28

The status of the use of computer applications in Danish archaeology

Jens Andresen*

28.1 Introduction

Although considerations and experiments on the use of computers have a relatively long tradition in Danish archaeology, no comprehensive scientific project has yet been carried through. The use of computers in archaeological science is reduced to storing and retrieval purposes (besides text-processing) and, until now, leaving the analytical potentials as almost unexploited. The level of Danish theoretical archaeology is the main reason for this situation.

Generations of archaeologists educated before about 1970 were dominated by the cultural-history tradition, and their humanistic approach was by definition in contradiction to a 'hard science' like mathematics. So, computers were thought to be 'incompatible' with the archaeological theory of that time. Between World War II and about 1970 the introduction of precise definitions and measurements in archaeology, due to a strong positivistic influence, was supposed to change archaeology to a 'scientific' state, 'scientific' here meaning 'value-neutral/objective.' For the generation of archaeologists who were influenced by this approach, computers were a natural choice, but they were at that time 'user-unfriendly' and the archaeologists had no educational background for using them. Despite these new methods, the goal of archaeology seemed to be still the same, as well as the tendency towards empiricism, and, in consequence of that, theory-hostility.

This picture changed at the universities about 1970, where Danish archaeology became influenced by the processual 'new archaeology' and by neo-marxistic approaches. Where the last approach tended to be strongly anti-empiristic it kept close ties to the old humanistic tradition, and in these qualitative analysis there was no use for computers. 'New archaeology' never got a real foothold at Danish universities. As far as I can understand from the development abroad, the use of computers in 'New archaeology' seems restricted to simulation-applications; computer archaeology, as far as it exists in Danish research, for those reasons seems to be stuck in a kind of 'stalemate' situation. What must be the force behind a future computer archaeology is a dynamic integration

* Institute of archaeology,
University of Århus
Moesgård,
DK-8270 Højbjerg
Denmark

of theory and empiri by combining the best from the old as well as the best from the new archaeology (Trigger 1986). From the old archaeology we need source-criticism and the thorough and comprehensive knowledge of the archaeological record. From the new archaeology we need model-formation and theoretical concepts.

28.2 Initializing the dynamics of progress

28.2.1 Analytical and formal concepts

So far the ideal. Yet, back to reality, where today's subjects of computer archaeology seem very primitive compared to those discussed in the theoretical literature. The 'gap' between data(-processing) and theory (Madsen 1988, Doran 1986) is very visible in our (at least my own) inability to express operative terms and concepts in computer language: how shall I for instance formalize concepts like 'social stratification' and 'economy' just to mention a few?

We have to start somewhere. User-interfaces based on conceptual schemas, as presented for instance by R. Cribb (Cribb 1986), are very inspiring. Basing the research on conceptual schemas of the archaeological record with its various levels, means that one is not bound to fast changing technology, but the creation of different tool-boxes must also have a priority. Where sites, excavation techniques and typological orderings are different from case to case, the procedures involved in the analysis are considered to be mainly common.

28.2.2 Organisation

Until the PC explosion, the use of computers in Danish archaeology was concentrated in a few people connected to the universities; this is a general picture for the whole of Scandinavia (Bertilsson 1981) and Western Germany (Gebühr & Kampffmeyer 1982). Now, even where computer-power is economically accessible and widespread in Danish archaeological institutions, scientific use of the computer is still very rare. The development of research-tools in the form of special dedicated software is mainly beyond the capacity of the practical archaeology at the local museums—at least until now it has no precedence.

Concerning the use of the computer in archaeology we consider ourselves in a strange dilemma: the practical archaeology possesses the necessary technical equipment (Floryan *et al.* 1987), but has no software to put into it: there is a 'market' which has needs, but no means to fulfill them. The theoretical archaeology at the universities, is only slowly and gradually discovering the immense potential of the computer. A way out of this dilemma is—for a start—to get connection to the international 'network' of computer-archaeologists and to participate in the development of dedicated tools in terms of software, and to get these tools out to the end-users at the museums by means of an national distribution network (Madsen this volume).

28.3 A short history of Danish computer-archaeology

28.3.1 Chronological framework

In the following I will take a look back in the past archaeological research in Denmark and see what the two or maybe three handfuls of Danish archaeologists, who have

contributed to the subject, have dedicated their research to. I will try to draw some parallels to the development on this subject abroad, in so far as it can be followed in the numerous articles on the history of computer-archaeology.

But to start with the past, I will begin with the outline of a relative, chronological framework: because the access to computer-power very simply is of decisive importance for computer-archaeology, Danish computer-archaeology to date can be divided into three phases, of which the invention of the PC about 1982 constitutes the third phase (see also Gaines 1981, Gaines 1984). The first phase was the 'computer archaeology without computers' from the end of World War II to about 1970, when mainframes were installed at the university computing centres in Copenhagen and Århus, constituting the second phase. The implementation of PC-networks on a broader scale at the archaeological institutions will form a fourth phase.

I. Scollar (Scollar 1982) came to similar conclusions earlier, although (in the author's opinion) he over-emphasizes the importance of the available technology at the expense of the analytical, archaeological method and theory.

> 'I believe that the developments in all three categories (*of computer-archaeology, J.A.*) are technology driven, that is, advances in hardware, operating software and high level languages offer opportunities for invention which drive progress.' (Scollar 1982)

The Danish research on computer archaeology to date has been relatively easy to survey and has generally speaking been concentrated on the following subjects: 1) museum cataloguing and central data-files, 2) registration and analysis of single sites, and 3) descriptive and analytic statistics, and these are dealt with in the following sections.

28.3.2 Museum cataloguing and central data-files

This subject has been of main interest in Danish computer archaeology, but, popularly speaking, the attitude to the subject has been similar to the attitude to the weather: everybody is talking about how bad is—no one is doing anything to change it. For about 30 years there has been a lot of talking, little writing and no action.

As a part of the historical background it must be mentioned here, that the National Museum in Copenhagen under Professor Sophus Müller until his departure about 1920 had an 'imperialistic' attitude towards the local museums scattered in the Danish landscape. The super-position of Copenhagen in Danish archaeology was vitally changed with the establishment of an archaeological institute in Århus in 1949 with P. V. Glob as a professor and at the same time head of the new Prehistoric Museum. Like the National museum, but unlike the local museums, the Prehistoric Museum had and still has the permission to make excavations all over Denmark. It may therefore also, besides the dissatisfaction with the structure of the central files in Copenhagen, have been connected with a good deal of politics when three archaeologists in Århus in 1950 proposed the establishment of a central card file for the Danish archaeological record to be located in Århus (Voss 1967).

It was a great idea, but the project was—mildly speaking—ambitious. At that time the heads of the museums invented 'the(ir) best system' for museum cataloguing. Add to this that the individuals in the group did not agree on the structure and contents of

the card file, and it is no wonder that nothing happened until the idea had a renaissance in the middle of the 60's.

Due to the theoretical development through to 40's, 50's and 60's, by scientists like J.-C. Gardin and M. P. Malmer, the analytical tool for an all purpose generalized data bank seemed to be present. The idea was, that if the objects of scientific research were split-up into the 'smallest possible' traits/'minimal units of observation' (Scholtz & Chenhall 1976) the description of the object became objective. So the aim of many archaeologists was to find the 'natural clustering' of artifact-traits, possibly by means of an automatic classification with a computer.

After the publication of the article by Hill & Evans in 1972 (Hill & Evans 1972), this theoretical position was left behind. It was now considered that 'minimal units' and standard types did not exist. Data, as Hill & Evans stated, were problem-specific, so the goal of creating a general data bank with detailed descriptive information of the items, became incompatible with the new theoretical paradigma in archaeology (Whallon 1972, Stewart 1984). Because Denmark, compared with the USA, is behind in technological development, the theoretical development overtook the idea of the central data-file before practical steps towards computerizing were taken. For Denmark, as for other countries as well (Scholtz & Chenhall 1976), it may also have been of major importance that the practical consequences, for instance in terms of the amount of labour involved with the registration work, were overwhelming.

An alternative was set up by P. Crabb and P. Kjærum in collaboration with the computer centre in Århus (Crabb & Kjærum 1966). But in contradiction to the previous proposal, the databank was not intended to contain primary descriptive data of the objects recorded (see also Cleere 1984). In 1968 Rex Andersen made research on the administrative procedures involved at the museums (Andersen 1968). He worked very consciously on rationalizing and computerizing these procedures, and in a slightly modified version Voss presented Rex Andersen's results to the Danish archaeological museums at a meeting in 1972 (Voss 1972). The system was introduced at the museum in Odense and was implemented in 1984, in collaboration with a semi-public computer organisation (Anonymous 1984), on a mainframe system.

It was not until 1982 the idea of a central data-bank of the Danish archaeological record partly became a reality with the establishment of the DKC ('Det Kulturhistoriske Centralregister', The National Museum, Copenhagen). Partly, because the database so far is 'only' intended to contain all known Danish archaeological sites (minimum 120,000) (Høy 1988), although recently sites and finds under sea-level have also been recorded and stored in a central data-base (Christoffersen 1987).

Due to a very large endowment the National Museum has begun working on the registration of informations on the moveable objects from the sites (Larsen *et al.* 1987). The field description of the database is already finished and an immense amount of registration-work remains. For the smaller local museums a similar, but reduced version is under development. The implementation of these systems makes it necessary standardize the codes and concepts used. I will only state here, that it is a political problem to standardize concepts between independent institutions (Huggett 1987). Many attempts have been made at the research level (Voss 1970, Anonymous 1985b) leaving the political problems unsolved. There is a general political problem between the interests of the central government and the local authorities. The idea of 'sharing' data in central files is very easily confused with the concept of expropriation of data.

In order to achieve control over an area which is developing very fast, the organization of the local museums in Denmark, DKM, in cooperation with Statens Museumsnfvn, the service organisation of the museums, established a board which is supposed to organize the innovation of computers at the museums. Their first action was to define a recommended hardware-standard, the IBM-standard (Anonymous 1985a). This action has been followed up by reports with recommendations on word-processing and spreadsheet software (Floryan *et al.* 1987). At least, an administrative system is planned to be developed in near future (Anonymous 1987).

28.3.3 Registration and analysis of single sites

At the beginning of the 70's funds from the Danish Research Council made it possible for Fischer & Mortensen (Fischer & Mortensen 1977) to develop the first piece of dedicated Danish software for archaeological research: the ARCADY system. It is implemented at the computer centre at the university of Copenhagen and was designed mainly for documentation and analysis of sites from the stone age and exhibits similar features as Newell & Vroomans 'Automatic Artifact Registration' (Newell & Vroomans 1972). Despite the general aim of ARCADY, however, no other site than the 'test site' to my knowledge has been analysed using the package.

At the university of Århus similar projects took place at that time, but here the applications took advantage of standard software packages such as SPSS and DISSPLA. The most comprehensive project of this kind was the analysis of the causewayed camp Sarup, Funen. The site contains over 3,200 features and approximately 285,000 objects, which are recorded and stored in approx. 4,000 and 41,000 'cases' in SPSS-files (Andersen nd). Nowadays the role of the university computer-center in Århus is gradually replaced by the PC's. There will be less and less need for the center as more and more PC's with peripherals are installed and connected by local networks with ports to the outside world.

The iron-age weapon-offering from Illerup (16,000 objects) is the first Danish attempt to document and analyse a site entirely on the PC with creation of dedicated database- and analysis-programs in dBase III+ and Pascal. It is planned to continue this work with special programs for analysis and documentation for graves and graveyards of the iron age of northern Europe (Andresen nd). A collaborative team of Danish and American scientists has presently come up with a first version of a dedicated toolbox for spatial analysis called ARCOSPACE (Blankholm & Price 1988). It contains the majority of known procedures for spatial analysis and will be launched in summer 1988.

28.3.4 Descriptive and analytic statistics

While Andersen, Voss & Ørsnes only planned to use statistics in the analyses of the archaeological record, Poulsen made a first attempt in this direction in 1970 (Poulsen 1972). He recorded in a very detailed manner ceramic material (16,000 sherds) from Tonga, Western Polynesia (1963–64 at the Australia National University, Canberra). The final analysis was carried out in Århus.

A few years later, a systematic research in this field was initiated by Madsen. Previous applications of statistics in Danish archaeology (with or without the use of computer) were mainly descriptive. Madsen introduced very complicated multivariable

statistics, like correspondence analysis with great success in Danish archaeology (Madsen 1985). This research is theoretically and practically well-founded and is planned to be continued by transferring the statistical programs from the mainframe to a PC-version (Madsen 1988).

References

ANDERSEN, K. R. 1968. *Museumsregistrering*. Handelshøjskolen i Århus.

ANDERSEN, N. H. n.d. "Sarup".

ANDRESEN, J. n.d. "Anwendung del EDV bei der Auswertung der Funde von Illerup, Dänemark".

ANONYMOUS 1984. *Brugervejledning for museumssystemet*. Kommunedata.

ANONYMOUS 1985a. *Anskaffelse af EDB-udstyr i de danske museer. Delrapport fra Statens Museumsnævns EDB-udvalg*. Statens Museumsnævn.

ANONYMOUS 1985b. *Thesaurus of archaeological terms*. RCHM.

ANONYMOUS 1987. *Kravspecifikation for museumssystem*. Statens Museumsnævn.

BERTILSSON, U. 1981. "Dokumentation av arkeologiska data". *in* Anonymous, (ed.), *Dokumentation–forskning. En fältarkeologisk programdiskussion*, pp. 47–62. Riksantikvarieämbedet, Stockholm.

BLANKHOLM, H. P. & T. D. PRICE 1988. *ARCOSPACE. A package for spatial analysis of archaeological data*.

CHRISTOFFERSEN, J. 1987. *Det marine register*. Nationalmuseet, Copenhagen.

CLEERE, H. 1984. "Only connect". *in* Martlew, R., (ed.), *Information systems in archaeology*, pp. 9–20. Alan Sutton, Gloucester.

CRABB, P. & P. KJÆRUM 1966. *Landsregister*. Moesgaard, Århus.

CRIBB, R. 1986. "Introducing the Concept of a Dedicated Spatial Analysis Package for Archaeology", *Archaeological Computing Newsletter*, 9: 5–12.

DORAN, J. 1986. "Formal methods and archaeological theory: a perspective", *World Archaeology*, 18: 21–37.

FISCHER, A. & B. N. MORTENSEN 1977. "Trollesgavebopladsen. Et eksempel på anvendelsen af EDB indenfor arkæologien.", *Fra Nationalmuseets Arbejdsmark*, 1977: 90–95.

FLORYAN, M. *et al.* 1987. *EDB på museerne. Et nyt redskab i de danske museers daglige arbejde*. Statens Museumsnævn.

GAINES, S. W. 1981. "Computerized data banks in archaeology: the european situation", *Computers and the Humanities*, 15: 223–226.

GAINES, S. W. 1984. "The impact of computerized information systems in american archaeology: an overview over the past decade". *in* Martlew, R., (ed.), *Information systems in archaeology*, pp. 63–76. Alan Sutton, Gloucester.

GEBÜHR, M. & U. KAMPFFMEYER 1982. "Überlegungen zum Einsatz von Kleinrechnern in der Ur- und Frühgeschichtsforschung", *Acta Praehistorica et Archaeologica*, 11/12: 3–20.

HILL, J. N. & R. K. EVANS 1972. "A model for classification and typology". *in* Clarke, D. L., (ed.), *Models in archaeology*, pp. 231–274.

HØY, G. 1988. "From hand-written archive to computer-readable data". *in* Ruggles, C. L. N. & Rahtz, S. P. Q., (eds.), *Computer and Quantitative Methods in Archaeology 1987*, International Series 393. British Archaeological Reports, Oxford.

HUGGETT, J. 1987. "Computer Usage in British Archaeology–a review", *Archaeological Computing Newsletter*, 10: 12–17.

LARSEN, C. U. *et al.* 1987. *Samordnet genstandsregistrering. Forslag til systemløsning.* Nationalmuseet, Copenhagen.

MADSEN, T. 1985. *Numerisk dataanalyse for arkæologer.* Århus Universitet, Århus.

MADSEN, T., (ed.) 1988. *Multivariate Archaeology. Numerical approaches in Scandinavian Archaeology*, Jutland Archaeological Society Publications XXI. Århus University Press, Århus.

NEWELL, R. R. & A. P. J. VROOMANS 1972. "Automatic Artifact Registration and Systems for Archaeological Analysis with the Philips P1100 Computer: A Mesolithic Test-case.", *Anthropological Publications.*

POULSEN, J. 1972. "On the processing of pottery data", *Jysk Arkæologisk Selskabs Håndbøger*, II.

SCHOLTZ, S. & R. G. CHENHALL 1976. "Archaeological data banks in theory and practice", *American Antiquity*, 41,1: 89–96.

SCOLLAR, I. 1982. "Thirty years of computer archaeology and the future, or looking backwards and forwards at the same time while trying not to twist one's neck". *in Computer Applications in Archaeology 1982.* University of Birmingham, Birmingham.

STEWART, J. 1984. "Museums—'Cabinets of curiosities' or centres of information?". *in* Martlew, R., (ed.), *Information systems in archaeology*, pp. 76–89. Alan Sutton, Gloucester.

TRIGGER, B. G. 1986. "Prospects for a world archaeology", *World Archaeology*, 18,1: 1–20.

VOSS, O. 1967. "Dokumentationsproblemer indenfor arkæologien", *KUML*, 1966: 97–134.

VOSS, O. 1970. *Udkast til artsfortegnelse/registrant over oldsager.* Århus Universitet, Århus.

VOSS, O. 1972. "Hvad er en sag?".

WHALLON, JR., R. 1972. "The computer in Archaeology. A critical Survey", *Computer and the Humanities*, 7 (1): 29–47.