aquatic and terrestrial environment.

The studied terrace is located near the Doroshivtsi Village (Chernivtsi region, Ukraine), on the right bank of the Dniester River, in the inner-canyon part of the valley. The total thickness of the terrace sediments is approximately 20 m, of which at least 7 m are subaerial sediments. Below (at the depth 7-16.5 m) lies a layer of rhythmic beds of sands, sands, and loams with signs of embryonic soils. These deposits form a floodplain facies of alluvium. The upper 10-meter part of the terrace section contains cultural layers of the multi-layered Upper Palaeolithic site Doroshivtsi 3. For these cultural layers, the 14C dates of 22,300 ± 100 BP, 20,976 ± 76 BP, 20,700 ± 90 BP, and 20,504 ± 83 BP were obtained, that corresponds to the Last Glacial Maximum (Bug Stage, bg, MIS-2) (Kulakovska et al., 2015; Haesaerts et al., 2020).

The channel alluvium is composed of beds of gravel and pebbles with sand filling. Only mollusc shells were found in the channel alluvium. The fauna of freshwater molluscs confirms that at the time of sediment formation, the conditions were typical for a river channel. According to the terrestrial species, we concluded that during the alluvium formation, the open, moderately humid, and dry, non-cold landscapes predominated on the banks of the Dniester.

The geomorphological position, base height, age of overlying sediments, and palaeoecological reconstructions by the mollusc fauna allow us to suggest that the channel alluvium was deposited during the relatively warm Vytachiv Stage (vt) (MIS-3). Still, later, with the climate cooling and, accordingly, runoff changes, the Dniester riverbed here turned into the floodplain and subaerial phases. The obtained data on the conditions of the terrace alluvium formation, its composition and molluscs fauna, together with the upper part of the terrace sequence studied earlier, makes this section the most studied Upper Pleistocene (vt-bg) terrace at this part of the Dniester valley.

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MICROTUS AGRESTIS AND MORPHOLOGICALLY SIMILAR SPECIES WITHIN THE UKRAINIAN AREA DURING THE LATE MIDDLE PLEISTOCENE

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The appearance of Microtus agrestis in the Late Bicharian fauna Kozi Grzbiet, Poland (Nadachowski, 1985) is the earliest reliable first-appearance event (FAE) for recent Microtus species; and what is of special importance, this is the FAE that is recognizable on the basis of purely morphological criteria (Nadachowski, 1984; Navarro et al., 2018; Luzi et al., 2019).

In different part of Europe, the replacement of the ancestral M. nivaloides with the new species M. agrestis occurred with different rates. Namely, the appearance of M. agrestis in Central Europe precedes the appearance of this species in Western Europe and in the northern part of Eastern Europe (Markova, Puzachenko, 2018). Then, in the second part of the Zavadivka (Holsteinian) stage of the Middle Pleistocene (Rekovets et al., 2007), M. agrestis appears in the south of Eastern Europe (the Southern Bug area).

In order to clarify palaeogeographical, stratigraphical and adaptive context of the replacement of M. nivaloides with M. agrestis, we have been studied the Middle Pleistocene arvalis-like voles from localities Ozerne 2, Morozivka 2 (Odesa region) and Medzhybizh (Khmelnitsk region), Ukraine. The morphometric study (mainly, according to Nadachowski, 1984) shows a continual transition between M. nivaloides and M. agrestis, which confirms close phylogenetic relations between these species. At the same time, no M. agrestis that would be more ancient than the Medzhybizh 2 (the Zavadivka stage of the Middle Pleistocene) has been detected. It confirms the difference c. 200 KY between FAEs of M. agrestis in Western and in Central Europe. It is quite probable that to the south from Medzhybizh, in the Northern Black Sea area, the process of the replacement of M. nivaloides with M. agrestis was even more impeded; thus, M. nivaloides and M. agrestis coexisted for some time within the Ukrainian area. The Azov area was outside of the zone of this transformation, although was the part of the range of M. nivaloides.

An important factor that slowing down the emergence of M. agrestis in the south of Ukraine may be the positive correlation between body size and the increasing water demand with the increase of temperature, similarly to M. agrestis of the Pleistocene of the Southern and Central Europe (Luzi et al., 2019). Medzhybizh M. agrestis decreased in size in the course of the climatic aridification that occurred between the deposition of the low and upper alluvial cycle of Medzhybizh 1. Further to the south, the selective pressure toward the size decrease for the optimization of water metabolism must have been even stronger; which must have been incompatible with other demands (thermal homeostasis, competitive success).

The replacement of M. nivaloides with M. agrestis corresponds to the scenario of phyletic speciation, with different rates of the process within different parts of the (future) species range.

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NEW IMPLICATIONS OF BIOSTRATIGRAPHICAL DATING BY LARGE MAMMALS ON MULTI-LAYERED PALAEOLITHIC SITE MOLODOVA V (UKRAINE)

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Molodova V is a famous multi-layered Palaeolithic loess site on the Middle Dniester, containing 18 cultural layers since Mousterian till Mesolithic (Chernysh, 1987). Although the Late Palaeolithic layers were precisely dated with 14C (Haesaerts et al., 2009), the lower part of the loess-paleosol, containing Mousterian industry (Layers 12, 12a, 11, and Horizons 11b, 11a, and 10v), remained dated just after the open radiocarbon dates (>40 kyr), made in 1980th. Accordingly, they were dated to the period between ≈55 and 33 kyr. In 2014, the lower horizons at the depths near 8.5-10.5 m (cultural Layers 10b-11b) were dated by TL to around 112±16 - 121±16 kyr (Łanczont et al., 2015).

I. Foronova made the first input to the biostratigraphical dating by the Proboscidea at the site. The scholar analysed several mammoth teeth from the cultural Layer 11, stored now in the Geological Institute (Russian Academy of Sciences). She came to the conclusion that mammoths from this layer occupy an intermediate position between the two thin-enamel forms: *Mammuthus primigenius* cf. *fraasi* (end of Saalian) and the later form *M. primigenius* ssp. (first half of Weichselian), and approximately it corresponds to the period from 100 (110) to 55 (60) kyr or MIS 5 a-d. (Foronova, 2014). In our opinion, the average meanings of plate frequency (PF) on 100 mm of a crown (7.5-8), length of one plate (PL) (12.5 mm), and enamel thickness (E) (1.4 mm), given by I Foronova, according to her own diagrams of the mammoth species and subspecies determination (Foronova, 2001), fit exactly to the meanings of *Mammuthus primigenius fraasi* and puts the Layer 11 to the end of Saalian (MIS-6). This fact does not contradict the Ivanova's statement about the cold climate in the time of this layer deposition (Ivanova, 1987).

At present, the cape, where the site locates, is strongly eroded by the waves and water currents of the reservoir of the Dniester Hydropower Plant. The loess-paleosol cliff now is just in few tens meter from the excavation pit. Every year, the water erosion destroys a few meters of the riverbank and outcrops numerous flints and bones. In winter 2020, when the water table in the lake was quite low, at the foot of the loess cliff, we collected some bone remains, including few mammoth and horse teeth. Among them, two lower molars (m3) belonged to *M. intermedius* (PF=7; E=2.2 mm) (probably from the same individual), and one to the thin-enamelled form, called by Foronova as *Mammuthus* sp. (PF=7; E=1,4 mm). One more tooth, collected at the same place previously, belongs to the individual close to the *M. chosaricus* (PF=6; E=1.9 mm). The measurements were done according to the standard methods of the mammoths species determination (Dubrovo, 1960; Garutt and Foronova, 1976).

The measurements of horse teeth, according to the methods by (van Asperen, 2012), fit to the meanings close to *Equus mosbachensis* and *E. achenheimensis*, both correlated with MIS 9.

The obtained data evidence about the presence in the sequence sediments dated much older than it was considered before, up to MIS-9 (337-300 kyr BP). As the bone accumulations at the site origins mainly from humans' activity, we can expect the finds of the industries older than Mousterian in some cultural layers that probably are bedded beneath the Layer 12.

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PRELIMINARY RECONSTRUCTION OF MAMMAL ASSEMBLAGE EVOLUTION IN MIS6–MIS1 STAGES IN THE MIDDLE EUROPEAN CENTRAL (NORTHERN PART) BIOREGION: IN SEARCHING OF STEADY/UNSTABLE STATES OF THE REGIONAL ECOSYSTEM

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Keywords: *mammals, Late Pleistocene, global climate*

The Late Middle Pleistocene–Late Pleistocene–Holocene (MIS6–MIS1, ~ 175–4 kyr BP) evolution of European mammal's fauna (excluding bats) was first explored based on data from 425 dated localities situated within the Middle European Central (Northern part) bioregion. The latter includes the territory of Poland, Lithuania, Belarus (entirely), Latvia (most of the territory) and (partially) - northeastern Germany, north of Czech Republic, northern part of Ukraine, southwestern Estonia, and Russia (central and western regions of the European part of the country). All the data (106 species "presence – absence") were aggregated by 34 time intervals (time scale with unequal beams). We obtained a generalized two-dimensional model of fauna composition changes. The main (first) coordinate of the model correlates with the species richness variation and the global climate ($\delta^{18}O$), and the second one – with the geologic age. The model describes the transitions from MIS6 to MIS5e, from MS4 to MIS3, from MIS3 to MIS2, and finally from MIS2 to MIS1. The temporal faunal complexes were in steady states between irreversible unstable transitional states. The time succession of steady states reflects the irreversible evolution of the regional mammal assemblage between the end of the Middle Pleistocene and the Holocene. We assume three waves of extinctions (at the regional level): MIS4 (~ around 75 kyr BP), MIS2 (~ 23–20 kyr BP), and at the boundary the Pleistocene and the Holocene (~ 12.5–9 kyr BP). The "Last Glacial faunal assemblage" was formed at the beginning of MIS3 in this bioregion, and it lasted until the Younger Dryas climatic event.

20 000 YEARS CLIMATIC RECORD FROM CENTRAL AND WESTERN HIMALAYA USING LAKE SEDIMENTS AND CAVE DEPOSITS

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Keywords: *Himalaya climate, Last Glacial Maxima*

The reconstruction of last ~20,000 years climatic anomalies is done by using the speleothems and lake sediments from the Central and Western Himalaya. Generally, the climatic fluctuations in the Himalaya are controlled by the variations in South Asian Monsoon and the cyclonic storms associated with the midlatitude subtropical Westerly Jet, referred as Western Disturbances (WDs) due to its topographic height and unique geographical position. The long term proxy records from the Himalayan region display a large variation during the last glacial and interglacial cycles. These events of glacial and interglacial cycles exhibit a vast diversity regionally from west to east; this is due to the diverse precipitation within Himalayan regions. Although the South Asian Monsoon circulation influence the entire Himalaya during the monsoon precipitation escalating eastward with additional impact of WDs during the winters, which decreases eastwards. The evaluation of long term proxy records from Central and Western Himalayan regions indicate a widespread prolonged phase of cooling event, representing the large expansion of glaciers around 20,000 to 18,000 yr BP, which corresponds well with the global cooling event known as Last Glacial Maxima (LGM ~20,000 to 18,5000 yr BP), in contrast to this lowest upwelling has been recorded from Arabian Sea indicating weaker monsoon which clearly signifies the role of stronger WDs during LGM over Himalaya. The proxy data also reveals another phase of cold dry spells spanning between ~15,000 to 14,000 yr BP from Trans-Himalaya and Tibet indicating strong WDs during this period. Furthermore, two prominent events representing weakening of Indian Summer Monsoon and strengthening of westerly influence between ~13,300 to 11,500 and ~8,700 to 6,000 yr BP corresponding with globally known events of Younger Dryas and an abrupt global cooling event in the northern hemisphere regions around ~8,200 yr BP subsequently. Our data suggest a climatic oscillation between ~6,000 to 4,000 yr and much younger speleothem records of $\delta^{18}O$ spanning the last ~4,000 years shows a phase of aridity with declined precipitation from ~4,000 to 3,500 yr BP. The last ~2,000 years record manifest two significant climatic anomalies: the warming phase "Medieval Warm Period (MWP ~1080-1160 AD) and the relatively cold Little Ice Age (LIA ~1500 - 1850 AD). The stalagmite record shows a rapid growth during 830 to 910 AD, most likely the lower part of Medieval Warm Period (MWP), and 1600 - 1640 AD, the middle part of Little Ice Age (LIA). The Inter Tropical Convergence Zone (ITCZ) was located over the cave location during wetter/warmer conditions and might have shifted southward causing the depleted precipitation over the study area.

LATE PLEISTOCENE-EARLY HOLOCENE FAUNA OF MAMMALS IN FERGANA VALLEY (BASED ON STADY OBISHIR-5 COLLECTION)

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Keywords: *Late Holocene, Early Holocene, mammals, Central Asia*

The Obishir-5 is a rockshelter located in south Kyrgyzstan, at the southern margin of Fergana Valley. The site was discovered in 1965. Recently, qquestions about the spread of Early Holocene cultures trough Central Asia have caused the resumption of complex excavations in the Fergana Valley. Re-excavations at Obishir-5 were started in 2015 by a joint Russian-Kyrgyz archaeological expedition. The purpose of study was to clarify the stratigraphy, obtain samples for absolute dating, and recognize the palaeoecological context of the human occupation.

During 2015-2019 seasons, the total area of 22 m2 was excavated. The Quaternary succession at Obishir-5 comprises mostly talus deposits essentially represented by matrix-supported diamictons of different textures. The skeleton consists mainly of fresh and weathered limestones clasts, shale clasts and rounded pebbles. Several stratigraphic units were distinguished on the basis of differences in colour, consistency, limestone clasts amount and accumulation of boulders. We subdivided the sequence into six main units (layers 0 to 5, downward), some were then subdivided into subsequent sublayers. The overall structure is characterised by the layers dipping from the inside of the rockshelter toward SW and a large number of animal burrows.

The layers 5-4 are dated to Late Pleistocene, around 13 ka BP, the layers 3-2 to Early-Middle Holocene, around 10-7 ka BP, the layer 1 represents Bronze Age to Middle Ages. Numerous remains of large mammals were found in the layer 1. They belong to domestic animals: goat, sheep, cow and horse. The most part of the assemblage belongs to the group Ovis-Capra. The collection of small mammal remains is plentiful in the layers 2.2-2.3. It is represented by three orders: Chiroptera (Myotis cf. blythii, Myotis sp.), Lagomorpha (Lepus sp., Ochotona sp.) and Rodentia (Spermophilus sp., Allactaginae, Alticola argentatus, Ellobius ex gr. tancrei, Ellobius sp., Cricetulus migratorius, Meriones cf. libyscus, Apodemus sp., Mus cf. musculus, Rattus sp.). Data of the fossil small mammals indicates the predominance of mountain-steppe habitats in the area of the Obishir-5during the sedimentation. Forest and shrubs could growth in wet lowlands and along mountain streams. Also in the area there were rocky taluses, salt marshes and rubble semi-deserts.

Most likely due to the isolated geographic position of the Fergana Valley, the fauna of small mammals did not undergo serious changes. Fossil fauna contained species which are recently common in the territory of Kyrgyzstan.

At the moment, Obishir-5 is a unique object in the western part of Central Asia, which has a continuous accumulation of cultural horizons from the Upper Pleistocene to the Holocene and present time.

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LATE PLEISTOCENE CRYOGENIC UNITS AND COLD HYDROMORPHIC PALEOSOLS IN THE NORTH OF WEST SIBERIA AS A KEY TO CORRELATE ANCIENT PERIGLACIAL EUROPEAN ENVIRONMENTS AND PROPERLY CRYOGENIC SIBERIAN ENVIRONMENTS

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Keywords: *cryogenic units, cold hydromorphic paleosols, Siberia, environments*

Within the new scenarios the northern part of the West Siberian Lowland persisted free of continuous ice sheets at least since the Marine Isotope Stage (MIS) 6; however the authors share the concept that this region was never occupied by ice sheets all over the Pleistocene. This revision implies development of non-glacial surface processes in this region during the Quaternary. Contrary to the southern part of West Siberia where continuous stratified loess mantle was developed, in the north of the West Siberian Plain the sedimentation was more heterogeneous and patchy: fluvial, lacustrine, eolian deposits form a complex mosaic largely controlled by local geomorphic factors. On the other hand, horizons generated by cryogenic processes and paleopedogenesis are spread much more uniformly. They are specific for certain chronological intervals and thus could serve as reliable stratigraphic markers for inter-regional correlation. At present 3 major Late Pleistocene pedostratigraphic levels are identified and studied, and some of them accompanied by the indicators of cryogenic processes in the sedimentary sequences of the high river terraces on both sides of the Siberian Uval, a highland at the right-hand Middle Ob' River's bank. The lowest level identified in the Middle Ob' terrace sections Kiryas and Belaya Gora yielded U/Th dates 100–120 ka BP and thus is attributed to the MIS5 thermochrone. It is represented by a pedocomplex in which the lower paleosol unit has micromorphological signs of clay illuviation (indicative of taiga pedogenesis) whereas the upper one consists of the peat and gleyic horizons – the product of cryohydromorphic pedogenesis. (We correlate this level with Mezin pedocomplex of the East European loess sequences). The second (intermediate) pedostratigraphic level lies above the MIS5 level being separated by the alluvial sediments containing dropstones. Its paleosols have 14C-dates from the soil organic materials in the range 25–35 ka BP and thus correspond to MIS3. These paleosols show macro- and micromorphological features of redoximorphic processes and frost action indicative of soil development under tundra-steppe ecosystems with permafrost. (We correlate this level with the Bryansk paleosol of the East European scheme). The third pedostratigraphic level corresponding to the end of MIS2 (14C-dates – 10–16 ka BP) was identified in the uppermost parts of the high terrace sections of the Taz and Nadym rivers' basins. This strongly gleyed paleosol is presented by pedosediments filling large polygonal ice wedge casts. In some profiles at least two stages of the ice polygonal wedge development were identified. (We are to associate this paleosol development with the warming events at the end of MIS2, its analogue in the Eastern Europe could be Trubchevsk paleosols). Such a sequence may be correlated with the Vladimir and Yaroslavl cryogenic horizons of the East European scheme.

STRATIGRAPHIC DISTRIBUTION OF THE LARGE QUATERNARY MAMMALS ON THE TERRITORY OF WEST SIBERIA

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Keywords: *Quaternary large mammals, Western Siberia, Mammoth faunal complex, biostratigraphic*

New studies of the geological distribution of Quaternary large mammals from locations in Western Siberia show a number of stratigraphic features:

1) the established taxonomic diversity of the seven faunal complexes in the Pleistocene is very uneven. It is due to the extremely small number of remains of large mammals in the Eopleistocene deposits of Western Siberia and reflects an insufficient degree of study. The species diversity reaches its maximum for the Mammoth faunal complex, and the minimum is for the Razdolian complex;

2) the level of taxonomic differences between the Podpusk-Lebyazhie and Razdolian complexes is significantly higher than between the complexes established for the Neopleistocene;

3) for faunal complexes of the Neopleistocene, rather gradual (with a high degree of continuity) changes in taxonomic diversity are observed;

4) mounted at 2.6 million years the lower boundary of the Quaternary biostratigraphic, in large mammals, is under the early complex in Podpusk-Lebyazhie complex (Sands of Irtysh suites location Lebyazhie 2 and Podpusk). The mammalian finds noted By I.A. Vislobokova in the underlying clays (Lebyazhie 1) are attributed to the lower Piacenza, and the latest Pliocene mammalian complex for Western Siberia is the Kyzyl-Aigir complex, obtained from deposits of the Seletinskaya formation;

5) the new position of the lower boundary of the Quaternary coincides with the appearance in Western Siberia of important phylogenetic lines of Quaternary large mammals Archidiskodon-Mammuthus and Equus. The boundary between the Eopleistocene and Neopleistocene is marked by the appearance of the genus Bison, Praeovibos-Ovibos, Cervalces-Alces, and the horse line E. mosbachensis-E. gallicus;

6) Podpusk-Lebyazhie complex of large mammals has a General similarity with the Eastern European Khapry complex at the level of some common genera and species (Archidiskodon meridionalis gromovi, Paracamelus gigas, Equus livenzovensis, Elasmotherium sp., Pachycrocuta sp., Homotherium sp., Eucladoceros sp.). The systematic position of some taxa from the Podpusk-Lebyazhie complex Requires clarification (hyenas, homoteria, elasmotheria, deer). At the same time, such relicts as mastodon (Anancus alexeevae) and hipparion (Hipparion moriturum) are characteristic of the Khapry complex. These differences suggest that the transition from the Hipparion supercomplex to the Quaternary supercomplex in Western Siberia occurred earlier than in Eastern Europe and the Baikal Region;

7) according to V.S. Zazhygin small mammals, the Mukkur and Karagash faunas are distinguished between the Podpusk-Lebyazhie and Razdolian complexes. The Karagash fauna has no analogues in Europe and Asia and is associated with the very end of the Gelasia (the Olduvei paleomagnetic episode). For large mammals, this interval, as well as the entire early Calabrian period, is not currently characterized;

8) Razdolian complex for large mammals is currently not possible to divide into stages, due to the significant rarity of localities of this age and the scarcity of available material, while for small mammals V.S. Zazhygin distinguishes three stages;

9) faunal complexes of the Neopleistocene of Western Siberia have almost complete similarity (more than 90%) with the same-age Eastern European complexes of large mammals;

10) for the beginning of the middle Neopleistocene (MIS 9-11), the Irtysh faunal complex with the type locality Grigoryevka (Pavlodar region) is proposed. The species

composition of the complex is compared with the Singil complex of Eastern Europe;

11) for Western Siberia, a new position of the border between the Khazar and Mammoth faunal complexes at the MIS 5 – MIS 4 level is proposed. These changes are based on the presence of two dominant representatives of the Khazar fauna in the Kazantsevo deposits – Mammuthus trogontherii chosaricus and Stephanorhinus kirchbergensis. In this regard, the volume of the Khazar faunal complex is estimated from Samara (MIS 8) to Kazantsevo (MIS 5) time, and the Mammoth faunal complex from Ermakovo (MIS 4) to Sartan (MIS 2) time;

12) the extinction of the dominant Mammoth fauna taxa within Western Siberia occurred differentially for different species and for the same species within the territory. The process began in the second half of Karginsky time (about 40-45 thousand years). The extinction was not accompanied by Vicariate species substitution, as in previous epochs, which led to the destruction of the paleoecological structure of the fauna that existed for about 7 million years (since the beginning of the Hipparion fauna).

GEOPHYSICAL IMAGING OF KARST CONDUITS EVOLVED WITHIN LOWER PALAEOZOIC MARBLES (SUDETES, SW POLAND)

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Keywords: *karst, 3D caves models, Electrical Resistivity Tomography, Ground Penetrating Radar, LiDAR DTM*

Karst caves evolved within Cambrian-Ordovician strongly folded metamorphic basement of Orlica-Śnieżnik Dome (OSD) in the Sudetes (Bohemian Massif, Central Europe) were investigated with an application of non-invasive, geophysical prospecting. We applied both Electric Resistivity Tomography (ERT) as well as Ground Penetrating Radar (GPR) techniques. Resultant geophysical images have been combined with 3D models of karst conduit systems obtained through paperless cave mapping (DistoX) supplemented with structural measurements (faults, joints) and LiDAR-based digital terrain model (DTM). We tested three different sites of interest: Niedźwiedzia Cave (Śnieżnik Massif), Radochowska Cave (Złote Mts.) and Solna Jama Cave (Bystrzyckie Mts.), all of which developed within lower Palaeozoic marbles of Stronie Formation. Radochowska Cave and Solna Jama Cave represent shallow, paleophreatic caves which formation was strongly associated with local water table changes during the Neogene. Niedźwiedzia Cave represents a more complex karst system speleogenesis, including both phreatic and vadose conduits with remarkable in size chambers (Kasprzak & Sobczyk, 2017).

Interpretation of geophysical imaging have been supplemented with detailed cave 3D models and LiDAR DTM data and allowed to distinguish interference areas associated with underground karst conduits. Basing on results obtained for the areas characterized by known karst conduits distribution, potential areas of unknown underground voids have been recognized.

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THE HUMAN-ENVIRONMENT RELATIONSHIP BASED ON PALEOECOLOGICAL RESEARCH AT A MULTICULTURAL SITE IN SMÓLSK (KUYAVIA, CENTRAL POLAND)

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Keywords: *paleoecological research, multicultural settlement, palynological analysis*

The Smólsk site, located in the eastern part of the Kuyavian Lakeland, was subjected to archaeological rescue excavations. The entire area, extending on several hectares, makes a settlement complex exceptionally abundant in traces of settlement, particularly Neolithic, even in the earliest chronological horizons.

The multicultural settlement in Smólsk covers the surface of a morainic plateau, however its nearby surroundings showed a strongly diversified in a landforms, plants and soil covers. Typical archaeological studies were accompanied by preliminary interdisciplinary research in the field of environmental archaeology. The south-eastern peripheries of the site include a kettle hole, developed within a tunnel valley, presently filled with organic deposits. Drillings, carried out in this area revealed presence of thick lacustrine and wetland deposits. The obtained, nearly 10 m thick profile of these sediments provide basis for numerous palaeoecological analyses. These sediments, with the oldest parts originating most likely from the end of the Late Glacial, bear a history record of changes in the palaeolake environment, climate, vegetation during the period of human colonization of the area since the Palaeolithic until the present.

Palynological analysis have allowed to conclude that the tree stand, surrounding the study site included pine and birch as well as deciduous trees of higher temperature requirements, such as oak, elm, lime and shrubs of hazel. Herbaceous vegetation was typical of humid habitats (Filipendula, Thalictrum, Solanum dulcamara). Cereals were planted in the area from the Early Neolithic.

Results of plant macroremain analysis showed that in the Neolithic the area included a relatively deep basin with the shores overgrown by communities requiring high trophic conditions. Nitrogen-rich habitats were abundant in Urtica dioica. Periodic fluctuations in the water level may have involved the appearance of communities similar to the present day Rumicetum maritimi association, with Rumex maritimus and Ranunculus sceleratus, on the dried shores. The presence of only infrequent remains of trees and shrubs is

likely to indicate either deforestation or an intensively developed swamp belt, hindering the supply of terrestrial plant remains into the basin. Malacofauna identified in the top part of the palaeolake profile includes terrestrial species, particularly forms typical of open habitats with variable humidity, accompanied by aquatic molluscs, mainly taxa characteristic to periodic basins. The dominance of littoral Cladocera suggests that water level was low or the lake shore was close to the sampling place. The most dominant were littoral macrophytes / sediment-associated taxa. However, there was also the increase in abundance of sediment-associated taxa. Their presence may reflect inorganic matter of terrestrial origin supply into the lake. The results of the geochemical analysis has provided information about the main sedimentation processes in the basin.

The obtained results allow for the detailed reconstruction of natural environment evolution as well as human occupation environmental conditions in the whole Holocene and also they show the record of human impact from the Early Neolithic.

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ARCHAEOZOOLOGICAL ANALYSIS OF IGREN' 8 AS AN EXLUSIVE MESOLITHIC SITE OF KUKRECK CULTURE

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Keywords: *archeozoology, Mesolithic, Kukreck culture*

The archaeological site Igren' 8 is a settlement of Mesolithic hunter-gatherer tribes of Kukrek culture. The settlement is located in close vicinity to the city of Dnipro, the Middle Dnieper area of Ukraine. The earliest sites of Kukrek culture were located in the territory of the Crimea peninsula and the northern Black sea region. As time progressed, Kukrek tribes appeared in Lower and Middle Dnieper areas. The unique of this site is that 10 pit-dwellings were found, being constructed in the 8th - 7th millennia BC. The sample comprises more than 3,000 specimens of animal bone. The present study focuses on revising the animal's osteological material according to modern archaeozoological techniques. Due to involvement of dedicated experts, it was possible to specify classes of animals. The species composition of this collection is typical for mixed landscapes. Among them, game animals like aurochs deer, roe deer, as well as fur animals like fox, wolf, and hare were of great importance. Hunting for large game animals was complemented by fishing, hunting for waterfowl and turtles. The study findings are related to seasonal fluctuations of the settlement, the hunting specialization of its inhabitants, details of taphonomy and traceology of the bones found. This research confirmed the wintertime activity in the settlement and clarified the periods of its seasonal activity. The findings of bone and antler tools prove the past value of the animal-derived type of production. The results of the comprehensive analysis of all findings at Igren' 8 illustrate the variability of the economic strategy of riverine area Mesolithic tribes

ON THE FEATURES OF THE RHYTHMICS OF CLIMATE HUMIDIFICATION IN CONNECTION WITH ITS EFFECT ON THE ENVIRONMENT, AND OF MIGRATIONS OF VEGETATION, FAUNA AND HUMAN

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Keywords: *Quaternary, climate change in humidity*

Most scientific studies of paleoclimatic content give preference to changes in temperature, while changes in humidity are either ignored or recognized as a controversial issue.

In the Ukrainian paleogeographic direction of research of the Quaternary period (M. F. Veklych), back in 1986, N. A. Sirenko and S. I. Turlo, based on paleo-pedological and palynological data, substantiated the presence of regular changes in climate humidity in comparison with temperature changes [2]. The conclusions about the existence of a regular correlation between changes in humidity and temperature of the paleoclimate were also confirmed by A. M. Karpenko for the ancient soils of the Jurassic and Triassic periods of Donbass (1980), as well as by the author, based on the results of studying the facies structures alluvial, submarine (estuary) and marine terraces, and also reflected in the geological structure and relief of paleogeographic phenomena (Veklych, 1995, 2000, 2011, 2018).

It should be noted that the history of the study of global changes in the humid-aridity of the climate is quite long (it is at least a hundred years old), and there are still supporters of two opposite views - either its synchronicity, or meta- and polychronous its changes in different climatic zones of both hemispheres. (Berg, 1947; Gumilev, 1966). The results of the studies mentioned above prove, nevertheless, the reliability of the global nature of changes in humidity, as well as the fact that temperature and humidity rhythmics are aspects of a single climatic rhythm.

Climate humidity changes are an integral part of the climatic rhythm. In fact, changes in humidity and temperature are aspects of a single rhythm, however, there are significant differences between these components in the course of changes. The rhythm of humidity begins with a sharp increase in humidification at the end of the cold beginning of the warm stages and then gradually decreases towards the end of the cold stage, that is, until the end of the "warm-cold" rhythm. At the same time, for humid and arid belts, the nature of the intensity of these changes is different, but this (cyclical) nature of changes is still global in nature (Veklych, 2018).

It should be added that such a staged-temperature and cyclical-humidity climatic rhythm concerns global paleoclimatic rhythms of all ranks. Such conclusions, on the one hand, expand the understanding of the regularities of paleoclimatic rhythmics, and on the other hand, provide additional methodological frameworks for modeling the migration of biota and humans in the Quaternary.

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BOVIDAE FROM THE LATE MIDDLE PALAEOLITHIC SITE AT HALLER AV. IN WROCŁAW, POLAND

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Open-air site at al. Haller Avenue in Wrocław, SW Poland, is known above all for two Middle Palaeolithic cultural levels, dated to MIS 5a-MIS 5c and MIS 3. Among the lithic artefacts the remains of fauna were recovered. However, so far, no separate taphonomic studies of the biological remains have been undertaken.

The paper aims to answer the question of whether the bovid remains from both levels of Haller Av. site are the result of human activity or a substrate of the geological context. We tried to resolve the problem using several methods. Initially, we studied the spatial distribution of bovid and other species bone remains with GIS tools to determine if they were involved in river displacement. Then we analysed the collection in terms of body profiles, age and traces of carcass partition. On this basis, we concluded that the finds from Haller Avenue site are associated with hunting practices, and more specifically with the treatment of bovid carcasses. Although we found no direct evidence to prove it, we consider the relationship of bovid remains with the existence of the killing site in the close vicinity.

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TWO MODELS OF GRAVETTIAN SUBSISTENCE STRATEGIES IN CENTRAL EUROPE

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Keywords: *Gravettian hunters-gatherers, mammals remains, zooarchaeological studies, cut marks*

Between 30,000 and 20,000 years ago, rapid climatic changes occurred in Europe as the Scandinavian ice sheet expanded. Not only did palaeoenvironments change, but human societies also transformed themselves. A considerable cultural unification occurred in Europe, which resulted in the origin of the widespread so called Gravettian technocomplex. Throughout the next millennia, Gravettian hunters-gatherers occupied a huge part of Europe, in an area covering several million square kilometres, stretching from the Atlantic Ocean to the Russian plains.

In Central Europe the better-known Gravettian open-air sites are located in Austria, Czech Republic, Slovakia, and Poland. The Gravettian technocomplex includes, among other phases, the earlier Pavlovian and later Late Gravettian. Zooarchaeological studies of avian and mammalian remains from sites in Austria, Czech Republic, Poland, and Slovakia provide glimpses into human life in Central Europe at ~30-20,000 years ago. The studies allow us to reconstruct and compare subsistence strategies, animal food resources from various sites and different periods of the Gravettian.

We were analysed osteological material from the Pavlovian sites: Dolní Vistonice I and II, Pavlov I, II, and VI (Czech Republic), and from Late Gravettian sites: Kraków Spadzista, Jaksice II (Poland), Willendorf II (Austria) and Moravany-Lopata II (Slovakia). The Pavlovian animal bone assemblages from South Moravia (Czech Republic) are dominated by animals that were small (birds, hares, foxes) and medium size (wolves, reindeer, wolverines), although bones of large mammals also occur (bears, cave lions, horses, and mammoths), showing the wide spectrum of the hunters' prey choices. It should be point out the presence at Moravian sites of cut marks made during carcass dismembering different carnivore taxons, both small (foxes), medium (wolves, wolverines and large (bears, cave lions) indicating these group of mammals was also a source of food for Gravettian people. Late Gravettian localities are different in that they show an apparent trend towards specialization in hunting. Clear exemplars are the sites Kraków Spadzista, Milovice I, and Moravany-Lopata II, where remains of mammoth and reindeer dominate the osteological assemblages. Another visible distinction is that Pavlovian sites were occupied for longer times and were semi-permanent types of settlements, while Late Gravettian localities were occupied for short times.

Significant attribute of Gravettian hunters-gatherers life, both during Pavlovian and late Gravettian, was hunting of large and dangerous carnivores, bears and cave lions. Presence remains of these animals at many Gravettian sites shows that they hunting was not accidental but intentional.

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