Description of the main research directions investigated by the institute

The IAP carries out its research activities within four teams. These teams overlap with the administrative structure of the IAP (see Fig. 1).

Figure 1. The IAP's research teams.

2. 1. Department of Prehistorical Archaeology

2. 1. 1. Research goals

The original constitution, as well as current existence of the Department of Prehistorical Archaeology (hereinafter referred to as the "Prehistoric Dept."), is based on the need to gather researchers focusing on the prehistorical and early historical archaeology (i. e. the Migration Period). The primary focus of the Prehistoric Dept. is on basic theoretical research. Research approaches of individual researchers have been and deliberately are divergent, which brings both a highly diversified view of the interpretation of particular prehistoric eras and, at the same time, allows to address changes in methodological and theoretical trends. The targeted topics significantly contribute to the enrichment of the historical and cultural basis, on which the identity of the population of the Czech Republic has been built.

As a whole, the Prehistoric Dept. primarily focuses on a stage of the past, the understanding of which entirely relies on the acquisition and correct interpretation of archaeological sources as there are no written sources available (Prehistory) or their number is a very limited (Protohistory). The Prehistoric Dept. is structured in a way that, with the exception of the Palaeolithic and Mesolithic, at least one specialist is available for each basic chronological prehistorical unit (Neolithic, Aeneolithic, Bronze

Age, etc.). Their task is to study the relevant topic in detail at the European level, and, thus, serve as a kind of national authority and arbitrator. The department successfully fulfils this goal as it represents, within the context of the national archaeological discourse, the absolute top of the field. The number of awarded grant projects, the number of publications and the realised and planned scope of foreign co-operation corroborate this fact.

The Prehistoric Dept. also includes a branch office in Kutná Hora, which evolved from the former archaeological field expedition to the Neolithic settlement at Bylany located nearby. The branch office in Kutná Hora is responsible for conducting archaeological heritage management in the regions of Kutná Hora and Kolín. In addition to the standard set of such activities, the branch office tests new methodical and methodological procedures of fieldwork. Its contribution also enabled to conduct the most extensive one-off fieldwork campaign of the IAP, i. e. the construction of a road bypass of the city of Kolín. Archaeological data obtained in the course of excavations has become part of the research in the form of grant projects and publications of the Department. This branch office of the Prehistoric Dept. also manages an extensive research data collection of one of the most extensive fieldwork conducted at the site of the Neolithic settlement in Bylany near Kutná Hora; the data collection is quite unique at the European level. The branch office manages the storage of not only archaeological finds but also the data consisting of a database and a GIS system map. All parts of the database are available to experts from all over the world.

A significant part in the activities of Prehistoric Dept. represents the administration of archaeological sources that have been obtained and acquired in the course of its activities for the period of their technical processing and scientific evaluation, before handing them over to a collection-creating institution.

2. 1. 2. Prehistoric Dept. research groups

Researchers and PhD students at the Prehistoric Dept. focus on three larger thematic areas, which are, traditionally, defined according to their chronological specialization. Furthermore, partial projects are addressed within each area.

“1A-Neolithic” - Neolithic is the first and chronologically earliest set of issues, framed by a single prehistoric stage. Specialists in settlement archaeology (including ceramics and the stone industry), anthropology of archaic societies and digital morphometry, the phenomenon of the origin of agriculture, and Neolithic circular enclosures co-operate on joint projects.

“1B-Dawn of the Bronze Age” - The second topic conceived in such a broad way is the archaeology of the turn of Aeneolithic and Bronze Age periods. Partial topics include copper artefacts, cultural contacts and distribution of artefacts, depots, and the archaeometallurgy of copper and bronze.

“1C-Protohistory” - The third thematic horizon focuses on the turn of Prehistory and Protohistory. The group consists of co-operating specialists in the field of the Hallstatt,

the La Tène and the Early Roman periods. They address, among other things, topics such as the establishment of elites in these periods, the political economy of later Prehistory, as well as the issues of the relationship between historical and archaeological sources.

“1D-Virtual Archaeology” - The Virtual archaeology group emerged from the Neolithic Virtual Museum project, which, after its completing, has remained active. In the last three years, the group has created a unique portfolio of know-how, as well as equipment comparable to the world’s top institutions. The group focuses on methods of registration and presentation of archaeological monuments in the virtual world. It also includes procedures such as terrestrial and aerial (drone) photogrammetry technologies, 3D scanning, advanced modelling methods, augmented and virtual reality.

2. 2. Department of Medieval Archaeology

2. 2. 1. Research goals

The main research tasks of Department of Medieval Archaeology (hereinafter Medieval Dept.) concentrate on the Early and High Middle Ages, and Post-Medieval period, i. e. historical periods that are of the utmost importance as they correspond with the creation of national and local cultural identities. As in other periods evaluated through archaeological methods, the primary sources are the remains of settlement structures and evidence of burial and material culture. Traditionally, this period is considered in terms of political history and researchers emphasise that it is a period when the first state units are being gradually constituted in our country, the society is gradually being Christianised, and finally, the early Czech state is established. Also, this particular phenomenon is taken into account in the research, which takes efforts to break out of the paradigms related to the historical development of our territory in the 20th century, revise the results of previous archaeological research, and expand the range of approaches to create an authority of the archaeological evidence, and, thus, contribute to the general discourse with new perspectives and approaches. Therefore, the interdisciplinary cooperation with the humanities, sciences and technologies represents a necessary condition so that we can perceive our country in a European context and better understand the processes related to the development of society and its cultural, religious and economic parameters.

The choice of currently investigated topics relies on finds of the IAP that manages the archaeological documentation of several important Early Medieval sites since the beginning of their research Connection of the archaeological research results and their setting within the broader Central European context represent the second important factor influencing the choice of topics. The topicality and contribution of the selected topics have been corroborated by the successful solution of projects awarded to our researchers by Czech and European grant agencies and foundations. A natural part of the professional work of the Medieval Dept. is the presentation of scientific results

to the general public through publications, exhibitions, audiovisual documents, and websites.

The current form of the Medieval Dept. was established in July 2017 by merging the existing Department of Medieval Archaeology and the branch office at Prague Castle. Until then, the branch office at Prague Castle had been part of the Department of Field Archaeology (focused on rescue excavations). Currently, the Medieval Dept. takes over the main tasks of both units and, therefore, continues in the traditional development before 2003. It consists of a primary team and two field offices located on particular sites (Prague Castle, Vyšehrad).

2. 2. 2. Medieval Dept. research groups

Researchers and PhD students from the Medieval Dept. are integrated within a core group, one team, and two workplaces.

“2A-Core group” - The core group consists mainly of researchers of the original Department of Medieval Archaeology who were its members prior to the reorganisation in 2017. Their research covers a wide range of activities, including research into small material culture, burial grounds and Early and High Medieval central places.

“2B-Prague castle” - From a scientific point of view, the branch office systematically focuses on topics related to the structural development of Prague Castle, its material culture, the position and importance of Prague Castle in the context of Bohemian and European history, as well as history of research; last but not least, the issues of the history of technologies (especially construction technologies, glass, jewellery and ceramics) are investigated. The branch office publishes the Castrum Pragense series and systematically participates in the application of the archaeological research results of Prague Castle in public space.

“2C-Vyšehrad” – Currently, the field office monitors construction and earthworks conducted at the Vyšehrad National Cultural Monument (NKP in Czech), evaluates the find units and documentation (primarily with regard to the scientific projects addressed), and manages the find funds. Any other tasks that go beyond the scope of the current agenda are ensured primarily from grant projects.

“2D-Medieval castles” - The Castle Research Centre was established in order to fully utilise the potential of the work left behind by the prematurely departed Prof. Tomáš Durdík. The merging of finds that had been obtained from thirty archaeological sites and their transfer to the relevant collection-creating organisations has been completed in close co-operation with the University of West Bohemia. Currently, field documentation is being consolidated, and data are being prepared and structured for future projects.

2. 3. Department of Natural Sciences and Archaeometry

2. 3. 1. Research goals

The main research topic of the Department of Natural Sciences and Archaeometry (hereinafter referred to as the “Natural Sci. Dept.”) encompasses the relationship of man to natural resources, the process of their acquiring, transformation and cultural and economic consequences resulting from such processes for human society in different periods, environments, and economies (hunting-gathering, agricultural, pastoral, etc.). Within the framework of the topics mentioned above, the Natural Sci. Dept. focuses its attention on the crucial periods of cultural and economic transformations when subsistence strategies changed
(e. g. hunting-gathering to agriculture, changes in agricultural strategies) or new materials were being established (e. g. lithics, metals or glass). Issues addressed include subsistence strategies, intra- and inter-cultural contacts, mobility of artefacts and living individuals, and changes in the natural environment. Technological processes, issues of basic and advanced production and distribution of nutrients, raw materials, artefacts, as well as ideas and know-how, form an integral part of the research.

As far as the methodological approach is concerned, members of the Natural Sci. Dept. team strive to increase the narrative possibilities of archaeological data within various archaeological contexts, and also to study the influence of post-deposition processes on archaeological evidence. The rather unique character of the department lies in its structure as it is composed of specialists in various scientific disciplines and the overall character of the department is, thus, significantly multidisciplinary. The Natural Sci. Dept. does not, therefore, focus in principle on the cultural-historical interpretation of history, but follows exact interdisciplinary procedures in the acquisition, analysis and interpretation of data.

The Natural Sci. Dept. aims to contribute to topics related to the social and economic development of human societies through the development of internationally recognised methodological procedures applied to a wide scope of archaeological materials ranging from metal, stone, ceramics and glass to biological materials. The methodological intention of the department is to increase the interpretative possibilities of these sources within various archaeological contexts, as well as to study the influence of post-deposition processes on archaeological material sources.

Members of the department are mainly involved in current projects within the department; however, they also closely co-operate with other teams and researchers across the institute and are engaged in international projects as well. The department, focuses also on the establishment of larger synthesising or research projects that examine and interpret the fundamental issues of human ecology, technology and paleoeconomics.

2. 3. 2. Natural Sci. Dept. research groups

As part of the Natural Sci. Dept. research programme, the topics described above in the text are being assessed within the following thematic groups:

“3A-Environment and Society” - The group professionally focuses mainly on research and interpretation of human interactions with the natural environment. Its researchers focus on 1) the processes of human adaptation and use of natural resources, 2) subsistence strategies, and 3) changes in the natural environment and animal (including humans) and plant species habituating there. Scientific specialisations within the group are as follows: archaeobotany, palynology and pedology (geoarchaeology).

“3B-Osteology (Physical Anthropology and Archaeozoology)” - The group’s professional focus is the research of human and animal skeletal remains. Its researchers apply the following procedures: 1) physical anthropology and archaeozoology, 2) taphonomy, 3) geochemistry (i.
e. chemical and isotopic analyses), 4) DNA and aDNA, etc. The currently tested new discipline is 5) development of cementochronology for more accurate determination of the age of the deceased and its impact on the study of the demography of historical populations, and 6) advanced possibilities of dating biological materials.

“3C-Archaeogenetics” - The group focuses on the population history of Africa and Arabia, as well as topics regarding evolution and migration of anatomically modern humans from Africa and the influence of the Neolithic transition on the genetic structure and health of individual human populations. With its current research on genetic imprints, the group will bridge over the boundaries between traditional categories of scientific work in the humanities and natural sciences.

“3D-Archaeometry” - The group specialises in archaeometric methods applied to archaeological material concerning the development of historical technologies, provenance and mobility. Its researchers focus on the application of the most advanced methods and procedures (metallography, X-ray, XRF, SEM/EDS, (LA) MC-ICP-MS, etc.); methods and procedures are also realised in the form of interdisciplinary co-operation with specialised institutions such as the Faculty of Science, Charles University, University of Chemistry and Technology, Prague, Geological Institute of the CAS, Institute of Nuclear Research in Řež, Technical University of Liberec, etc. In terms of raw materials and archaeological materials, the activities concern five areas: 1) the development of textile production in Prehistory and the Middle Ages, 2) archaeometallurgical and archaeometric research of metal artefacts, 3) technological analyses of finds made of non-ferrous and precious metals, including corrosion processes, 4) topics related to the technologies and provenance studies of Prehistoric glass, and 5) technologies of the chipped industry of the Late Palaeolithic to Neolithic societies.

“3E-Restoration and Conservation” – The group carries out comprehensive treatment and conservation of finds obtained in the course of archaeological fieldwork. In addition to theoretical research in the field of processing and interpretation of finds, its

researchers specialise in 1) the metallography of metal objects, 2) conservation and exploration of tinned and silver items, 3) ceramic products, and 4) remnants of textiles and textile fragments preserved in corrosion products.

2. 4. Department of Information Sources and Landscape Archaeology

2. 4. 1. Research goals

Activities of the Department of Information Sources and Landscape Archaeology (hereinafter referred to as the “Info. and Landscape Dept.”) focus on topics closely related to the landscape and its utilisation as an archaeological source. The research of the Info. and Landscape Dept. concentrates on the formation of the landscape in the past, settlement history as seen in the long temporal and spatial perspective and the development of methods for obtaining archaeological data in a broad spatial scope. The Info and Landscape Dept.’s activities are specific because they include not only scientific research in the narrower sense, but also the systematic archaeological archiving and building and administration of a centralised information system of Czech archaeology in the sphere of the management of archaeological fieldwork and its results. This system, the Archaeological Information System of the Czech Republic (AIS CR), has been registered in the Roadmap of Large Infrastructures for Research, Experimental Development and Innovation since 2016. It is currently beginning to be a generally shared infrastructure used by most professional institutions in the Czech Republic and the general public.

Research of the Info. and Landscape Dept. focuses on archaeological sources in their broadest definition, i. e. the landscape and the past environment, through several thematic topics. The first topic encompasses the study of the settlement of Bohemia as seen in a long-term perspective through the so-called “big data,” i. e. extensive scientific databases (primarily Archaeological Map of the Czech Republic - AMCR, the AIS CR infrastructure core), environmental data sets, information obtained in the course of non-destructive fieldwork, etc. The topic also includes the social dimension of the landscape across periods, i. e. the landscape understood as the “environment gaining its purpose through man”, not just as the sum of natural elements and economic resources.

Theoretical research of the Info. and Landscape Dept. is closely related to the development of the AIS CR infrastructure. Thus, the Info. and Landscape Dept. concentrates specifically on: (i) the operation of AIS CR and creation of technical tools and organisational measures for more profound interconnection of the various parts of the system and other information sources outside the IAP (e. g. heritage care information systems, bibliographic databases, museum systems, international aggregators), including overall digitisation of research processes in
Czech archaeology; (ii) fieldwork activities of the department in the form of remote sensing (aerial prospection and documentation, for example by using drones), application of geophysical methods, surface surveys and collections and targeted archaeological excavations focusing on addressing long-term research, such as

documentation of extinct Prehistoric and Early Medieval enclosures, and methodological topics (for example, the study of transformation processes and so-called reflexive archaeology); (iii) the general cultivation of work with scientific data and their archiving by means of standardisation, workshops, suggestions for the IAP management and other organisations, evaluation of the quality of excavation reports, management of the IAP digital repository; (iv) the systematic supplementation of AMCR with data regarding previous fieldwork (it is estimated that the AMCR still lacks records of about 30% of archaeological events conducted on the territory of Bohemia), and important categories of other sites such as strongholds, castles, fortresses, burial grounds with tumuli, mining areas, etc.; and (v) processing old funds of the Archive of the IAP (incl. estate funds) and their utilisation to present the IAP to the scientific community and the general public.

The development of the Czech Radiocarbon Laboratory and the systematic creation of a database of radiocarbon data for Bohemia can be seen as a separate task (although also related to the creation of a research infrastructure). This topic is currently addressed by an extensive project called the “Research of ultra-trace isotopes and their use in the social and environmental sciences by applying accelerated mass spectrometry (RAMSES)” that is implemented in cooperation with the Nuclear Physics Institute of the Czech Academy of Sciences.

2. 4. 2. Info. and Landscape Dept. research groups

The team was constituted in its current form in the years 2016-2017 when the entire department was reorganised in connection with the concluding of several grant projects and the launch of others. The previous recommendations of the evaluation committee concerning the reduction of overlaps and the clarification of the focus of the sub-departments within the IAP were also taken into consideration. The staffing and its organisation have been optimised according to the needs of ongoing and promising research projects and maintenance of the research infrastructure.

“4A-Settlement and Landscape Research” - The group addresses research topics relating to the areas mentioned above in the text and manages several partial grant projects more or less connected with the AIS CR infrastructure. As part of their activities, the researchers utilise mainly spatial analyses, statistics and modelling, geomorphometry, reflexive archaeology and advanced methods of absolute dating in order to study the settlement development, central and supra-community areas, formation processes, climate development, and the social dimension of the landscape.

“4B-Archive” – The group deals with the management of the archive of analogue field documentation, both from a methodological, theoretical, as well as practical point of view, ensures the operation of the archive and cares for individual archive funds (text documents, photographs, plans, etc.), including their digitisation. The group’s activities are closely related to the processing of large estate funds, which need to be classified, their informative possibilities must be utilised as much as possible and presented to

the scientific community and general public for use. An essential task of the group also includes scientific evaluation and processing of the IAP's history and archaeology as a whole, either in the form of publications or other modern tools such as virtual exhibitions.

"4C-Digital Infrastructure" - The group focuses on the creation and management of digital information systems of the AMCR, the Digital Archive of the AMCR, the Archaeological Atlas of the Czech Republic, and others within the framework of the AIS CR infrastructure. The group closely co-ordinates its activities with the Institute of Archaeology of the Czech Academy of Sciences, Brno, as the infrastructure encompasses archaeological data from all over the Czech Republic and is closely related to the legal obligation of the IAP in the field of heritage management. The group is active not only in terms of data management, but especially in the development of advanced software applications and digital services, comprehensive international co-operation within several programmes (Horizon 2020, COST Action, Interreg Europe), and dissemination of FAIR Data and Open Science principles.

Research activity and characterisation of the main scientific results

Research in the Prehistoric Dept. in brief

Researchers and PhD students from the Prehistoric Dept. are divided into five (respectively six) research groups. Three groups are defined chronologically (1A-Neolithic, 1B-Dawn of Bronze Age, and 1C-Protohistory), and two methodically (1D-Virtual archaeology, 1E-Cross- cultural). At the end of the evaluated period, a sixth group was established focusing on archaeological fieldwork of Prehistory of non-European areas (1F-Beyond Europe). In addition, a branch office in Kutná Hora operates within the Prehistoric Dept.; its employees are responsible for carrying out archaeological heritage management in the region.

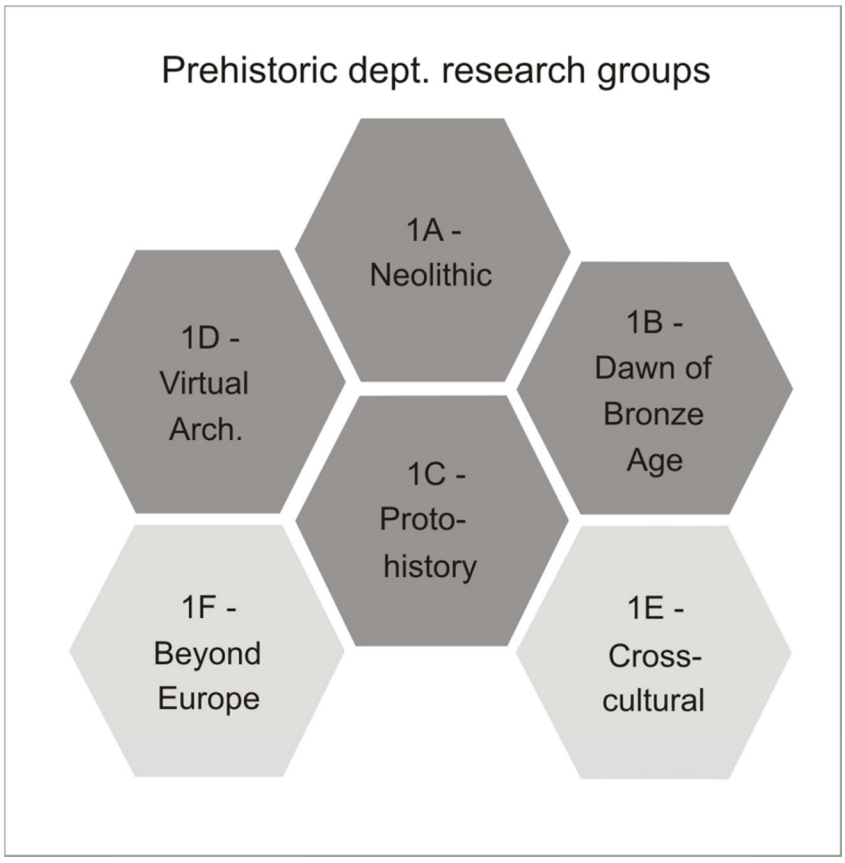

Figure 1. Prehistoric Dept. research groups.

"**1A-Neolithic**" - Neolithic research group was defined on the basis of a single historical period – the Neolithic and comprises the first and chronologically earliest set of topics. Specialists in settlement archaeology (including pottery and stone industry), anthropology of

archaic populations, digital morphometry, the phenomenon of the origin of agriculture, and rondels (circular ditched enclosures, Kreisgrabenanlagen) focus on joint projects.

"**1B-Dawn of Bronze Age**" - The transition between the Aeneolithic and the following Bronze Age represents the second theme of archaeological topics. Partial issues dealt with within this group are as follows: studies of hoards, migration, mobility, cultural contacts, distribution of artefacts, and their **'**archaeologisation**'**.

"**1C-Protohistory**" - The third thematic horizon focuses on the turn of Prehistory and Protohistory. The group consists of co-operating specialists in the Hallstatt, the La Tène and the Early Roman periods. They address, among other things, topics such as the establishment of elites in these periods, the political economy of later Prehistory and the problem of the relationship between historical and archaeological sources.

"**1D-Virtual Archaeology**" - The Virtual archaeology research group emerged from the Neolithic Virtual Museum project, which, after its completing, remained active (http://www.archaeo3d.com/). In the last three years, it created a unique portfolio of know- how, as well as equipment comparable to the world's top institutions in this field. The group focuses on methods of keeping records and presentation of archaeological monuments in the virtual world. This also includes the application of virtual tools in physical anthropology, as well as other procedures such as terrestrial and aerial (drone) photogrammetry technologies, 3D scanning, advanced modelling methods, augmented and virtual reality.

"**1E-Cross-cultural**" - This research group emerged at the end of the evaluated period as a spontaneous association of researchers seeking comparisons across the historical and geographical spectrum, as well as cross-sectional studies of cultural history. At the same time, they also try to determine the methodological and theoretical standards of such research. The IAP management decided to support the establishment of this group because the research direction is promising and intercultural research, as an approach, has been significantly underestimated in the Prehistoric Dept.

"**1F-Beyond Europe**" – This research group was set up at the end of the evaluated period to organise research activities focusing on field excavations of Prehistoric sites outside Europe. These field expeditions currently concern Turkey and, more recently, Sudan (a large international project within the Lumina Quaeruntur programme of the Czech Academy of Sciences entitled "Research on Mesolithic and Neolithic Adaptations in the Shaqadud Mountains").

The detailed evaluation of the research in the Prehistoric Dept.

"1A-Neolithic"

A four-year project focused on public archaeology and called "Archaeological 3D virtual museum. New technologies for the documentation and the presentation of a Neolithic settlement" (Project No. DF12P01OVV032) was completed. The following items belong among its outputs: virtual museum, gallery, certificated method and

map, several papers and book. Results of the project are available on the website: http://www.archaeo3d.com/

The technology of Neolithic pottery was addressed in a project conducted in co-operation with the University of Hradec Králové. It was possible to prove that ceramics in the early Neolithic period of Bohemia could only be fired by using bonfire structures. On the other hand, the connection between technological aspects and social or regional structures cannot be ascertained (R. Thér, A. Kallistová, Z. Svoboda, P. Květina, L. Lisá, P. Burgert, and A. Bajer. 2018. How was Neolithic pottery fired? An exploration of the effects of firing dynamics on ceramic products. *Journal of Archaeological Method and Theory*, https://link.springer.com /article/10.1007/s10816-018-9407-x, doi: https://doi.org/10.1007/ s10816-018-9407-x.

The project “Building Structures, Activity Areas and the Site Layouts of the Late Neolithic Settlement Areas” (5000/4900 - 4500/4400 BCE) addressed the topic of comparing Neolithic settlement with and without circular structures – the so-called rondels (Kreisgrabenanlagen), from the first half of the 5th millennium BCE. Consequently, a significant project supported by the NEURON Foundation followed; and it focused on the research of the so-called monumental constructions in the Late Neolithic period (first half of the 5th millennium BCE). A new hypothesis was proposed concerning the background of the group social hierarchy. Members of teams involved in humanities, as well as natural sciences, participated in the project; their collaboration culminated in the publication of a synthetic monograph published by Oxbow Books (J. Řídký, P. Květina, P. Limburský, M. Končelová, P. Burgert, and R. Šumberová. 2019. *Big Men or Chiefs? Rondel Builders of Neolithic Europe*. Oxford and Philadelphia: Oxbow).

A model macro-regional study focusing on the Neolithic settlement of the East Bohemian area (finished in the form of a PhD thesis and subsequently also a monograph) was conducted (P. Burgert, 2019. *Neolithic in Eastern Bohemia. Case study of its later development*. Prague: Academia).

A project focused on the study of the extraction and distribution of stone raw materials in the course of Prehistory, and their reflection in Neolithic communities (leading site: Bílý Kámen u Sázavy) has been launched and is still ongoing. The Faculty of Science of Masaryk University in Brno co-operates on the project.

The project “Lifestyle as an unintentional identity in the Neolithic” has been launched. It is still continuing in co-operation with the Faculty of Arts of Masaryk University in Brno and the Moravian Museum. It aims to analyse mobility and bioarchaeological indicators of diet in the Neolithic. Another project “International exchange of methodological experience in the study on the impact of emergencies on migration and economic strategies of the past human populations” was implemented in connection with the same topic. It was financed under the EU Operational Program Research, Development and Education Mobility. One PhD and a Post-Doc spent six and seven months on internships abroad, and one senior researcher spent six months abroad; moreover, one foreign Post-Doc spent eight months working at the IAP.

The analysis and interpretation of two fundamental Neolithic sites (Kolín, Bylany)

have continued, as well as the fieldwork in the region of Kutná Hora (rescue excavations conducted, for example in Bylany). The research specifically focused on monitoring formative processes at polyculture sites.

Researches engaged in the "1A-Neolithic" research group have also participated in important scientific collaborations focused on evaluating anthropological and genetic analyses of burial finds that came from Neolithic and Aeneolithic sites.

Researchers engaged in the Neolithic working group have also collaborated on archaeological fieldwork outside Europe. Their research focused, for example, on the analysis of Mesolithic, Neolithic and Chalcolithic stone tools from the territory of southern Turkey and central Sudan.
Publications of the **"1A-Neolithic"** from the list of I. stage of evaluation: no. 4, 8, 15, 17, 21, 22, 24.

"1B-Dawn of Bronze Age"

The first major topic is the transition between the Aeneolithic Period and the Bronze Age.

This research group comprises studies focusing on the beginnings of Central European metallurgy, Bohemian Middle Aeneolithic (including, among other things, publications and evaluations of fundamental material on the classical stage of Baden culture from Kolín, and publications concentrating on the phenomenon of Early Aeneolithic ditch enclosures).

The Early Bronze Age cemetery in Prague-Miškovice have been evaluated within the framework of this working group. The project included a comprehensive multidisciplinary assessment of the site, which was also supported by a grant awarded by the Czech Science Foundation (M. Ernée, No. 404/07/1408), preparation of a publication within the Alexander von Humboldt Stiftung scholarship (M. Ernée) at M. Luther University in Halle/Saale. The monograph was published in Germany by the German Archaeological Institute and Philipp von Zabern Verlag with significant financial support from the Alexander von Humboldt Stiftung (Michal Ernée et al. 2015, *Prag-Miškovice. Archäologische und naturwissenschaftliche Untersuchungen zu Grabbau, Bestattungssitten und Inventaren einer frühbronzezeitlichen Nekropole*. Römisch-Germanische Forschungen, Band 72, Philipp von Zabern, Darmstadt).

The project was followed by another large international project supported by the Czech Science Foundation (No. 16-14855S, *Mobility and social status of the Early Bronze Age population on the Amber Road. The testimony of the cemetery in Mikulovice*) with more than
30 participants from four countries - CZ, D, GB, FI) and focused on the analyses and publication of the essential Early Bronze Age cemetery at Mikulovice (in the form of several articles and a monograph). The monograph published within the scope of the project was published in 2020 (Ernée, M. - Langová, M. et al. 2020: *Mikulovice. Early Bronze Age Cemetery on the Amber Road* (Památky archeologické, Supplementum 21). Praha: Institute of Archaeology of the Czech Academy of Sciences, Prague).

The Early Bronze Age research also included analysis of the settlement structure in the north- eastern part of central Bohemia - the case study of a fortified settlement in Brandýs nad Labem-Vrábí. Michaela Langová, member of the Prehistoric Dept., also

defended her PhD thesis dealing with this topic. Furthermore, the researchers analysed the funeral activities at the site of Vliněves. Their interpretations were set within the context of the Early Bronze Age in Central Europe. In this connection, the research group initiated co-operation with the large OP RDE Project 'Ramses', which emphasised radiocarbon dating and interpretation of the results of measuring the content of selected stable isotopes.

In the given period, co-operation on the research of archaic European DNA was established and developed, in close co-operation with the leading foreign partner – the Max Planck Institute in Jena, Germany. Members of the "1B-Dawn of Bronze age" group participated in the ERC project "PALEoRIDER - Human Health and Migration in Prehistory" led by W. Haak. This co-operation has brought several excellent results, which we enlisted in the framework of significant large collaborations (studies in the journals Science and Nature).

As far as later stage of the Bronze Age are concerned, the researchers focused on the description and analysis of new hoards found. Their efforts resulted in a monograph (Chvojka,
O. - Jiráň, L. - Metlička, M. et all. 2017: *Nové české depoty doby bronzové. Hromadné nálezy kovových předmětu učiněné do roku 2013* / *New Bronze Age depots in Bohemia. Hoard finds of metal objects discovered until 2013*. Episteme - edition of the University of South Bohemia in České Budějovice. České Budějovice - Prague - Pilsen).

Our researchers also participated in the international project "Bronze Age Hillforts between Taunus and the Carpathian Mountains."

Evaluation of the most considerable discovered cemetery of Lusatian culture in Bohemia (the site of Čáslav - Na Stínadlech) has begun, as well as setting the obtained data and finds into a broader cultural context. This activity will continue further in the future.

Publications of the "1B-Dawn of Bronze age" from the list of I. stage of evaluation:
no. 12, 16, 18, 20.

"1C-Protohistory"

As far as the earlier stage of Protohistory is concerned, the researchers focused on Bohemia and Central Europe of the Early Iron Age in terms of the settlement hierarchy, centralisation processes and long-distance contacts connecting this area with the ancient Mediterranean world. Manifestations of social elites of the Bohemian Iron Age were studied. The finds and archaeological contexts from the settlement agglomeration located at the confluence of the Elbe and Vltava rivers and dating to the 6th - 5th centuries BCE were evaluated and published. In this context, we may also mention documentation, interpretation, and publication of finds from a hill-top position near Spolí, district Český Krumlov.

A rather important project focused on the research, assessment, evaluation, and publication of the results of the revision archaeological fieldwork of an Early Iron Age tumulus in Rovná, district Strakonice, which took place as part of an international project.

Furthermore, research on technological aspects and distribution of amber of the Early Iron Age and the course of the Amber Trail in Central Europe (documentation, evaluation, and publication of finds of amber dated to the Early Iron Age) was carried out.

In co-operation with ZBSA Schleswig, a project focused on the registration and inventory of prehistoric and Early Medieval fortifications in Bohemia and their evaluation took place; particular attention was paid to the Iron Age and Early Middle Ages. The research focused on the evaluation of Bohemian oppida set within a pan-European framework and their inclusion in the broad chronological context of Bohemia.

Our researchers also participated in the organisation of the exhibition *Sachsen Böhmen 7000: Liebe, Leid und Luftschlösser = Saxony Bohemia 7000,* in co-operation with the Landesmuseum in Chemnitz and the National Gallery in Prague.

Publications of the "1C-Protohistory" from the list of I. stage of evaluation: no. 1, 11, 13, 23.

"1D-Virtual Archaeology"

The group of virtual archaeology evolved from the project of the virtual museum of the Neolithic (http://www.archaeo3d.com). Since the project completion in 2016, its members have continued working and created unique portfolio of know-how and equipment comparable to the world's best institutions.

The group leader - J. Unger, focused on the use of 3D digital non-contact documentation techniques (multi-image photogrammetry, laser scanning, drone) in rescue archaeological fieldwork, a survey of medieval mining works, documentation of cultural and historical heritage, and research into the possibilities of using virtual and augmented reality for the presentation of archaeological contexts and their applications in practice (mobile applications, visual parts of museum exhibitions, online platforms).

The group members became a co-investigator of the significant international project "VirtualArch - Visualise to Valorise - For better utilisation of hidden archaeological heritage in Central Europe (Interreg Central Europe)". The project engaged researchers from eight foreign partners. Its primary focus is the research into the contribution of computer 3D visualisations for the presentation of inaccessible archaeological heritage.

Member of the team (H. Brzobohatá - physical anthropologist) focused on 3D imaging and analytical methods both in archaeological and anthropological applications, participants in the development of shape analysis software tools (together with Faculty of Science, Charles University, Prague). She systematically processed anthropological finds from the Kutná Hora region. She also published articles and studies focusing on topics covering the fields of bioarchaeology, forensic anthropology, paleopathology and bone shape analysis with particular attention to lower limb loading of past populations.

Publications of the "1D-Virtual archaeology" from the list of I. stage of evaluation: no. 5, 10.

“1E-Cross-cultural”

This research group was established at the end of the evaluation period by an association of researchers concentrating on comparisons across the historical and geographical research spectrum, as well as at the cross-sectional studies of specific cultural phenomena.

The research focused on the study of archaeological evidence of slavery and its cultural correlates. Furthermore, researchers focused primarily on the topic of past human mobility. Namely, they studied 1) childhood mobility of past populations using multiple-tooth strontium analysis, and 2) post-marital residence patterns from the cross-cultural perspective using comparative phylogenetic analysis.

A significant and ground-breaking area of interest of this particular research group is the study of the phenomenon of tools used for determining the quality of precious metal (touchstones), both in Prehistory and the Middle Ages. The phenomenon is analysed both in terms of their social significance in ritual contexts, especially funerals, and archaeometallurgy, i. e. interpretation of the chemical composition of metals whose abrasions have been preserved on the test stones.

Publications of the “1E-Cross-cultural” from the list of I. stage of evaluation: no. 3, 6, 7, 9, 14, 19.

“1F-Beyond Europe”

The group was established at the very end of the evaluation period in autumn 2019. The formation of the group is primarily related to a significant international project “Research of Mesolithic and Neolithic Adaptations in Shaqadud Mountains” launched through the support of the Lumina Quaeruntur programme of the Academy of Sciences. With this in mind, the group has not yet generated any outputs.

Branch office in Kutná Hora

Its members participated in the provision of the archaeological heritage in the district of Kutná Hora and partly in the district of Kolín (archaeological excavations in the area of the historic medieval town of Kolín, especially the cathedral of the St. Bartholomew 2018-2019 and the city walls). Over the period 2015-2019, members of the field office led more than 30 field rescue excavations.

On the long-term basis, the branch office focuses on combined archaeological and historical research of the development of the Early and High Medieval settlement and silver mining in the district of Kutná Hora, especially on the example of significant settlement sites (stronghold of Kutná Hora – Malín; extinct Cistercian monastery at Kutná Hora – Sedlec, primarily archaeological fieldwork at the cathedral of the Virgin Mary and Charnel-House; and area of the historical medieval mining town of Kutná Hora, mostly archaeological fieldwork at the Italian Court - Central Bohemian mint and the cathedral of St. Barbora).

Research activity and characterisation of the main scientific results

Following the merger of the Department of Medieval Archaeology and the Prague Castle Department, researchers and doctoral students are integrated into a core group, one team and two field offices. The core group consists mainly of employees of the previous Department of medieval archaeology who were its members before the re-organisation in 2017. Their activities cover a wide range of topics, including research into items of small material culture, burial grounds, and central places in the Early and High Middle Ages. The primary tasks of the Prague Castle team, which has existed within the IAP since 1925, either individually or as part of various organisational units, remain unchanged. A new team is being built at the Vyšehrad field office. There, scientific research and professional care for the archaeological cultural heritage should be developed to the same extent as in the case of Prague Castle. We expect the field office to expand in the future. The Castle Research Centre is also newly formed; its task is to capitalise the results of the work of the prematurely deceased Prof. Tomáš Durdík. Attention is also paid to the development of post-mediaeval archaeology.

The research is based on two main corner axes, which run through the entire period under study and related topics. The first research axis includes research and evaluation of architecture and settlements, some of which have been investigated by the IAP staff practically throughout its entire existence. Fieldwork and its documentation are developed, and the emphasis is placed on revision research and new assessment and forms of handling and evaluating the evidence. The development of information systems, which shall become part of the Archaeological Information System of the Czech Republic (AIS CR) managed by the Info. and Landscape Dept., therefore, meets this particular purpose. The second research axis includes the study of artefacts in all their aspects. Mainly the study of historical technologies has undergone significant development. These two fundamental cornerstones are accompanied by the study of the medieval population, society, material evidence of Christianisation and the possibility of their interpretation. Due to the nature of research in the 20th century, researchers also pay attention to the history of research and interpretation as it contributes to our more in-depth understanding of the role of archaeological research in the creation of national and local cultural identities and the changing interaction between research and social demand in the 20th century. The framework of our research, which has traditionally been limited by the Czech Republic, is also gradually expanding because the Central European and European context is being perceived increasingly.

The first research axis includes the project DF13P01OVV014 "*Integrated Information System of Archaeological Sources of Prague*" led in 2013-2017 by Ivana Boháčová. It aimed to create a portal to make the archaeological sources of Prague accessible to experts and the general public and to expand the possibilities of protecting the archaeological heritage. In addition to professional information based on maps, the portal also provides several virtual exhibitions and other information intended for the public.

A long-term project with multi-source support is the "*Archaeological Atlas of Prague Castle"* aiming at the systematic revision of archaeological research at Prague Castle

and Hradčany starting from the second half of the 19th century. The basis is the reconstruction of the georelief (7) of this particular site. The newly evaluated elements of wooden and stone architecture are gradually being placed on the georelief, and the individual construction phases are being reconstructed on an ongoing basis. The newly obtained data, continuously published in scientific papers, studies and on websites have contributed to the reassessment of the development of the settlement of the Hradčany promontory that is directly connected with the beginnings of the Czech state. Thus, such data forms the background of other, following, sub-projects. One of them was the comprehensive assessment of the architectural and culture-historical development of the Cathedral of St. Vitus (16), supported by private sources. The resulting publication - *Visible and Invisible Cathedral* - relied on the evaluation of pre-Romanesque rotunda and Romanesque basilica. To understand their architectural form, function and significance, it was necessary to create an interdisciplinary team and gain a wide range of information on the development of the liturgy, liturgical topography, music and art. On the same principle, all the later construction phases up to the present have been evaluated. Thus, a monograph inspired by the method of places of memory and the theory of cultural layers was created, which introduced the contemporary reader to the deep tradition of the metropolitan church and the form of its transmission through various artistic media.

In 2018, two projects were launched, which systematically address important and long-term researched sites. The first - GA18-16362S "*Beginnings of Vyšehrad. Archaeology and the establishment of a leading political centre of the early Czech state*" - follows on the monograph published in 2015 (8) and other projects supported by SAS 21. Fieldwork focusing on the pre- Romanesque Church built on a triconch plan was concluded within the framework of this particular project, as well as part of the Vyšehrad workshop for the processing of silver and gold ore from around 1000, was explored. The project will be completed in 2020. The project GA18-00477S "*Between the Avar and the Carolingian Empire. Nodal points of long-distance contacts in Bohemia in the 8th and 9th centuries*" led by Naďa Profantová has the same solution period. The project primarily focuses on the site of Tismice, Kolín district, which was investigated in years 2018-2019. That particular fieldwork significantly deepened our understanding of the Early Medieval fortified settlement through first scientific data; furthermore, a new Aeneolithic fortified settlement was also discovered. Moreover, other hilltop sites have been surveyed and assemblages of Early Medieval finds processed. The project will be completed in 2020. As part of the study of fortified settlements, Filip Laval contributed to the GA17-20106S project "*Celtic oppida and other fortified settlements - an intercultural comparison*", led by V. Salač from the Prehistoric Dept.

The project GA19-17636S "*Sázava - Archaeology of the Benedictine monastery*" led by Petr Sommer is currently in its second year of the solution. The project aims at processing the long-term research conducted in the monastery complex and contributing to understanding its oldest construction phase, structural development and topography of the complex. It also includes the assessment of the burial ground excavated in the 1980s and 1990s.
The second research axis includes three projects awarded by the GA MC within the Ministry of Culture programme (NAKI and NAKI II) that are dedicated to the research of historical lime technologies. Their leading researcher in the Institute of Theoretical and Applied Mechanics and the IAP participate therein as a co-researcher because

the Prague Castle department addresses some issues. The first project was awarded for the period 2011-2015: DF11P01OVV010, "*Traditional lime technologies of historic buildings and their use today*," followed in the years 2016-2020 by project DG16P02H012 "*Lime materials for the restoration and conservation of authentic elements of historic buildings*". The main goal of the first project was the research and development of traditional lime technologies, which should enable their reuse in the reconstructions of architectural monuments. The archaeological part focused on the identification of desolated raw material sources and specific technologies of lime processing in connection with their use in historical constructions. In addition to partial publications, the Calcarius database was created. Furthermore, a lime kiln and traditional firing technology for small-scale production of lime binders were developed and implemented. The second, follow-up, project focused on historic lime mortars. One of its partial goals was the documentation of authentic elements of historic constructions with regard to preserved traces and manifestations in relation to the materials and technologies used in order to improve possibilities of their protection and preservation and to create a specialised map of applications of lime technologies for permanently uncovered archaeological areas at Prague Castle. It was followed by two projects awarded in 2020, namely DG20P02OVV028 "*Possibilities of radio-carbon dating of historic mortars*" and TL03000603 "*Hidden under the surface. Archaeological terrains of Prague Castle, their protection and presentation in the modern world*".
The same research axis also includes projects dedicated to glass and ceramics technologies. In 2016, the project GA ČR 14-25396S "*Archaeology, Archaeometry and Informatics: Prehistoric and Medieval Glass in the Czech Republic*" (2014-2016) led by Natália Venclová from the Department of Natural Sciences and Archaeometry was concluded (Kateřina Tomková participated in it). Within its framework, a model of the development of glass artefacts during the 10^{th} – 13^{th} centuries was created, taken into account the archaeological and archaeometric aspects. Moreover, it also enabled research of glass beads from Early Medieval Bohemian burial grounds, and the first overview of polychrome beads from Bohemia was prepared together with Š. Křížová. This project was further followed (since 2019) by the GA CR 19-23566S project "*Prehistoric and historical glass in the Czech Republic. The continuity of the dialogue between archaeology and archaeometry*", led by Kateřina Tomková.

Finds from Prague Castle and Hradčany are used for the research in the field of Early Modern ceramics. As part of the study of Early Modern ceramic production, an ongoing long-term co- operation with the Institute of Ceramics and Glass from the Institute of Chemical Technology in Prague aims at the exact evaluation of changes and development of technological processes of ceramic production. In co-operation with the Geological Institute of the CAS, v. v. i., long-term research of glass production is being carried out. Based on the obtained results, ceramic and glass finds are compared with contemporary Bohemian production and integrated into the European context. The project DG18P02OVV028 "Technology of treatment and identification of degradation processes of ceramic finds from Hradčany palaces - Methods of restoration and conservation of porous and sintered ceramics and porcelain", led by Gabriela Blažková on behalf of the IAP, deals with the technologies of Early Modern glazes.

In the field of medieval population research, which has been simultaneously investigated in several projects, one of the most significant project was GB14-

36938G "*Medieval population in the centre and the countryside. Archaeology, bioarchaeology and genetics in the burial grounds of Prague Castle, Central and Eastern Bohemia*," awarded in 2014 and led by Jan Frolík (originally five-year-long project). It included multidisciplinary research of a selected sample of Early and High Medieval burial grounds and so-called elite graves. From the archaeological point of view, in addition to making large assemblages of finds available to the public, it was beneficial for the development of research methodology and assessment of High Medieval church burial grounds, as well as for the specification of the form of the so-called source edition, i. e. a suitable way of publishing large data assemblages from complex field contexts. Rescue archaeological research at the ossuary in Sedlec near Kutná Hora (a set of 1837 graves, including 32 mass graves), offering a unique opportunity to look into the changes in the population of an important medieval town and to monitor the effects of disasters (famine, plague), represents a significant benefit. Unfortunately, it turned out that the project was specified too broadly and consisted of too many entities. There were serious mistakes on the part of the project management and coordination, and the results did not meet the demands placed on the centres of excellence, did not form coherent units, and the planned methodological synergy has not been gained. Therefore, it was terminated prematurely by the Czech Science Foundation (hereinafter GAČR). In the course of the project, a series called *Archaeology - Bioarchaeology - Genetics* was established under the *Castrum Pragense* series, which enabled assessment of several burial grounds of Prague Castle, and publishing of two monographs devoted to the Early Medieval burial ground in Lažany. Furthermore, fifty articles and studies were dedicated to the project.

In the field of research on medieval society, the past five years have been dominated by projects devoted to monastic orders and their impact on contemporary society in various aspects. In 2015, the project DF11P01OVV007 "*Culture and Art of the Benedictine Order in Central Europe 800-1300*" was concluded; Petr Sommer led its archaeological part. The research of Jakub Sawicki has focused on the society of the late Middle Ages and the Early Modern period. Currently, he studies social stratification in Medieval and Early Modern cities, with interests in ecologies of towns, social status and identity, material culture studies (including assemblage archaeology) etc. within the project GA18-26503S "*Clothing accessories and social life in medieval cities of Central Europe (Prague - Wroclaw)*", which is based on specific evidence of material culture.

The history of research and interpretations, monitoring the interaction between national and local cultural identities and the effort to integrate the results of national research into the broader European context has been conducted through exhibitions for the general public and scientific publications (e. g. 19, 24).

Research activity and characterisation of the main scientific results

Research activities of the Natural Sci. Dept. have been mainly organised within its research groups. They were subject to both specific topics and projects and also methodological development associated with analytical procedures of data collection and analyses. In addition
to the research topics carried out within particular research groups (cf. below), two essential monographs on the history of Celtic coinage were published within two GACR projects [**15, 20**]. Furthermore, an extensive monograph dedicated to Natalia Venclová was prepared, edited, and published [**19**]. More than 20 foreign research authorities published their articles in this monograph.

"3A-Environment and Society" group:
In recent years, our attention has been focused on the reconstruction of the prehistorical environment [**2, 9, 12**], and we have addressed the issue of prehistoric agriculture, either in terms of selection of crops in response to the environment or gradual development of field weeds. As part of international research, the group also engaged in archaeobotanical research abroad, especially in sub-Saharan Africa where researchers examined the topic of domestication of lesser-known crops such as sorghum (*Pokorná -Kuncová, 2016*).
Another topic addressed was the research of soil cover and its transformations due to human influence (*Vysloužilová et al. 2016*). As part of this studies, new analytical procedures for the study of soil archives, such as NIRS (*Schwartz et al. 2015; Strouhalová et al. 2019*) or analysis of n-alkanes (*Schäfer et al. 2016*), have been applied or developed.
Members of the group participated in projects GA17-17909S "*Hidden Human Activities in Mountain Areas. Archaeological and palaeoecological research in Šumava*" (researcher D. Dreslerová), and GA16-14855S "*Mobility and social status of the early Bronze Age population on the Amber Trail. Testimony of the cemetery in Mikulovice*" (researcher M. Ernée), and "Archaeomontan" (*Tolksdorf et al. 2019*) examining prehistoric and medieval mining activities in the Ore Mountains (the Erzgebirge), the Bohemian-Moravian Highlands, and the Jeseníky Mountains. The aim is to survey mining and prospecting and production areas (glass, metallurgy) dating from prehistoric and medieval times.
Fieldwork and publication of their results are an integral part of the environmental group. Members of the group have participated in the research of Neolithic wells (*Rybníček et al. 2018, Vostrovská et al. 2018*) or the elite burial dated to the Hallstatt Period that was excavated in Prague Letňany [**11**].
In 2015, an informal working group "Underwater Archaeology of the Czech Republic" was established, associating specialists interested in the field of underwater archaeology in the Czech Republic, as well as interested members of the general public. Since 2018, fieldwork focused on the revision of underwater historical monuments has been carried out under the auspices of the IAP.

“3B-Osteology” group:
This group has been significantly affected by personnel changes, the termination of employment of two physical anthropologists and the recruitment of a new one in 2/2018. Until then, attention was paid to pathological changes in the bones (e. g. *Brzobohatá - Šumberová - Likovský 2015*), and the anthropology of the Early Middle Ages (*Štefan et al. 2016; Stránská et al. 2015, Frolík et al. 2016; Ibrová et al. 2017; Kaupová et al. 2019*), as well as the publication of material from archaeological fieldwork (*Limburský et al. 2015; Limburský et al. 2018; Chytráček et al. 2019; Ernée et al. 2015*).
Since 2018, the main research activities of the anthropological department are twofold, namely 1) research in the field of the age determination of past populations – it is related to a dissertation thesis (Faculty of Sciences of the Charles University, biological anthropology), which mainly concerns the collection of recent and archaeological material (single root teeth) to significantly refine the life expectancy estimation based on skeletons by application the method of cementochronology; and 2) assessment of human skeletal remains obtained from archaeological fieldwork by using modern osteological methods.

Within archaeozoology, several topics related to individual animal species have been addressed. In this evaluation period, attention has been paid to the earliest history of domestic horses and cattle in the Czech Republic, primarily through detailed osteometric analyses (*Kyselý 2016; Kyselý - Peške 2016*). Other publications dealt with the history of turkey and mud turtles. A significant part of the sub-topics has been evaluated in connection with fieldwork conducted by other members of the IAP. Many of these activities were concluded with a publication with IF [**5, 10, 11**], (*Kyselý 2018; Kyselý et al. 2016; Kyselý - Pecinovská 2018; Kyselý - Meduna 2019*, etc.). The group collaborates on projects applying new methods to the research of livestock economic strategies (GA18-10003S “*Animals in the Medieval City. Archaeozoology and Stable Isotope Analysis*”).

“3C-Archaeogenetics” group
In this particular period, the research activities of the archaeogenetics team focused mainly on detecting migrations and genetic adaptations in food production companies (grants GAČR 13- 37998S and 18-23889S). We have concentrated on the area of the African Sahel as it is possible to study this relationship on the differences between nomadic herders of domestic animals and settled cereal producers. Our research addressed the current genetic diversity of certain enzymes that show metabolic activity, and which facilitate to read the past (prehistoric, historical) events.
We have corroborated, for example, that today’s pastoralists are characterised by a much higher proportion of individuals able to digest milk sugar (lactose) in adulthood, i. e. they have a higher ratio of the so-called lactase persistence. According to our results, the mutation responsible for such an ability in western Saharan pastoralists was obtained by mixing with the Eurasian population during the Holocene in North Africa [**13**]. This trend may be related, with a high probability, to the spread of cattle breeding, respectively dairy production, which occurred in North Africa about 8,000 years ago. The more precise timing of the contact of the ancestral pastoral population of today’s sub-Saharan Africa with the Eurasian population is the subject of our team’s ongoing research. We have also conducted similar research in Eastern Saharan pastoralists. There, we have been able to determine mutations that clearly refer to a wave of migrations related to the disintegration of ancient empires,

especially in southern Arabia, and the spread of Islam to Africa [**6**].

Similarly, our group studied the body's ability to remove xenobiotics, mainly arylamine N- acetyltransferase 2, an enzyme involved in the metabolism of xenobiotics. The rate of acetylation in humans is closely related to mutations in the NAT2 gene. While hunter- gatherers generally show a higher ratio of individuals who can degrade xenobiotics rapidly, in food-producing populations, individuals with such a phenotype occur to a much lesser extent. The style of food preparation can explain this (hunter-gatherers roast food, farmers tend to cook it as they use pottery vessels more frequently) or a variety of their subsistence (unlike hunter-gatherers, whose subsistence is more varied and includes some mildly poisonous plants and animals, farmers based their diet on safe domesticated resources). Our research results in pastoralists and Sahel farmers suggest a particular interaction between food and the chemical environment [**3**]. The question of food preparation remains widely unanswered. In Africa, pottery was used earlier than in the Near East and was already produced by hunter- gatherers 11,5000 years ago; and even then, it was probably used for cooking. In the following period, we would like to address this topic by researching amylase, i. e. an enzyme that breaks down starch (whether cultivated cereals or harvested grasses in the area of the so- called green Sahara of the Upper Holocene). This topic had been planned to be addressed already in the previous period; however, our plans had to be postponed due to two parental leaves of E. Podgorná.

Last but not least, we have also addressed the issue of migration, namely the colonisation of Eurasia and movements within the Sahel itself [**4**]; [**8**]; [**7**]; *Černý et al. 2016; Fernandes et al. 2015*). Regarding this topic, we had followed up with the previous five-year period when we evaluated the genetic diversity of Arabian populations, especially in Yemen. Our results have shown that Arab populations are biologically older than the Middle East, but that demographic growth has been slower in Arabia. Overall, it seems that previous migration traces, such as the colonisation of Arabia by anatomically modern humans 60,000 years ago, appear to have been covered by later migrations. Our studies, thus, show that Arabia has a complex evolutionary history with a significant share of the gene flow that disrupted its initial structure. These results, including the extensive geographical, archaeological and ethnographic origins of South Arabia, have been published for the general public in the book *Po stopách ʿÁdů: Jižní Arábie v čase a prostoru* / *In the footsteps of the ʿÁds: South Arabia in time and space* [**16**], published by Academia.

"3D-Archaeometry" group:

Archaeometry of prehistoric and early medieval glass was supported in the evaluated period (2014-2016) by the project GA14-25396S "*Archaeology, archaeometry and informatics: prehistoric and medieval glass in the Czech Republic*." As part of the work on the project, extensive assemblages of glass from the La Tène period (3rd - 1st centuries BC) from the oppida of Třísov, Staré Hradisko, and the agglomeration of Němčice were analysed. The research resulted in a series of articles in peer-reviewed and impact publications (*Vaculovič et al. 2017; Venclová et al. 2018*) and monographs: "*Němčice and Staré Hradisko. Iron Age glass and glass-working in Central Europe*" [**17**]. The monograph provides information on hitherto unknown aspects of production and distribution mechanisms of so- called Celtic glass. The provenance of La Tène glass finds was also addressed within the

framework of the project GA18-20096S "*Mobility of materials and life cycles of artefacts: archaeometry of metals and glass of the La Tène and Early Roman period*," focusing mainly on the technology of glass production from the oppidum of Třísov (*Křížová et al. 2020*). In the evaluated period (11/2018-2/2020 - prematurely terminated due to the situation with COVID-19), Dr Joelle Rolland worked at the Natur. Sci. Dept., as a post-doc, supported through the Fyssen Foundation scholarship. Her project concentrated on the processing of glass from the site of Němčice nad Hanou. Together with members of the archaeometric group, she also addressed the issue of the provenance of pigments in glass using lead isotope analyses. Joint publications are being prepared.

Archaeometry of non-ferrous and precious metals (bronze, brass, copper, silver, gold) was addressed mainly within various scientific projects. Project GA18-20096S "*Mobility of materials and life cycles of artefacts: archaeometry of metals and glass of the La Tène and Early Roman period*", deals with so far understated topic of production technologies and provenance of La Tène and Early Roman artefacts with respect to the acquisition and distribution of raw materials. Based on the results, general conclusions have been formulated regarding socio-economic strategies, cultural norms and long-distance contacts [**12**] and (*Danielisová et al. 2018a; Danielisová et al. 2018b*).

As part of the research focusing on the **historical development of textile production**, attention was paid to the High and Late Middle Ages. Within the framework of the project GAČR 14-06451S, a unique set of textiles originating from the waste heaps of medieval Prague was analytically processed and evaluated. The results were published in a comprehensive monograph [**18**]. Considerable attention was also paid to the study of textile ties used in the Middle Ages, which were identified in textile finds from various Czech and Moravian sites [**14**]. This study became the methodological background for the project GAČR 19-00166S focusing on the overall processing of medieval and early modern textiles obtained from archaeological contexts of Prague Castle, especially funeral textiles from the royal tombs (e. g. *Bravermanová - Březinová - Voda 2019*).

Attention was also paid to the intensive research into **medieval blacksmith technologies**, especially the observation of traditions and innovations applied in the production of swords. The research was closely linked to the comprehensive evaluation of swords dating from the 8th to the 16th centuries from the Czech Republic (GACR grant P405/12/2289). It included not only a series of metallographic, radiographic and restoration analyses and surveys but also an extensive and critical revision of previous research results, not only in the Czech Republic but also abroad, (e. g. *Hošek - Košta - Žákovský 2019*). The project enabled obtaining a unique corpus of data which, in conjunction with the newly introduced methodology for classifying sword blade structures, makes it possible to follow the fundamental development trends of sword production covering a broad period of time, starting from the 5th to the 16th centuries, much more accurately. In connection with welded damask, we can mention another interesting result of our research, namely the explanation of the significance of the so-called phosphorous iron in the production of damask composites (the possibility of effortless and effective visibility of patterning [**21**]).

The study of the **production technologies of the lithic industry** focused on the Mesolithic period (*Kapustka - Walls - Eigner 2020*), and partly also on the Neolithic (*Burgert - Kapustka*
- Beneš, 2018). Archaeological material came from the Czech Republic and Sudan. The current research of Mesolithic settlement strategies in the Kokořín area is carried

out in co- operation with the University of Calgary; University of Copenhagen, and Centre for Theoretical Studies.
Research activities in the laboratory also focused on the technical study of **Early Medieval Bohemian elite jewellery**. A specific methodology of the investigation was developed and applied to the study of elite jewellery. It integrated the material and construction characterisation as well as the understanding of the multiple steps of manufacture validated from experimental archaeology (*Děd – Ottenwelter - Šejvlová* 2016; *Ottenwelter – Děd - Barčáková* 2017).
Additionally, research was conducted on the application of voltammetry of micro-particles and demonstrated that voltammetry of micro-particles was a valuable alternative non-invasive analytical technique [**1**].

"3E-Restoration and Conservation" group:
The main activity of the restoration laboratories was the care of archaeological finds obtained in the course of fieldwork conducted by the IAP and other institutions in the Czech Republic. Among the largest assemblages of preserved objects were finds from poly-cultural research of the Slaný - Velvary bypass, the Iron Age burial ground from Prague - Letňany, medieval fieldwork from Chrudim and Kutná Hora or excavations carried out during the construction of the Blanka tunnel in Prague. As part of metal conservation, members of the laboratory have developed their research specialisation in the field of jewellery production technologies (*Ottenwelter - Děd - Barčáková 2017*). As far as organic materials are concerned, we have focused mainly on the treatment of amber beads (*Svobodová 2016*). Restoration of ceramic finds accompanied every research carried out in the IAP, and attention was also paid to methodological procedures and their development over time (*Svobodová - Kloužková 2016*).
Restorers and technicians are involved in addressing scientific projects implemented within the IAP such as GA18-16362S (L. Varadzin), GA18-00477S (N. Profantová), GA16-14855S (M. Ernée), TACR-Théta TK01010040 (A. Danielisová), and NAKI II. DG18P02OVV028 (G. Blažková). They are also involved in the multidisciplinary research activities, where individual parts of our team are mutually interlinked [**11**].

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With the restructuring of scientific teams in 2017, **all laboratories existing within the IAP** came under the management of the Natural Sci. Dept. They comprise archaeobotanical, palynological, osteological (anthropological and archaeozoological), archaeogenetic and now also a restoration and conservation laboratories. Since then, we have been systematically modernising and improving the laboratory infrastructure and their equipment. The process of modernising laboratories forms part of the department's long-term concept. We use financial programmes of the Czech Academy of Sciences for the acquisition of expensive devices necessary for the modernisation of laboratories and instrument infrastructures. As part of this process, the department

has managed to acquire specialised equipment, including a specialised device for radiographic non-destructive analyses; since 2019, supplemented by a computer tomographic device.

The department's activities also include the co-operation with **radiocarbon dating laboratory - the CRL**, which was established in 2005 as a joint workplace of Nuclear Physics Institute of the CAS and IAP (head Ing. Ivo Světlík PhD). The laboratory performs dating based on the conventional method; during 2014, the lab successfully completed the basic test procedures for the processing of micro wood and charcoal for ^{14}C measurements using accelerator mass spectrometry (AMS). The CRL takes a crucial part within the RAMSES project (OP RDE led by the Nuclear Physics Institute of the CAS) aimed at establishing an AMS device in the Czech Republic. The beginning of our own measurements are expected in 2022. Currently, the ^{14}C measurements are done with the collaboration of foreign laboratories, especially at HEKAL ATOMKI HAS in Debrecen. Annually the laboratory handles hundreds of samples for dating purposes as well as the control of analytical procedures. The laboratory also provides consulting support both for professionals and for the general public and is involved in the interpretation of results of determination of ^{14}C from other departments.

Within the scientific and data infrastructure of the Natural Sci. Dept., we have created or managed several **databases or comparative collections**. Providing research facilities and cross-disciplinary services is of great importance for archaeological research activities at the national level and abroad (RTG and computer tomography equipment, CZAD - archaeobotanical database of the Czech Republic (*Dreslerová - Pokorná* 2015), laboratory for Archaeogenetics, zoological-osteological collection, radiocarbon laboratory and VITREA – an on-line database on archaeological glass from the Czech Republic). The **VITREA** database includes glasses from the Bronze Age to the Middle Ages and the post-medieval periods. Besides Bohemia and Moravia, the analysed samples also come from archaeological finds in other countries -Slovakia, the Netherlands, Sweden and the Mediterranean area. Recorded are data gained by various analytical methods such as SEM-EDS and NAA. http://en.arup.cas.cz/cz/VITREA/Index.htm.
Another applied research is the on-line database **CZAD** - Archaeobotanical database of the Czech Republic. It is a database of archaeobotanical data obtained by the analysis of plant macro-remains from archaeological contexts. It was created as a result of the project Archaeobotanical database of the Czech Republic - ArboDat: http://www.arup.cas.cz/czad/.

Dreslerová D. - Pokorná A., 2015: Archaeobotanical Database of the Czech Republic. In: Structuring archaeological evidence. In: Kuna M et al. (eds.) The Archaeological Map of the Czech Republic and related information systems. 129–134, Institute of Archaeology, Praha.

As part of its research activities, the Natural Sci. Dept. has been very successful in obtaining **scientific research projects**. Due to the nature of the team's focus, the projects mainly encompass basic research; however, we have also been involved in the applied research project (TACR) and major

operational programmes. The team also utilises the funding programmes of the Czech Academy of Sciences to support young researchers.

Between 2015 and 2019, a total of 28 research projects were obtained by the department.

> The Czech Science Foundation (GACR): Seven projects where the members of the department are the principal investigators, eight projects where department members are team members.

> Technology Agency of the Czech Republic (TA CR): one project ("**Archaeological analogues for verification of container life models for deep radioactive waste repositories**", TACR-Théta, TK01010040, 2018-2022; co-researchers: The University of Chemistry and Technology, Prague, ÚJV Řež, a.s., and the IAP of the CAS, Prague, v.v.i.). The project aims at creating mathematical models of the decay of metal objects in various soil conditions, which are to serve for the development of containers for nuclear waste. The IAP obtains and supplies samples of archaeological finds for analysis, and provides X-ray imaging, cf. https://starfos.tacr.cz/en/project/TK01010040#project- participants

Other projects: NAKI (1), GAUK (1), various (3)

Operational programs:
OP RDE Excellent research "**Ultra-trace isotope research in social and environmental studies using accelerator mass spectrometry**", (hereinafter referred to as the Ramses). The project focuses on the development of a methodology for ^{14}C dating of archaeological samples in connection with the newly built accelerator at the ÚJV in Řež. The project is led by the Info. and Landscape Dept. (D. Dreslerová), and one employee of the Natural Sci. Dept. participates (A. Danielisová).

OP RDE Mobility "**International exchange of methodological experience in the study of the impact of emergencies on migration and economic strategies of past human populations**." As part of the project, team members spent some time at the Max Planck Institute in Jena and the Muséum national d'Histoire naturelle in Paris.

Funded by the Czech Academy of Sciences:
- Strategy AV 21 (1),
- Support programme for perspective human resources – postdocs (3),
- Project for international co-operation of starting researchers (1).

Publication outputs 2015-2019 - due to the team's focus, publication outputs mainly concentrated in the IF journals. Numerous publications in monographs and editing of international proceedings also show the broad professional scope of the department.

Articles in scientific periodicals	143
Jimp WOS)	70
Jimp (S IF)	41
Jsc	74
Jost	48
Monograph	16
Chapter in a monograph	40
Conference paper	19
Conference proceedings	2

Research activity and characterisation of the main scientific results

Four thematic areas of activities of the Info. and Landscape Dept. and their important segments (projects, topics) are presented in the following diagram (Fig. 1). The table included in Fig. 2 presents basic information on the primary research projects (larger grey capitals in Fig. 1). The most important research topics (smaller black capitals in Fig. 1) are further elaborated in the text and are always highlighted in **bold**.

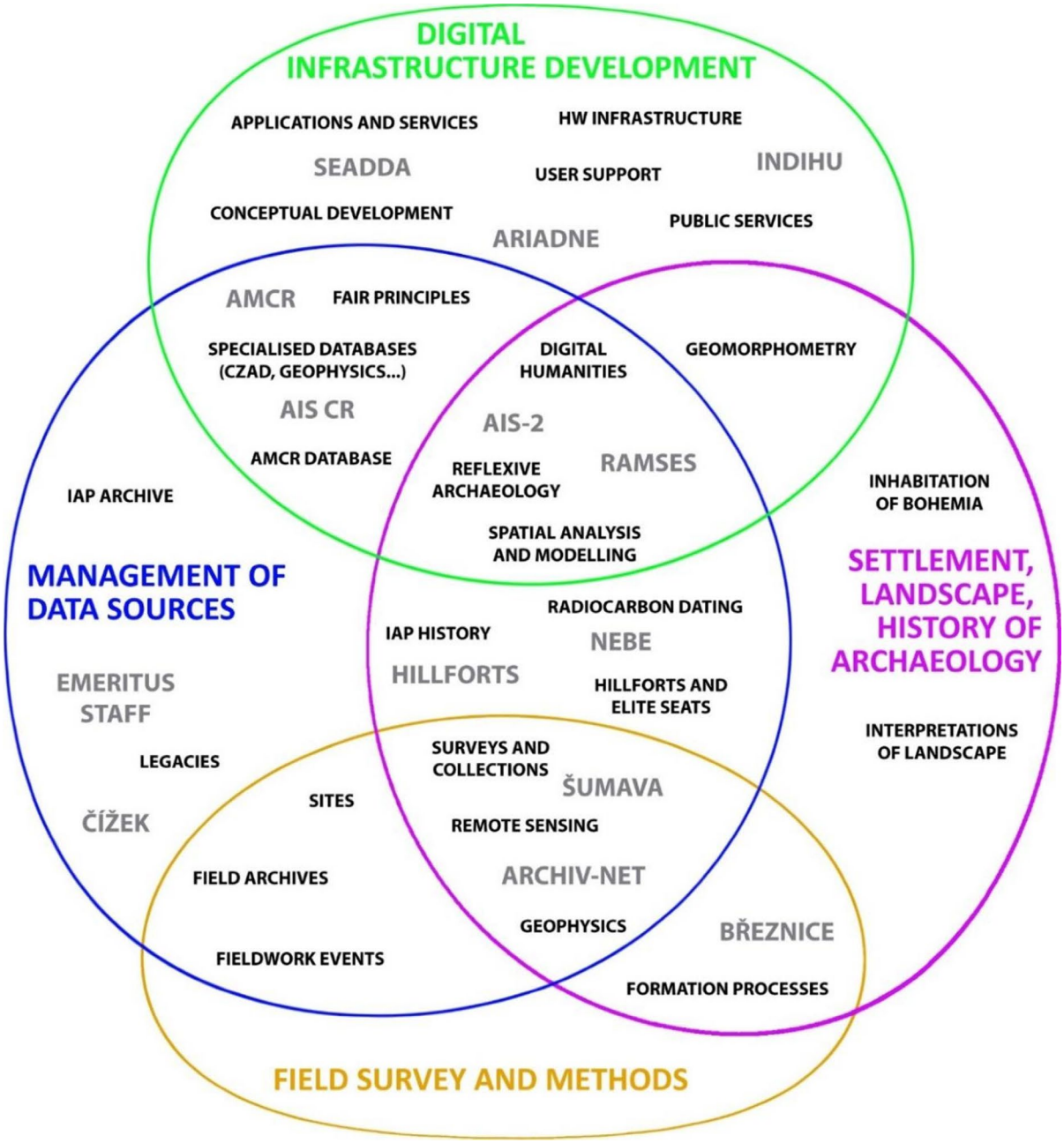

Fig. 1. Diagram (mind map) of the main areas of the team's activities indicating their relationship to the main topics/tasks (black) and major grant projects (grey).

Project title (abbreviation)	Source	Years	FTE (per year)	contracted staff (hours)	Funding for IAP (EUR)	Fieldwork	Theory	Data	Infra
AMCR	NAKI	2012-2015	4,85	7 747	658 824	x		x	x
From Find to Structure	Czech Grant Agency	2013-2015	1,36	1 167	180 392		x	x	
ARIADNE	EU FP7	2013-2017	0,89	-	109 804				x
Geophysics in Ústí Region	CAS Regional Cooperation	2014-2016	-	207	6 863	x	x		
AMCR development	Strategy AV21	2015-2016	-	1 000	28 627			x	x
Geophysics in Poland	no specific funding	2015-2019	-	-	-	x	x		
AIS CR	Research Infrastructures	2016-2019	2,95	3 333	298 039			x	x
INDIHU	NAKI II	2016-2020	0,50	1 667	58 824				x
Processiing J. **Čížek**'s legacy	Strategy AV21	2017	-	1 667	11 765			x	
Digital plans of aerial sites	Strategy AV21	2017	-	800	4 706			x	
Past settlement of **Šumava**	Czech Grant Agency	2017-2019	0,30	1 793	121 569	x	x	x	
AIS-2	EU Structural Funds	2017-2021	3,00	18 000	639 216		x	x	x
History of IAP	Strategy AV21	2018	-	300	3 569			x	
Register of **Hillforts**	Strategy AV21	2018-2019	-	1 787	15 294		x	x	
Emeritus Staff	Strategy AV21	2018-2019	-	300	7 647			x	
Archiv-Net	Interreg Central Europe	2018-2020	2,20	1 820	125 490	x	x	x	
Březnice Bronze Age site	Czech Grant Agency	2018-2020	0,30	500	30 196	x	x		
NEBE	NAKI II	2018-2022	0,75	2 000	141 176		x	x	
RAMSES	EU Structural Funds	2018-2023	3,00	10 007	1 007 843		x	x	x
Geophysics of enclosures	CAS Regional Cooperation	2019	-	67	2 745	x	x		
ARIADNEplus	EU Horizon 2020	2019-2022	0,45	-	52 941				x
SEADDA	COST Action	2019-2023	-	-	-				x

Fig. 2. List of major grant projects of members of the Info. and Landscape Dept. that was implemented in the years 2015-2019, their basic specifications and assignment to research areas. The projects included in Figs. 1 are marked **in bold**.

The settlement, landscape and history of archaeology

The study of **inhabitation of Bohemia** seen in a long-term perspective represents a cross- cutting topic affecting almost all of the team's activities. The research primarily relies on the Archaeological Map of the Czech Republic (AMCR), the core of the AIS CR infrastructure, and other "big data" in contemporary Czech archaeology, i.e. environmental data, results of non-destructive fieldwork, remote sensing, radiocarbon data, etc.

Methodologically, the research relies on the advanced application of databases and **spatial analysis and modelling** in various levels of detail. The Info. and Landscape Dept. team, among other things, has developed new algorithms for the calculation of spatial and chronological models of prehistoric settlement using radiocarbon and relative chronological data, taking into account the uncertainty of the spatial determination of archaeological finds obtained during surface and subsurface fieldwork.[1] Within the project focusing on the study of peripheral mountain ranges, predictive models of the development of prehistoric settlements based on environmental variables and the calculation of maximum entropy were successfully tested (see **Šumava**; GA17-17909S).[2] A number of other studies by D. Dreslerová that were highly accepted, also addressed the topics of the relationship between

[1] Demján, P. – Dreslerová, D. 2016: Modelling distribution of archaeological settlement evidence based on heterogeneous spatial and temporal data. Journal of Archaeological Science 69, 100–109. https://doi.org/10.1016/j.jas.2016.04.003

[2] Dreslerová, D. – Romportl, D. – Čišecký, Č. – Fröhlich, J. – Michálek, J. – Metlička, M. – Parkman, M. – Pták, M. *in press*: At the end of the world? Settlement in the Šumava mountains and foothills in later prehistory. Praehistorische Zeitschrift.

the settlement, the character of the landscape and its exploitation, special attention being paid to agricultural production.[3] The range of team's interests for the years 2018–2020 was expanded by the **Archiv-Net** project (Cooperation Program Free State of Saxony - Czech Republic 2014–2020 - INTERREG SN – CZ 2020-100346365), which under the leadership of
K. Derner addresses the topic of exploitation of ore deposits in the Ore Mountains and focuses on the cross-border interconnection of cultural and historical collections in the Czech Republic and Saxony in relation to the cross-border mobility of miners in the Ore Mountains in the Middle Ages and Early Modern Times.

The topic of the social dimension of the landscape in a diachronic perspective can be determined separately in order to monitor the cultural variability, behavioural factors, events and intentionality of the behaviour of the landscape creators. Currently, the topic is represented by the study of the structure of supra-community and elite residential areas (**hillforts**, **elite seats** of the Middle Ages and the Modern Age), monitoring the relationship between cemeteries/burial grounds, the landscape and residential areas, **interpretations of landscape** in terms of social units, etc. These topics were addressed not only by D. Novák[4] in his comprehensive article based on the use of **geomorphometrical** methods[5] in modelling the functional potentials of the landscape via GIS, but also a project aimed at studying the Bohemian hillforts that were funded by the AV21 Strategy programme. Based on this evidence, a team under the leadership of M. Kuna and in co-operation with the Slovak University of Technology in Bratislava and the IT4Innovations infrastructure managed to prepare eight variants of the total visibility model of Bohemia in 2019, which shall serve as a starting point for several planned impact studies in the coming years. Subsequently, the model shall also be fully published for further use. It represents the first application of the total visibility principles in the study of landscape characteristics and human behaviour therein on such a large scale.

Equally important are other topics, which have been systematically addressed by M. Kuna, namely the issue of **formation processes** in the landscape and their impact on the preservation and informative potential of archaeological sites. Demonstrably, their form is significantly influenced by the cumulative nature of archaeological source material and the

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[3] **[6]** Dreslerová, D. et al. 2019: Settlement activity in later prehistory: invisible in the archaeological record but documented by pollen and sedimentary evidence. Archaeological and Anthropological Sciences 11, 1683- 1700. https://doi.org/10.1007/s12520-018-0614-x.

Dreslerová, D. 2015: Fields in prehistoric Bohemia - fact and fiction. In: Retamero, F., Schjellerup, I., Davies, A. (eds.), Agricultural and pastoral landscapes in pre-industrial society. Oxford, 109–124.

Dreslerová, D. 2016: 'Salaš': summer farming and transhumance in the Czech Republic from a (pre)historic and environmental perspective. In: Collis, J., Pearce, M., Nicolis, F. (eds.), Summer farms. Seasonal exploitation of the uplands from prehistory to the present. Sheffield, 33–46.

Dreslerová, D. – Kočár, P. – Chuman, T. 2016: Pravěké osídlení, půdy a zemědělské strategie. Archeologické rozhledy LXVIII, 19-46.

Dreslerová, D. et al. 2017: Cultivation with deliberation: cereals and their growing conditions in prehistory. Vegetation History and Archaeobotany 26, 513-526. https://doi.org/10.1007/s00334-017-0609-z.

[4] **[4]** Novák, D. 2019: Funkční klasifikace a vývoj vrchnostenských sídel ve středověkých a raně novověkých Čechách. Památky archeologické 110, 307–382.

Novák, D. 2019: Emblems of Power, Administrative Centres or Luxurious Residences? A Digital Archaeological Analysis of Medieval and Post-Medieval Elite Manorial Seats. In: Popović, M. S. – Polloczek, V. – Koschicek, B. – Eichert, S. (eds.), Power in Landscape. Geographic and Digital Approaches on Historical Research. Leipzig, 245–274.

[5] Novák, D. 2018: Wykorzystanie ALS do zautomatyzowanej analizy krajobrazu. In: M. Gojda, Z. Kobyliński (eds.), Lotnicze skanowanie laserowe jako narzędzie archeologii. Archaeologica Hereditas 11. Warszawa, 69–84.

principles of material fragmentation. It is, therefore, necessary to correctly distinguish between functional, behavioural and post-depositional factors influencing the archaeological concept of reality.[6] The variable detection of archaeological features also forms an essential factor, as shown, for example, by the geophysical study of the influence of erosion on the preservation of archaeological features, a topic systematically addressed in projects of R. Křívánek.[7] A project concentrating on a specific settlement area in Březnice by Tábor, aiming at the evaluation of long grooves, which had been discovered in larger numbers in settlements dating to the Late and Terminal Bronze Ages in southern and western Bohemia, Bavaria and Austria, can be seen as the latest contribution in this field. Our understanding such ritual aspects of prehistoric behaviour in settlements can provide new general insights into other archaeological contexts known from Prehistory (see **Březnice**; GA18-10747S).

The published reflections and internal discussions are followed by the topic of **reflexive archaeology**, i. e. the research focusing on the ways how archaeological evidence and its interpretation can be influenced by the research method, the history of research, and the social context of the fieldwork. The AMCR extensive database offers a rich source of information in this regard and the Info. and Landscape Dept. team is focusing its attention on this particular topic.

In the past period, the issue of **radiocarbon dating** was an important team's interest, namely research topics related to the collection and processing of samples and topics based on radiocarbon data sequences. This interest and the possibility to develop such topics are related to the **RAMSES** project (CZ.02.1.01/0.0/0.0/16_019/0000728) financed from the Operational Programme, Research, Development and Education (OP RDE). Within its framework, a new laboratory focusing on radiocarbon dating by using the AMS method is being established as a joint department of the IAP and the Institute of Nuclear Physics of the CAS. So far, there is no such facility in the Czech Republic. The team is involved in the project in the form of research tasks related to 14C isotope dating in archaeology and paleoecology (http://crl.odz.ujf.cas.cz/). Scientific activities follow several courses such as sample selection and research methodology, critical assessment of the sample quality, modelling using Bayesian statistics, depth-age models, but also topics such as the expansive phenomenon of prehistoric societies or understanding of processes dealing with social, economic and cultural changes in Prehistory and the Early Middle Ages. To implement the project, our team consisting of four people co-operates with the Natural Sciences and Archaeometry and Prehistoric departments, represented by one person each.

The outline of **IAP history**, which was included in the publication on the centenary of the IAP can be seen as an additional but not negligible topic of study. The publication, prepared under the authorial guidance of M. Kuna and M. Starcová (with the help of other IAP teams), represents a balanced publication not only for the professional but also for the general public.[8] M. Starcová, as the administrator of the archives, further examines the development of archaeology in the territory of former Czechoslovakia with the support of projects funded by the Czech Academy of Sciences (AV21 Strategy Programme; http://av21.avcr.cz/).

Fieldwork and its methodology

The team's activities are not limited to theoretical research; they also include fieldwork, especially using non-destructive or low-invasive methods, which enable us to study archaeological sources on a broader spatial scale. In this respect, **remote sensing**, namely aerial survey and documentation (including the use of UAVs) to search for archaeological features in the landscape, documentation of immovable archaeological monuments, and testing of promising survey methods play a crucial role in our efforts. In part, it involved the completion of the project **From Find to Structure** (Czech Science Foundation – hereinafter GAČR, id. GA13-19041S) that was successfully conducted in 2013-2015, but also other follow-up activities within the AV21 Strategy and Archaeological Information System - Second Generation (**AIS-2**; CZ.02.1.01/0.0/0.0/16_013/0001439) or Archaeology From the Sky: Analysis and Presentation of Moravian and Silesian Remote Sensing Archives (**NEBE**; DG18P02OVV058) projects. These activities culminated in the form of a comprehensive synthesis by M. Gojda[9] defended during the awarding of his DSc title. Other studies by M. Gojda presented new approaches to the topic.[10]

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6 Kuna, M. 2015: Categories of settlement discard. In: Kristiansen, K., Šmejda, L., Turek, J. (eds.), Paradigm found. Archaeological theory - present, past and future. Oxford, 278–292.
Kuna, M. 2017: Space, time and prehistoric settlement. In: Kysela, J., Danielisová, A., Militký, J. (eds.), Stories that made the Iron Age. Studies in Iron Age archaeology dedicated to Natalie Venclová. Prague, 41–49.

7 **[7]** Křivánek, R. 2019: The contribution of new geophysical measurements at the previously excavated neolithic rondel area near Bylany, central Bohemia. Archaeological Prospection 2019, 1–14. https://doi.org/10.1002/arp.1755.
Křivánek, R. 2015: Application of geophysical methods for monitoring of surface and subsurface changes of origin archaeological terrains - case studies of sites in the Czech Republic. In: Yen, Y. N., Weng, K. H., Cheng, H. M. (eds.), International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences 40-5/W7. Göttingen, 257–262. https://doi.org/10.5194/isprsarchives-XL-5-W7-257-2015

8 **[10]** Kuna, M. – Starcová, M. – Maříková-Kubková, J. (eds.) 2019: Sto let v archeologii. Objevy, nálezy a expedice Archeologického ústavu v Praze 1919-2019 / 100 years in archaeology. Discoveries, finds and expeditions of the Institute of Archaeology in Prague 1919-2019. Prague.

9 **[8]** Gojda, M. 2017: Archeologie a dálkový průzkum. Historie, metody, prameny / Archaeology and remote sensing. History, methods, and sources. Prague.

10 Gojda, M. – Gojda, O. 2019: Metody leteckého průzkumu pohřbených krajin: mapování archeologického dědictví v prostředí GIS. Historická geografie 45/2, 183-206.
Gojda, M. 2019: Current Development in Archaeological Remote Sensing: A Central European Experience and Evaluation. IANSA 10/2, 155-164. https://doi.org/10.24916/iansa.2019.2.5

We have already partially mentioned the application of **geophysics** in fieldwork in the previous chapter. It is one of the major cornerstones of field prospecting and methodology used by the team. Long-term geophysical documentation of extinct Prehistoric and Early Medieval enclosures (and selectively also other types of sites) is suitably linked at many levels with the research intentions of the team. R. Křivánek is a permanent provider of expert geophysical services for projects across the IAP and co-operates with external experts in the regions and with other scientific institutions, incl. implementation of contract research (e.g. regional co-operation projects R300021421, R300021901, R300021802, Czech Science Foundation projects - GAČR GA18-00477S, GA18-10747S, internal support PIP-999004, etc.). The work of R. Křivánek can be related to a number of high-quality publications from recent years.[11]

Fieldwork also includes targeted excavations, **surveys and field collections** focusing on solving specific research topics within the grant projects mentioned above (e. g. Šumava, Archiv-Net, Březnice, etc.). Such research helps to solve theoretical and methodological issues, e.g. in the monitoring of empty components and border areas, the practical application of predictive approaches in searching for archaeological sites, data collection for radiocarbon dating, etc.[12] Research and documentation activities also focus on monuments from the recent periods of human history, such as the defunct Rolava mining complex and the related World War II prisoner of war camp.[13] This successful and up-and-coming research project was later transferred to the Department of Medieval Archaeology team for capacity and practical reasons.

The Info. and Landscape Dept. also deals with the use of state-of-the-art knowledge and techniques applied in processing the results of fieldwork. Analysis of lipid residue of pottery vessels was used in the course of excavations of the La Tène site in Sklářské údolí in Šumava/Bohemian Forest, which revealed the processing of animal carcass products and plant lipids derived from either olive or hazelnut oil. For the first time, lipids soaked into the ceramic mass were directly dated using radiocarbon dating.[14]

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[11] Besides those that were already mentioned, for example:
Křivánek, R. 2015: "Atypical" use of combinations of geophysical methods for archaeological heritage preservation in the Czech Republic. Archaeologia Polona 53, 472–476.
Křivánek, R. 2017: Comparison study to the use of geophysical methods at archaeological sites observed by various remote sensing techniques in the Czech Republic. Geosciences 7, 81. https://doi.org/10.3390/geosciences7030081.
Křivánek, R. 2018: The application of non-destructive geophysical measurements for mapping and surveying the hillforts in the Czech Republic. Archaeologia Lituana 19, 62-77. https://doi.org/10.15388/ArchLit.2018.19.4.

[12] **[5]** Dreslerová, D. – Demján, P. 2019: Modelling prehistoric settlement activities based on surface and subsurface surveys. Archaeological and Anthropological Sciences 11(10), 5513-5537. https://doi.org/10.1007/s12520-019-00884-7.

[13] **[3]** Hasil, P. – Novák, D. – Hasil, J. 2015: Smrt dolu Sauersack/Rolava, okr. Sokolov: zánik důlního závodu v mezioborové perspektivě. Archaeologia Historica 40, 179–205. https://doi.org/10.5817/AH2015-1-11

[14] Dreslerová et al. 2020: Seeking the meaning of a unique mountain site through a multidisciplinary approach. The Late La Tène site at Sklářské Valley, Šumava Mountains, Czech Republic. Quaternary International 542 (2020), 88-108, https://doi.org/10.1016/j.quaint.2020.03.013.

Development of digital infrastructure

As mentioned above in the text, the theoretical research of the Info. and Landscape Dept. team is specific as it closely and intentionally follows the construction and development of the AIS CR infrastructure. Although it is a complicated and comprehensive task in the case of infrastructure, its merger with the research department focusing on landscape studies proves to be a very beneficial decision, bringing a number of synergetic effects. Thanks to the direct co-operation of experts within the team, it is possible to ensure conceptual support for research activities,

better set data management priorities in relation to practical needs of archaeology as a scientific branch and, at the same time, demonstrate the qualities and pitfalls of data collection and tools created on specific case studies.

One of the milestones in this field was the preparation and publication of the "Structuring Archaeological Evidence",[15] which occurred in the initial stage of the period under review and marked an ending of the previous stage of consolidation of digital services started after 2002. Finally, the book was a first step towards modern AIS CR digital infrastructure.

Since 2016, the **conceptual development** of the AIS CR has become the team's primary research task. AIS CR is a platform on which digital sources of Czech archaeology are integrated. Its main goal in the first phase (2016-2019; see the **AIS CR** project - LM2015080) was the application of the AMCR information system in the practice of archaeological institutions and individuals in the Czech Republic, its enrichment and connection with other data sources. Processing of databases for Moravia and Czech Silesia regions and their unification with existing databases has played a vital role in this process as the infrastructure is jointly managed by both Archaeological Institutes of the Czech Academy of Sciences in Prague and Brno.

Further strengthening the role of the AIS CR infrastructure represents the primary goal of the ongoing **AIS-2** project (CZ.02.1.01/0.0/0.0/16_013/0001439). It is achieved on three levels: technical, data and scientific. The technical development of the infrastructure includes the completion of the data repository, the creation of an interface for communication between AMCR and other segments of the information system (internally and externally), the development of user applications, standardisation and personnel ensuring of the system operation. The development of the infrastructure information content includes the registration of sets of information on fieldwork that has not been recorded in central databases, on as yet unexplored sites, and on sites, which were attested by specific methods of archaeological research (through aerial photography, geophysical survey, surface collections). Support for the synergy of infrastructure and scientific research aims to exploit its professional potential for our understanding settlement trends in the Czech Republic,

[15] **[9]** Kuna, M. et al. 2015: Structuring archaeological evidence. The Archaeological Map of the Czech Republic and related information systems. Prague.

developing procedures for digital analysis of landscape as a prerequisite for the emergence of new information layers, and identifying processes leading to formation of archaeological sources and records (i.e. topics mentioned above in the text). Several published studies have summarised the latest advances and the overall structure of AIS CR.[16]

In the field of theoretical background, the development of infrastructure is mainly related to methodological **user support** and the cultivation of curation of archaeological data. Such activities take the form of workshops, suggestions for IAP management and to other licensed organisations, standardisation of the quality of archaeological documentation, management of the IAP digital repository or education of specialists on the data management and long-term data archiving in archaeology. In this regard, thanks to the ongoing **Archiv-Net** project (INTERREG SN – CZ 2020-100346365), the team members have gained experience by participating in workshops located in the most important museums and archives on both sides of the Czech-Saxon border (Dresden, Freiberg, Annaberg, Zwickau, Prague, Karlovy Vary, Kadaň, Teplice).

The implementation of **FAIR principles** of data management through standardisation, open access to information and freely available online tools seems to be inevitable.[17] The team is, therefore, taking practical measures to achieve this goal. The organisation of a colloquium on the topic of publishing information in archaeology in 2017 had far-reaching consequences, as it was possible to find a consensus on good practice in disseminating research data, summarised in a special issue of the Zprávy památkové péče journal.[18]

The development of **web applications and services** in terms of technology and functionality forms an integral part of the work on the infrastructure. In recent years, the core infrastructure services have been completed (see http://www.aiscr.cz/), we have launched the preparations of new specialised modules (for metal detector surveys, a library of 3D models, the MEDCEM[19] portal, etc.), user interfaces have been further developed, and an open API has been set up. These steps were financed not only from the main infrastructure projects but also from the funds provided by the AV21 Strategy programme or the international project **ARIADNE** (FP7-INFRASTRUCTURES-313193).

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[16] Lečbychová, O. – Novák, D. – Kuna, M. – Kosarová, Z. 2019: The Archaeological Information System of the Czech Republic – A Big Solution for Big Data. In: W. Börner, S. Uhlirz (eds.), Proceedings of the 23rd International Conference on Cultural Heritage and New Technologies 2018. CHNT 23. Vienna [online]. http://www.chnt.at/proceedings-chnt-23/.

Kuna, M. – Novák, D. – Hasil, J. – Křivánková, D. 2017: Archaeological Map of the Czech Republic. Current state and future visions of virtual research tools in the Czech Republic, Internet Archaeology 43. https://doi.org/10.11141/ia.43.10.

Novák, D. – Kuna, M. – Lečbychová, O. 2019: IT and the Humanities in the 21th Century – The Case for Archaeology. In: 9th International Conference on Advanced Computer Information Technologies, ACIT 2019 - Proceedings. České Budejovice, 496–499. https://doi.org/10.1109/ACITT.2019.8780027.

[17] Novák, D. 2018: Věda 2.0 a zveřejňování informací v digitálním věku / Science 2.0 and publishing information in the digital age. Zprávy památkové péče 78/1, 13–19.

[18] Kuna, M. 2018: Česká archeologie v informační společnosti ú Czech archaeology in the information society. Zprávy památkové péče 78/1, 3-12.

Kuna, M. – Lečbychová, O. – Kosarová, Z. – Novák, D. 2018: Obsah vytvářený komunitou / Community- created content. Zprávy památkové péče 78/1, 35–44.

[19] **[1]** Eichert, S. 2019: Medieval Cemeteries at the Periphery of the Carolingian World [online]. https://github.com/ARUP-CAS/aiscr-medcem.

The strategic role of the AIS CR infrastructure is also confirmed by its position as a connecting element for the co-operation within the **NEBE** (DG18P02OVV058), **INDIHU** - Development of Tools and Infrastructure for Digital Humanities (DG16P02B039), **ARIADNEplus** (H2020-INFRAIA-2018-1-823914) or Saving European Archaeology from the Digital Dark Age (**SEADDA**; CA18128) projects. The quality of the AIS CR system and the competence of the related team has been corroborated by the interest of external projects in close co-operation in the development of tools, ensuring the sustainability of their results and expert advice.

The team includes IT specialists, dealing with the maintenance of basic server systems, **HW infrastructure** and network of the IAP and AIS CR. By doing so, high-quality backup services in accordance with good practice, continuous operation, capacity building, monitoring and updating of selected solutions have been ensured.

The team is actively involved in the development of **services for the public** by using digital platforms, such as the Archaeological Atlas of the Czech Republic (http://www.archeologickyatlas.cz/) or the Archaeology Online portal (http://www.archeologieonline.cz/). It has also systematically sought (within and outside the Czech Academy of Sciences) to support activities in the field of **digital humanities**, through active interdisciplinary and international co-operation in building infrastructure, creating tools, sharing good practice, and providing data to external aggregators. A practical example of the team's contribution to the overall modernisation of the field is the development of hardware and software for digital scanning and analysis of ceramic finds and co-operation with international teams in the implementation of this system in practice (http://www.laseraidedprofiler.com/). This category also includes tools developed in the interdisciplinary **INDIHU** project initiated by the Library of the CAS, such as a tool for creating virtual exhibitions (its quality has been tested by the crisis associated with the spread of COVID-19 and temporary transition of memory institutions to present their collections online), online OCR tool, tool for creating virtual knowledge bases and a standard index for digital humanities resources of the CAS (https://indihu.cz/). A by-product of all these activities was the establishment of the Czech Association for Digital Humanities (CzADH; https://www.czadh.cz/) in which the team members actively participated.

Management of data sources

Within the management of the branch infrastructure, the team is responsible for the management of the **AMCR database**, which fulfils the role of the IAP in the field of organisation and administration of field research in relation to the Heritage Law, incl. collection, control and storage of new and ongoing research data. This activity also includes the ongoing processing of **field archives** of the IAP, i.e. their digitisation for online access, their long-term storage in digital form and the creation of links between various records across sources to facilitate their search and re-use. The team purposefully implements and supports digitisation projects that lead to the completion of a fund documenting the archaeological heritage of the Czech Republic (e.g. digitisation of the archives of the former IAP field office in Most, processing of personal or legacy collections, etc.). The task also includes the collection of data on **fieldwork events** and their inclusion in the "authority" list of archaeological events in the AMCR. This is a task of comparable importance to the development-led archaeological research. Without its fulfilment, we can face a risk that information about a large part of the excavations carried out in the Czech Republic will be lost forever (we estimate that

the AMCR still lacks records of about 30–50% of archaeological events conducted on the territory of Bohemia). Other possible risks were indicated by losses in the archive collections caused by floods in 2002 or associated with the unorganised process of digitisation of the field. Later ones are addressed by the international project **SEADDA** (CA18128; https://www.seadda.eu/), whose steering committee includes D. Novák.

Complementary to the previous sources, systematic evidence of archaeological **sites** is being built, resp. their selected types; e.g. hillforts, castles, fortified manors, mound burial grounds, mining areas, deserted villages, etc. The registered sets of sites form a separate layer within the AMCR. The collection of detailed aerial laser scanning data for the Ore Mountains area and its processing (visualisation, vectorisation) for the purpose of an essential passport of the source foundation of anthropogenic relief is also being supplemented. The AV21 Strategy programme supported the creation of a digital corpus of Bohemian hillforts, which was practically utilised in connection with the recently published inventory publication of another team.[20]

Creating and managing **specialised databases** for the registration of expert data (aerial photographs, geophysical survey, radiocarbon data, archaeobotanical data) also forms a standard part of the team's activities. Thus, comprehensive processing of the archive of aerial photographs (digitisation, a database of sites and photographs, rectification, interpretation and creation of plans of registered newly discovered sites) for the Digital Archive of the AMCR (https://digiarchiv.aiscr.cz/),[21] a database of radiocarbon data from archaeological contexts in the Czech Republic have been created. Moreover, the creation and maintenance of the Czech Archaeobotanical Database (CZAD) are also supported.

One of the working groups within the team is responsible for the operation of the **IAP Archives** as a research room and workplace providing support to researchers and the general public. The Archives also manage materials on the history of the IAP; photographs, documents and personal memories or other information from current and former employees and external institutions are being collected and described there. The staff of the Archives ensures the processing of important **legacies** related to the **emeritus staff**, which they publish digitally in a sorted form; such materials are further used for primary and secondary scientific research. Again, these activities have been systemically funded by the AV21 Strategy programmes.

As the previous summary illustrates, the team's research activities combine all aspects of evaluating archaeological data related to the landscape, settlement-historical research, theoretical and methodological studies, as well as providing research support through modern services for domestic and international audiences. Thanks to the increasing professionalism of the team, the offered solutions are becoming irreplaceable for the Czech Republic and are in great demand in Europe. These trends are also confirmed by the interest of the general public, as evidenced by the ever-increasing number of visitors to online tools. In connection with the high-quality outputs of theoretical research based on data and services of AIS CR, we believe that the establishment of Info. and Landscape Dept. in its current form was a good step towards improving the research activities of the IAP.

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[20] Salač, V. (ed.) 2019: Atlas pravěkých a raně středověkých hradišť v Čechách = Atlas der vor- und frühgeschichtlichen Burgwälle in Böhmen. Praha – Schleswig.

[21] **[2]** Novák, D. – Křivánková, D. – Kuna, M. 2017: Digitální archiv AMČR / Digital archive of the AMCR[online]. https://github.com/ARUP-CAS/arup-da-amcr.