COMPUTERS AND SEDIMENT ANALYSIS IN ARCHAEOLOGY

by
M.L.Shackley
Dept of Archaeology, University of Southampton

Abstract

This note presents some ideas on the potential application of computer techniques to the analysis of sediments from archaeological sites. It ventures into realms of possibility, rather than probability, but is intended to give an idea of the role that the computer could play in the formation of this rather ill-defined field.

The use of a computer to store and manipulate sedimentological data is a standard geological technique, but little work has been done on archaeological applications. This is, perhaps, a function of the general lack of interest in the systematic study of archaeological sediments, fostered by excavators who regard them as the component of a site biosphere with the lowest potential information yield. Thus any archaeological sediment analysis is likely to be aimed at solving a problem which has eluded all other available methods. This 'last resort' approach is only gradually being replaced by the view that a study of the sediments on a site is as vital to an understanding of its potential as a study of pollen, or animal bones. In order to encourage this view it is necessary to apply problem-orientated analytical techniques, often adapted from other branches of the earth sciences, which stimulate rapid accurate analysis, and clear presentation of results.

Computerised methods of data-storage and data-recovery should therefore form an integral part of a well-organised system for dealing with archaeological sediments, and may be applied at three separate levels.

Data recovery and storage

In an ideal situation certain basic sedimentological characteristics, such as colour, texture or pH, would be recorded straight from sections during the progress of an excavation, selected samples then being removed for specific laboratory analysis. As far as the writer is aware this double procedure has never been fully carried out, certainly inadequate storage of data and publication has not allowed the formation of a data bank, vital for research purposes. The range of field descriptions carried out by the average excavator is severely limited, generally consisting only of a verbal description, unaccompanied by any quantitative data, although in addition to the above-mentioned characteristics the presence or relative abundance of many chemicals, for example phosphates, may easily be recorded in a semi-quantitative manner, from field work.

The selection of samples for laboratory study involves difficult decisions on the part of the site sedimentologist, since his own desire to explore the potential of the site may conflict with the desire of the excavator to obtain an answer to a particular question, and with the material and financial resources available to him. Ideally the results of any sediment analysis, however cursory, should be expressed in quantitative terms, and should thus be ideally suited to computerised methods. Such techniques as particle size analysis, grain shape, fabric and texture analysis, colour, pH and various chemical tests are particularly suitable, as well as more complex or time consuming techniques, such as X-ray diffraction, heavy mineral analysis, or spectrometry which would only be applied as a last resort.

The computer may thus be used to store data obtained from this double investigation, initial site-gathered data, transmitted either by remote-terminal site recording systems, or stored by more conventional methods for later retrieval, and data obtained from laboratory tests. Permanent data storage on discs or magnetic tape is obviously far preferable to a card system, and has the additional advantage of having the basic data instantly available within the computer, for recall in minimal time with infinite cross-reference potential. Further data manipulation and comparative work is therefore facilitated by a computer-based system.

Basic data manipulation

Assuming, optimistically, that this basic method has been followed, it is then possible to use the computer for routine mathematical and statistical tests, such as Students' t, Chi square, or correlation and regression. Such techniques may, of course, be done by hand, but are often extremely laborious and time-consuming. Work has already been done on computer-assisted particle size analysis for archaeology, where the computer received data simply in the form of weights, and would then compute percentages, cumulative percentages, complex descriptive parameters and textural descriptions. The American-designed program used for this particular scheme will perform all the calculations in approximately 3 notional seconds (1 C.P.U. second) per sample, using an ICL 1900 computer and a compile store requirement of not more than 19K words. Thus using this system 20 samples may be processed in 100 notional (30 C.P.U.) seconds, including compilation time, running and print-out, which, even allowing for the time taken to punch the cards, represents a time-saving of at least one hour per sample over other methods, and a great increase in accuracy. Similar programs are available for use with other techniques. The computer may also be utilised at this level for visual presentation in the form of graphs, and to perform any number of minor arithmetic chores. Since sediment analysis is of necessity an incredibly slow process, basic analysis of one sample taking up to three days, the time saved by computation is far from unimportant. Perhaps in the future work will be further speeded up by the adoption of totally automatic methods, such as the image-analysing computer, but if any progress at all is to be made, speed of processing is going to be vital, the time and resources available being minimal.

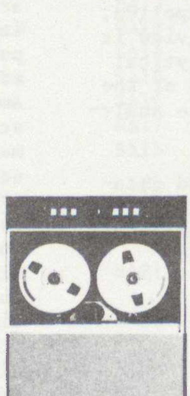
Complex data manipulations

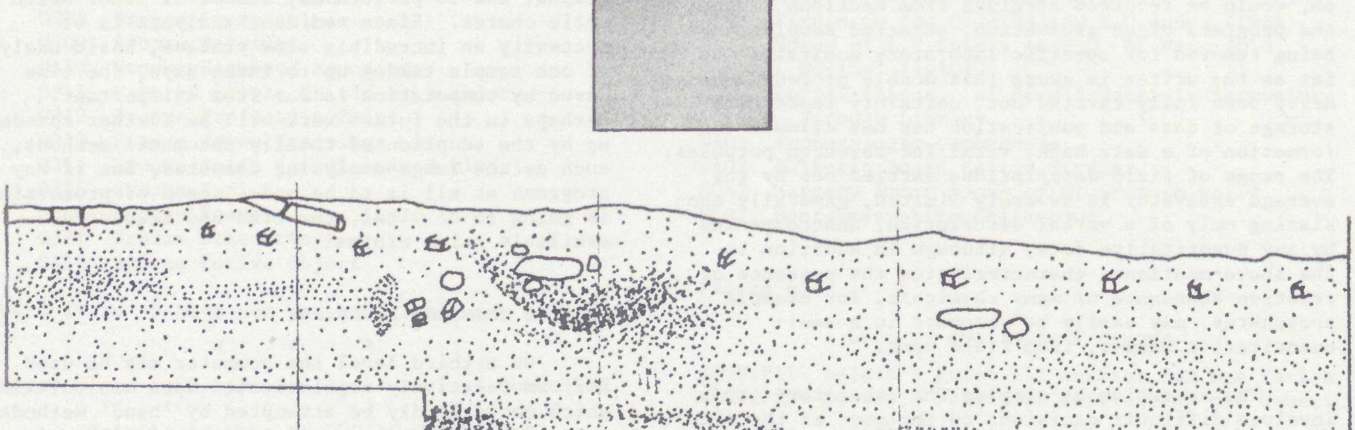
On a third level the computer may be used to perform relatively sophisticated data-manipulations, which could hardly be attempted by 'hand' methods. Extensive use has been made of this facility in other branches of archaeology, the techniques of matrix analysis, seriation, cluster analysis and multi-dimensional scaling being particularly fashionable at the moment. This is, however, a field which has yet to be applied to archaeological sedimentology, due to lack of basic information, although cluster and discriminant analysis seem likely to yield interesting results in specific problems or sites, and one could perhaps utilise the computer for tasks such as the construction of theoretical models for ditch and bank silting, and comparison with actual results, a task which is already being undertaken.

Conclusion

It could reasonably be said that the computer is likely to become an important tool in this field, although at present little progress has been made. Quantitative data is all too rare in the present day, since few excavators are convinced either of the relevance or the potential of sediment analysis. Very little computerised data storage on the first level has been accumulated for this reason, although the current interest in such techniques augurs well for the future. The greatest progress has been made on the second level of applications, using the computer as a labour-saving statistical aid. The writer does not consider that much progress is likely on more sophisticated techniques or applications, due to the lack of raw data. It is to be hoped that since quantitative sediment analysis is in itself new in archaeology the computer will become integrated as a vital part of the subject as it grows, but for practical reasons the ideal situation described above will be long in coming, and the growth rate is likely to be slow.

M.L.Shackley.
Dept of Archaeology,
The University,
Southampton,
Hants. SO9 5NH





LIST OF PARTICIPANTS

Mr P.A.Barker	4, St George Square, Worcester
Mr P.C.Barker	Society of Ancients
Mr A.M.Barringer	5, Westbury Road, Westbury on Trym, Bristol BS9 3AY
Mrs F.Bettess	170, Queen Alexandra Road, Sunderland, Co. Durham
Mr F.Bettess	- ditto -
Mr T.F.C.Blagg	84, Mansfield Road, London N.W.3
Mr P.Buckland	Birmingham University
Mrs D.J.Burkhardt	Birmingham University
Mr John Clark	Guildhall Museum, 55, Basinghall Street, London EC2V 3AY
Mr P.O.Couldrey	28, Pondfield Road, Hayes, Bromley, Kent BR2 7HS
Mr N.G.Gammer	East Gate Lodge, Embley Park, Romsey, Hampshire
Mr J.M.Graham	University of Reading, White-knights Park, Reading RG6 2AF
Miss J.M.Harrison	Birmingham University
Mrs E.Healey	9, Manor Park, Lewisham, London SE13 5QZ
Mr J.D.Hedges	Planning Department, County Hall, Chelmsford, Essex
Miss C.M.Hills	45, Rudall Crescent, London N.W.3
Mr W.E.Jenks	18, Langford Avenue, Upper Pulley, Shrewsbury SY3 OJU
Dr Juliet Jewell	British Museum, Zoology Department, Cromwell Road, London S.W.7 5BD
Mrs M.U.Jones	Mucking Excavation, Stanford le Hope, Essex
Mr W.T.Jones	- ditto -
Mrs D.R.Laflin	37, Freemans Close, Leamington Spa, Warks
Miss S.Laflin	University of Birmingham
Miss C.Lavell	c/o C.B.A., 8, St Andrews Place, London NW1 4LB
Mr N.Loughlin	University of Southampton
Mr Arthur MacGregor	York Archaeological Trust, 47, Aldwark, York
Mr J.R.Marjoram	Hazel End, Shottlegate, Derby
Mr C.R.Orton	39A Benhill Wood Road, Sutton, Surrey
Mrs B.Ottaway	Edinburgh University, 19/20 George Street, Edinburgh EH8 9JZ
Mr P.J.Parr	Institute of Archaeology, 31/34 Gordon Square, London WC1H OPY
Miss I. Philips	5, Lassa Road, Eltham, SE9 6PU
Mr W.A.Preen	Dinham, Underdale Avenue, Monkmoor, Shrewsbury (Shropshire Gazetteer Group)
Mr R.A.Pryor	8A Queens Park W. Drive, Bournemouth, Hants BH8 9BY
Mr D.F.Purcell	8, Dryburgh Mansions, Putney SW15 1AJ
Mr A.Saunders	Churchill Hall, Stoke Park Road, Bristol, BS9 1JG (Mucking Excavation)
Miss M.L.Shackley	Southampton University SO9 5NH
Mr C.T.Shay	Botany School, Downing Street, Cambridge CB2 3EA
Mr D.Smith	Mucking Excavation, Stanford le Hope, Essex
Mr Des E.Walshe	26, Oupen Avenue, Belfast 10, N.Ireland
Mr J.P.M.Whiting	156, Finborough Road, London SW10 9AH
Dr J.D.Wilcock	N. Staffordshire Polytechnic, Blackheath Lane, Stafford ST18 OAD
Dr D.B.Williams	British Museum, Zoology Dept., Cromwell Road, London SW7 5BD
Dr S.H.Hollingdale	University of Birmingham
Dr N.W.Alcock	University of Warwick
Mr J.Doran	Atlas Laboratory Chilton, Didcot Berks
Mr W.Ford	Archaeology Officer, County Lib. & Museum, H.Q., By the Sea Road, Trowbridge, Wilts
Mr R.A.Rutland	Keeper of Antiquities, Leicester Museum & Art Gallery