LERNIE - PHASE III

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Since the Second Conference in 1974 (pp.59-63) it has been possible to move forward along a number of routes - at least a few steps.

The most significant paths have remained within the two narrow bands specifically drawn in 1974: there is promise of immediate movement in both.

1. Collative report writing

The data described in 1974 have now been transferred from the original punched card set to D.M.S. data base on the Mark III system operated by Honeywell I.S. The program allows for actual text consisting of three lines of eighty characters each. With fully automatic print-out of the final report in mind, ultimately, some care has been taken to expand the information suitably during this transfer. From the rather sketchy, memory-jogging, timesaving note form on the cards the text has moved as far as possible towards the stage where it can be generally read and immediately understood.

The intermediate retrieval operates in pairs of complementary, alternative interactive steps. After the initial straight checklists have been run, as described in 1974, a multiple conbination of codes is chosen for detailed investigation. For example, a banker is retained for the group "Material, Fibres; Material, Human; Concept, Preservation"; this covers all data with a bearing on the persistance of human hair.

To search for possible causes of such persistence a series of retrievals is run on such a group with one additional code in turn. Thus the factors which are responsible for preservation or active against it can be classified in some manner that reflects one of the chosen Key Concepts: they may be present in or due to one of the specific material categories - in the Soil generally, due to Other Metals (i.e., other than iron or copper) or Other Botanicals (i.e., besides wood) such as fungi; or they may be the result of Cultural customs such as certain forms of burial, or again of Technical processes in burning gypsum or making cosmetics.

These first-order retrieval runs produce, in effect, sets of columns of text without logical order but the chances are, as in any other game of 'Consequences' that something stimulating may turn up! An inherent drawback built into the initial coding is that much of the text must by its very nature be multi-classed. As a result any one series of retrieval runs may initially be heavy with redundant data, the same text turning up under several different combinations.

Superfluous information may be removed in two ways. One is automatic and can be programmed, e.g. by asking for all data "Having Concept Cultural but NOT Having Concept Technological", and then vice versa. Conversely, one can also ask in the print-out for each bit of text to have any desired selection of data associated with it - such as the (original card) serial number, and a list of codes also on the card,other than the chosen grouping. The other way of weeding at this stage is part of the next, alternate interactive step. This is to edit a series of retrievals by asking for a print-out of selected bits of text in a chosen order, by serial number.

In such a list there will be at least the bare skeleton of a logical sequence into which some of the missing links can be fitted almost at first sight. At this stage it may also be useful to run a quick check on reliability. This can be done either at the same time - by including the relevant code key (<u>Present Evidence</u>, <u>Others' Inference</u>, etc.) in the request for the selected print-out - or afterwards by calling for codes of certain key bits of text only.

Similar retrieval series are run on other aspects of the evidence, such as the cultural and technological implications of gypsum in burials, or the significance of the lead distribution in the deposit as a whole. At the end of this first-order stage a final study of the print-outs may suggest further modifications in sequence, either of the aspects discussed or within each list of text.

Out of this ordered and selected array of original data, a new set of(second-order)information is then created by statements which relate bits or groups of text - either in making inherent links explicit, or by finding fresh connections. These statements form a new data base which can then be worked over in the same way as before to give an optimally coherent sequence of digested output.

Depending on the mass and complexity of the original data, a third-order analysis - or even further ones - may be needed before any really rewarding patterns begin to appear. But the whole process is very much more efficient and effective than this rather cumbersome description of it might suggest, especially when seen against the somewhat daunting prospect of analysing the scientific evidence from over 1,000 similar graves in the near future.

The most obvious need for improvement lies in the input area. Clearly it is best to have small bits of text and avoid excessive multiple coding. But this gives too high a coding:text ratio and involves much wasteful duplication. At the same time, the most important and time-consuming step is obviously the coding decision. The present short-term aim is to adapt the most suitable translator-reader to provide automatic coding from adequately clued bits of text.

In the middle distance one can see the progressive elimination of intermediate steps along the route from evidence to input. In time all specialist reports would come to be typed by the originator straight onto a terminal with agreed coding.

At that stage, development could proceed along two complementary lines. First, there would be a movement towards instant selective retrieval on a global scale which would eventually make all publication obsolete, as I suggested in 1974. Secondly, but independently, I envisage a gradual drift away from literate writing, in principle, so that symbols would take the place of code words and ultimately even of text. In such terms, the present activity would become an exercise in symbologic frequency pattern interpretation. The Chinese would start with a tremendous advantage!

I am grateful to David Haddon-Reece, of this Laboratory, for help in adapting DMS, and to John Coad, of Honeywell, for seeing me through the System and arranging the present demonstration.

2. Parallelography

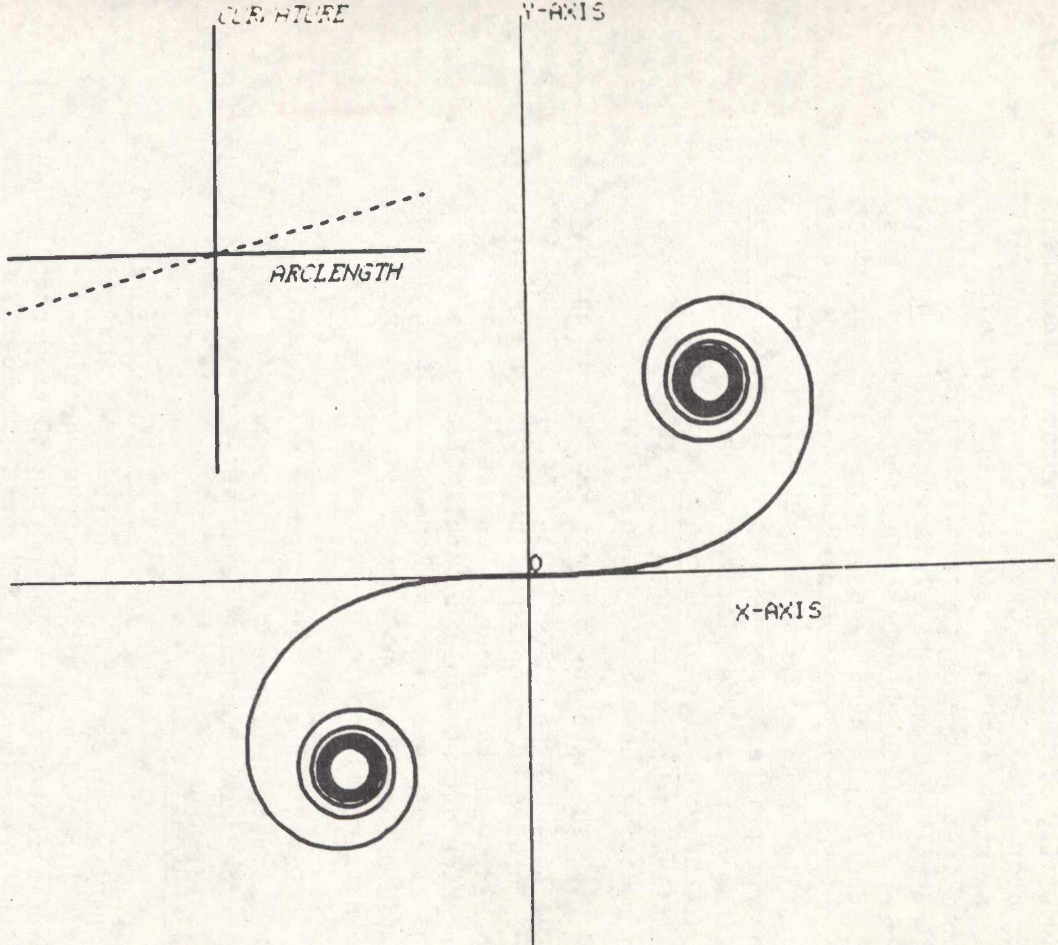
In the Department of Engineering at the University of Cambridge, A.W.Nutbourne and his Computer Aided Design Group are currently perfecting an ingenious method of storing and displaying curvilinear patterns of great complexity. This is based on the Cornu Spiral in which arc length is proportional to curvature, expressed in radians, and can easily handle any change in direction of an outline however involuted or re-entrant it may be. The computer matches spans of the outline to appropriate Linear Curvature Elements (Linces) of the Spiral. The display is built up from the consecutive series of Bilince pairs formed at each Profile Breakpoint and can be suitably smoothed by removing insensitive data points.

The matching of iron knifeblade outlines from radiographs suggested by me in 1974 has been put forward as an optional project for students working with the Group. The results of any such graphics output would naturally beintegrated with the kind of reporting outlined in Section 1 above, as in an ordinary publication, for as long as this form of communication remained in use.

The largest single segment of activity in which further progress in the comprehensive, umbrella service seems most promising is:-

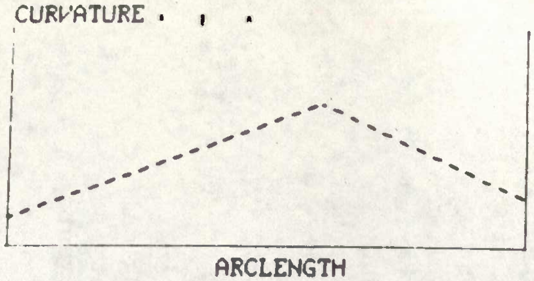
3. Animation

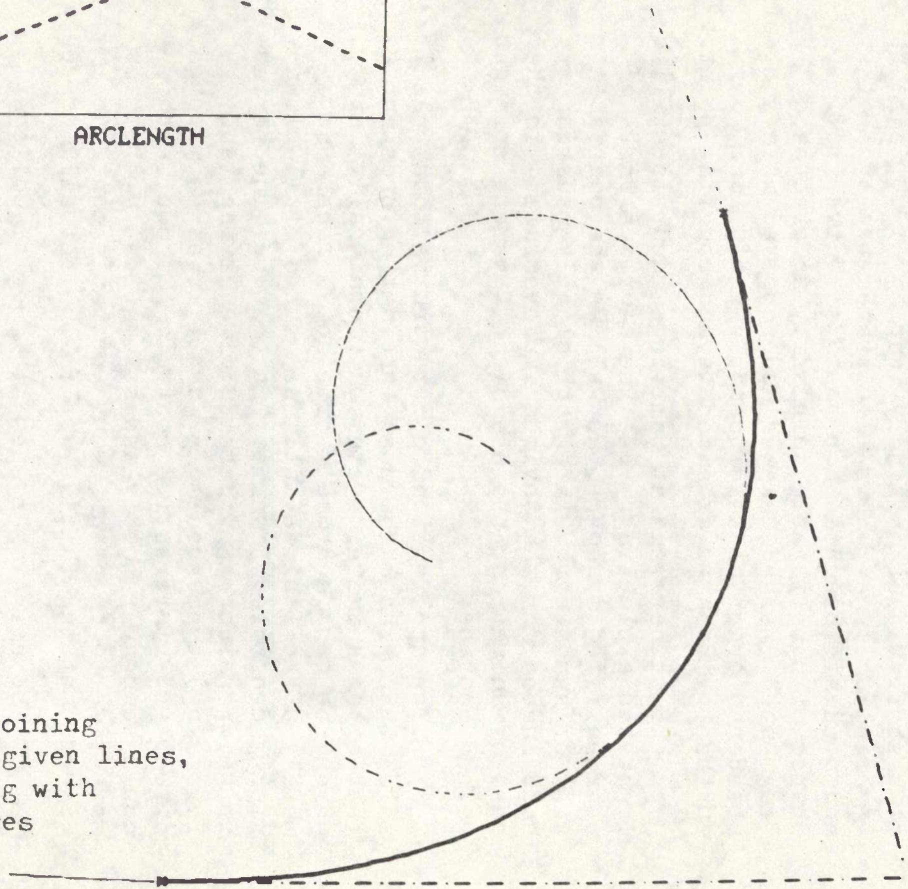
At the Department of Mechanical Engineering, Imperial College, the Computer Aided Animation Unit of C.B.Besant and colleagues has developed a very sophisticated system for moving 3D projections about with great impact and fluency. Basically a fully computerised strip cartoon, it would seem to have boundless vitality and infinite versatility, and it could clearly be applied at once to the total volume of archaeological experience.



Computer display of a Cornu Spiral

(Courtesy A.W.Nutbourne)





Computer Bilince joining
two points on two given lines,
starting and ending with
specified curvatures

(Courtesy A.W.Nutbourne)

RESULTANT AND PARENT CURVES

Almost by definition, it is impossible to convey the kind of experience which the Conference was able to share at the end of the day in looking at a short videotape kindly lent by A.R.Diment of Imperial College. This illustrated the type of animated aid produced for the Open University. Shapes of unbelievable complexity are stretched, fragmented, merged, skewed and revolved in a sort of abandoned order of kaleidoscopic profusion. Our furthest vision is extended beyond boggling point.

Both here and at Cambridge input is still by light table plotting. But the enormous waste of overqualified manhours, as well as the constant risk of human error, are both clearly pressing very hard indeed for the obvious improvements - in the case of animation, the use of a TV camera straight onto videotape.

The application to our work is total, as I said; but perhaps the most fascinating prospect is that of an animated system on global call, into which one can feed one's artefact series - not merely of knifeblade outlines, but of full-blown richly decorated jewellery in colour. The series is held, against a procession of evolving (and revolving) type specimens, until itcan be matched directly by interactive control. Of course this could be done remotely and automatically, but for some time to come this would probably continue to be something that we would like actually to see!

The existing system at Imperial College could be provided and adapted for archaeological use within a year for about £ 200,000 - that is about a tenth of the figure mentioned two years ago. 1976 could be a really exciting year!