

## 30

### Hypercard as a teaching tool

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#### 30.1 Introduction—what is Hypercard?

Hypercard is an item of software that comes free with every purchase of a Macintosh Plus or SE microcomputer. Superficially, it resembles simple data management programs such as Cardbox. Information is stored on *cards*, which each fill a 9-inch screen, and a sequence of which forms a *stack*. A reader may *browse* through a stack in order, or jump from one card to another at will. Each card may be divided into *fields*, which may contain textual, numerical or graphic information. The information may be typed in or created through the 'draw' and 'paint' parts of the program, or imported, e.g. from a word-processing program or a scanner. Fields may overlap each other, allowing information to be hidden, and text in a field may be scrolled so that only part is visible at a time.

Two aspects of Hypercard make it more than just another data management program. The first is the *button*: a symbol which, when pointed to, causes the program to jump to a specified card in the stack, or indeed in another stack. Buttons can be made invisible, so that (for example) by pointing to an area on a map one can jump to a card giving information about that area—a sort of primitive GIS, or a friendly front-end to a serious GIS.

A second aspect is the existence of a programming language Hypertalk, which enables series of actions (*scripts*) to be followed when a button is activated. We have yet to explore the full potential of this language, but have found the use of *visual effects* particularly valuable; instead of a simple jump from one card to the next, the move may be animated, e.g. by a *zoom*, *dissolve* or a series of effects.

#### 30.2 Uses at the Institute of Archaeology

Hypercard is currently used in two courses at University College London Institute of Archaeology: Quantitative Methods in Archaeology (CRO) and Microwear (RG). Within one or other of these courses it is used at four levels:

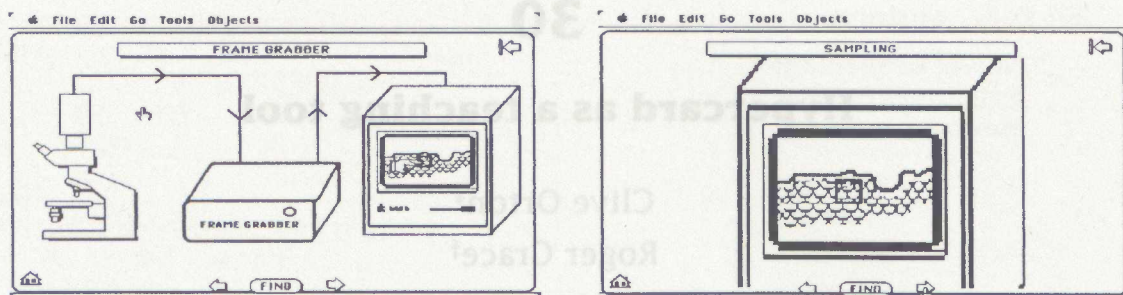
1. for display purposes to accompany a lecture
2. as an interactive 'game' to illustrate a seminar
3. as interactive teaching stacks that enable students to study at their own pace
4. as an expert system to carry out and explain diagnosis.

The first two are used in Quantitative Methods and all except the second in Microwear.

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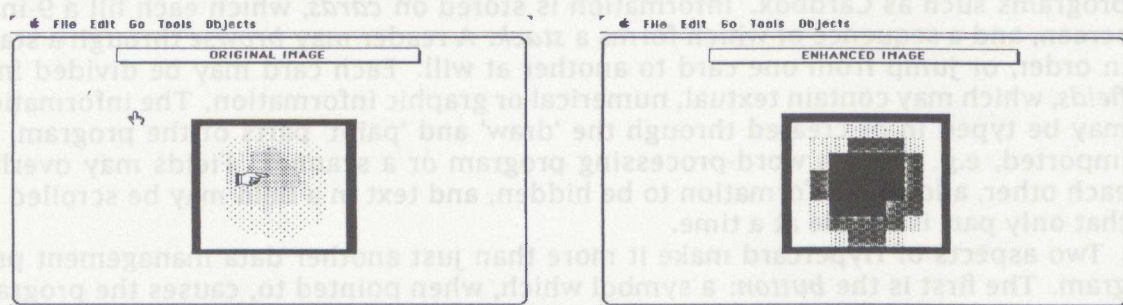
† Institute of Archaeology  
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31-34 Gordon Square  
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card 1

card 2

Figure 30.1: Effect of zooming



card 1

card 2

Figure 30.2: Dissolve to enhanced image

### 30.2.1 Display to accompany a lecture

The Macintosh SE is used in conjunction with a Viewframe, an external LCD screen (linked by means of a special board) which sits on an overhead projector and is projected on to a wall, enabling all of the large Quantitative Methods class (30–35 students) to see the screen. A lecture can be rewritten as a stack; the simple linear structure of the stack can be enriched into a tree-structure with choices of loops at the nodes. Sections which prove difficult can be repeated. Invisible buttons can be placed over words which may be unfamiliar to students; if requested, activating the button jumps to an optional card which gives a definition or further explanation. Afterwards the stack can be made available on disk (see section 30.2.3) or printed out and deposited in the Library. So far 11 stacks have been created, covering such topics as summarising and presenting data, probability, permutations and combinations, sampling theory, statistical distributions and introduction to computing at the Institute.

A second example of this display mode is the stack designed to explain the procedures of image processing of microwear polishes on flint surfaces. This uses the visual effect of zooming from an area of illustration to show a magnified view (Fig. 30.1) and dissolving from one illustration to another to emphasise the process involved, so that the student can see the mathematical transformations take place, as for example from an original image to an enhanced one, in order to demonstrate the effect of a digital enhancement program (Fig. 30.2). A hand symbol indicates the button that has to be pressed to activate the effect referred to in the text.

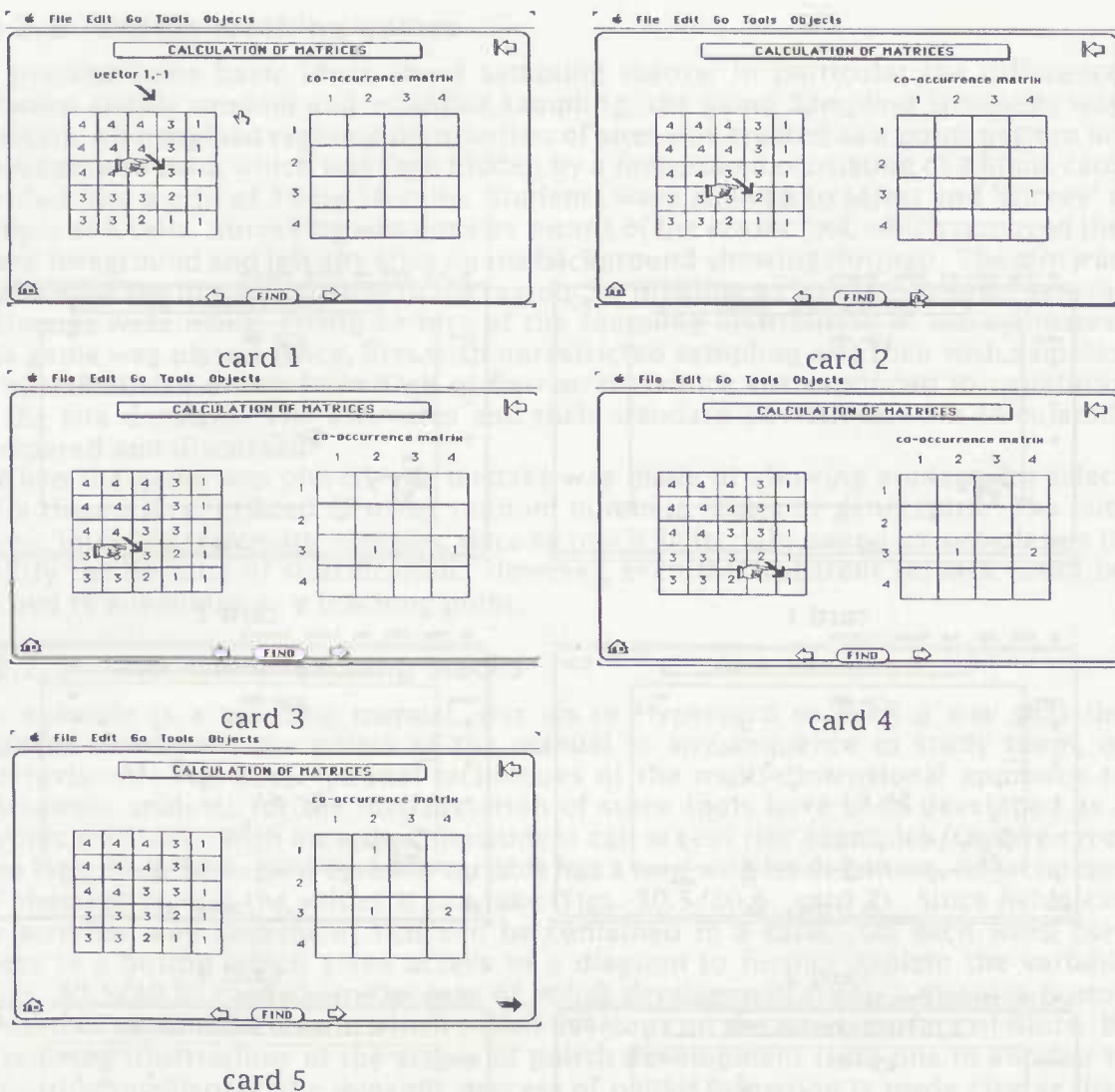
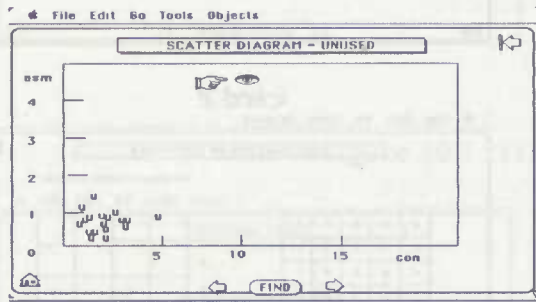
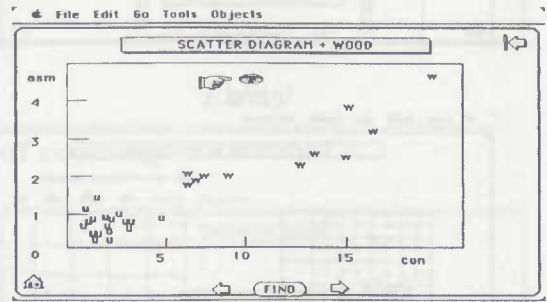


Figure 30.3: Calculation of co-occurrence matrices

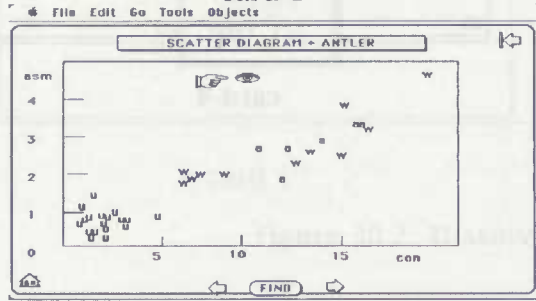
The calculation of co-occurrence matrices is often a difficult concept to communicate to students with no mathematical training. Cards can be used to demonstrate these calculations by illustrating the relationship between the grey levels of pixels at specified vectors and the appropriate cell in the matrix, in order to make this procedure much clearer. The use of arrows of set length and direction to represent vectors, and their superposition on the grey-level arrays explains these mathematical concepts through a simple visual image. The multiple calculations involved in producing co-occurrence matrices can then be seen as a simple sequential process (Fig. 30.3). Another use of the dissolve effect is to illustrate scatter diagrams. Each category of variable can be dissolved in to the scatter diagram, so that the gradual build-up of the diagram can be emphasised, and the effect of each variable seen in relation to the others, in order to simplify and to give a less confused illustration (Fig. 30.4).



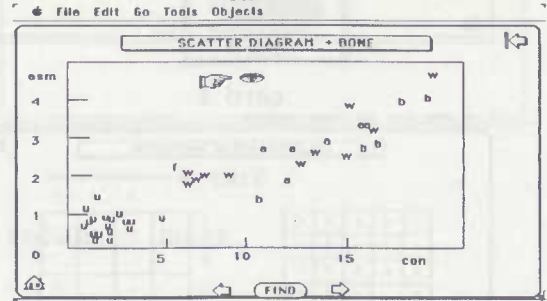
card 1



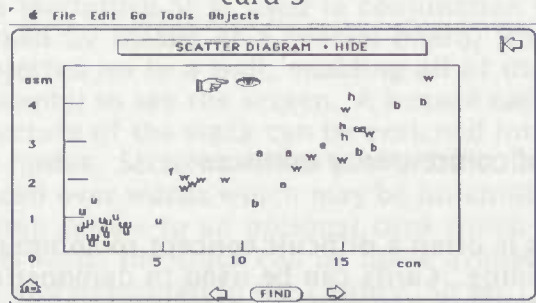
card 2



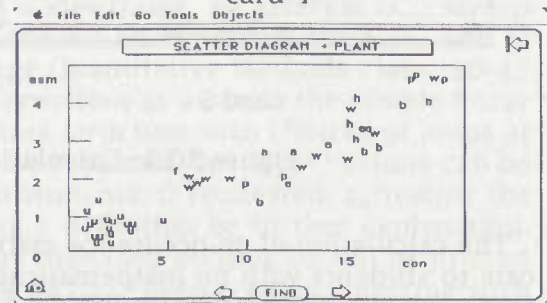
card 3



card 4



card 5



card 6

Figure 30.4: Dissolve each variable into scattergram

### 30.2.2 Simple teaching games

To present some basic ideas about sampling theory, in particular the difference between *simple random* and *stratified* sampling, the game *Sampling Strategies* was devised. An imagined regional distribution of sites was created as a point-pattern on a *background card*, which was then hidden by a *foreground* consisting of a blank card divided into a grid of 28 by 16 cells. Students were allowed to select and 'survey' a sample of K cells. Surveying was done by means of the *eraser tool*, which removed the blank foreground and left any sites on the background showing through. The aim was to estimate the number of sites in the region. By dividing a class into groups, several estimates were made, giving an idea of the sampling distribution of the estimates. The game was played twice, first with unrestricted sampling and then with samples of specified size drawn from each of four strata (which corresponded to variations in the site density). The estimates and their standard deviations were calculated, compared and discussed.

When the game was played, the mistake was made of allowing students to select cells themselves, instead of using random numbers tables or generators. The outcome, intuitive *systematic samples*, were so much 'better' than random samples as to nullify the benefits of stratification. However, even this apparent setback could be turned to advantage as a teaching point.

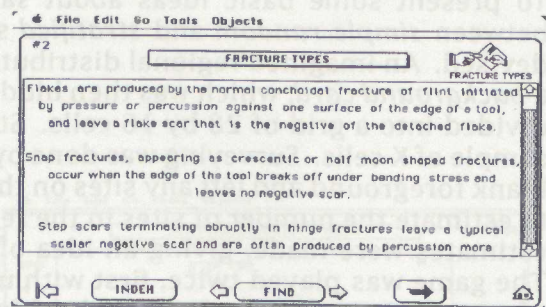
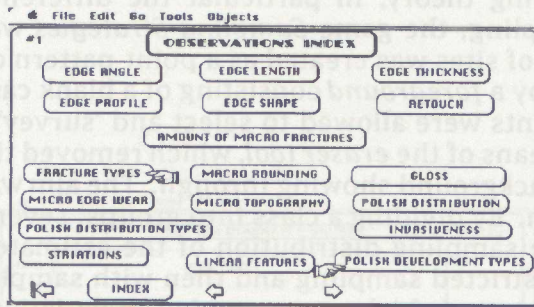
### 30.2.3 Interactive teaching stacks

An example is a teaching manual, put on to Hypercard in such a way that the student can access the points of the manual in any sequence to study them, or for revision. The observational techniques of the multi-dimensional approach to microwear analysis for the interpretation of stone tools have been developed as a Hypercard stack. With an index the student can access (for example) *fracture types* (see Figs. 30.5/30.6: card 1). Each variable has a card with its definition, its technique of observation and the values it can take (Figs. 30.5/30.6: card 2). Since fields can be scrolled, any amount of text can be contained in a card. On each *word card* there is a button which gives access to a diagram to further explain the variable (Figs. 30.5/30.6: card 3). In the case of *polish development types*, a dissolve button is used to explain the way in which polish develops on the micro-surface of flints. By dissolving illustrations of the stages of polish development from one to another in a continuous display, the dynamic process of polish formation is made clearer than would be the case with a sequence of static slides (Figs. 30.5/30.6: cards 5 to 10).

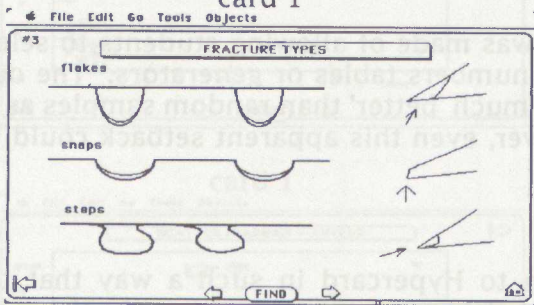
The different motions used in conjunction with this method are also defined and illustrated by accessing from the motions index card (Figs. 30.5/30.6: card 11). In addition, on the drawing card the motion is demonstrated by using animation so that the tools are seen to move in the relevant motion (Figs. 30.5/30.6: card 13). This is carried out by pressing the MOTION button with the eye icon; the piercer on the left rotates whereas the one on the right pushes holes into the material. Part of the manual is concerned with the way in which data are entered into the database (Figs. 30.5/30.6: card 15), and an example of the data card is given (Figs. 30.5/30.6: card 16).

### 30.2.4 Expert systems

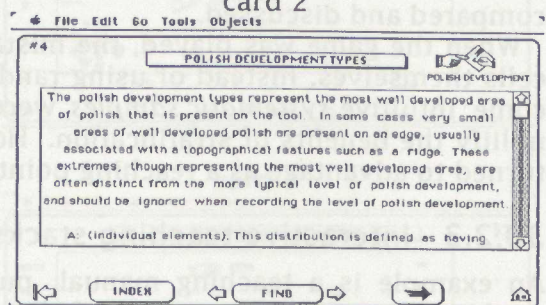
After the data have been recorded in the way set out in the manual, an expert system is used to assess them and the inter-relationships between variables, in order to make functional interpretations. The expert system is quite complicated, and using it by simply pressing buttons would not enable a student to understand the underlying processes and therefore how the interpretations are made. An extended version of the expert system has been created, so that a student can follow the process through



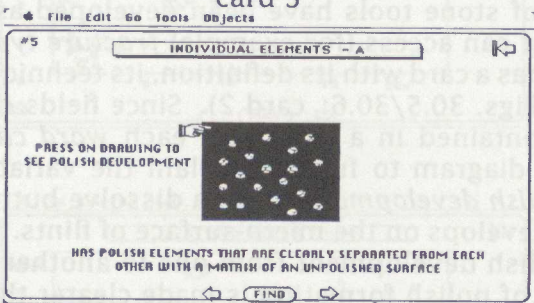
card 1



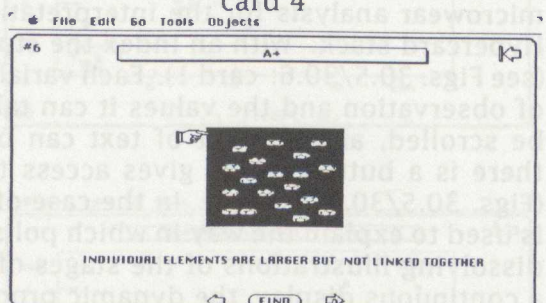
card 2



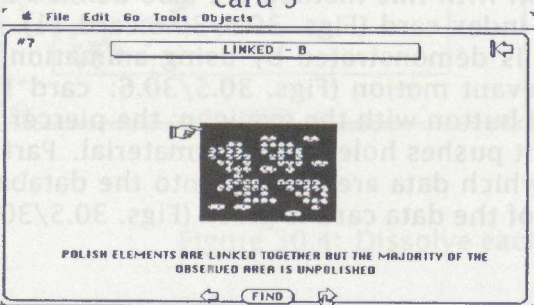
card 3



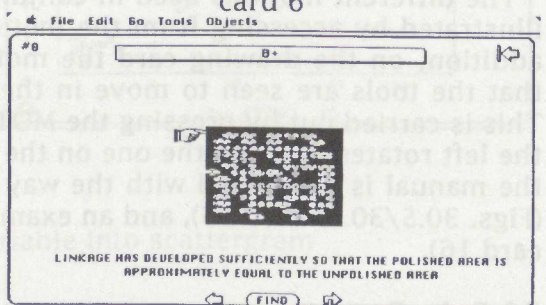
card 4



card 5



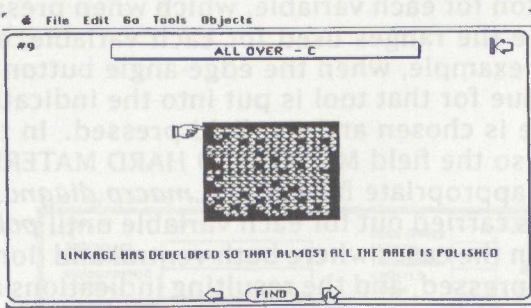
card 6



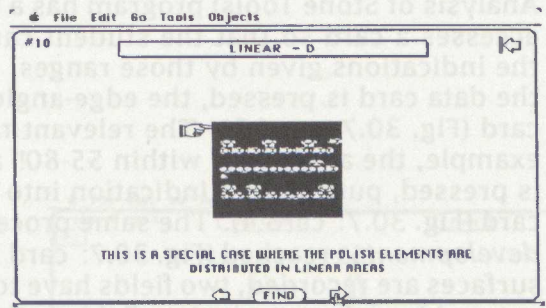
card 7

card 8

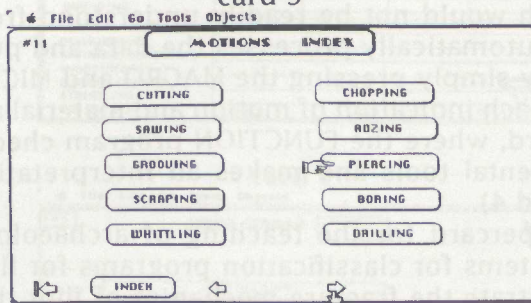
Figure 30.5: Microwear manual



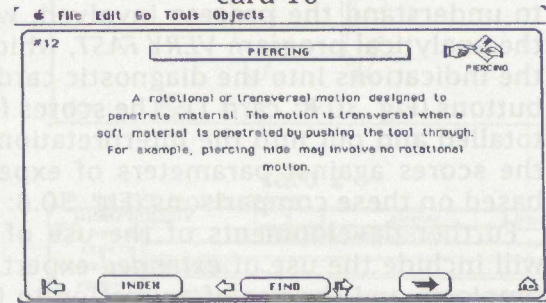
card 9



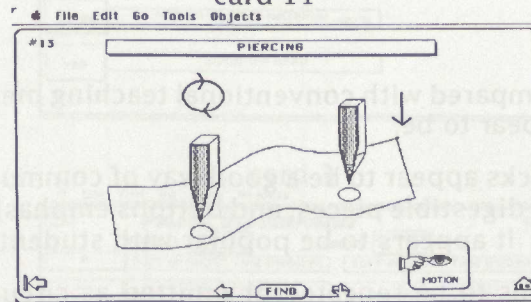
card 10



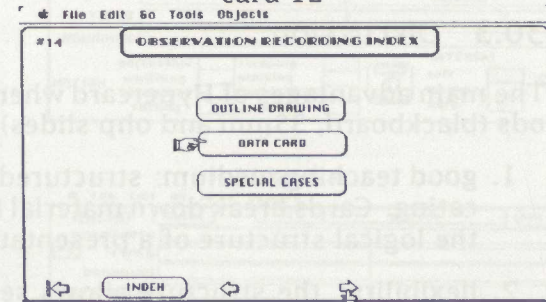
card 11



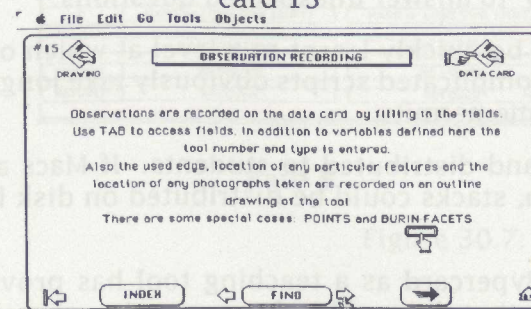
card 12



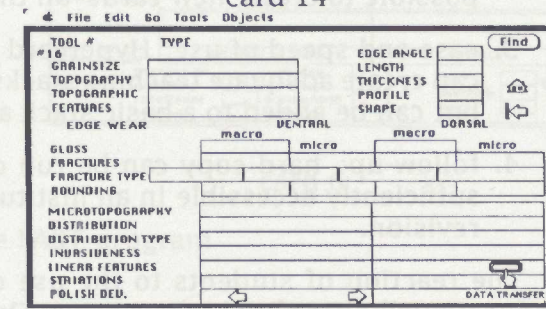
card 13



card 14



card 15



card 16

Figure 30.6: Microwear manual (cont.)

each variable. Each example in the stack has a drawing of the tool which can be accessed by pressing DRAW (Fig. 30.7: card 2). The data card in the *FAST* (Functional Analysis of Stone Tools) program has a button for each variable, which when pressed accesses a card so that the student can see the ranges used for each variable, and the indications given by those ranges. For example, when the edge-angle button on the data card is pressed, the edge-angle value for that tool is put into the indication card (Fig. 30.7: card 3). The relevant range is chosen and the field pressed. In this example, the angle falls within 55-80! and so the field MEDIUM TO HARD MATERIAL is pressed, putting that indication into the appropriate field of the *macro diagnostic* card (Fig. 30.7: card 4). The same process is carried out for each variable until *polish development* is reached (Fig. 30.7: card 5). In the cases where both ventral and dorsal surfaces are recorded, two fields have to be pressed, and the resulting indications are entered into the appropriate field on the *micro diagnostic* card (Fig. 30.7: card 6).

By going through each variable in turn and seeing the indications, a student learns to understand the process involved, which would not be readily understood from the analytical program *VERY FAST*, which automatically processes the data and puts the indications into the diagnostic cards by simply pressing the MACRO and MICRO buttons (Fig. 30.8: card 1). The scores for each indication of motion and material are totalled and put into the interpretation card, where the *FUNCTION* program checks the scores against parameters of experimental tools and makes an interpretation based on these comparisons (Fig. 30.8: card 4).

Further developments of the use of Hypercard for the teaching of archaeology will include the use of *extended* expert systems for classification programs for flint typology, and the use of animation to illustrate the fracture mechanics of flint that occur during the manufacture and use of tools.

### 30.3 Discussion

The main advantages of Hypercard when compared with conventional teaching methods (blackboard, 35mm and ohp slides) appear to be:

1. good teaching medium: structured stacks appear to be a good way of communicating. Cards break down material into digestible pieces, and buttons emphasise the logical structure of a presentation. It appears to be popular with students.
2. flexibility: the structure allows sections to be repeated or omitted as circumstances require. Explanations can be provided according to need. It is even possible to create new cards 'on the fly' to answer unexpected questions.
3. ease and speed of use: Hypercard can be quickly learnt to a level at which one can create adequate teaching stacks. Complicated scripts obviously take longer, but can be added to a basic stack as time permits.
4. follow-up: hard copy can be run off and distributed to students. If Macs are sufficiently accessible in an institution, stacks could be distributed on disk for revision.

The reaction of students to the use of Hypercard as a teaching tool has proved educationally beneficial in two ways. One is that the graphical presentation of material has enabled students to grasp complex procedures by seeing those procedures in action. They have understood the calculation of co-occurrence matrices (see Fig. 30.3) much quicker and easier by seeing that process graphically illustrated in Hypercard rather than through lengthy verbal explanation. Secondly they have found that the presentation of material in more versatile and adaptable structures



with the use of the linking facilities of Hypercard is more natural than the artificially imposed linear arrangement of information in formal publications. The facility to link back to subjects and the ability of students to create their own links has enabled them to assimilate the information in their own way, rather than the presentation of information being determined through the subjective bias of an instructor.

In the specific case of the use of the FAST program for the interpretation of the function of stone tools, students have been able to operate this program using their own data in such a way as to achieve results of 80% accuracy within a limited

File Edit Go Tools Objects

TOOL # 16 TYPE Find

#16 GRAINSIZE TOPOGRAPHY TOPOGRAPHIC FEATURES EDGE WEAR

EDGE ANGLE LENGTH THICKNESS PROFILE SHAPE

macro DENTRAL micro DORSAL

GLOSS FRACTURES FRACTURE TYPE ROUNDING

MICROTOPOGRAPHY DISTRIBUTION DISTRIBUTION TYPE INVASIVENESS LINEAR FEATURES STRIATIONS POLISH DEV.

DATA TRANSFER

File Edit Go Tools Objects

TOOL # BT 3 OBS CARD Find

#2

BT 3

card 1

File Edit Go Tools Objects

#3 RULES 59

<30 CUTTING SOFT

30-55 CUTTING OR SCRAPING MEDIUM MATERIAL

55-80 MEDIUM TO HARD MATERIAL

>80 SCRAPING HARD

card 2

File Edit Go Tools Objects

MORPHOLOGY 3 piercer OBS CARD

#4

ANGLE MEDIUM TO HARD MATERIAL

LENGTH

THICKNESS MAX 1 POINT

PROFILE

SHAPE

YENTRAL RULES DORSAL

GLOSS

FRACTURES MEDIUM RETOUCH

TYPES

ROUNDING

MOTION percussive whittling rotational cutting

scraping piercing boring/drill grooving

MATERIAL soft medium hard

DATA

card 3

File Edit Go Tools Objects

#5 POLISH DEVELOPMENT

DENTRAL B+ DORSAL Retouch

A SOFT or SHORT TIME [MEDIUM] SOFT or SHORT TIME [MEDIUM]

A+ SOFT to MEDIUM SOFT to MEDIUM

B MEDIUM or LONG TIME [SOFT] MEDIUM or LONG TIME [SOFT]

B+ MEDIUM to HARD MATERIAL MEDIUM to HARD MATERIAL

C HARD or LONG TIME [SOFT] HARD or LONG TIME [SOFT]

D HARD MATERIAL HARD MATERIAL

ABSENT NO POLISH NO POLISH

RETOUCH RETOUCH RETOUCH

card 4

File Edit Go Tools Objects

MICRO RULES 3 piercer OBS CARD

#6

FRACTURES

TYPES

ROUNDING

TOPOGRAPHY

DISTRIBUTION

TYPE

INVASIVENESS

LINEAR

POLISH DEVELOPMENT

MOTION percussive whittling rotational cutting

scraping piercing boring/drill grooving

MEDIUM to HARD

RETOUCH soft medium hard

DATA

card 5

card 6

Figure 30.7: The FAST program

each variable. Each example in the stack has a drawing of the tool which can be accessed by pressing DRAW (fig. 30.7: card 2). The data card in the FAST (Functional Analysis of Stone Tools) program has a button for each variable, which when pressed accesses a card so that the student can see the ranges used for each variable, and the indications given by those ranges. For example, when the edge angle button on the data card is pressed, the edge-angle value of that tool is put into the indication card (fig. 30.7: card 3). A relevant range is chosen and the FIND pressed. In this example, the angle is 59 which is within 0.5-90, and so the field MEDIUM to HARD MATERIAL is pressed, producing the appropriate field in the diagnostic

File Edit Go Tools Objects

TOOL # 3 TYPE piercer

EDGE ANGLE 59

GRAINSIZE fine  pointLENGTH 10

TOPOGRAPHY flat  THICKNESS 4

TOPOGRAPHIC FEATURES absent PROFILE 0

SHAPE 0.21

EDGE WEAR macro VENTRAL micro macro DORSAL

GLOSS absent absent absent absent

FRACTURES absent absent retouch retouch

FRACTURE TYPE absent absent retouch retouch

ROUNDING absent absent retouch retouch

MICROTOPOGRAPHY flat retouch

DISTRIBUTION gapped retouch  point

DISTRIBUTION TYPE <0.5 retouch

INVASIVENESS absent retouch

LINEAR FEATURES absent retouch

STRIATIONS absent retouch

POLISH BEJ. 0- retouch

card 1

File Edit Go Tools Objects

MORPHOLOGY 3 piercer

ANGLE MEDIUM to HARD MATERIAL

LENGTH SCRAPING or GROOVING HARD

THICKNESS mod 1 CUTTING

PROFILE SCRAPING MEDIUM or HARD

SHAPE SCRAPING

VENTRAL MACRO DORSAL

GLOSS NON-DIAGNOSTIC NON-DIAGNOSTIC

FRACTURES MEDIUM MATERIAL RETOUCH

TYPES NON-DIAGNOSTIC RETOUCH

ROUNDING SOFT to MEDIUM RETOUCH

RULES? percussive  scraping  4 projectile

MOTION whitling  piercing  1 soft 1

rotational  boring/drill  5 medium 5

cutting  1 grooving  1 hard 4

FIND

card 2

File Edit Go Tools Objects

MICRO 3 piercer

FRACTURES SOFT MATERIAL RETOUCH

TYPES NON-DIAGNOSTIC RETOUCH

ROUNDING SOFT to MEDIUM RETOUCH

TOPOGRAPHY NO EFFECT RETOUCH

DISTRIBUTION NON-DIAGNOSTIC RETOUCH

TYPE GROOVING/CUTTING HARD RETOUCH

INVASIVENESS MEDIUM to HARD RETOUCH

NON-DIAGNOSTIC RETOUCH

LINEAR NON-DIAGNOSTIC RETOUCH

POLISH DEVELOPMENT MEDIUM to HARD RETOUCH

RULES? percussive  scraping  projectile

MOTION whitling  piercing  3 soft 3

rotational  grooving  1 medium 1

cutting  1 boring/drill  4 hard 4

FIND

card 3

File Edit Go Tools Objects

TOOL # 3 piercer

PERCUSSIVE 0

WHITTLING 0

ROTATIONAL 0

CUTTING 1 + 1 2

SCRAPING 4 + 4 8

GROOVING 1 + 1 2

PIERCING 0

PROJECTILE 0

BORING/ DRILLING 0

SOFT 1 + 3 4

MEDIUM 5 + 3 8

HARD 4 + 4 8

MOTION GROOVING

CHOPPING/ ROZING

RULES?

FUNCTION

OBS CARD

CLEAR ALL

FIND

card 4

Figure 30.8: The VERY FAST program

follow-up. A copy can be run off and distributed to students. If Macs are available, the program can be run in an institution, stacks could be distributed on disk for revision.

The reaction of students to the use of HyperCard as a teaching tool has proved educationally beneficial in two ways. One is the graphical presentation of material enabled students to grasp complex procedures by seeing those procedures in action. They have understood the calculation of co-occurrence matrices (see fig. 30.3) much quicker and easily by seeing that process graphically illustrated in Hypercard rather than through lengthy verbal explanation. Secondly they have found that the presentation of material in more versatile and adaptable structures

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In the specific case of the use of the FAST program for the interpretation of the function of stone tools, students have been able to operate this program using their own data in such a way as to achieve results of 80% accuracy within a limited time. This compares favourably with other micro-wear analysts of considerably more experience but who have learned the techniques from printed material.

The increasing use of visual material, and computer literacy in schools, means that the presentation of information through the medium of Hypercard is seen as a natural progression for University students, rather than reliance on the written word and formal lecturing. The use of some of the 'gimmicks' in Hypercard such as musical accompaniment to demonstration programs and animation of diagrams has educational value in that it makes the presentation more entertaining, thereby holding the interest of students. The use of teaching programs requires interaction from the student rather than passive assimilation from published material.

The main drawback is the cost—over £3000 for an SE with Viewframe, after deduction of the educational discount. However, many institutions now possess SEs or Mac Pluses on which stacks can be created, and the SE with the special board needed to drive the Viewframe can be shared amongst several teachers. The future for educational stackware looks promising.