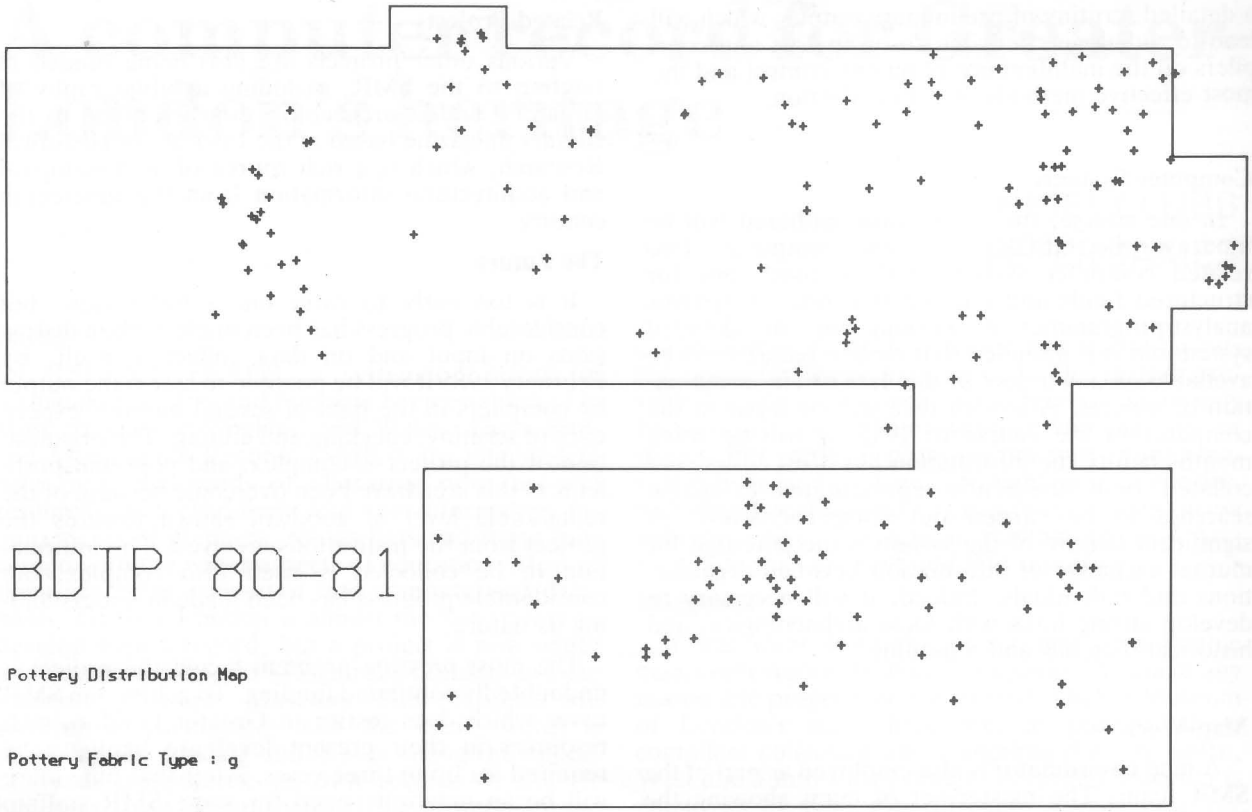

Fig. 1

Hard Copy Graphic Displays for Archaeologists

BRYAN ALVEY
JONATHAN MOFFETT

Introduction

AT A TIME WHEN more and more pressure is being put on archaeologists to excavate in less time for less money, it may seem that computers would form an expensive luxury on a limited excavation budget. This article seeks to demonstrate how a computer may be used in conjunction with a digital plotter to produce graphic displays essential to archive reports and publications of excavations quickly and at little cost.

Over the last ten years, modern recording methods have been streamlined in response to the pressure of rescue excavations; this has often meant that much time has been saved in the field, but at the expense of additional time needed in post-excavation to recover the data in order to make the series of plans essential for the analysis of the site.

One example of this is in the recording of skeletons; rather than each skeleton being planned individually on site, coordinates are taken in conjunction with vertical photographs to enable a swift removal. In post-excavation, the analyst or draughtsman is presented with a mass of coordinates which have to be copied laboriously onto plan again and

Fig. 2

again for each aspect of the site which is investigated. This process is a tedious task, and is expensive in labour, often resulting in an inadequate investigation.

Using a computer to store the data in files or databases, it becomes possible to draw plans automatically in a relatively short time. This paper shows some examples of how the plotter may be applied; all the programs are comparatively simple and may be run from any computer that has an RS232 serial interface for the digital plotter. In fact it is possible to use the digital plotter without the need to write computer programs, as text files of coordinates can also be used.

Graphics at the Institute of Archaeology

The examples given below were all produced at the Institute of Archaeology, University of London. This section describes the equipment used.

The Computer Systems

Two machines have been used. The first is a Sirton Computer Systems Midas 3HD. This is a Z80A microprocessor based microcomputer which has a 20 megabyte hard disk and a one megabyte floppy disk. The system runs CP/M 2.2 and therefore can use any of the software available for that operating system. The languages used at the Institute are Pascal and Basic. The system costs about £5500, but the graphics described can be achieved on any microcomputer which can communicate with the plotter.

The second machine is a PDP 11/73 running the Xenix operating system. This is a multi-user computer and is used for teaching computing at the Institute. Students are taught either Pascal or C, but versions of both Fortran and Basic are available.

Both machines have an RS232 serial interface for communications to peripherals such as printers, and any computer which has this type of interface can be used to produce the examples given below. This includes such 'home' computers as the Sinclair Spectrum for which it is possible to buy an RS232 interface.

The Digital Plotter

The plotter used at the Institute is a Houston Instruments DMP-7 Digital Plotter which has a plot bed size capable of taking A3 paper. It costs about £1200, but there are also A4 size plotters which cost

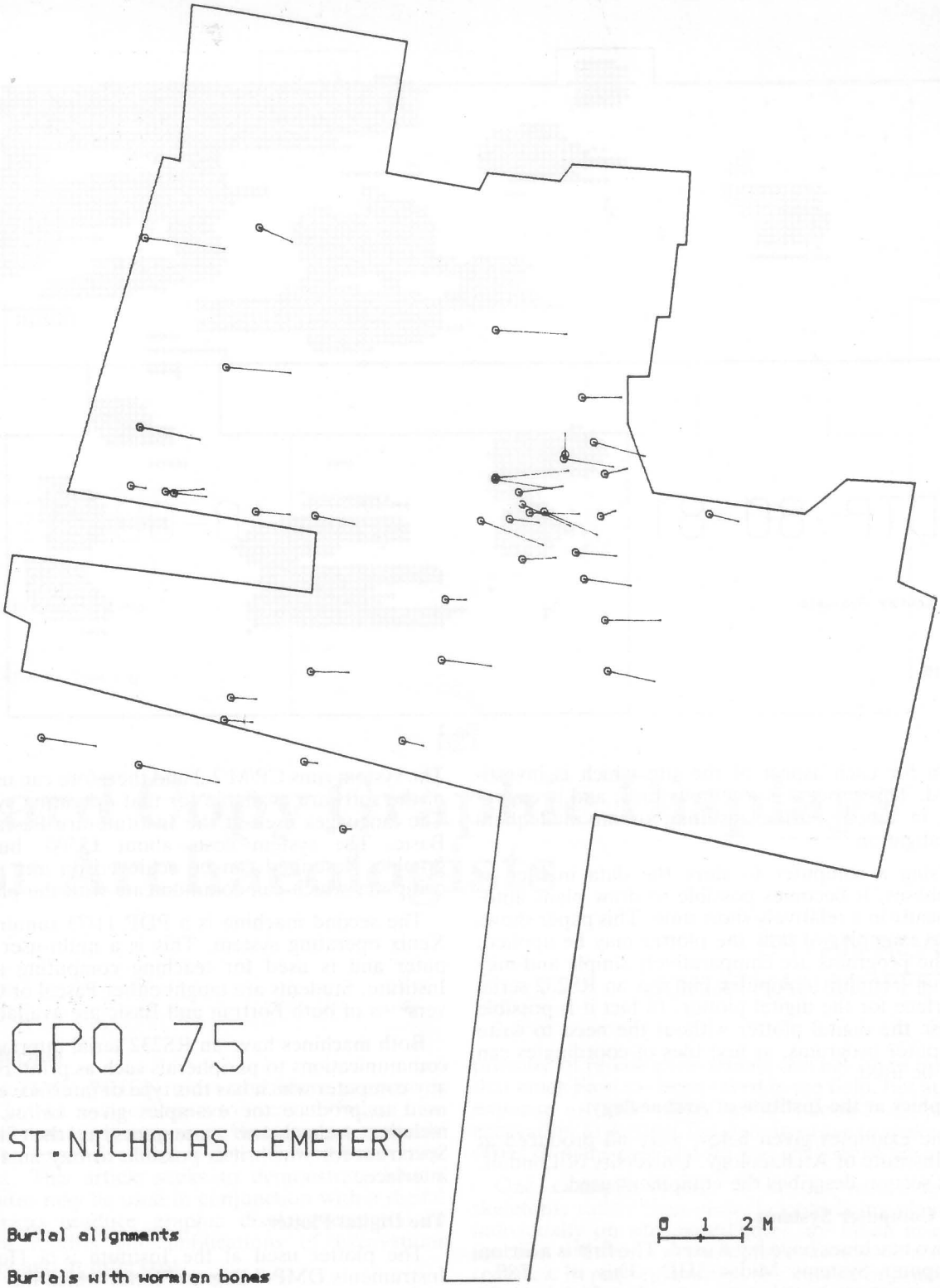
GPO 75
ST.NICHOLAS CEMETERY
Burial alignments
Burials with wormian bones
0 1 2 M

Fig. 3

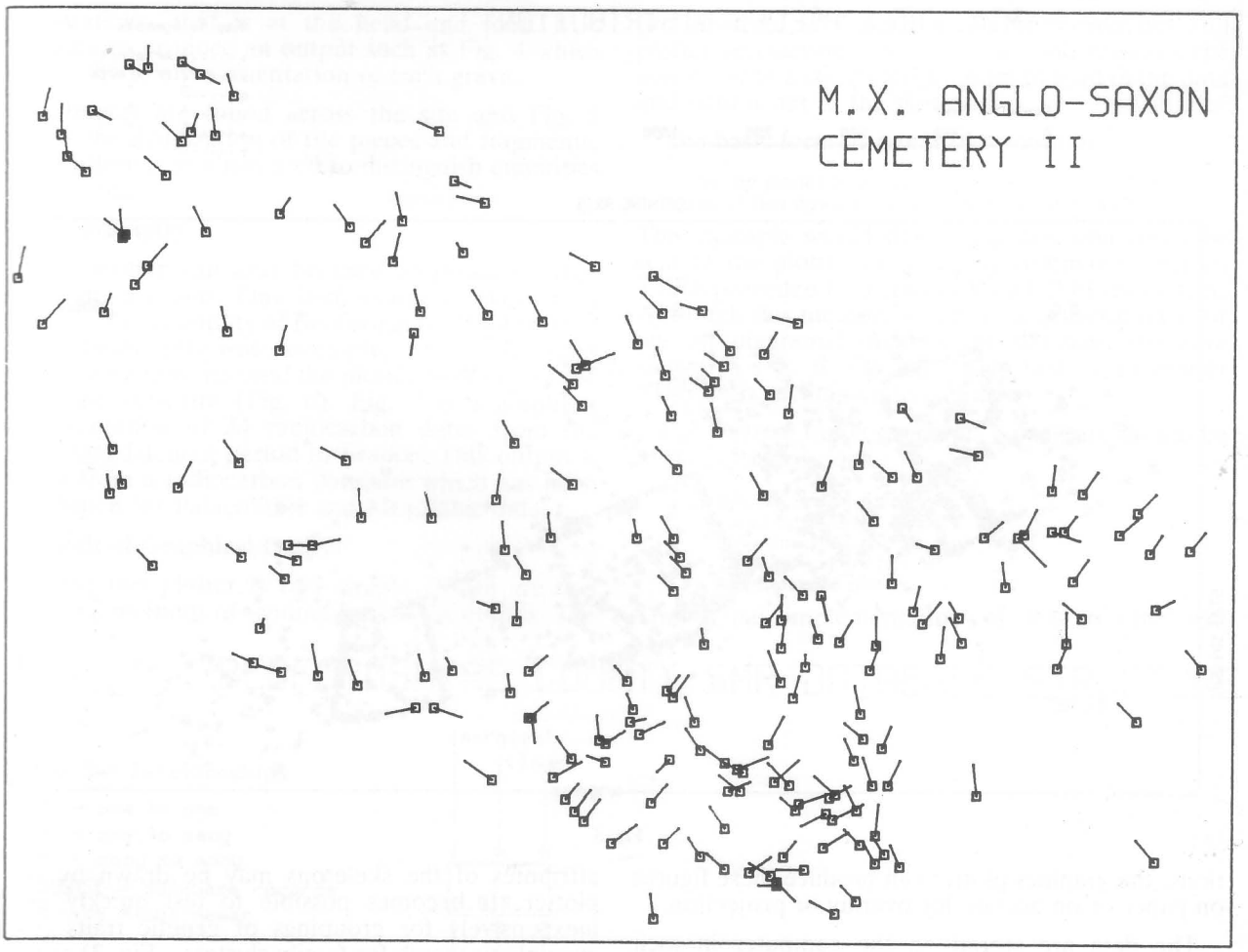

Fig. 4

under £1000. A range of different pen colours is available, as well as different types of pen, for writing in felt tip or ink, or for writing on overhead transparencies.

The plotter can be connected to the serial interface of any computer, and sent instructions. It has a predefined character set and six different centred symbols. The characters and symbols can be written in five different sizes in four different directions.

Examples of Graphical Output

The following illustrations demonstrate some of the useful applications of computer graphics to sites recently under excavation as well as one of the author's (JM) work with databases.

Ban Don Ta Phet

Ban Don Ta Phet is a protohistoric cemetery site in western Thailand, in an area of highly leached alluvial silt[1]; in such conditions almost all the organic material has dissolved, and no visible stratigraphy is present. The graphics plotter has been used to illustrate the spatial distributions of different categories of finds; for example all pottery of a specific fabric (Fig. 1) or the measurements of concentrations for intrasite spatial analysis (Fig. 2)[2]. Using the heights and one coordinate it is possible to create a vertical projection of various pottery fabrics to compare depths. In sites of little stratigraphy, the illustrations of different categories of material may be of particular importance in determining associa-

1. I. C. Glover, P. Charoenwongsa, B. Alvey and K. Narawat, 'The cemetery of Ban Don Ta Phet, Thailand: results from the 1980-1 excavation season', *in* B. Allchin (ed.) *South Asian Archaeology, 1981* (1984).

2. B. A. P. Alvey, 'Grid Contour Analysis and its appication to archaeology: an example from Ban Don Ta Phet, Thailand', *A. P.* **23** (forthcoming).

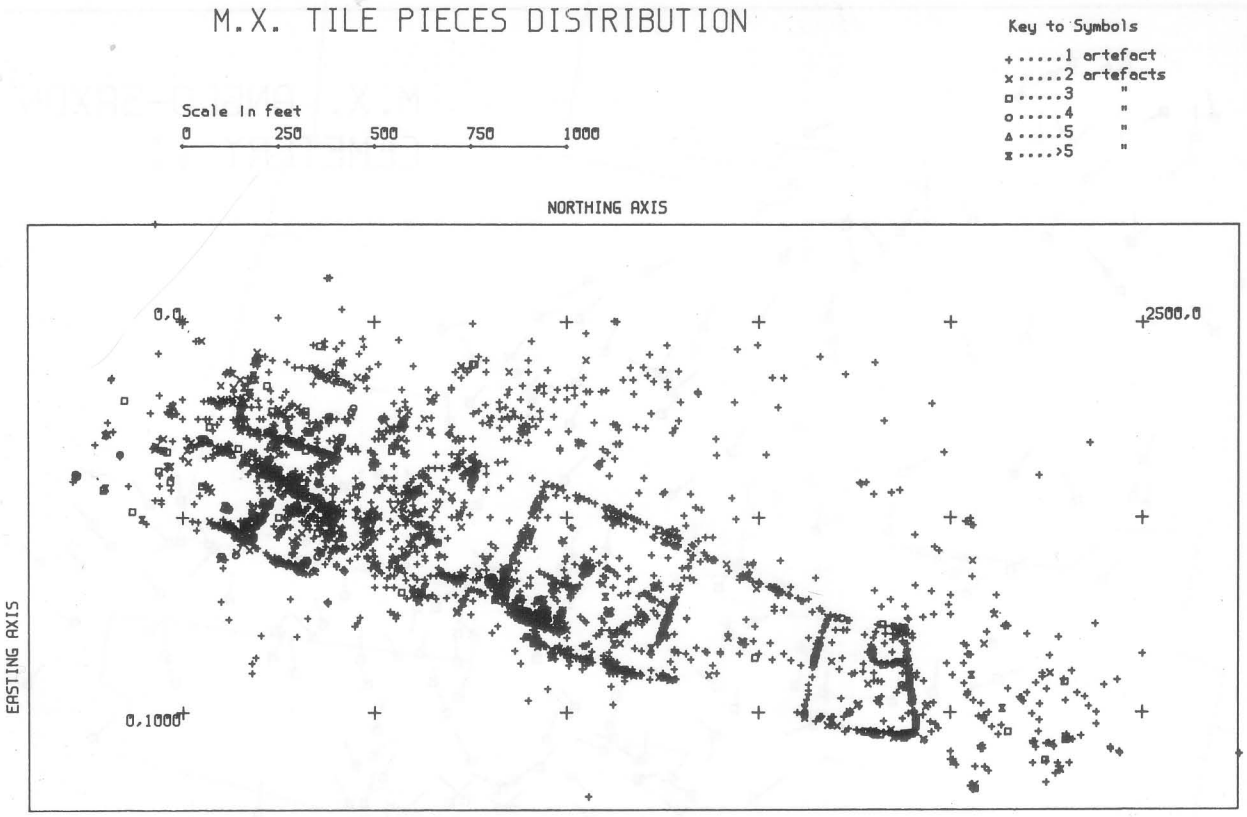

Fig. 5

tions; the graphics plotter can produce these figures on paper or on acetate for overlay or projection.

The data are stored on the computer in ascii character files, and each line contains all the information on a find. Each aspect or *field* for a find is separated by a semi-colon (but any character could be used as a field separator). The program to produce the plot reads each field of the line and the field relating to the category of find is tested. If the find is of the required category then the coordinates are transformed for the plotter bed, assigned a symbol, and passed to the graphics plotter for illustration.

St. Nicholas Church, GPO Newgate Street site, London

The graphics plotter has been used on material from this site to discover the spatial distributions of different aspects of the skeletons of the medieval cemetery[3]. Using a procedure similar to that described above, any attribute or combination of attributes of the skeletons may be drawn by the plotter. It becomes possible to test quickly and inexpensively for groupings of genetic traits (for example to search for family clusters – Fig. 3) or for work-associated traits, to search for signs of any social stratification within the cemetery. What would once have been considered by most archaeologists to be an expensive and lengthy procedure can now be accomplished in a matter of days.

Mucking Excavation

The site of Mucking was excavated between 1965 and 1978, yielding a vast amount of material. Most of this has now been stored in one form or another on to computer readable media. A large range of different data has been stored, from animal bone, slag, fired clay, to the contents of burials and features such as round houses[4].

The Anglo-Saxon Cemetery II of the site provides a very good example of what can be achieved by the plotter. If two sets of coordinates are known for

3. W. White, A. Thompson and J. Schofield *The Cemetery of St. Nicholas Shambles, London*. L.A.M.A.S. Monograph, forthcoming.

4. J. P. J. Catton, M. U. J. Jones and J. C. Moffett, 'The Mucking excavation (1965-78) computer database', *Computer Applications in Archaeology 1981* (1982).

inhumations, that is at the head and foot, it is possible to produce an output such as Fig. 4 which shows the relative orientation of each grave.

Artefacts are found across the site and Fig. 5 shows the distribution of tile pieces and fragments, with different symbols used to distinguish quantities of material.

Other examples

The plotter can also be used to produce other types of diagrams. One such example relates to a S.M.R. for the county of Bedfordshire. While one of the authors (JM) was developing a database management system, he used the plotter to draw out the database structure (Fig. 6). Fig. 7 is a graphical representation of 34 radiocarbon dates from the Late Magdalenian period in France. This output is taken from a radiocarbon database which has been developed for Palaeolithic and Mesolithic dates.

Methods of Graphical Output

Using this plotter is very simple. There are two principal methods of sending data to the plotter. The first involves writing a text file of coordinates and plotter instructions, while the second requires the user to write a computer program to read in the data and send it out to the plotter.

The basic form of a text file would be:

```
Set up plotter commands
x1,y1 pen down x1,y2 x2,y2 x2,y1 x1,y1 pen up
```

This example would draw a square, and could be sent to the plotter by a display command, such as *TYPE* preceded by a control/P on CP/M computers. Although this method is simple, it is useful only for one-off diagrams, such as the database structure shown in Fig. 6. For repetitive tasks a computer program is recommended.

For plotting out coordinates a program should be of the following form:

```
While not end of data
    read in x and y
    transform to scale for plotter bed
    allocate symbol type
    send data to plotter
```

The actual implementation of this routine will

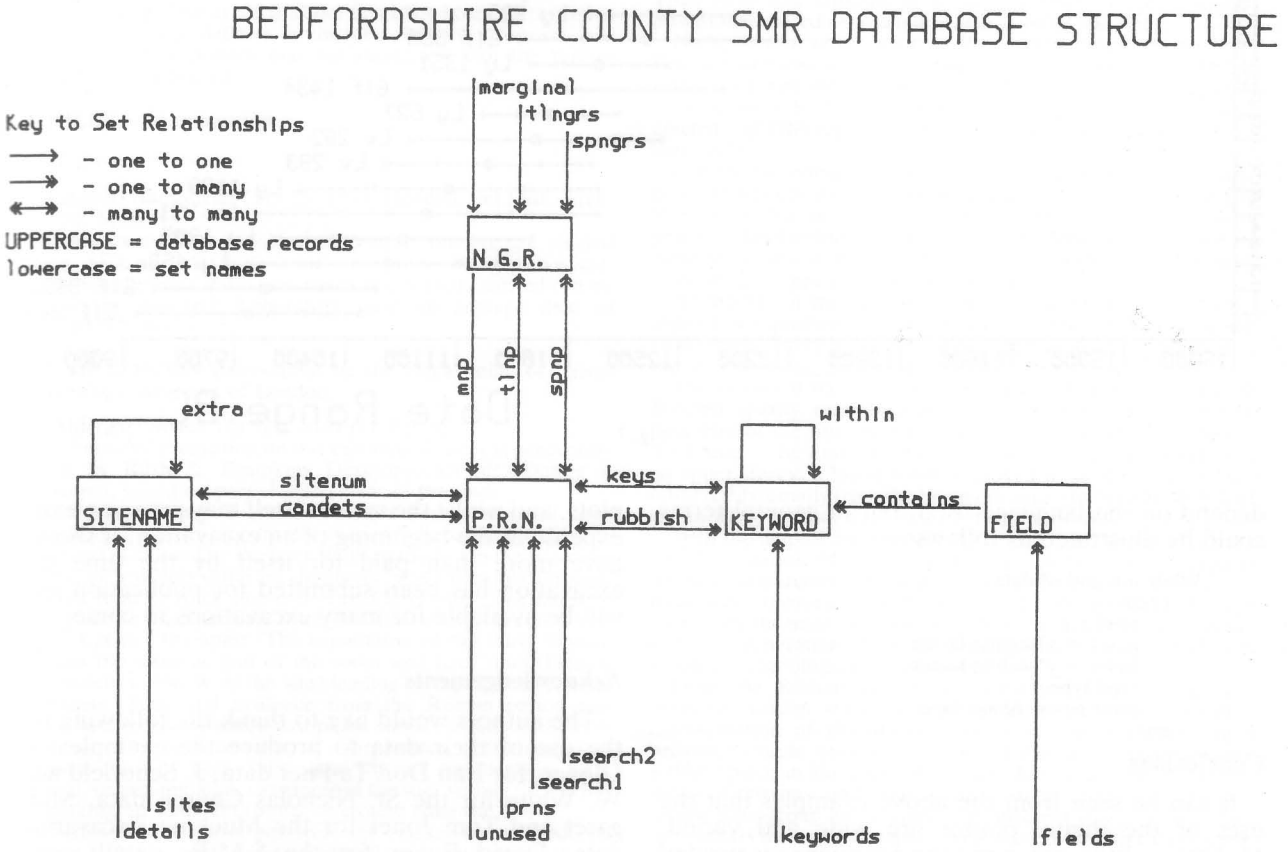

Fig. 6

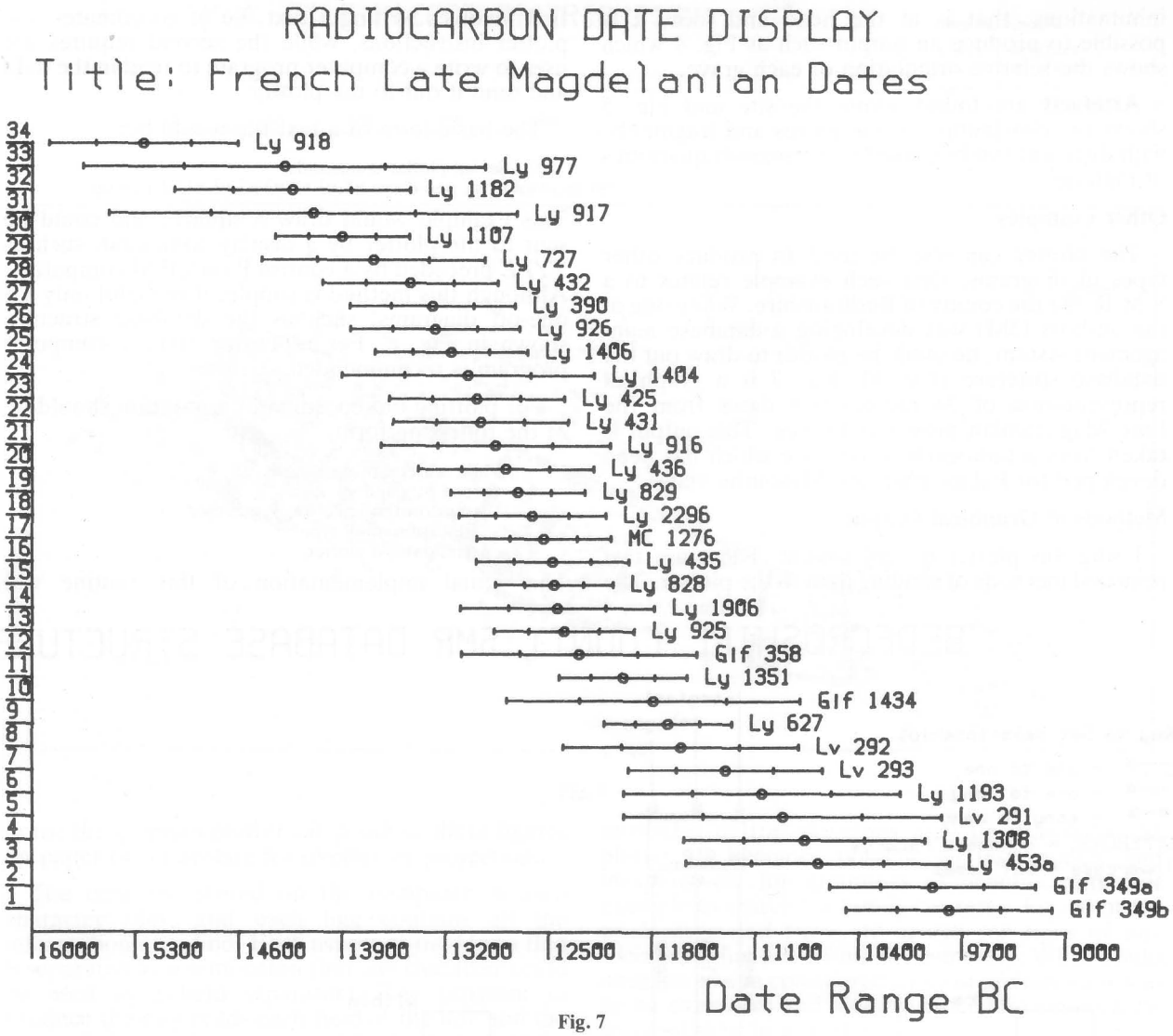

Fig. 7

depend on the language used, but in general terms could be illustrated as follows:

```
While not end of data
  begin
    read x,y
    newx = x*scaling factor
    newy = y*scaling factor
    read type
    print newx, newy, type
  end
```

Conclusions

It can be seen from the above examples that the uses of the digital plotter are wide and varied. Moreover, little programming experience is needed to be able to run the computing system to obtain the plots, and whilst the system itself may prove an extra expense at the beginning of an excavation, it should have more than paid for itself by the time the excavation has been submitted for publication and will be available for many excavations to come.

Acknowledgements

The authors would like to thank the following for the use of their data to produce the examples: I. Glover, for Ban Don Ta Phet data, J. Schofield and W. White for the St. Nicholas Church data, Margaret and Tom Jones for the Mucking Excavation data, David Baker for the S.M.R. details, and Esmée Webb for the radiocarbon dates.