„ALEXANDRU IOAN CUZA" UNIVERSITY FROM IAŞI
HISTORY FACULTY
DOCTORATE SCHOOL

APPLICATIONS OF GEOGRAPHICAL AND GEOPHYSICAL METHODS IN INTERDISCIPLINARY RESEARCH OF THE CUCUTENI SETTLEMENTS FROM MOLDAVIA. CASE STUDIES

SUMMARY OF THE PHD THESIS

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RECTORSHIP
No. ……from ……

Mrs./Mister…..…….

We inform you that on ……., hour…., in the hall…., at the History Faculty of „Alexandru Ioan Cuza" University from Iaşi, the public presentation of the doctorate thesis entitled: **„Applications of geographical and geophysical methods in interdisciplinary research of the Cucuteni settlements from Moldavia. Case studies",** by candidate **Andrei Asăndulesei**, will take place, for granting the scientific title of PHD in the fundamental field **Humanist Sciences,** doctorate field **History.**

The board committee will be composed of:

President: PHD **Ion-Lucreţiu BÎRLIBA**

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We forward you the doctorate thesis and invite you to attend the public presentation.

CONTENT OF THE DOCTORATE THESIS

I. Introductive problems

The development of new archaeological research paradigms in the second half of the last century led to the approach and later on, implementation on a large scale of new means of analyzing the ancient natural and anthropic environment, at the local or regional level. Their profoundly interdisciplinary character is obvious in the numerous collaborations between archaeologists and other scientists, many of whom are meant to underline the interdependency relation of man towards the environment.

Nowadays, within the scientific community preoccupied with archaeology, there is an agreement on the fact that archaeological sites are threatened by natual and especially anthropic medium. As a consequence of their activity, archaeologists are concerned, more than ever, with this present problem. A wise management of cultural patrimony (*CRM-cultural resources management*) operates a classification of archaeological sites in three categories:

a. those located in unaffected areas by the above mentioned factors;

b. those located in areas where there are potential natural risks or major anthropic alterations are about to take place;

c. sites that are to be destroyed in their entirety and identification and collecting the data is compelling.

In any of these situations, research methods originating from the field of geography or geophysics used in evaluating an archaeological site, can provide important data, thus proving the paramount importance of the above mentioned approaches. The resulted information, corroborated with the surface research or from the archaeological researches, marked with specific symbols on the topographic maps, can generate important data regarding the ancient human activities. A preliminary analysis of the material obtained as a result of normal periegesis can chronologically place an archaeological site, but it can't establish with accuracy the specific characteristics that determined the habitation in a certain area, the surface covered by a settlement, the zones with most archaeological material, or the depth on which they were concentrated,

interrogations that can be easily answer through implementation of spatial analysis or non-intrusive researches.

Lately, the archaeological research makes use more and more of methods „borrowed" from geography or physics, which are combined through a GIS type of program to shape a category of rapid, economic and adjustable methods for any kind of archaeological medium, while providing essential information about the knowledge of ancient human communities and their relation with the environment. Interpreting the obtained data and representing them into meaningful content for the serious archaeologist, together with a rigorous documentation on the possibilities and limitations of the methods should lead to establishing an accurate methodology for a successful research.

Our thesis aims at being a methodological approach, with great emphasis on Cucuteni culture interdisciplinary methods of research taken from geography (*Geographic Information Systems*, aerial photography) or physics (non-intrusive prospections) and less on a historical interpretation. We hope to raise the interest of archaeological community towards such initiatives, and in the same time, to obtain the necessary information regarding the human-environment relation.

Modern research methods taken from the geography and physics fields selected here for the use of the thesis cannot be applied in archaeology, without corroboration with complex studies of environmental archaeology (*Environmental Archaeology*) or landscape archaeology (*Landscape Archaeology*). Archaeological topography, aerial photography, digital cartography, spatial distribution analysis or non-intrusive prospections, integrated, processed and interpreted in the GIS medium, represent effective tools, vital in a geo-systemic analysis, focused towards identifying the relations between the prehistoric communities and the environment they used to live.

Choosing the research of Cucuteni culture from the Eastern Carpathian space is easily understandable if we consider the justified interest manifested by archaeologists towards this cultural phenomenon. Despite the numerous researches made over the years in the proposed area, which resulted in paramount works for the study of Cucuteni culture, the subject is very much of present interest, as it has a high potential of originality. The large number of

settlements in the area reflects the preference of Cucuteni communities for a complex landscape, with various features of the landscape units to be found into a natural geographic frame. Obviously, our researched area cannot be treated in an exhaustive manner, therefore we opted for chronological arranged case studies, that alternate the different landscape units.

Our main objective consisted in implementing modern interdisciplinary research methods, borrowed from geography and physics in the study of Cucuteni communities from the Eastern Carpathian space. Among the specific objectives we can also mention: mapping the sites from the case studies area, realizing spatial analyses for a certain area (Bahluieţ river area) or geophysical prospection (magnetometry, electrical resistance, *Ground-penetrating radar*) for many Cucuteni settlements.

We consider that deciphering and analytical interpretation of the geo-systemic balance from the above mentioned period through the instruments used, vital for any archaeological research, can only enrich the historiographical image of the Cucuteni culture. Far from listing all the research approaches in this field and without any pretentions of being comprehensive, our work serves as encouragement in using modern, interdisciplinary methods that can bring about valuable data in the prehistoric archaeology.

We have to mention that we were able to complete the researches within the doctorate project thanks to the financial support provided by the POSDRU/88/1.5/S/47646 grant.

We respectfully thank PHD Nicolae Ursulescu, the scientific coordinator of the thesis, for his professional guidance in completing the work, for numerous advices, explanations and suggestions generously offered to facilitate a rigorous documentation.

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II. Geographic prospecting methods in archaeology

Deciphering and analytical interpretation of the geo-systemic balance in the Chalcolithic period, East of Carpathians, represents a main objective of our work. In order to achieve this goal, we mainly applied methods from the geography field, aimed at acquiring, gathering, management, manipulation, modelling and visualization of spatial data, gathered under the acronym *Geographic Information Systems*. „Spatial technologies" are based on modern research, especially on computer applications, of real help for the archaeologist work, which implies an immense amount of spatial information.

III. Geophysical prospecting methods in archaeology

In this chapter we realized a presentation of the most used geophysical methods in archaeology, with notable results up until now, taking into account the theory and basic scientific principles for these techniques, as an introduction for the reader, especially the archaeologist, to the discipline. While it is true that the amount of information borrowed from physics can appear excessive at times, for a study concerned with archaeological research, the

interdisciplinary approach ethic requires the use of exact sciences and not only. For the archaeologist, a brief approach, in a simplified manner, of sciences behind the methods can clarify certain aspects related to research management (choosing a method in order to apply it with the inherent knowledge) and help immensely in interpreting the results. Usually, the geophysical methods are classified, depending on the used instrument, in two major groups: passive and active. In the first group, the signal amplitude generated by the archaeological characteristics is measured, while in the second, an artificial impulse is send through the soil and intercepted later, more or less distorted.

IV. Spatial analysis of the Cucuteni settlements from Moldavia (Case study: Bahluieţ river basin)

This section develops our case study main objectives, methodological elements and equipment used throughout the research. In order to complete our objectives, as a first step, we made a repertoire regarding all Cucuteni settlements from the Bahluieţ river basin to be found in the bibliographical references and subsequently located during practical applications. A large percentage of the sites were identified on the field based on geographical descriptions and collected archaeological material while precisely georeferenciated with the help of GIS technology (*Global Positioning System*).

A new working method was dedicated in the attempt of identifying a model of habitation of the Cucuteni settlements in the area, respectively the approach, in a GIS medium, of spatial analysis tools or through geomorphological research methods.

V. Geophysics techniques applied for the Cucuteni settlements from Moldavia (Case studies)

Chapter five contains archaeological topography and cartography activities and especially, those illustrating non-intrusive prospection. The geophysic applications made in the Cucuteni settlements chosen as case studies are presented in detail (magnetometry, electrical resistivity and GPR): Filiaşi-*Dealul Mare*, Fulgeriş, *La trei cireşi*, Tăcuta, *Dealul Miclea*, Ripiceni, *Holm* (*La Telescu*), Brăteşti, *Chicera*.

VI. Final considerations

Interdisciplinary research of the Cucuteni culture between Carpathians and Prut using geographic and geophysical methods is becoming more and more necessary in the archaeologists attempt to reconstitute, as truthful as possible, both the environment as well as the inhabited space of the above mentioned communities. The combined application of these methods, at local or regional level, proves that it is possible to generate important scientifical results regarding the prehistoric communities' way of living.

The spatial analysis of Cucuteni settlements from the studied area seemed relevant to us as it can provide essential information in explaining the man-environment topic. Main factors that define the specific landscape inhabited by the Cucuteni communities: altitude, slope, side exposure, distance to water sources. Also, it was possible to establish the areas where the habitation was more intense and the factors (always connected to environment), that led to certain population concentrations in some areas, while using the realized geophysical prospections important data regarding the fortification elements of the settlements or their planimetry were recorded. Through the corroboration of the obtained information and integrated and level-headed interpretation, we were able to sketch a favourable environment for Cucuteni settlements, a fact that can be useful in ellaborating a predictivemodel, extended on a much bigger scale.

Selective bibliography

Aitken Martin J. 1958 – *Magnetic prospecting. I. The Water Newton survey*, Archaeometry, 1, p. 24-29.

Idem 1974 – *Physics and archaeology*, Claredon Press, Oxford.

Idem 1986 – *Proton magnetometer prospection: Reminiscences of the first year*, Prospezioni Archeologiche, 10, p. 15-17.

Aldenderfer Mark, Maschner Herbert D. G. (eds.) 1996 – *Anthropology, Space, and Geographic Information Systems*, Oxford University Press, Oxford.

Allen Kathleen M. S., Green Stanton W., Zubrow Ezra B. W. (eds.) 1990 – *Interpreting Space: GIS and Archaeology*, Taylor & Francis, London.

Atkinson Richard J.C. 1953 – *Field Archaeology*, Methuen, London.

Becker Helmut 1995 – *From nanotesla to picotesla. A new window for magnetic prospecting in archaeology*, Archaeological Prospection, 2, p. 217-228.

Idem 2001 – *Duo- and quadro-sensor configuration for high speed/high resolution magnetic prospecting with caesium magnetometer*, in: *Magnetic prospecting in archaeological sites*, (eds. Helmut Becker, Jörg W. E. Fassbinder), ICOMOS, Munich, p. 20-25.

Idem 2009 – *Caesium-magnetometry for landscape-archaeology*, in: *Seeing the unseen: geophysics and landscape archaeology*, (eds. Stefano Campana, Salvatore Piro), Taylor & Francis Group, London, p. 129-165.

Idem 1998 – *Geophysical Exploration for Archaeology: An Introduction to Geophysical Exploration*. Special Report No. 1. U.S, Department of the Interior, National Park Service, Midwest Archeological Center, Lincoln, Nebraska.

Bevan Bruce W. 1983 – *Electromagnetics for mapping buried earth features*, Journal of Field Arcaheology, 10, p. 47-54.

Bewley Robert H. 2000 – *Aerial photography for archaeology*, in: *Archaeological method and theory: an encyclopedia*, (ed. Linda Ellis), Garland Publishing, New York – London, p. 3-10.

Binford Luis R. 1982 – *The archaeology of place*, Journal of Anthropological Archaeology, 1, 1, p. 5-31.

Boghian Dumitru 2004 – *Comunităţile cucuteniene din bazinul Bahluiului*, Editura Bucovina Istorică, Suceava.

Butzer Karl W. 1982 – *Archaeology as human ecology: Method and theory for a contextual approach*, Cambridge University Press, Cambridge – New York – Melbourne – Madrid – Cape Town – Singapore – São Paulo.

Clark Anthony 1990 – *Seeing beneath the soil. Prospecting methods in archaeology*, B. T. Batsford, London.

Connoly James, Lake Mark 2006 – *Geographical Information Systems in Archaeology*, Cambridge University Press, Cambridge.

Conyers Lawrence B. 2004 – *Ground-Penetrating Radar for Archaeology*, Walnut Creek – Lanham – New York – Toronto – Oxford.

Dincauze Dena Ferran 2000 – *Environmental archaeology: principles and practice*, Cambridge University Press, Cambridge – New York – Melbourne – Madrid – Cape Town – Singapore – São Paulo.

Fassbinder Jorg W.E., Gorka Tomasz H. 2009 – *Beneath the Desert Soil – Archaeological Prospecting with a Caesium Magnetometer*, in: *New Technologies for Archaeology Natural Science in Archaeology*, (eds. M. Reindel, G.A. Wagner), Springer-Verlag, Berlin, Heidelberg, p. 49-69.

Gaffney Chris, Gater John 2003 – *Revealing the Buried Past. Geophysics for Archaeologists*, Gloucesternshire.

Gaffney Vincent, Stančič Zoran 1991 – *GIS approaches to regional analysis: a case study of the island of Hvar*, prefaţă de Kenneth Kvamme, Ljubljana.

Hodder Ian 1995 – *Theory and practice in archaeology*, Routledge, London – New York.

Knapp Bernard A., Ashmore Wendy 1999 – *Archaeological Landscapes: Constructed, Conceptualized, Ideational*, in: *Archaeologies of Landscapes. Conteporary Perspectives*, (eds. Wendy Ashmore, Bernard A. Knapp), Blackwell Publishers, Oxford, p. 1-30.

Kvamme Kenneth L. 1989 – *Geographic Information Systems in Regional Archaeological Research and Data Management*, Archaeological Method and Theory, 1, p. 139-203.

Idem 1995 – *A view from across the water: the North American experience in archaeological GIS*, in: *Archaeology and GIS: A European Perspective*, (eds. Gary Lock, Zoran Stančič), Taylor & Francis, London, p. 1-14.

Idem 1999 – *Recent Directions and Developments in Geographical Information Systems*, Journal of Archaeological Research, 7, 2, p. 153-201.

Idem 2003 – *Geophysical Surveys as Landscape Archaeology*, American Antiquity, 68, 3, p. 435-457.
Idem 2006 – *Magnetometry: Nature's Gift to Archaeology*, in: *Remote sensing in archaeology: an explicitly North American perspective*, (ed. Jay K. Johnson), University Alabama Press, Tuscaloosa, Alabama, p. 205-233.
László Attila 2006 – *Introducere în arheologie*, Editura Demiurg, Iaşi.
Lerici Carlo Maurilio – *Una grande avventura della archeologia moderna (1955-1965) Dieci anni di Prospezioni archeologiche*, Lerici, Torino.
Linford Neil 2006 – *The application of geophysical methods to archaeological prospection*, Rep. Prog. Phys., 69, p. 2205-2257.
Lock Gary 2003 – *Using computers in archaeology: towards virtual pasts*, Routledge, Taylor & Francis, London – New York.
Lock Gary, Zoran Stančič (eds.) 1995 – *Archaeology and Geographical Information Systems: A European Perspective*, Taylor & Francis, London.
Neubauer Wolfgang 2001 – *Images of the invisible-prospection methods for the documentation of threatened archaeological sites*, Naturwissenschaften, 88, p. 13–24.
Idem 2004 – *GIS in archaeology – the interface between prospection and excavation*, Archaeological Prospection 11, p. 159-166.
Neubauer Wolfgang, Eder-Hinterleitner Alois 1997 – *Resistivity and Magnetics of the Roman Town Carnuntum, Austria. An example of combined interpretation of prospection data*, Archaeological Prospection, 4, p. 179-189.
Oswin John 2009 – *A field guide to geophysics in archaeology*, Praxis Publishing, Chichester.
Palmer Rog 2009 – *Implicaţii ale arheologiei aeriene pentru arheologia din România*, in: *Arheologie aeriană în România şi în Europa*, (eds. Rog Palmer, Irina Oberländer-Târnoveanu, Carmen Bem), CIMEC-Institutul de memorie culturală, Bucureşti, p. 8-61.
Petre Aurelian 1966a – *Noi metode tehnice de prospecţiuni arheologice*, SCIVA, 17, 1, p. 198-209.

Idem 1966b – *Noi metode tehnice de prospecţiuni arheologice* (partea a II-a şi a III-a), SCIVA, 17, 3, p. 165-182.
Piro Salvatore 2009 – *Introduction to geophysics for archaeology*, in: *Seeing the unseen: geophysics and landscape archaeology*, (eds. Stefano Campana, Salvatore Piro), CRC Press – Taylor & Francis Group, London, p. 27-64.
Pollard Mark A. 1999 – *Geoarchaeology: an introduction*, in: *Geoarchaeology: exploration, environments, resources*, (ed. Mark A. Pollard), Geological Society, London, Special Publications, 165, p. 7-14.
Renfrew Colin 1981 – *Space, Time and Man*, Transactions of the Institute of British Geographers, Serie nouă, 6, 3, p. 257-278.
Renfrew Colin, Bahn Paul 1991 – *Archaeology. Theories, methods and practice*, Thames and Hudson, London.
Schmidt Armin 2007 – *Archaeology, magnetic methods*, in: *Encyclopedia of Geomagnetism and Paleomagnetism*, (eds. D. Gubbins, E. Herrero-Bervera), Springer, Encyclopedia of Earth Sciences Series Heidelberg, New York, p. 23-31.
Schmidt Armin, Ernenwein Eileen 2011 – *Geophysical Data in Archaeology: A Guide to Good Practice*, ediţia a II-a revizuită, ADS: Archaeology Data Service, Oxbow, Oxford.
Schmidt Hubert 1932 – *Cucuteni in der oberen Moldau, Rumänien. Die Befestigte siedlung mit Bemalter Keramik von der Steinkupferzeit bis in die Vollentwickelte Bronzezeit*, Verlag von Walter de Gruyter & co., Berlin –Leipzig.
Scollar Irwin, Tabbagh Alain, Hesse Albert, Herzog Irmela 1990 – *Archaeological prospecting and remote sensing*, Cambridge.
Văleanu Mădălin-Cornel 2003 – *Omul şi mediul natural în neo-eneoliticul din Moldova*, Editura Helios, Iaşi.
Vita-Finzi Claudio, Higgs Eric 1970 – *Prehistoric Economy in the Mount Carmel Area of Palestine: Site Catchment Analysis*, Proceedings of the Prehistoric Society, London, 36, p. 1-37.
Weller Olivier, Brigand Robin, Nuninger Laure, Dumitroaia Gheorghe 2011 – *Spatial Analysis of Prehistoric Salt*

Exploitation in Eastern Carpathians (Romania), in: *Archaeology and Anthropology of Salt: A Diachronic Approach*, (eds. Marius Alexianu, Olivier Weller, Roxana-Gabriela Curcă), BAR International Series 2198, Archaeopress, Oxford, p. 69-80.

Westcott Konnie L., Brandon R. Joe (eds.) 2000 – *Practical Applications of GIS for Archaeologists: A Predictive Modeling Kit*, Taylor & Francis, London.

Weymouth John W. 1986 – *Geophysical methods of archaeological site surveiyng*, in: *Advances in archaeological method and theory*, (ed. Michael B. Schiffer), Academic Press, Orlando – San Diego – New York – Austin – London – Montreal – Sydney – Tokyo – Toronto, p. 311-389.

Wheatley David, Gillings Mark 2002 – *Spatial Technology and Archaeology. The archaeological applications of GIS*, Taylor & Francis, New York.

Zubrow Ezra B.W. 2006 – *Digital Archaeology. A historical context*, in: *Digital archaeology: bridging method and theory*, (eds. Thomas L. Evans, Patrick Daly), Routledge, Taylor & Francis Group, London – New York, p. 8-27.