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VOLUME I

Archaeometry

Statistics and Classification

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Vasile Chirica

A Survey of the Development of Computer Applications in Romanian Archaeology

1 Introduction

Situated in southeast Europe, Romania has been from the oldest times a region favourable to man's life, as well as to cultural contacts and influences. As a result of this, archaeological remains are extremely rich and diverse. Before the Second World War, Romanian archaeological research followed the general development of the discipline elsewhere in Europe. After the Second World War, when the communist system was created in Romania, this natural development stopped. First of all, the relationship with the West was broken, and later, after Ceauşescu's National Socialist regime took power, contacts with other socialist countries were cut to a minimum. Although the progress of human thought can be hindered by such obstructions, it cannot be irrevocably stopped. Inevitable technical progress, although slow, and the permanent searching process which is a general feature of the human mind, led to Romanian researchers becoming interested in computer applications and quantitative methods in archaeology.

2 The beginnings

The first studies concerning the application of quantitative methods in archaeology and related sciences were spontaneous and disorganised. The use of mathematical models was necessary in those fields of research where large numbers of similar objects existed. This is why the first applications of statistical methods was in numismatics (Mihăilescu-Bîrliba 1969).

At the same time, the end of the 1960s, at the Mathematics Institute of the Romanian Academy, Professor Grigore Moisil started a course in mathematical methods for archaeologists and numismatists from Bucharest. Some joint projects between mathematicians and archaeologists were completed and it seemed that a period of favourable co-operation was beginning.

On the initiative of the same great Romanian mathematician, the Romanian Academy and the Royal Society of London organised the Anglo-Romanian Conference on Mathematics in the Archaeological and Historical Sciences, which took place in 1970 at Mamaia (near Constanţa, ancient Tomis). Numerous well-known researchers, both from Europe and other continents, took part. The proceedings were published in the following year (Hodson *et al*. 1971). The papers included dealt with cluster analysis, seriation, and the identification of tree structures. The editors wrote:

> 'the first point made by the contributors to this volume is that statistical methods, quantification and computer processing of data do not suddenly transform history from a subjective to an objective study... [because] such mathematical analyses... [are] capable only of reducing the level of uncertainty'.
>
> (Edinburgh University Press, 1971: dust-jacket).

Nine Romanian archaeological papers by twelve authors were published. The themes presented at this conference included: 'Some mathematical aspects of taxonomy and diagnosis in archaeology' (Manolescu/Bordenache 1971), 'Discrimination and classification of certain types of pottery' (Savu 1971), 'Applications of mathematical methods to epigraphy' (Ştefan 1971a), 'Some possibilities for using the volume of information in archaeology and history' (Oprescu 1971) and so on. Some of these studies moved beyond mathematical methodological considerations and dealt with real archaeological problems. Examples included how one could infer the cultural origin of the group of artefacts from the Middle Bronze Age when this origin is uncertain, through their assimilation with 'inference problems' or 'Federal problem' and solve this using Bayes' theorem (Iosifescu/Tăutu 1971); and the chronological seriation of Greek inscriptions using the methods elaborated by Hole and Shaw (1967) for archaeological sites, adapted for epigraphy (Kivu-Sculy 1971; Ştefan 1971a, 1971b).

3 Stagnation

Naturally, after the Mamaia conference, the application of mathematical methods in archaeology should have grown rapidly. Unfortunately, this did not happen because politics interfered again. Immediately after Professor Moisil's death in 1973, the Mathematics Institute of Bucharest was dissolved, the buildings and computers were given to other institutions and the researchers were sent to work in other towns or factories. What had happened? Ceauşescu's daughter, who was working at the Institute, had a 'strange

adventure' which annoyed her father. After visiting the Institute he decided to close it down. During this period, a 'mini-cultural revolution' was underway. Any possible opponent had to be eliminated and intellectuals were particularly targeted. Everybody had to know that there was only one omnipotent master.

A period of stagnation, which lasted for more than a decade, followed. However, progress could not be stopped entirely and there were individual efforts during those years. Thus, at the Institute of Archaeology in Iaşi, Cătălina Bloşiu proposed a general system model of archaeological data computer processing. The proposed system relied upon standardised descriptions which then may be used as a basis for information retrieval, and with the advantage of automatic generation of catalogues (Bloşiu 1972-1973). Alexandra Ştefan also continued to work on a method of chronological seriation of Greek inscriptions (unpublished). Unfortunately, their emigration from Romania put an end to these projects. In 1979, a 'Round Table' was held in Paris on the theme 'Statistics and Numismatics' (Carcassonne/Hackens 1981) and papers were presented by Mihăilescu-Bîrliba (1981, 1981-1982) and Poenaru Bordea (1981). Both papers examined statistical methods for numismatics.

4 A new beginning

From the start of the 1980s, computer applications in archaeology again began to expand and some research teams were founded. A strong team was instituted at the *Information Centre for Culture and Heritage* (CIMEC). CIMEC, led by Dan Matei and Irina Oberländer-Târnoveanu, is responsible for the development and administration of the National Cultural Information System (Oberländer-Târnoveanu this volume). SI-PCN was designed and tested from 1978 to 1981[1] and implemented over several years, beginning in 1982.

Another research centre was founded at Cluj-Napoca where archaeologists such as Gh. Lazarovici and Z. Kalmar, from the Museum of the History of Transylvania, started co-operating closely with mathematicians and physicists from the Institute of Isotopic and Molecular Technology, Cluj; the Faculty of Mathematics and Physics, Cluj and the Institute of Nuclear Engineering, Bucureşti-Măgurele. As a result of this close co-operation two national conferences on the application of physics and mathematics in archaeology were organised, both in Cluj-Napoca, in 1987 and 1989. The papers have been published in two volumes of proceedings (Frangopol/Morariu 1988, 1990).

These two conferences in Cluj give a clear picture of the stage of Romanian research in this field before the revolution of 1989. We shall quickly mention some of the themes covered in those volumes. For example, Frenţiu and Lazarovici (1988, 1990, 1993) used cluster analysis, factor analysis with VARIMAX rotation, and seriation methods in the classification of archaeological materials; Stănescu (1990) examined the possible astronomical significance of the sacred precinct at the late Iron Age site of Sarmizegetusa Regia;[2] Blăjan, Oproiu and Popa (1990) investigated the orientation of graves in the early medieval cemetery at Alba Iulia; Dumitrescu and Lazarovici (1990) proposed a new fuzzy clustering procedure for archaeological data; Mărgineanu-Cârstoiu, Harhoiu and Cârstoiu (1990) undertook a comparison of various multivariate data reduction methods including principal components analysis, correspondence analysis, and classic and non-metric multidimensional scaling; Morariu, Salvanu and Frangopol (1990) undertook a dimensional analysis of pottery and Rişcuţia *et al*. (1990) performed an archaeometric investigation of human groups and produced cladogram projections on time co-ordinates. An information system for archaeology called BAZARH was presented for the first time. This project was established at the History Department of the Museum of History of Transylvania. The BAZARH system had three components: a database, a knowledge base, and an expert system for analysing the information in the knowledge and databases. Data processing varies from statistics and simple classification to complex mathematical analyses (Kalmar/Corbu 1990).

There were other projects developing computer applications in this period, but they were not satisfactorily developed, or were abandoned due to a lack of hardware and software (e.g., Cârstoiu 1990; Dumistrăcel/Mantu 1987; Harhoiu 1990; Mărgineanu-Cârstoiu 1990).

5 The Present Day

The revolution of 1989 has brought some major benefits. One of them is the free circulation of people, information and technology, and a freedom of initiative. Consequently, in 1992, CIMEC organised the *Eastern and Central European Regional Conference on Museum and Cultural Heritage* in Sinaia (RECOMDOC 1992). On this occasion CIMEC's computer based projects were presented. These are large! About 28 experts work at CIMEC. The National Cultural Information System (SI-PCN) is the largest in southeast Europe and the fourth largest in the world. The database has 740,000 entities recorded in machine readable form and about 740,000 data entry cards await processing. It also includes a museums reference database with 1,500 items of information about museum services; museums activities data collections; museum professionals' reference databases (for about 2,000 Romanian specialists); and a Romanian theatre history database. Recently, a historical monuments and archaeological sites database has been added with about 17,000 items. The 'National Database' includes an archaeological database (ARH) with more than

120,000 items and a numismatic database (NUM) with more than 140,000 items. The National Database is based on *thesauri* which standardise object and specimen description and thus enable data retrieval. These *thesauri* contain about 28,000 terms. Since 1989, CIMEC has used IBM compatible computers; software includes PARADOX, AXES, and for numismatic materials CHI-WRITER (Geber 1992; Matei 1992; Oberländer-Târnoveanu 1992; Oberländer-Târnoveanu/Geber 1992; Scorpan 1992).

Besides CIMEC there are other *nuclei* of researchers in Bucharest. The Institute of Archaeology 'Vasile Pârvan' has a group of researchers interested in computer applications. They use IBM PCs running PARADOX, SYSTAT, GIS and CAD programs for databases, seriation, clustering and classification, graphics and so on. In the Romanian National History Museum in Bucharest, there is another team of five analysts using PCs to construct databases of archaeological material, topography etc. The numismatic department is developing a database for a catalogue of coins from Roman Dacia and of the Byzantine collections. Lastly from Bucharest, at the Romanian Institute of Thracology, another team is creating a database of archaeological and anthropological materials.

The National Conferences on Archaeometry continue to be held in Cluj-Napoca; six have been held so far. The co-operation between archaeologists from Cluj and the experts from the Institute of Nuclear Physics (Bucureşti-Măgurele) and the Institute of Isotopic and Molecular Technology (Cluj-Napoca) also continues.

Other projects in Romania include a database at the Museum at Constanţa, and the analysis of the cemeteries from Cerneachov-Sântana de Mureş by Ion Ioniţă from the Institute of Archaeology in Iaşi. The final example comes from outside Romania, from the Republic of Moldova. In the Institute of Archaeology, Chişinău, researchers were working on databases of archaeological evidence and monuments, as well as applying quantitative methods to the study of neolithic and Middle Age settlements (Dergaciov 1980; Postică 1994). Unfortunately, their only computer is currently broken.

6 Conclusions

In Romania, computer applications and quantitative methods have developed unevenly — periods of progress were followed by periods of stagnation. However, development could not be stopped. At present the main areas of research are the development of archaeological databases and the application of statistical methods. Graphical methods are less developed and GIS is impossible due to a lack of access to map data. The following problems face us:

1. computers are uncommon and often old;
2. as a result of 1. few archaeologists can use them in their work;
3. available software is not always suitable.

We hope that as the number of computers increases, and closer contacts with the rest of Europe improve, so research in this field will advance rapidly.

notes

1 The system was developed using MISTRAL 2 on a FELIX 256 mainframe, the only hardware and software available in Romania at that time.

2 See Daicoviciu, Ferenczi and Glodariu (1989) for a description of the site.

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