ASSOCIATION *of* ARCHAEOLOGICAL ILLUSTRATORS & SURVEYORS

Technical Papers

Association *of*
Archaeological
Illustrators
& Surveyors

AAI&S TECHNICAL PAPERS

The Association has had requests from both individuals and organisations for a chance to obtain Technical Papers which have sold out. This folder has been compiled using photocopies of AAI&S Technical Papers 1-7 (edited by Richard Bryant). These papers are now out of print although some are presently under revision.

The reader should be aware that some of the advise is now very dated particularly as work on information technology and computer aided design has advanced at an enormous pace. However even the old information is of considerable interest in the history of archaeological illustration in general and of the Association in particular. Paper 4 was a joint publication with IFA (their Paper 10) and was assigned this number at a later date as Technical Paper 4 was never produced
The papers are as follows:

1. **The Preparation of Archaeological Illustrations for Reproduction**
   by A.S. Maney (1980)

2. **Computers in Archaeological Illustration**
   by J.D. Wilcock (1982)

3. **Drawing Ancient Pottery for Publication**
   by C. Green (1983)

4. **Preparation of Artwork for Publication**
   by C. Philo and A. Swann (IFA Technical Paper 10 1992)

5. **The Archaeological Illustrator and the Law of Copyright**
   by M. Vitoria (1984)

6. **Photogrammetry & Rectified Photography**
   by R.W.A. Dallas (1981)

7. **Drawing for Microfiche Publication**
   by R. Bryant (1984)

Mélanie Steiner (Technical Papers Editor 1999)

added 2006

12. The Survey and Recording of Historic Buildings
by David Andrews, Bill Blake, Mike Clowes and Kate Wilson

Technical Paper 2
Computers in Archaeological Draughtsmanship

J. D. Wilcock

1. What is computer graphics?

"Computer graphics" is the name given to various techniques whereby the computer is enabled to draw pictures and diagrams, either in transitory or permanent form. It has been said that one picture is worth a thousand words, and this is not far from the truth in archaeological publication, where maps, site plans, sections and drawings of artefacts are important, not to say indispensable aids to the description of a site. Particularly in statistical studies of finds, the various diagrams which are available for the illustration of conclusions are far more preferable than long columns of figures, although both have a place in specialist contributions. Thus the logical finale to any computer analysis of archaeological material is the production of diagrams by computer graphics for publication.

In archaeological draughtsmanship the computer could be of great use, particularly if the site data have already been entered into the computer for information retrieval. Microfilm output could be particularly useful; for its low cost, small bulk and light weight means that it can be distributed by normal mail to all who require it, and it is particularly suitable for Level 3 data. It must be admitted, however, that a computer-produced diagram has a certain pristine sharpness and has none of the character of a hand-produced diagram. This may be acceptable for statistical diagrams but whether it would be for plans, sections and pictures of artefacts is for archaeologists to judge.

2. Computer graphics hardware

The main pieces of hardware available for the production of computer graphics are the cathode ray tube *line-drawing display unit*, with *light pen* (or alternatively *tracker ball* or *joystick*) for point positioning and selection of options from a "menu", *tablet* or *digitising table* for recording a picture in computer-readable form, *function switches* for selecting desired actions, and keyboard for inserting text or labels; and the *graph plotter* or *microfilm plotter* for the production of publishable diagrams. These are used in basic man-machine interaction, and are the core of any graphics system for archaeological applications.

Graph plotters and automatic drafting machines enable a pen to be moved over paper, or a beam of light over a photographic plate to record images. The pen is moved on a pen-carriage, and there may be several pens of different colours, while the paper also moves on a drum in the simple plotters (see Plate 1). The plotters can in general draw only small straight lines, so the pictures are made up of a series of zig-zag lines, but the increments employed are so small (0.1mm) that these imperfections are not visible. Flatbed plotters incorporate paper sizes up to about 3m square. Microfilm plotters use similar principles except that the diagrams are copied onto microfilm using a beam of electrons at about eight complete frames per second. For archaeological publication the micro-fiche is probably the best form, each fiche containing many reduced pages.

In the line-drawing display unit (Plate 2) a cathode-ray tube is used to display lines and characters building up a diagram. The light pen is a flexible bundle of fibres which transmits light from the screen to a photomultiplier in the electronics, and this passes a signal to the computer program, indicating that the currently-displayed item has been "seen." This may be used to recognise items to be deleted, to recognise "light buttons" i.e. groups of displayed characters which specify certain actions to be performed, or to move a "tracking cross" around the face of the tube to specify points. The operator may also use keyboard input and press function switches to indicate the desired course for the computer program to take. A "tablet" may be used to input coordinate information (see the description of digitising below). The display unit is really a small computer in its own right, with its own program running under the general control of the large computer. The line-drawing display tube uses conventional television-type refresh techniques, i.e. the picture is redrawn many times per second to avoid flicker. The human eye detects flicker if the refresh rate is less than 25 times per second, and the display often refreshes about 60 times per second. There is the advantage that the picture may move to create animation, as in the rotation of 3D figures in perspective, but the technique requires complex programming. A cheaper form of display is the direct-view bistable storage tube, where the picture is drawn only once and can remain on the screen unfreshed for about 15 minutes. This of course has the disadvantage that once written the picture cannot be changed without erasing the whole screen and starting again. Alternative forms of hardware for recording points are the tablet (which uses a stylus to indicate points direct from a diagram), the digitising table (which translates the whole of a diagram into computer-interpretable numbers using a lens and cross-wires — see Plate 3), the tracker ball and the joystick unit.

3. Graphics for archaeologists

What appear to be the first archaeological publications describing the use of man-machine interaction are papers by Burton (1970) and Burton et al. (1970). The Assistant Curator of Egyptian Art, Metropolitan Museum of Art described the freehand drawing of figures on the cathode ray tube using a light pen. Using this method Egyptian pottery was classified according to shape and decoration. A tablet was used for digitising the outlines of pots, by laying a drawing or photograph on the tablet or projecting a slide onto it, and following its outline with a stylus. Using the tablet in this way, point-to-point measurements may be communicated directly by identifying the points on the line drawing, and this may be acknowledged for the operator's benefit by

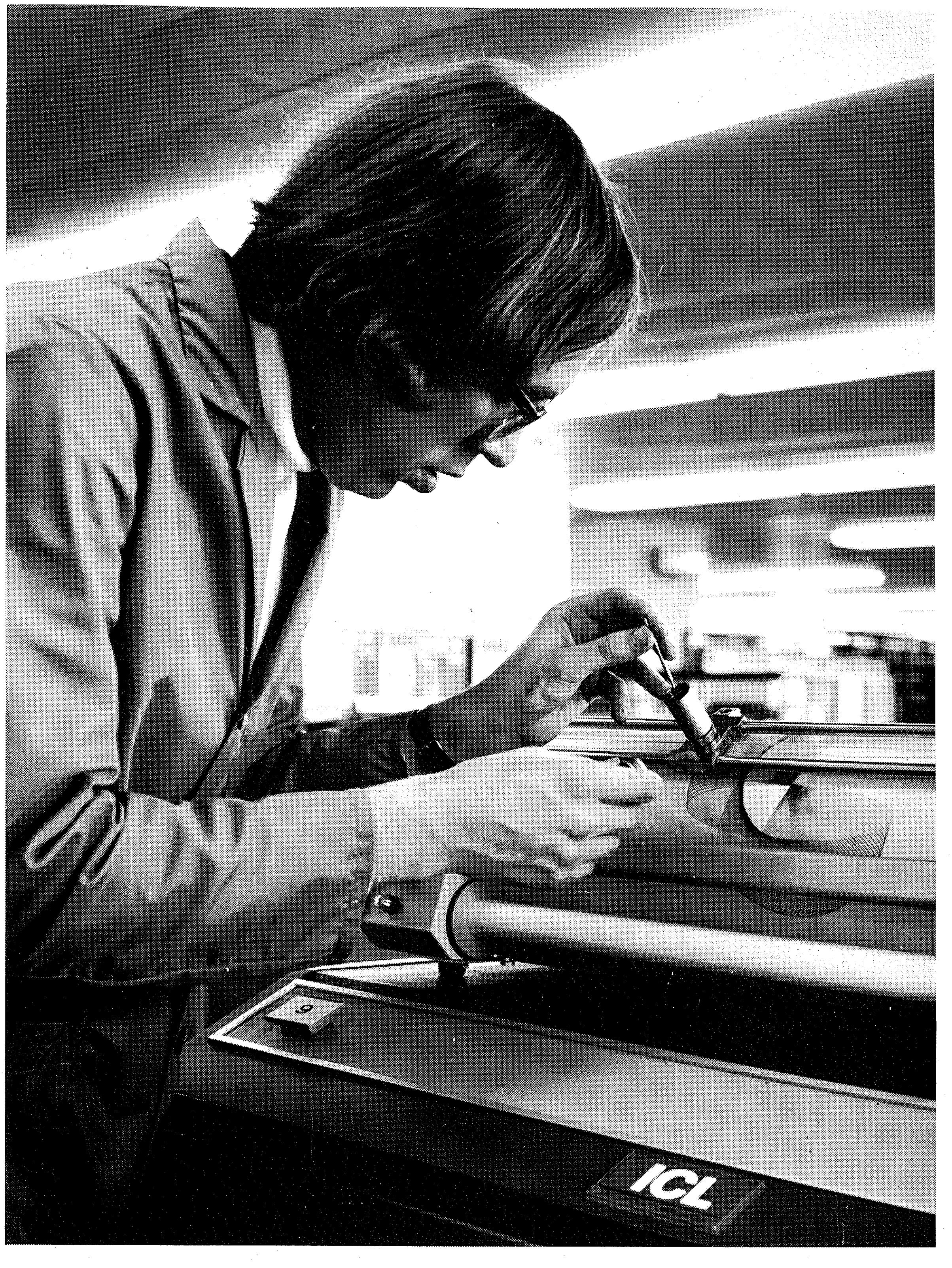

Plate 1. A typical graph plotter (digital incremental plotter). The operator is shown changing the pen. The picture is built up from a series of movements of the pen carriage, and the drum carrying the continuous stationery. There may be several pens of different colours.

WILCOCK Photograph by courtesy of ICL.

the computer drawing a line on the screen between the two points selected. Light buttons (individual choices of a "menu" of possible actions displayed on the screen) were used by Burton to scale the diagrams, to correct foreshortening on the photographs used for input, to change the size of part of the diagram, to compare shapes and to present a rotating three-dimensional display calculated from plane views. If the hardware provides insufficient function switches for all desired actions in such an application, the scope may be improved by using light buttons, by typing in characters on the keyboard, or by using one function switch as a master switch to step through several different tables of functions for the other switches, a powerful technique. Overlays with legends are often placed over the keys to identify the different functions. The Metropolitan Museum of Art used a *Geo-space plotter* which produced diagrams in 32 shades of grey; not many computer installations, let alone archaeologists, could afford such an expensive facility. Another project on which this system was employed was the Akhenaten temple project. This temple at Karnak (Luxor) was completely demolished by the priests of Amun-Re on the death of Akhenaten, and the blocks incorporated into the foundations of later pylons. These have now been excavated by archaeologists and dispersed to museums and collections throughout the world. The project was to photograph the blocks, wherever their present location, and to use the graphic descriptions of the carvings to try and "reconstruct" the temple on the computer. The descending rays from the Aten disc, a common motif, proved particularly useful in this work, and the project was partially successful.

Wilcock (1974a, 1974b) described the PLUTARCH System (Program Library Useful to ARCHaeologists), a segmented interactive graphics program written in ALGOL 60. The system employed man-machine interaction using a light pen, function keys and keyboard to control modules for information retrieval, statistical analysis and graphics, all inter-ked. The PLUTARCH System selected program modules by menu using the lightpen. Diagrams were built up using straight lines and curves, with a deletion facility. A wide variety of upper and lower case fonts including italics could be chosen for labelling. Simulated three-dimensional perspective display was avail-

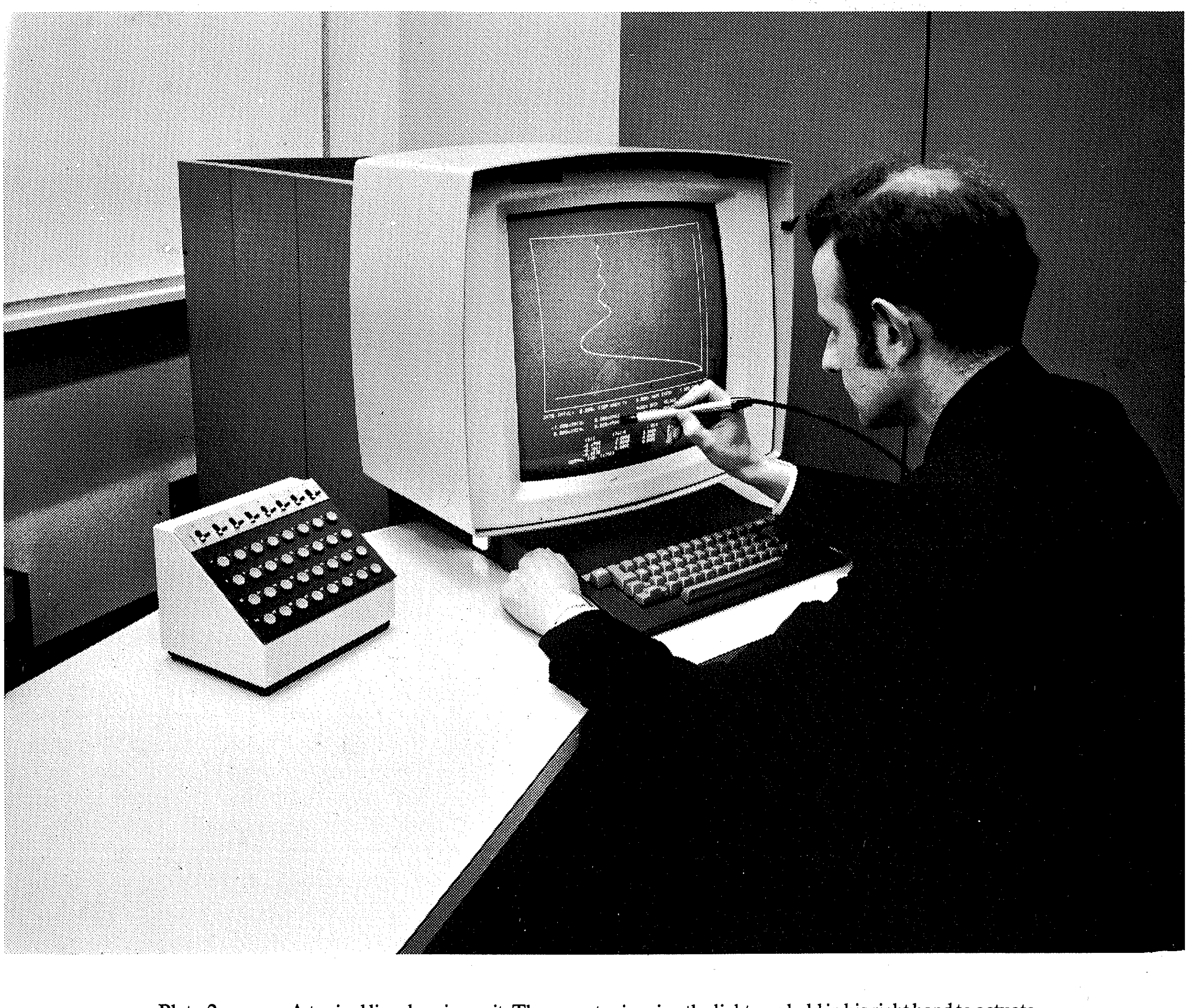

Plate 2. A typical line drawing unit. The operator is using the light pen held in his right hand to actuate a 'menu' of light buttons displayed on the screen. He may also use the keyboard below the screen and the function diagrams may be produced on a graph plotter (see plate 1).

WILCOCK Photograph by courtesy of IBM.

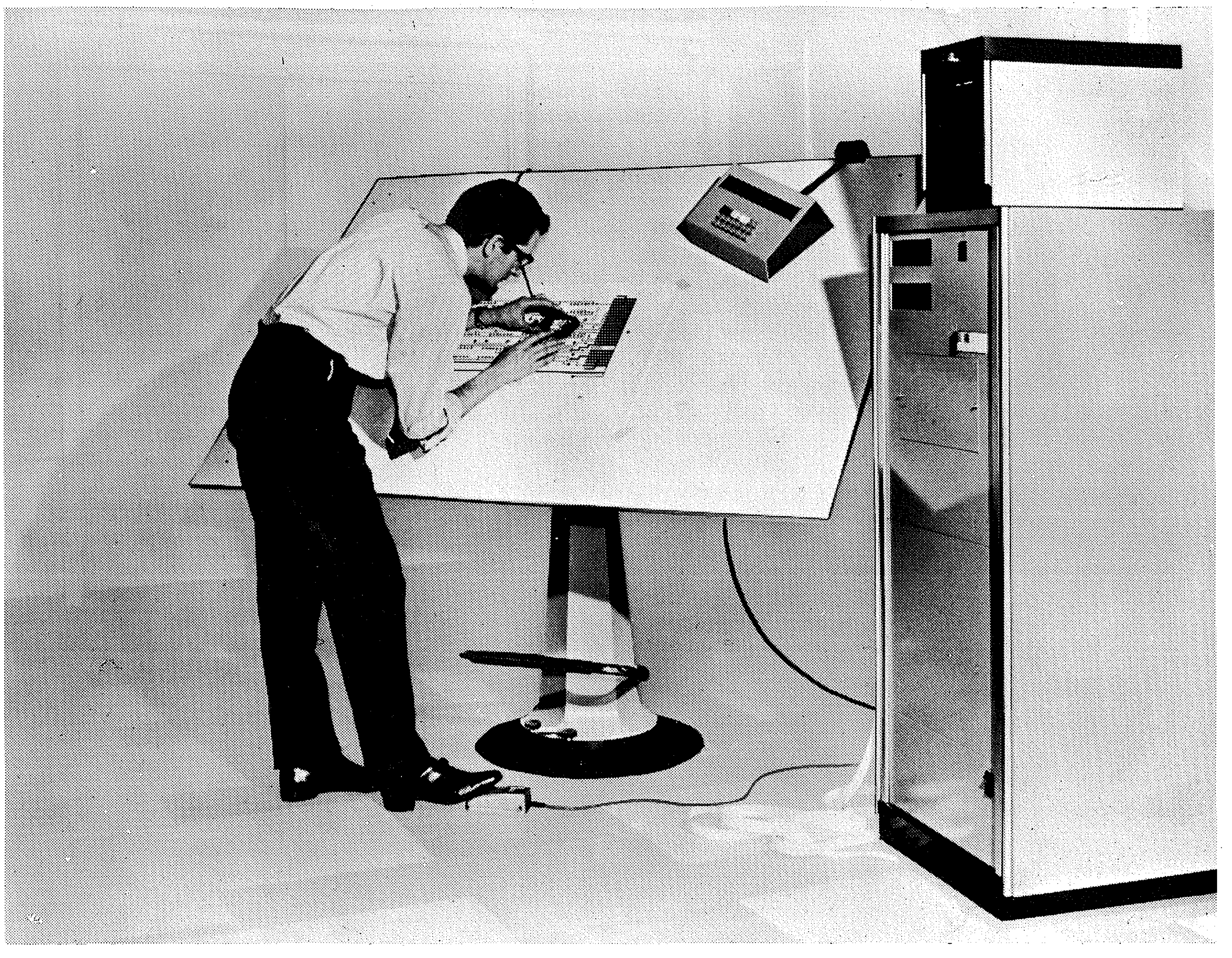

Plate 3. A digitising table. The operator is using the 'pencil' (lens and cross wires) and footswitch to produce coordinate pairs for input to the computer. The keyboard (top right of table) is used for punching alphanumeric titles for identification purposes.

WILCOCK Photograph by courtesy of d-Mac Limited.

able. Profiles of artefacts were produced by digitising. A freehand sketching facility was also available. Several different types of statistical diagram (scalogram, dendrogram, skyline plot, scattergram, histogram, piechart) could be produced. Distribution maps and map outlines, border, scale and north point, and grid references plotted using several different types of symbol could be generated. Instrument survey readings (from resistivity meters and proton gradiometers) could be plotted. Finally diagrams could be permuted on the screen to determine evolutionary trends in style.

4. Advanced Computer Graphics

In advanced graphics systems three-dimensional objects may appear with differential shading, giving the effect of highlights on the surface of objects such as bottles. In the portrayal of three-dimensional line drawings, lines at the "back" of the object are deleted, as they would not be visible; this is called "hidden line removal", and requires complex programming. Even stereoscopic views may be produced by drawing two slightly different pictures and viewing them through a stereoscopic viewer.

5. Microprocessors in graphics

The availability of cheap microprocessors and microcomputers with graphics facilities has now placed computer-assisted draughtsmanship within the reach of archaeological units. "Quick look" graphics may be viewed on a screen and printed on a portable printer. These equipments may even be taken to archaeological sites and run with a generator in the absence of electricity supply. The addition of flexible magnetic discs ("floppy discs") for storage and a high-quality printer enables the microcomputer to operate as a "Word Processor" enabling text and publishable graphics to be edited and printed in a form ready for direct offset litho printing.

6. Conclusion

This brief summary of computer graphics facilities has been intended to illustrate the breadth of equipments available, and it is hoped that archaeological draghtsmen will be able to use these facilities to enhance archaeological publications. The chief use will probably be for statistical diagrams and distribution maps based on information already held in the computer. Furthermore the use of microfilm will be of great use in the publication of large bodies of Level 3 data.

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