

Transdisciplinarity and the New Ways for Preservation and Investigation of the Cultural and Historical Heritage

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Abstract. The main objective of the paper is to present the latest developments and achievements of the scientific field Cultural and Historical Heritage (CHH) and National Identity of the Bulgarian Academy of Sciences (BAS) for digitization and preservation of the Bulgarian cultural and historical heritage by using transdisciplinary approaches.

Keywords: Transdisciplinary Approaches, Digitalization, Cultural and Historical Heritage, Bulgarian Academy of Sciences.

1 Introduction

In my paper I will try in my capacity of Scientific Secretary of the research field Cultural and Historical Heritage (CHH) and National Identity of the Bulgarian Academy of Sciences to present the latest scientific developments and achievements for digitization and preservation of the Bulgarian cultural and historical heritage. I will focus on the main objectives of the National Scientific Program *Cultural and Historical Heritage, National Memory and Social Development*, supported by the Council of Ministers of Bulgaria, which has just started and aims at creation of a modern and sustainably supported research infrastructure – of content for this infrastructure and its organization in a highly efficient and widely available online platforms. The specific objectives of the program are: development of digital tools for research, presentation and popularization of the Bulgarian cultural and historical heritage, including the creation of information systems and platforms with geolocation of the cultural and historical heritage in Bulgaria, in order to study, preserve and popularize it and make it a socially useful resource as well as creation of research and educational programs in the field of Bulgarian cultural heritage as a part of the European one, covering the *tabula rasa* of knowledge in this area. (Natsionalna nauchna programa *Kulturnoistoricheskoto nasledstvo, natsionalna pamet i obshtestveno razvitiie*, p. 2-3).

Leading organization of this program is Sofia University *St. Kliment Ohridski*. Partners are on one hand the Bulgarian Academy of Sciences and several other Bulgarian universities such as Southwest University *Neofit Rilski*, Plovdiv University *Paisii Hilendarski*, Shumen University *Bishop Konstantin of Preslav*, Technical University of Sofia on the other. From the part of BAS mainly scholars from the humanities, as well

as few scientists from ten institutions inside the Academy: Institute for Bulgarian Language *Prof. Lyubomir Andreychin*; Institute for Literature; Institute of Balkan Studies with Centre of Thracology *Prof. Alexander Fol*; Institute for Historical Studies; Institute of Ethnology and Folklore Studies with Ethnographic Museum; Institute of Art Studies; National Institute of Archaeology with Museum; Cyrillo-Methodian Research Centre; Institute of Mathematics and Informatics; Central Library of BAS, are participating.

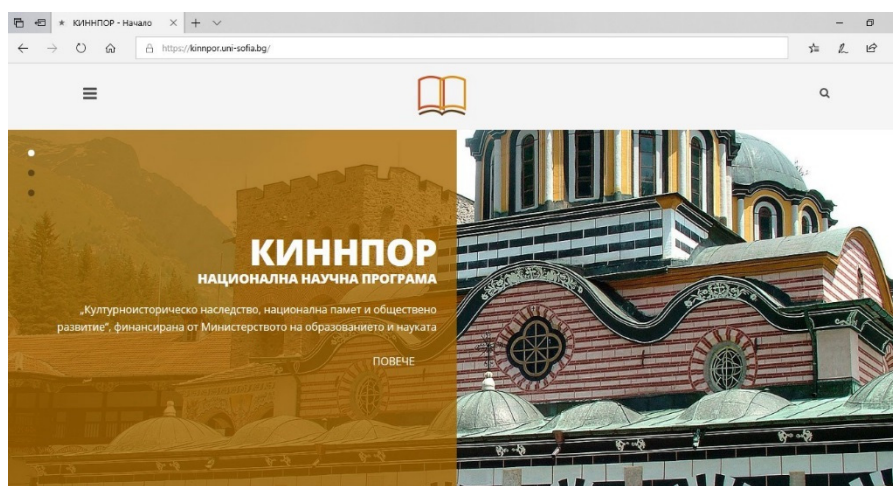


Fig. 1. The title page of the website of the program, still in construction <https://kinnpor.uni-sofia.bg/>

The whole program is constructed by its creators (I dare to say that I am one of them) on the principle of following a transdisciplinary method of research. This opportunity is facilitated by the fact that Bulgarian Academy of Sciences is very complicated scientific institution which combines nine fields of scientific researches: Information and Communication Sciences and Technologies; Energy Resources and Energy Efficiency; Nanosciences, New Materials and Technologies; Biomedicine and Quality of Life; Biodiversity, Bioresources and Ecology; Climate Change, Risks and Natural Resources; Astronomy, Space Research and Technologies; Cultural-Historical Heritage and National Identity; Man and Society.

This multifaceted structure preconditions the transdisciplinary, multidisciplinary and interdisciplinary research in the Academy.

I want to outline that the interdisciplinary projects, where the researchers interact with the goal of transferring knowledge from one discipline to another and they inform each other's work and compare individual findings, is rather popular among the scientists and scholars of the Academy. In fact nowadays usually the scientific projects are interdisciplinary.

Also the use of multidisciplinary approaches, where the researchers from a variety of disciplines work together at some point during a project, but have separate questions,

separate conclusions, and disseminate in different journals, is not rare phenomenon for the Academy.

But recently we witness a profusion of projects drawing together SSH (Social Sciences and Humanities) scholars and STEM (Science, Technology, Engineering and Mathematics) scientists from the Academy and in partnership with scientific organizations all over the world to study and recommend solutions for a wide range of problems. The results from such efforts where new ideas are generated is already evident. Such transdisciplinary researches (Rosenfield, 1992) can provide a systematic, comprehensive theoretical framework for the definition and analysis of the social, economic, political, environmental, and institutional factors, influencing human life and well-being. Such type of researches create a unity of intellectual frameworks beyond the disciplinary perspectives. (Jensenius, 2012) This collaboration, where the researchers exchange information, alter discipline-specific approaches, share resources and integrate disciplines, finally carries the prospective for achievement of a common scientific goal. Recently the transdisciplinary projects become more and more important to solve the actual problems of human beings. In this way science contributes to the development of society and thus fulfils at least part of the 17 sustainable development goals.



Fig. 2. The global goals for sustainable development (<https://www.globalgoals.org/>)

2 Transdisciplinary projects of the Bulgarian Academy of Sciences

In this respect I would like to give just few examples of transdisciplinary projects, developed recently by scholars and scientists in the Bulgarian Academy of Sciences in collaboration with other scientific organizations all over the world.

2.1 *The Black Sea Marine Archaeological Project* is a large project of this kind in the period 2015-2019. The purpose of the project is mapping the underwater cultural heritage and the sunken ancient landscapes in the Bulgarian Black Sea waters. The field-work is conducted entirely in the Bulgarian Black Sea aquatory and is funded by the *Expedition and Education Foundation*, Great Britain. Partners in the project are the Center for Underwater Archeology, Bulgaria and the Center for Marine Archeology, University of Southampton, UK, the National Archaeological Institute with a Museum at the Bulgarian Academy of Sciences, the University of Connecticut, the US Archeological Research Institute, Söderthyor University, Sweden and the Greek Center for marine research. Extensive research results have been achieved: more than 1000 bore-holes were made to acquire and study samples from the seabed to collect data on sea level and climate over the past 20,000 years; geophysical equipment scans more than 1,800 square kilometers of the seabed to locate shipwrecks, create a digital terrain model of the scanned area, and collect data on submerged ancient ladders; 60 sunken vessels from different periods (5th century BC, 3rd century, 5th-6th century, 9th – 10th century, 12th – 14th century and 17th – 19th century) have been investigated. After the final processing of the collected data and samples, the project might contribute significantly to elucidate the dynamics in the development of the Black Sea basin in the post-glacial period.

In addition to the scientific researches, the main elements of the project are educational program and creation of a documentary film.

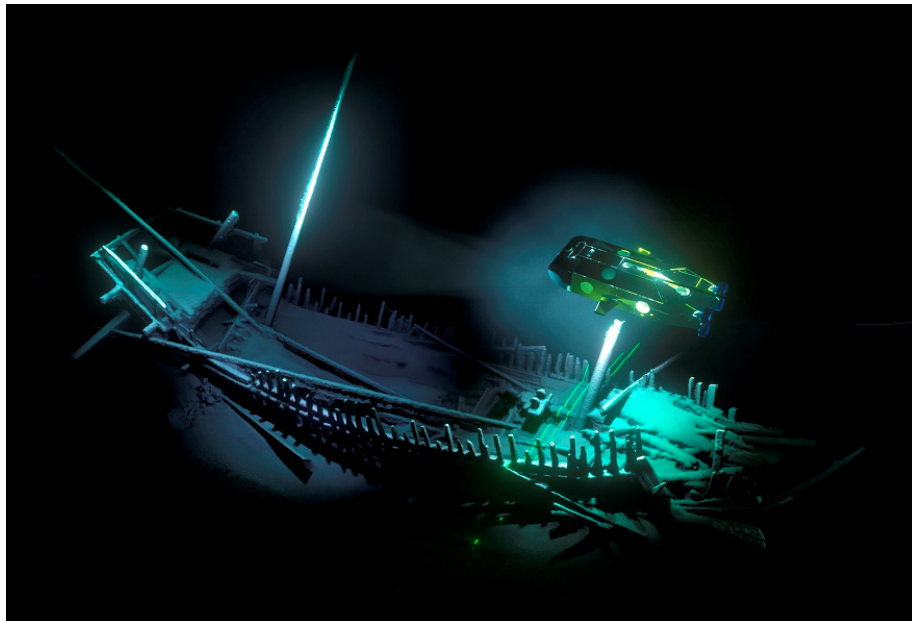


Fig. 3. Photogrametric 3D model of sunken ship (depth 350 m)

2.2 *The Thracians – Genesis and Ethnic Development, Cultural Identities, Civilization Interactions and Heritage of Antiquity* is the first general academic project that

brings together 27 scientific units of the Bulgarian Academy of Sciences with the participation of universities and research centers from Canada, Italy, Germany, Japan and Switzerland. The Thracian heritage is firstly thoroughly and complexly studied and an interdisciplinary approach is applied. There will be research on genetic material, sign technologies from the construction of necropolis and sanctuaries, acoustic studies of sacred Thracian sites, mining, ceramics, food and beverage technologies. The latest technological advances in science for cultural heritage research and DNA analyzes to establish continuity in the gene pool are used. Emphasis is placed on the period from the Neolithic to the late Middle Ages, the population of our lands will be traced and a database for the Thracian material culture will be built.

In 2017 the book *Thracian antiquity: technological and genetic research, history and intangible heritage* was issued. It is divided into four parts. The first one discusses the exploration of metal archaeological finds or casting molds from the late Bronze Age to Late Antiquity. The second part is devoted to archaeological research of horse bone remains from the Early Bronze Age and Thracian Antiquity. The third part includes eight versatile archaeological and historical studies of Thracian culture during the Iron Age, Roman Age and Late Antiquity, as well as its interactions with neighboring regions – Greece and Egypt. The fourth part examines the multidimensional Thracian cultural heritage in modern times – language, folklore, material culture, rituals and rites, symbolism, etc. The collection ends with an article on some aspects of the study of the world-famous prehistoric monument Provadia-Solnitsa and its radiocarbon dating.

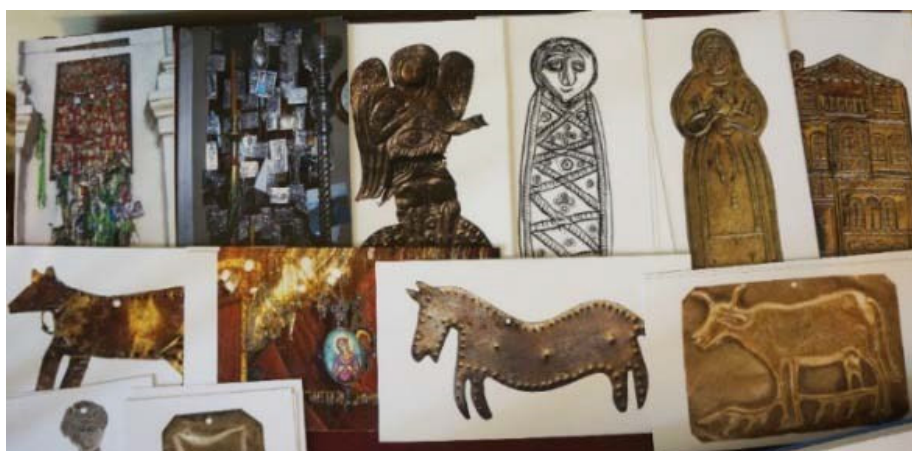


Fig. 4. Different objects found and investigated under the project *The Thracians – Genesis and Ethnic Development, Cultural Identities, Civilization Interactions and Heritage of Antiquity*

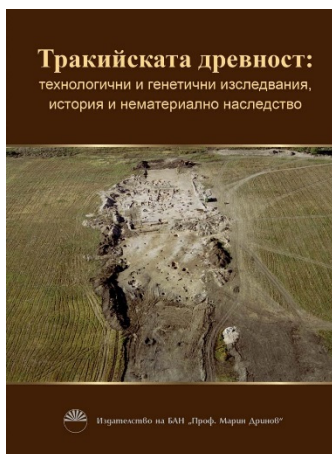


Fig. 5. *Thracian antiquity: technological and genetic research, history and intangible heritage* („Тракийската древност: технологични и генетични изследвания, история и нематериално наследство“, С. Издателство на БАН, 2017)

2.3 Virtual anthropology – an innovative approach to investigations in the field of biomedicine is in its core transdisciplinary.

Virtual anthropology is a new scientific field that combines elements of various sciences as diverse as anthropology, medicine, statistics, information and communication technologies, scientific visualization, and industrial design. The main purpose of the analysis of human bone remains of unknown individuals in paleoanthropology and forensic medicine is the determination of their biological profile. The correct determination of sex and age as crucial factors in the anthropological studies as well as the data collection of soft tissue thicknesses used in facial reconstruction are of worldwide importance. Virtual anthropology provides almost unlimited possibilities for various quantitative and qualitative morphological analyzes using 3D models, specialized software and statistical approaches. The implementation of the research project will contribute to different spheres of social life, not only about the past of humankind but as well as for more secure societies. For example in criminalistics, here including the fight with terrorism.



Fig. 6. Anthropological facial reconstruction of the skull of the Thracian princess from Vratsa (4th century BC) is an example of the application of the method of anthropological facial reconstruction.

2.4 The EU Council Presidency Translator was developed by Tilde, a leading European language technology company, and the Institute for Bulgarian Language, based in Sofia. Tilde helps the EU to craft multilingual policy by providing input on the current state of language technology innovation. This multilingual communication tool enables users to instantly translate texts, documents, and websites between Bulgarian and English. It is using a new approach to Artificial Intelligence (AI). The EU Council Presidency Translator features the world's best Bulgarian machine translation systems built with neural networks, a high-powered approach to AI and machine learning. When translating, Neural MT systems examine the full context of a sentence, producing more fluent, readable, humanlike translations than ever. The EU Council Presidency Translator is powered by the European Commission's automated translation infrastructure CEF e-Translation, which features machine translation systems for all 28 official EU languages and various domains. CEF e-Translation enables EU public administrations to exchange information across language barriers and allows digital services to become fully multilingual. The CEF e-Translation infrastructure is currently being integrated into cross-border digital platforms across Europe. (<https://ec.europa.eu/cefdigital/wiki/display/CEFDIGITAL/eTranslation>; <https://www.tilde.com/>)

3 Bulgarian Academy of Sciences and the National Scientific Program *Cultural and Historical Heritage, National Memory and Social Development* (CHHNMSD)

In 2019 the National Scientific Program *Cultural and Historical Heritage, National Memory and Social Development*, supported by the Council of Ministers of Bulgaria has started. This program gives new opportunities for digitization, preservation and investigation of the Bulgarian cultural and historical heritage. The main activities and expected results are rather important for the Bulgarian society and the European culture. I will focus only to those ones, which follow transdisciplinary approaches such as:

- developing platforms to ensure the exchange of information and access to these resources for scientific institutions and other users of research results;
- developing innovative open-source pilot courses available for everyone – MOOC, Google Classroom or other similar well-established and widely used international free system – including video lectures and other educational content on topics such as: language and functional literacy, media literacy and analytical skills, digital literacy, knowledge and use of data on Bulgarian cultural and historical heritage, introduction to the achievements of national and world art and literature, etc.
- application of arrays and collections of structured data on Bulgarian cultural and historical heritage for the creation of: virtual maps, digital atlases, geographic information systems, virtual museums and galleries, online dictionaries and guides, films, mobile applications and online games related to presentation and popularization of the Bulgarian cultural and historical heritage;

- exploring and geolocating different types of objects of cultural and historical heritage from different historical periods and studying the interdependencies between them; elaboration of geospatial models of distribution of historical written monuments in the Bulgarian language; construction of Geographic Information System (GIS) models with chronological and typological layers, as well as networks of geo-centered persons and objects that can serve as basis for new research on demography, toponymy, territorial borders, ethnic composition, cultural and industrial development, etc., of the Bulgarian land and the creation of advertising, promotional and tourist products;
- developing a system for lexicographic description of language units from the Bulgarian language (based on the already developed and freely available standards of the European lexicographic infrastructure ELEXIS)

The final aim is to establish a common national Virtual Interactive Platform (VIP) for Cultural and Historical Heritage (CHH) of Bulgaria as a part of the European Culture.

In less than few months period the reported results by the working groups of BAS in different areas of humanities are impressive.

- Already a number of periodicals from the digital collections of the Institute of Literature – BAS are exhibited in the *DSpace* platform in the Central Library of BAS and are free on the Internet.
(<http://digilib.nalis.bg/xmlui/handle/nls/30827>)

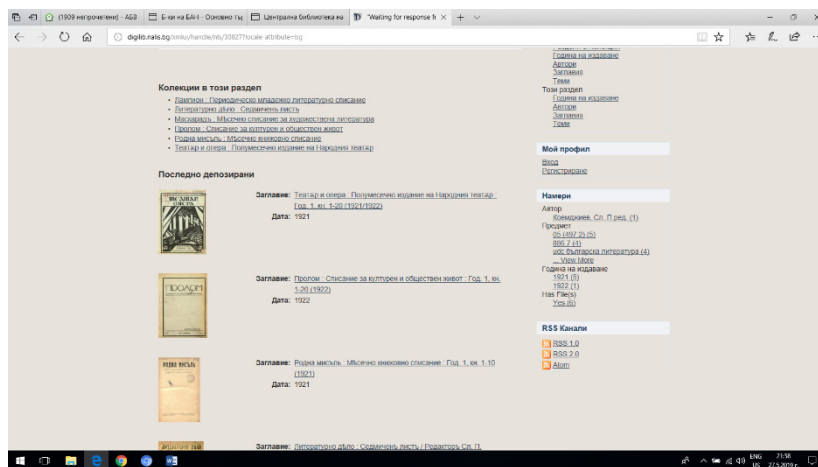


Fig. 7. DSpace. NALIS Repository website

- In the library-information system ALEPH500, which is operated by the Central Library of the BAS, a special bibliographic database was made for integration of bibliographic records from the electronic bibliography of the Cyrillo-Methodian Center of BAS.

- Institute of Literature is working on *Encyclopedia of the Bulgarian Revival: Advanced Digital Corpus and Book Edition*, as well as on virtual exhibition devoted to little known facts and documents on the life and creative path of Bulgarian classic writers.
- Scientists from the Institute of Mathematics and Informatics – BAS (IMI) develop a virtual museum concept, which involves specifying a system architecture, functionality, and services model of the virtual museum. Also online games in the field of cultural heritage – game strategies, design and content, gameplay patterns, and player interaction with learning content are in process of creation.

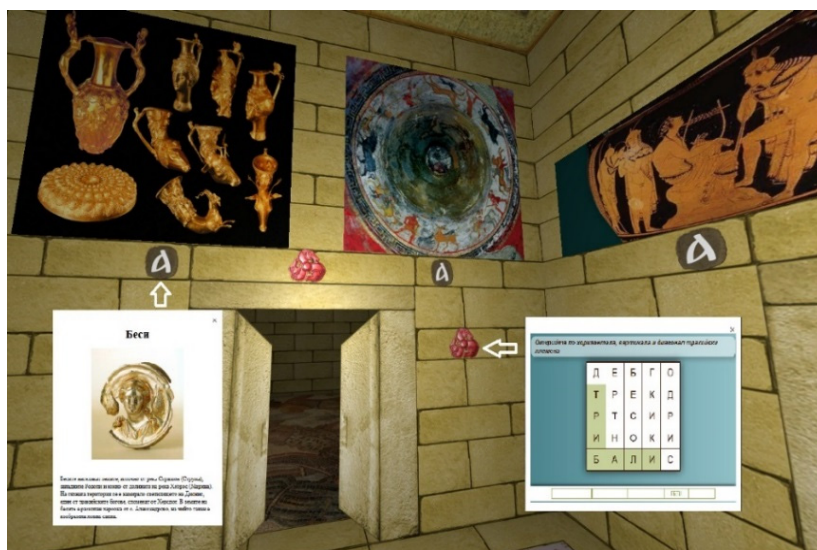


Fig. 8. A print screen of the educational game *Thracians*, developed under the project *Serious Educational Games as Tools for New Educational Applications* of IMI

- Fragments of ceramic vessels from the Neolithic and Chalcolithic layers in the prehistoric archeological site at Nova Nadejda, Haskovo were selected, put into a database and prepared for archeometric analyzes. Some of them will be examined by optical microscopy and a part is prepared for SEM-EDX analysis (scanning electron microscopy with energy dispersive X-ray spectroscopy).



Fig. 9. Head of a ceramic anthropomorphic figure. Nova Nadejda. The beginning of the 6th millennium BC.

- In Institute of Bulgarian language the network of points of the:
 - *Digital Map of the Dialect Division of the Bulgarian Language* (https://ibl.bas.bg/bulgarian_dialects/);
 - *Language Consultations on the Internet Guide* (<http://ibl.bas.bg/ezikovispravki/kategorii/>);
 - *Online Guide Written Remains. Write Right!* (https://ibl.bas.bg/ezikovi_spravki/)
 are further developed.

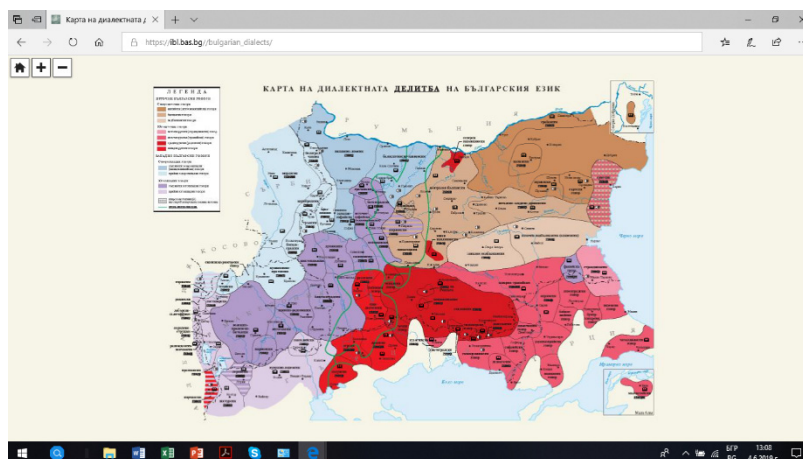


Fig. 10. Digital Map of the Dialect Division of the Bulgarian Language

4 Conclusions

In conclusion I would like to outline that the transdisciplinary approaches in SSH and STEM nowadays are obligatory. They are inevitable and reveal new paths for preservation and investigation of the cultural and historical heritage. The researches from different scientific fields already interweave to meet the new challenges and to reach the sustainable development goals of our global world, such as: no poverty; no hunger; good health; quality education; gender equality; clean water and sanitation; renewable energy; good jobs and economic growth; innovation and infrastructure; reduce inequalities; sustainable cities and communities; responsible consumption; climate action; life below water; life on land; peace and justice and, finally, partnerships for the goals.

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