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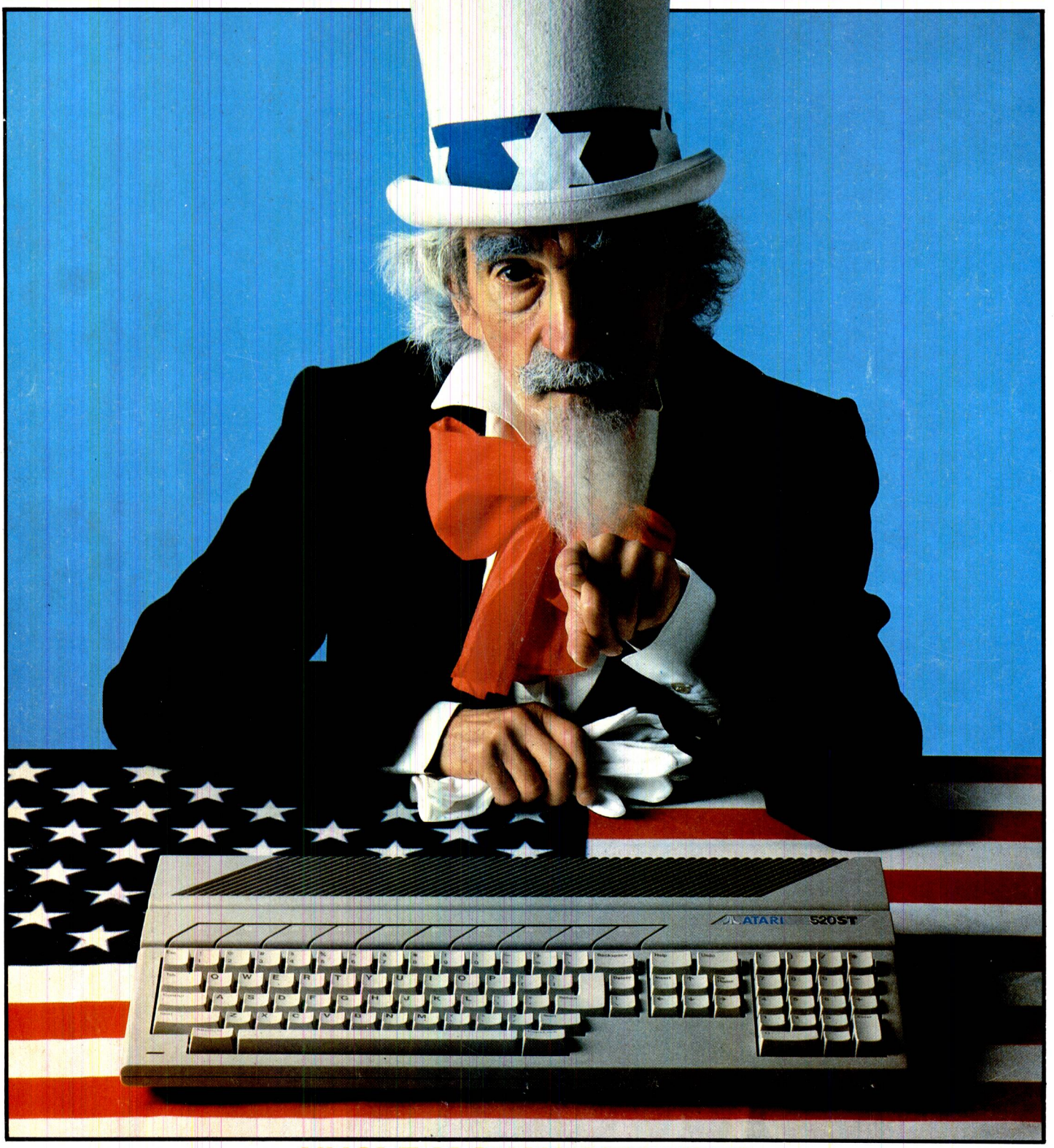

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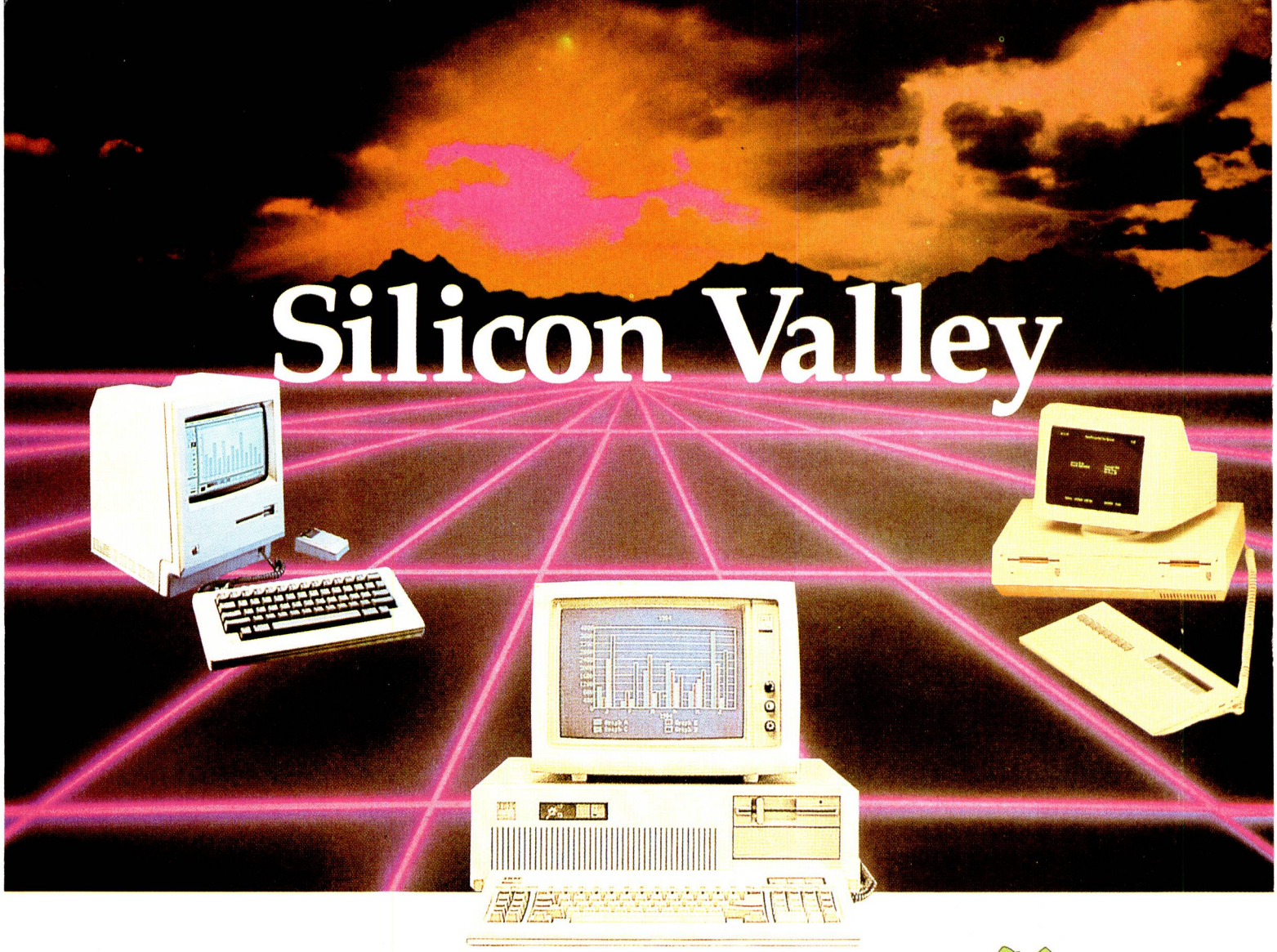

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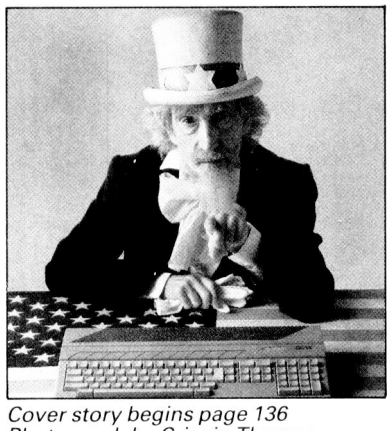

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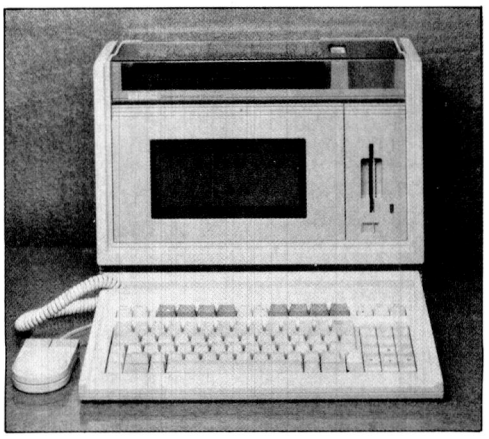

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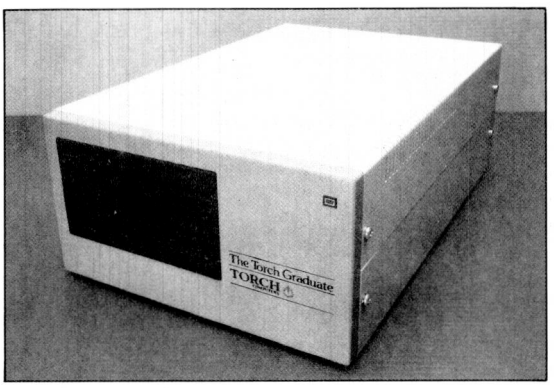

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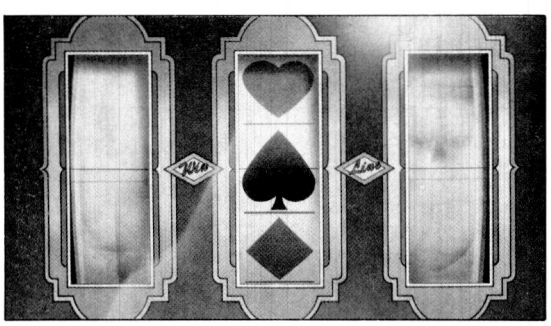

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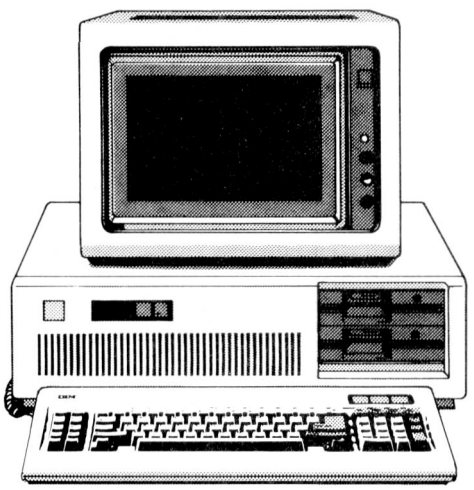

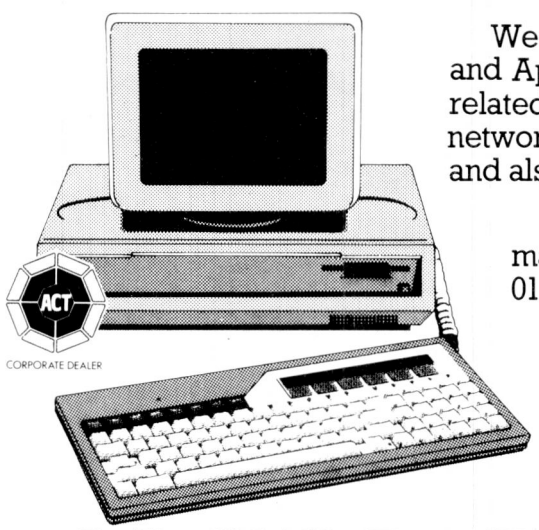

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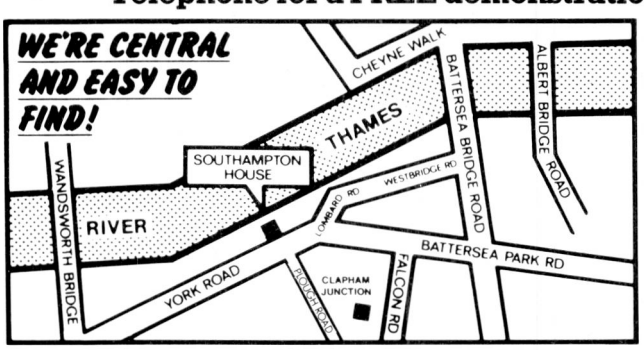

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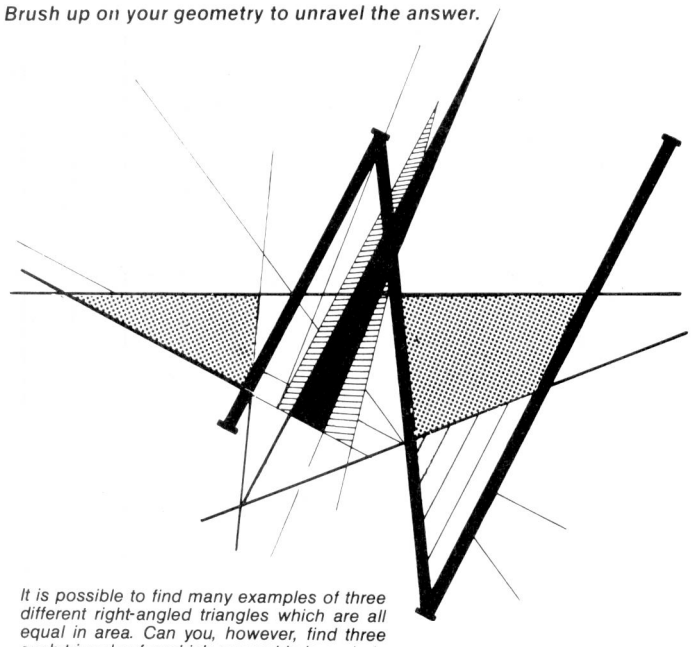

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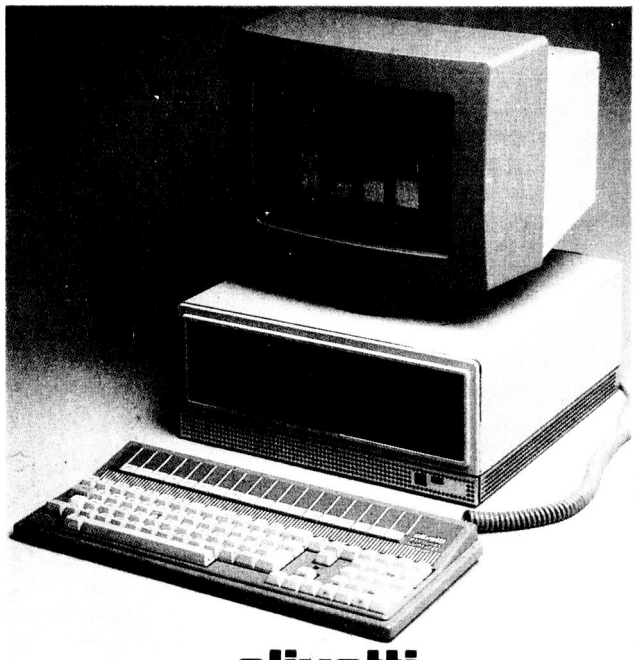

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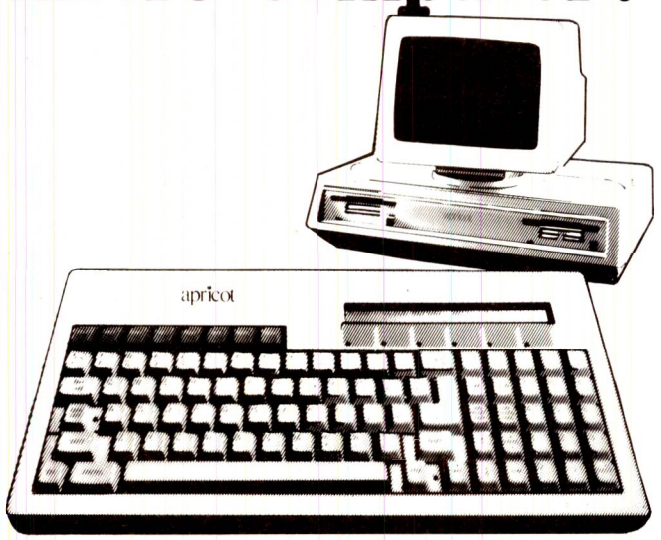

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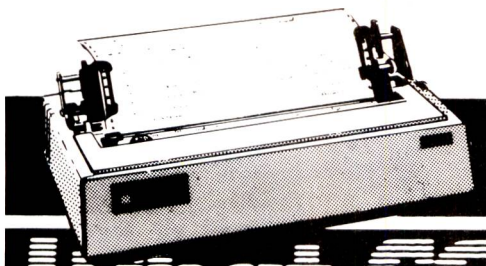

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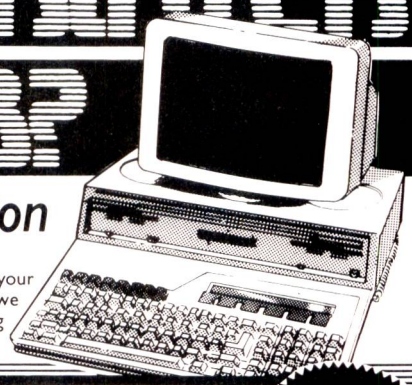

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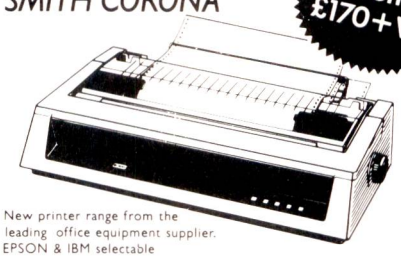

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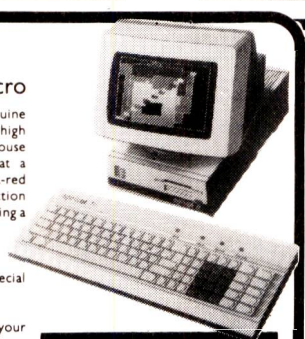

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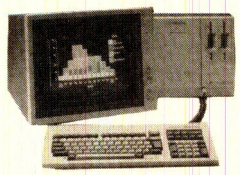

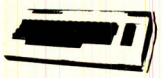

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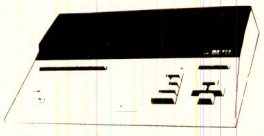

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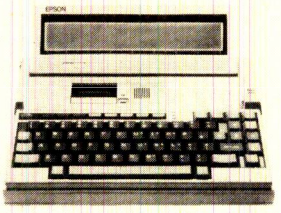

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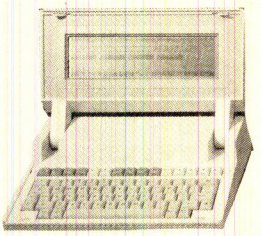

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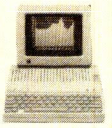

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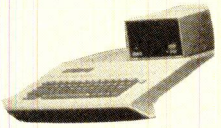

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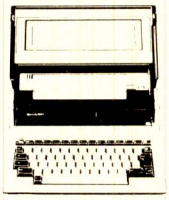

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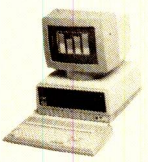

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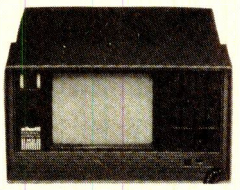

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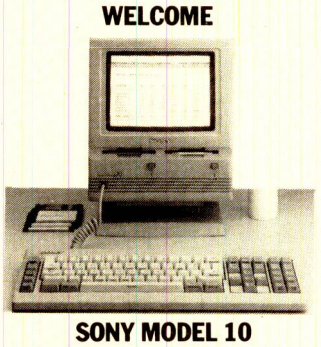

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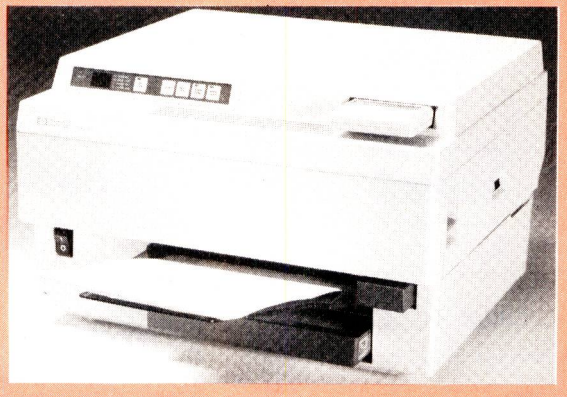

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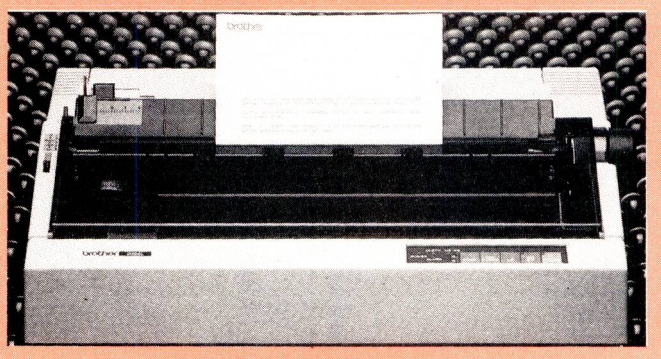

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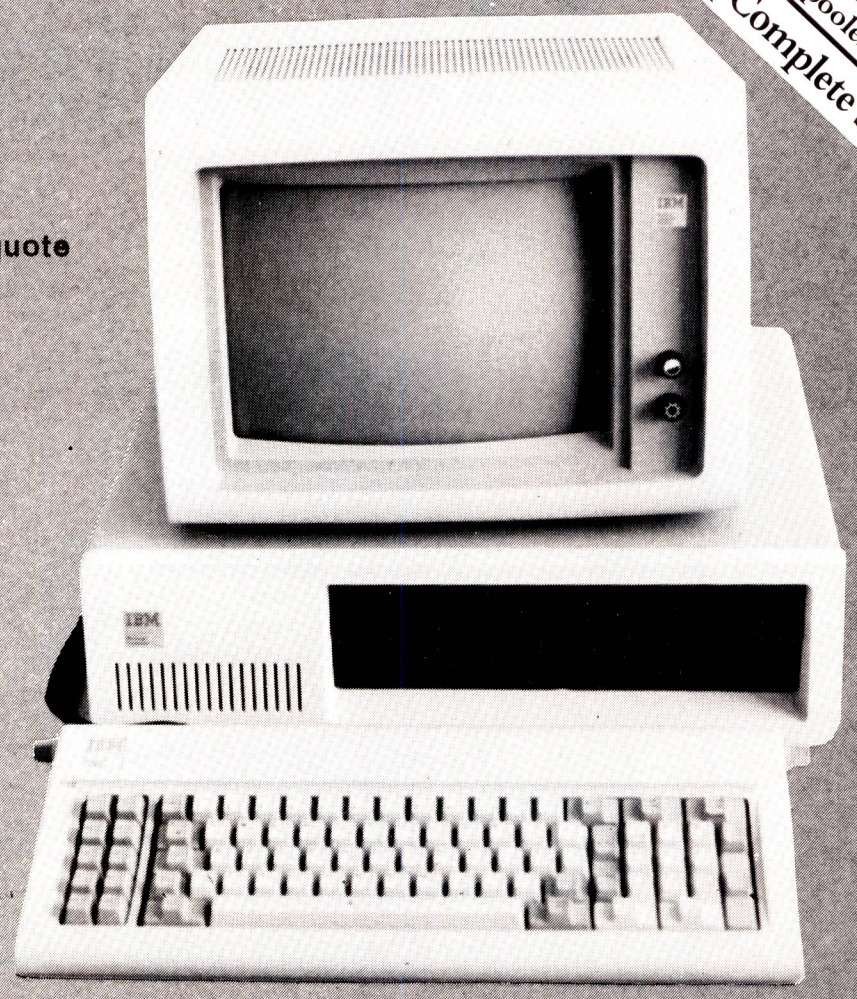

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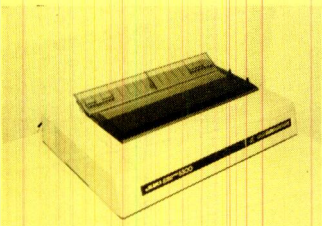

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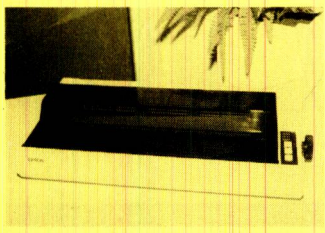

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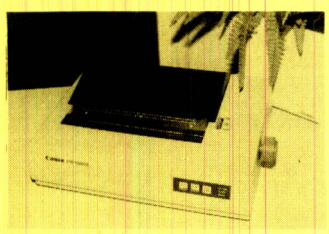

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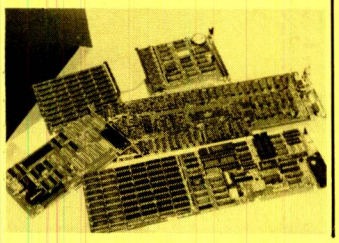

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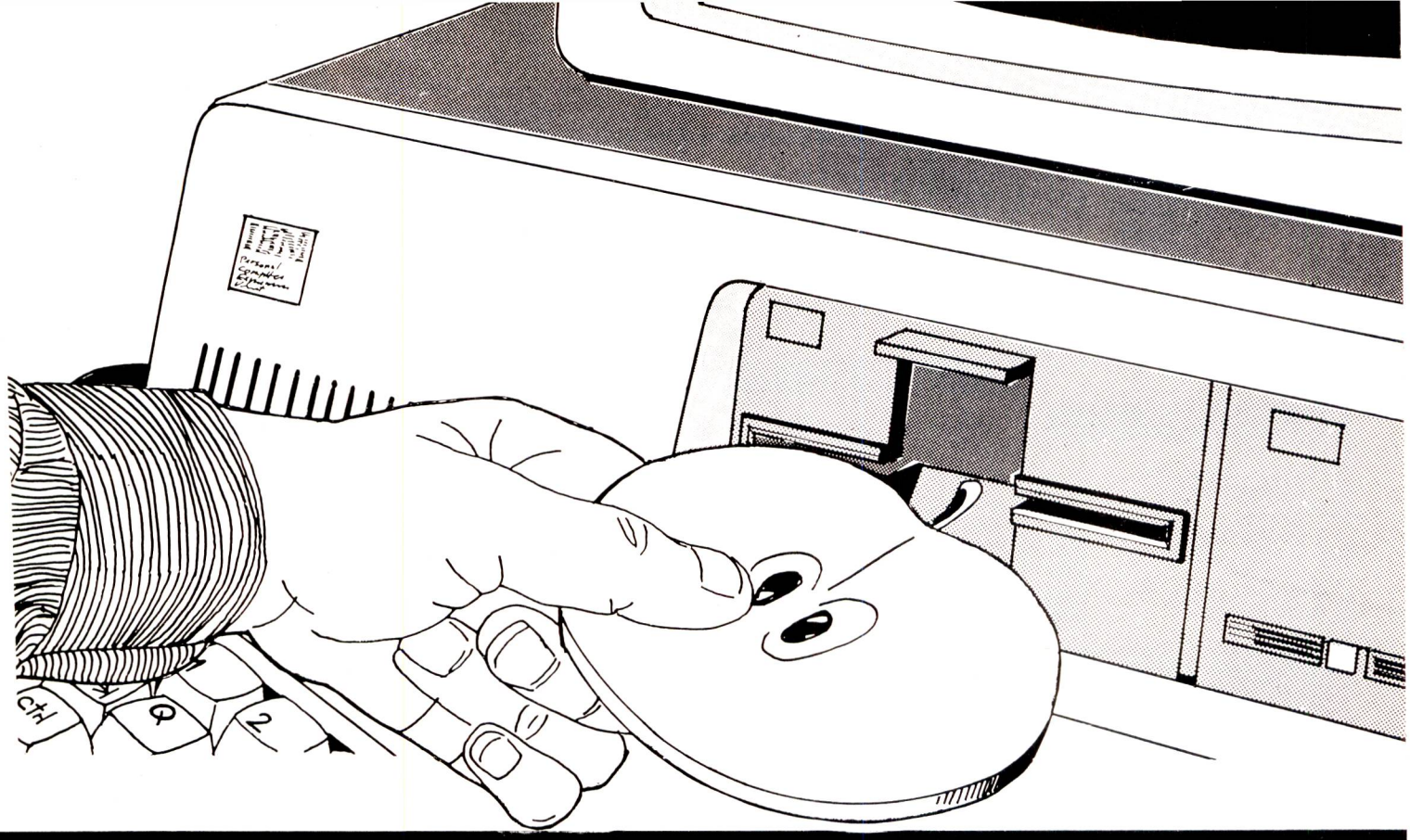

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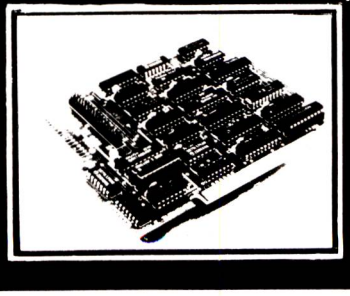

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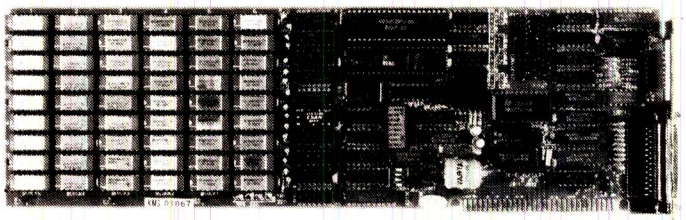

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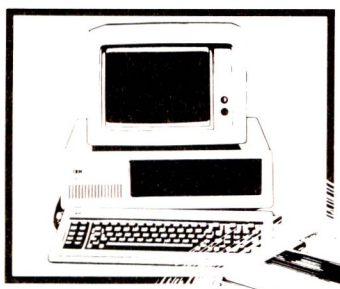

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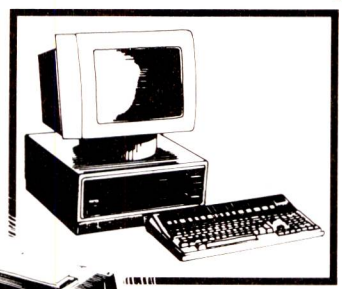

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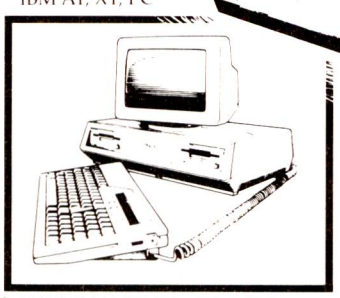

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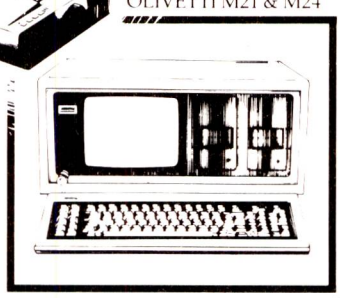

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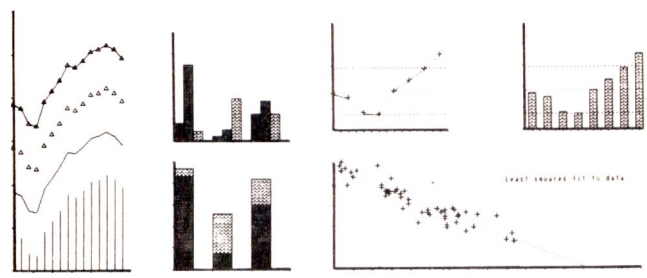

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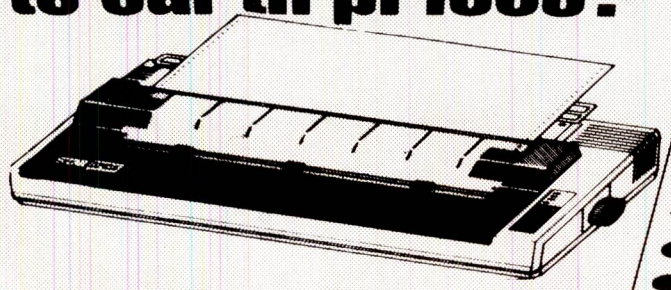

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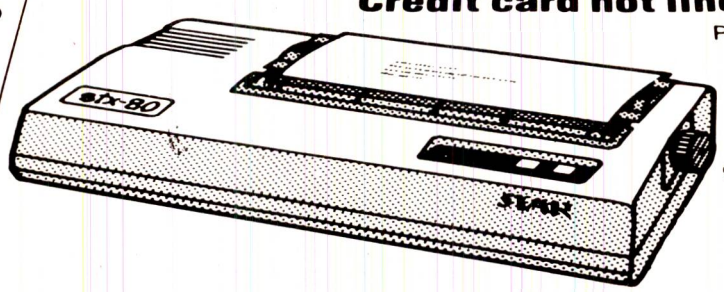

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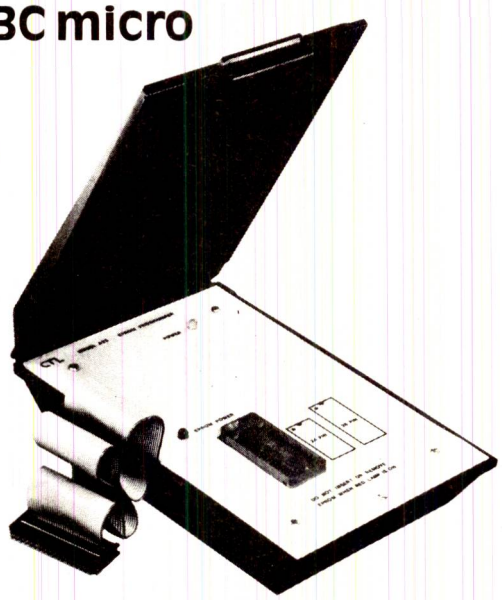

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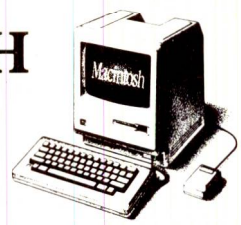

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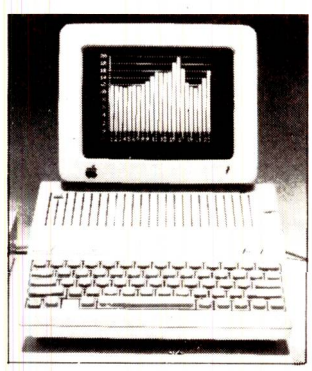

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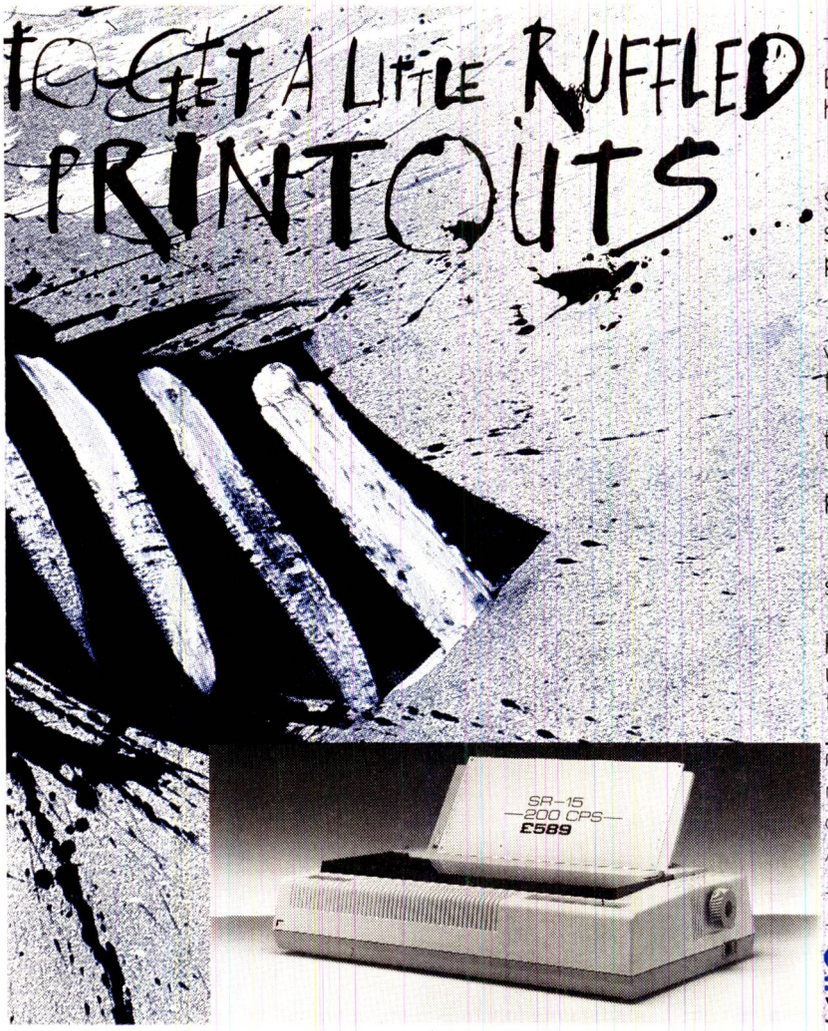

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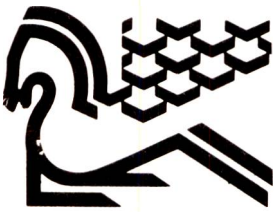

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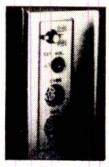

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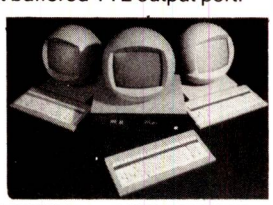

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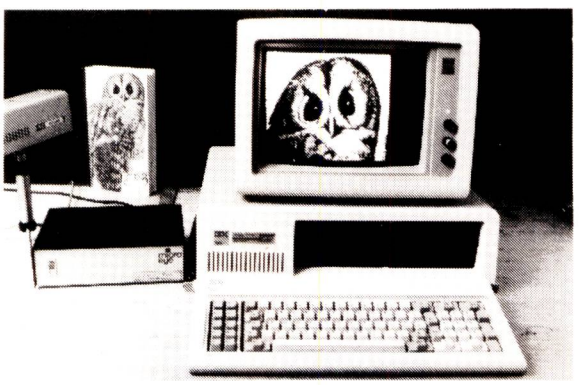

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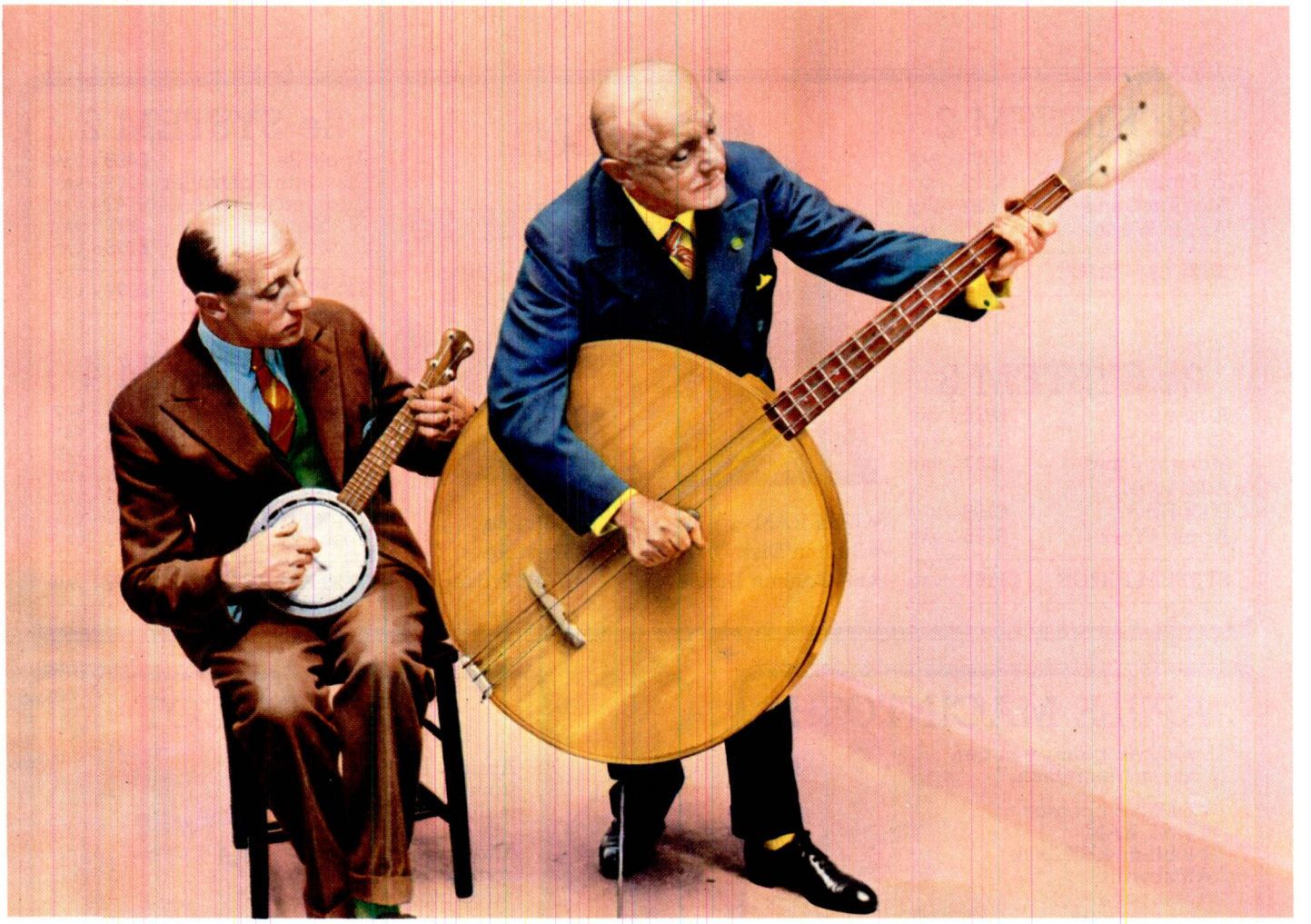

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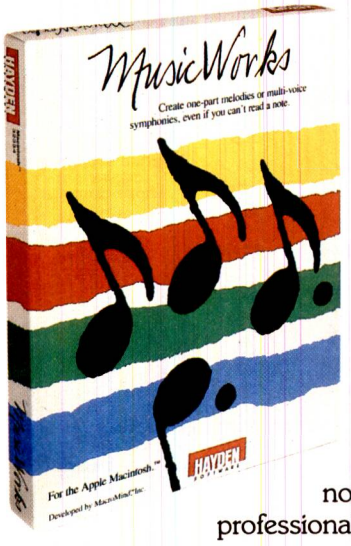

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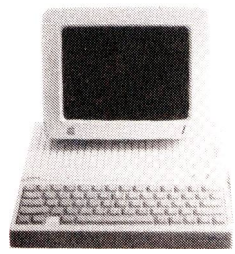

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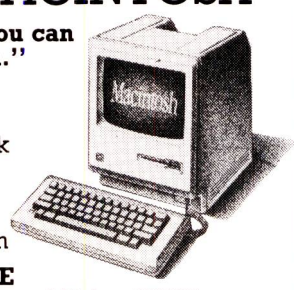

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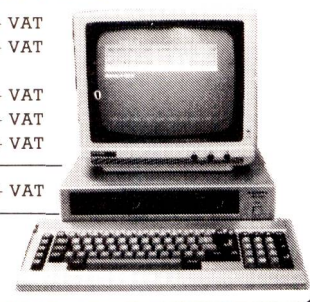

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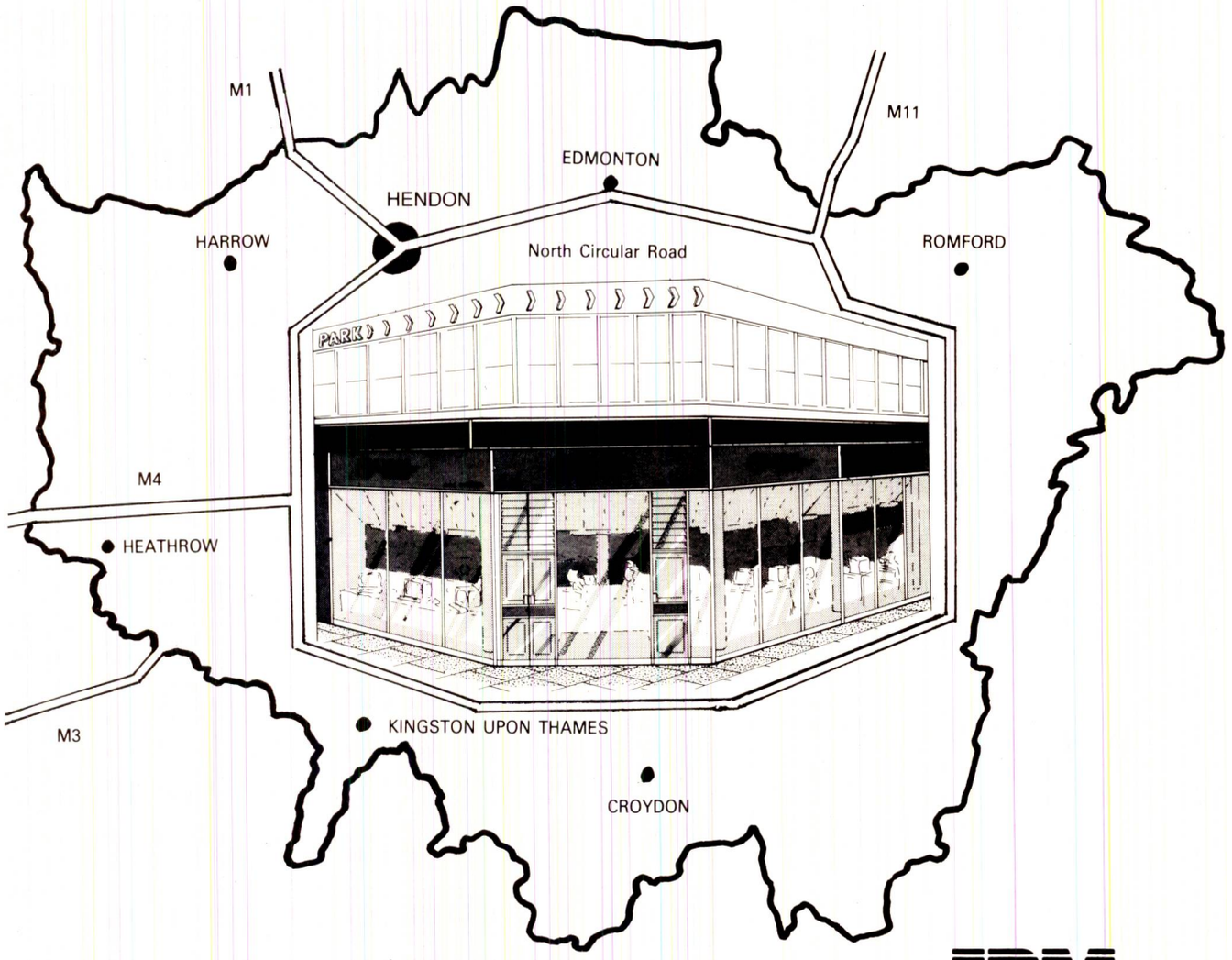

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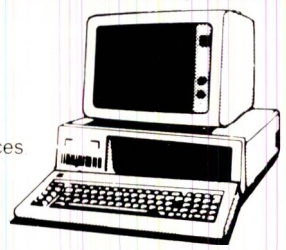

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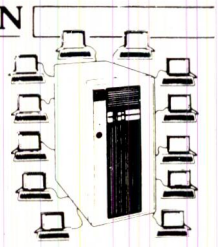

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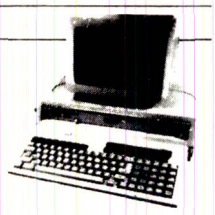

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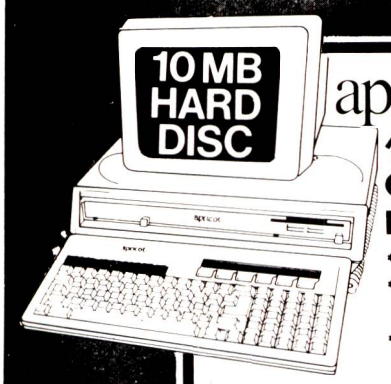

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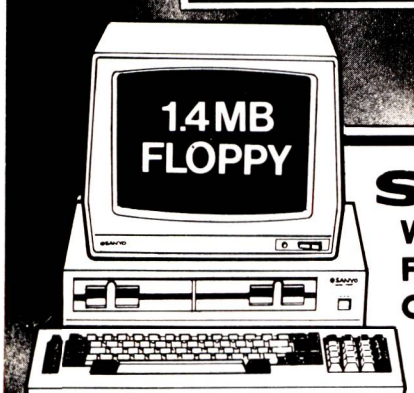

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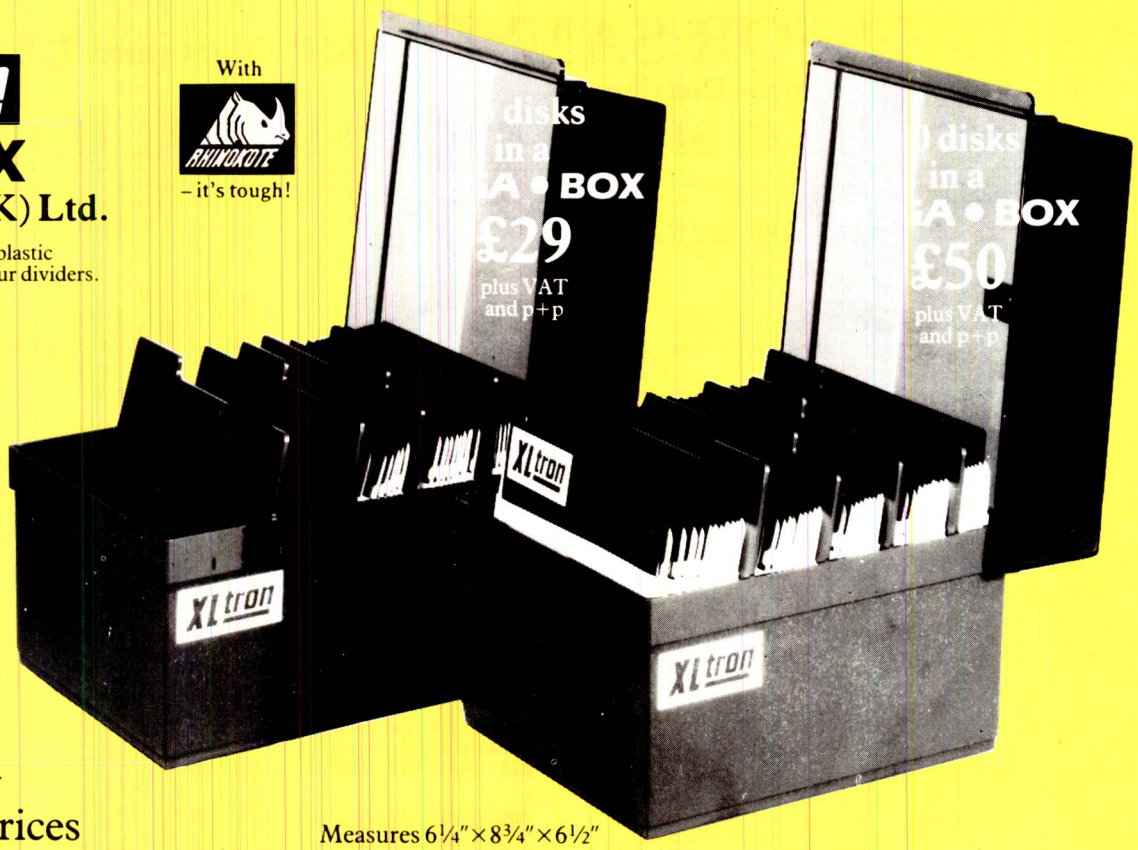

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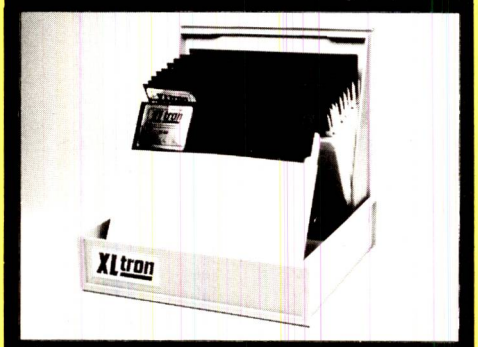

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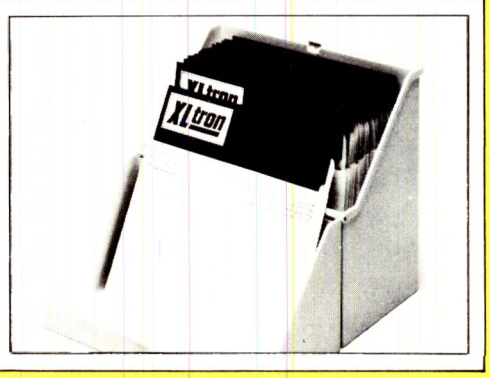

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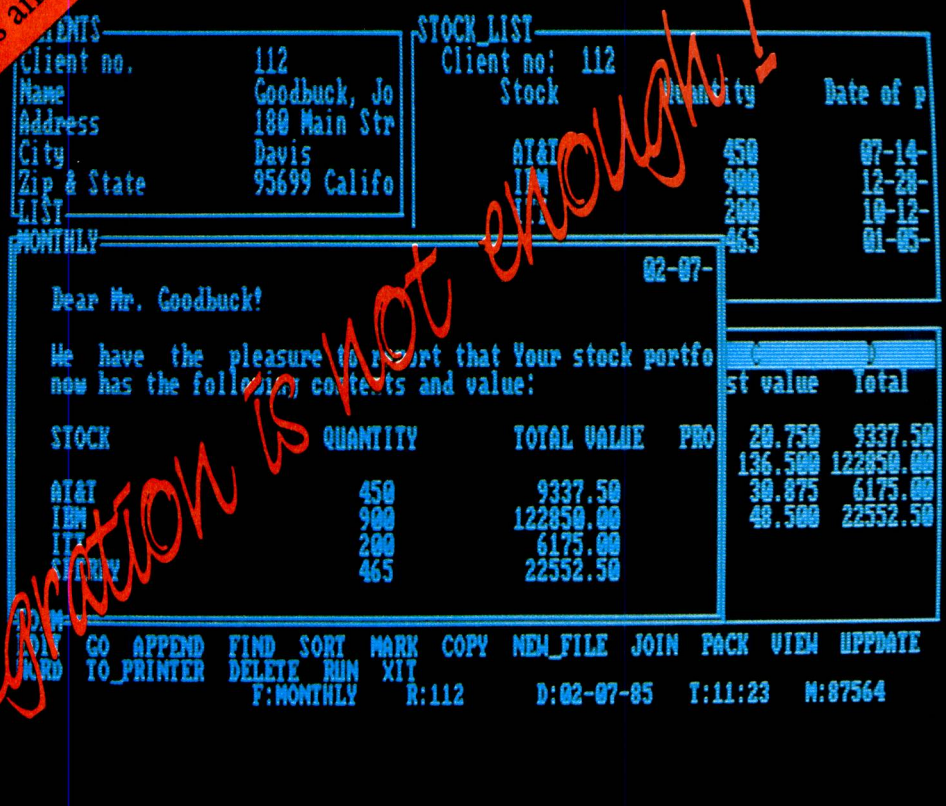

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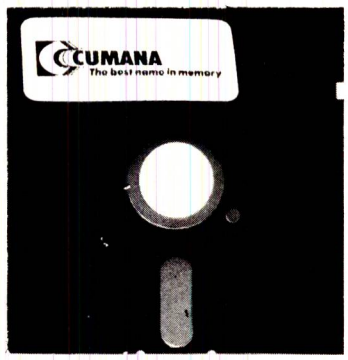

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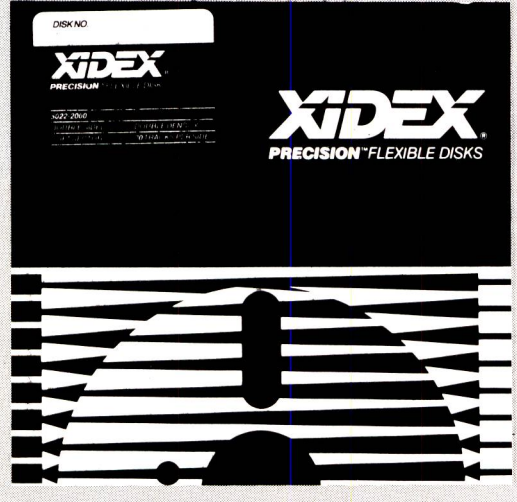

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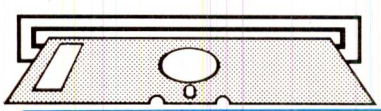

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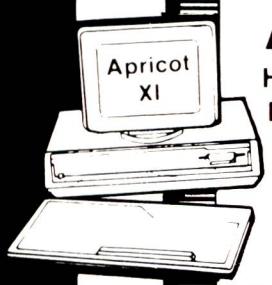

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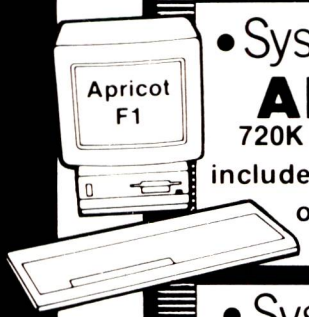

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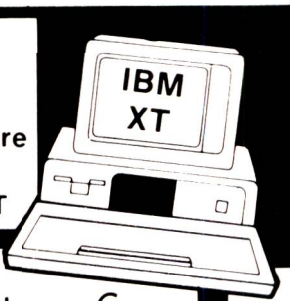

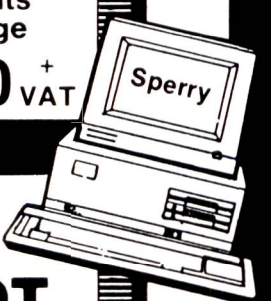



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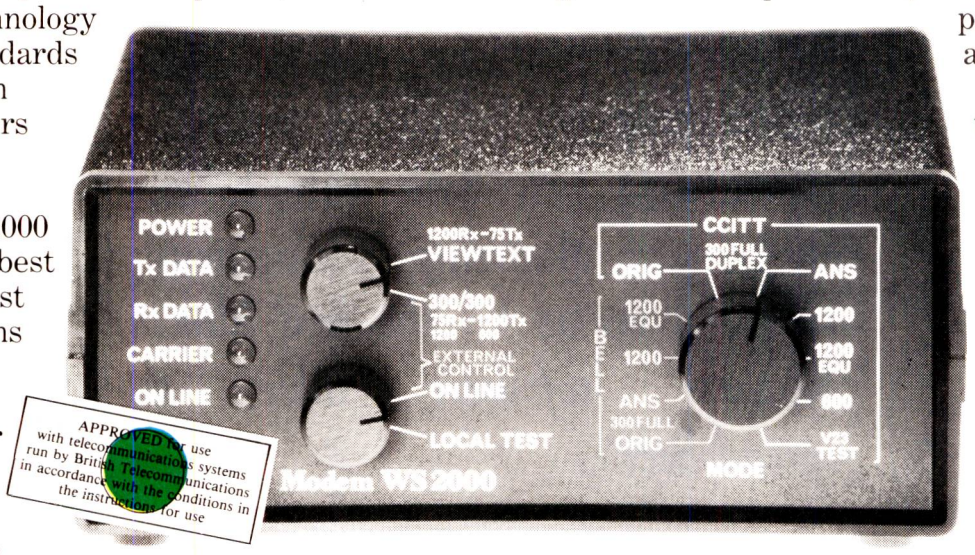

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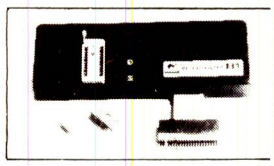

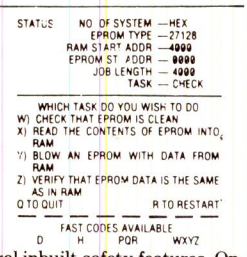

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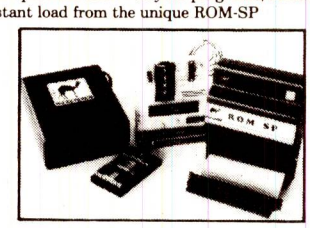

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TASWORD EINSTEIN Tatung Einstein
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The TASCOPY screen copiers print high resolution screen copies with different dot densities and patterns for the various screen colours. This gives the screen copies a shaded effect which presents on a monochrome scale the colours on the screen. With TASCOPY you can keep a permanent and impressive record of your screen pictures and diagrams. TASCOPY supports all the printers mentioned under TASPRINT.

TASCOPY (Spectrum + Interface 1)

The Spectrum TASCOPY is for use with the RS232 output on ZX Interface 1. It produces monochrome copies (in a choice of two sizes) as well as copies with the shaded "grey scale" effect described above.

TASCOPY ZX Spectrum
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TASCOPY 464

Adds two new commands to the 464 Basic to give both a standard shaded screen copy as well as a "poster size" copy which is printed onto two or four sheets which can be cut and joined to make the poster.

TASCOPY 464 Amstrad CPC464
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TASCOPY QL

TASCOPY QL adds new commands to QL Superbasic. Execute these commands to print a shaded copy of the screen contents. Print the entire screen or just a specified window. TASCOPY QL also produces large "poster size" screen copies on more than one sheet of paper which can then be cut and joined to make the poster, and high speed small copies.

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BROTHER HR5
SHINWA CP-80
COSMOS-80
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DATAC PANTHER II

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DATA-RUN → A FUTURISTIC SCRIPT
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MEDIAN – a serious business-like script
Palace Script – a distinctive flowing font

Typical Tasprint output. Please note that different makes of printer produce different sized output.

TASPRINT (Spectrum)

Drives all the printer interfaces compatible with TASWORD TWO and can be used to print TASWORD TWO text files as well as output from your own Basic programs.

TASPRINT 48K Spectrum
cassette **£9.90**
microdrive cartridge **£11.40**

TASPRINT 464

Can be used to print AMSWORD/TASWORD 464 text files in addition to output from your own Basic programs. Drives the Amstrad DMP 1 in addition to the printers listed to the left.

TASPRINT 464 Amstrad CPC 464
cassette **£9.90**
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TASPRINT QL

TASPRINT QL includes a screen editor used to modify files created by other commercial software, such as QUILL, or by the user from BASIC. These modified files include TASPRINT control characters and may be printed, using TASPRINT, in one or more of the unique TASPRINT fonts.

TASPRINT QL Sinclair QL
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The Mail Merger

Transfer data from MASTERFILE to TASWORD TWO! Letters and forms typed on TASWORD TWO can be printed with addresses and data taken from MASTERFILE. The mail merge facility allows, for example, multiple copies of a letter to be printed, each containing a different name and address taken from your MASTERFILE data. To use TASMERGE you must have one or more microdrives as well as TASWORD TWO and MASTERFILE by Campbell Systems. (version 9 or later).

TASMERGE ZX 48K Spectrum **£10.90**

TASWIDE

The Screen Stretcher

With this machine code utility you can write your own Basic programs that will, with normal PRINT statements, print onto the screen in the compact lettering used by TASWORD TWO. With TASWIDE you can double the information shown on the screen!

TASWIDE ZX 16K + 48k Spectrum **£5.50**

TASMAN PRINTER INTERFACE

Plug into your Spectrum and drive any printer fitted with the Centronics standard parallel interface. Supplied complete with ribbon cable and driving software. The user changeable interface software makes it easy to send control codes to your printer using the method so successfully pioneered with TASWORD TWO. The cassette contains fast machine code high resolution full width SCREEN COPY SOFTWARE for Epson, Mannesmann Tally, Shinwa, Star, and Tandy Colour Graphic (in colour!) printers.
TASCOPY, shaded screen copy software for this interface (value £9.90 – see description on left) is included in this package.

CENTRONICS INTERFACE ZX Spectrum **£39.90**

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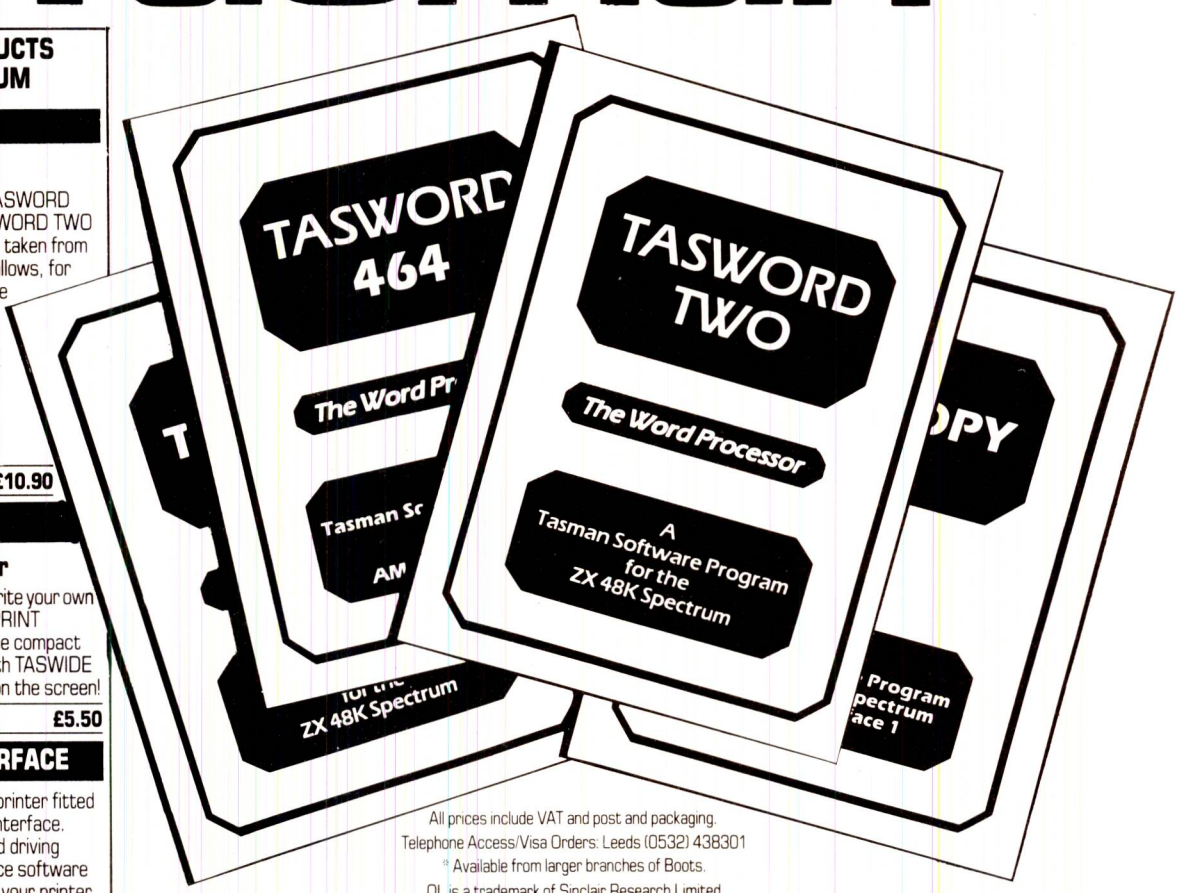

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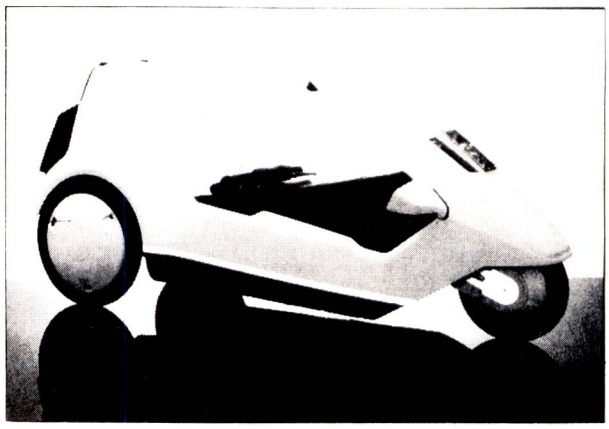

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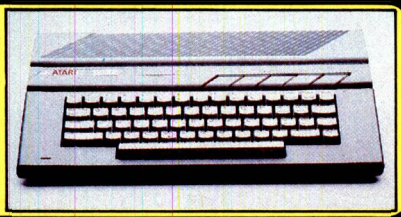

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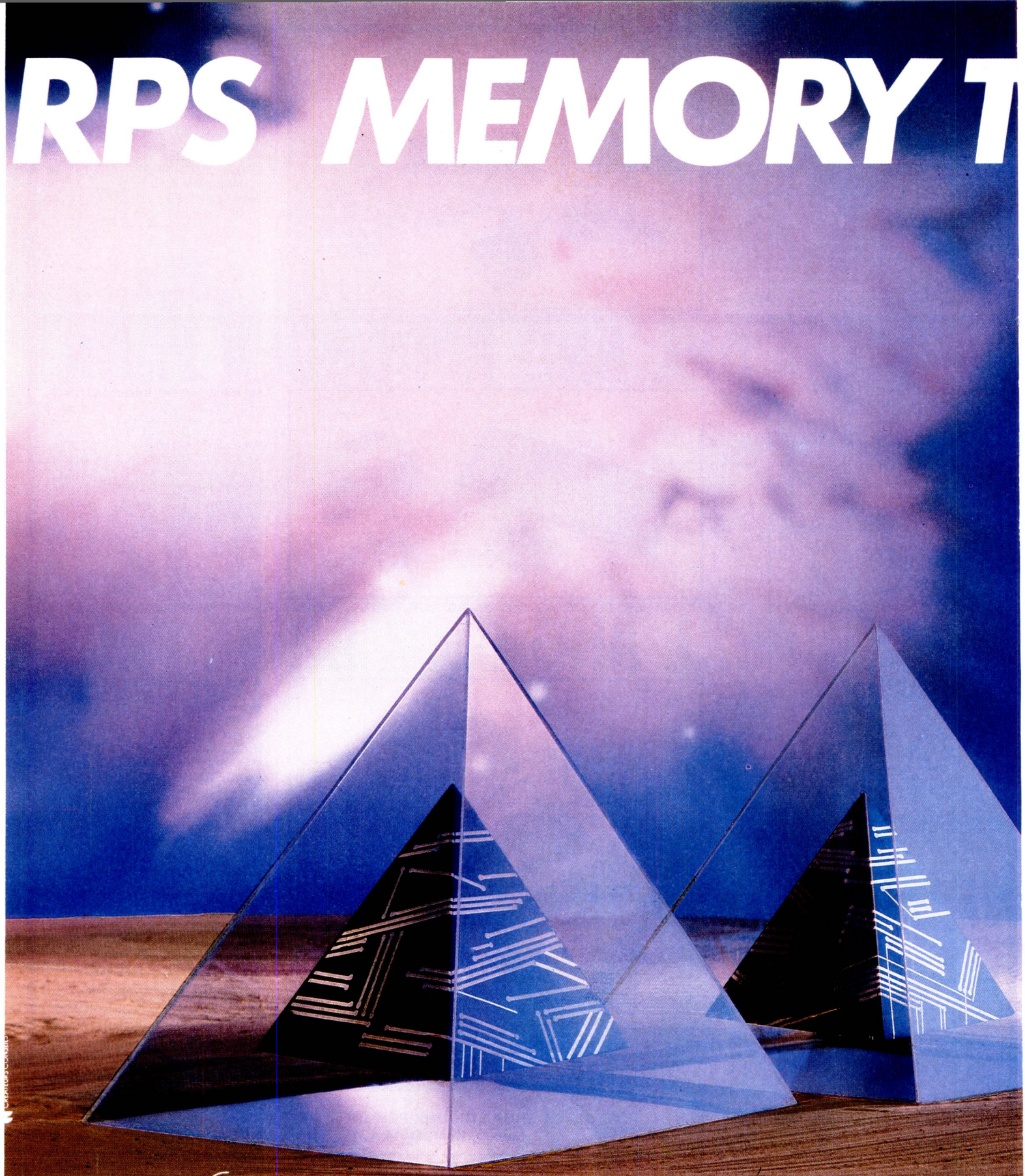



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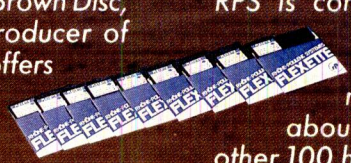

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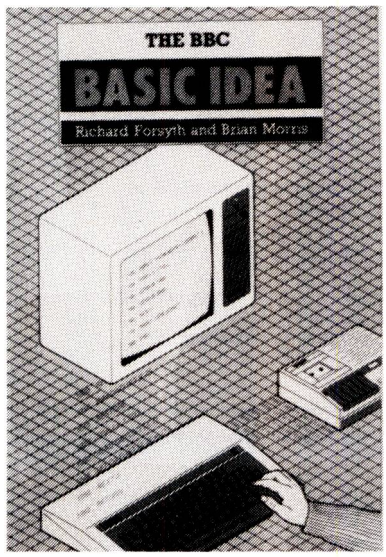

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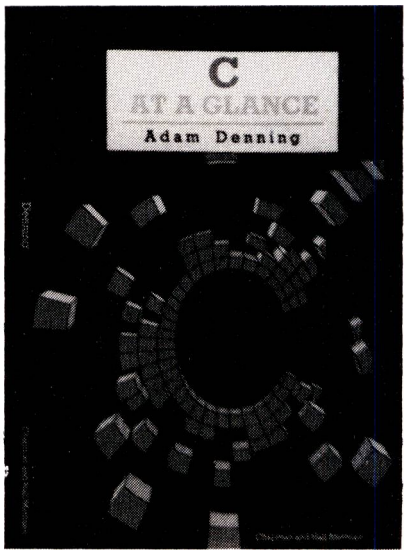

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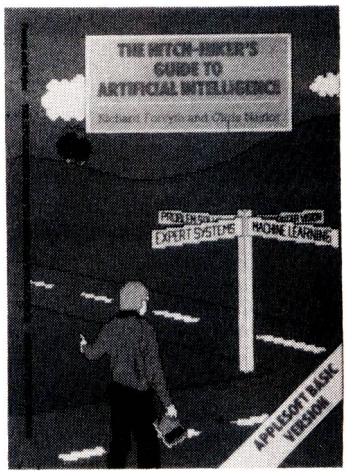

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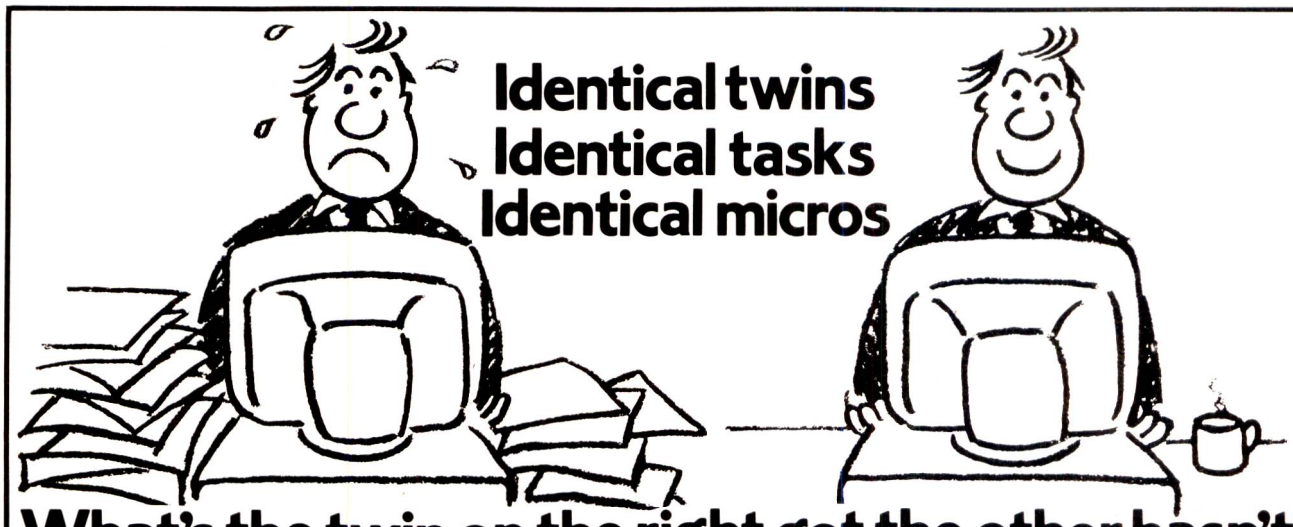

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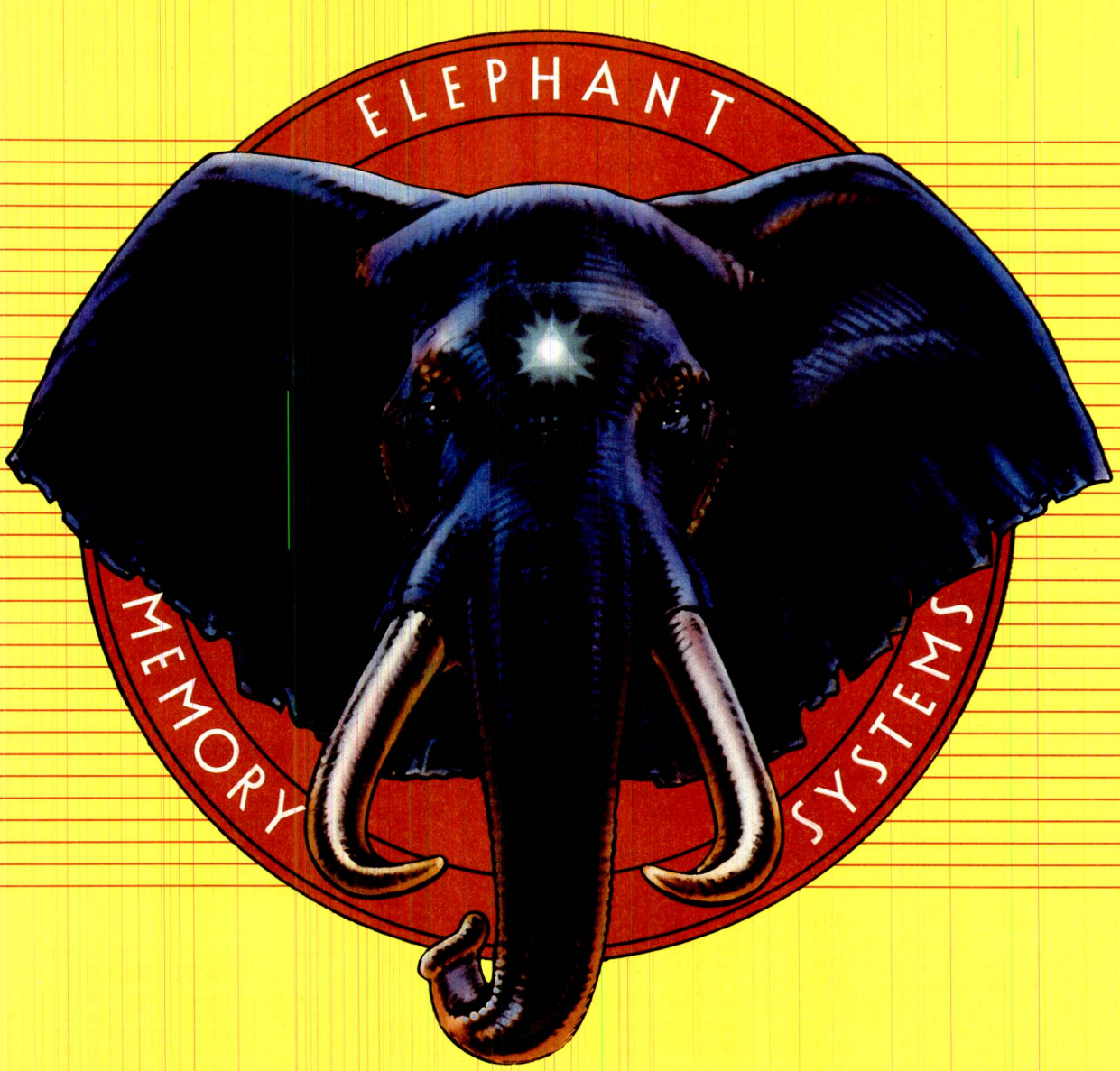



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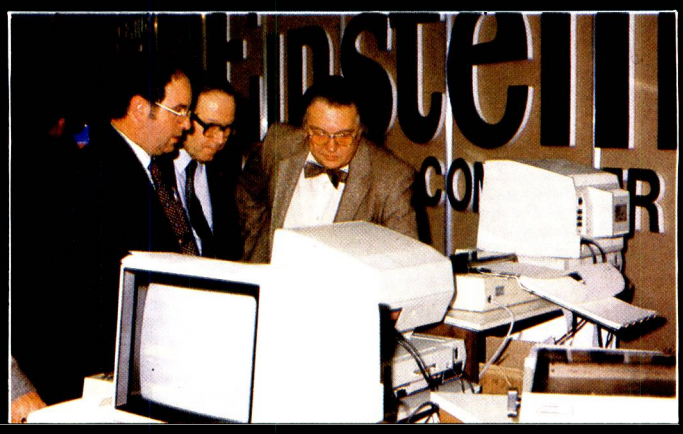

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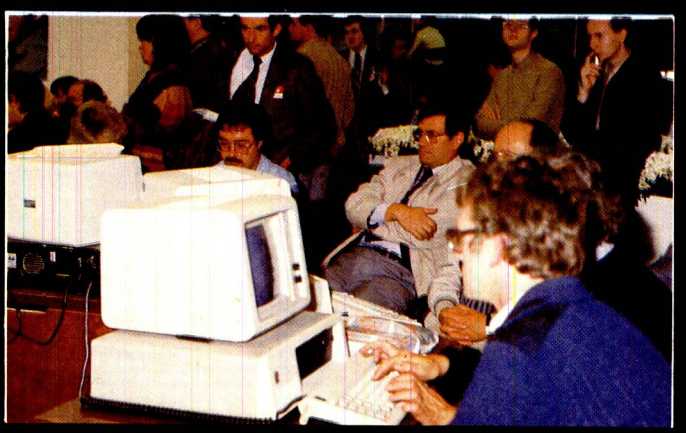

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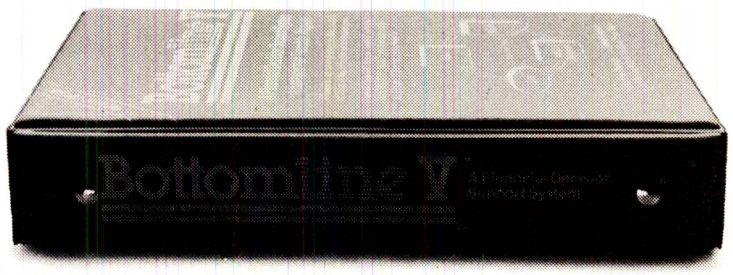

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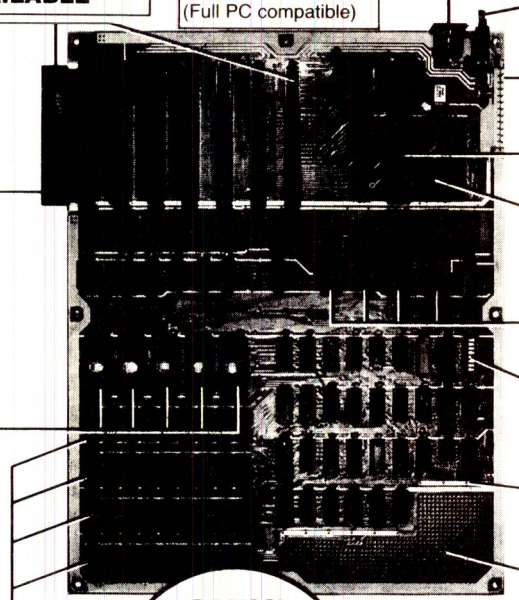

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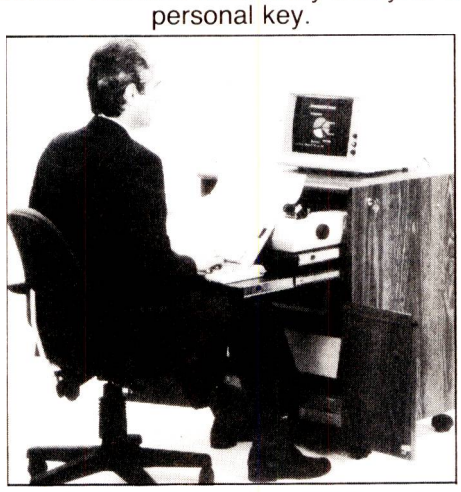

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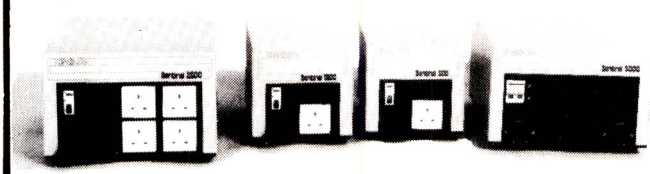

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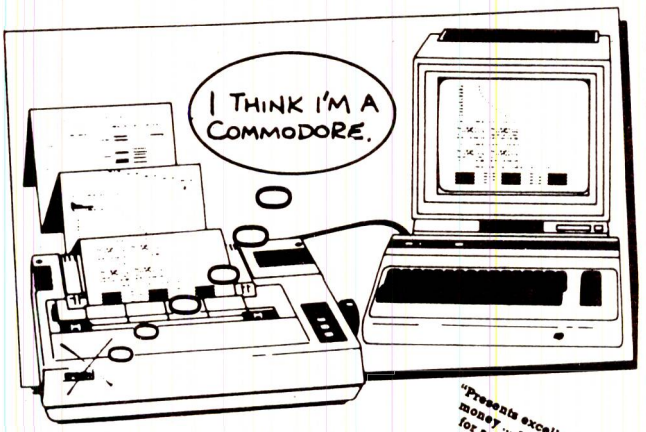

How many Commodore home computer owners, when faced with buying a printer, have longed to own an Epson but been put off by the problems involved? Firstly, it's not easy to connect the two together. Secondly, even when connected, it may be necessary to load driver software or the cartridge slot may be unusable. Finally Commodore-specific characteristics such as graphics and formatting commands will not be available.

Now Micro Control Systems have the solution. Just plug the Comprint circuit board inside the Epson, connect the cable supplied to the Serial I/O port on the Commodore computer and Hey Presto! The Comprint fools the Commodore into thinking it is working with a Commodore printer. All the features are there — total emulation. And it even provides a 2K buffer as well.

What's more all the additional features that have made Epson so successful, such as condensed print and other type styles, are accessible directly by the Commodore computer. For the business user the ability to use 15 inch paper (in the MX/RX/FX-100 range) and print a £ sign (or other Epson special characters) will prove invaluable.

So go on — spoil yourself. If you are the owner of a Commodore personal computer treat yourself to an Epson — and a Comprint of course!

"Presents excellent value for money ... a worthy purchase for any Commodore 64 or VIC 20" – PCN, January 12th, 1985

"This is one of the most versatile printer interfaces I have used ... a combination that will do almost anything you ask of it" – Commodore User, January 1985

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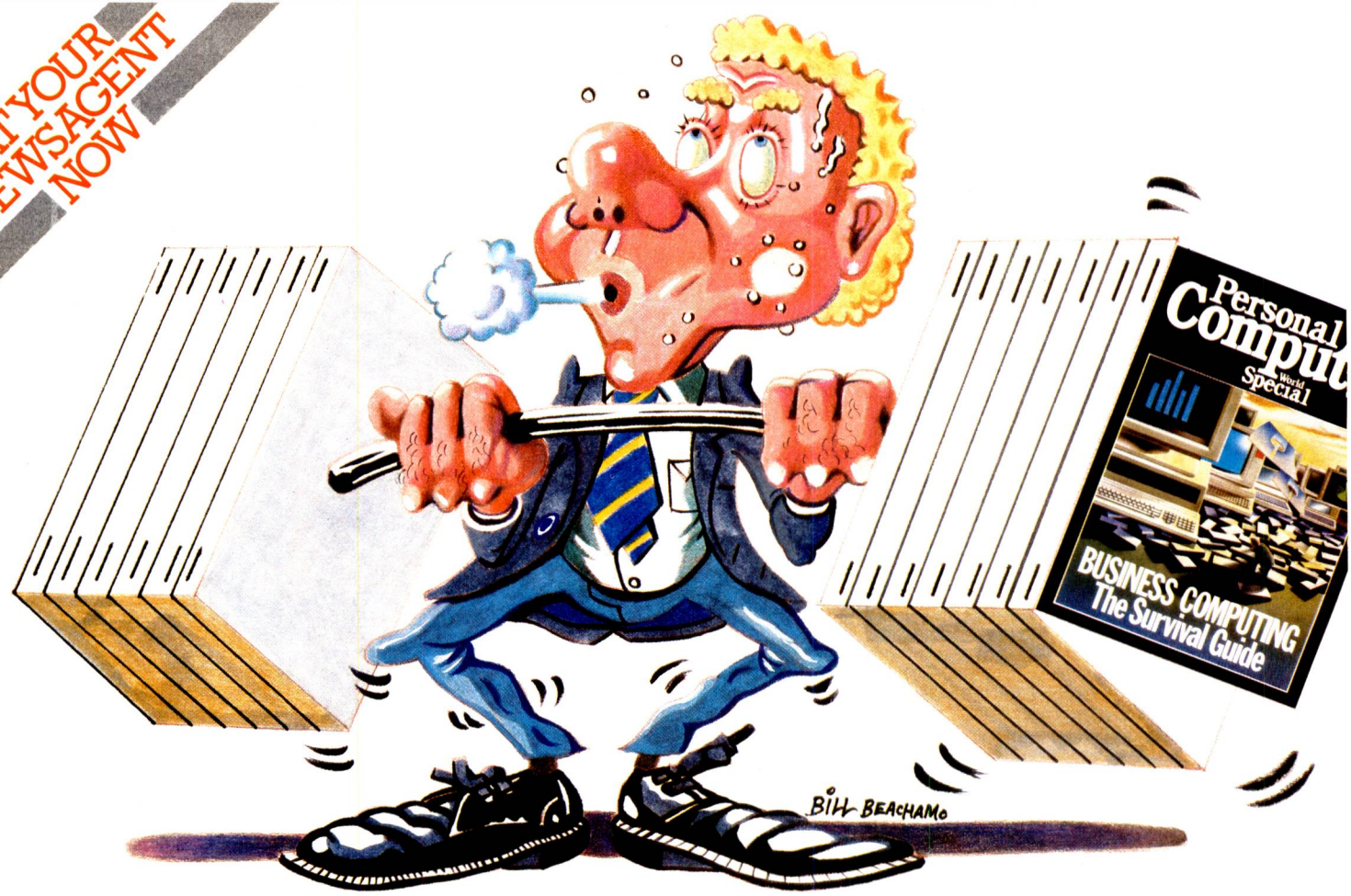

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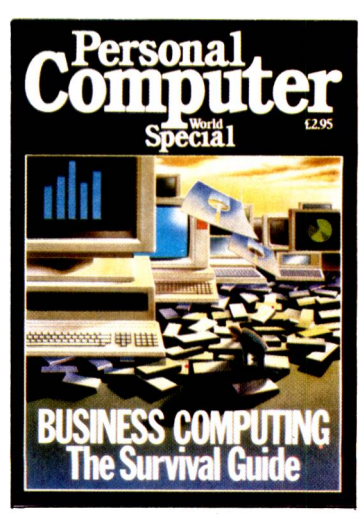

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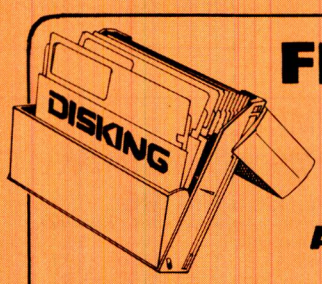
(capacity ten disks)



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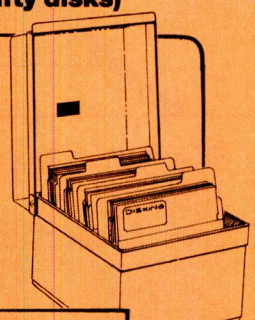

FREE with Deals D,J,P,U E,K,Q,V

Diskettes	Prices exc VAT — All diskettes individually certified & with hubrings				
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ALL DEALS GET:

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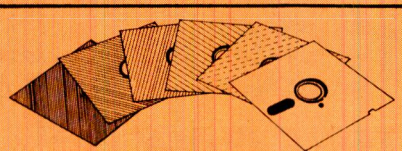

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NEW FROM DISKING. To brighten up your office desk, just pick up the 'phone and order your very own SUPERB Colour Coded diskettes. We have *RED, ORANGE, YELLOW, GREEN, PALE BLUE* and BLUE. They are packed in fives of one colour, and come with a *FREE* SEE 10 Library Box, and pack of Colour Coders. So before you erase the wrong disk or accidentally leave the master disk out in the dusty environment — *COLOUR CODE THEM!*

THE DISKING BD (British Disease) AWARD. *Our BD award this week for another useless company, goes to Corralls (Powell Duffryn Fuels Ltd), who, when asked for an urgent delivery of heating oil that we required, answered "We cannot give you a delivery time, and we cannot give you a price, I'm only here to take orders". If any of you out there understand that, we'd love to hear from you?*

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MD1-DD S/S 96 tpi	34.90	33.90	32.90
MD2-DD D/S 96 tpi	42.90	41.90	40.90

Certified for single OR double density. 48 tpi suitable for 35 or 40 track operation. 96 tpi suitable for 77 or 80 track operation.

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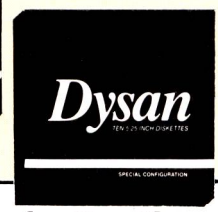

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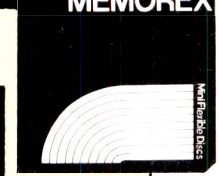

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5¼" Diskettes

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3504 S/S 96 tpi	28.90	27.90	26.90
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5¼" Diskettes (HIGH DENSITY)

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5500 D/S 1.6 MByte	49.90	48.90	47.90

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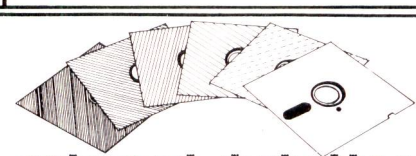
Prices and quantities relate to ***Ten-Packs***

Prices exc VAT	1-4	5-9	10+
6100 S/Sided 0.5Mb	42.90	41.90	40.90



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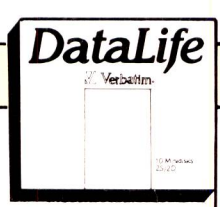
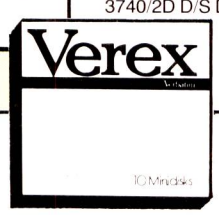
5¼" Supplied in *Five-Packs* of one colour

Prices and quantities relate to ***Five-Packs***

Prices exc VAT	1-9	10-19	20+
1D S/S 48 tpi	12.90	11.90	10.90
2D D/S 48 tpi	18.90	17.90	16.90
1DD S/S tpi	18.90	17.90	16.90
2DD D/S 96 tpi	21.90	20.90	19.90

To order the colour of your choice, just precede the type number with the appropriate letter, (R) RED, (O) ORANGE, (Y) YELLOW, (G) GREEN, (B) BLUE & (P) PALE BLUE. For the actual colours, please see our full colour advertisement back a couple of pages, or call and ask for our full colour brochure.





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Prices and quantities relate to ***Ten-Packs***

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MD 550-01 D/S 48 tpi	29.90	28.90	27.90
MD 577-01 S/S 96 tpi	28.90	27.90	26.90
MD 557-01 D/S 96 tpi	36.90	35.90	34.90

Certified for single OR double density. 48 tpi suitable for 35 or 40 track operation. 96 tpi suitable for 77 or 80 track operation.

8" Diskettes

Prices and quantities relate to ***Ten-Packs***

Prices exc VAT	1-4	5-9	10+
FD 34-9000 S/S S/D	31.90	30.90	29.90
FD 34-8000 S/S D/D	31.90	30.90	29.90
DD34-4001 D/S D/D	36.90	35.90	34.90

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Verbatim Verex = Value

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Prices and quantities relate to ***Ten-Packs***

Prices exc VAT	1-4	5-9	10+
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MD250-01 D/S 48 tpi	23.90	22.90	21.90

48 tpi suitable for 35 or 40 track operation.

8" Diskettes

Prices and quantities relate to ***Ten-Packs***

Prices exc VAT	1-4	5-9	10+
FD34-1500 S/S S/D	22.90	21.90	20.90
DD34-1501 D/S D/D	29.90	28.90	27.90

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Complete with a FREE SEE 10 library box and Colour coders, these disks are certified and are from one of the manufacturers in this ad.

Prices and quantities relate to ***Ten-Packs***

Exc VAT (No hub ring)	1-4	5-9	10+
UL1D S/S 48 tpi	13.90	12.90	11.90
UL2D D/S 48 tpi	20.90	19.90	18.90
UL1DD S/S 96 tpi	20.90	19.90	18.90
UL2DD D/S 96 tpi	24.90	23.90	22.90

Suitable for single OR double density.

Exc VAT (With hub ring)	1-4	5-9	10+
UL1DHR S/S 48 tpi	14.90	13.90	12.90
UL2DHR D/R 48 tpi	21.90	20.90	19.90
UL1DDHR S/S 96 tpi	21.90	20.90	19.90
UL2DDHR D/S 96 tpi	25.90	24.90	23.90

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DISKETTE STORAGE

BUDGET RANGE



only 5·90

Buy 3 of a kind and get the 4th one FREE

Budget 30
30 Minidisk capacity in smart beige brown complete with five coloured dividers.

Part No	Description	Price exc VAT
B30	30 Minidisk capacity	5.90

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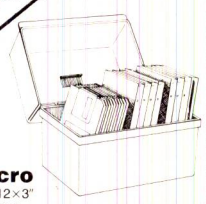

Budget Micro
30 Microdisk capacity (or 12×3" disks). Smart two-tone beige brown.

Part No	Description	Price exc VAT
BM	30 Microdisk capacity	6.90

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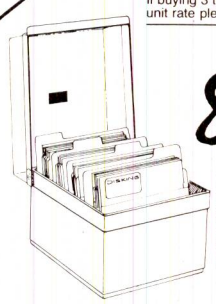
6·90



8·90 Great Value!

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50 Minidisk capacity in smart two-tone brown, complete with four dividers and non-scratch rubber feet.

Part No	Description	Price exc VAT
B50	50 Minidisk capacity	8.90

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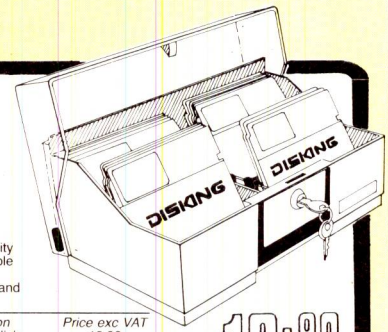

Jumbo Swinger
A massive 120 minidisk capacity (with arms removed). Adjustable arms compensate for less diskettes, complete with keys and carrying handle.

Part No	Description	Price exc VAT
JUMBO	100+ Minidisk capacity	18.90

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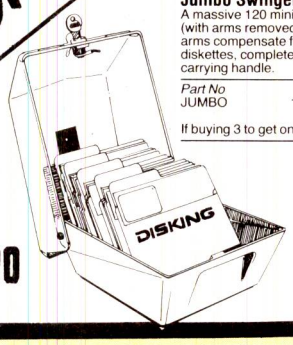
18·90



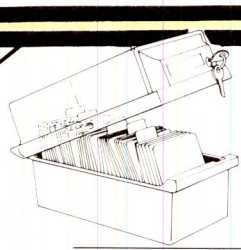
17·90

Disking Swing-Lid Lockable Box
60 Minidisk capacity, complete with keys, dividers, tags and even built in carrying handles.

Part No	Description	Price exc VAT
DSLB	60 Minidisk capacity	17.90

If buying 3 to get one FREE, p&p @ 4 unit rate please.

EXECUTIVE



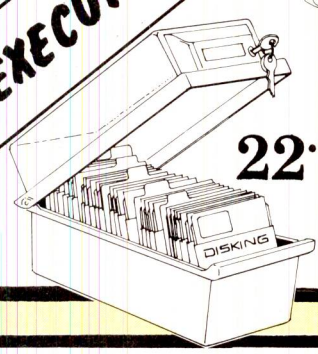
19·90

Executive Range
The ultimate in quality. Luxurious two-tone brown, with dividers, tabs, keys, removable lids — you name it!

Executive Micro 50
Fifty 3.5" microdisk capacity complete with removable lid, dividers, tabs, lock and 2 keys.

Part No	Description	Price exc VAT
EM50	50 microdisk capacity	19.90

If buying 3 to get one FREE, p&p @ 4 unit rate please.



22·90

Executive Mini 100
100 5.25" minidisk capacity complete with removable lid, dividers, tabs, lock and 2 keys.

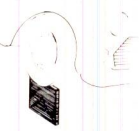
Part No	Description	Price exc VAT
EM100	100 minidisk capacity	22.90

If buying 3 to get one FREE, p&p @ 4 unit rate please.

DISKING supermailers

These diskette mailers come packed in 100s and are of a very clever copyright design. They well hold up to 4 diskettes complete with envelopes and are extremely robust.

Part No	Description	Price exc VAT
DSM 100	Supermailers	24.90



NEW

Memorex Cleaning Kits

The latest computer care range from Memorex represent fantastic value for money, and are available individually or with a discount if purchasing all three.

Buy all three kits together, and we will reduce the total price from £18.70 to £14.90 SAVING £3.80 — A BARGAIN IF EVER WE SAW ONE!

Part No	Description	Price
MKEY	Case/keyboard cleaning kit	4.90
MTV	VDU screen cleaning kit	4.90
MDD	Disk drive head cleaning kit	8.90



Postage and Packing Rates

UK Shipping Rates exc VAT

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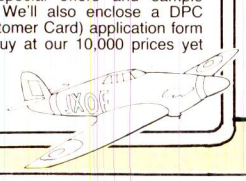

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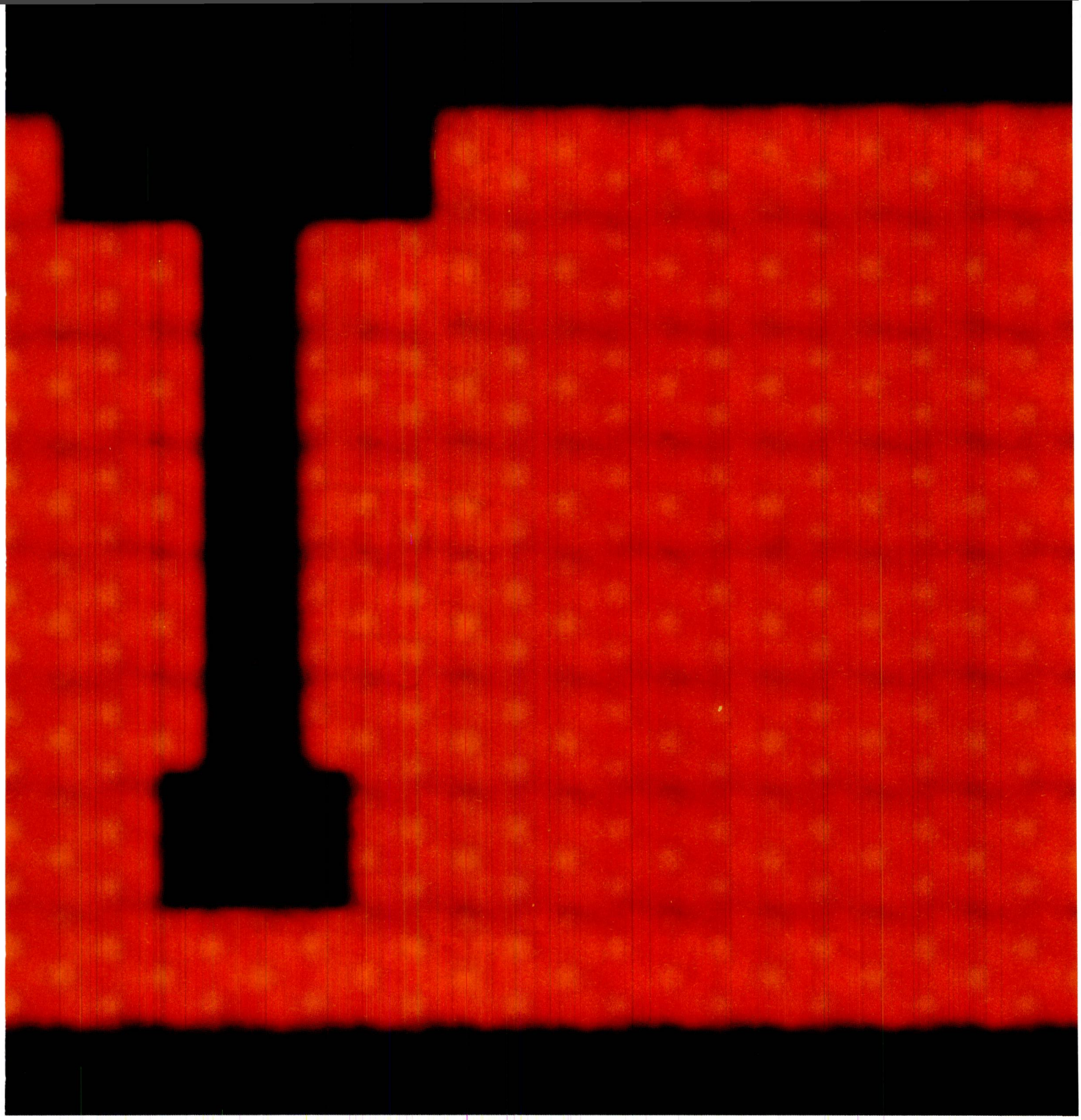

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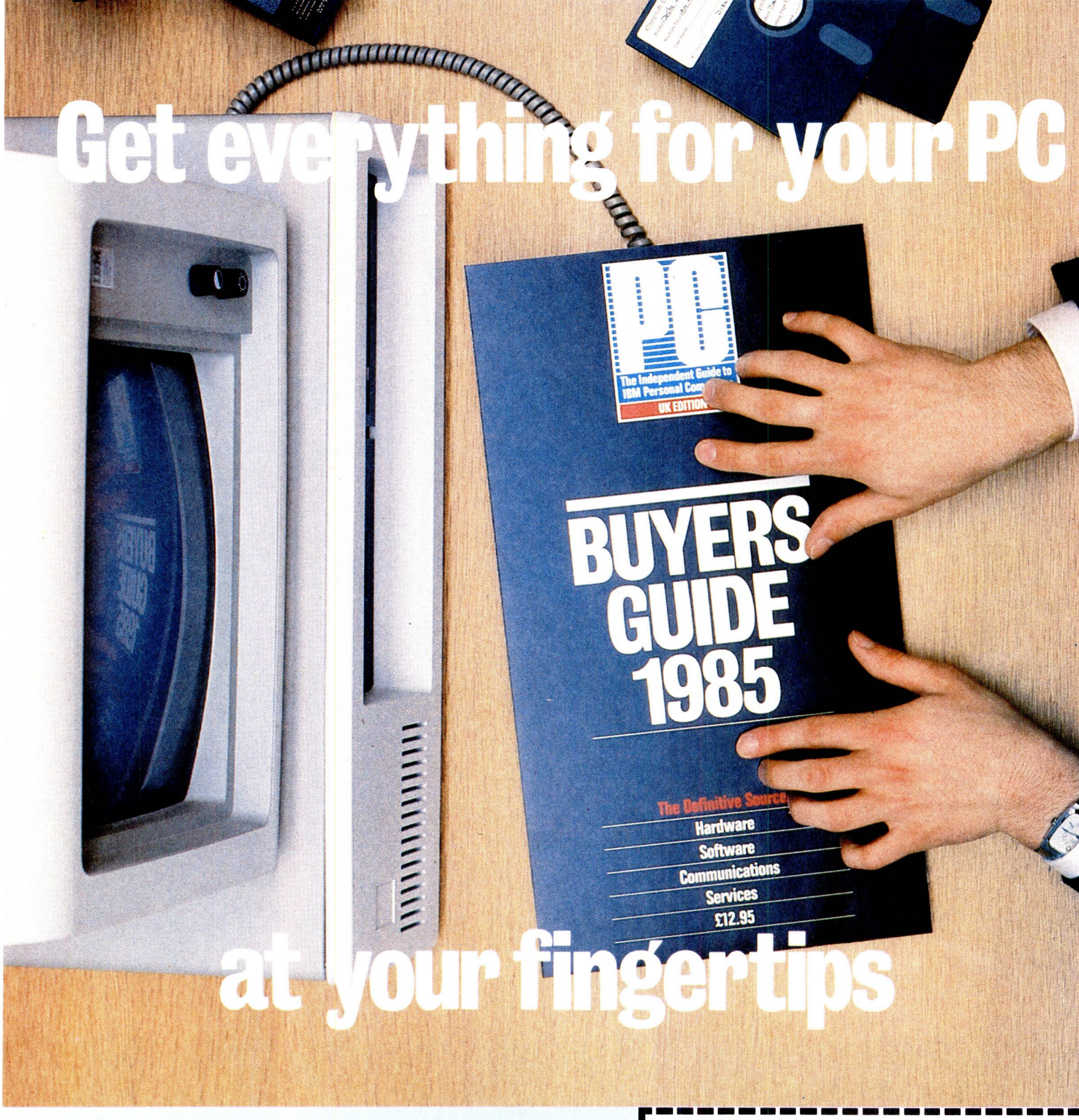

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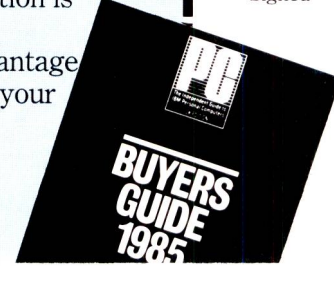

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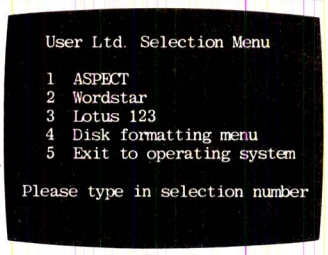

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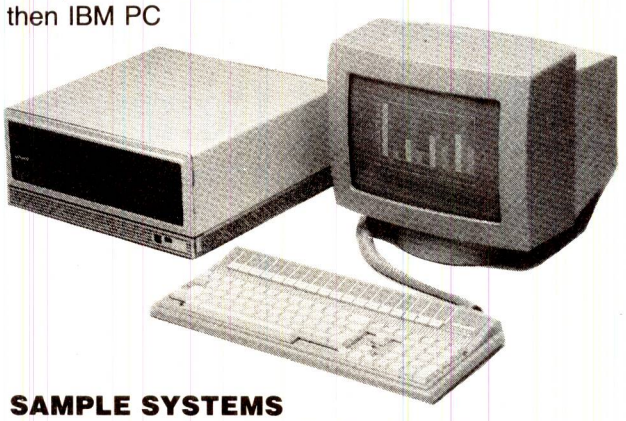

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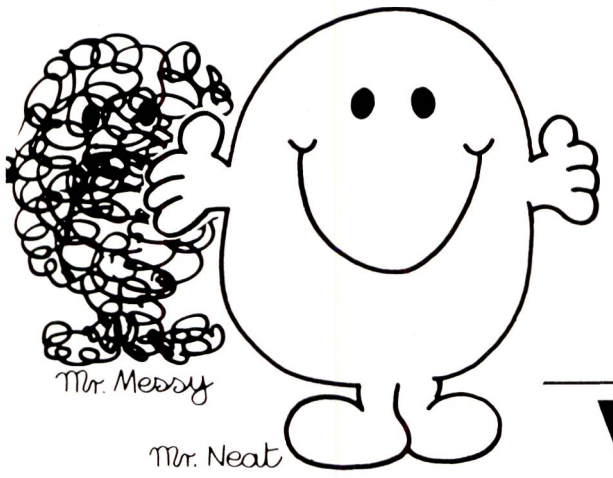

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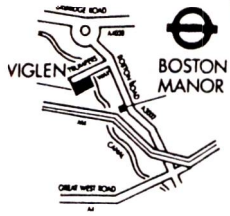

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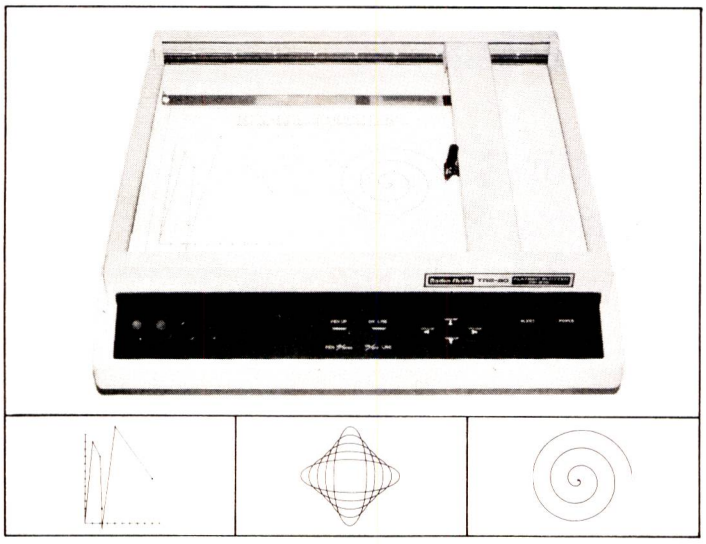

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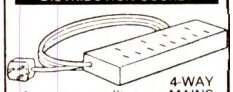

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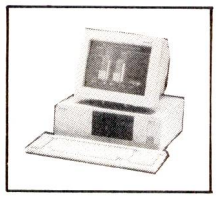

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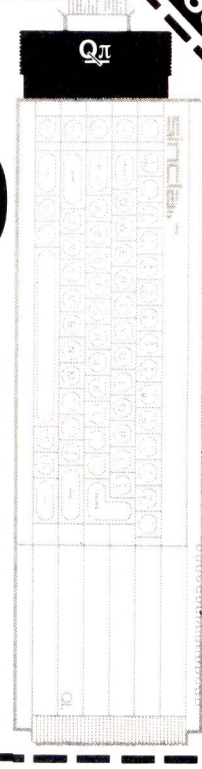

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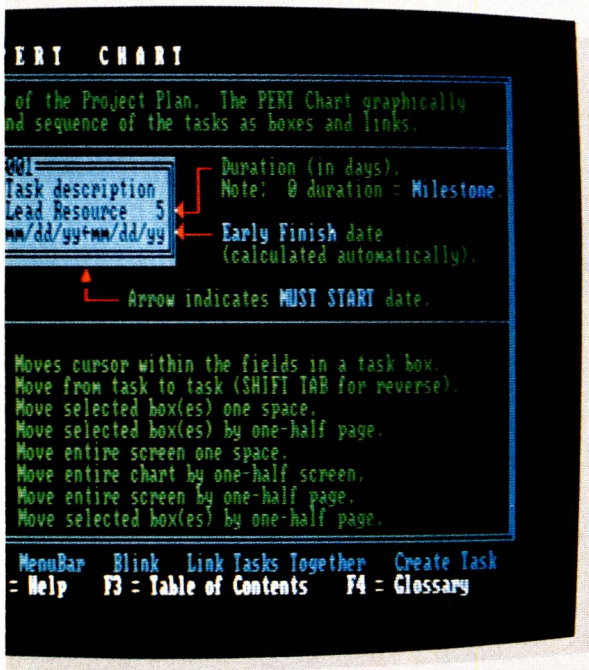

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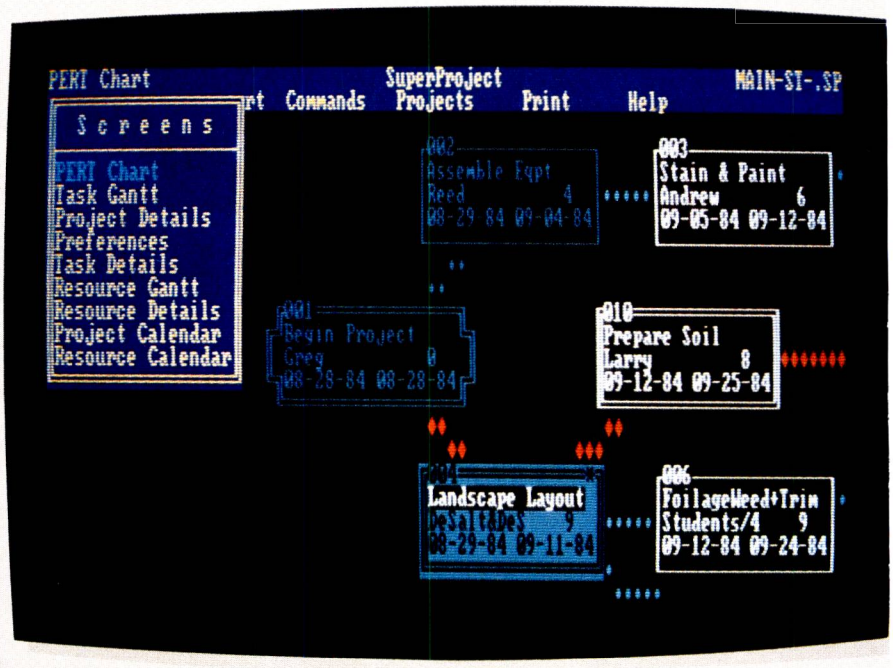

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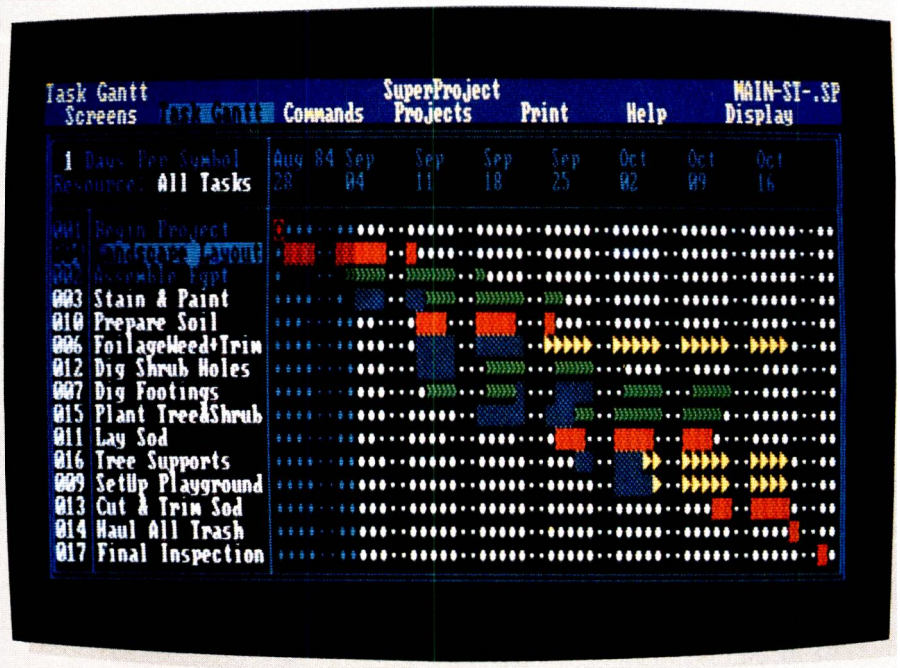

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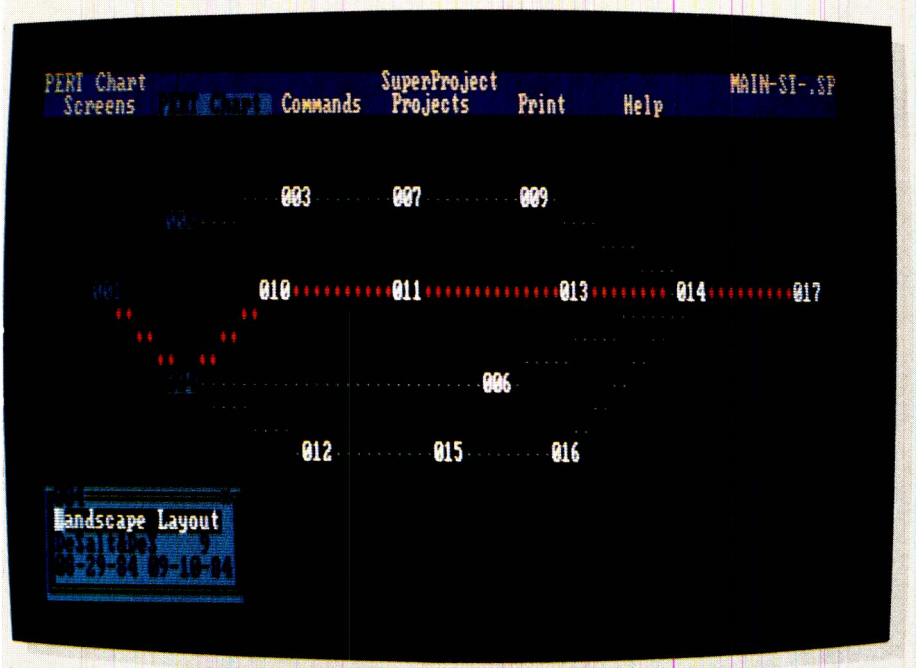

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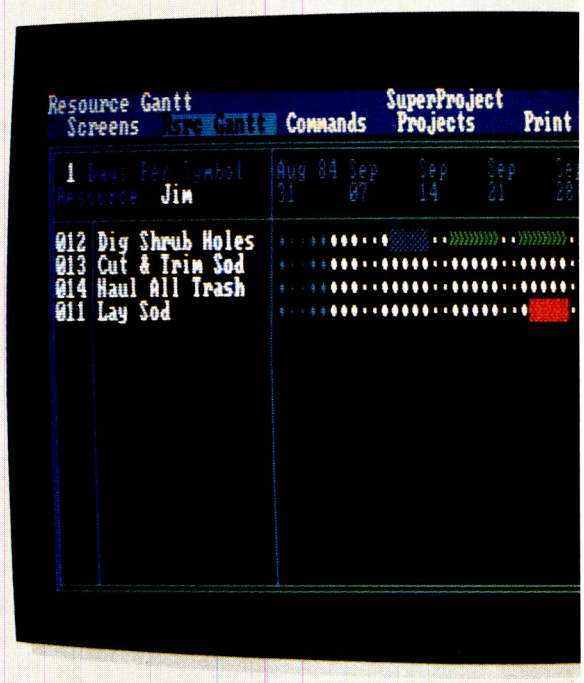

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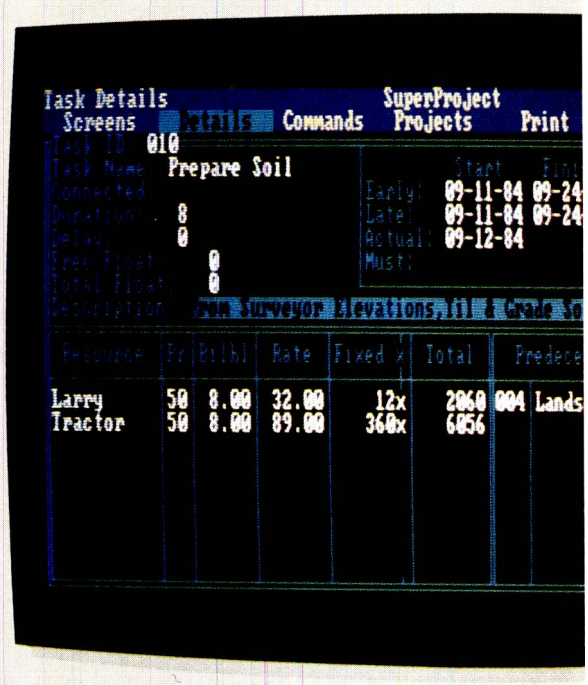

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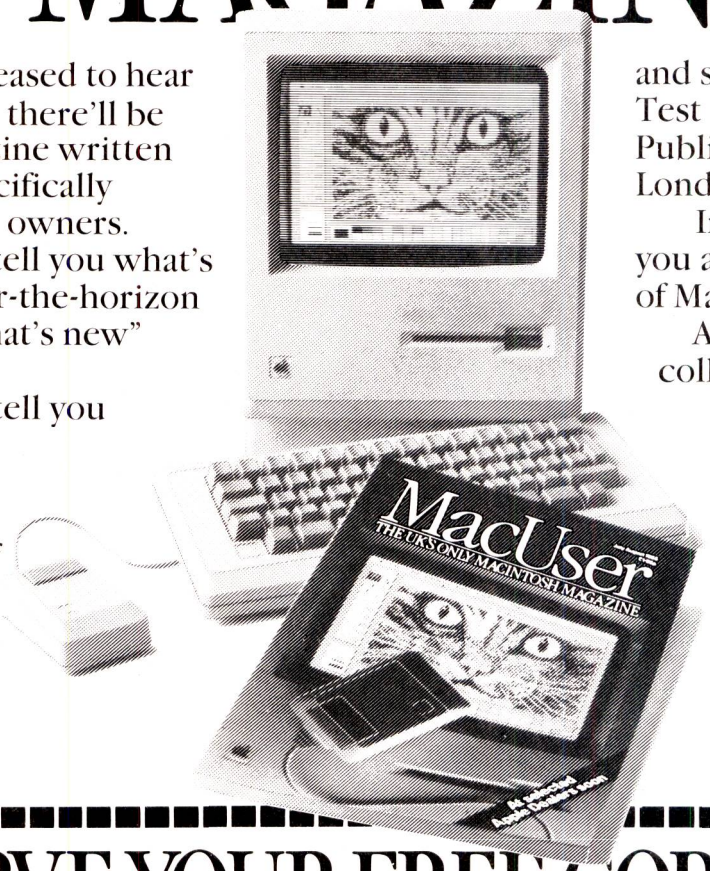

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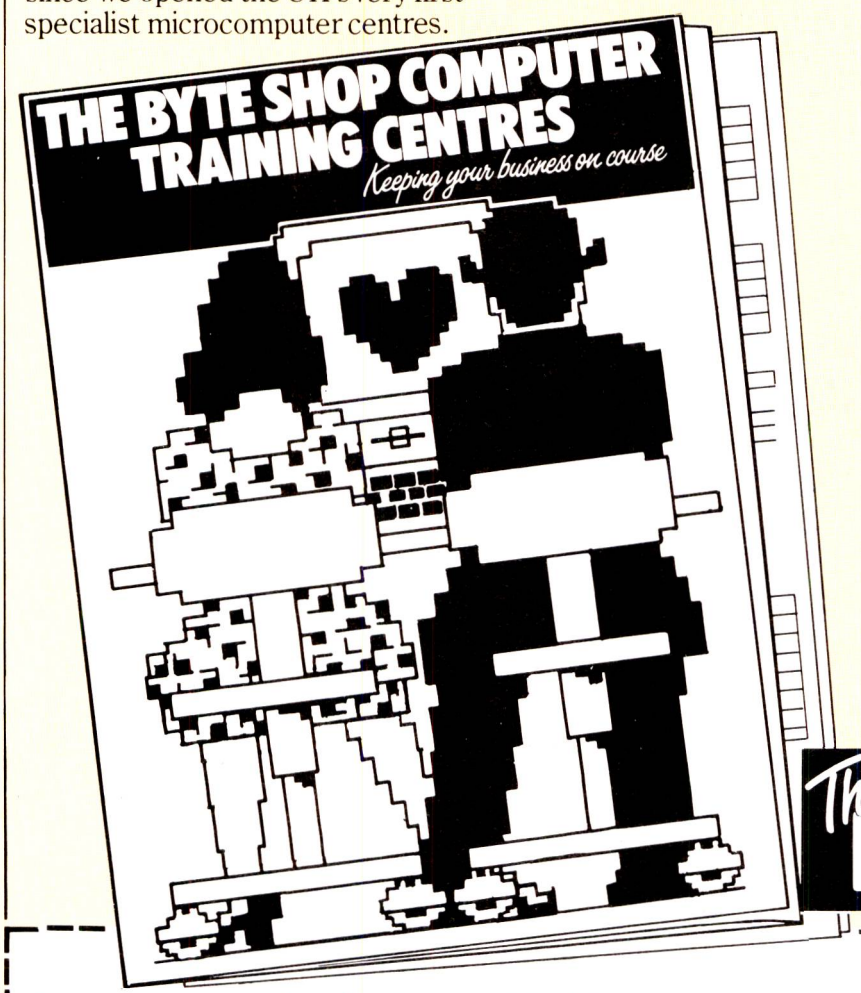

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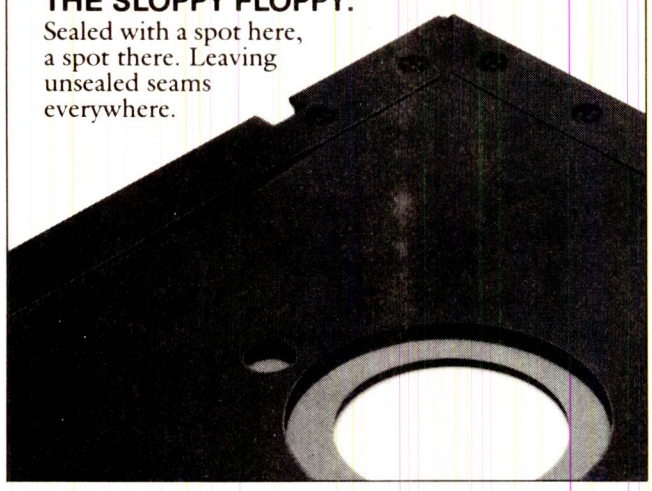

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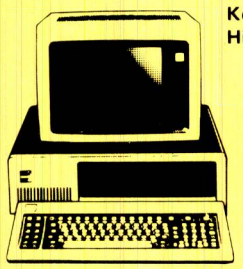

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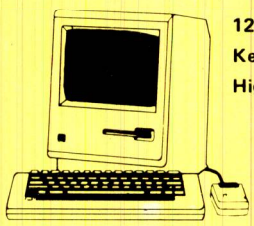

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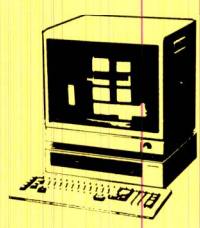

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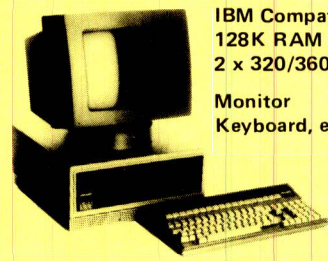

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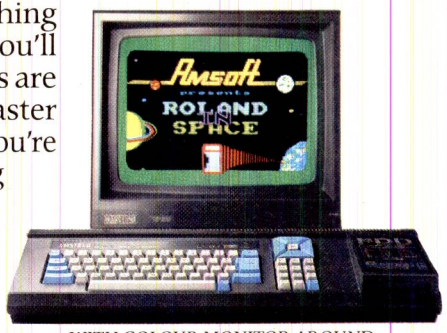

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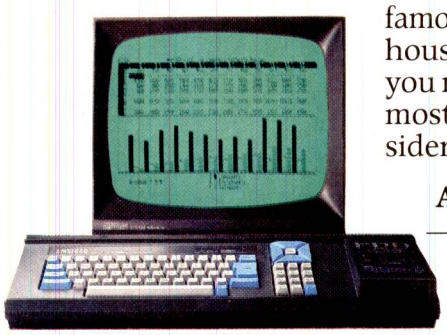

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Although a disc drive will make games more fun (and there are loads of them to choose from) it also makes the CPC 664 a serious proposition for the business user.

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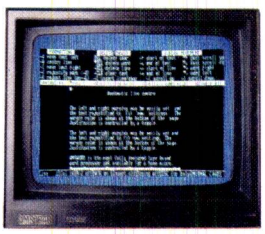

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The one thing you won't need a computer to work out is that the Amstrad CPC 664 represents outstanding value for money.

You only have to check the cost of buying all the elements separately (64K computer, disc-drive, monitor) to realise that the Amstrad package is very hard to beat.

With a green screen monitor the cost is just £339. With a full colour screen it costs £449. And after you've saved money on the price of the computer itself, you go on saving on the price of software.

There are hundreds of programs for business or pleasure available on disc (and cassette) to CPC 664 users. Many from Amsoft, others from other famous-name software houses. Few will cost you more than £49 and most will cost you considerably less.

AN EXPANDING · SYSTEM ·

There is a complete range of peripherals available to CPC 664 users which plug directly into the built-in interfaces.

These include a joystick, additional disc drive (to double your on-line storage) and the Amstrad DMP-1 dot-matrix printer. (There's also a cassette interface so that you can use CPC 464 programs on tape). And there are many more peripherals from Amstrad and other manufacturers which can be used to enhance the CPC 664.

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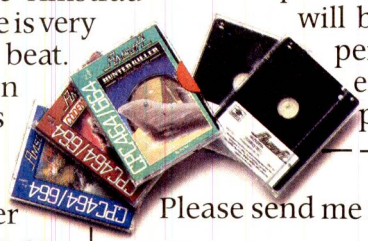

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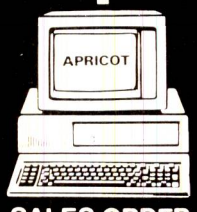

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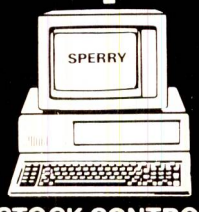

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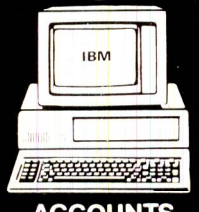

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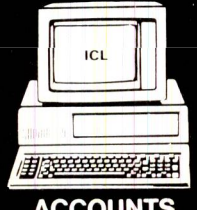

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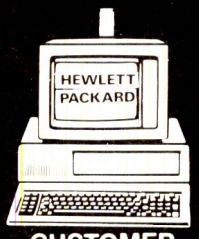

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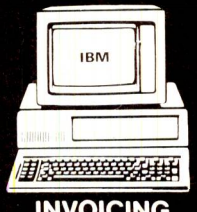

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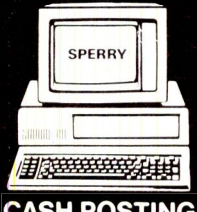

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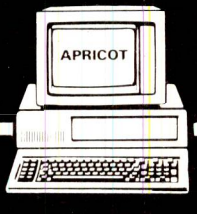

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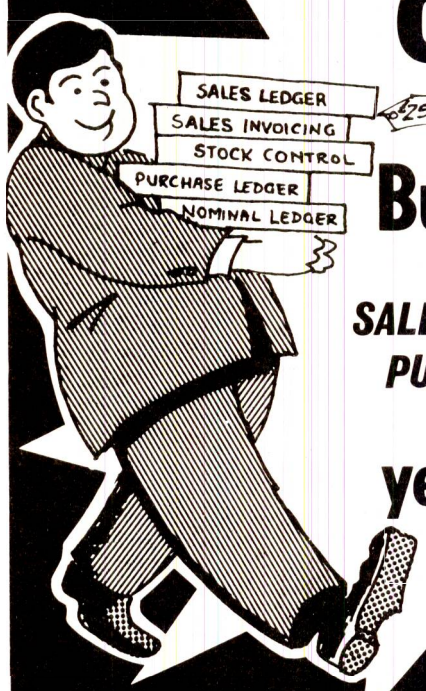

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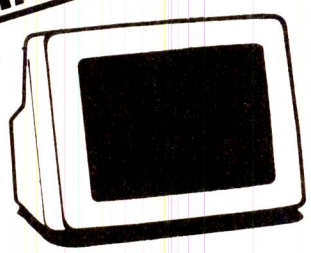

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NEWSPRINT



The Einstein steps out of the shadows as Guy Kewney tracks down this month's hot news. CD ROMs are nearly here and plans are a-foot for this years PCW show.

Brains before beauty

The important part of last month's announcement about the new Amstrad was the missing bit — the fact that a much nicer Amstrad is still waiting in the wings and will actually be fully CP/M-compatible.

But until then, the Tatung Einstein, one of last year's forgotten launches, has a chance — and with the assistance of Dixons, it is going for it in a big way.

The difference between the Einstein and the Amstrad family is that they have different crippling limitations as CP/M machines. Neither is guaranteed to run CP/M applications straight from the CP/M user group — the Amstrad because of memory problems, the Einstein because of screen problems.

The Amstrad family is short on memory. CP/M distributors have flatly refused to support the machine, on the fairly obvious grounds that there isn't anything in it for them. As one put it: 'We might sell a few copies of SuperCalc One — big deal! WordStar won't run, so what's the point?'

That's exaggerating, but not by much (and Amstrad does have an implementation of WordStar running).

The Tatung machine, however, was handicapped by a similar bodge-up — a 40-column screen. Try running any CP/M software on that, and see what sense you can make of what you see . . . and, it turns out, a cumbersome screen display system adds to the problem.

No-one is saying how long we have to wait for the 64k TPA (transient program area) version of the Amstrad. But in the meantime, the Einstein has repaired its missing limb by releasing a module to give it 80-column display, and has cut its price to give the Amstrad a run. For around £500, the Einstein now comes with a high-resolution monitor (good enough for 80 columns in colour, which I warmly suggest you don't try on a colour Amstrad) and two disks, and is supported by Xitan, the CP/M specialist distributors of Southampton.

Geoff Lynch is quite excited by the amount of interest, if a little miffed at the timing. 'We'd run down the CP/M market quite gently,' he grumbled happily, 'and suddenly we're having phone calls from all these Dixons branch managers, wanting software for the Einstein.'

Dixons bought 10,000 Einsteins inside two months, and if they sell, will buy more.

At the price, you can't really fault the machine unless you want to do one thing. That thing is: communications.

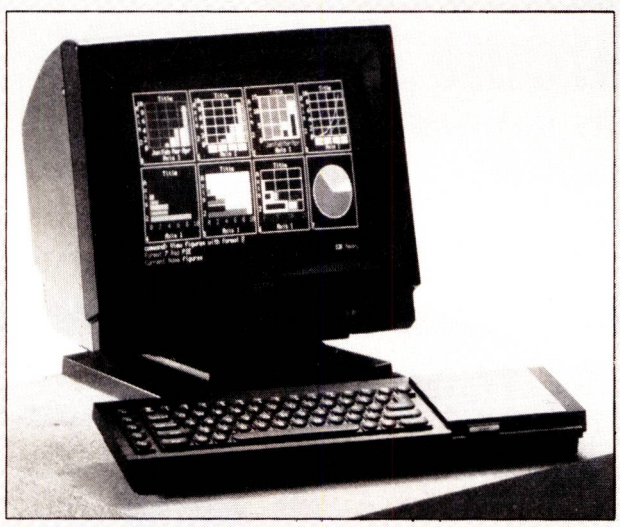
It will, my sources tell me, run the universal communications program, Bstam, which is widely used by programmers for getting software from one machine directly into another when they can't read each other's disks. With a little care, Bstam can even be used to drive a modem, but not easily, nor by a beginner (nor by me!).

But Bstam is a line-buffered program. Most terminal programs like to display each key on the screen as you type it; Bstam waits until there is a whole line, and then puts it up.

Each character on the Einstein takes five milliseconds to display, with the internal software grinding away furiously. That makes it impossible to use the machine as a terminal, even at 300 baud duplex — there isn't time to get the characters onto the screen at that speed.

A solution, apparently, is on the way. Despite several attempts to contact Tatung staff in the week before going to press, I couldn't get any 'horse's mouth' information on when, or how, or whether previous users will be able to buy it.

In the meantime, anyone wanting the Einstein should contact their nearest Dixons store for details.



The main difference between this Microvitec 'business user' Cub for the QL and the normal 'domestic user' Cub for the QL, is that this one is more expensive but you get a swivel and tilt stand.

Just for once, I'll resist the temptation to suggest that people who want a 'deluxe' screen might seriously consider buying a deluxe micro to go with it, because QL business users seem to be a loyal lot.

The Independent QL User Group has had to withdraw (under gentle pressure from Sinclair Research) its call to members to take the company to court for providing a system 'not suitable for ordinary business use'. The reason was simple — hardly anyone agreed. Those who did, one presumes, bought another micro.

Multi-tracking

That sinking feeling you get when, at the end of a really hard bit of program writing, the lights go out, can be avoided. Use the auto-save feature given to a BBC Micro by Software Services' new ROM, and it will make a copy to disk every four minutes.

This is one of 14 new commands provided by the ROM, including a very suspicious feature called *CLONE which makes a complete copy of any (40-track) disk in four minutes.

The one I like, however, is *CONVERT, which turns a 40-track disk into an 80-track disk with 40 spare tracks.

Full details of the £30 chip on (051) 427 7894.

Sharp chips

Sharp makes chips as well as micros — chips rather more successfully than micros, actually. And its latest release is really rather exciting in its small way — it gives Z80 systems a way of working on multiple tasks.

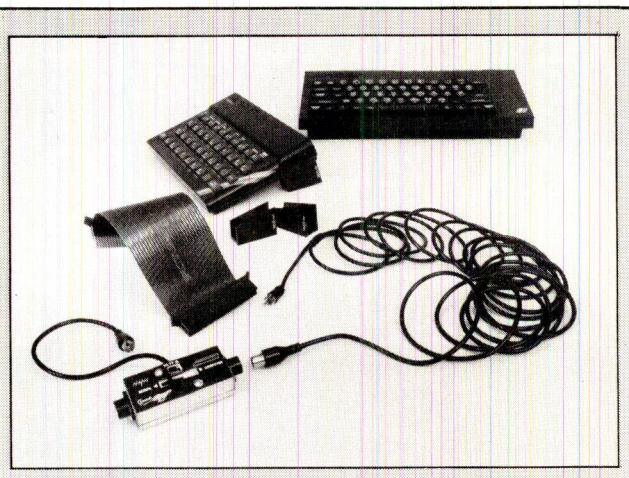
The component is the LH 8575, and it is a 'multi-tasking support processor', or MTSP. It will control multiple tasks on a priority basis, up to a maximum of 255.

Altek Microcomponents, the distribution company which drew the product to my attention, points out that the device works in response to commands issued from the main processor chip, the Z80 (Sharp builds a version of that chip) 'so it can work with a variety of different bus structures and popular processor types', says Bob Green at Altek.

The processor operates 'in a manner similar to a conventional real-time operating system, and forms task management routines such as creation, deletion, and so on, independently of the primary processor. User programs are selected on a priority or time-slice basis'.

There is some way to go before an add-in circuit like this gives us a multi-tasking Spectrum, however.

The system selects user programs and switches between them by an interrupt generated by the MTSP (but the way most Spectrum games are hacked, you can bet that some genius has already used that interrupt for



Best value for money in this collection of odd add-ons for the Spectrum is the silver box at bottom left — a two-way aerial adaptor. You plug the TV and the micro into that, and then switch between software and* Dallas *without reaching behind the TV each time. At £2.25 it beats the 15ft aerial extension lead at £1.50, or the Hi-Stak feet at £2.99 for two, though should you buy the feet to tilt your Spectrum (they also work with the Vic-20, ZX81, and so on) you will probably want that flat cable, the extender for the rear port — it stops your add-ons from hanging loosely in the air. Details, if you can't get them from stores, from Cheetah on (01) 833 4909.

something quite different), and instead of switching between word processor and communications, your interrupt is likely to fill the screen with the dreaded 'Game Over' message.

But at least the possibility now exists of doing a multi-tasking Spectrum, cheaply.

Details from Bob Green on (0734) 791579.

Spectrum life-saver

One step better than the 'Romantic Robot' for transferring programs from tape to Spectrum Microdrive is the Mirage Microdriver from Mirage Microcomputers.

The Romantic Robot was foolproof in untangling programs that wanted to live on audio cassette, but some program writers, more concerned with security than sales, actually prevented it from working by building timing routines into the load process. Loading from Microdrive would be too quick, and the program wouldn't load. This was supposed to be clever.

The Mirage Microdriver is a bit of hardware, not just a program like Romantic Robot. It costs £40, and is available by mail order only from Mirage at 24 Bank Street, Braintree, Essex CM7 7UL. In the interest of clarity, I must point out that this product hasn't been tested, nor do I have any personal evidence that the company exists other than the announcement, so you order entirely at your own risk.

However, assuming that the product is available, it works rather like the Quickshot on the Apple II by taking a photograph (so to speak) of what is in the memory of the computer and saving it to Microdrive, as follows.

'The user loads and runs programs in the usual way, with the Microdriver attached to the Interface 1 expansion port. At any time, the button on the Microdriver can be pressed, and program operation is halted.'

At this point, the Microdriver stores the contents of the Z80 processor registers and selected areas of memory in its internal 2k of RAM, and two lines of text appear at the top of the Spectrum display. These are used to print a menu, and there are other prompts to guide the user through saving and loading.

The drawback (from a pirate's point of view!) is that the version of the software now stored on Microdrive will only run with the Microdriver itself. When the program is run, it will restart exactly from the point reached when the button was pressed.

This gives a whole new feature which Mirage doesn't go into — game 'save' ability.

A game which has been taken through the third level after 10 minutes work is often only just getting interesting. At that point, inevitably, the phone rings, and you have to watch in agony as your remaining three lives, so carefully conserved through the aeons of painstaking play in the boring initial stages, are squandered by a little man on the screen who lets the snakes eat him, the dwarf hit him on the head with the sausages, the pit open up under his feet, or granny run off with the bottle of milk.

Fear not! — the Microdriver will save the game at this point, and let you restart it, from this point.

You can also modify the program, as there is an option in the Microdriver menu to return to Basic and use the POKE command to change critical memory locations — giving infinite lives, for example. Again, the saved program will only work if run with the Microdriver.

Phone (0376) 48321 for details.

PC Prestel

There are many ways of using an IBM PC to watch Prestel, and most of them involve hard work. Almost without exception, you are required to plug a chip into the main board to provide the Prestel characters.

The exception is Datasoft's communications package, which costs a generous £315 including modem, and does all screen-handling purely with software. The modem is a Thorne-EMIO DataTech VX543/10, but a version of the program is also available to drive 'any suitable modem', says the company.

It's quite a comprehensive list of features which Datasoft has sent me with its announcement, and I look forward to testing it — but, just picked out from the list, I note that there is a window-driven option, a full-screen videotext editor, a file encryption option, and voice-call support.

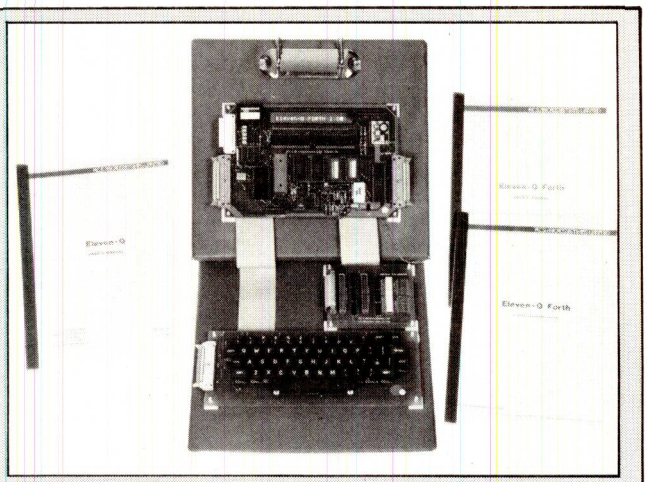
Details from Datasoft on (04605) 4809.

Charting success

'Obviously', says JVC (UK) Limited, as though only a fool could fail to see it — 'obviously all the rather dubious press the MSX computer format has received over the past few months has been slightly off the beam.'

The fact that makes this obvious is the appearance of what JVC rather endearingly calls 'three softwear titles' (slippers? a fur muff?) in the computer 'softwear top 50'.

It's very kind of JVC to draw our attention to the appearance of Zaxxon, Buck Rogers, and the The Hobbit in MSX format in the top 50 — but most people, I'm afraid, will fail to agree that 'MSX as a format is gaining considerable support from the computer-buying public'. One might note that the most outrageously successful program ever for the BBC Micro, Elite, never made it to the top of the chart because



One look at these bare boards, with one-line, 20-character displays described as 'human interface', and you know two things: firstly, it's 'educational'; and secondly, it's expensive. This is a tutorial course in the Forth language, called Eleven-Q, and the advantage is that you can stick in your soldering iron without worrying about your warranty.

Cost is around £300 for a system with 'space for RAM and ROM', but a full price list is available from RCS Microsystems at The Kings Arms (no, it's been deconsecrated, and is just an office now), 141 Uxbridge Road, Hampton Hill, Middlesex TW12 1BL. The price list could do with a little editing — it shows a system with keyboard as being cheaper than one without. Phone (01) 979 2204 for clarification.

Instead of computers cat
technology now has to ca



The way we see it, technology has suddenly got quite a race on its hands.

There's no other home computer in the world that's so expandable or so updatable as the new Enterprise 64.

And if you're wondering quite how we've managed that, kindly take a closer look at the outputs on our remarkable new machine.

You'll notice that amongst all the usual sockets and terminals, we've gone and incorporated a special 66-way expansion port.

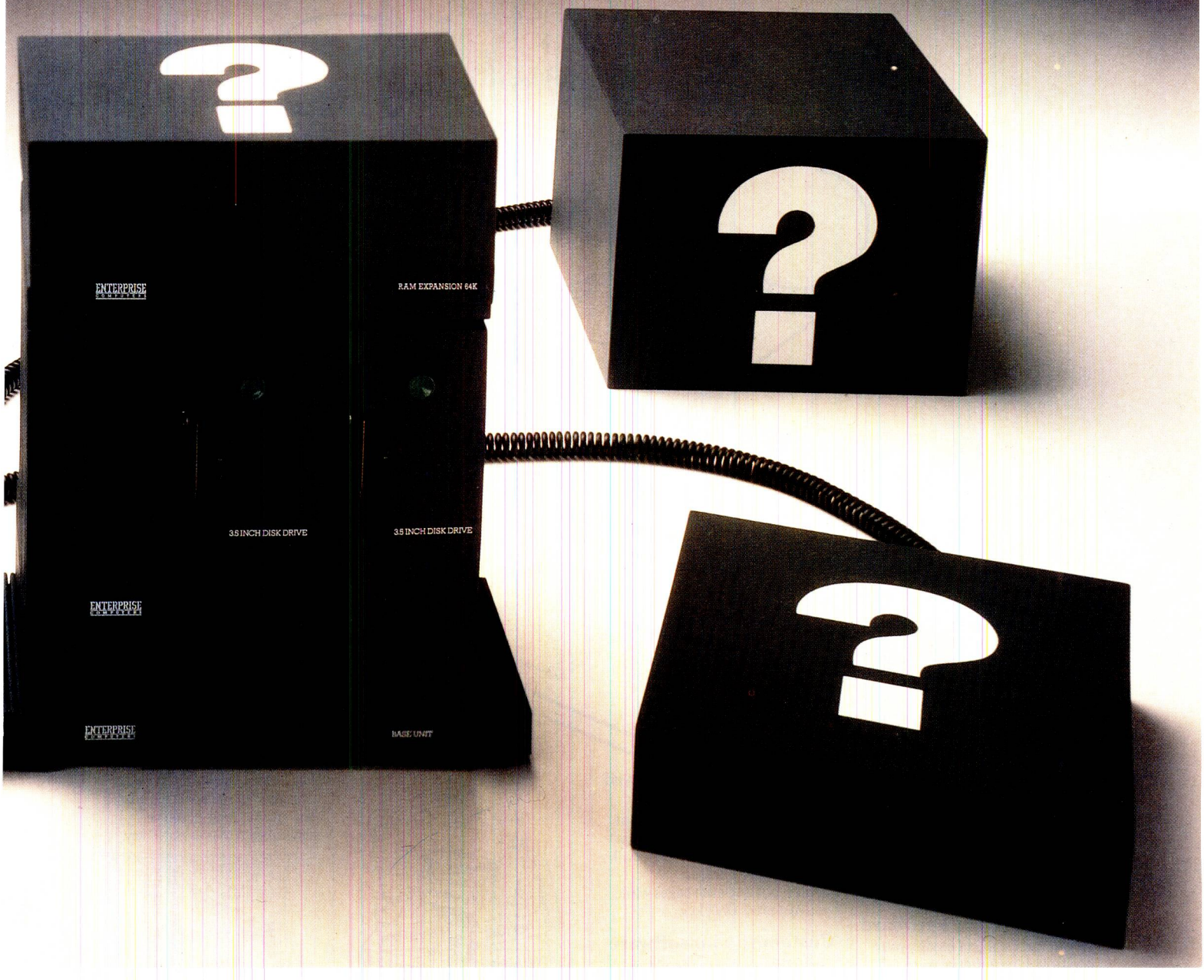
This will accept a whole range of new peripherals that are in the pipeline. Including those that are a mere twinkle in the eyes of our hardware designers.

We thought this expandability principle was such a good idea, we applied it to the Enterprise's memory, too.

Even in its most basic 64K form, this puts more user RAM at your disposal than almost any other competitor.

But plug in our special Rampacks to the base unit, and you can progressively increase that figure to a truly extraordinary 3,900K.

hing up with technology, tch up with a computer.



Not that that's the only challenge we present to today's ambitious programmers.

With a screen resolution of up to 672 x 512 pixels, 256 colours and a high speed video processor, the Enterprise will outgun all but the highest quality TV monitors.

And the sophisticated sound chip generates no fewer than 4 voices across 8 octaves in full stereo.

Combine the two and you can create effects that leave today's games looking like pub video tennis of the mid-seventies.

For anyone with literary aspirations, the Enterprise also comes complete with an integrated word processor.

Whilst the really serious user will be delighted to discover analogue RGB and TV outputs, as well as parallel, RS423 serial and network ports.

Both Cobol and 'C' will be available with CP/M running, and you can even use Lisp, Forth and Z80 assembly language on cartridge without encroaching on user RAM.

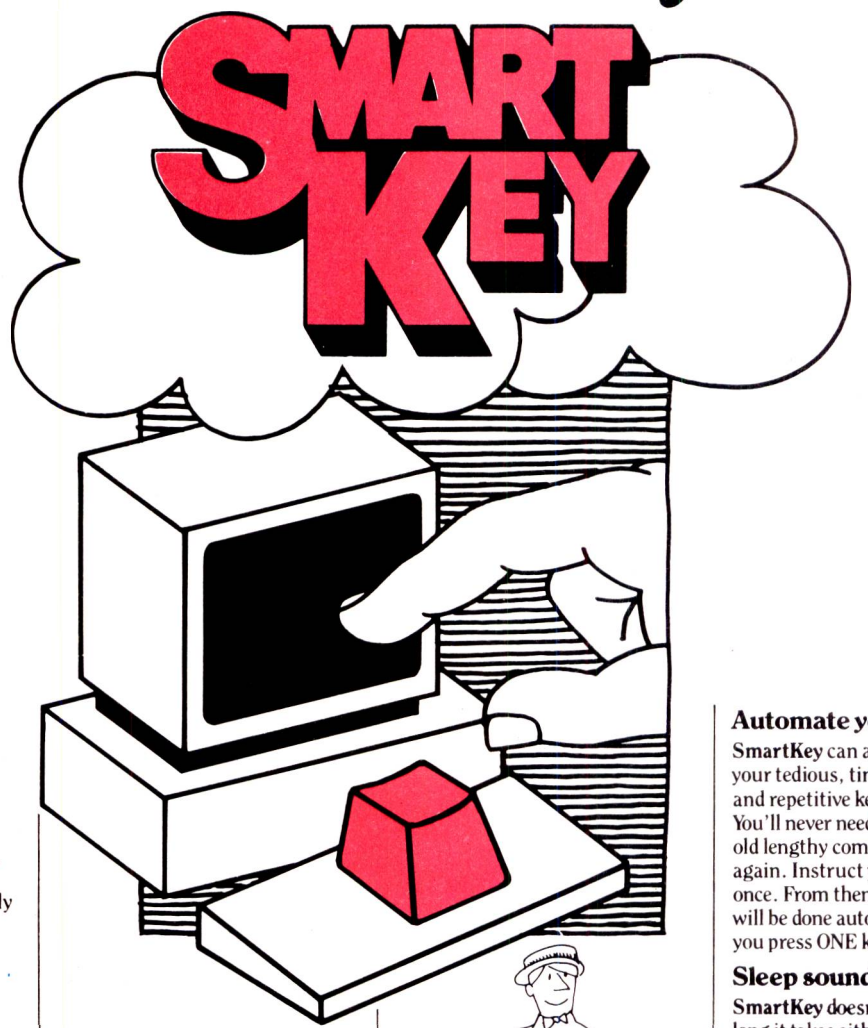
The new Enterprise 64.

It hasn't just overtaken technology. It's left every other home computer straggling in the distance.

ENTERPRISE
COMPUTERS

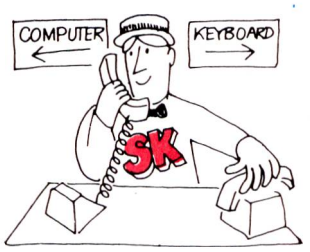
WITH OBSOLESCENCE BUILT-OUT

The Electronic Assistant is here today . . .



SmartKey is an electronic assistant in the form of a computer program available for today's standard business microcomputers.

He works at the speed of light, will pander to your every whim and has the power to dramatically improve the way your personal computer works for you.



Customise your keyboard

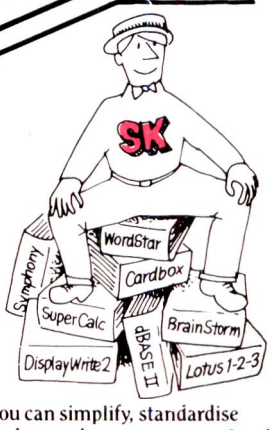
He can intercept and modify your keystrokes, reconfigure your whole keyboard to suit each application, and make your foreign characters, graphics characters and mathematical symbols just ONE stroke away.

Automate your keyboard

And **SmartKey** does so much more. You can ask your assistant to assign several thousand characters to a single key. He will type standard phrases, paragraphs and even pages while you just press ONE key.

Customise your software

SmartKey understands all the complex sets of commands and control sequences you use to drive your software. Your electronic genius will provide you with hundreds of function keys so you can simplify, standardise and control your programs. Load a file, select a report, modify and print it . . . by pressing ONE key.



Automate your software

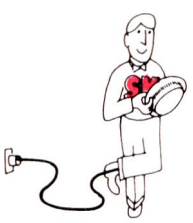
SmartKey can automate most of your tedious, time-consuming and repetitive keyboard work. You'll never need to type the same old lengthy command sequences again. Instruct your assistant once. From then on, the work will be done automatically when you press ONE key.

Sleep soundly

SmartKey doesn't mind how long it takes either. Your assistant will continue working for you long after you've gone home to bed – just as long as you've remembered to press ONE key.



He could be working for you tomorrow . . . order now!



Available under DOS 2.0 (or later) for the IBM PC, XT, AT and all true compatibles. Price £99 + £3 P&P+VAT

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You may think this picture of Info 85, an exhibition which attracted 20,000 visitors over three days, proves no more than the inefficiency of the ticketing arrangements. However, my sources report that it was indeed a successful exhibition, where Commodore's new IBM clone made one of its first public appearances in the UK.

The new Commodore is not being launched as a colour system, but will take many colour boards available for the IBM PC, and its near 30 per cent discount on the original has attracted more interest than I'd guessed.

Five big-name hardware distributors have undertaken to supply this machine to the thousands of dealers around the country who are not entitled to sell the IBM because IBM would never consider appointing them as dealers. These distributors are Pete and Pam, Northamber, Norbain, STC Electronic Services and Westwood Distributors. Pete and Pam, together with Software Ltd, have special software departments to handle this machine, too.

The result is that, although the Zenith PC is now seen as one of the major alternatives in the States, Commodore's distributor agreement in the UK may have given it an edge, a view which puts me slightly at odds with the Benchtest in the May issue.

I agree that now, four years after the launch of the IBM PC, is a strange time to arrive with a clone, but the software market is there, and the AT isn't yet available in volume. And the PC II isn't even announced as I write this. So make hay, Commodore, while there is sunshine.

Back to Info 85: the details of next year's show are: 25-27 March 1986, at Olympia's National Hall. Anyone requiring further details should contact BED Exhibitions on (01) 647 1001.

the BBC is, by comparison with the Commodore 64 and Spectrum, very much a minority machine.

And by comparison with even the BBC, the MSX format is not even an also-ran, and anyone who knows no more about the industry than how to spell 'software' correctly, is fully aware of this.

Patching the problems

Just about everyone who has ever used WordStar will know the frustration of having a nice dot-matrix printer capable of the highest-quality print, tiny superscripts and subscripts, and genuine underlining — but having instead to use WordStar's clumsy double-type for boldface, or single underline characters . . . you will all be fascinated to hear of WordPatch.

The program tackles the simple problem that WordStar doesn't give you enough space inside it. WordStar assumes (quite wrongly) that you can switch a printer to superscripts with a control sequence of four ASCII codes. Most printers take more. Worse, WordStar assumes that the sequence to subscripts is the reverse of the superscripts — it tries to roll the platen up or down to print above or below the line. Your matrix printer has totally unrelated control codes, and all hell breaks loose if you try to fit the instructions from your printer manual into the WordStar Install program.

This has been known to MicroPro since the first Epson came out. The response of MicroPro — nothing.

WordPatch makes three changes to WordStar: it expands the printer instruction area; it writes the appropriate instructions into the new, enlarged print area, for your printer; and it also changes the menu, so that when you type control-P (the sequence which prepares WordStar to send a printer control sequence) a menu appears, showing what the new control characters actually are. (On my versions of WordStar, the menu tells you to set a certain code to use the other ribbon colour. I use it for underlining.

The American company which produces this is CMB3 Technologies, and it is looking for dealers; telephone (415) 930 0470. It expects the product to retail at $50.

By any other name

You may feel entitled to be puzzled by the simultaneous announcement by First Software of Basingstoke of add-on boards for the PC/AT, and the announcement by First Software of First publishing, of a set of business software packages for the Commodore 64.

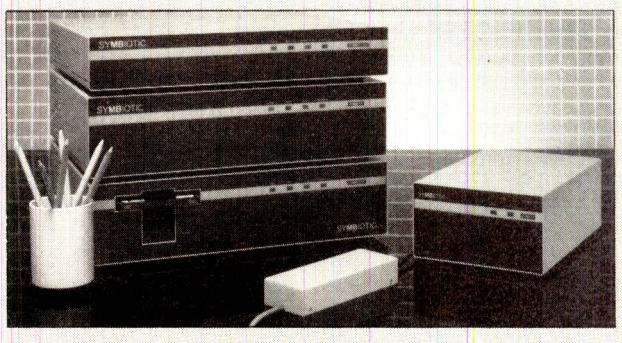
The first First Software was, of course, the American company. That has set up in this country in association with John Weatherhead's Reflex software distribution business, and is distributing Tecmar add-ons for IBM machines. The Maestro multi-function board is its launch.

However, the title First Software was actually being used around Sepember last year by Sara Galbraith, ex-Peachtree, who (as far as I can determine) registered the company name around two weeks before Weatherhead's lot did.

Sara Galbraith has worked on the assumption (very reasonably) that people who use IBM PCs at work can't afford to buy another for home use (and we all know how portable they are). She's trying to produce software which fulfills similar functions, so that executives with a 64 at home can get some useful work done.

Galbraith's First Software is part of her new company, First Publishing, which does books for the 64, too. Her software starts off with an assembler/monitor for £19.99, a word processor at £35.99, and includes a database manager, Pascal, and a Basic compiler. The books include *Anatomy of the 1541 disk drive* which 'unravels the mysteries of using the misunderstood disk drive,' which makes it sound as though the horrible little box has made at least one friend.

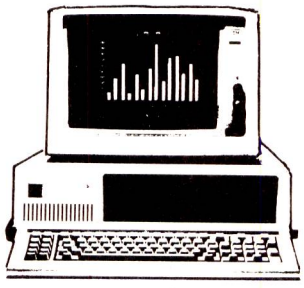
The squabble over the name will no doubt proceed until it is resolved, and I'll let you know as soon as it is. And when Galbraith lets me have a phone number, I'll give you that, too. Meanwhile, contact her through the energetic Peter Jones, her publicist, on (01) 580 8418. He's a sweetie, but a trifle inclined to take his job single-mindedly ('In answer to your question, I've contacted them, and they do have it in stock. What price? I'll have to ask. I'll call you back'), so make sure you know what you want in detail before you call.
Weatherhead's outfit,



The 'half-price Apple II for education' scheme has been widened to include the Macintosh, which is going out at a 30 per cent discount — not greatly to anyone's surprise. However, what is surprising is the announcement by Symbiotic, which does hard disks and local nets on Apple hardware, that it is joining in. It is offering a 50 per cent reduction on its Symbnet which normally costs £4000 including a 10 Mbyte disk, and now starts at £2000.

MORSE: THE TOP TEN SYSTEMS

£ Value ? Advice Software Printers Support



1 **IBM Personal Computer.** The World's best selling Personal Computer, as well as ours. Although a recent increase by IBM has pushed our price slightly higher, we can still offer the PC with twin 360K disks, monochrome display, UK keyboard, printer adaptor and DOS 2.1 with full 12 month warranty, and bundle 6 utility programs, simple spreadsheet, text editor and 10 others. **SAVE £560 ON IBM PC's NORMAL PRICE!** **£1600**

2 **IBM COLOUR PC.** Like the above system this IBM PC has two 360K IBM disk drives, keyboard, DOS 2.1, Basic and full 12 month warranty, but we've exchanged the IBM monochrome display for the colour display and graphics adaptor. Morse also supply a selection of free programs including utilities, spreadsheet & word-processor. Printer adaptor £87, extra memory, £70 each 64K. **This system normally over £2480!** **£1900**

3 **IBM XT.** The 10Mb Winchester version of the PC is still as popular as ever, and we suspect the shortage of AT's is the reason. Our 128K RAM, monochrome system with communication port is ideal for planning, database or accounts applications. **SAVE OVER £410!** IBM XT now: **£3190**

4 **COMPAQ DESKPRO.** This superfast machine almost matches the IBM AT's performance, and 30Mb disk option is in stock **NOW!** With 640K, 10Mb disk, tape backup, we supply with **FRAMEWORK or SYMPHONY, NEC NLQ printer, disks, cable at NO EXTRA COST, SAVING £970!** **£5595**

5 **COMPAQ PLUS.** Compaq Portable + 10Mb Winchester = strength + value. This 256K computer has a reputation for being really tough and reliable. Morse stock this popular machine at nearly **10% below the list price,** so you can store more and pay less. **SAVE £355!** Only: **£3590**

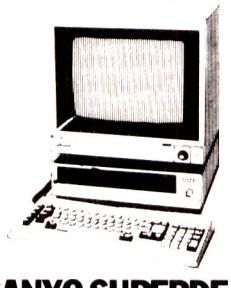
6 **COMPAQ PORTABLE,** the No.2 PC in the U.S., and the best of all compatibles. With 256K, unique graphics and text display, dual 360K disk drives and of course, portability, the Compaq is great value. Now it's even better value because you **save £200** at Morse. Why pay any more? **£1990**

7 **APRICOT Xi.** Superfast and super powerful 10Mb version of the Apricot. Full hard disk computing at even lower prices. Morse have cut the price by £300, and are giving away the NEC nlq printer & cable worth £380. Bundled with Superwriter etc. **SAVE £680!** **£2690**

8 **APRICOT PC.** Compact, powerful, friendly, British. This hugely popular system now has Lotus 1-2-3, Symphony and many other programs available. **SAVE £300!** High demand has allowed us to prune the prices to £1690 for twin 720K disks, and now on twin 315K disks: **£1490**

9 **APRICOT PORTABLE.** The computer you can talk to! Remarkable piece of technology with flat liquid crystal display and speech recognition. 256K as standard, 720K disk drive, loads of software, all in a 12lb. pack. Morse can supply it from stock. **With FREE £95 MOUSE!** **£1695**

10 **APRICOT F1.** Incredible value full specification business micro. Bright colour display, 256K memory, 720K disk drive, infra-red cordless keyboard. Bundled with word-processor and spreadsheet. In stock now. Mono display £200, Mouse £95 **£995**



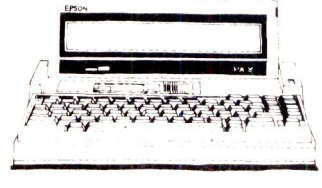
SANYO SUPERDEALS!

The Sanyo MBC 555 series has proved very popular. It's ideal as the basis of an office system. Now Morse have even better prices!
SANYO MBC 550, 160K disk drive, 128K RAM, WordStar & CalcStar, MSDOS, (RRP £795), now **£600**
MBC 555, 2 x 160K drives, 128K, Word-, Spell-, Info- & CalcStar, Mailmerge etc. (RRP £995), **£795**
MBC 555 (x2), as above, with twin 360K disk drives (£1395) **£995**
CRT 36 green monitor: **£127**
CRT 70 colour monitor: **£495**



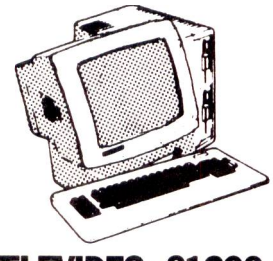
MORSE HARDWARE

Digital Equipment make some of the finest wordprocessors, and the dedicated **DEC MATE II** can be found in many offices. Morse offer the DecMate II (list price £3049) at **£1790, saving over £1200!**
NEW PRODUCTS AT MORSE. By now we should have the new grey Apricot Xi's, with 512K and 20Mb hard disks. The HP7475 6-pen plotter is just in. Use with 1-2-3 or Chart. Coming soon: Tapestry, IBM's network. You can link up with **£1600 IBM PC's** at Morse.



EPSON AT MORSE

Selling like hot cakes, the 64K **EPSON PX8**. Lap-held CP/M, with 80 column LC display, WordStar, CardBox, Calc, diary etc only **£795**
NOW IN STOCK: PF10 battery operated 360K disk drive, **£395.**
JX80 seven colour printer, **£560.**
CASIO FP200 portable computer. Basic, CETL etc, (list £299). With **FREE** £35 database and other software, at Morse only **£230.**
CASIO PB700 pocket computer with Basic & graphics (£110) **£86.**
Plotter, tape, expansion, available.



TELEVIDEO: £1290

Completely IBM PC compatible computer with 128K memory, good-looking 14" graphics display, twin 360K disk drives. Runs Flight Simulator, Framework, 1-2-3 etc without any problems. List price £1990, unbeatable at **only £1290.**
NEW SOFTWARE AT MORSE. IBM Topview is expected very soon. On our shelves now, Apricot WordStar 2000, Symphony, Lotus 1-2-3. etc.
Many more items too numerous too mention. All Morse prices are exclusive of VAT at 15%. E.& O.E.

MORSE

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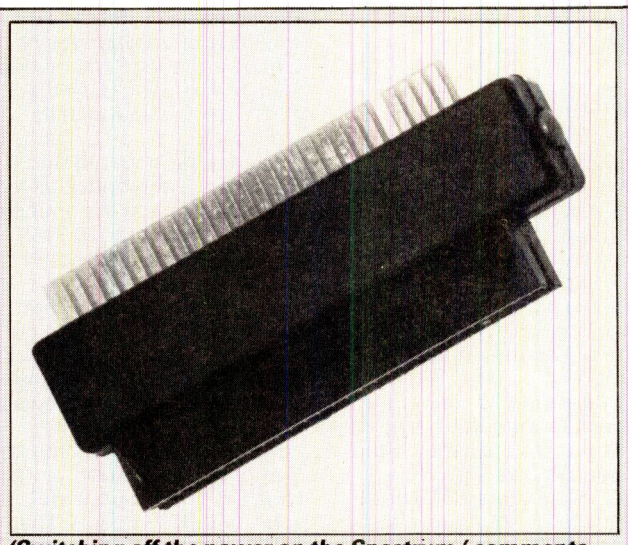


'Switching off the power on the Spectrum,' comments Nidd Valley Micro, 'to cure a program crash is about as nonsensible as switching off the National Grid to change a light bulb.'

What one wants is a reset button. 'The Z80 processor,' observes Nidd Valley, 'is provided with a proper reset line which gently resets the system. No power is lost to the computer or peripherals, so by using this, there is less likelihood of damage to microdrive programs. While programmable interfaces like joysticks remain programmed, only the game or program needs to be reloaded.' That's what 'reset' means.

Of course, but Sinclair Research always said it would add too much to the cost of the Spectrum to provide one.

It adds a whole £5, including VAT and delivery. It is also a quite useful extender to the back end of the Spectrum, making it easier to fit keyboards and add-ons — what more do you need to know?

The phone number is (0432) 864488; the address is Stepping Stones House, Thistle Hill, Knaresborough HG5 8JW, North Yorkshire.

whatever it ends up being called, is on (0256) 463344.

Surprise response

The Department of Education's Microelectronics in Education Programme (MEP) has learned a lot of painful lessons.

It has spent five years looking at software, and at the end of this, has produced a book with suggestions of what to do, what not to do, and how to avoid doing it, aimed at education people.

The book will be of interest to programmers and analysts, 'but we feel it will be of particular value to those who set out as producers', explains MEP director Richard Fothergill in the book's publicity blurb.

The book is entitled *Educational Software — a Creator's Handbook*. It costs a thumping £25 plus £2.88 UK postage, and the distributor is Tecmedia Ltd, 5 Granby Street, Loughborough LE11 3LD. Don't ring the MEP about it — it is delightfully 'other-worldly' about this sort of thing. I mentioned the book one day on my Oracle page (557, plug) and got a bewildered phone call from Cambridge asking why 'all these people were calling them for details?' as if the last thing the MEP had anticipated from sending out a press release was actual response.

Mac BCPL

BCPL, an ancestor of the C language, is still much adored by programmers in Cambridge, where Top Express has now produced a version for the Apple Macintosh.

The package 'includes Mac BCPL on a disk, a demonstration program source, a complete systems manual, and a copy of a book, *BCPL: the language and its complier*, published separately by Cambridge University Press,' explains the publicity blurb.

We fully intend to review this product in some way or other (to follow this month's review of BBC and QL implementations), but this isn't the moment: if I put the disk into my Mac, I'll never get around to writing another word. For details, contact Top Express on (0223) 355427.

Forward booking

A few dates for the next few months. A show for construction people using computers is scheduled for 25-27 June. At the time of writing, I know only that the Second Construction Industry Computer Fair will be held at the Barbican, but nowhere in the information sent to me on the First Construction Industry Computer Fair do the organisers mention the trivial detail of exactly where to go. I suggest you contact them on (01) 637 8991 if you are interested.

A seminar on IBM's impact in Europe is being held by Frost and Sullivan at the Hyde Park Hotel on 27-28 June. This one costs, and details of who pays how much are available from Anne Drayton on (01) 486 0334/5.

For education people, the Microcomputer Users in Education (MUSE) group is running a July Summer Course/Conference, aimed at teachers at all levels from primary to higher education. There are 26 speakers, so I will refrain from attempting a list. Details available from MUSE at PO Box 43, Hull HU1 2HD, or phone (0482) 20268. 'Bookings should be made before 1 July,' it says cryptically, 'though late applications will be regarded with sympathy.' Flowers only, please.

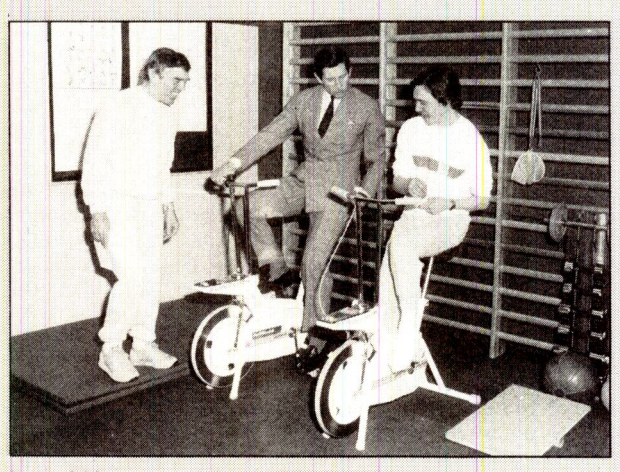
Finally, for personnel experts, a conference and exhibitions on Computers in Personnel is being organised by the Institute of Manpower Studies with the Institute of Personnel Management. The 'double event' will be from 9-11 July at the Royal Lancaster Hotel, London W2. Details on (0273) 686751, the Institute of Manpower Studies.

68000 expertise

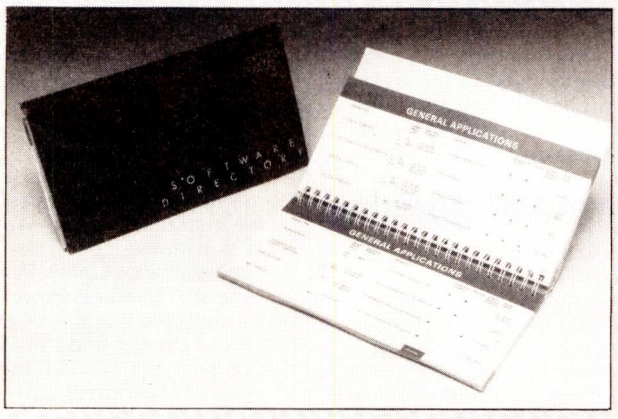
Those experts on the 68000 (and machines like the Mac, Atari, Amiga, QL, and so on) Metacomco, has moved well up from its normal assembler programs (for all those machines, some of them still secret, heh, heh) to announce an artificial intelligence language, Cambridge Lisp 68000, 'for any machine running CP/M 68k'. It should be available on everything except the Mac, and also on things like the Stride and the Wildcat, the U-Man 1000 and the Sord 68.

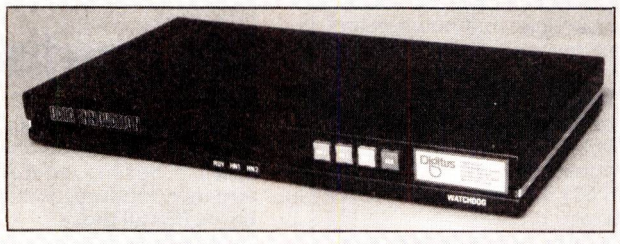
Morals in question

It is immoral to sell someone software, and then claim that you haven't sold software but



It could be argued that setting up a special centre to train disabled people in the skills of computing, as Rank Xerox has just done, isn't going to get the company's profits up — so it must be a search for publicity. Well, if it is (and getting Prince Charles along to open the ITeC in Slough does support this theory) it will always work in this column. The photo shows the gym — part of ITeC's overall rehabilitation course. I'm delighted to see this collaboration between the company and the local authority, and look forward to seeing reports of the trainees getting jobs in our short-staffed industry.





It seems to be HiNet's month. The little booklet in the first picture is a software directory. Before you scoff at its slimness, I ought to warn you that it is highly unusual — it's a guide to software which runs on a local area net, Digital Microsystems HiNet.

Networkable software is rare, and a 153-page booklet is very fat by network standards.

Not all the products here are guaranteed to work, but they do at least run. They are classified under three headings, showing how much research has been done: those that have been 'run', then those which have been 'tested', and finally, and most impressive, those which have been 'installed' — actually taken to a user network, loaded, and proved to work properly.

You can't run them all because they use different operating systems, but they include languages, databases, communications packages, spreadsheets, word processing and Cad/Cam packages, as well as vertical market products and accounting applications.

The other picture shows a Watchdog. It, too, runs on HiNet, and is an invention of Digitus. Without going into needless detail, it takes control of a HiNet network if the master station fails. Details on (01) 379 6968 from Tim Edgar, who will also have some knowledge of the DMS software catalogue, or contact DMS direct on (0734) 793131.

a tape with software on it. It's immoral because if I have a program, I want to load it from tape only if I don't have a disk. And the cost of transferring it to disk is the effort of 10 minutes of my time.

I know I've got into trouble before on this subject but my opinions remain the same, even when it's the BBC which is asking buyers to spend £12.45 on a program (Vu-Type) which they already own. The program costs £18.40 on disk, and the BBC is very 'generously' offering a discount to owners of the tape version.

The reason BBC Software has to do this is that it has protected the tape, and theoretically you can't copy it. Naturally, most users by now have utilities which do this for them. For those who don't, I seriously suggest that the BBC (and other publishers) offer a free upgrade, charging only the price of the disk and postage. I suggest it in their own interests — if the only disk copies lying around are ones made by hackers, you can bet they won't be copy-protected. And this policy is exactly designed to guarantee that the only disk versions will be hacker-generated.

If you agree with me, feel free to contact BBC Software at 35 Marylebone High St, London W1M 4AA, tel: (01) 927 4218 and write to *PCW* whether you agree or not, the issue of upgrading to disk isn't going to go away.

Amstrad azimuth

People with difficulties loading software (unless they have been stuck with one of the new, 'improved' Commodore tape drives that won't recognise old Turboload tapes) often find that the playback head on their unit isn't exactly where it was on the unit that made the tape.

Interceptor Micros report high sales of a kit to adjust the 'azimuth' of the head on the 64, and has now produced one for the Amstrad. The £9 kit includes software, a test program, a manual, a special screwdriver and a pointer.

It is available from retailers, or contact Interceptor on (07356) 71505.

Apparently, a Spectrum version is on the way, a prospect which fascinates me since Spectum users don't have standard tape drives.

The proof's in the running

Minicomputer-builder DEC has a bone to pick with micro-maker Intel: apparently, Intel has been telling fibs about how fast its micros are, compared with DEC's minis.

In 1981, an American magazine (*Byte*) supposedly printed a Benchmark which Intel picked to illustrate the power of its System 86/330. When Intel ran the Benchmarks in 1982, it said that its system was 'clearly superior to the LSI-11 on this Benchmark'. The LSI-11 is DEC's micro version of its PDP mini.

Digital has now run the Benchmark and finds that 'on the contrary, just the opposite is true — both the LSI-11/2 and 11/23 executed the Benchmark faster and required less memory than the System 86/330'.

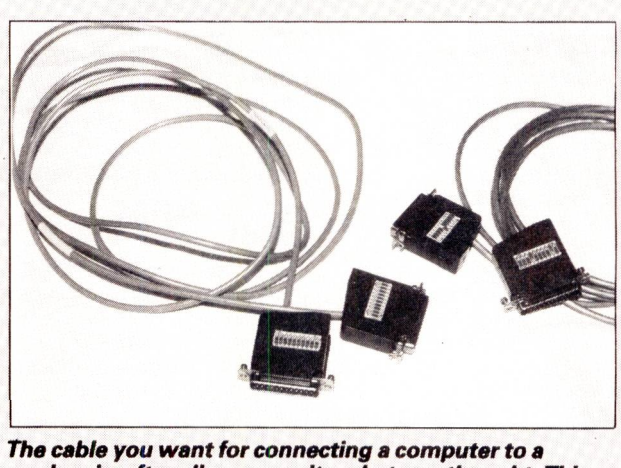
All good fun. What I found fascinating was the fact that this (Pascal) Benchmark was tried out on 20 different combinations of machine and compiler; the fastest being the PDP-11/70, a powerful mini, with NBS Pascal. That took 2.6 seconds, compared with the Intel system's 9.20 seconds. The best 8-bit system was a Z80 with MT+Pascal, taking 19 seconds.

No, that isn't the amusing bit. The amusing bit is the time taken by the Apple II with UCSD Pascal. It took 516 seconds . . .

Goodwill to all men

The reason modem-maker OEL called in the receivers earlier this year was partly a question of bad debts from Prism and Oric, and partly the failure of a chip maker to produce a central processor on time.

The company made the QL modem, which has been announced but not shipped,



The cable you want for connecting a computer to a modem is, after all, never quite what you thought. This switch-configurable cable can overcome most of those problems and, what is more, if you have two devices, you can switch it for both. And it looks like coming onto the market at around £30, which is only very little more than the cost of an ordinary cable. If you have trouble finding a dealer, ask for Tri-Point on (01) 669 6502, or contact Ferrari Software, P&P Micro Distributors, Westrex, MT Direct, Norbain Micro, and Stack Computer Services.

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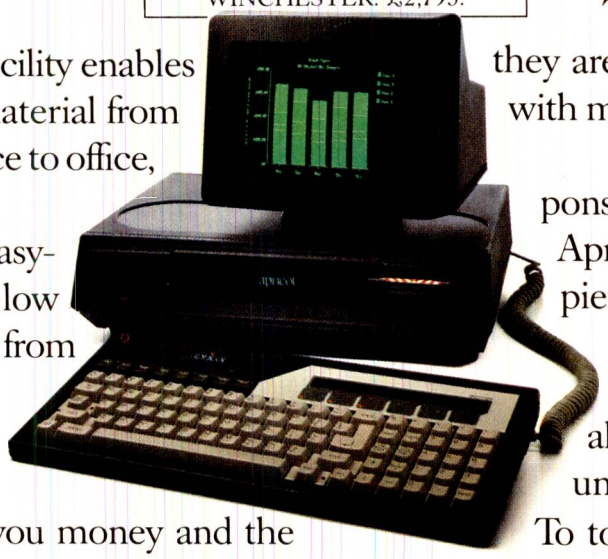

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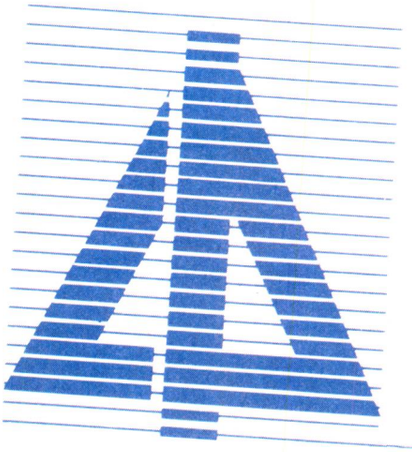

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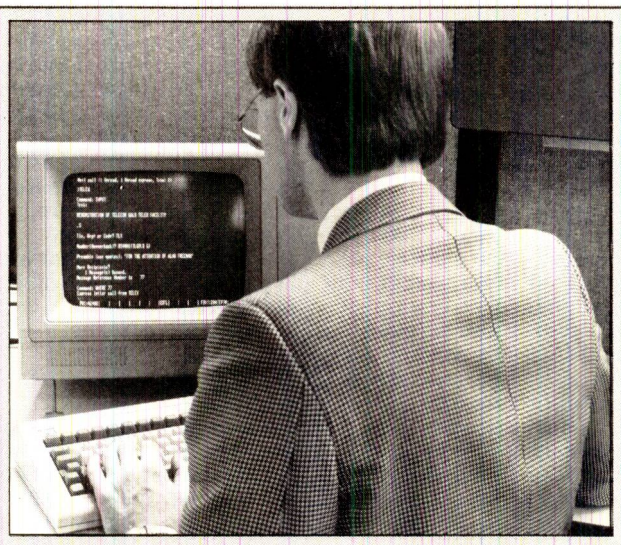


This man is reading a telex which has arrived on his Telecom Gold electronic mailbox. It cost him 50p.

The service is welcome: it had previously been possible to use Gold to send telexes, but not to receive them. Nonetheless, I'm a bit disappointed. There was an exciting-sounding development related to the telex service: 'A simple routine is also available', said the announcement, 'which will convert standard telex upper-case format into lower-case, making text much simpler for the recipient to edit when required.'

This can be quite easily done, of course, with the CP/M command PIP, so hardly warrants much fuss. What I had been hoping for, however, was something more clever — some way of providing upper and lower case through telex.

Without doing any research at all (well, I wrote to Telecom Gold, but since I used electronic mail, I have only myself to blame for not having received an answer) it occurs to me that telex uses several 'invisible' characters. For example, the NUMBERS character switches from alpha to numeric, and back. Two NUMBERS characters sent together could be interpreted as a depression of a SHIFT LOCK key by Gold users, but would be totally ignored by telex machines.

I'm sure there's a very good reason why that won't work, and I'm almost sure that one day, Telecom Gold executives will read their mailboxes and tell me why . . . but don't hold your breath waiting for the answer.

and had announced (and started shipping) a teletext adaptor.

The teletext adaptor (for the Spectrum) was publicised on 4-Tel, Channel 4's own Oracle-based service which has dreams of publishing software for Spectrum owners. However, in the absence of any software, the adaptor was only useful for people who wanted to read Oracle. And since, to read the ads, you had to have Oracle anyway, sales of two decoders were quite impressive, really.

The QL modem is apparently completed, working and approved, but late. Its central microprocessor has 4k of code built into it at the factory, and Texas Instruments was given the order after General Instrument failed to deliver, say staff. They don't blame Texas for having it late — it takes time to design a chip mask including 4k of program, and build the part. But late it was, which meant long costs and no revenue.

At that point, according to managing director Martin Ansell, one of his biggest backers, a flour-making group, pulled out. Other people hoping to put money in weren't quick enough or eager enough, and the receiver had to be called.

For customers, of course, this is good news. Send money to a company which is struggling, and you are likely to get a note from the receiver pointing out that you are now an 'unsecured creditor' and good-bye money. Send money to a company being run by the receiver, and you will get your goods.

For those people in the industry who have written software, supplied prototypes, and extended credit, of course, it is a disaster, and their only hope is that the QL modem looks a sufficiently convincing 'winner' for the receiver to be able to sell off the company as a going concern.

The goodwill inside the group is encouraging: the factory staff were working for two weeks without pay after being laid off, before the receiver was called in, in order to try to keep the company going.

Where Unix goes, others follow

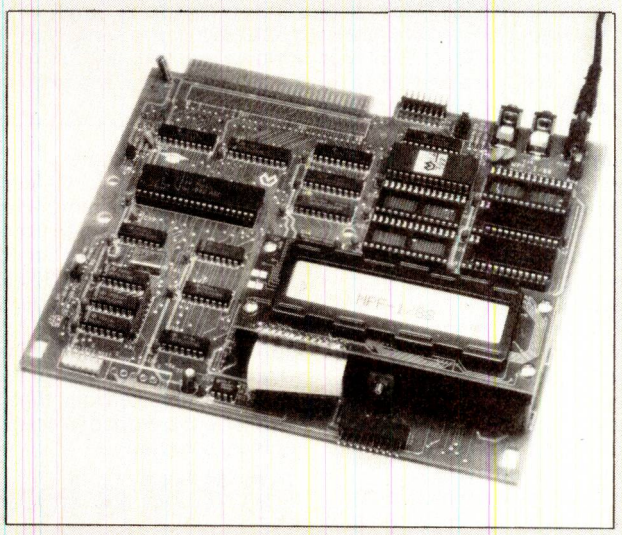
It's not a bandwagon I feel like jumping on, but the Unix one certainly looks like being it's beginning to roll.

The business industry's big guns, IBM and AT&T, neither of whom get all their shots on target, are both on there — plus a host of other companies including Hewlett-Packard (whose Integral PC is reviewed in this issue) and Commodore, which has been receiving some bad publicity recently.

Systems house Digitus, for one, is convinced that the operating system's time has come. It's published a £95 report on the Unix market which says that 'with sales doubling in 1984 and 180 per cent growth predicted by 1986, it is set to become one of the most dominant multi-user systems'. However, Digitus doesn't expect the shortage of IBM PC/ATs to be corrected until the end of the year, and it's even less optimistic about multi-user Xenix. This AT implementation of the Microsoft Unix lookalike isn't expected until next year.

To make life even more confusing, Commodore's contender is based on another Unix clone, Coherent. The Commodore machine should come in two versions, both called the 900. There's a personal workstation with a very high-resolution (1024×800) bit-mapped monitor coupled with Commodore window manager software and mouse control, or alternately you can plump for the multi-user option with a 67Mbyte hard disk from which you can hang up to eight terminals. Both versions come with 512k of RAM as standard, and are based on an obscure Zilog 16-bit processor, and Z-8001. Coherent at the moment is compatible with System Seven Unix, but will in time be made compatible with the more widely available System Five, says Commodore.

The best I could get in the way of a price is 'approximately half the price of its nearest rival' or 'very



At £325, this little card is a really nostalgic look into the roots of the micro industry — it's a development card with an 8088 chip on it, designed for teaching hardware and software engineering with the Intel processor. You can attach wires to literally anything you like, in contrast to the packaged electronics of most MS-DOS office systems, and you can work like mad for months, coming up with something that rings a bell. But you will be an expert at the end of the process.

Contact Fight Electronics for details of the MPF 1/88, on (0703) 34003.



Another triumph of ingenuity over sense: the Seiko RC-1000 is 'the world's smallest computer terminal'. It is 'an ingenious way of carrying data which would normally be kept at home in a personal computer'.

You feed the information from your home micro into the wristwatch, and later you can scan through 80 'pages' of 24 characters each, with phone numbers, reminders . . .

No I don't believe it either, and it did arrive at the end of March. But a horrible, sinking feeling tells me that if you ring Hattori UK (publicity agents Headway Public Relations will take calls on (01) 379 6339), the company will not say 'April Fool', but will take your money.

There's no accounting for the mountains people will climb just to prove they can do it.

competitive', which could mean anything between £2500 and £7500. Delivery starts towards the end of 1985, although software developers are getting the machines now.

For me, optimism based on Unix is misplaced optimism, but I'm pleased to be able to record it so that we can look back with hindsight in a year's time. AT&T is placing its future trust on its 7300 personal micro, which looks like a Macintosh but runs Unix software.

That machine uses the 68000 processor, a close relative to the one inside the Macintosh, but don't run away with the idea that programs will need relatively little conversion from Mac to Bell.

Most programs written for the Mac don't address the chip but use the high-level routines built into the Macintosh by Apple. Unless AT&T produces an emulator of the window manager, there is going to be a whole host of nothing to run on the 7300 for a long time. Except, of course, for the possibility of converting Xenix applications — and despite the theory that Xenix is very like Unix, that won't be the work of a couple of weeks, either.

CD ROM is here!

It looks as though compact disk ROMs are finally arriving with the announcement by Hitachi of the CDR-1502S — a CD-ROM with parallel interface for the IBM PC. Memory is not quite up to the one giga-byte first speculated, with the Hitachi drives storing 522Mbytes which is still about 270,000 A4 pages. Interfaces for other machines are expected later this year. Happily it is using the same mechanism as the music compact disks so we can expect the price to drop as music CDs drop and the disks themselves should be relatively abundant.

The CDR-1502S is expected to sell for just under £1000 which is twice the price of its audio counterpart, apparantly the addition of an extra chip will allow it to be used as an audio-CD player which makes it sound more reasonable. A number of computer manufacturers have expressed an interest in it with a view to replacing their bulky instruction manuals with a single disk. In addition it seems as if the race is on between the CD-ROM manufacturers to sign a deal with Encyclopedia Britannica to be the first to offer this on CD.

Acorn anti-climax

If you've been holding your breath waiting to see what Acorn does next, news of the BBC B+ is likely to leave you a little disappointed.

The machine provides 64k of RAM and two more ROM sockets. Oh yes, and all the ROM sockets have been moved to make them easier to get at. That's about it, although the disk interface chip is included in the expected recommended retail price of £499.

Seemingly, BBC B prices will be cut with the availability of the new model, but no-one would tell me by how much — the phrase used was that 'price differentials between models will be maintained'.

Not much was being said about the Communicator either, which will appear first as an OEM machine, probably in the autumn. Meanwhile, the ABC 200s are scheduled to continue under the Acorn name, pitched at the scientific market, while the 300s are also waiting for an OEM deal.

The Show principle

On the principle that *PCW* readers are busy people who like to plan ahead, I've some early details on this year's *PCW* Show.

The Olympia centre in west London is the venue again, and the dates to note in your diary are Wednesday to Sunday, 4-8 September.

But this year's event has something of a new look. The Olympia 2 hall is set aside for business computing, while all the action for home computers is next door in the National hall. That's where the big names like Acorn, Atari, Commodore and Sinclair will be, together with all the related software and peripherals.

New features in the National hall include Tomorrow's Micro Home, where one of the MSX companies will give a glimpse of its vision of the future, with the computer at the centre of the 'wired living room'. Old favourites in this area include the Top 20 Games and, of course, the Association of Computer Clubs, which will have a larger presence than in previous years.

In Olympia 2, visitors will be able to get impartial advice on choosing a micro for business, courtesy of the NCC Microsystems Centre. The NCC will be running daily seminars at the show, and will also have a stand to which visitors can take individual queries.

Philip Virgo, the centre's end-user systems manager, reckons that buying a micro system in the early 1980s 'is like buying a delivery van in the early 1920s. The world is full of enthusiastic amateurs and ex-chauffeurs discussing the relative merits of Raleigh Runabouts and Rolls-Royces, united only in their denigration of the Model T Ford'. The NCC promises to provide a more sensible approach.

Also in the business area will be the *PCW* Show applications advisory service. If you want to know exactly what software is available for your particular business problem, that will be the place to ask: the database directory will list all known applications software. This hall has its own entrance, with separate ticketing for trade and business visitors who can register in advance to walk straight in at the door.

Further details from: *PCW* Show, 11 Manchester Square, London W1M 5AB. **END**

Guy Kewney can be contacted on electronic mail. His numbers are Source TCK 106, and Telecom Gold 81: JDS018. The Prestel mailbox number is 01-802 2679.

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YANKEE DOODLES



When you can't see the shelves for the software, there must be another way of selling. David Ahl reports from the States on electronic distribution and the latest American news

The hard sell

With over 27,000 personal computer software packages on the market, it's impossible for a computer store to carry more than about 1 per cent of the total offerings. Even the largest software distributors, Softsel and First Software, carry less than 20 per cent. Thus, software manufacturers are turning to a variety of other methods of selling their wares.

Some vendors saw electronic distribution as the answer, but it has not proved commercialy successful. Nevertheless, General Electric, AT&T and several new companies are continuing to experiment with such systems, and are convinced they will be in widespread use by the end of the decade.

An alternative to direct electronic distribution is provided by One Point, a distributor that maintains an electronic software catalogue of some 7000 titles. A customer can dial up the catalogue from his home computer or one in a retail store, and receive product descriptions and reviews of packages. If he is interested, he can place an order which will be shipped within 48 hours.

Unimart is trying an approach which allows a customer to dial up a software package and try it out with his own data. If he likes it, he can buy it.

Several software vendors have turned to outlets other than the traditional computer or software store. Intuit, for example, sells its home finance package through banks. Several vendors sell packages through trade associations, and at least one vendor sells its package through home builders who include a computer and a home management software system in every new home that they build.

Away from home?

Although some industry watchers have interpreted IBM's decision to stop producing the PCjr as the death knell for the home market, I disagree. The PCjr never completely recovered from its initial introduction in the US with a Chiclet-style keyboard and limited expansion capabilities, although the deep price cuts for a bundled system before Christmas gave it a short-term boost.

If anything, IBM's exit provides some opportunities for Apple and Tandy who currently market full-featured systems in the under-$1000 price range.

Later this year when the new Commodore and Atari computers hit the shelves, the competition will be tough but the time window seems to be wide open for Apple and Tandy for the next few months.

Is IBM out of the home market for good? Not likely. It is reportedly still looking at building an MSX machine at a very attractive price, and you can be sure that when IBM sees significant profits in the market, it will jump back in with both feet.

Meanwhile, the bundled PCjr price of late 1984 prompted Apple into responding with a cash rebate program on the Apple II. Although the program ended on 30 April, it still caused a (needless) loss of revenue for Apple.

Below target

Kaypro, with its cheap but functional computers and direct distribution to retailers, was riding high a year ago while companies with more advanced products and 'proven' distribution schemes were hurting.

However, an antitrust complaint was filed against Kaypro in March for threatening some of its dealers with termination for not selling at list prices. Kaypro paid $19,500 in civil penalties and court costs to settle the suit and, although the company did not admit or deny the allegations, it would appear that it will now have to give its dealers greater latitude of action in setting prices, selling to non-Kaypro dealers, and advertising mail order sales.

Dealers have also expressed scepticism that Kaypro has the ability to support its recently-announced 286i, a high-end IBM PC/AT clone, or even the K-16, and XT-type entry. The 80286-based 286i with 512k and dual floppy disk drives sells for $4550, while a 256k, 10Mbyte hard disk version of the K-16 sells for $3295. All Kaypro systems include bundled software. Although the Kaypro prices are 18-25 per cent under the cost of similar IBM units, the IBM systems are frequently discounted by approximately 20 per cent. Therefore, the only advantage of the Kaypro is the bundled software.

Several dealers to whom I've spoken feel that the extra software — said to be worth $2000 by a Kaypro spokesman — is not enough. After all, Columbia, Eagle and TeleVideo also had a price advantage and were largely unsuccessful against IBM. Most dealers agree that while many customers are looking for an alternative to IBM, the three magical letters — I, B and M — are still the most sought.

One said: 'I hope Kaypro can do in the AT world what Compaq did in the PC world, but they're going to have a tough, tough time.'

Random bits

The Software Publishers Association reports that sales of Macintosh software have jumped from nil to 8 per cent in early 1985 . . . In March, Compaq shipped its 200,000th personal computer . . . IDC predicts that the market for business graphics will grow from $59 million in 1984 to over $1 billion in 1989 . . . Acorn has had a tough time in the US market, but may get an unexpected boost from Olivetti's 49.3 per cent stake in the company. AT&T, 25 per cent owner of Olivetti, is said to be considering an agreement to help Acorn crack the US education market, now dominated by Apple . . . Consumer Products, a maverick division of giant AT&T, has released an image capture board (for the IBM PC) which captures a standard composite video image, and allows modification and manipulation of it by the computer. It is made possible by the development of a new design architecture using RARAM memory, a high-density, low cost, two-port dynamic memory with a very fast access time . . . Having discontinued its 16/8 and 820 family of computers in February, Xerox is negotiating with Olivetti to sell the M-24 IBM-compatible unit . . . Lotus and Cullinet have joined forces to develop and market products to connect Lotus 1-2-3 and Symphony to powerful IBM (and compatible) mainframe computers. One catch: while the integrated package, Symphony Link, is expected to cost only $300 to $500, customers will have to buy a communications peripheral for each PC (about $1100 each) plus Cullinet's mainframe Information Centre Management System package for a cool $150,000 . . . Its no secret that videotext has been a colossal failure in the US. The operators of three experimental systems (Viewtron, Keyfax, and Gateway) spent a total of $90 million in development yet attracted fewer than 5000 subscribers in total. Nevertheless, even bigger players are planning to enter the business, specifically three joint ventures: one between IBM, CBS and Sears; a second between AT&T, Time Inc, Bank of America and Chemical Bank; and a third between RCA, Citicorp and a third unnamed partner. END

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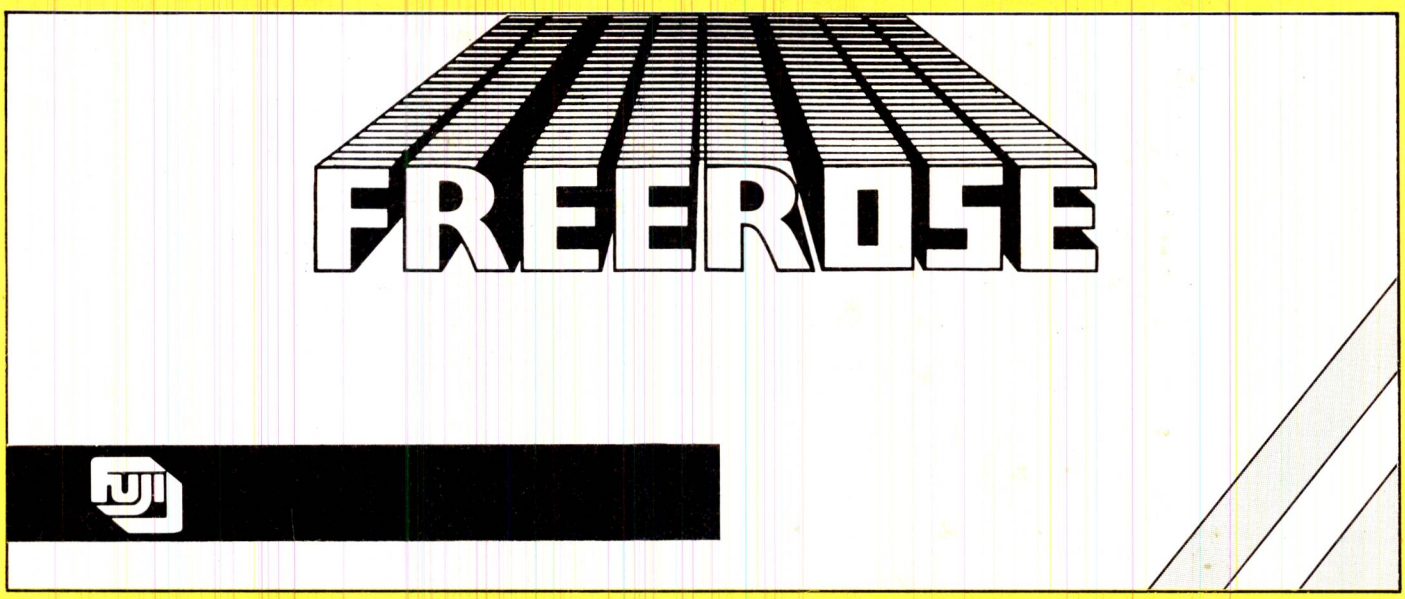

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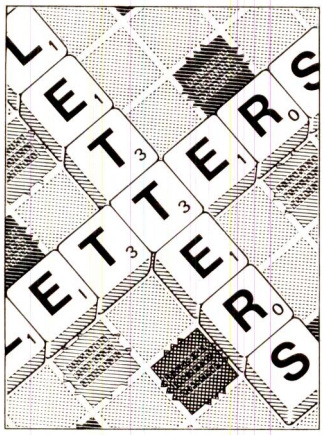

This is the chance to air your views — send your letters to Communications, Personal Computer World, 62 Oxford Street, London W1A 1HG. Please be as brief as possible and add 'not for publication' if your letter is to be kept private.

Oh no, not again!

I am typing this on my week-old Amstrad CPC 464 (called 'Arnold', I believe) and I am hooked! The printer is borrowed but the word processor is the free one with the machine, and it is good enough for my typing.

I am also becoming hooked on *PCW* and I like the artwork — especially March, page 153 — but my wife wants to know where the bowl of petunias and the whale went? She must have been Hitch-hiking again.

John H Taylor, Craigavad, Co Down

The mice nibbled away the petunias and whale — much to the annoyance of the illustrator Eddi Gornall. These scientific mice just have no respect for art.

Programs, please

I am a lecturer at a college of further education in the Cleveland area. Having previously worked as a microprocessor development engineer, I knew the type of systems that were available in the 'real world' and the capabilities of such systems. One of my responsibilities is the development of courses in assembly languages and interfacing techniques.

In the latter part of 1983, I did a major search of the then current personal computers with a view to choosing one which would become the basis for the development of such courses. The system I chose was the Memotech MTX512. The main reasons behind this choice were:

i) Integration of Basic, Z80 assembler and a text processing language Noddy.

ii) An easy upgrade route to a full CP/M system.

iii) Robustness, a feature not unnecessary in this situation.

iv) The whole system cost was very small in comparison with similar systems. In fact, an entire laboratory was equipped with 13 MTX512s and two full CP/M systems for well under £4000. The systems are used for software development, and code which is produced is transferred downline to EPROM programmers.

Since the launch of the machine in late '83, there has been considerable work put into the formation of a vibrant user group, GENPAT, whose current membership spans a great deal of Europe and beyond. The group offers substantial discounts on both hardware and software as well as providing a telephone problem answering service.

Since the launch and early reviews of the system, there has been an almost total lack of interest in the machine. While I realise that there are several good machines on the market, there seems to be no interest in producing articles and/or reviews of current software or add-ons. This is shown most graphically in that, in current magazines, there are major programs being written for machines that are now totally unavailable (by any means) and reviews of some of the earliest software written for the MTX series in 1983, with no mention of current, vastly more powerful software. At the present time there are available, via GENPAT's own software house, Syntax software, or from others, in excess of 100 titles, ranging from word processor packages to games.

It includes macro assemblers which are comparable in power with ones used in industry, other languages such as Pascal and Forth, several utility programs, one of which for example allows printing of current programs while doing other things — that is, a spooler program, and a whole host of games, several of which are unique to the MTX series.

I write this in the hope that it may stir into action some thought of producing software for a very good machine.

Terry Trotter, Billingham, Cleveland

You'll get no disagreement from us about the machine's quality — see our review of the RS128 (October 1984). But we only receive rare submissions for T.J's Workshop and Program File (see page 212 T.J's Workshop for one such Memotech program). Our Memotech is ready and waiting — what we need now is more software. And your point on reviews has been noted and will be acted upon.

Star failure

We have had a North Star Dimension running in our office since August '84, and while we are generally very pleased with the machine we would like to comment on several statements made in your review (*PCW*, March 1985) in the light of our experience.

First and foremost, the machine is very cost effective provided that the user is running standard software tailored for the machine (for example, Pegasus accounts that we use). However, we have had to rely on IBM documentation for both hardware and MS-DOS in order to do any serious programming of our own, and even then some things don't work. The system software that came with our machine was version 1.0.2, which does have some bugs in it. We were promised a free update to a true multi-user system 'within a few months' — this has not materialised and we are very disappointed, particularly as the Pegasus accounting system allows shared access to files.

The review mentions a *Technical Manual* which we understood did not come with the machine. We have had a copy on order since September '84 and it has still not arrived, despite repeated requests and reminders. Our *Users' Guide* was not hard-bound and easily gets lost. The *DOS manual* does not have enough information in it to allow the user to write device drivers for the serial or parallel ports. We understood that a *Programmers Guide* would be available early in 1985; needless to say, this has not materialised either.

We consider that the memory expansion prices are unreasonably high, as 128k of RAM these days costs about £60 — if the price was nearer to £150, we would buy. I suspect that we will end up manufacturing our own and perhaps offering it to others.

The review mentions the fact that the fan is rather noisy and we would agree. In fact, we have had independent measurements made by Acoustic Management Systems Ltd that indicate a sound level of 59dBA at one metre. This level is approximately 6dBA above what would be considered reasonable in a modest-sized office. The nature of the noise is particularly obtrusive and, we believe, merits investigation.

Finally, any intending purchaser should make certain that any 'promises' made at or before the time of sale are sufficiently documented to allow pressure to be brought to bear if they are not kept.

It is a pity that such an excellent machine should be hamstrung by such niggling problems.

J L Oliver, technical director, Spectrum Audio Ltd, London

Sad to say, after-sales problems aren't restricted to only the Dimension. Before buying any system, a written statement should be obtained to make sure promises are kept. But not all experiences are bad — as the next letter shows.

Star success

Back in October 1984, I upgraded my 48k Spectrum to do word processing by purchasing Microdrives, an Interface 1, and a Star Delta 10 printer. I chose the Star for several reasons — Epson compatibility, serial and parallel interfaces, 8k buffer and low cost (for so many features).

Unfortunately, the machine would only operate with the Spectrum at 1200 baud in text mode. In graphics mode, spurious characters kept

appearing at regular intervals. Having consulted many sources here in Riyadh, I still was unable to print graphics successfully, so I wrote to Star's head office in Germany and to the technical support group in California.

Less than three weeks later, Star Germany sent me a brand new serial interface board (its latest version) free of charge, and the technical support group sent me the latest manual — also free of charge. Both these items were accompanied by covering letters containing detailed answers to some technical questions I had asked.

The new Interface board works faultlessly at 9600 baud with the Spectrum, and the manual is full of useful programs to help me get the most from the printer (even though the Spectrum is not actually mentioned).

All in all, Star deserves a lot of praise as far as I am concerned. After all, service like this from a large company is not too frequently heard of these days.

Jon Calvert, Riyadh, Saudi Arabia

Not all bad taste

The Music System is without doubt the best program I have ever used on the BBC Micro. It is well-written, well-behaved, user-friendly, well-documented, beautifully presented, stimulating, educational, and its many facets are a pleasure to explore.

Like Frank Valloton (*PCW* April, 'Letters') I find the advertisement for The Music System distasteful, but this advert is totally at variance with the style and presentation of the program itself. Fortunately, I buy from reviews, not from advertising, and all the reviews that I have read have been unequivocally enthusiastic. Had I only seen the advertisement, I should never have dreamed of buying the program.

Margaret J Leonard, London

All tied up

In the daytime I am a respectable minicomputer consultant, working with high-resolution dedicated terminals. At night I am a secret home micro fan.

Until recently, I found the appalling quality of even high-resolution colour monitors difficult to live with.

I thought I had found the solution when I discovered the wonderful CEAF Romag filter, which lifts the quality to just the right side of the pain barrier. However, the damned thing kept falling off due to the sub-standard glue used to hold on the little sticky pads.

But just today I have discovered the ideal solution, and I can now supply any users of the Romag filter suffering from this problem with unlimited quantities of Serial Television Receiver Image Nhancement Girth at the knock-down price of £1 per yard.

Colin Walls, Bristol Business Centre, Bristol 8

Is this a firm offer?

Pin trouble

I would like to issue a few words of warning to other readers. I have just bought a Canon PW-1080A printer to attach to my Apricot PC but found that everything I printed was double-spaced. After much headscratching, I compared the Canon interface description with that for my old Centronics printer. The answer is that the Centronics and the Apricot expect pin 14 of the interface to be ground, but the Canon (and, presumably, the similar Taxan/Kaga model) uses pin 14 as 'auto line-feed'.

When this pin is held low (ground) the printer performs a line-feed after a carriage return. The solution is simple: do not connect pin 14 of the Centronics interface of this type of intelligent printer.

This seems to be the only conflict at this time, but I'm sure there will be others in the future. What price standards?

Jonathan Hurwitt, Greenford

New version spotlight

Following the review of Spotlight (*PCW*, 'Office Practice', March), I was a little disappointed that no mention was made in the review of the extra facilities embodied in the newer 1.1 version of Spotlight (auto-dial, full AT and hi-res screen support, Kaleidoscope, and so on), although we went to great lengths to ensure that these were known about.

It is also surprising that no mention was made of the very important aspect of stability — as far as we can ascertain, Spotlight is much more reliable in this respect, particularly when run with some of the more popular applications programs.

A factual error was made in the summary — Spotlight costs £103.48 excluding VAT, and not £125 as reported. This is also important, bearing in mind the emphasis the reviewer puts on value for money.

RAD Sumner, Software Arts International, Ipswich, Suffolk

We reviewed what we had, which was version 1. Apologies for getting the price wrong — but Sidekick is still cheaper. As far as stability goes, we had no problems with any of the packages.

New links

We are currently looking into the possibility of setting up a scheme to offer the following facilities to disabled people in the Winchester area.

i) A bulletin board system for the deaf, Typed messages would be passed on through the normal voice phone network by the system operator — and the deaf user would receive a reply in his mailbox. Hopefully — we would be able to reduce the normal four-five day wait for a reply to a letter to less than an hour. This would *not* be an emergency system: it would be for use in the same way as the normal phone system.

ii) Transcription of one of our local papers into Braille, possibly using some kind of optical character recognition system.

iii) Cheap or free access to normal computing facilities for people who, because of a disability — might not be able to leave their homes or afford to buy a computer.

We would be grateful for any help, either details of experience with similar schemes or just general technical assistance that any readers might be able to offer.

Alan Walker, assistant secretary, Winchester Unemployed Peoples Centre, 28 Staple Gdns, Winchester

HP9836 Benchmarks

I read with interest in *PCW*, January the article on Benchmarks 'On your marks' and, in particular the report on the Pinnacle, whose Benchmarks must surely be hard to surpass.

Before reading the report, I really thought I was in with a chance of providing the leader in desk top computers. I obtained the following results on a Hewlett Packard 9836 machine, which uses a Motorola 68000 processor running at 8MHz (all timings are in seconds).

BM1	0.18
BM2	0.70
BM2	1.50
BM4	1.75
BM5	1.90
BM6	3.06
BM7	4.56
BM8	16.56
Ave	3.78

Despite being displaced from the top of your table by the Pinnacle, it is worthwhile noting that the HP desk-top's Basic operates in a truly interpretive manner and has a slower MPU clock.

I believe that HP has now released a 12MHz version of the same machine, and it would be interesting to discover its Benchmark rating.

The HP9836 is, in general, used as an engineering workstation and number cruncher rather than a business machine, although I believe there are a number of standard business packages available for it.

R Soja, Clarkston, Glasgow

Loading problems

The most common and frustrating fault with the Commodore 64 system is loading problems with the C2N tape deck. Users may frequently find that a tape will not load on their own system but will on another. The reason for this is that the tape deck is set up in production to accommodate a data transfer rate of 300 baud, but currently much of the software is designed to run at 1200 or even 3000 baud, and at this rate the alignment angle of the head to the tape is critical if a clear signal is to be transferred to the computer.

I have solved this problem by using the newly developed Azimuth Head Alignment Tape marketed by Interceptor Micros. The process can be done in a matter of minutes. A game on the reverse side of the tape loads at 3000 baud and gives a final accuracy check.

Michael A Jay, Solihull, West Midlands

END

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BANKS' STATEMENT

Ivor's dream

Ivor Catt's vision of a quick, convenient successor to the Von Neumann method of processor control has come to fruition with the help of Sinclair. Martin Banks tells the story.

Seven years ago I met a man called Ivor Catt, a man who was trying very hard to make a great many waves, and seemed to be creating a large number of enemies along the way.

Ivor, you see, had a dream. He had worked in and around the semiconductor industry for some time, and before that had worked with Ferranti on computer systems when computer systems really were 'clever stuff'. Ivor could genuinely remember working on machines that were the archetype; they had less power than a Sinclair ZX81 and really were as big as a house. He had seen how the computer had come to be organised along the lines established by John Von Neumann, the man who developed the first stored-program computer system.

Ivor's dream was that the so-called Von Neumann architecture, the classic way in which the processor controls all the activities of the memory, peripherals, and so on, was bunk: there were other ways of doing things, he felt. Ways that were quicker, more convenient and, given the majority of tasks that computers are used for, more logical than a centralised single processor having to 'housekeep' an entire computer system.

Like all dreamers, Ivor was laughed at. Most of the semi-conductor establishment of the day were refusing to have anything to do with him. 'After all, the world is full of crazy guys who know they have *the* answer' would be a suitable paraphrase of their collective views on Ivor's dream.

What Ivor needed, of course, was money. This would have shown once and for all whether his dream could be made into a working reality. He managed to get enough in the way of research grants to keep the idea alive, with small projects running at places like Middlesex Polytechnic. He kept body and soul together in those days by running a course on digital electronics, plus some consultancy work.

To the semiconductor industry in general, however, as well as the mainstream computer industry, he was something of a pariah. But that was way back when.

There was a certain wry grin on my face when the Inmos Transputer appeared, for here were some of Ivor's ideas about the structure of computers appearing, in a different form it is true, but without Ivor.

It was with some interest I heard that Ivor had suddenly surfaced again, and not just surfaced like a piece of driftwood. He had risen meaningfully in the harbour of Sinclair Research. There, if anywhere, Ivor could find a home for outlandish ideas, a home where many such ideas have been shown to be perfectly practicable with enough applied courage.

Ivor's dream is about to see some reality as an add-on for Sinclair's QL. If it works, it could point the way to a radical change in the way we all think about computers and their peripheral systems.

I rather liked the idea of Ivor's dream the first time I heard him expound upon it. Certainly, the criticisms he had of Von Neumann's architecture made considerable sense. Imagine for just a second what this architectural structure actually involves. All actions in a computer are controlled by a single processor in a Von Neumann system. It is the processor which goes to memory and receives a program instruction; it's the processor which then goes to memory to get a byte or word of data; it's the processor which then executes the instruction; and it's the processor which then sends that processed data back to memory. Every single action is controlled and executed by the one single processor. It is a fundamental tenet of Ivor's dream that this structure is inherently slow. It can only be speeded up by increasing the speed of the processor, and there must be a finite limit to that capability.

Although such a structure is good at number-crunching applications, the majority of computers are used to performing mundane data manipulations of the 'add-this-data-to-that-record-in-the-file-named-xxx' variety. All very boring and, what is more, all involving intensive processor I/O activity. Essentially, Ivor's dream said: 'Do the processing where the data is — in memory.'

Stage one of a plan to produce such a system (that is, proving the technology) would seem to be what Sinclair is about to launch. Ivor's dream is coming alive as a 'solid-state Winchester disk', an add-on system for the QL which will provide half a megabyte of storage which is available at an access time of under 100 microseconds. This may not appear to be a lot of data, but it will be on tap to the machine at least 100 times faster than anything that can be achieved with a real electro-mechanical system.

It has to be said that this first product will not see a full culmination of Ivor's true dream. It will be a high-speed secondary data storage system that should give the QL some respectable clout as a computer, and which could overcome the drawbacks of the often-criticised Microdrives. It will, however, utilise the technology he has propounded for so many years.

This is wafer-scale integration. Instead of cutting up the devices on a semiconductor wafer into individual chips and packaging them for sale, leave them on the wafer and, if the right combinations of chip are put together, connect them up to make a working sub-system or system. The problem with this is that the defects inherent in semiconductor manufacture mean that it would be almost impossible to get a full, working wafer. Ivor Catt found a way round that all those years ago. He called it the Content Addressable Memory, and the basic structure, which is now to be used in the Sinclair 'Winchester', is also the vehicle by which the full dream of processing in memory can be achieved.

The physical structure of the Sinclair wafer is a collection of serial registers, each with a small amount of switching logic added. The logic dynamically links these registers together in chains, finding workable registers by successively injecting test patterns into neighbours on the wafer. This means that the system is inherently fault-tolerant and can find its way round any defective wafer elements.

This technology is being used first of all to produce what is, in effect, a cheap RAM disk. It will be cheap because one wafer will be easier to produce than lots of separated memory chips. Add a bit more logic, however, and there is the basis of a pipelined processing system. Here, probably, lies the basis of Sinclair's aspirations for fifth-generation computing. END

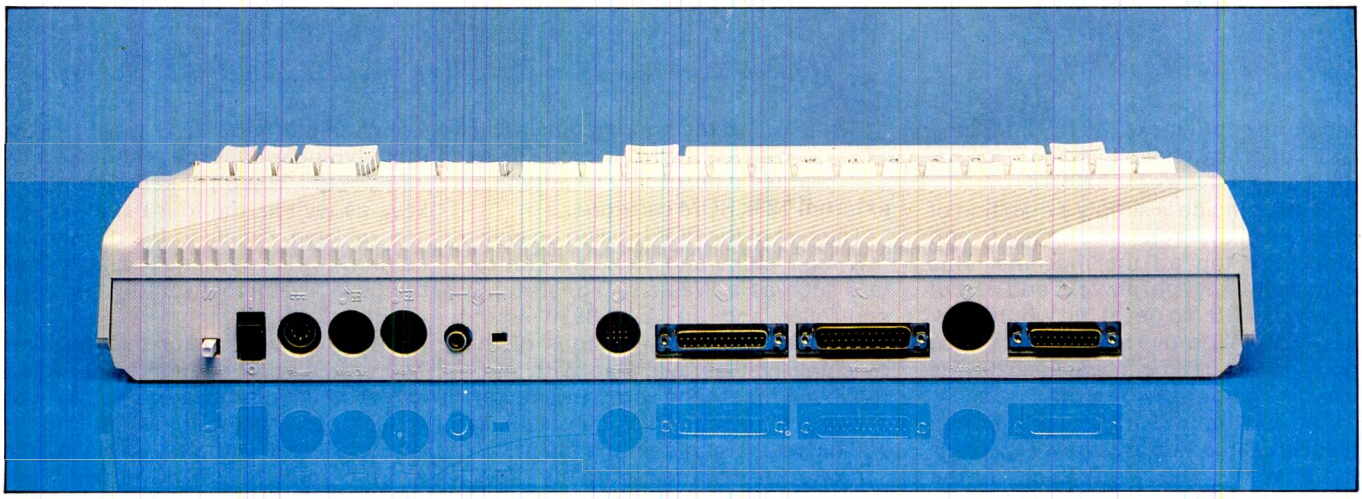


Illustration by Eddi Gornall

Atari 520ST

The Atari 520ST is based on the powerful 68000 processor with user-friendly GEM, lots of I/O facilities, large RAM and a low price tag. Peter Bright finds out if this is really the all-singing, all-dancing machine it claims to be.





The 520ST is well-endowed with I/O facilities — including a MIDI synthesiser port

Maybe I'm getting old. Then again maybe the micro world is just becoming a little boring, but there are very few new micros that I get excited about any more. The last one was the Sinclair QL and look what happened to that.

At the beginning of the year I went to the CES show in the US and saw a machine worth getting excited about — the Atari 520ST. At the time the machine was announced there were two models — the 130ST and the 520ST. Both based on the ultra-powerful Motorola 68000 processor, both offering the GEM user-friendly interface in ROM lots of I/O facilities including both floppy and hard disk interfaces, and either 128k of RAM (130ST) or 512k of RAM (520ST). All this was promised at an unheard of low price level.

We have been trying to get a review machine ever since. Unfortunately even review machines are in short supply and tend to move around a great deal. Just when we though we had one, we were told 'sorry it's gone to Hanover in Germany'. So if Mohammed won't go to the mountain . . .

When I arrived at the Hanover trade show I was told that Atari had decided to drop the 128k 130ST and concentrate instead on the 512k 520ST. That was fine because that was the machine I wanted to look at anyway. So here I am sitting on the grass next to the fountains at the Hanover show typing my thoughts on the 520ST into a trusty Hewlett Packard 110. It's a hard life!

Hardware

The Atari 520ST is a surprisingly good looking beast. Jack Tramiel's previous machines haven't been renowned for their design content or overwhelming good looks. The 520ST, however, comes in a sleek mid-grey casing with matched mouse, disk drive and a range of monitors.

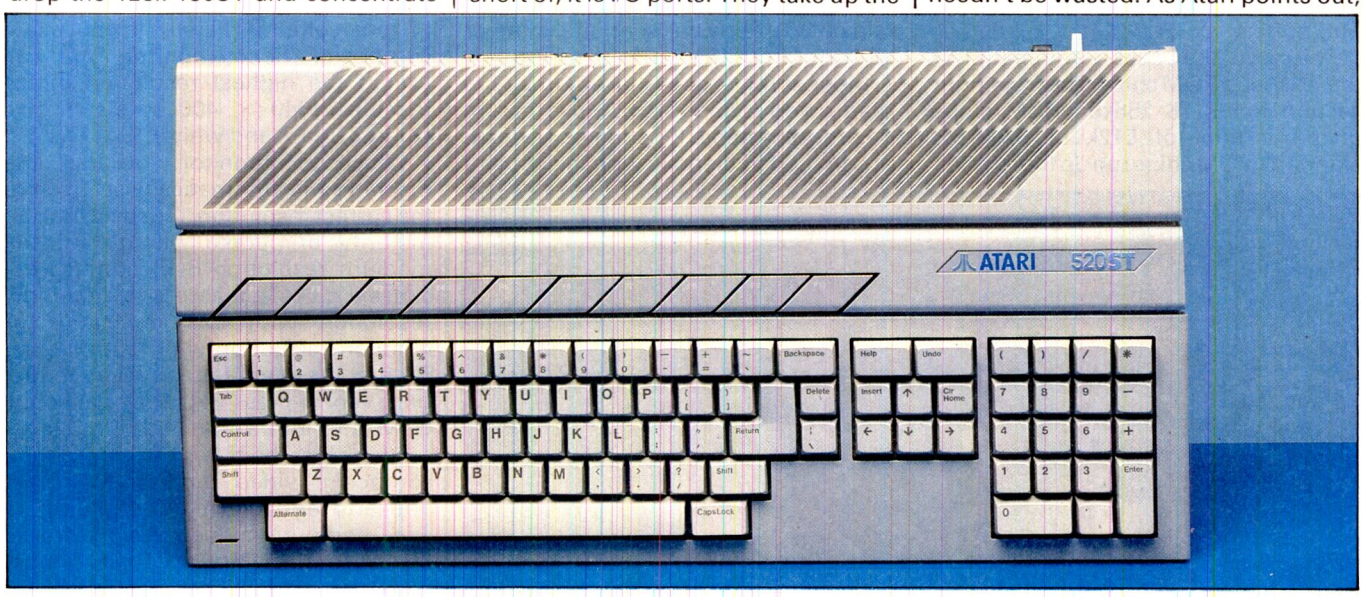
The keyboard takes up most of the front of the machine with ventilation slots using up the rest of the available top surface space. The design shows neat touches throughout; for example, the way the function keys are sloped to match the ventilation slots. The overall effect is very good. Apart from the keyboard and the ventilation slots the only other objects of note on the top of the unit are a small red LED power indicator and the Atari badge.

If there is one thing the 520ST is not short of, it is I/O ports. They take up the whole of the back of the machines as well as part of each side.

The left side houses a ROM-pack expansion slot which is capable of handling up to 128k of ROM. The right side houses two joystick ports, one of which is usually used as a mouse port. The back panel houses: power-in, MIDI-in, MIDI-out, RS232 serial-port, Centronics parallel-port, TV video-out, RGB video-out, composite video-out, floppy disk port and Winchester port. That's quite a long list of I/O ports for what is, after all, a comparatively cheap machine.

Perhaps the most interesting ports on the above list are MIDI-in and MIDI-out. MIDI is a standard interface designed to allow synthesisers and other electronic musical instruments to be hooked together so that they can communicate and control each other.

I'm surprised that the MIDI interface is comparatively rare as a standard fitment on home micros. All it requires in hardware terms is a couple of fast (31,250 bits per second) serial ports, one for input and one for output. Even if you don't want to hang a synthesiser onto your Atari, the two MIDI ports needn't be wasted. As Atari points out,



The keyboard is well laid out and feels nice. The function keys are styled to blend with the cooling slots

the ports could make the basis of a very cheap (if slow) local area network for 520STs.

Getting inside is simply a question of removing the retaining screws and lifting the top off the machine. This reveals the keyboard works and part of the main PCB. To get at the whole PCB, you have to remove the keyboard base plate. In fact getting inside the 520ST is very like getting inside a BBC.

The first thought that struck me when I looked at the PCB was how few chips there were. The electronics in the machine are a work of art. When you consider that it was designed and built in five months, you realise that some good people are working for Atari.

The heart of the 520ST is a Motorola 68000 running at 8MHz. I'm sure most of you are familiar with the 68000. Suffice it to say that it is one of the most powerful 16-bit processors around and in many respects it is close to being a 32-bit chip. It is a close relative of the processor in the QL, but where as Sinclair used a cut down 8-bit bus version of the processor, Atari has used the full 16-bit version.

Supporting the processor are no less than four custom-designed chips. All four were designed by Atari. Two of the chips are easily recognisable because they are of the new square design with pins down all four sides while the other two are contained on conventional DIL packaging.

Atari is coy about what each chip does, but as far as I can make out one of the square chips controls the RAM and some timing functions. The second square chip is called 'Glue' and does general housekeeping.

Of the other two custom chips, one acts as a video controller for the different screen modes and the other is a custom DMA controller with a high throughput 32byte FIFO (first-in-first-out) buffer.

The rest of the board is dominated by the RAM and ROM chips. The front right section holds 16 256kbit RAM chips giving a total of 512k of RAM as standard. ROM chips run up the left side of the board giving a total of 192k of ROM. This can be expanded if necessary by adding an external 128k ROM cartridge.

The rest of the PCB is taken up with a few logic chips and standard controllers such as a Western Digital floppy controller and an AY-3-8910 sound chip. Atari says that versions of this machine will be available with more RAM, but unless the company can find cheap one megabit RAM chips, I think it will have to re-engineer the board.

As well as manufacturing the 520ST, Atari is also producing a range of peripherals for the machine. These include 3½in micro-floppy disk drives and 5¼in hard disks.

The 520ST comes with a Western Digital floppy disk controller as standard, so adding a floppy disk drive to the system is simply a question of plugging it in. Although floppy disk drives are sold as optional extras to the 520ST, you'd be pretty silly if you didn't buy one. The 520ST doesn't have a cassette port, so disks of some description are necessary if you are going to get anything useful out of the machine.

Floppy disks are available in two versions: either 500k (unformatted) or one megabyte (unformatted). They depart from Atari and Commodore traditions by using parallel connection rather than the old (and very slow) serial connection. You can daisychain a maximum of two floppy disk drives onto the system.

Hard disks are expected to be available in either 10 or 20 megabyte specifications and to connect via the hard disk interface to the DMA controller. By doing this the system achieves a maximum data transfer rate of 10 megabits per second.

Like most micros of this type, the keyboard is an integral part of the main casing of the 520ST. The keyboard is laid out in a fairly conventional manner with a total of 94 keys in four main areas.

Most of the space is taken up by the main qwerty typing area. Above this are 10 programmable function keys which are shaped to blend in with the cooling slots behind them. To the right of the main typing area is the editing section with 'Help', 'Undo', 'Insert' and 'Clear' keys as well as the four usual cursor-control keys. Finally to the right of the editing keys is a numeric keypad with all the usual mathematical functions and an 'Enter' key.

I liked the keyboard on this machine. The unit is wide enough to allow the different functional areas to be well spaced out, making it easy to find the key you want without risking hitting spurious ones. I also liked the feel of this keyboard. It dispells the QL myth that because you have a cheap machine, the keyboard must also automatically feel cheap.

Both the keyboard and the joystick (mouse) ports are controlled by a dedicated intelligent controller chip mounted underneath the keyboard base plate. The mouse movements simply return control codes into the keyboard buffer. This means that you can mimic the mouse movements from the keyboard if you need to.

The mouse itself is a stylish looking two-button affair. It plugs into one of the joystick ports via a standard 'D' plug. In use the mouse cursor movement was very smooth with none of the jerking that you find on some mouse systems.

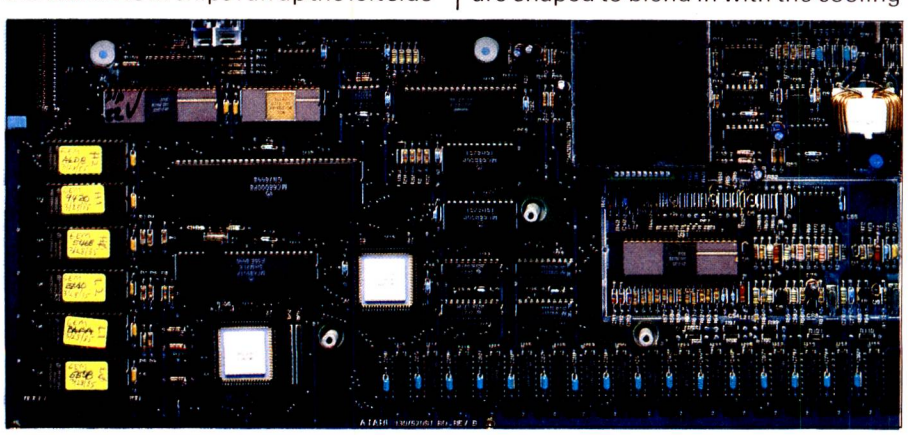
The 520ST is very well endowed with display facilities. In fact it boasts virtually every display standard going — TV modulator, RGB and composite video.

Atari has announced a wide range of monitors which are designed for use with the 520ST. Your choice of monitor governs the display resolution of the 520ST. If you use a domestic television, the resolution is 320 × 200 pixels with up to 16 colours on screen. If you use an RGB monitor, you can choose between low resolution (320 × 200 in 16 colours) or medium resolution (640 × 200 pixels in four colours). Finally if you use a composite video monitor, you can access the highest resolution of the machine (640 × 400 pixels in two colours, black and white).

Whichever monitor you use, the machine will automatically set itself to the correct resolution. I suspect that the majority of people will go for the medium resolution RGB monitor because it gives you access to either low resolution with lots of colour or medium resolution with four colours. Both of these modes allow you to produce very impressive graphics although GEM does look a little odd in lo-res.

I think that the hi-res black and white composite video monitor will only appeal to the dedicated Mac immitators and computer-aided design freaks among us. Having said that, I must admit that it was my personal favourite.

In addition to the straight RGB and composite monitors, Atari can also



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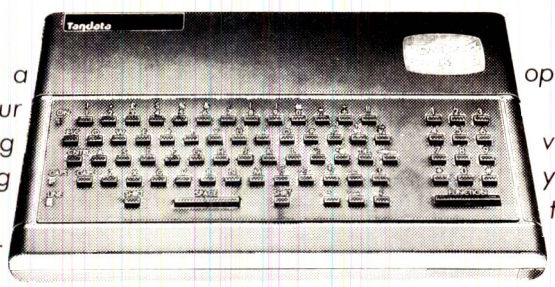

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supply a natty little monitor with built-in disk drive. This makes the 520ST system into a very neat desktop package.

System Software

The system software in the Atari 520ST works at two levels. On the top is a friendly Mac-like front and underneath is a fairly standard disk-operating system.

Both the front end and the disk operating system are supplied by Digital Research (DR). In fact Atari has licensed the entire range of DR's products ranging from operating systems through utilities to all its languages. So we can expect any advances by DR to be reflected in Atari products. Unlike most other disk-based machines both the DOS and the front end are contained in ROM. This allows the machine to go directly into its operating system on start-up without having to read from disk.

Although it is unlikely that the average user will ever want to descend into the DOS, I think it is a good idea to look at the front end and the DOS separately. The disk operating system on the Atari 520ST has been rather unfortunately named 'TOS'. This apparently stands for 'Tramiel Operating System' although I fail to see why anyone would want to operate a Tramiel.

Although its name is unlike any other operating system, TOS is actually based on Digital Research's CP/M-68k. This is a little-known and not very popular version of CP/M for the Motorola 68000 processor. The main difference between TOS and CP/M-68k lies in the area of file handling. TOS has a hierarchical file structure *à la* MS-DOS whereas standard CP/M-68k does not.

The command language of TOS is a strange hotch potch of CP/M, MS-DOS and Unix-like commands. When you enter the system level you are greated by a version of the familiar CP/M-DOS-style 'A' prompt. However, unlike CP/M you can enter path-names, play around with sub-directories, and the like.

Most of the old unfriendly CP/M commands are there with the addition of a few commands of uncertain parentage. You can type 'DIR' and get a directory, or you can type the Unix equivalent 'LS' to get the same result.

But as I said earlier, it is unlikely that anyone other than software developers will want or need the command-line functions of TOS. For most people the friendly front end will be the face of the 520ST.

Because it has licensed Digital Research's entire range of software, it was logical for Atari to use DR's GEM friendly front end for the 520ST. I have written quite a bit in past issues about GEM (see *PCW*, February 1985), so I'll just do a quick re-cap of the most interesting features here.

GEM stands for Graphics Environment Manager. It allows companies who use it to give their machines a user-friendly graphics interface which closely resembles that of the Macintosh.

This similarity extends to the use of movable re-sizable windows, ikons to represent objects such as disks and disk files, and the use of pull-down menus and mice. The GEM environment makes it much easier for the novice to do all the usual housekeeping chores as well as making it easier to call up programs from disk.

In addition to making life as easy as possible for the user, GEM also makes life comparatively easy for the applications programmer who wants to move his program from machine-to-machine. To understand this we need to look at how GEM works.

One of the functions of GEM is to provide a standardised interface to the graphics screen and graphics devices in much the same way as a disk operating system provides a standardised interface to the disks.

By using GEM, a programmer can write to this 'Virtual Device Interface' rather than having to go directly to the hardware of the specific machine he is writing for. This makes it much easier for the programmer to move his masterpiece to other machines which use the GEM environment.

Originally, Digital Research demonstrated GEM on the IBM PC, but it also works on compatibles and machines like ACT's Apricot range and the Atari.

GEM Desktop on the Atari looks very similar to GEM on most other machines. You have the disk ikons and trash can at the right of the screen, a menu bar along the top, and windows can be opened, closed and moved in the same way as on other GEM machines. However, as you would expect, because of its fast 68000 processor, GEM moves along with much more of a clip on the 520ST than it does on something like an IBM PC or an Apricot which can sometimes be quite slow — especially when updating more than one window at a time.

Atari has added a couple of desk acessories into the 'Desk' pull-down menu. These included a Macintosh-style 'Control Panel' which allows you to play around with some of the system settings such as the colours used to display the GEM Desktop. Atari has also included a simple terminal emulator and a utility to set up the RS232 serial port.

One of the nice features of GEM is that it adapts itself to the different specifications of the hardware it is running on. Consequently, as you would expect, there is quite a difference between the way it looks in the hi-res black and white mode to the lo-res colour modes.

Personally I liked the hi-res mode more than the colourful lo-res modes. Other people seem to prefer the colourful modes. In its hi-res black and white mode, GEM makes the 520ST look more like the Macintosh than any other GEM machine I have seen.

One nice feature of GEM on the 520ST is tht it allows you to have two logical disk ikons operative, even if you only have one physical disk drive atttached to the system. GEM treats them as separate disks and allows you to do all the things you would do on a twin-drive system by prompting you to change disks in the drive when necessary. I found this was extremely useful, especially when I was trying to copy disks.

Overall, the implementation of GEM on the Atari is very good. Having GEM in ROM makes the loading process much faster than the tedious rigmarole you have to go through to get it to load on something like the IBM PC. It also means that if the system bombs out for any reason, it goes to GEM as the base routine rather than some obscure monitor or suchlike.

Although the Atari implementation is good, what you can do with the GEM Desktop is still limited to some extent by the operating system underneath GEM.

Applications software

When the 520ST goes on sale, it will be supplied with GEM, Basic and Logo. At the time of writing there still seems to be some debate within Atari as to whether these will all be in the internal ROM or whether parts will be on disk. It seems likely that early machines will have software on disk for debugging purposes and later machines will have the software in ROM.

Both of the programming languages are again supplied by Digital Research. The Basic is its Personal Basic and the Logo is its DR Logo. Both of these products are widely available on other machines, although they have been modified somewhat for the Atrai machine.

In its usual form, Personal Basic is functionally very similar to standard Microsoft Basic. At the time of writing the Atari modifications were far from finished. The most obvious difference between the standard version and the Atari version is that the user interface has been changed. Whereas before you had a simple command line, there are now pull-down control menus, mouse control, and different windows for editing output and so on.

Eventually your Basic programs should be able to control the whole GEM user interface. So you should be able to write mouse-driven high resolution colour programs with lots of windows, bells and whistles. However, at the time of writing the only way to do this was by using loads of PEEKs,

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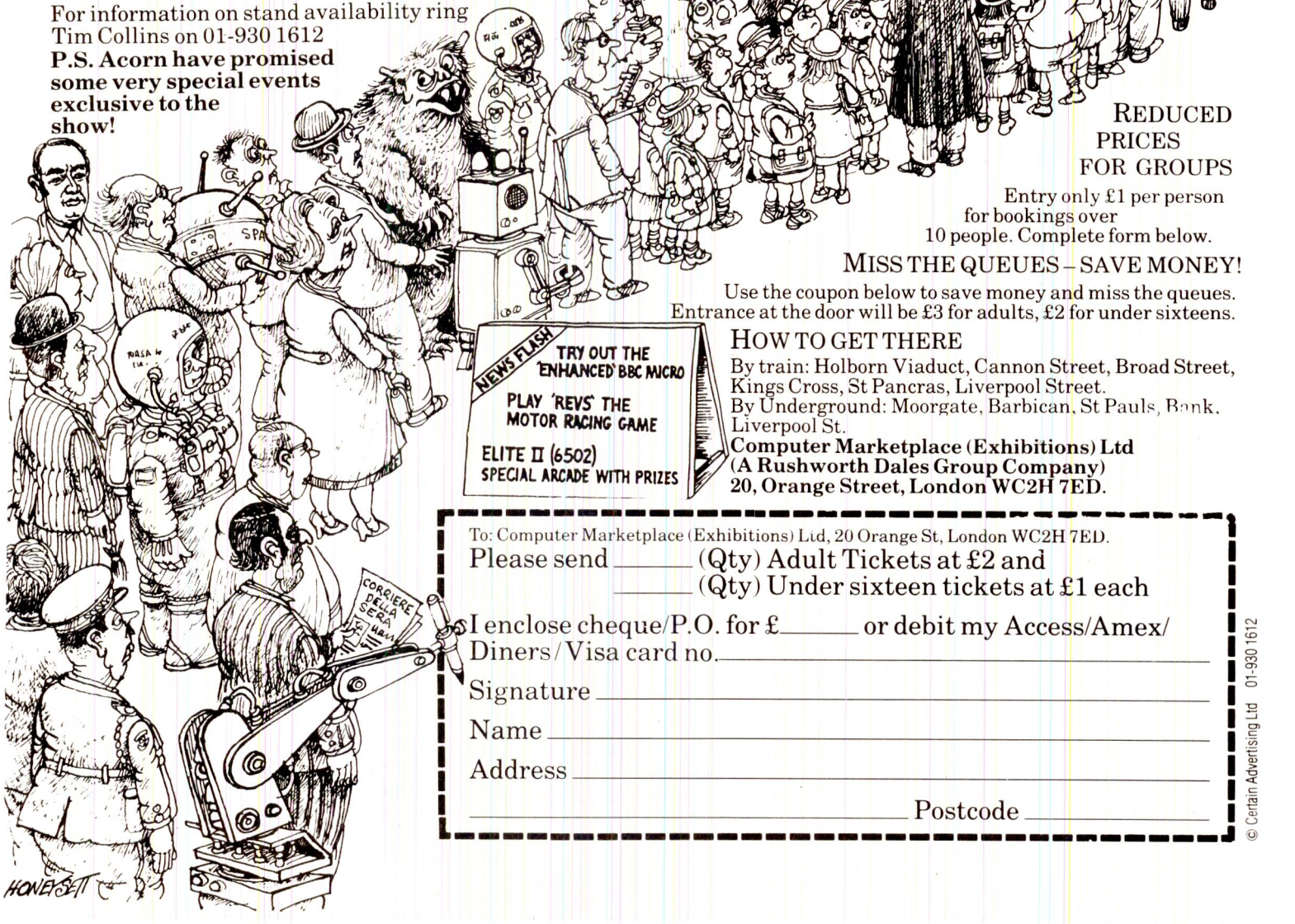

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POKEs and machine code CALLs. The people at Atari say that the release version will have extra keywords to control all these features. While I'm happy to believe them, remember that Jack Tramiel's last machine was the Commodore 64! Enough said.

The Atari version of DR Logo was in much better shape. DR Logo is a popular version of the language for CP/M and MS-DOS machines. Like the Basic, the user interface of DR Logo has been changed to take advantage of the user friendly GEM interface.

In the case of Logo there are different windows for commands, editing, output, and so on, with many options being available from the pull-down menu bar. So you can watch the turtle rushing around in one window while the debugger works through your program in another. Very pretty.

For the serious software developer, the most popular language is likely to be C. Most of GEM is written in C and Digital Research provides a full set of C bindings to GEM to make applications easier to develop.

A number of software developers seem to be taking advantage of GEMs Virtual Device Interface and developing software on IBM PCs and then downloading and re-compiling it on the Atari.

As far as finished applications packages are concerned, Atari says that it has sold over 100 development systems to US software houses and that they are beavering away converting their packages.

Only time will tell if this is true, but the Atari software guy did have a lot of interesting looking discs in his bag at Hanover.

Future products

Atari in general (and Tramiel in particular) seems adamant that the 520ST is just the start of a range of future enhanced machines. The most likely enhancement is more memory (although 512k seems enough for most purposes!) and the introduction of a local area network of some description.

Perhaps the most interesting new product however, is the addition of a CD ROM unit. We ran an article on CD ROMs a couple of months ago (see *PCW*, April 1985). They use the same kind of optical-digital compact disks as the home hi-fi systems except that the computer versions don't need the complex digital-to-analogue converters as in the audio units. Instead of carrying digitised audio signals, computer compact disks store digital computer data.

The main differences between compact disks and magnetic disks is that whereas you can get about 720k on a double-sided magnetic disk, you can get 550*megabytes* of data on one compact disk. The trouble is that whereas you can write to a magnetic disk, you can only read from a laser disk — hence the name CD ROM.

Atari plans to launch its CD reader for around $500 which is about half the price everyone else is charging. Its first piece of CD software will be a fully indexed (right-down-to-word-level!) multi-volume encyclopaedia on a single compact disk. This should get into the shops later this year.

Documentation

As this was a pre-production machine no documentation was available.

Prices

The 520ST with single 500k disk drive will sell for £699.99. Prices of the other peripherals in the range were still being discussed as we went to press.

Conclusion

There can be no doubt that the Atari 520ST is a very impressive machine.

From the technical viewpoint the machine seems to have everything going for it — good keyboard, lots of I/O facilities, lots of RAM and what, for many, is the nicest 16-bit processor around.

When you add in the GEM friendly user interface and the availability of cheap disk drives, you end up with a very impressive system indeed. I'm still not sure whether to classify it as a home or business machine. Its abilities are well suited to both. I have a feeling that in the US it will be treated more as a home machine and over here it will appeal to business users.

Having said that, it is a good machine, there are still two areas that you should think about before you rush off to your local Atari dealer to part with your hard earned cash.

The first is the availability of good applications software. It's a virtual certainty that Digital Research's word-processing and graphics applications programs will be available soon, as will Atari's Infinity integrated package. But I'm not so sure if or when third party applications will begin to appear. Remember, it took the best part of a year for applications to start appearing on the QL.

The second point to watch is the price of the system. The original 130ST was set to sell in the US for $399. This set people thinking that the range is cheap. While this is still true when you consider what you get, remember that the 130ST has been dropped and you are looking at about £700 for a 520ST and disk drive. When you add a monitor and other bits and pieces, you won't see much change out of £1000.

Even so, the bottom line is that when the machine appears in the shops, I'll be at the front of the queue to buy one. END

Technical specifications

Processor:	Motorola 68000 running at 8MHz
ROM:	192k containing O/S and GEM
RAM:	512k
Mass Storage:	500k or one megabyte (unformatted) 3½in micro-floppy disks, choice of hard disk capacities.
Keyboard:	94 keys including 10 function keys.
I/O:	RS232 serial, Centronics parallel, floppy disk, Winchester, TV video, RGB video, composite video, MIDI-in, MIDI-out, joystick, mouse, ROM cartridge
DOS:	TOS, GEM
Bundled software:	Personal Basic, DR Logo

In perspective

By the time you've got a 520ST, disk drive, monitor and so on, you are looking at a system that is just about below the magic £1000 price barrier. This puts the 520ST into competition with machines such as the Sinclair QL and the ACT Apricot F1 (or the even cheaper 'e' version).

As far as technical specification goes, the 520ST is far ahead of both these machines — it's got a better processor, more RAM and a friendlier user interface than either of them.

However, things get much closer when you look at the way these machines compare in terms of usability. This is especially true of the Apricot F1. Where the 520ST has a faster processor and more RAM, the Apricot F1 has access to a far wider range of applications programs. Both machines run (or are capable of running) GEM. The Apricot F1 has a 3½in disk drive built-in — the 520ST offers a cheap external 3½in drive. The more I think about it the more functionally similar the 520ST and Apricot F1 become.

The Atari 520ST is extremely competitive in the sub £1000 market. In terms of technical merit it is far ahead of the field. In terms of usability for the money, it beats the QL but the Apricot F1 comes very close.

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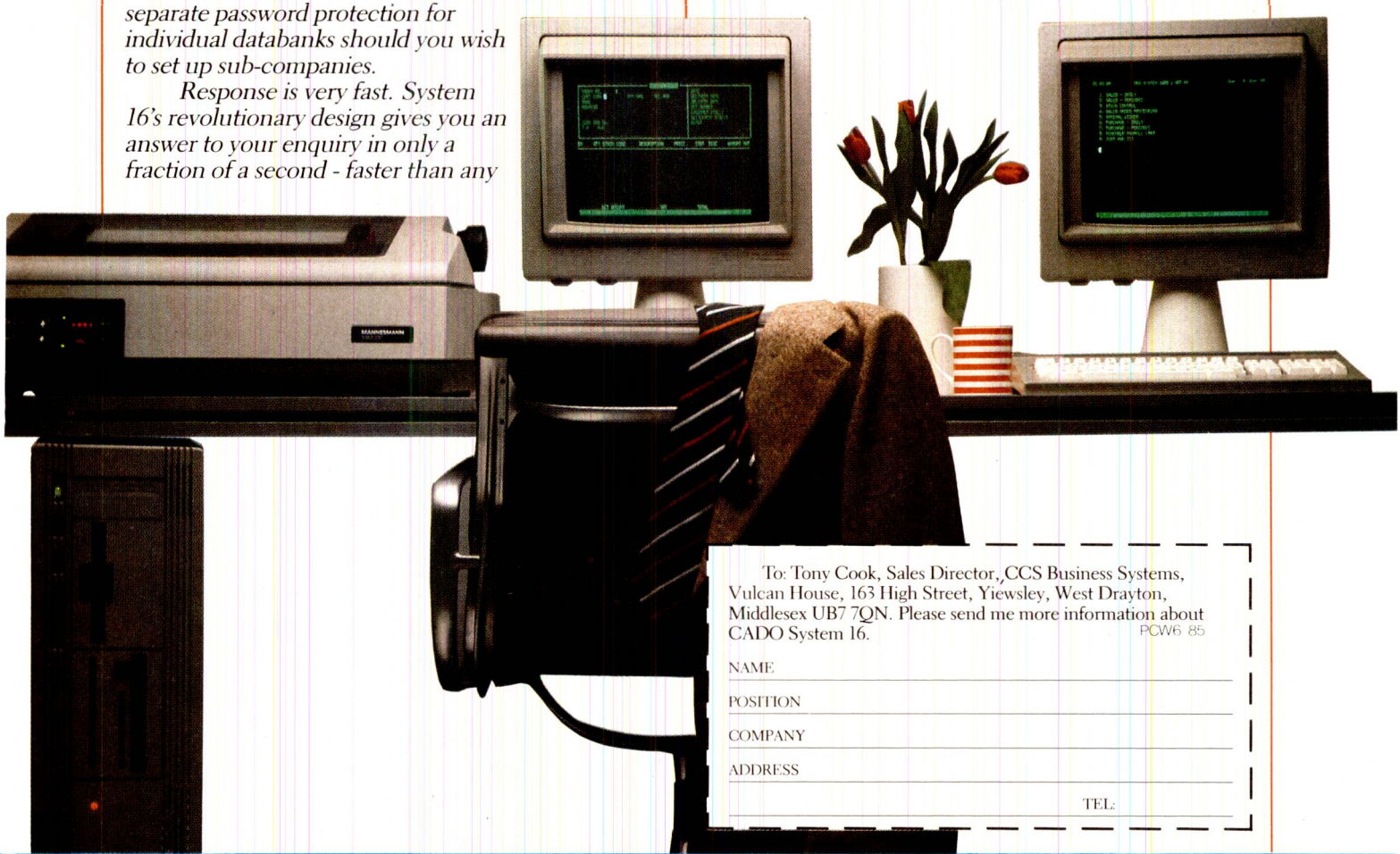

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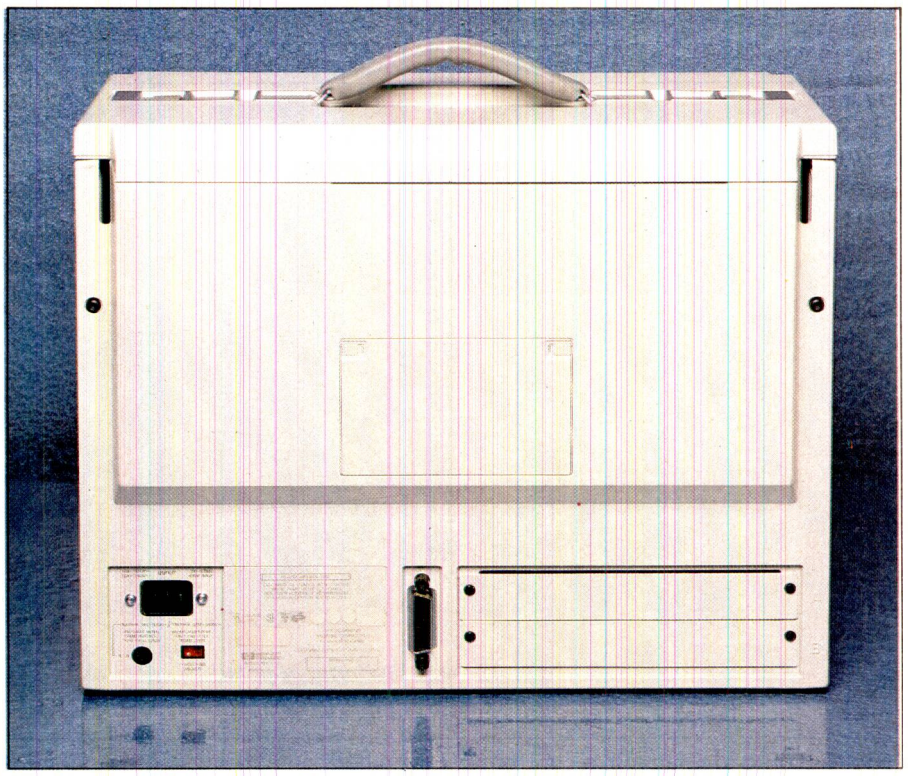
Hewlett-Packard Integral PC

Hewlett-Packard has attempted to build the ultimate portable — minicomputer specification and power in a compact, modern design. Nick Walker takes a look at the single-user, Unix-based Integral PC.





The Integral PC is encased in extremely durable hard, grey plastic

The Hewlett-Packard (HP) Integral Personal Computer has a specification that reads like a list of state-of-the-art micro-computer technology: 68000 processor with electroluminescent display; Think-Jet printer; 3½in microfloppy disk drive; and the Unix operating system.

I expected a large multi-user system with the traditional hefty Hewlett-Packard price tag. In fact, the machine is single-user and contained in one 25lb transportable box — the only thing I was right about was the price.

Hardware

At 25lbs and with physical dimensions similar to that of a sewing machine, the Integral is most definitely in the luggable category. It is smaller than other luggables, such as the Osborne, and fits comfortably on overhead shelves or under aircraft seats. When packed away the machine is encased in hard, grey plastic capable of taking the bumps and knocks of life on the road. HP went to some length to ensure the machine's durability, including dropping it from over three feet onto a solid floor.

To open the unit, slide two metal catches on the top outwards; the lid then slides back to reveal the printer. The keyboard detaches from the side, exposing the screen. You then plug in the keyboard at the front, mains power at the back and switch on. The first thing that strikes you is that the machine looks odd compared to other luggables. Due to the screen being so thin, the Integral can remain in its standing position (unlike other luggables that are tilted onto their side) so that it takes up considerably less desk space.

The Integral PC is based on a 16/32bit 68000 micro-processor running at 8MHz, supplemented with a 16-bit custom graphics processor. Standard RAM is 512k made up of 256k by 1-bit DRAM chips with no parity chips. This is expandable to 1.5Mbytes internally, or 5Mbytes by means of an expansion card on one of the expansion ports. An extra 32k of RAM is reserved for the display and graphics processor, and hence is not seen by the user. The ROM is a massive 256k containing the Unix operating system, a window manager and a user-friendly interface.

Within the case is an almost silent fan. HP claims that the Integral will work in extreme conditions (that is 40 degrees C and 80 per cent humidity).

The real centrepiece of this machine is the electroluminescent display, which is as slim as an LCD but much clearer, faster and quite readable in direct sunlight. Such displays are not common as they are still an emerging technology and hence expensive, and, more importantly for portable manufacturers, really require mains power.

The Integral can display a full-size 24 lines by 80 columns on its amber-only display. The screen itself measures 8 ins by 4 ins (twice the size of the Grid Compass display — the only other machine with the same screen technology) and when used graphically with its 512×255 bit-mapped pixels gives very high resolution. A number of fonts are provided for character displays, as well as a font editor to create your own. The viewing angle is adjusted by pulling the bottom of the display.

Only one true interface is available on the back of the machine, the (Hewlett-Packard) standard IEEE-488 HP-IB interface bus. To this can be added standard HP peripherals such as plotters or other HP printers. In addition, this port is designed to accept a wide range of instrument controllers as used on HP scientific computers. A bus expander is available to hook up more instruments and peripherals. Further I/O capabilities such as RS232 communication are available with the purchase of an additional I/O board which plugs into one of the two expansion ports (also used for adding external memory). The two small British Telecom-style jack plugs on the front of the machine conform to HP's protocol for human input devices HP-HIL (Hewlett-Packard Human Interface Loop); the keyboard plugs into one, leaving the other free for mouse, touch tablet or any other HP-HIL device.

The low-profile detachable keyboard is a full-size qwerty device with 90 keys including numeric keypad, eight function keys and numerous control keys. It has a good feel and a tilt mechanism at the rear to bring it to the right angle. The numeric keypad also has special functions which are accessed via the SHIFT key, such as delete line and insert character, and at its base are the cursor



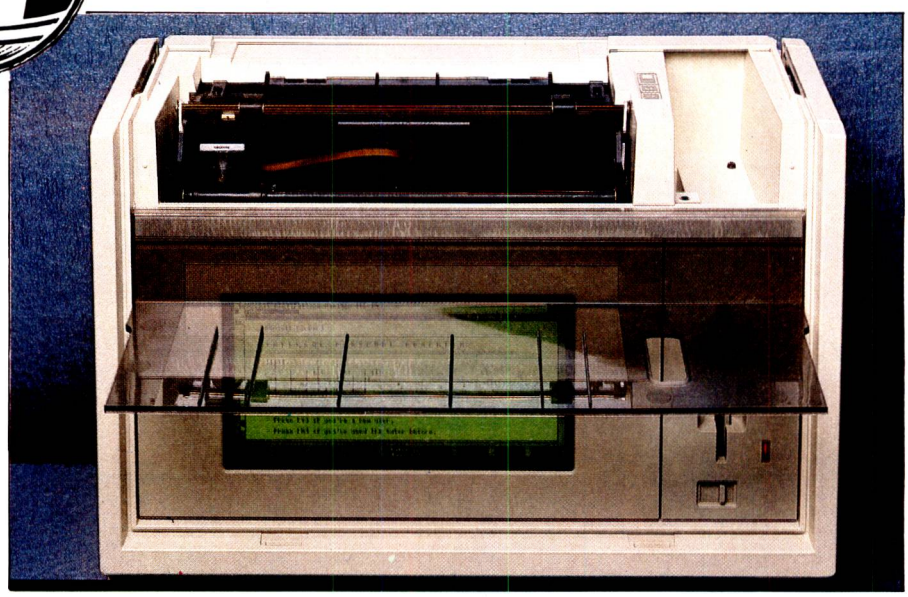
The back of the machine supports just one true interface — the standard IEEE-488 HP-IB bus

control keys. The integral also has a SELECT key, used to select the active window for human interaction; an EXTENDED key for special characters; a PRINT key to dump any screen to the printer. The RESET/BREAK and STOP keys are in the top left-hand corner out of harm's way. The keyboard is completely soft-mappable, with the current definition of the function keys shown on the bottom lines of the display.

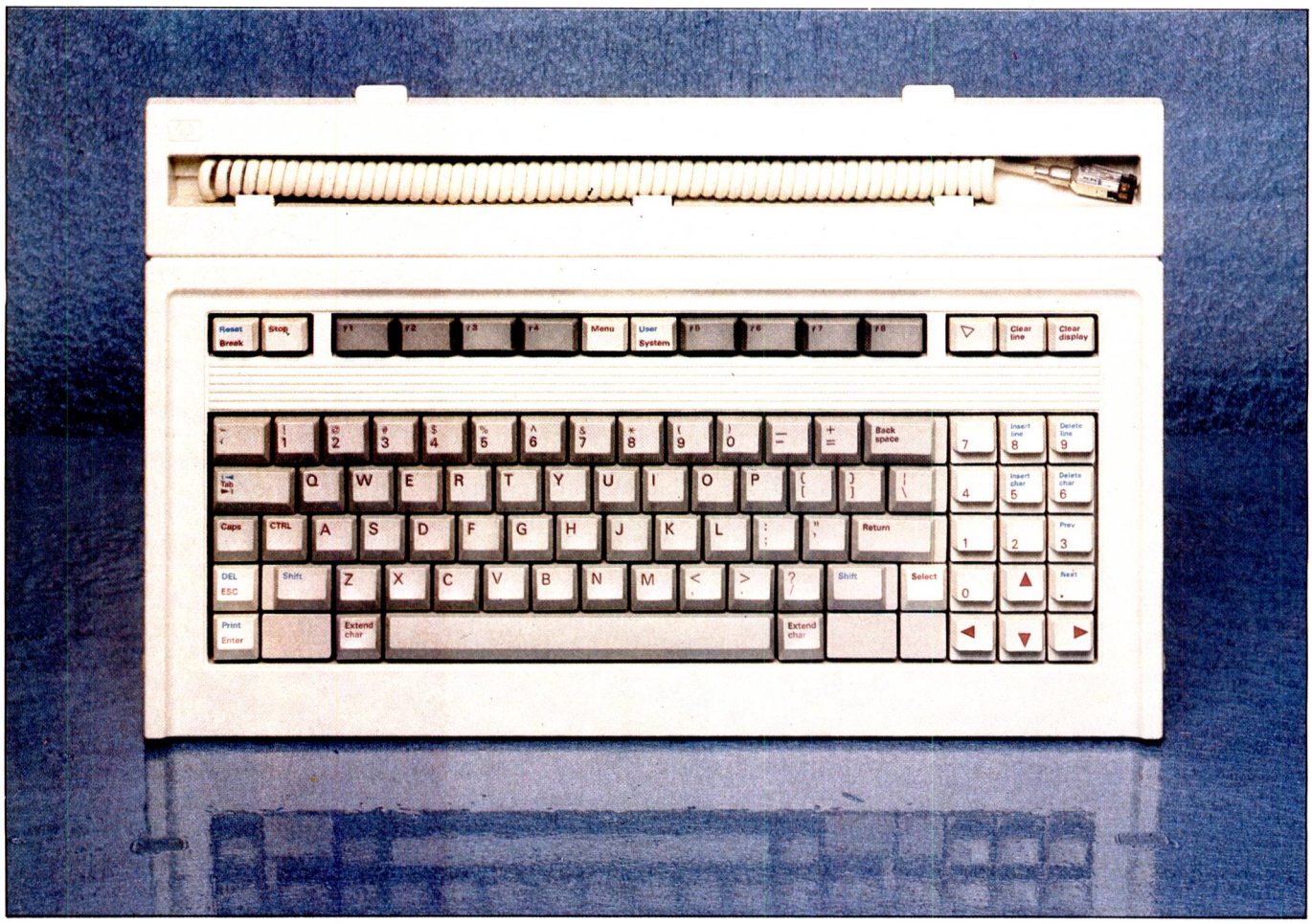
Probably the biggest disappointment on a machine of this price is that HP has only included one disk drive. This is a 3½in micro-floppy drive to the right of the screen with disks inserted at 90 degrees to the normal. Although the lack of a second drive was somewhat compensated for by the OS being entirely in ROM and the ability to define half of the available RAM as a RAM disk, I still missed a second drive. If the RAM was expanded to 1.5Mbytes and a reasonable amount was set aside for a RAM disk, the loss wouldn't be as bad. The Integral takes hard-sectored, double-sided, double-density disks with a total storage capacity of 710k per disk. You can have more mass storage externally right up to a 55Mbyte hard disk drive.

The Integral has a built-in HP Think-Jet printer which uses a sack of ink squirted onto the paper in a controlled manner. HP also sells this printer as a peripheral with a Centronics interface to hook on to an IBM PC, BBC or any other machine with a Centronics port. Before using the printer for the first time, you have to insert an ink sack complete with a strategically placed piece of blotting paper to catch the initial spurt of ink when the machine is switched on. The cartridge contains enough ink for 500 pages of text and the entire print head mechanism (a solid-state column of 12 individual squirters), so when you change the cartridge you also insert a new print head.

Although the printer will work with almost any paper, the mechanism is actually shooting droplets of ink at the paper, so very absorbent paper suffers



Inside: The Think-Jet printer and electroluminescent display



The low-profile detachable qwerty keyboard has 90 keys, a good feel and a tilt mechanism

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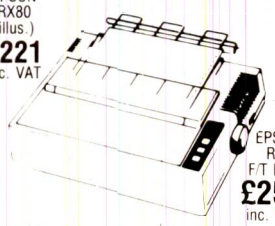

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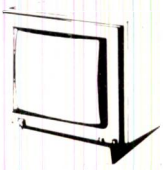

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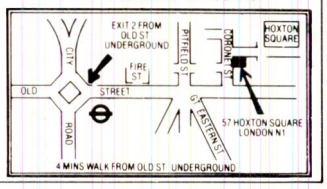

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from some fuzziness. HP supplies its own paper that works excellently. Two things about the paper loading annoyed me: firstly, a pile of paper behind the machine substantially increases the desk area used; and secondly, there is no platen knob so care is needed with the line-feed button.

In operation I was impressed by how quiet the printer was: there are no print head pins hitting the paper. It is also fast and flexible, printing at up to 150 characters a second in four different pitches. Graphics printing is supported, and any screen dumped will be printed accurately. The print quality falls between that of dot-matrix and daisy-wheel, and is certainly good enough for general letter-writing.

Electrical paths lead from each squirter to the front of the ink sack, where they meet with contacts on the carriage assembly. When the contact is activated, a small squirt of ink is projected from the ink sack to the paper.

The Think-Jet's four pitches are: normal 12 characters per inch(cpi) giving 80 characters per line; expanded six cpi giving 40 characters per line; compressed 21.3 cpi giving 142 characters per line; and 10.7 cpi giving 71 characters per line.

Each of these modes can be bold, underlined or both. Unlike dot-matrix printers that take multiple passes of the print head to print bold or underlined, the Think-Jet can do it in one, keeping its 150 characters per second print speed. You can also set the line spacing and the number of lines of text on each page.

A number of optional peripherals are available for the system including hard disks, laser printers, and plotters. The only optional peripheral with the review machine was the mouse, which I consider absolutely essential in order to use the windows and user-friendly interface. HP's mouse must rate as one of the most elegant designs with a circular hand grip and twin buttons. The only problem with the mouse is that the BT socket is to the left of the machine; for right-handed use,a cable stretches across the keyboard.

System software

Two levels of system software are supplied with the Integral — the underlying Unix environment and, on top of this, HP's own user-friendly Personal Application Manager (PAM). Formatting the output from these and other applications is a program called HP Windows. All three are all in ROM, including Unix.

The Unix supplied is an AT&T Bell Laboratories System III-compatible version called HP-UX 2.1, which is referred to in HP's literature as a 'vanilla' Unix environment. While the multi-user features of Unix are obviously lost on this machine, the multi-tasking features are not.

It is quite possible to be printing from one application while monitoring an instrument and updating a spreadsheet. I found no limit to the number of applications you can have running at one time, although the machine gets noticeably slower after about five or six. Even given all this, Unix does seem to be a case of overkill in a single-user micro. There is no way you can directly interact with the Unix ROM; to enter Unix commands, you need to run the HP-UX commands disk which gives you 32 standard Unix commands including the Berkley enhancement 'csh', a Unix C Shell.

'From the nature of the manuals and software developed, it is obvious that HP also sees the machine selling to business and first-time users.'

There are three other system software disks included: a utilities disk for performing standard system functions and system customisation; a diagnostic disk that tests all system components and reports any faults; and a system programming disk with the HP graphics language (HPGL), window and serial port drivers, and real-time extensions.

For users who use a mainframe system, the Integral can act as an intelligent terminal. You could then write source code on the mainframe, and download to the Integral to compile and run or *vice versa*. The Unix on the Integral is very flexible, as it can dynamically update itself through a RAM jump table. This gives the ability to emulate Xenix, System V and other Unix derivatives.

As a single user, it is rare that you will need to deal with Unix directly. All file manipulation and applications-running can be done from the Personal Application Manager (PAM), which is fundamentally the same front-end as found on the HP-150 but with some additions to incorporate the multi-tasking nature of the Integral and the operation within the window manager. The most significant advantage of PAM on the Integral over the HP is that all the software is in ROM, making it much faster and less cumbersome to use.

Upon the machine being switched on, PAM reads the disk drive, looks for installed applications and displays the names onscreen. The PAM window is divided into two sections. The upper portion, the command area, is where you issue commands and receive feedback from PAM. The lower portion, the folder area, displays the name of applications and data files. At the bottom of the screen is a user menu containing eight frequently-used file operations. Further system commands such as FORMAT are available on the system disk as PAM applications.

To run an application, you highlight the application name by mouse or by using the keyboard, and hit the function key corresponding to start (f1), again using either the mouse or the keyboard. A full description of PAM was featured in *PCW*'s review of the HP-150 (May 1984), so I'll just concentrate on those features specific to the Integral.

PAM on the Integral supports pipelining: that is, two or more programs can be connected, whereby the output from one acts as the input to another while running concurrently. This means you could have program A obtaining data from the user, which would be passed via the first pipe to program B where it would be checked for validity. The validated data could then be passed by the second pipe to program C for formatting into a report. This would be specified to PAM as: program-A / program-B / program-C.

Similarly, there are times when it is necessary to specify purely sequential processing, such as making a back-up of a disk. A program can be set to run by itself only by adding a semicolon to the end of the program name: that is, backup 1;.

Also in ROM is HP Windows; a window, graphics, mouse and function key interface. Although not of the same quality as that of the Macintosh, Windows does provide a natural environment for multi-tasking. Windows allows you to place, stretch, hide and shuffle multiple windows, and is much easier to use when operating with a mouse. The top window is the only one with which you can interface directly. Each window is in fact treated as a separate 9600 baud terminal with 80 columns and 20 lines, and uses the

Benchmarks Hewlett Packard Integral PC

BM1	1.9
BM2	3.5
BM3	6.9
BM4	7.1
BM5	8.8
BM6	18.3
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BM8	21.9
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All timings in seconds. For a full listing of the Benchmark programs, see page 185, January issue. Machine loaned by Proteck.

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Applications software

A number of software packages are now available for the Integral. These include Microsoft's Multiplan, Ashton-Tate's dBaseIII, HP's own Memomaker and Visicorp's TK!Solver. On the software development front there are a number of Unix development tools, the C programming language and Basic.

The Basic is HP's technical Basic which is a version of ANSI Basic with extensions for maths, graphics and instrument I/O. Basic programs written on the HP 85/86 and on series 200 and 500 machines will immediately run on the Integral. Applications written in C in a Unix environment can be downloaded and compiled on the Integral. The C provided can access a Device Independent Library (DIL) for high-level control of instruments. And real-time extensions available through HP-UX provide interrupt-handling and priority setting for multi-tasking instrument control environments.

More software is being developed, both by HP's own software division and by independent vendors. It is unlikely, however, that the machine will have as wide a range, or as competitive prices, as the IBM PC.

Six disks are bundled with the Integral: a tutor, a utilities disk, HP-UX commands, standard applications, diagnostics and a system disk. All except the standard applications are described in this review; standard applications furnishes you with two editors (font and text), three games and several alternative fonts.

Documentation

The Integral PC is supplied with two A5 manuals — a user guide and a comprehensive guide — and a tutorial on disk.

Both manuals are clearly written and well indexed. The user guide is a step-by-step guide to using the Integral, the comprehensive guide gives more information on each aspect of the machine. I found that the comprehensive guide didn't go far enough in explaining the technicalities of the system, and should have been supplemented with a reference manual.

Beginners would be advised to forget the documentation and plug in the tutorial disk. This tutorial covers everything in the user guide and takes an estimated eight hours to fully absorb. It is broken up into eight lessons with each lesson subsequently broken into chapters; subjects include file organisation, use of windows, printing and creating files. Generally it's very well done, but it has a rather American 'Isn't this amazing' style. The Integral's documentation also includes a cartoon booklet showing you how to set up and start, and also how to pack the machine away for transportation.

Prices

The Integral Personal Computer follows HP's tradition of high quality and high price it costs £5450. The optional mouse costs £152, and the Think-Jet printer on its own costs £550 with an HP interface or a Centronics interface.

Conclusion

I started this Benchtest with considerable doubts about the viability of a machine that uses Unix in ROM and which is designed purely for a single user. However, HP has created a machine that makes an awful lot of computer power easy to use. The windowing software makes multi-tasking a natural activity with no worries about task priorities, foreground/background tasks and scheduling. One week of using this machine and then returning to MS-DOS on an IBM PC really made me realise the power of Unix.

As for the possible market for the machine, it is hard to tell who will buy it. Certainly, computer scientists who use Unix now will appreciate the benefit of a complete, luggable Unix system. Similarly, scientists using HP's existing scientific computers will find it a logical upgrade. The multi-tasking facilities may well draw other users who have outgrown operating systems such as MS-DOS.

From the nature of the manuals and software developed, it is obvious that HP also sees the machine selling to business and first-time users. But with it's high price and limited and expensive software, I don't forsee many sales in this area. It may sell to those who want to find a way of switching to Unix at a reasonable price, or those who purely want to cast a vote against the IBM PC.

If nothing else, the Integral PC must be admired for it's all-in-one-box approach, the state-of-the-art technology, easy-to-use multi-tasking, high build quality, and the ingenuity that went into making Unix a ROM-based operating system. END

Technical specifications

Processor:	8MHz 68000 supplemented with 16-bit graphics processor
RAM:	512k (additional 32k for graphics)
ROM:	256k
Mass storage:	One 3½in 710k micro-floppy
Keyboard:	90 keys, numeric keypad and eight function keys
Size:	8½ins×13ins×17ins
Weight:	25lbs
I/O:	HP interface bus (HP-IB, IEEE-488), two expansion ports, two human interface loops (HP-HIL)
DOS:	HP-UX UNIX System III
Bundled Software:	Personal Application Manager (PAM) and HP Windows in ROM. Six disks containing Tutor, Utilities, HP-UX commands, Standard Applications, Diagnostic, System commands.
Peripherals:	Built-in Think-Jet printer.
Options:	RAM expandable to 1.5Mbyte internally, 5Mbyte externally. Hard disks, printers, plotters and I/O cards.

In perspective

There is little or no direct competition for the HP Integral PC. If it is purely considered as a single-disk transportable system, there is no doubt that it is very expensive, but that is comparing it with an MS-DOS transportable such as the Apricot or Compaq. If a Unix machine is what you are looking for, then this may well be the cheapest way of obtaining one with the added advantage of portability, although higher-priced Unix machines will be multi-user and higher performance.

As for its viability as a business transportable or professional beginner's machine, there are a number of IBM PC compatibles and MS-DOS transportables with a wealth of business software and a considerably lower price tag. Beginners looking for a particularly friendly business machine would do better with the Apple Macintosh, although the Integral is the friendliest way I've seen to introduce multi-tasking.

Where the Integral is really on its own is as a transportable for computer scientists and software engineers who work on a Unix mainframe, who could use it as a terminal at work and to develop software at home. Scientists planning to use its instrument control features would be well advised to look at the HP's lesser machines such as the HP-85 or 86 before paying extra for the Integral. But having said that, the Integral would be capable of monitoring far more complex experiments due to its multi-tasking nature.



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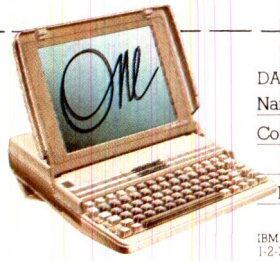

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Beating the system

A rags-to-riches story could be yours — Ken Barker applies random number generation to the problem of winning a fortune from casino blackjack.

Am I alone in feeling humbled, frustrated, humiliated even, by the enormous advances which have been made in computer games recently? Ten years ago I could sit down to a game of chess with any computer in the country, confident that it couldn't hold out for more than 10 minutes. But now I regularly get thrashed, not only at chess but at draughts, reversi, backgammon, go-moku — even Scrabble.

Is this really what computers were meant to do? Is mankind really destined to pour hours of concentrated effort into a sophisticated program just to emerge the loser? Surely, with all the number-crunching power of a modern machine, there must be a way of letting the computer do all the hard work so that we can improve our game.

Many's the time I've pondered this point as I sat brooding over a hand of cribbage — a game where there are many decisions to be made solely on probabilistic grounds. Could I program a computer, not simply to play cribbage itself, but to devise a strategy to improve my skill in ordinary face-to-face play?

The problem, of course, is lack of motivation: cribbage is a happy-go-lucky, time-wasting game, played for fun, not for blood. Writing thousands of lines of code to devise a world-beating strategy for cribbage would be like putting in hours of secret practice in order to beat your children at snap.

Last year, while browsing at a news stand, I picked up a booklet which contained the quote: 'Of all the casino games, blackjack is the one game where . . . you can actually turn the advantage in your favour by as much as 5%,' and immediately I knew that in blackjack I had found a game worth studying — and not just from the financial angle.

Blackjack is perfect for the kind of approach I had in mind. It is a 'one-sided' game, in the sense that the player plays against a banker who makes no independent decisions. There are situations which repeatedly occur in which the correct decision is far from obvious. There is only a limited choice of options at any given stage in the game, and because a pack of cards can be simulated using a random number generator, the correct strategy for any given situation is easy to determine with a computer. Ready to make my fortune, I bought some more books on the subject and sat down at my micro.

For those of you who have never been into a casino, let me summarise the British version of the rules of the game. Blackjack is a simple version of the card game known as 21 or pontoon, with a few changes to reduce the odds in favour of the bank. Each player places a bet, which can be any amount from the table minimum (typically £3) up to the maximum (typically £200), whereupon the dealer gives two cards to each player and one to himself. The players in turn then ask for as many extra cards as they wish, one at a time, until they either choose to stick with the hand they have, or the total of their cards exceeds 21 (picture cards counting as 10, aces as one or 11), in which case they are said to have 'bust' and they immediately lose their bet.

When all the players have either stuck or gone bust, the dealer plays his own hand. He plays in exactly the same way as the players except that (and this is the first main difference between pontoon and blackjack) the dealer must keep taking extra cards until his hand totals 17 or more, and then he must stick. There is therefore no skill in the game for the dealer: his actions are determined entirely by fixed rules.

If the dealer busts, he loses and pays all the players who have not themselves bust. If the dealer does not bust, he pays all the players with a higher total than his, and collects from those with a lower total. If there is a tie, no money changes hands — another difference from pontoon, where the dealer always wins tied hands.

As in pontoon, if you are dealt two cards of the same value, you can split the pair by doubling your bet and getting a new card on each of the originals; this rule creates more headaches when programming than any other rule of the game. You also have the option of doubling down, which means doubling your bet and receiving exactly one more card. There is no five-card trick in blackjack.

In blackjack, though, the odds are constantly changing. If you are dealt two aces on the first hand, the chances of you getting an ace on your second hand are smaller than they were previously because there are fewer aces in the pack. This is the basis of all winning systems. By watching the cards which have been played, you can get some measure of the odds against you. When your expected profit on a hand is negative, you bet the minimum; when the odds swing in your favour, you bet high.

A winning streak

The first player to make a winning system popular was Edward O Thorp in his book *Beat the Dealer*, first published in the early 1960s. Thorp's system caused such a stir in Las Vegas that the casinos changed the rules — only to change them back again when players refused to play under the new rules!

Other authors, programmers and mathematicians were quick to refine Thorp's strategy, and Las Vegas and the other gambling centres of the world were soon flooded with winning systems and skillful players (known as 'counters') who could use them. Before long it was impossible to use the strategies outlined in *Beat the Dealer*: every casino trained its personnel to watch out for anyone who made a minimum bet several times running and then for no apparent reason dramatically increased his bet. Such players were soon banned from the blackjack tables.

New strategies were devised which kept the bet range down in order to conceal the fact that a system was being used. When I decided to investigate blackjack there were several books available, all of them proclaiming their system as 'the best', 'the most effective', 'the least detectable under all playing conditions', and, invariably, 'computer-proven to be the most workable blackjack system available today'. But how to decide which to use? And just how effective are these systems anyway?

I started out by writing a 1500-line interactive program which took the part of the dealer while I played the game. Such a program would be fairly easy to test, fun to play around with, easy to modify into the number-cruncher which would do my analysis, and be useful for practice when I finally had my system designed.



I wrote it in Pascal, designed from the top down according to the best traditions of structured programming. I did this more for reasons of convenience than anything else, but was pleased to see structured programming vindicated. The program was as easy to test and debug as I had hoped, and I soon progressed to a version which took the part of both the player and the dealer, and which I could leave running overnight to produce statistically significant results.

The biggest problem was the difficulty in debugging a program which includes a pseudo random number generator. Most generators have a period of 2^{16} (that is, after generating 2^{16} numbers, the sequence of numbers repeats itself); as I intended to play several million hands of blackjack each night, I had to include a generator of my own.

Most random number generators are multiplicative: that is, each number is generated by multiplying the previous number by some suitable constant, adding another constant, and taking the remainder when divided by a third, fairly large constant, thus:

$X_{n+1} = (aX_n + c) \bmod m$

As each number depends only on the previous number, and since there are only m possible values for X_n, the sequence must start to repeat itself in less than m numbers.

I decided to use the additive random number generator of Mitchell and Moore. This works by adding two previous numbers from the sequence together according to the formula

$X_n = (X_{n-24} + X_{n-55}) \bmod m$

where the first 55 values are assigned arbitrarily, and the sequence is taken to be random from, say, X_{50000}.

As each number depends not just on the previous number but on the previous 55 numbers, it can be shown that the sequence has a period of at least $2^{55} - 1$ which is approximately 10^{15} — far more than I was ever likely to need.

An added bonus of writing my own code for the generator, rather than relying on the system's, was that I could

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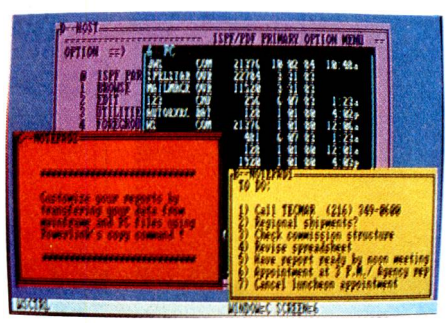

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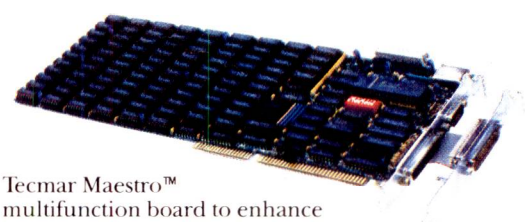

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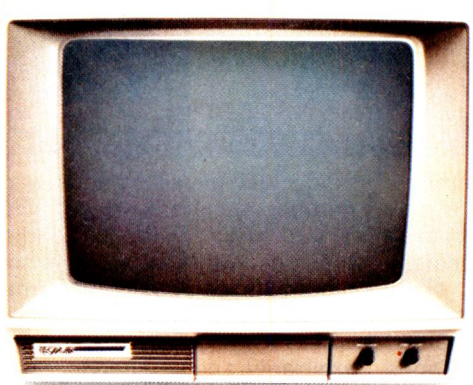

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write it so that it needed a 'seed' before it would run. This meant that on successive nights I could use different random numbers to simulate the shuffled pack of cards; it was simply a question of using a different seed when the program was initialised.

But there were problems which I was not expecting. The mathematician Von Neumann said that anyone who considers arithmetical methods of producing random digits is in a state of sin; after wasting several hours attempting to do just that, I was starting to believe him. Normally, when you debug a program, although the bug may take weeks, months, or even years to emerge, when it is finally spotted you can usually be certain that the program isn't running as it should, and the errors are repeatable. With random numbers, I discovered, there is such a thing as a probabilistic bug!

Debugging the program

When I first ran my program, the results appeared a little biased: the machine seemed to be dealing more picture cards than it ought to. I repeated the run each night for several nights, and found that sometimes the proportion of picture cards was higher than it should be, and sometimes it was lower — but there seemed to be rather more nights when there were too many picture cards than when there were too few. I carefully examined the code, but could find no coding errors. Eventually, I decided that I would have to analyse the results statistically.

I borrowed a textbook on probability which told me more than I wanted to know about chi-squared tests and other statistical tests to determine just how likely it is that the results of a random test really did occur by chance. After an hour's calculation I had found that the probability of my results could have occurred by chance, but the probability of this happening was only one chance in 20 — so it was 95 per cent certain that my program had a bug, but there was a five per cent chance that I had just been unlucky.

I had already run the program every night for a week, and was getting impatient to start playing in a casino — winning the vast fortune the books had promised me. Still, I reasoned, better to get the maths sorted out first and be sure of what you're doing.

A second week of calculation followed, with the machine buzzing and whirring all night, and the results this time still showed a slight bias towards picture cards but not as much as previously. I repeated the chi-squared tests and even after allowing for the previous run there was still a bug in the program, with 95 per cent probability.

I still don't know whether I was just unlucky or whether there really was a bug, because at this point I lost patience. I gave up on the code I had written and started with new code. It was still based on the Mitchell-Moore algorithm, but I structured the program differently, styling it so that I would be able to carry out the statistical tests faster. 10 test runs of the new routines went through the machine on the first evening. Nine of them gave results which were exceptionally close to the theoretical values, but to my deep dismay, test run number seven gave a result so unlikely it could only have occurred by chance once in every ten thousand runs.

After another thousand runs, all of which gave values exactly as the chi-squared tests said they should, I was satisfied that results as amazing as run number seven would only occur once every ten thousand runs, and it was just bad luck that I had turned up such a run so near the beginning of my tests.

The books all agreed that with a perfect playing strategy, the odds against you are about 0.67 per cent. As a final test of my program, I set it playing, using the strategy it had calculated for itself. After five days of machine time, the machine had played about six and a half million hands and the average loss per hand was 0.65 per cent, well within an acceptable margin of error.

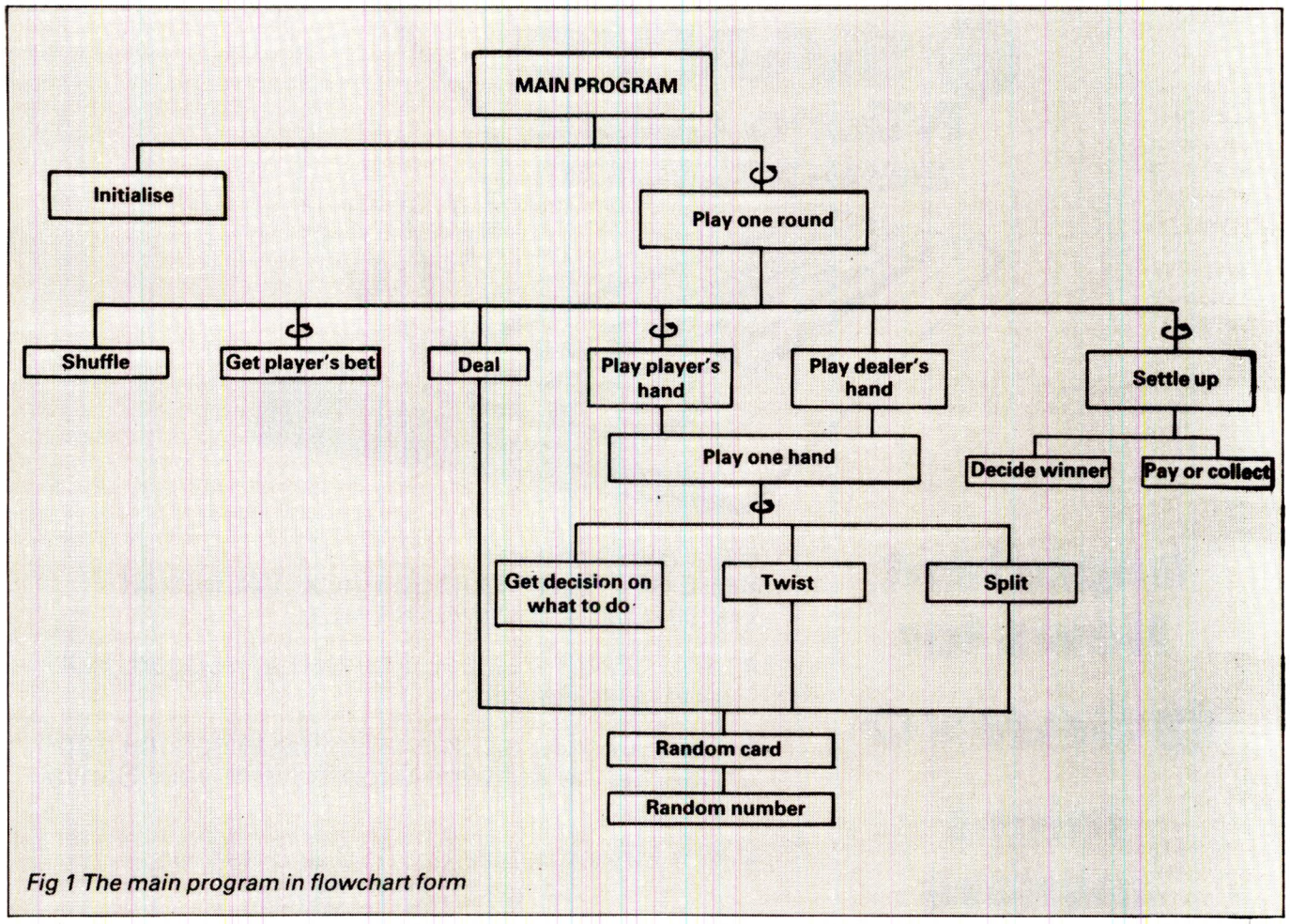

Fig 1 The main program in flowchart form

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The end was in sight. I had worked out the correct way to play the cards, and now all that was left was to determine how to decide when the pack is 'good' and thus when I should increase my bet, and when the pack is 'bad' so that the bet should be kept to a minimum. This proved to be the easiest and most interesting part of the whole experiment.

No-one can memorise exactly which cards have been played and simultaneously calculate how they affect the odds in your favour in a game of blackjack, so all winning systems use a simplified method which consists of assigning numerical values to each of the cards, positive if the card is good for the bank, and negative if the card is good for the player. By keeping a running total of all the cards played, the player can determine when the chance of winning the next hand is greater than zero, and thus when to increase his bet.

The question is: what are the best values to assign to the cards? Rather than let the computer attempt to find a system, I compared six different popular systems with one I created myself based on the knowledge I had acquired from my study of the game.

At least two of the books Revere and Canfield asserted that they had tested all the other systems on the market and analysed them by computer. As both of them said their system came out better than any other, I was particularly interested to see how well they fared.

After twelve million hands, the results were fairly conclusive. There was very little to choose between five of the systems (including my own, I was pleased to note). Thorp's system took sixth place, which, considering it was the first ever published and the foundation for all the others, is very creditable. Canfield's so-called 'expert system' came a very poor seventh.

Conclusion

And now the most important questions: how much can a card-counter expect to win? And why, if I have got such a great system, am I telling you all about it rather than going into a casino and making my fortune?

The answer to the second question is contained in the answer to the first. As I have explained, the amount you expect to win depends on the ratio of your maximum to minimum bet. If the ratio is too small, you won't win. If it's too big, casino personnel will spot what you're doing and throw you out. I can't offer advice on what is an acceptable level of betting, but from the experiences of Messrs Canfield, Revere, Thorp *et al*, you won't get away with a much bigger spread than 5:1.

The minimum bet in a typical casino is £3. So, assuming a 5:1 betting spread, you will need to bet £15 when the odds are in your favour. If you split a pair, you're now up to £30, and if you double on both of the two hands (and you must double if you don't want to sacrifice any of your profit) you could be betting as much as £60 on one hand. Playing this kind of money, there's little point in gambling at all unless you're prepared to lose at least £150 an hour.

But what about the profit? You only lose £150 an hour sometimes and at other times you win. On average, a winning system will win money — by definition.

Indeed, in the long-run, you will win. The books all agree (although they are rather elusive about how great your fortune will be) and my calculations agree with them — and the rate of winning (with a betting spread of 5:1) is no less than 0.3 per cent. In financial terms, this means that if your minimum bet is £3, and for which you are risking £150 an hour, you can expect a net profit of around 90p — and that's before tax!

For those of you who want to write a program to play blackjack, either to play the game against the machine as dealer or to check my results, here are a couple of tips to point you in the right direction.

Firstly, make sure you thoroughly understand all the rules you want to include, together with their implications, before you start to program. If you want to use the rules played in the UK, the only book I have discovered which explains them correctly is *A Book on Casino Blackjack* by CI Tulcea. Incidentally, this is one book whose results agree very closely with mine — of all the books I've mentioned, this is the only one I would recommend for serious study.

Secondly, I strongly recommend a top-down approach to writing the program. Start by breaking the main task into a few fairly big sub-tasks, each of which will be split into several smaller sub-tasks.

If you do this thoughtfully, the program can be written in several stages, with each stage being thoroughly tested before it is incorporated into the code. A flow diagram illustrates this approach (Fig 1).

Finally, despite all my testing, there's still the possibility of an error in my results. If you do write a blackjack program which gives results substantially different from mine, or if you can think of a new tactic to divert the casino from spotting a counter at work, then do let me know. **END**

Number of hands dealt	6518742
Hands dealt from 'good' decks	1034811
Hands dealt from 'bad' decks	5483931
Total loss (betting £1 per hand)	£36,672
Loss on 'bad' decks	£50,737
Profit on 'good' decks	£14,065
Average loss per hand	0.56 per cent = 0.56 pence per hand
Betting spread necessary to break even	3.6:1
Profit with betting spread of 5:1	0.3 per cent = 0.3 pence per hand

(The average loss of 0.67 per cent quoted in the article assumes a fixed playing strategy. By using a different strategy for good and bad decks, the loss can be reduced to 0.56 per cent.)

Fig 2 Assessment of strategy



'He might be a child prodigy, but he could let someone else have a go occasionally.'



Telesketch

The Telesketch is a combination of communications terminal and stand-alone micro, but does the UK market have room for its impressive specification? Stephen Applebaum takes a look.

The Telesketch is a machine with an identity crisis. On the one hand it is a communications terminal, while on the other it is a stand-alone computer with powerful graphics capabilities. The only way I can describe the Telesketch is as a kind of overpriced One Per Desk. In fact, the basic machine could cost some £800 more than the OPD, having a provisional price of somewhere between £1,800 and £2,000.

Hardware

I say the Telesketch is overpriced because unlike the OPD, and even some smaller personal micros such as the Amstrad, it does not come with any kind of storage device fitted as standard. Not even a mere cassette recorder. However, that aside, what you do get is a Motorola 6809E-based machine with a 512 × 384 pixel green-screen monitor, 64k of dynamic RAM, 16k of static RAM (expandable to 32k), 32k ROM (expandable to 128k), a Centronics interface, modem and telephone handset, and a very accurate light pen, all set into a compact 9ins × 10ins × 15ins case. For input, there is a qwerty-style keyboard which attaches to the main console via an ugly, short length of wire.

Although the review model was fitted with all its graphics and communications software, it lacked even the slightest hint of a progamming language. I was assured that if and when the machine goes on sale here in the UK, it will be fitted with either Basic or Forth (depending on the user's preference), plus a spreadsheet, as standard.

Externally the Telesketch is bizarre, looking like something out of an old sci-fi movie. In a groove, on top of the main console, sits the telephone handset, while the light pen sticks out of a receptacle in front of the screen. Also on the front is a small hole which leads to a microphone, enabling the machine to be used as one would an intercom, freeing the hands for making notes or lifting the odd cup of coffee.

On the rear of the unit are several interfaces and minor controls. Working from the left there is a brightness control, an expansion bus to which an interface box with a Centronics interface can be attached, a hand-set plug, a light pen socket, phone line plug and reset switch.

Unscrewing the Telesketch's bottom and lifting off the top uncovers a large PCB packed chock-a-block with chips. The RAM and ROM were immediately evident, as was an interesting, but obscure, custom chip. Towards the rear of the machine a mass of wire runs to a power supply and speaker, as well as running below the board to the monitor.

In use

Getting started with Telesketch is quite simple: you plug the unit into a telephone socket (like any hard-wired modem), plug into the mains and switch on.

Immediately after power-up, Telesketch goes into 'idle' mode. Idle, in this case, means that it can transmit and receive files to and from another Telesketch without any intervention from the user. By switching the unit into 'Auto-on' mode, the user can 'program' the machine to send a file at a preset time. This is done by storing a file in the system's catalogue, along with a time at which it is to be transmitted. A file need not consist only of text but can also be graphics, or a mixture of the two.

Lifting the light pen or hand-set switches the system into 'phone' mode. The screen changes to display a telephone touch-pad, volume control for the speaker, a directory of telephone numbers, a 'soft' keyboard for data entry using the light pen, and a menu along the bottom of the screen.

When in phone mode, Telesketch can be used in the same way as a normal phone with the additional facility of being able to send both graphics and text using a 'send' option. Unlike a normal phone, a number can be dialled onscreen using the touch-pad and light pen, or via the hand-set. To save time, numbers can be entered into the machine's telephone directory from the soft keyboard. Up to 40 numbers can be stored in the machine's battery-backed static RAM, being retained even when the machine is switched off. A number stored in this way can be automatically dialled by touching the appropriate box in the directory. If a number is engaged, a retry option enables Telesketch to redial the number up to 16 times at intervals of 30 seconds.

As mentioned, Telesketch features an onboard modem. By dialling up a public database and switching to terminal mode when the tone is heard, Telesketch can be used just like any other telephone and modem.

Both Bell 202 and CCITT V23 transmission requirements are supported, so bulletin boards cannot only be dialled within Europe, but in the US too. Both 300 and 1200 baud are supported by the modem, the latter not only being useful for logging onto boards such as Prestel, but also for talking to other Telesketches.

At the time of publication the Telesketch had not received BT approval, although there were no forseeable problems as to why it should not.

Operation modes

The menu at the bottom of the screen in phone mode gives access to five modes of operation: phone, draw, text, file and terminal.

In draw mode you can create pictures to send to other Telesketch users. The obvious machine to compare the Telesketch's graphics facilities with would be the Macintosh, as they are both in the same price bracket. However, close inspection shows that the two are worlds apart, each being equipped for very different uses. Whereas the Mac gives the 'arty' user full range with its different textures, paint sprays and so on, most of Telesketch's tools are based on simple mathematical figures, such as the square and the circle, and are orientated to the technical rather than the home/business market.

Just as in phone mode, all the various

drawing tools are selected from a menu along the bottom of the screen. Whereas Macintosh users have a mouse to control the cursor, the Telesketch uses one of the most accurate light pens on the market, resolving to plus or minus half a pixel. And when you consider that graphics can be drawn straight onto the screen with a greater degree of accuracy, it is a wonder how the mouse has become so successful.

True, we've all heard the reasons given by the big guns, such as Apple and Microsoft, as to why they have chosen to adopt the mouse rather than a light pen; the most obvious one being that it is more comfortable to use. But even this is overcome by the Telesketch's screen size. Every corner of the screen can be reached with the elbow resting on the desk, so there is little chance of contracting pins and needles through holding up your arm for too long.

Gamma Communications Corp, the manufacturer of the Telesketch, considers the light pen to be such a good product in its own right that it is anticipating selling it on its own, as well as with the Telesketch.

One of the beauties of the Telesketch is its ease of use, something that is highlighted by the draw option. For example, to draw a rectangle, all you do is touch the appropriate option in the menu with the light pen, and then pinpoint the lower-right, lower-left and top-left corners on the screen. The rectangle will then be drawn automatically, between the points. Practically the same method is used for drawing arcs, polygons and lines, as well as perfect vertical and horizontal lines. Text can also be input through the keyboard to annotate diagrams.

Unfortunately a FILL command is missing, but that can be rectified by using 'write', an option allowing very accurate free-hand drawing. And, if you make a mistake, single pixels or whole blocks can be removed with the aid of some neat erasing functions.

The third mode, 'text', provides the user with a crude word processor. Telesketch's manual points out that a document can be as long as 99 pages, although I would not like to use the machine for writing a full-blown article, mainly because the screen only operates in 40 columns and there is no word-wrap facility. The available functions, however, make the Telesketch perfect for letters and short notices.

Apart from the lack of a word-wrap facility, text mode is quite fun to use. 'Move' is an impressive little function which allows text to be transported from one part of the screen to another, simply by underlining it with the light pen and then touching a point on the display where you want it to reappear. 'Copy' works in much the same way, except this time the original text is left onscreen, unlike with 'move' which erases it.

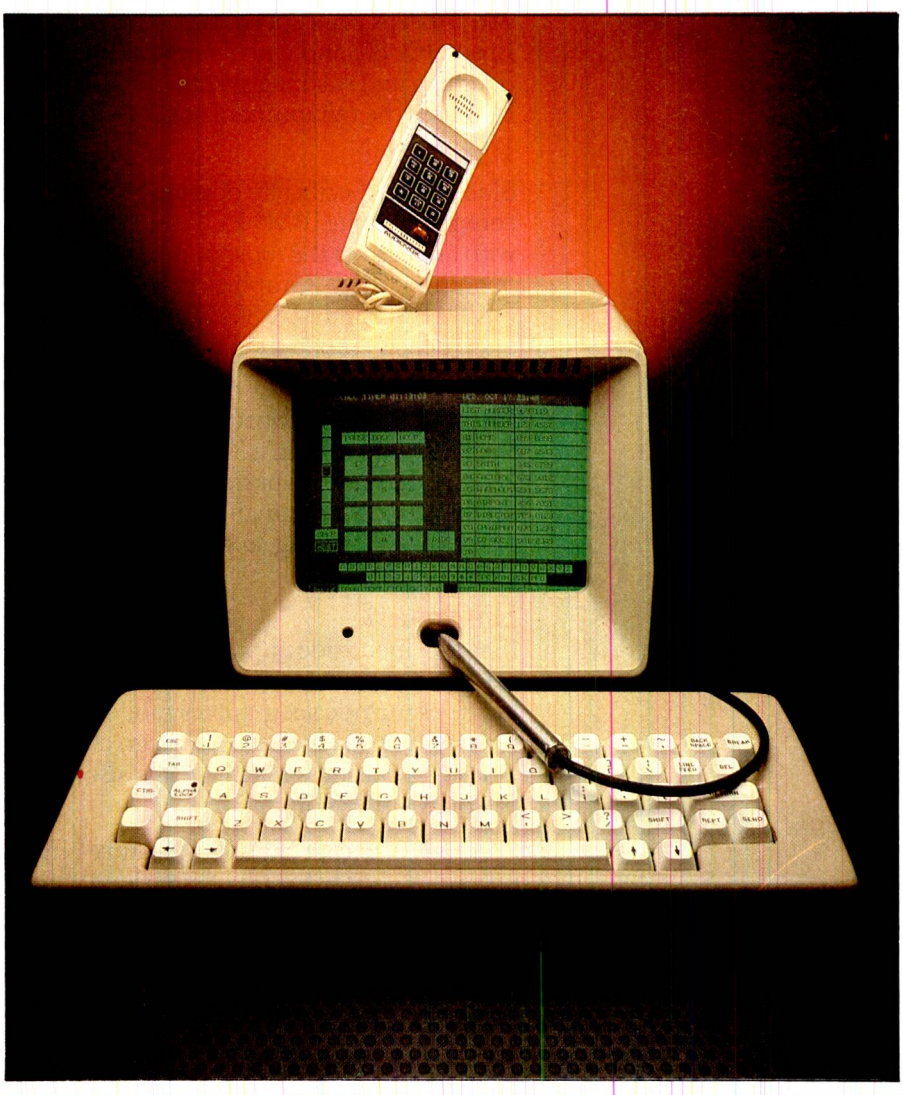
Several formatting functions such as 'justification', 'insert' and 'tab' are available, but as these are the only ones, text mode is not suitable for serious word processing.

One of Telesketch's fanciest features is the ability to send files containing either graphics or text down the line to another Telesketch. At any time during a phone call, one of the machines can be switched into 'file' mode, and one of the files in the machine's catalogue can be sent down the line to the user at the other end. This is a much quicker way of sending files than in text or draw mode, as it automatically transmits the whole document in one go, rather than page by page. It takes about 30 seconds to send four pages of text or graphics.

Of course, it isn't possible to talk while a document (or page) is being transmitted, because the two would then be using the same line.

Along with a document name. Telesketch's catalogue displays characters which indicate to the user the time at which a file was received, the phone number of the sender, and the type. Urgent files can even be marked with a code which causes a beep to go off at a specified time, thus reminding the receiver to read the message.

The fifth and final mode, 'terminal', literally turns the Telesketch into a stand-alone computer, utilising either Basic or Forth as its language. Unfortunately, terminal mode was not fully implemented on the evaluation model, although the functions available are no less than you would expect to find on a machine in this price bracket. One very Mac-ish feature is the inclusion of an onscreen calculator, which can be operated using the light pen. There is also a direct connection mode which allows the Telesketch to be linked to a mainframe via a bi-directional RS232 interface, some powerful editing functions and a terminal mode which uses the built-in modem.

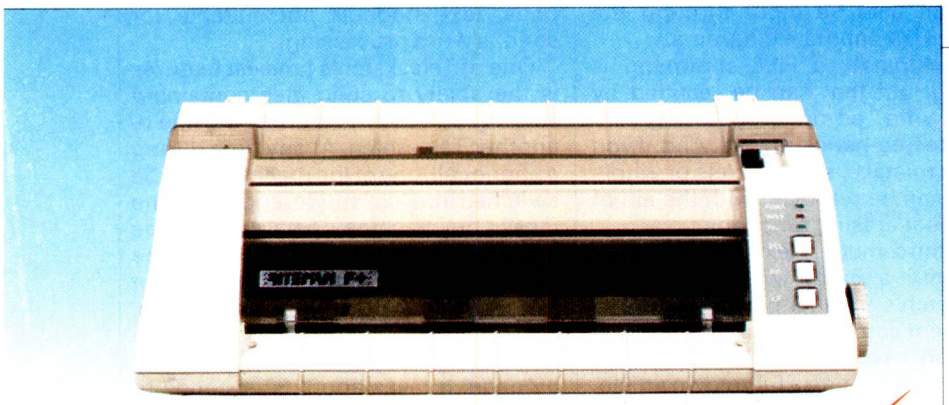


Conclusion

As it stands, the Telesketch is an excellent little machine although it is overpriced, even with its impressive specification. Several enhancements, including floppy disk operation software (the hardware is already fitted), bubble-pack software (the hardware is already present), a 640 × 480-resolution monitor, colour, a video digitiser, and various ROM-based packages, are planned. But until these are available, the Telesketch could have a very limited market in the UK.

Anyone who is interested in becoming a Telesketch dealer/distributor should contact Andrew Sheldon on (06928) 2468. END

:RITEMAN:



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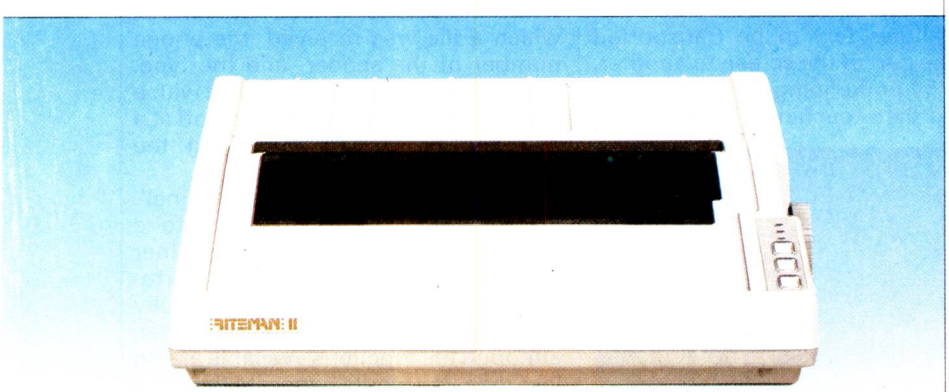

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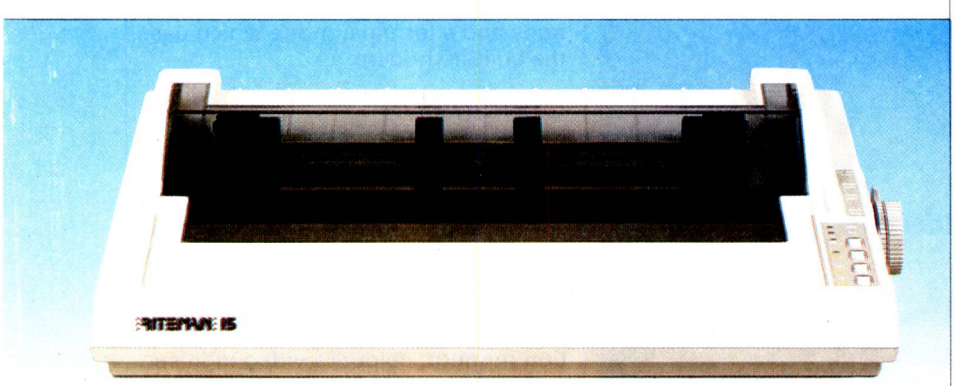

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Torch Graduate

Twin-disk, 256k IBM PC compatibility on a BBC Micro for £1000 seems an alluring offer, but is it possible? Jon Vogler tests the Torch Graduate.

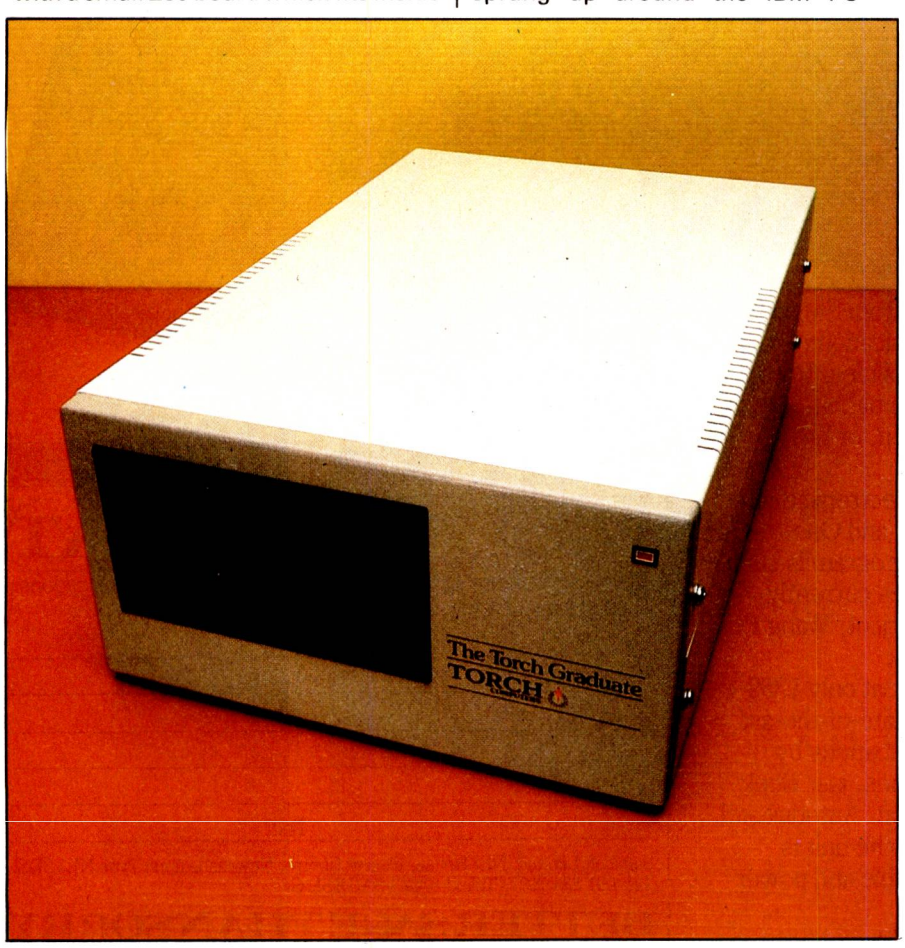
Within the close-knit tribe of Cambridge computer entrepreneurs, the name of Martin Vlieland-Boddy continually occurs. Joint-founder of Torch only a few years ago, he fell out with the financiers and left to set up Data Technologies Ltd, a small design and development company, whose first significant product was the Graduate. Data Technologies first advertised it a year ago, then — silence! No product appeared on dealers' shelves.

Delay-shocked users of BBC Micros had already been rescued once by Torch, whose Z80 second processor reached the showrooms long before its 'official' Acorn rival. Once again, Torch played the knight in shining armour.

The Torch range of micros begins with a small Z80 board which fits inside a standard BBC computer, giving CP/M capability and 64k of memory. It ends with a stylish business machine that hides enormous power: a massive 20Mbyte hard disk, coupled with a Motorola 68000 processor capable of running substantial multi-user systems; multi-tasking Unix and other high-power languages; and up to 1Mbyte of RAM.

However, there is still a lack (at least in the UK) of business applications software on Unix. Torch has hitherto deftly avoided challenging the giants in the MS-DOS arena. This policy has kept the company small but healthy. It has also left a noticeable gap in the product range: none of its products could run the 'sexy' executive software that has sprung up around the IBM PC — programs like Lotus, Framework, Symphony and dBaseIII. It was into this cavernous hole that the Graduate, with an MS-DOS operating system (so close to IBM's PC-DOS as to be virtually indistinguishable), and with quantities of random memory or memory expansion slots, fitted neatly.

Then Torch too misjudged how long it takes to convert a good design into stacks of boxes on dealers' shelves. It allowed advertising to continue and soon had a flood of orders — but no Graduates. It is now available without delay and has 256k of RAM, two 320k (formatted) disk drives, no variations and, bundled with an excellent suite of integrated Psion Xchange software, it sells at £999.99 plus VAT.



Hardware

The Graduate is a 6in-high steel box, 10ins wide and 16ins deep, in the front of which are dual Cannon disk drives. It is solidly constructed and pleasantly finished in two-tone hammer grey, and the top cover easily removes to permit service access. Inside are the disk drives. In operation these made a slight clanking sound. On one occasion a disk did not eject, but proved easy to ease out with fingers. Torch tells me that present production machines are using quieter, Epson disk drives. There is also a separate power supply (no more problems with the BBC overheating) and an acceptably silent cooling fan. A single, enormous, motherboard bears the 8088 16-bit processor running at 5MHz, and an array of RAM chips (the 256k can increase, with a standard expansion board, to 640k — adverts quoting 1.2Mbytes were in error); and two welcoming expansion slots. While this is less than the five on the IBM PC itself, Torch points out that, unlike the PC, you do not need to tie them up with colour graphics or printer ports: these are all provided by the BBC.

Access to the motherboard is restricted by the disks above it, but would only be required for repairs. The expansion slots are readily accessible.

A good feature is that the unit will operate as well on its side (with the disk

drives vertical) as on its four rubber feet. For many users this may be the most convenient arrangement. The 32-strand ribbon cable that plugs into the BBC's '1MHz' bus connector is just too short for the device to sit, on its feet, anywhere except just to the right of the BBC. I found it very convenient, on its side, to the right of the screen. To work with the Graduate the BBC needs no internal ROM fitting, so connecting up is a matter of a few seconds: insert the ribbon cable into the socket beneath the BBC's keyboard and plug the Graduate into the mains.

In use

Switch on the Graduate and it boots the MS-DOS operating system from disk. If no disk is present it 'looks down' the 1MHz bus, becomes confused, waits and eventually signals an error message. Put in the right disk and it boots MS-DOS forthwith. Press the BREAK key and it automatically re-boots. Jerky screen scrolling is due to the screen memory all being held in the Graduate box and having to come across the 1MHz bus; however, Torch informs me that, in current production machines, this problem has been overcome.

The commands are standard MS-DOS so, although many, such as COPY and DEL, are familiar, others will be a little strange to BBC users. For example, DIR for directory (equivalent to the BBC's CAT), while DIR/W spreads the directory across the screen width and stops it scrolling. BBC users will miss the Beeb's twin (text and graphics) cursor, so useful for copying text from higher up the screen. MS-DOS has only one cursor but offers instead soft keys that repeat either all or part of the last command typed in, which I found most inferior.

But what I grieved for most of all was the BBC's 32-line-deep screen. MS-DOS uses the pitiful IBM standard of only 25 lines and, with some software, even all this is not available. Psion's Xchange suite, for example, likes to use the top five lines as a 'control area' and the bottom three as a 'status area', which means you are down to virtually half a screen for text—quite inadequate when rapidly scrolling through a spreadsheet or trying to edit text. Using Perfect Writer's split screen, an invaluable aid to rapid text juggling, I was left with text areas no more than 10 lines deep. Very restrictive.

My other grouse is the lack of speed. It is not just the Graduate: a PC or a Compaq would be the same. MS-DOS on floppy disks is an awfully slow system. First there is the dreadful disk shuffling. Even the simplest command, such as COPY (a file from one disk to another) requires that MS-DOS has been loaded. I have become used to Torch's Z80 second processor, which employs a CP/M lookalike known as CPN. This holds the most vital commands in ROM so they are there at switch-on, even if no disks are in use. It also squeezes 400k from a double-sided floppy so I grieved for the loss of both time and file capacity. In practice, to save 'shuffling time', you would write an MS-DOS batch file to load automatically and also copy the essential file (called COMMAND.COM) onto virtually every disk in use, which would immediately absorb 16 or more Kbytes of the (already modest) 360k capacity disks.

Once loaded, disk operations and processing both seemed painfully drawn out. MS-DOS commands are clumsy too: for example, on Torch's Z80 I can change the screen background colour by typing B 2 RETURN whereas in MS-DOS you need COLOUR 0,2 RETURN. BBC users do not always realise that their machine, despite its despised tiny memory, is well-designed and impressively fast. The Graduate is no slower than any IBM PC, but it is nonetheless slow!

So far I have been critical of MS-DOS, but of course it has some capabilities not available in CP/M. There are definite compensations: the facility to 'pipe' output from one program to form the input of another, and the ability to redefine all the keys on the keyboard, are both powerful tools. The file structure is better organised than in CP/M. It grows, like a tree, so that in the main directory (catalogue) you can have sub-directories that can, in turn, themselves contain files or even other sub-directories. This is not of great value on a floppy disk system, where the number of files on a given disk is limited. But on a hard disk, with hundreds of files, it is invaluable. It is possible to hang an IBM-compatible hard disk onto the Graduate.

Limitations

The important question for would-be buyers is: 'If, to save about £1000, I buy a Graduate instead of an IBM PC, will it really do everything just as well?' The main shortfalls are some modest limitations of the keyboard and larger restrictions on the graphics. The former are easily overcome by simple combinations of keys with SHIFT and CONTROL, and are therefore insignificant. The screen was quite another matter.

The worst loss was of colour for serious applications software. The Graduate inherits the BBC Micro's inability to provide more than black and white in 80-column mode. In the past this was sufficient: serious business users stuck to monochrome because colour screens were too blurred. Although the IBM PC offers 16 colours in 80-column mode, only four of them can be onscreen at any time and users have accepted this. Now, with high-resolution screens at modest cost, all has altered.

I ran Thorn-EMI's exciting new version of Perfect software on both a PC and the Graduate. One of Perfect II's best features is that, when working on multiple texts or spreadsheets (up to 15 spreadsheets can reside in memory at the same time), you can paint each one different colours (both letters and background) which is an enormous aid to avoiding confusion, especially when using a split screen. On the PC they came out in glorious technicolour; on the Graduate only in black and white. (For more on Perfect II, see *PCW* May.)

The Graduate contains no screen controller; the display is produced by the 6845 video generator chip inside the BBC Micro. The IBM PC uses an identical chip. Its operation is controlled by an address register and a data register in the computer's main memory. However, with the Graduate system, the memory for the BBC's 6502 processor is quite separate from the memory of the 8088 second processor that makes it 'IBM-ish'. Programs such as Microsoft Flight Simulator, which expect to find a 6845 video generator in the memory of the 8088 chip, cannot be run.

But for serious business use, on a monochrome screen, I found little restriction. As well as Perfect II and Xchange I used the Graduate with Lotus 1-2-3 and WordStar, and it worked satisfactorily on them all.

Conclusion

I envisage two types of buyer: those without and those with a BBC Micro. Are the former likely to go out and buy the BBC and Graduate together? For around the same price they could purchase an IBM clone, such as the Ferranti Advance, which will apparently run anything which runs on the IBM PC, even the screen-related programs such as Flight Simulator. But the Advance comes with Perfect I, which many users find difficult and which has no graphics. A strong reason for buying the Graduate would be to obtain the Xchange suite of software on disk.

I have not discussed Psion's Xchange suite here because it has been fully reviewed in *PCW* before (October 1984). Let it suffice to say that it is an excellent suite: it's easy to use and very easy to swap data between the different facilities. I know of no other package, at this price, which would combine MS-DOS or equivalent capability with so excellent a suite of applications software.

The existing BBC business user, who wants to expand the power and memory of the BBC and run professional software, is the most likely customer. For him there are three alternatives:

— To buy the Acorn Z80 package, with its rather limited Plan business software, at £400.

— To buy the Torch Z80 with Perfect I software, or with Sage Accounts, for under £300.

— To buy the Graduate, with Xchange, for £1000.

Only those strapped for cash will choose the former options. The latter, offering access to PC software, is much more attractive. **END**



SCREENTEST

BCPL

John Dallman introduces the BCPL language, and gives an overview of its basic contents and usage with the help of comparison Benchmark results for the BBC and QL.

The imminent arrival on the QL of BCPL makes this an ideal time to reassess Acorn's BBC implementation — and indeed to introduce any unfamiliar readers to the power of one of the first portable programming languages.

BCPL is intended for use in writing 'systems' programs such as assemblers, compilers and operating systems. It was one of the first languages designed for this, and the better-known C language was developed from it.

BCPL is similar to C although much simpler, and forms a good introduction to it while also being rather easier to implement on a micro. Versions are currently available for the BBC Micro, the QL, and for CP/M-80, as well as many mini and mainframe computers. BCPL is highly portable, and programs can generally be run almost unchanged on different machines.

Of the languages widely known among micro users, BCPL most closely resembles Pascal as a structured language used via a compiler rather than an interpreter. It differs, however, from Pascal in one fundamental respect: where Pascal has several 'types' of data (for example, integer numbers, real (floating point) numbers, Booleans (logical values) and character strings) and prevents their mixing, BCPL has only one data type, the word. This is conceptually defined as simply a group of bits, of a size defined by the computer in use. In practice, it occupies several adjacent bytes of memory, and can be considered as a binary number.

Words usually occupy 16, 24 or 32 bits, depending on the computer in use. The contents of a word can be considered as an integer, as a logical value, or as a 'pointer'. As a pointer, the word holds the address of another word or a group of words (a vector). As a pointer can point to other pointers, this allows grouping of data in a manner very similar to the arrays used in other languages. While the contents of a word can take many meanings, these exist only in the mind of the programmer, and the language does not enforce them or even know of their existence. This almost gives the power of assembly language while retaining the virtues of high-level code.

Programming

A BCPL program consists of a set of procedures, and starts executing at the procedure START. A very simple BCPL program is therefore:

```
LET start () BE
$(
LET a,b,c = 3,4,?
c : = a + b
WRITES("Sum of 3 & 4 is ")
WRITEN(c)
$)
```

Variables and procedures are both declared with LET, and variables may be given initial values (here, a is given the value 3 and b is 4), or left undefined as c is in its declaration here. The standard library procedures WRITES and WRITEN are used to output strings and numbers. Note that ':=' is used for assigning a value to c, as opposed to the '=' of Basic. The section brackets '$(' and '$)' are used, like 'BEGIN' and 'END' in Pascal, to group commands together.

As well as normal arithmetic, BCPL provides remainder and shift operations such as those found in assembly language. Floating point numbers and operations are not part of the basic language, but are provided as groups of library procedures. BCPL is not intended for number-crunching, and these operations are not usually used in systems programing.

A vector of words can be declared as a variable:

```
LET atoz = VEC 26
```

or, for large vectors, by a library procedure, GETVEC. This requests an area of memory from a memory management system:

```
allchars := GETVEC(255)
```

The variables 'atoz' and 'allchars' in these examples hold the address in memory of the first word in the vector; the individual words are addressed by the indirection operator '!'. This will be familiar to users of BBC Basic and works in just the same way in BCPL, with the meaning 'access the word pointed to by my operands'. For example:

```
atoz!4 := 7
```

puts the value 7 in the fourth element of the vector 'atoz', and

```
allchars!'a' := 1
```

puts 1 into the word in the vector 'allchars' that is indicated by the ASCII code of 'a', the 97th. Data is read out of vectors in the same way:

```
ch.count := allchars!c
```

puts the c'th element, where c is a variable, into the variable 'ch.count'. BCPL will let you PEEK and POKE with '!' anywhere in the computer's memory, not just in vectors, but care must be used to avoid corrupting programs or data.

To test conditions, the IF and TEST statements are used:

```
IF ch = 'A'
THEN ch := 'a'
```

TEST is used when an ELSE clause is needed:

```
TEST ch < 'a'
THEN upper.case.chars :=
  upper.case. chars + 1
ELSE lower.case.chars :=
  lower.case.chars + 1
```

Complex tests are allowed, so that:

```
IF 'a' <= ch<= 'z'
THEN
$(
      ch := ch + 'a' - 'A'
      chars.converted :=
        chars.converted + 1
$)
```

```
File s.bm1:

SECTION "MAGNIFIER" // Benchmark 1

GET "TSTHDR" // Declares library

LET START() BE
$(
   LET a  =  ?

   WRCH('S')

   FOR count1 = 1 TO 10000
   DO
   $(
      a := 0
   $)

   WRCH('E')
   WRCH('*N')

$)
```

Benchmark 1

```
File s.bm2:

SECTION "FOR.LOOP" // Benchmark 2

GET "TSTHDR"  // Declares library

LET START() BE
$(
   LET a  =  ?

   WRCH('S')

   FOR count1 = 1 TO 10000
   DO
   $(
      a := 0

      FOR count2 = 1 TO 10
      DO
      $(
         a := 0
      $)
   $)

   WRCH('E')
   WRCH('*N')

$)
```

Benchmark 2

```
File s.bm3:

SECTION "WHILE.LOOP" // Benchmark 3

GET "TSTHDR"  // Declares library

LET START() BE
$(
   LET a  =  ?

   WRCH('S')

   FOR count1 = 1 TO 10000
   DO
   $(
      a := 0

      WHILE a < 10
      DO
      $(
         a := a + 1
      $)
   $)

   WRCH('E')
   WRCH('*N')

$)
```

Benchmark 3

```
File s.bm4:

SECTION "REPEAT.LOOP" // Benchmark 4

GET "TSTHDR"  // Declares library

LET START() BE
$(
   LET a  =  ?

   WRCH('S')

   FOR count1 = 1 TO 10000
   DO
   $(
      a := 0

      $(
         a := a + 1
      $)
      REPEATWHILE a <= 10

   $)

   WRCH('E')
   WRCH('*N')

$)
```

Benchmark 4

would recognise lower-case ASCII characters, convert them to upper case, and keep a count of the number converted.

BCPL also provides a range of structured loop forms which are best illustrated by the Benchmark examples, and a CASE statement.

Character strings are stored in a special fashion in BCPL. They are packed into words, as many bytes in a word as will fit. The words form a vector. The zero'th byte in the string holds the length of the string, and they are therefore normally at most 255 characters long. A variable may be attached to a string:

string. name := "I'm a string"

and holds the address of the first word of the vector holding the string. Strings are manipulated either by procedures, usually called GETBYTE and PUTBYTE, or by the '%' operator. This is just like the '!' operator, but accesses a vector in terms of bytes rather than words. For example:

ch := "another string" % 4

puts the ASCII value of 't' into the variable ch, as would

string.var := "another string"

ch := string.var % 4

the two pieces of code having exactly the same effect.

Procedures are called by name, followed by a list of parameters in brackets. Like BBC Basic, copies of the values of parameters are passed, but there is no check on the number of parameters passed. Vectors can be passed simply by passing their address, and the address of a simple variable can be passed using the '@' operator which returns the address of its operand. Therefore:

a:=@b

!a:=44

puts 44 into b by using the address in a. Procedures may be called recursively, and functions may be created.

Input and output in BCPL are achieved through procedures which manipulate I/O channels (called streams) in a manner similar to most micros. There is at any time a single input and single output stream in use, although many streams may be used by a program one at a time. Random access filing is not part of the standard language, but a standard form exists for a set of procedures to provide it.

In use

An important concept in the design of BCPL is a mechanism for linking together sections of a program compiled in several pieces. This is done by means of the 'global vector', a vector provided by the language system rather than being created by the programmer.

This vector holds the start addresses of procedures that have been made global. This is done by declaring the name of the procedure and allocating it a word of the global vector to hold it's address, thus;

```
File s.bm5:

SECTION "NO.PARAMETERS" // Benchmark 5

GET "TSTHDR"  // Declares library

LET proc1() BE
$(
   RETURN
$)

LET START() BE
$(
   LET a  =  ?

   WRCH('S')

   FOR count1 = 1 TO 10000
   DO
   $(
      a := 0

      proc1()
   $)

   WRCH('E')
   WRCH('*N')

$)
```

Benchmark 5

```
File s.bm6:

SECTION "ONE.PARAMETER" // Benchmark 6

GET "TSTHDR"  // Declares library

LET proc1(param) BE
$(
   RETURN
$)

LET START() BE
$(
   LET a  =  ?

   WRCH('S')

   FOR count1 = 1 TO 10000
   DO
   $(
      a := 0

      proc1(a)
   $)

   WRCH('E')
   WRCH('*N')

$)
```

Benchmark 6

```
File s.bm7:

SECTION "MANY.PARAMETERS" // Benchmark 7

GET "TSTHDR"  // Declares library

LET proc1(a,b,c,d,e,f,g,h,i,j) BE
$(
   RETURN
$)

LET START() BE
$(
   LET a  =  ?

   WRCH('S')

   FOR count1 = 1 TO 10000
   DO
   $(
      a := 0

      proc1(a,a,a,a,a,a,a,a,a,a)
   $)

   WRCH('E')
   WRCH('*N')

$)
```

Benchmark 7

```
File s.bm8:

SECTION "CONST.TO.STACK" // Benchmark 8

GET "TSTHDR"  // Declares library

LET START() BE
$(
   LET a,b  =  ?,?

   WRCH('S')

   FOR count1 = 1 TO 10000
   DO
   $(
      a := 0
      b := 77
   $)

   WRCH('E')
   WRCH('*N')

$)
```

Benchmark 8



SCREENTEST

```
File s.bm9:

SECTION "STACK.TO.STACK" // Benchmark 9

GET "TSTHDR"  // Declares library


LET START() BE
$(
   LET a,b  =  ?,?

   WRCH('S')

   FOR count1 = 1 TO 10000
   DO
   $(
      a := 0
      b := 1
      b := a
   $)

   WRCH('E')
   WRCH('*N')

$)
```

Benchmark 9

```
File s.bm10:

SECTION "CONST.TO.STACK.VECTOR" // Benchmark 10

GET "TSTHDR"  // Declares library


LET S[illegible] BE
$(
[illegible]
```

Benchmark 10

```
File s.bm11:

SECTION "CONST.TO.HEAP.VECTOR" // Benchmark 11

GET "TSTHDR"  // Declares library


LET START() BE
$(
   LET a,b  =  ?,?

   b := GETVEC(9)

   WRCH('S')

   FOR count1 = 1 TO 10000
   DO
   $(
      a := 0
      FOR count2 = 0 TO 9
      DO
      $(
         b!count2 := 0
      $)
   $)

   WRCH('E')
   WRCH('*N')

$)
```

Benchmark 11

```
File s.bm12:

SECTION "IF.TRUE" // Benchmark 12

GET "TSTHDR"  // Declares library


LET START() BE
$(
   LET a  =  ?

   WRCH('S')

   FOR count1 = 1 TO 10000
   DO
   $(
      a := 0
      FOR count2 = 0 TO 9
      DO
      $(
         IF count2 < 10
         THEN a := 0

      $)
   $)

   WRCH('E')
   WRCH('*N')

$)
```

Benchmark 12

GLOBAL $(this.procedure: 100 $) allocates word 100 of the global vector to hold the address of the procedure 'this.procedure'. Procedures from the library supplied with the language are allocated specific words within the global vector, so that the program only has to know which word they are allocated to rather than containing the source code of all the library procedures it needs.

The global declarations required in a program are normally put into a header file, which can be included by the compiler, with the 'GET' directive. The way in which a program indicates which library procedures it needs, and which other sections of the program are required, is dependent on the implementation. The language defines a way of giving a section of program a name with the SECTION directive as illustrated in the Benchmark programs, so that it can be selected from a library itself.

The language is intended to be portable, and this is made easier by the provision of a standard compiler. This is written in BCPL and produces an intermediate code called O-code. To move the language to a new machine from one on which it is already available, it is only necessary to write a back-end for the compiler to generate the appropriate machine code from the O-code, in BCPL. The compiler can then compile a version of itself to run on the new machine. (This route was followed by the implementors of both systems reviewed here).

Benchmarks

The Benchmark suite featured here was designed to test the major constructs of the language in a similar way to the Basic (January 1985) and Pascal (December 1984) Benchmarks used by *PCW*. Like the Pascal Benchmarks, they are for 10000 loops. The raw Benchmark figures are strongly influenced by the time for the FOR loop construct, which is a legacy of the original Basic Benchmarks. In both BCPL and Pascal the other loops are used at least as frequently, and more meaningful results can be obtained by subtracting the MAGNIFIER or FOR.LOOP times from other Benchmark values.

In comparing the BBC and QL Benchmark results (Fig 1), it should be noted that the BBC not only has a far less powerful CPU but is running an inter-

```
File s.bm13:

SECTION "IF.FALSE" // Benchmark 13

GET "TSTHDR"  // Declares library


LET START() BE
$(
   LET a  =  ?

   WRCH('S')

   FOR count1 = 1 TO 10000
   DO
   $(
      a := 0
      FOR count2 = 0 TO 9
      DO
      $(
         IF count2 > 10
         THEN a := 0

      $)
   $)

   WRCH('E')
   WRCH('*N')

$)
```

Benchmark 13

```
File s.bm14:

SECTION "TEST.TRUE" // Benchmark 14

GET "TSTHDR"  // Declares library


LET START() BE
$(
   LET a  =  ?

   WRCH('S')

   FOR count1 = 1 TO 10000
   DO
   $(
      a := 0
      FOR count2 = 0 TO 9
      DO
      $(
         TEST  count2 < 10
         THEN a := 0
         ELSE a := 1

      $)
   $)

   WRCH('E')
   WRCH('*N')

$)
```

Benchmark 14

```
File s.bm15:

SECTION "TEST.MIXED" // Benchmark 15

GET "TSTHDR"  // Declares library


LET START() BE
$(
   LET a  =  ?

   WRCH('S')

   FOR count1 = 1 TO 10000
   DO
   $(
      a := 0
      FOR count2 = 0 TO 9
      DO
      $(
         TEST  count2 < 5
         THEN a := 0
         ELSE a := 1

      $)
   $)

   WRCH('E')
   WRCH('*N')

$)
```

Benchmark 15

```
File s.bm16:

SECTION "STACK.ARITHMETIC" // Benchmark 16

GET "TSTHDR"  // Declares library


LET START() BE
$(
   LET a,b  =  ?,3

   WRCH('S')

   FOR count1 = 1 TO 10000
   DO
   $(
      a := count1 / count1 * b + count1 - count1
   $)

   WRCH('E')
   WRCH('*N')

$)
```

Benchmark 16

preter, while the QL is running 68008 machine code directly. The BBC's interpreted language is Cintcode, the machine code of an imaginary 16-bit processor optimised for running BCPL, and is similar in essence to Pascal p-Code as used in the UCSD p-System.

The QL is, accordingly, considerably faster, notably in looping and conditional tests. The advantage is less marked in data moves and procedure calls, and surprisingly small in arithmetic. These Benchmarks can be affected by the compiler's ability in optimising, but in the STACK.ARITHMETIC Benchmark, which is most resistant to this, the QL is only 2.5 times faster. Admittedly it is doing 32-bit arithmetic, but there are hardware multiply and divide instructions on the 68008 which should more than restore that disadvantage.

```
File s.bm17:

SECTION "CONST.ARITHMETIC" // Benchmark 17

GET "TSTHDR"  // Declares library

LET START() BE
$(
   LET a  =  7

   WRCH('B')

   FOR count1 = 1 TO 10000
   DO
   $(
      a := count1 * 2 / 3 + 4 - 5
   $)

   WRCH('E')
   WRCH('*N')

$)
```

Benchmark 17

Accessing program sizes is rather difficult, given the different operating systems on the two machines. Differences, rather than absolute sizes, are again more useful. Cintcode is intrinisically more compact than the 68008 instruction set as all the operation codes are one, rather than two, bytes long, and only 16-bit rather than 32-bit addresses and embedded within the code. The code sizes given exclude procedure libraries required to run the programs.

Both compilers include the names of sections and of each procedure in the final code as text strings (10 bytes on the BBC, eight on the QL) for use in debugging. If space is short, they can be compiled out on the BBC.

No figures have been given for compilation times as these depend on the filing system in use. Compiling between Microdrives is very slow, but disks or RAM expansion will improve it. The BBC has no standard disk drive, and there was no point in giving times for my own rather slow system.

Implementations

Acornsoft BCPL

This was created by Richards Computer Products Ltd for Acornsoft, and is marketed as a BBC language ROM and a utility disk. The language ROM contains the Cintcode interpreter and a procedure library, while the disk holds the BCPL compiler, two editors, further libraries, debugging utilities, an assembler and example programs. A front-end environment from which programs may be run and operating system commands used is provided, along with some utility commands, by the language ROM.

The linkage of programs from separately compiled sections is rather unusual. Cintcode is stored in a relocatable form, and is located by the language ROM (and linked to the global vector) when a program is loaded. Consequently, sections are 'linked' by the user who is copying them into the same file without internal changes being made in them. If a few sections are to be extracted from a large library, the NEEDS compiler directive can be used to mark the required sections in the source file, and a utility program (NEEDCIN) supplied with the system can be used to automatically extract them. There is no need to do this for procedures in the language ROM's library as they are automatically available as needed.

As programs are stored in relocatable form, several can be stored in memory at once at different addresses. The BCPL language ROM provides a memory management system that allows this and, in addition, the use of RAM for 'store files', forming a very small silicon disk. This is invaluable when used with the batch file system supplied with the language, which allows compilations and program building to be reduced to single commands.

An assembler, written in BCPL, is provided to allow assembler subroutines to be easily included where Cintcode is not fast enough. Assembler routines can appear to be BCPL procedures, therefore easing integration.

The debugging utilities supplied are very complete, providing all the facilities of a first-class machine code monitor, together with tracing and statistics collection for program optimisation. Facilities are also provided for examining the memory management and I/O systems provided by the BCPL ROM. The Cintcode interpreter incorporates 'hooks' for these facilities, and includes low-level error detection for program corruptions, or calls to non-existent procedures.

Several add-on packages are available for this implementation. They include a stand-alone system, which provides the Cintcode interpreter and libraries to allow programs to run without the BCPL ROM. This provides facilities for packaging BCPL programs as language and utility ROMs, as well as disk or cassette-based programs. A floating point procedure set and random access filing procedures are also available.

'BCPL is intended for use in writing 'systems' programs such as assemblers, compilers and operating systems. It was one of the first languages designed for this and the better known C language was developed from it.'

The system works with the 6502 second processor, taking advantage of the additional memory. Disks or Econet are required to use the system effec-

Benchmark	Time (sec)		Code (bytes)	
	BBC	QL	BBC	QL
Magnifier	5.1	0.4	62	112
For loop	54.7	5.1	74	136
While loop	44.7	3.2	70	124
Repeat loop	39.3	3.3	68	120
No parameters	8.5	1.6	76	132
One parameter	9.1	1.7	78	132
Many parameters	14.7	2.6	88	164
Const to stack	6.3	0.6	64	116
Stack to stack	7.3	0.75	66	120
Const to stack vector	61.6	7.6	84	156
Const to heap vector	64.7	7.6	78	160
If true	72.3	6.8	78	144
If false	64.6	5.6	78	144
Test true	80.2	6.5	82	152
Test mixed	76.9	6.9	82	152
Stack arithmetic	18.2	5.6	70	152
Const arithmetic	17.4	5.4	70	140
Mean	40.0	4.2		

Times are means of 10 runs, timed by stopwatch

BBC: standard BBC B, code sizes are disk file sizes. Acornsoft/RCP BCPL, 16-bit word, compiler version 2.2, ROM version 7.0.

QL: Sinclair QL, code sizes are as reported by linker as QDOS will not give accurate file sizes. Metacomco BCPL, 32-bit word, pre-release version.

Fig 1 Comparison BCPL Benchmark results for the BBC and the QL

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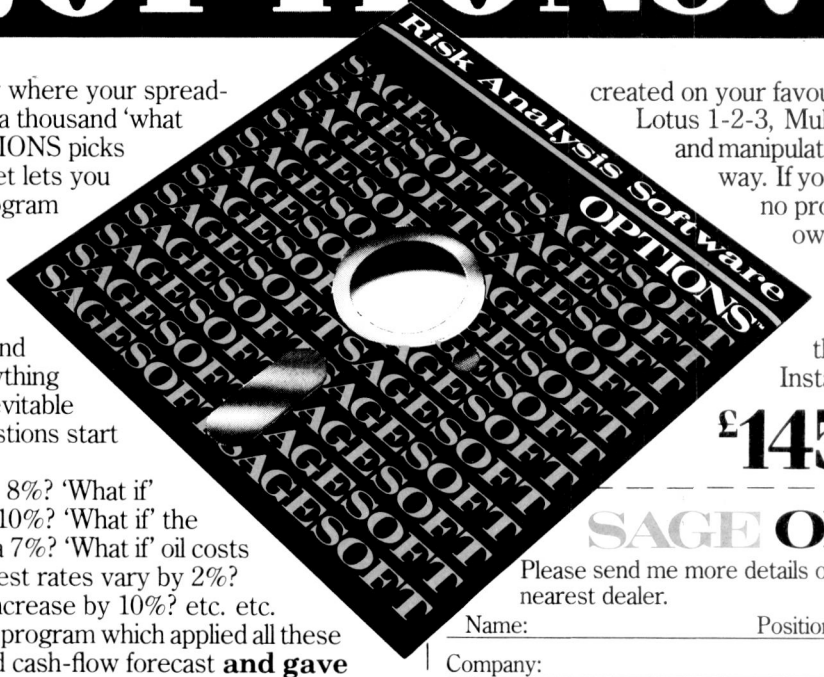

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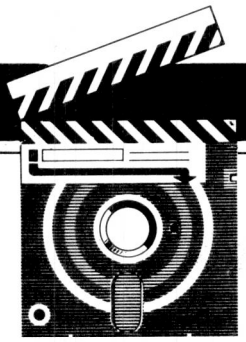

SCREENTEST

tively unlike the QL.

The documentation supplied does not teach BCPL, but it describes the system supplied very thoroughly and legibly. Some unusual library procedures provided with the system include: MOVE, a fast memory block move; RDARGS, a command-line interpreter; and calls to the memory management system to enable programs to use store files easily. Multi-tasking is not provided, but the BCPL extension for 'coroutines' is. This allows a program to readily swap between two tasks.

A Cintcode BCPL is also available from Richards Computer Products for CP/M systems. Compiled Cintcode programs are interchangeable between the two systems, provided only the library procedures available on both are used.

Metacomco BCPL for the QL

This is very similar to the BBC implementation, within the constraints of the two machines. The portable BCPL compiler was the starting point for both systems, and the same screen editor is provided with both packages. This editor is written in BCPL; it is intended for use in programming rather than word processing, and is excellent for the job. It has recently been adopted by Sinclair as the standard QL editor for software development.

Unlike Acornsoft BCPL, which provides a programming environment, this implementation works within the machine operating system, QDOS, generating 68008 machine code programs in a form that can use QDOS multi-tasking properly. This is a very simple way of exploiting the power of the QL in a way that QL SuperBasic fails to do. The usefulness of the system is well-illustrated by the fact that Metacomco's assembler, Lisp and Pascal packages have been written with it.

The package is supplied on Microdrive, containing the compiler, editor and a linker. This is much more of a bare-bones implementation than the BBC implementation, and lacks the other system's plethora of utilities. The one important lack is debugging facilities, although of course any QL debugger may be used on the machine code produced by the system. It seems intended as a part of a software production system, rather than a system on its own.

'The language is intended to be portable, and this is made easier by the provision of a standard compiler. This is written in BCPL and produces an intermediate code called O-code.'

It is compatible with the Metacomco assembler, and linking code produced by the two is simple. A notable advantage over the use of assembler within the BBC system is that BCPL routines, notably the input and output procedures, may be called from within the code written in assembly language.

Memory management is provided by QDOS, which allows SuperBasic programs to co-exist with BCPL code, and to be used as a batch command system.

The draft documentation I've seen is not as massive as that on the Acorn system, but perfectly adequate. The library includes floating point and random access filing extensions, rather than these being provided as add-ons at extra cost.

Conclusion

Simply comparing the two language packages is impossible, as the machines they run on are so different. Both form very powerful development systems for systems software, and seem quite robust.

The packages have considerable potential to be used together, with program modules being written on a BBC machine, and tested there, being able to use disk, as opposed to Microdrive, storage and the Cintcode debugger. When operational, they can be transferred to a QL by the RS232 serial link and re-compiled there. Some work needs to be done building compatible graphics libraries for the two machines, but procedures to access the operating system functions are adequate in both systems to do this.

BCPL products

Books

The definitive book on BCPL is *BCPL — the language and its compiler*, by Martin Richards and Colin Whitby-Stevens, published by Cambridge University Press. It is also accessible to anyone with a basic knowledge of programming, and is highly recommended. Acornsoft is to produce an introductory book, *Beginning BCPL on the BBC Microcomputer.*

Software

For the BBC/Acorn from Acornsoft, (0223) 216039: BCPL language system, (ROM, disk and manual), £59.80; manual separately, £15.00; BCPL stand-alone system (allows programs to run without ROM), £49.90; BCPL calculations pack (high-precision floating and fixed point maths), £19.90.

For the Sinclair QL from Metacomco, (0272) 428781: BCPL language system (Microdrive cartridge and manual), £59.90. END

Thanks to Richards Computer Products Ltd and Metacomco Ltd for their help and advice with the writing of this article.



'My God Atkinson! I think it says computer room.'

Getting together

There's more than one way to interface a BBC Micro and an Apple, but in this method only one piece of additional hardware is needed — a connecting lead. Gavin Haines explains.

If you already own one micro, you need a good excuse to buy another. When the Apple first appeared it only had a 40-column screen and no lower case. The BBC Micro by contrast has 80 columns, upper and lower case, as well as high-resolution graphics.

You can buy an additional graphics processor and 80-column boards for the Apple, but these can easily cost as much as a BBC Micro. Why not buy a BBC Micro and use it as a graphics and 80-column terminal? Your Apple can also be your BBC Micro's second processor.

There isn't anything new in the idea of the second processor: there are numerous additional circuit boards available for machines such as the Apple and IBM PC. On the BBC Micro, the second processors come in a separate box. The only disadvantage of owning a 'second micro' as opposed to a 'second processor' is that you will have two keyboards, which is a more visible extravagance and is harder to justify than a plug-in circuit board.

When you have accepted that the idea of owning two machines is not so bad, possibilities begin to suggest themselves. As the BBC Micro and the Apple are both 6502 machines, you immediately have cross-assembler facilities. With the DOS toolkit assembler, for example, you can create a source file of 1000 to 1500 fully-commented lines. This is about 30k, compared to 32k total RAM on the BBC Micro.

You can implement multi-tasking: while your assembler listing is being printed, you can continue working on the other machine. Another bonus is that BBC programs can be saved to Apple disks. (These considerations could apply to any two machines.)

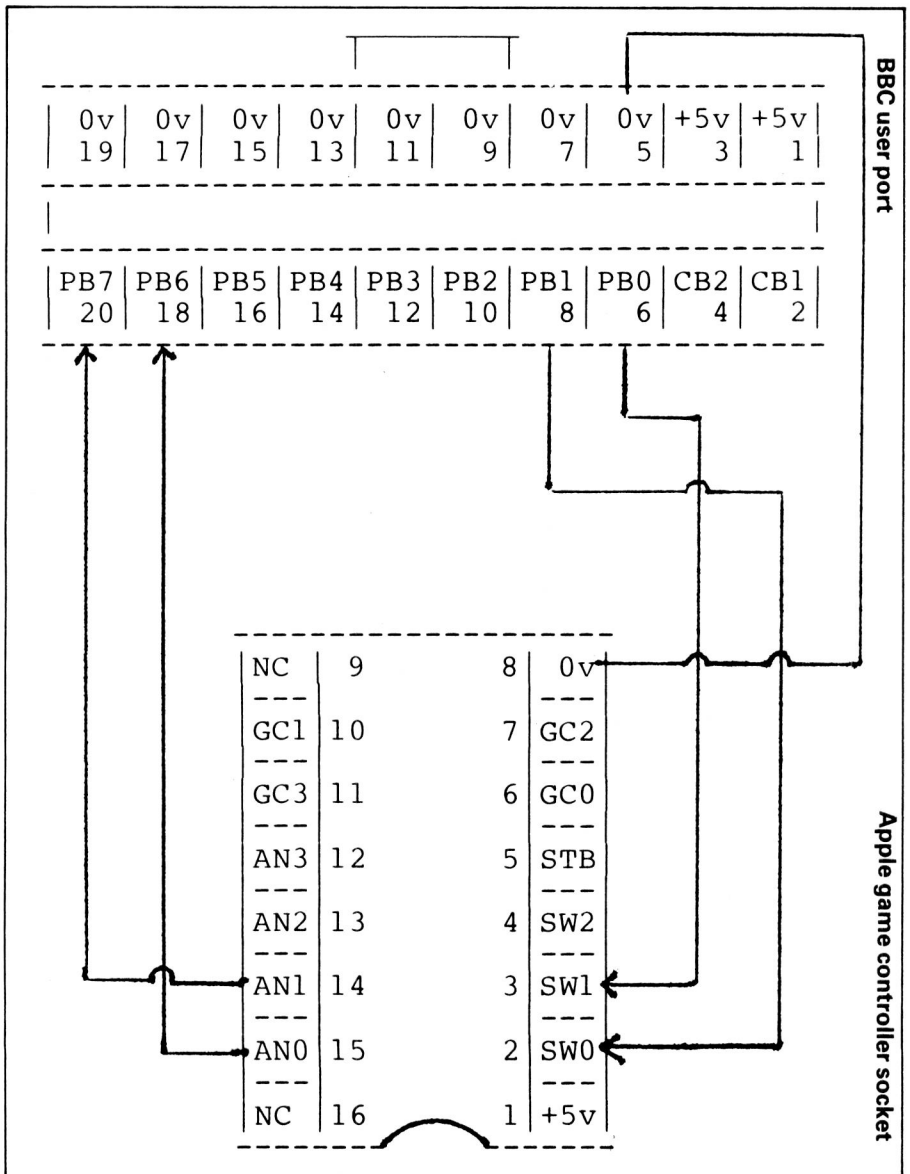

Fig 1 The wiring arrangement

Interfacing options

When you have your BBC Micro, how do you go about hooking it up to the Apple? There are several alternatives. The easiest (and most expensive) option is to buy a network adaptor for each machine. The software is already written, and you have your own private network to experiment with.

The next option is to buy an RS232 communications interface card for the Apple. The BBC Micro already has an RS232 interface, so you only need additional hardware at the Apple end.

However, an additional card is a further expense which uses up another slot in the Apple. How can you interface an Apple to a BBC Micro without using extra hardware?

The BBC Micro has a 6522 VIA (versatile interface adaptor) configured as a user port; the Apple has a games paddle socket. The sockets on both machines provide input and output lines at TTL (transistor-transistor logic) levels — about 5 volts. All you need to interface the two machines is a length of insulation displacement cable and software. The wiring arrangement is shown in Fig 1.

The old Apple reference manual, *The Red Book*, contains a program to drive a teletype via the games paddle socket. This suggests a possible solution: each computer could treat the other as if it were a printer, with similar programs at

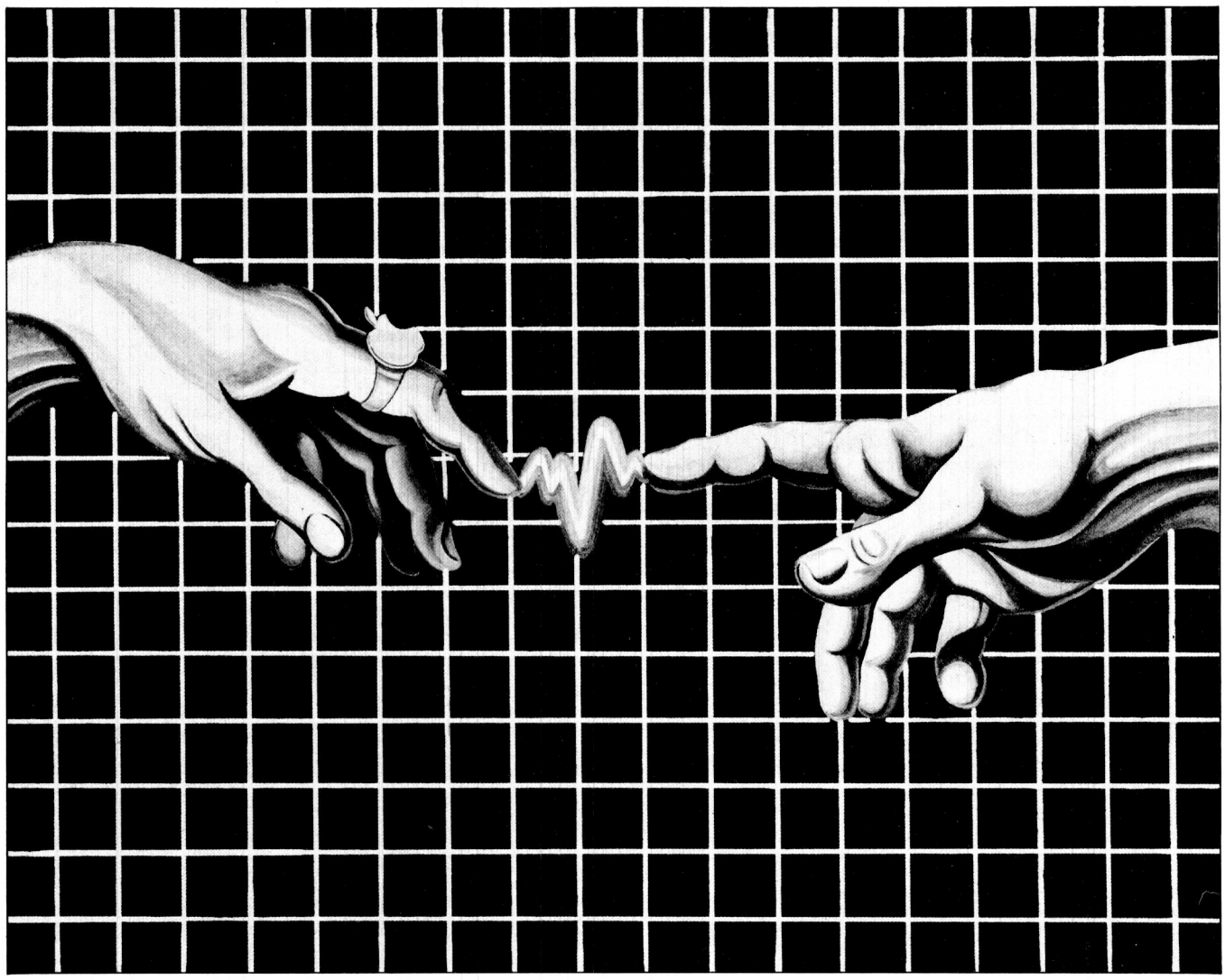

Illustration by Bill Butcher

both ends.

The Apple games paddle socket has three push-button inputs — SW0, SW1 and SW2 (see Fig 1). When you press the button on your paddle, the line goes high. There are four games controller inputs called GC0, GC1, GC2 and GC3; these are used to measure changes in voltage when you turn your paddle, and can be dismissed from consideration as data inputs. Next, there are four output 'annunciators' — AN0, AN1, AN2 and AN3. So, there is the possibility of using four outputs and three inputs.

Most interface circuits work at a fixed baud rate, with zeros and ones transmitted at certain voltages. Such interfaces are easily implemented with a few ICs (integrated cicuits), but if your skills are more in the software direction you can create an interface which does not cost anything.

If you hold an Apple games paddle in each hand, you can tansmit bytes to the machine by depressing the buttons in a certain sequence — get the other machine to do the button-pushing and you've got your interface. You could, of course, use any transmission code, but it makes sense to use ASCII. It's possible to transmit text files with a seven-bit code, but it's wiser to use eight bits.

You can transmit data from the Apple by toggling the annunciators. However, at this point you can run into difficulties. Firstly, the information given in the Apple II reference manual is incorrect. This is the actual position:

Annunciators

		Decimal	Hex
AN0	OFF	49241	C059
	ON	49240	C058
AN1	OFF	49243	C05B
	ON	49242	C05A
AN2	OFF	49245	C05D
	ON	49244	C05C
AN3	OFF	49247	C05F
	ON	49246	C05E

Inputs

PB0		49249	C061
PB1		42950	C062

You can change the setting of the annunciator soft switches by executing any instruction which merely reads these locations. This has several consequences, the main one being that it is possible to determine the setting of a given line by software. You can only keep a record of the state of the switch somewhere else in the program.

There is another snare with the 6502 itself. An indexed instruction which crosses a page boundary generates a false read. Unlike the writers of BBC Basic, the authors of Applesoft (Apple Floating Point) Basic used many indexed loops. Also, there are some instances where a page boundary is crossed; the most annoying occurs with the CHR$ function, as it generates a false read in the region C000-CFFF (hex). This is the area of the Apple's memory-mapped I/O.

The false read can toggle the annunciators and mess up your interface, so you must be prepared for everything to go dead once in a while.

There are three answers to this. The first is to include error checking and error recovery software, the second is to put up with it. The third is to fit a CMOS 6502 (which does not have this problem) to your Apple. The Rockwell 2MHz version does work, at least in the Apple: it doesn't work in some BBC Micros. The Acorn 6502 second processor is fitted with the GTE 3MHz version.

At the BBC end of the interface, the Model B is fitted with a 6522 VIA. This contains 16-bit interval timers, serial to parallel shift registers, and it can also be programmed to cause an interrupt. But, since there is no equivalent hardware at the Apple end, you don't need to use all these facilities.

The VIA B (that is, the user VIA) is used to provide the BBC Micro user port. There are eight data lines, PB0 to PB7, and two handshake lines, CB1 and CB2. As the Apple does not have facilities for handling interrupts, CB1 and CB2, the

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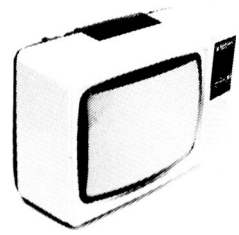

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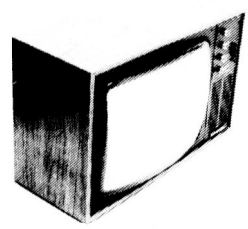

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```
ASM
                        1    * BEEB 1.4
                        2    *
                        3    * BBC TO APPLE INTERFACE SUBROUTINE
                        4    * LAST UPDATED 23/JUL/1983
                        5    * ENTRY POINT: $300
                        6    * WRITTEN BY GAVIN HAINES
                        7    * BIG MAC ASSEMBLER
                        8            ORG  $300
                        9    * ZERO PAGE LOCATIONS
                        10   WORD     =    $FA
                        11   *
                        12   * APPLE ROUTINES
                        13   KBD      =    $C000
                        14   KBDSTB   =    $C010
                        15   SETAN1   =    $C05A
                        16   CLRAN1   =    $C05B
                        17   SW0      =    $C061
                        18   SW1      =    $C062
                        19   COUT     =    $FDED
                        20   HOME     =    $FC58
0300: 20 58 FC          21           JSR  HOME
0303: A9 80             22           LDA  #$80       ;MASK FOR BIT 7
0305: 8D 5B 03          23           STA  FLAG
0308: 2C 61 C0          24           BIT  SW0        ;IS LINE HIGH?
030B: 10 4A             25           BPL  EXIT       ;EXIT IF IT IS.
030D: 2C 5B C0          26           BIT  CLRAN1     ;PULL LINE LOW
0310: A2 08             27   RDBYTE  LDX  #8         ;8 BITS TO READ
0312: AD 00 C0          28   READY   LDA  KBD        ;READ KEYBOARD
0315: C9 80             29           CMP  #$80       ;KEY PRESSSED?
0317: B0 37             30           BCS  KEYIN      ;YES BRANCH
0319: AD 61 C0          31           LDA  SW0        ;READ HANDSHAKE LINE
031C: 4D 5B 03          32           EOR  FLAG       ;CHANGED STATE?
031F: 10 F1             33           BPL  READY      ;NO, BRANCH
0321: AD 61 C0          34           LDA  SW0        ;SAVE STATUS OF HANDSHAKE
                                                     LINE
0324: 8D 5B 03          35           STA  FLAG
0327: 0A                36           ASL  A          ;SHIFT BIT INTO CARRY

0328: 90 05             37           BCC  AN1ON      ;SEND A ONE IF CARRY CLEAR

032A: 2C 5B C0          38           BIT  CLRAN1     ;SEND A ZERO IF NOT
032D: B0 03             39           BCS  RDBIT      ;AVOID RESETTING AN1 BY DEFAULT

032F: 2C 5A C0          40   AN1ON   BIT  SETAN1
                        41   *
0332: AD 62 C0          42   RDBIT   LDA  SW1        ;DATA LINE
0335: C9 80             43           CMP  #$80       ;SET CARRY FLAG
0337: 26 FA             44           ROL  WORD       ;SHIFT CARRY INTO BYTE
0339: CA                45           DEX
033A: D0 D6             46           BNE  READY      ;BRANCH UNTIL XREG=0
033C: A5 FA             47           LDA  WORD       ;BYTE CREATED
033E: 09 80             48           ORA  #$80       ;WE DON'T WANT FLASHING CHARACTERS

0340: C9 97             49           CMP  #$97       ;IS IT END MARKER (CTRL-W)

0342: F0 13             50           BEQ  EXIT       ;BRANCH IF IT IS
0344: C9 8A             51           CMP  #$8A       ;CTRL-J?
0346: F0 C8             52           BEQ  RDBYTE     ;YES,THEN SKIP IT
0348: 20 ED FD          53           JSR  COUT       ;CURRENT OUTPUT DEVICE
034B: 4C 10 03          54           JMP  RDBYTE
034E: F0 07             55           BEQ  EXIT       ;ALWAYS TAKEN
0350: 2C 10 C0          56   KEYIN   BIT  KBDSTB    ;MUST CLEAR STROBE
0353: C9 9B             57           CMP  #$9B       ;ESC?
0355: D0 BB             58           BNE  READY
0357: 2C 5A C0          59   EXIT    BIT  SETAN1
035A: 60                60           RTS
                        61   FLAG    DS   1
                        62   ********* END OF PROGRAM

--End assembly--

92 bytes

Errors: 0


Symbol table - alphabetical order:

   AN1ON   =$032F      CLRAN1  =$C05B      COUT    =$FDED      EXIT    =$0357
   FLAG    =$035B      HOME    =$FC58      KBD     =$C000      KBDSTB  =$C010
   KEYIN   =$0350      RDBIT   =$0332      RDBYTE  =$0310      READY   =$0312
   SETAN1  =$C05A      SW0     =$C061      SW1     =$C062      WORD    =$FA


Symbol table - numerical order:

   WORD    =$FA        RDBYTE  =$0310      READY   =$0312      AN1ON   =$032F
   RDBIT   =$0332      KEYIN   =$0350      EXIT    =$0357      FLAG    =$035B
   KBD     =$C000      KBDSTB  =$C010      SETAN1  =$C05A      CLRAN1  =$C05B
   SW0     =$C061      SW1     =$C062      HOME    =$FC58      COUT    =$FDED
```

Fig 2 BBC to Apple interface subroutine

programs do not use them. How do you get the interface to work?

In use

The easiest solution is to initialise both the Apple and the BBC Micro to a known state, and then send a signal byte — all ones, all zeros. Once the other machine knows which bit is the first bit of the first byte, all the other bytes follow in sequence. But if something goes wrong in this process, you get gibberish on the screen. To keep it simple, the software asumes that the BBC Micro is calling the Apple, and you have to run the BBC program first.

The BBC Micro user port is located at &FE60. The data direction register (DDR) is at &FE62. To designate a line as an output, you store a corresponding 1 in the DDR (there is an example in the user guide, pages 468-9). But like the Apple reference manual, the BBC Micro user guide is slightly misleading. It implies that all code routines must be written so that they will work over the 'tube', but using OSBYTE routines to write to SHEILA as the user guide suggests is very complicated, and execution time is considerably increased. Furthermore, a program which is running in the second processor cannot service interrupts generated by devices connected to the BBC Micro, and OS calls inside an event are not permitted. Programming across the tube is difficult, as Acorn found out.

In short, you may decide that it's more trouble than it's worth to make your software tube-compatible. Even if you have got a second processor, you can always switch it off and revert to using the BBC Micro as a 32k machine for user-interfacing applications.

The BBC Micro has a series of vectors in page two which act like a signal box. A railway has basically two tracks, the up line and the down line, input and output. The signalman can arrange for a train arriving on any line to arrive at any platform by changing the vectors. By intercepting the output stream, OSWRCH, you can easily make data go to another machine.

Having trapped the output vector, all characters will pass through your machine code routine; you then serialise each byte and transmit it. Line PB7 is directly testable with the negative flag (line PB6 can also be directly tested with the V flag).

The interface uses just five wires: two clock lines, two data lines, and a common return. Every time one machine wants to send a bit, it changes the state of the clock line. The other machine then changes its clock line in response, and so on.

To implement the interface, you would make up a lead as shown in Fig 1. The BBC program (Fig 3) can be entered directly. You can enter the Apple program as shown (Fig 2) if you have an assembler, otherwise you will have to enter the hex data into the monitor. For example:

CALL-151<cr>
300:20 58 FC
303:AD 61 C0, and so on
FP <cr
BSAVE BBC Micro 1.0, A$300, L$5B <cr>

The Big Mac assembler is a worthwhile investment. The BBC program has been written to receive and transmit data; the Apple machine language routine will only receive data. (Unfortunately, the complete package is too

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```
>L.
   10 REM ****************************
   20 REM * APPLE8:  BBC to Apple    *
   30 REM * interface program.       *
   40 REM *                          *
   50 REM *                          *
   60 REM * Sends data through       *
   70 REM * BBC User Port to apple   *
   80 REM * Game controller socket   *
   90 REM *                          *
  100 REM * Entry point: &900        *
  110 REM *                          *
  120 REM * Last Updated 2/7/84      *
  150 REM ****************************
  160 VDU 15:REM Page mode off
  170 BASIC%=&8E61:REM Clear screen
  180 REM Put Operating System Vectors i
nto variables
  190 REM
  200 REM Input vectors: ------------
  210 REM
  220 RDCHV%=&210:REM address of Read Ch
aracter Vector
  230 RDCHVL%=?RDCHV%:REM store low byte
  240 RDCHVH%=RDCHV%?1:REM and high byte
s
  250 REM store address pointed to by Re
ad Character Vector:
  260 OSRDCH%=RDCHVL%+256*RDCHVH%
  270 REM
  280 REM Output vectors: -----------
  290 REM
  300 WRCHV%=&20E:REM Address of Write C
haracter Vector
  310 WRCHVL%=?WRCHV%:REM store low byte
  320 WRCHVH%=WRCHV%?1:REM and high byte
  330 REM store address pointed to by WR
CHV:
  340 OSWRCH%=WRCHVL%+256*WRCHVH%
  350 REM
  360 REM User port locations:
  370 PORT%=&FE60
  380 DDR%=&FE62:REM Data Direction Regi
ster REM
  390 REM
  400 REM Zero page locations used by th
is routine:
  410 FLAG=&7A
  420 ACC=&7B
  430 WORD=&7C
  440 XREG=&7D
  450 WORDIN=&7E
  460 FUNC=&7F
  470 REM
  480 REM Now start the assembly....
  490 liston%=3:listoff%=2
  500 list%=listoff%:REM change to listo
n for listing.
  505 IF list%=listoff% THEN CLS
  510 FOR I%= 0 TO list% STEP list%
  520 P%=&900
  530 [OPTI%
  540 .K%
  550 LDA #3 ;set up Data Direction Reg
  560 STA DDR%
  570 LDA #&FF; high bit set in FUNC den
otes we are sending
  580 STA FUNC
  590 LDA #OUTPUT% MOD 256
  600 STA WRCHV%;change output vectors
  610 LDA #OUTPUT% DIV256 ;to point to s
tart address
  620 STA WRCHV%+1; of this routine
  630 LDA #2 ;initalize user port
  640 STA PORT%
  650 LDA #0
  660 STA FLAG
  670 STA ACC
  680 STA WORD
  690 LDX #1
  700 JMP WRBIT
  710 .L%
  720 LDA #3
  730 STA DDR%
  740 LDA #NXTCHR MOD 256 ;change input
vectors
  750 STA RDCHV%
  760 LDA #NXTCHR DIV 256
  770 STA RDCHV%+1
  780 LDX #10 ;initialize for input
  790 LDA #2
  800 STA PORT%
  810 LDA #0 ;zero stored in FUNC denote
s
  820 STA FLAG;input
  830 STA FUNC
  840 JSR WRBIT
  850 RTS
  860 .OUTPUT%
  870 STA ACC ;Save accumulator
  880 STX XREG ;and X register
  890 CMP #&7F ;DELETE Key?
  900 BNE WRBYTE; No branch
  910 LDA #8 ;turn delete into backspace
 for the apple
  920.WRBYTE
  930 STA WORD
  940 .NXTCHR LDX #8 ;8 Bits to read/wri
te
  950 .WRBIT
  960 ROL WORD
  970 BCC SEND0
  980 LDA #&C1;Mask with data bit on
  990 BCS WRBIT1
 1000 .SEND0 LDA #&C0; Mask for bits 6 a
nd 7
 1010 .WRBIT1
 1020 BIT PORT%
 1030 BPL SET
 1040 ORA #0
 1050 STA PORT%
 1060 BMI TEST
 1070 .SET ORA #2
 1080 STA PORT%
 1090 .TEST LDA PORT%
 1100 EOR FLAG
 1110 BPL TEST
 1120 LDA PORT%
 1130 STA FLAG
 1140 CLC
 1150 BVC MAKEBIT
 1160 SEC
 1170 .MAKEBIT ROL WORDIN
 1180 DEX
 1190 BNE WRBIT
 1200 LDA FUNC
 1210 BEQ CHRIN
 1220 LDA ACC
 1230 LDX XREG
 1240 CMP #&17 ;CTRL-W?
 1250 BEQ exitoutput; Yes, terminate bee
b to apple transmission
 1260 JMP OSWRCH% ;No, output character
 1270.CHRIN
 1280 LDA WORDIN
 1290 LDX XREG
 1300 CMP #&17 ;CTRL-W?
 1310 BEQ exitinput
 1320 CLC ;Declare chr valid
 1330 .EXIT RTS ;into the operating syst
em.
 1340 .exitoutput
 1350 LDA#WRCHVL% ;restore vectors
 1360 STA WRCHV% ;and exit via CLS
 1370 LDA #WRCHVH%
 1380 STA WRCHV%+1
 1390 LDA 0
 1400 JMP BASIC%
 1410.exitinput
 1420 LDA#RDCHVL% ;restore vectors
 1430 STA RDCHV% ;and exit via CLS
 1440 LDA #RDCHVH%
 1450 STA RDCHV%+1
 1460 LDA 0
 1470 JMP BASIC%
 1480 ]
 1490 NEXT
 1500 *KEY0CALLK% M
 1510 *KEY1CALLL% M
 1520PRINT'"BBC Micro to Apple transfer
program"''"Type function key on BBC BBC
Micro"'"before running apple interface p
rogram"
 1530PRINT'"To send data type f0"'"To re
ceive type f1"
 1540 REM Data out line is PB0
 1550 REM Clock out line is PB1
 1560 REM Data in line is PB6 - directly
 testable by the v bit.
 1570 REM clock in line is PB7 - testabl
e with negative flag
>
```

Fig 3 BBC to Apple interface program

long to include here.) Fig 4 is an Applesoft Basic program which writes the BBC Micro's data to a text file.

Once you have an interface of sorts up and working, you can easily add further features such as error checking. You could intercept the command line interpreter so that you could type *APPLE on the BBC Micro and have Apple facilities at your disposal. Then you simply type *BBC and continue processing.

```
]LOAD WRITER,D1
]LIST

5  REM  BEEB 1.3.1 RENAMED BEEB.O
     BJ0
10 D$ =  CHR$ (4)
13  IF  PEEK (768) = 32 THEN 15
14  PRINT D$"BLOADBEEB.OBJ0"
15  PRINT D$"MONOI"
16  PRINT "CHANGE DISC IF NECESSA
     RY..";: GET A$
17  PRINT
20  PRINT D$"OPEN BBC"
25  PRINT D$"DELETE BBC"
26  PRINT D$"OPEN BBC"
30  PRINT D$"WRITE BBC"
40  CALL 768
50  PRINT
60  PRINT D$"CLOSE"
70  PRINT D$"NOMONOI"

]
```

Fig 4 An Applesoft Basic program

This article features the BBC and Apple micros, but the idea could be used for any two machines not fitted with RS232 hardware.

CMOS 6502 and the manual are available from RCS Microsystems Ltd, 141 Uxbridge Rd, Hampton Hill, Middlesex Tel: (01) 979 2204. END



'I see you never having the faintest idea how to use your personal computer.'

Spellbound

Tom Vernon takes a break from recording TV and radio programmes to describe macro programming, the built-in ability to customise applications packages, using Spellbinder as an example.

Buying a word processor is buying someone else's way of thinking. It is like choosing a companion. As a writer, I spend more hours with the authors of Spellbinder than with any human being. I know Bintz and Gee (the said authors) quite well by now. Bintz was a psychologist: Gee was lecturer at UCLA in Davis, California. They had a small scientific instrument company that used microprocessors, and needed an editor for the programming. Like the Apple empire, Spellbinder grew up in a garage — developed first as a ROM for the Z80 Exidy Sorceror, and later for CP/M and MS-DOS.

I can cohabit with Bintz and Gee — at least in binary spirit — partly because they thought well in the first place, and partly because they sometimes let me hold the baby. Their program is itself partly programmable — the aspect which I will concentrate on in this article.

It makes sense to build flexibility into a package. Micro software writers rarely know the user, however well they understand the functions they are programming. Packages which are democratic in this way last better in a rapidly-changing marketplace. dBasell, for example, owes much — if not most — of its considerable success to its integral programming language.

But a professional-quality word processor needs a programmable element as much as any other database. Writing is the quirkiest, widest-ranging form of information: it is by humanity, for humanity — and only its simplest aspects are easy for machines. (The database to hold the elements of Shakespeare has yet to be created.)

Flexibility

Spellbinder's flexibility comes from three sources, apart from its macros: modes, tables, and use of function keys. It has two modes of working, Edit and Command, which treat text in different ways. Edit mode thinks in text units which may be either Word, Sentence, Paragraph or Character. (The Character unit allows you to underline or otherwise enhance spaces, which can be useful not only for printing, but also for drawing a band of reverse video to catch the eye in screen displays.) Command mode thinks in terms of screen lines, which are quick for deletion, movement by chunks, and for tucking text away in the temporary 'hold' buffer which is used for 'cut and paste' operations.

Until the latest version, users have not been able to work in screen lines while editing, which is irritating.

Spellbinder has always offered tables which allow the user to control printing extremely minutely (up to 1/960in on the Santec (Sanders) printer or a laser printer). The latest version, 5.30, has extended this principle to the point of embodying an extraordinary range of operating and configurating functions in decimal tables (relatively accessible, though not easy to figure out even with the help of *The Technical and Macro Manual* — a slim volume at a not-so-slim £50). The command PSn ('n' being from 1 to 14 and 128 to 137) displays the tables for alteration — at your peril — and PS puts them back. Use a *copy* of Spellbinder for experimenting.

Spellbinder's function keys are dynamic: that is, they change their function according to the type of operation in progress, in effect forming a command tree made out of a series of menus and sub-menus, with the changing key legends shown at the bottom of the screen. On the Sirius, seven function keys perform about 50 tasks relating to printing, disk access, formatting, searching, general editing, and global operations to deal with large files, which have to be progressively fed into memory and out again as you work on them.

Although ideal for novices, however, function keys are rather slower than the single-letter commands available from the keyboard, particularly as these can be strung together as autocommands. E/U/T/F368, for example, will instantly take you to line 368 from anywhere in the text, having first dumped (Unheld) the contents of the hold buffer at the End. Top/Forward is the quick way of moving the cursor to where you want to go. Getting into the habit of using multiple commands lined by slashes can be a great timesaver, particularly for simple repetition ('25 s//HESELTINE /' will produce 25 repetitions of HESELTINE, for example, or '5 PA/FF/T' will Print All of a file five times from the Top with a Form Feed at the end of each one).

Soon, however, you will find that some commands tiresomely insist on your intervention. You cannot save time reading in one file after another from disk with a command like RO/Heselfil.Brk/R/RD (Read Open/Filename/Read/Read Done), and nothing extra happens after a search command. The trick here is to type in the command at the end of whatever text you have in memory, put the cursor at the front and issue the commands AT (whereupon it will disappear) followed by A (to set it going).

Why not extend it? Add other lines, as in Fig 1. You have written your first macro.

```
RO/Heselfil.Brk/R/RD        ; Read Open/Filename/Read/Read Done
sa/Heseltine/rhubarb/       ; Search All (replacing Heseltine with
                              rhubarb)
t/sa/missile/carrot/        ; Top/Search All
t/pa/da                     ; Top/Print All/Delete All from memory
```

Fig 1 How to write your first macro

Macros

The Macro Programming Language (MPL) creates add-on programs that you can call up to work on the text in memory or on disk. Spellbinder is almost unique among word processors in providing them (although the Sirius Programmer's Toolkit contains PMATE, an editor entirely made up of much less friendly macros, and Word Perfect also has such a language).

Macros provide most of the features of Spellbinder which justify its claim to also be an 'office management system' — it must have been one of the earliest of all integrated packages! These features include: mailmerge; special



Illustration by Andrew Farley

printing functions such as two-column print, label and batch printing; standard form preparation and form filling; boiler-plating standard letters; calculation facilities which work from text or keyboard; sorting and keeping of lists as a simple database; column-moving; and entry of standard phrases at a single keystroke. Version 5.30 adds macros for footnoting and referencing, and tidying widows and orphans (stray lines of print isolated at the top or bottom of a page).

None of these macros, particularly the database, is going to break any records for speed, but they work. Many a small office or part-time business could probably run on them, keeping a few customer records, a semi-manual accounting system, and dealing more than adequately with its paperwork. Generally, however, the value of the macros is that they provide for an occasional need without the expense of buying new programs and — even more significant — the trouble of learning them.

Macros can be run from within Spellbinder at any time, providing there is space in the memory; they can be chained together; a menu of those available can be called up on a function key (which can also start them going again from the right point if they are interrupted); and Spellbinder begins and ends through macros, which gives you the chance of introducing sign-on and sign-off messages or facilities. I start with an automatic list of urgent things to do, for example (which I then ignore, of course).

Macros are fun to write. The language has its limitations — no PEEKing, rather limited maths, and it isn't practical to ask for continual screen rewriting (for example, showing the cursor moving one character at a time). But generally the language is easy and pleasant to use — and sometimes surprisingly powerful, since it calls upon most of the Spellbinder commands in addition to normal programming steps. It is easy to understand because processes going on in lines of text are concrete: the cursor moves comprehensibly around in a 26k block of text, altering it, searching it, shifting chunks of it, and formatting it.

Macros may be Heath Robinson programming — that is part of their charm — but they also have the advantage of being outstandingly portable. They are created as ASCII text files and stay that way, so they are easily transferred and run on any machine with Spellbinder. You can even write macros on another word processor: I regularly create them on Microwriter, for example.

Fig 2 is the macro I constantly use. It provides hold, movement and deletion facilities on the basis of cursor position, which is registered at the first press of the macro key that immediately dumps you back into edit. At the second press of the key, the macro registers the new cursor position and gives you the choice of deleting or holding everything between old cursor and new cursor, or of returning to the original place. Deleting backwards is not otherwise possible in Spellbinder, and you normally have to decide the end of your hold or deletion in advance. The macro also bypasses the safety procedures which ask you to confirm that loss of too much text is OK.

The macro starts by assigning a string variable used for later comparison. MPL has only 10 integer and seven fixed-point variables (%1 to %0 and %a to %g) but up to 26 13-character string variables, so it is often economical to use string variables as flags. (Maximum string size is set with an instruction like :SS 13 159 13, although it may be temporarily fixed with :SF and padded

```
;                                   CURSRCM1.WPM
:%B = "Hold"                          ; String variable B = 'Hold'
:in "#1/RETURN CURSOR AND INTER-CURSORS HOLD, DELETE - WARN AT ? LINES (No./Ret) " %1
:on %1 / / /+1
:%1 = 5
:%A = %1
:se %A
:cp
:ee 10
:pr "#13/     CURSOR NOTED     " ; NOTE FIRST CURSOR POSITION
:%2 = $2                          ; column number
:%3 = $3                          ; row number
:cp
:ee 16                            ; Exit to Edit Mode, with restart at line 16
;
:%C = " "                         ; CHOOSE FUNCTION
:pr "#13/  RETURN, DEL CHAR (kills lines, warns at %A), H (replaces hold) "
:rk %0
:on %0-17 / /+12 /                ; ASCII 17 is my Delete Character key
:on %0-42 /+4 /+2 /
:on %0-72 /+3 /+1 /
:on %0-104 /+2 / /+2
:%C = "Hold"
:on -1 /+7
:%0 = 0
t/f%3-1                           ; RETURN CURSOR TO ORIGINAL PLACE
:mc %2
:cp
:ee 10
;
;
:on %3-$3 /+9 / /+2               ; IS NEW PLACE FORWARD OR BACKWARD?
:on %2-$2 /+8 /+31 /
;
:%8 = %2                          ; ADJUST FOR BACKWARD
:%9 = %3
:%2 = $2
:%3 = $3
t/f%9-1
:mc %8
;
:%7 = 0                                   ; PREPARE FOR ACTION
:on ?-13 /+2 / /+2
:%7 = 1
:on -1 /+1
s//</
 :%6 = $3-1
 :%5 = %6-%3+%7
 :on %1-%5 / /+5 /+5
 :pr "#13/   * OVER LIMIT OF %A LINES   - BUT YOU CAN Esc IF YOU'RE QUICK *   "
 :%0 = %0                                 ; delay
 :%0 = %0+1
 :on %0-300 /-2 / /
 ;
 :%7 = 0                                  ; DELETION
 :on %B%C / /+7 /
 t/f%3-1
 :mc %2
 d%5+1
 :cp
 :ee 10
 ;
 ;
 :%5 = %5+1                               ; HOLD
 h0
 t/f%3-1
 :mc %2
 h%5/e/s//</                              ; get rid of cr at end of hold
 u/e/b1/s/</
 b%5/h0/h1000
 t/f%3-1
 :mc%2
 :cp
 :ee 10
```

Fig 2 This macro provides hold, movement and deletion facilities

or truncated accordingly.)

Line numbers are implicit: MPL lines begin with a colon whereas word processor command lines have none. MPL treats everything after a semicolon as a comment: in pre-version 5.30, it requires ingenuity to use a plain semicolon in a macro. You can move the cursor along until the ASCII value underneath it is returned as 59 (Fig 3).

Another way is to search for a semicolon using 's/*;/, which has an enhanced semicolon that the macro will not object to, and an asterisk for non-specific search so that it is likely to end up at an unenhanced semicolon instead.

The branch routines work by testing a value against 0. If it evaluates as less than 0, the macro jumps to the line number next to the left-hand slash; if 0, the middle line number; if greater than 0, the right-hand one. String comparisons are evaluated by ASCII code in the same way, although the syntax uses no operator but simply puts them together (for example, :on %A%B///). Strings are combined with the form :%C = %D%A%B.

Maths is limited to plus and minus and what you can do with them, although the calculator macro supplied with Spellbinder does quite well.

That is most of what is needed for a first understanding of the language, although there are also String Enhance and Read Key (for ASCII number) macro instructions, interrogators for String Length, and read or write file ($0 or $1) open or closed. INput and PRint work in much the same way as their Basic equivalents.

MPL is properly covered in the *Macro and Technical Manual*, which is well-written but expensive.

Since this macro in effect institutes a command branch at the second press of the CONTINUE key, there is no reason why other keys should not be used to perform other simple operations. But bear in mind, however, that the whole point of a macro addition like this is simplicity and efficiency. Beware of re-inventing an asymmetrical wheel. I was halfway through a macro for film budgets when I suddenly realised that I was writing a spreadsheet, and that I would be better off using Multiplan.

There are limitations to macros. Spellbinder is no better than most other micro word processors in being able to address only 28k of text in memory, including the macro. Larger files have to be manipulated on and off disk, as do files to be used by other programs.

There are two types of speed in computing — the instant answer, and the process that happens automatically while you are making a cup of coffee. Complicated macros, like my punctuation checker, TV script formatter, word counter, filer for random thoughts, and comparer of similar files, definitely come into the second category. I also have a simple dot-graphics program for a daisywheel printer.

```
:mc $2+1
:on $2-79/+//          ; when at end of 80-column line
f1                     ; move down one row
:on ?-59/-4//-4        ; loops back four lines unless ASCII under
                       cursor is 59
:%A = !                ; %A = the string under cursor
```

Fig 3 It requires ingenuity to use a plain semicolon in a macro

Programming wrinkles

You have to avoid commands which stop and ask for user intervention. Getting a directory, deleting a file, holding or deleting without specifying how many lines, and holding to a buffer that has something already in it will all stop you in your tracks. There are positional points to watch, such as allowing for the fact that variables start at 0 while line numbers start at 1, or that when a string is read from text with ! the cursor ends up after it, or after the delimiter if one is specified !,.

'. . . a professional-quality word processor needs a programmable element as much as any other database. Writing is the quirkiest, widest-ranging form of information . . . only its simplest aspects are easy for machines.'

It is much easier to see a cursor moving around in a chunk of text than to cope with the abstractions of normal programming, and the current state of play can be shown onscreen by using the Cursor Print instruction. Looking at what is happening is a main diagnostic tool, along with the AI command (which executes the macro step by step) and the :in instruction to stop the macro at that point. However, 'in' does not evaluate variables, so to show their current state on the message line with the cursor in text below, you need:

```
:pr "#1/ Variables are %1 %2 %A %a"
:cp
:in
```

Whether or not you use relative line numbers in branching (/+5 or /22) there is a good deal of line-counting writing macros, particularly when making alterations within nested loops. A macro to renumber line numbers in macros is useful, or you can write your macro in a numbered format. This is easily created, in spite of the semicolon problem, with extra indication of odd lines and tenth lines (Fig 4).

Other useful tools are macros to print ASCII values of the keys on the keyboard, to test printwheels, to make multiple searches for combinations of words occurring within a certain distance of each other, and to convert text to other formats, such as a database. Spellbinder creates either sequential or system files, but random access files need to be filtered through Basic.

Another limitation is the presence of the soft carriage return character ASCII 14 at the end of every screen line except those terminated by a carriage return. In practice, therefore, data must be in segments with not more than 158 characters between carriage returns (159 characters is the maximum Spellbinder screen line). This could be a limitation on some dBasell fields, for example, but not on DMS, which only allows half that length anyway.

Spellbinder is a very safe program, but people make mistakes. I find that a desirable addition to Spellbinder is a short Basic program (Fig 5) that PEEKs the memory and writes to disk anything there which you want to keep; then you never lose anything, unless you have to re-boot. With MS-DOS 1.25 on my system, this only happens if you try to print a dead printer, although you can also be dumped in the operating system if you give the wrong answer to the MS-DOS error message 'Abort, Retry or Ignore', which occurs if you access an empty driver. I have also known much-repeated use of the AT command to cause problems. With

```
:in "HOW MANY LINES?                ENTER NUMBER cr " %2
:in "NOW TYPE A SEMICOLON or          "  %A
;
:%3 = %3+1
:%1 = %1+1
s//%A -                                 %A %1</
:%1 = %1+1
:on %3-10/+3//
:%3 = 0
s//%A x                                 %A %1</
:on -1/+1
s//%A                                   %A %1</
:on %2-%1///-10
:ec
```

Fig 4 A macro written in a numbered format

لتزويد منازلكم بوسائل حديثة للمعرفة

٩٩٥ ريال



أدخل وعائلتك عالم الوسائل التعليمية والترفيهية الحديثة..

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كمبيوتر سنكلير جهاز مدمج ومحكم الصنع.. يمكن لأي شخص استخدامه
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الخبر	٨٦٤٦٧٨٧	الطائف	٧٤٥٣٢٨٧	قطر	٤٢٨٠٥٥
الخبر	٨٩٥٢٩٩٨	الطائف	٧٢٤١٥٦٠	البحرين	٢٥٣٤١٦
الرياض	٨٤٢٠٢١٥	بريدة	٣٢٣٥٠٦٢	دبي	٢٢١٥٨١
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				لندن	٨٠٢١٢٣٨

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ULTRAKIT is the most powerful interactive toolkit yet for ZX BASIC. All the features you will ever need:

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C combines high-level structuring with direct control over the machine, all at compiled speed. Our compiler is now available from good retailers, and has proved extremely popular. It supports all statement types (plus inline code) and over 40 operators; whilst char, int, unsigned and combinations using pointers, arrays, structures, unions, functions, and typedef are all allowed data types. External and static variables can have initializers, whilst auto variables support recursion. There are six preprocessor directives and over 60 library functions with a selective inclusion scheme.

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	Pascal £	DEVPAC £	C £	ULTRAKIT £	FONT 464 £
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other operating systems, Spellbinder can provide extra facilities such as text recovery and the ability to run other programs from within itself (apart from its own macros).

New versions

Version 5.30 of Spellbinder is a partial rewrite to make the program easier to adapt to new machines. It has a bundled spelling and grammar checker — Electric Webster — far below the standard of Spellbinder itself; and is the basis of the new Scientific Spellbinder, which contains a full set of Greek letters and scientific symbols among up to 224 different characters.

You can issue command mode commands from Edit, view disk directories selectively, and have two read files open at once. There are new macro instructions, but the greatest change is in adaptability.

Previous versions kept a proportional spacing table in quite accessible decimal/ASCII format. 5.30 has a major part of the configuration as tables which are capable of being manipulated by people who have some knowledge, but who have not yet graduated to machine code. You can redefine the way the function keys work, and the way the printer prints, the screen behaves or the keyboard works. You can have a second character set replacing the enhanced set, or control screen colour on an IBM PC.

This process is in a different league from macro-writing. The inexperienced user would be wiser to get a dealer to configure a package for special facilities like French accents, and so on. (Up to 16 extra characters are readily available, with their enhanced versions.) Sierra Systems of Epsom (which supplied my (early) copy of 5.30) throw in extra characters with the package, and will configure others cheaply.

There are several desirable macro features not listed in my older manual, but most of which seem to work with version 5.20 at least. An On Error instruction (:oe 1) brings you back to a specified line; and String Get (:sg %A %61) extracts the first character in a string and converts it to an ASCII value. There is a useful tracer in $4, which returns the current macro line number +2, and you can read indent values with the $5 function but change them only in 5.30 with the Set Indent instruction.

String Put (the opposite of String Get) solves the problem of the semicolon, being a means of converting an ASCII value into the character it represents. It leaves Spellbinder macros with few limitations as an easy (if leisurely) means of text-handling, notably: the fact that you cannot save a disk directory as a text file and use macros for disk housekeeping; and the size of the text buffer (a 64k text version has been seen, but not sold).

My current macro is one to create dot-graphics on a daisywheel printer. It is a ridiculous task to give to a word processor — every time I draw a cow it looks like a dachshund — but I am far from convinced that even here macros have met their match.

Thanks to Geoff Wilkinson of Sierra Systems, 6 The Greenway, Epsom, Surrey KT18 7HZ, tel: (03727) 22890, for supplying an early copy of Spellbinder 5.30 and the Technical and Macro Manual.

A Spellbinder Users' Group exists which will enable users to pool their knowledge and experience, and to seek help and advice from other users, especially on advanced applications and macro programming. It will be a non-profit, self-help group but will be supported by the UK distributors, who have promised technical advice and assistance with publicity.

Interested readers should contact Dermod Quirke at PO Box 14, Newark, Notts NG24 4TP, or phone (0636) 77313 between 10am and 10pm for details.

Tom Vernon is a journalist and broadcaster, and is best known for his radio and TV travelogues. END

```
10 REM          SALVAGE.BAS TRIES TO SALVAGE TEXT FROM SPELLBINDER CRASHES
20 REM          SPELLBINDER TEXT MEMORY 5136-33462 APPROX IN SIRIUS
30 REM
40 PRINT CHR$(27);"E";
50 PRINT: PRINT: PRINT: PRINT "SALVAGE PROGRAM": PRINT: PRINT
60 PRINT "TO USE THIS PROGRAM, READ MEMORY FIRST TO CHOOSE WHERE TO START"
70 PRINT "AND WHERE TO STOP SAVING TEXT."
80 PRINT "THE FIRST POINT AT WHICH A KEY IS PRESSED DURING THE READ WILL"
90 PRINT "BE THE START: THE SECOND PRESS OF A KEY WILL CHOOSE THE END.": PRINT
100 PRINT "1.   Read memory, and choose starting and stopping points.": PRINT
110 PRINT "2.   Save chosen part of memory to disk.": PRINT
120 PRINT: PRINT "                                CHOOSE 1 or 2": PRINT
130 G$=INKEY$: IF LEN(G$)=0 THEN 130
140 IF ASC(G$) <49 OR ASC(G$)>50 THEN 120
150 IF ASC(G$)=49 THEN 170 ELSE 390
170 PRINT: PRINT "                          WHAT STARTING ADDRESS?": PRINT
175 PRINT:INPUT "        (For Spellbinder text - 5136 upwards) ",C
180 PRINT
190 PRINT "                          WHAT ADDRESS TO END?"
195 INPUT "      (For Spellbinder text - below 33250 - enter  RETURN )",D
196 IF D=0 THEN D=33250!
198 PRINT CHR$(27);"E": PRINT: PRINT: PRINT "              ** STARTING AT ";C;":
ENDING AT ";D;" **"
199 PRINT: PRINT "              ** PRESS A KEY FOR PRECISE START; AND AGAIN FOR END
**": PRINT
200 FOR A = C+1 TO D
210 B=PEEK(A)
220 IF B=3 THEN 230 ELSE 240
230 PRINT: PRINT "              ** POSSIBLE END OF A SPELLBINDER FILE HERE! **":
PRINT
240 IF B=13 THEN PRINT
250 IF B=14 THEN PRINT CHR$(32);
260 IF B<32 OR B>126 THEN 280
270 PRINT CHR$(B);
280 H$=INKEY$: IF LEN(H$)=0 THEN 330
290 IF I$ = "SET" THEN 360 ELSE 300
300 I$ = "SET"
310 C = A-124
315 PRINT: PRINT
320 A = A-160
330 IF A = C THEN 340 ELSE 350
340 PRINT: PRINT: PRINT "              ** STARTING ADDRESS SET HERE: AT ";C; " **":
PRINT
350 NEXT A
360 PRINT: PRINT: PRINT: PRINT: PRINT "          ** START-STOP ADDRESSES ARE ";C;"
TO ";A;" **"
380 GOTO 50
390 PRINT CHR$(27);"E": PRINT: PRINT "          ** START ADDRESS: ";C; " STOP
ADDRESS: ";A: PRINT: PRINT
400 PRINT: PRINT: PRINT: INPUT "                FILENAME FOR SAVED TEXT ";
FILE$
402 IF LEN(FILE$) = 0 THEN 400
405 PRINT: PRINT
410 OPEN "O",#1,FILE$
420 FOR F = C TO A
430 B = PEEK(F)
440 PRINT#1,CHR$(B);
450 IF B=3 THEN 480
460 IF B=13 THEN PRINT
465 IF B=14 THEN PRINT CHR$(32);
470 IF B<32 OR B>126 THEN 490
480 PRINT CHR$(B);
490 NEXT F
500 CLOSE #1
510 PRINT: PRINT: PRINT FILE$; " IS NOW ON DISC": PRINT
520 END
```

Fig 5 Basic program to PEEK memory and save contents to disk

Return to sender

A mystique prevails over the exact workings of an electronic mailbox. Peter Vekinis presents his own mail database program which thoroughly illustrates the procedures involved.

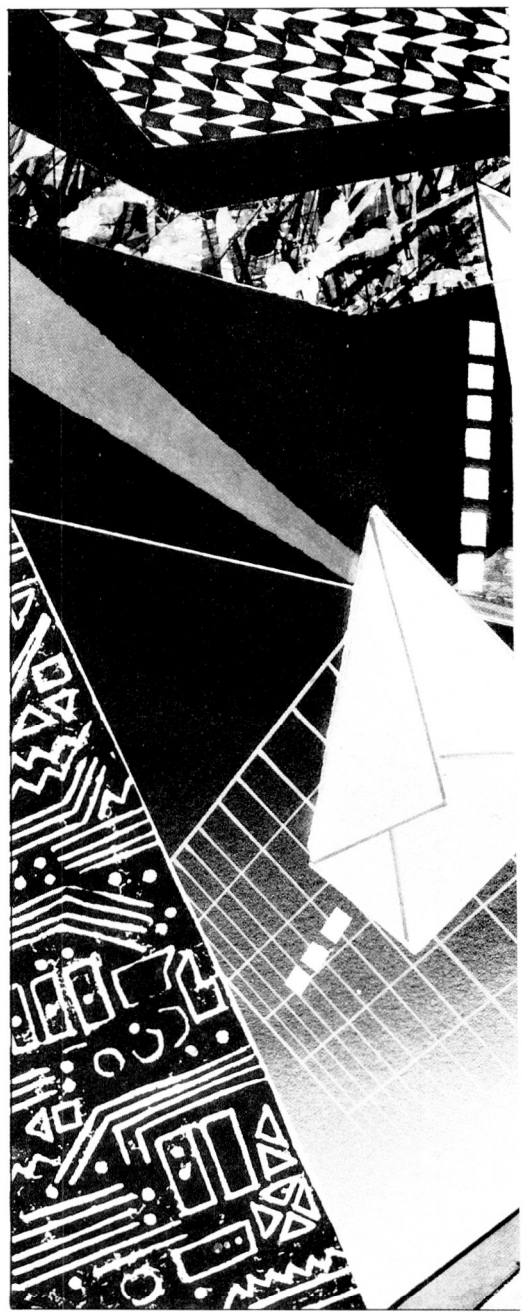


Illustration by Grahame Baker

The proliferation of personal computers in homes and offices over the last few years is the direct consequence of the never-ending search for increased productivity and improved communication by people around the world.

Although many facilities exist today that help the user type a letter, calculate a cheque or obtain a list of groceries, few possibilities exist to enhance communications needs. Mail has been the basic means of communication of millions for more than a century. The tie-in of mail and the personal computer would seem a natural evolution, but alas that is not the case.

Electronic mail companies do exist today; their service is a highly needed one and, in most cases, efficient. However, for most users electronic mail is something that resembles a mailbox. User A sends a letter to user B who, upon looking at his 'electronic' mailbox, reads the contents of the letter. Users do not know what actually takes place and how the letter goes from one place to another in the mailbox. All they have to do is dial a number, connect the personal computer to a remote computer system and send the letter after signing on. It seems that some kind of mystique prevails over the operation.

The program in Fig 3 illustrates in a pedagogigal way how an electronic mail program works. Although the program is mainly intended for illustrative purposes it can be used for on-site mail, and is designed in a way that permits easy expansion.

In use

Type the program into an appropriate computer (an IBM PC is ideal). When the program starts it asks for the date, and a menu appears from which the user is asked to select a function. The menu accepts various entries, each corresponding to a unique action as shown in Fig 1. Since this is the first time the program is run, press the '5' key, followed by the Enter (RETURN) key. This takes you to the system set-up code which will set up the required files used by the program.

Enter the password 'peter' as in Fig 3, or the password you have chosen, and the program will ask you for the number of sectors which indicates the maximum number of lines (each up to 80 characters long) the mail database can contain at any time. Type 100 and press RETURN. Then type in the name that you would like to call the mail database, and the system file will be initialised as shown by an appropriate message on the screen.

Operation Menu

1 = Send Message
2 = Get Message
3 = List Users
4 = Exit
5 = System Setup
6 = Display Data Base

Enter Action?

Fig 1 The operation menu

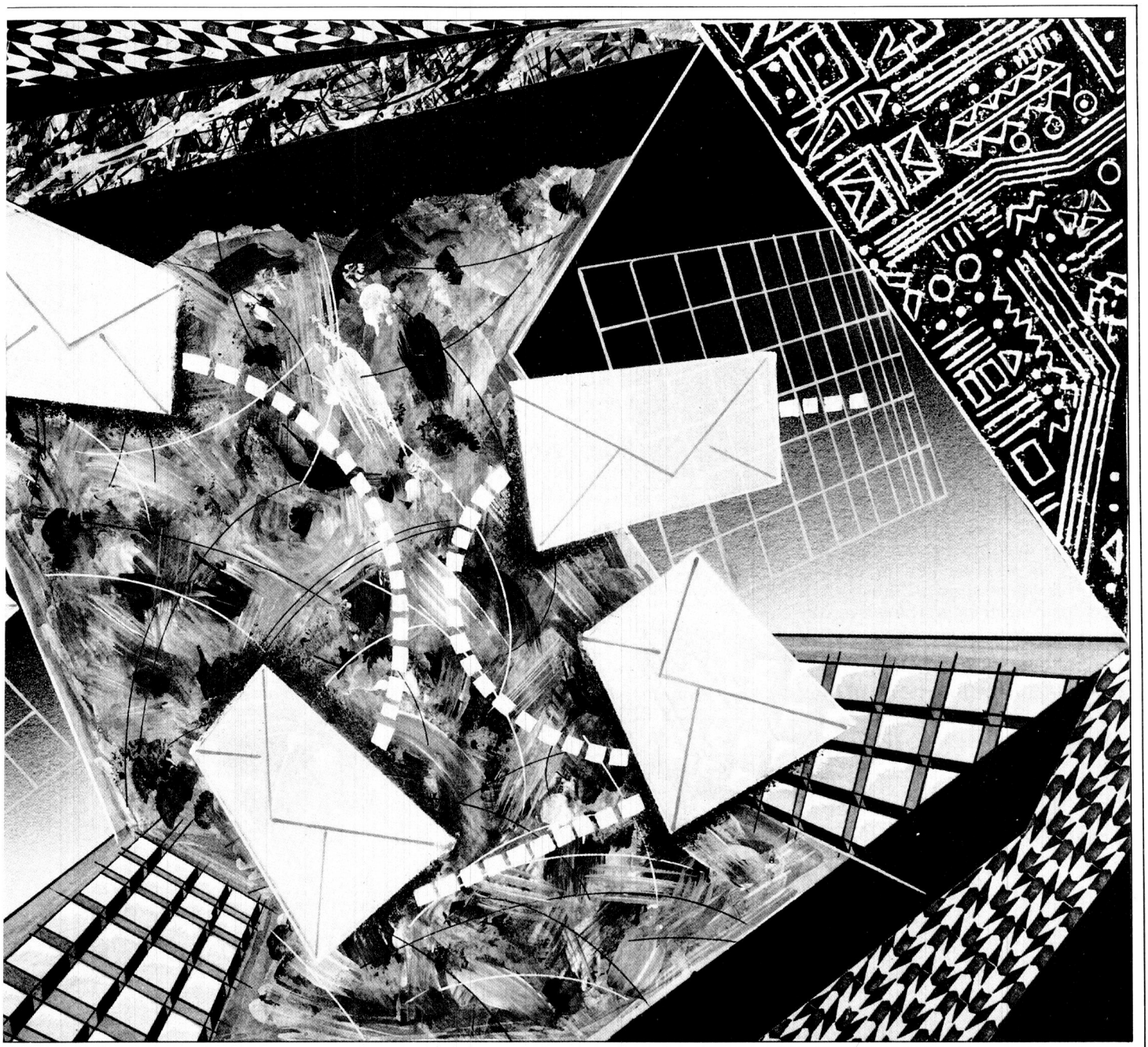
The program will then initialise the actual mail data file in a specific way called the 'sector availability sequence' (SAS), as well as keeping you informed of the sector being initialised.

The user list or directory is set up next, which requires you to enter the mail system users' names. You can enter a name up to 30 characters long, although only the first four are significant. When the names are entered, enter the name 'END' which signifies the end of the user list; a maximum of 20 names may be entered. The program has now finished the initialisation of the required files and you are taken back to the main menu.

To send a message, press the '1' key followed by RETURN and the program will ask you for the name of the message which may have up to 30 characters of text. The screen will be cleared and the program will wait for your message entry. The message is normally composed of lines which are terminated by the RETURN key, as on a typewriter. When the message is finished, the sequence "[@@@]" must be typed, which tells the program that the message entry is finished.

The user name must then be entered, which is a name that corresponds to one of the names entered in the user directory. At this point the program will return to the main menu and wait for another command.

To see the message on the user list, press the '3' key followed by RETURN and the user list will be shown. You will notice that the 'Cnt=' field of the line displaying the user's name selected shows the number '1', which means that one message is actually tagged to that user. Also, the 'Total cnt=' entry also has '1' as this is the first message.



System file 'SYSTEM.SYS'

Database name	Date created	Date last used	First free sector number	Last free sector number	Sectors used	Total sectors
(8 bytes)	(8 bytes)	(8 bytes)	(3 bytes)	(3 bytes)	(6 bytes)	(4 bytes)

User directory entry 'USER LIST'

User name	Date created	Count of current messages	Count of total messages	First sector pointer	Last sector pointer	Usage flag
(30 bytes)	(8 bytes)	(3 bytes)	(5 bytes)	(3 bytes)	(3 bytes)	(2 bytes)

Mail database 'MAIL.DAT' typical sector (record)

Previous sector pointer	Message name	Text data — line	Actual record pointer	Next sector pointer
(3 bytes)	(30 bytes)	(80 bytes)	(3 bytes)	(3 bytes)

Fig 2 The SYSTEMS.SYS, USERLIST and MAIL.DAT files

To read the message, press '2' after returning to the main menu: this takes you to the program part that reads messages for each user. Assuming that you are the target user, enter the user name used as the target name in the send operation, and the system will try to find the message. If you have entered the correct name, the system will ask you whether you want the message printed on a printer, at which point reply 'n' followed by RETURN. The last line on the screen (that is, the 25th line) will show the message name, while the message will be shown on screen. If the message exceeds 18 lines, the RETURN key must be pressed to continue the display. When the process is finished, the system will ask you whether you would like to accept the message or not. If you enter 'Y' the system will update the files, so for all practical purposes the message has been deleted (in reality it has not, as will be shown). Subsequent display of the user list will have a zero in the current count field although the total count field will contain a '1'.

If you enter anything but 'Y', the program returns to the main menu and

```
20 REM  ************************************************************
30 REM  *                                                          *
40 REM  *              IBM PC Electronic mail executive            *
50 REM  *                                                          *
60 REM  *             Copyright Peter P. Vekinis 1984              *
70 REM  ************************************************************
80 REM  *                                                          *
90 REM  *                  Micro Business Products                 *
100 REM *                 43 ave. De L'Observatoire                *
110 REM *                   1180 Brussels, Belgium                 *
120 REM *                     Tel : 02/ 375 3709                   *
130 REM ************************************************************
140 KEY OFF
150 REM The following opens the three files
160 GOSUB 2400
170 CLS
180 LOCATE 10,20
190 PRINT" IBM PC Electronic mail Package"
200 DA2$=DATE$:LOCATE 14,30:PRINT DA2$  'get the date and show it
210 LOCATE 25,70:PRINT TIME$
220 GOSUB 2380
230 CLS
240 GET #1,1     'get the system file from the disk
250 LOCATE 10,30         'show the startup menu
260 COLOR 8,1
270 PRINT"      Operation Menu"
280 LOCATE 13,25
290 PRINT"1 = Send Message"
300 LOCATE 14,25
310 PRINT"2 = Get Message"
320 LOCATE 15,25
330 PRINT"3 = List Users"
340 LOCATE 16,25
350 PRINT"4 = System Setup"
360 LOCATE 17,25:PRINT"5 = Exit"
370 LOCATE 25,70:PRINT TIME$
380 LOCATE 22,25:INPUT"Enter Action";A
390 COLOR 7,1:ON A GOTO 410,950,1520,1670,1530      'show the menu with
400 IF A < 1 OR A>4 THEN 230                        'highlight mode and
410 REM the send message code function
420 CLS                                             'check the input
430 IK=1                                            'if it is ok, then
440 CN3=CVI(PERCENT$)                               'check to see thet
450 IF CN3=(CVI(TOTSEC$)) THEN CLS:LOCATE 15,30:PRINT"Data Base Full":GOSUB 2380
:GOTO 230
460 LOCATE 10,10                                    'there is space in the
470 INPUT"Enter message name please";PNAM$          'data base to store
480 FREST=CVI(FRESTR$)                              'new messages and ask
490 GET #3,FREST                                    'for the message name.
500 TEMP=FREST                                      'get the first free
510 CLS:LOCATE 25,1:PRINT"Enter the text with CR at each line end. Enter [@@@] t
o end"
520 LINE INPUT TEX$                                 'record, and store it
530 LSET PNAME$=PNAM$                               'at the sector. Also
540 FREX=CVI(RECND$)                                'store the message
550 IF TEX$="[@@@]" THEN 640                        'name. If the string
560 GET #3,FREST                                    'indicates end of input
570 LSET PNAME$=PNAM$                               'then exit, else ensure
580 CN3=CN3+1                                       'that there is space on
```

Fig 3 Program which illustrates how an electronic mail program works

System file

Name	Date created	Date last used	First free sector	Last free sector	Sectors used	Total sectors
Mailbase	1984 0606	1984 0608	10	11	9	11

User name	Date created	Current MSG count	Total MSG count	First sector pointer	Last sector pointer	Flag
Peter		1	1	1	5	0

User name	Date created	Current MSG count	Total MSG count	First sector pointer	Last sector pointer	Flag
John		1	1	6	9	0

Mailfile

Message																										
Text																										
0	1	2	1	2	3	2	3	4	3	4	5	4	5	0	0	6	7	6	7	8	7	8	9	8	9	0	0	10	11	10	11	0

Previous record | Record number | Next record

Fig 4 The mail database with two users

Fig 3

```
590 IF CN3=(CVI(TOTSEC$)) THEN CLS:LOCATE 15,20:PRINT" Data Base Full - Force st
ore":GOSUB 2380:GOTO 640
600 LSET TEXT$=TEX$                                    'the data base.
610 PUT#3,FREST                                        'store the text and read

620 FREST=CVI(NEXTP$)                                  'the next free sector
630 GOTO 520                                           'which is pointed to by
640 CLS                                                'a field in the current
650 HHJ$=MKI$(FREX)                                    'record and loop.
660 LSET FRESTR$=NEXTP$                  'use the next pointer as the new first
670 GET #3,CVI(HHJ$)                     'available sector while ensure that
680 LSET NEXTP$=MKI$(0)                  'the next sector field of the current
690 LSET DATEL$=DA2$                     'sector is set to zero. Update the date
700 PUT #3,CVI(HHJ$)                     'and store the data.
710 LOCATE 15,30
720 INPUT" Send to ?";USE$               'ask for the user name and look for
730 RE=1                                 'it in the user list.
740 GET #2,RE
750 IF LEFT$(USE$,4)=LEFT$(USER$,4) THEN 780     'if the first 4 letters match
760 IF EOF(2) THEN 1550                          'then continue else show message

770 RE=RE+1:GOTO 740
780 PUNI=CVI(POIN$)                      'if the user already has a message
790 IF PONT1<>0 THEN GET#3,CVI(POINTE$):LSET NEXTP$=MKI$(TEMP):PUT #3,CVI(POINTE
$):GOTO 810
800 LSET POIN$=MKI$(TEMP)                'on the list then get the sector that
810 LSET POINTE$=HHJ$                    'is the last sector and update the next
820 CN=CVI(TOTCNT$)                      'sector number field. The messages are
830 CN=CN+1                              'now linked. Update the list pointers
840 LSET TOTCNT$=MKI$(CN)                'and the total sector counter.
850 CN1=CVI(CNT$)
860 CN1=CN1+1
870 LSET CNT$=MKI$(CN1)                  'also update the counter of messages
880 PUT #2,RE                            'for the user and store it in the
890 REM                                  'directory entry.
900 LSET PERCENT$=MKI$(CN3)
910 PUT #1,1
920 GOTO 230
930 REM
940 REM  The following code performs the get message function.
950 GET #1,1
960 CLS
970 LOCATE 10,10
980 CN4=CVI(PERCENT$)                                  'Get the number of sectors used
990 INPUT" Enter user name please";USE$                'and the user name
1000 CLS:RE=1
1010 GET #2,RE
1020 IF LEFT$(USE$,4)=LEFT$(USER$,4) THEN 1050         'If the first 4 letters match
1030 IF EOF(2) THEN 1580                               'then continue, else show error

1040 RE=RE+1:GOTO 1010
1050 PO=CVI(POIN$):IF PO=0 THEN CLS:LOCATE 15,30:PRINT"No messages":GOSUB 2380:G
OTO 230
1060 GET #3,PO                                         'get the sector pointed to by
1070 PO2=PO                                            'the user directory entry and
1080 CLS                                               'ask the user whether printed
1090 LIN=3                                             'output is needed for lprint.
1100 CLS:LOCATE 15,20:INPUT"Use the printer ?(Y or N)";ADR$:CLS:IF ADR$="Y" THEN
 VC=1 ELSE VC=0
1110 GET #3,PO                                         'Get the first sector and
1120 LOCATE 25,10:PRINT"Message name = ";PNAME$        'show the message name on screen

1130 IF EOF(3) THEN LOCATE 15,30:PRINT"no more - end of disk":GOSUB 2380:GOTO 23
0
1140 NEX=CVI(NEXTP$)                                   'Get the next sector by fol-
1150 IF VC=1 THEN LPRINT TEXT$                         'lowing the list pointers until
1160 LOCATE LIN,1:PRINT TEXT$                          'it is zero which means the end
```

the message remains in the system for further examination. Additional messages to the same user will be run consecutively, while messages for other users will be allocated accordingly.

Although one main file is used for the actual message information, the system always keeps track of the relation of the messages to the respective target users using pointers.

Database design

The correct allocation of the messages and user directory pointers relies upon the contents of three files used by the program. These files, whose structures are shown in Fig 2, are called the 'SYSTEM.SYS', the 'USERLIST' and the 'MAIL.DAT'.

The SYSTEM.SYS file is used to store the name of the mail database, the date of creation and the date of last use, the count of total sectors available for messages, the count of sectors used, and two pointers which give the number of the first and last available sector. In order to understand what the pointers do, it is better to know what the MAIL.DAT is made of.

When the program is used to initialise the database and the user is asked to enter the number of sectors required for

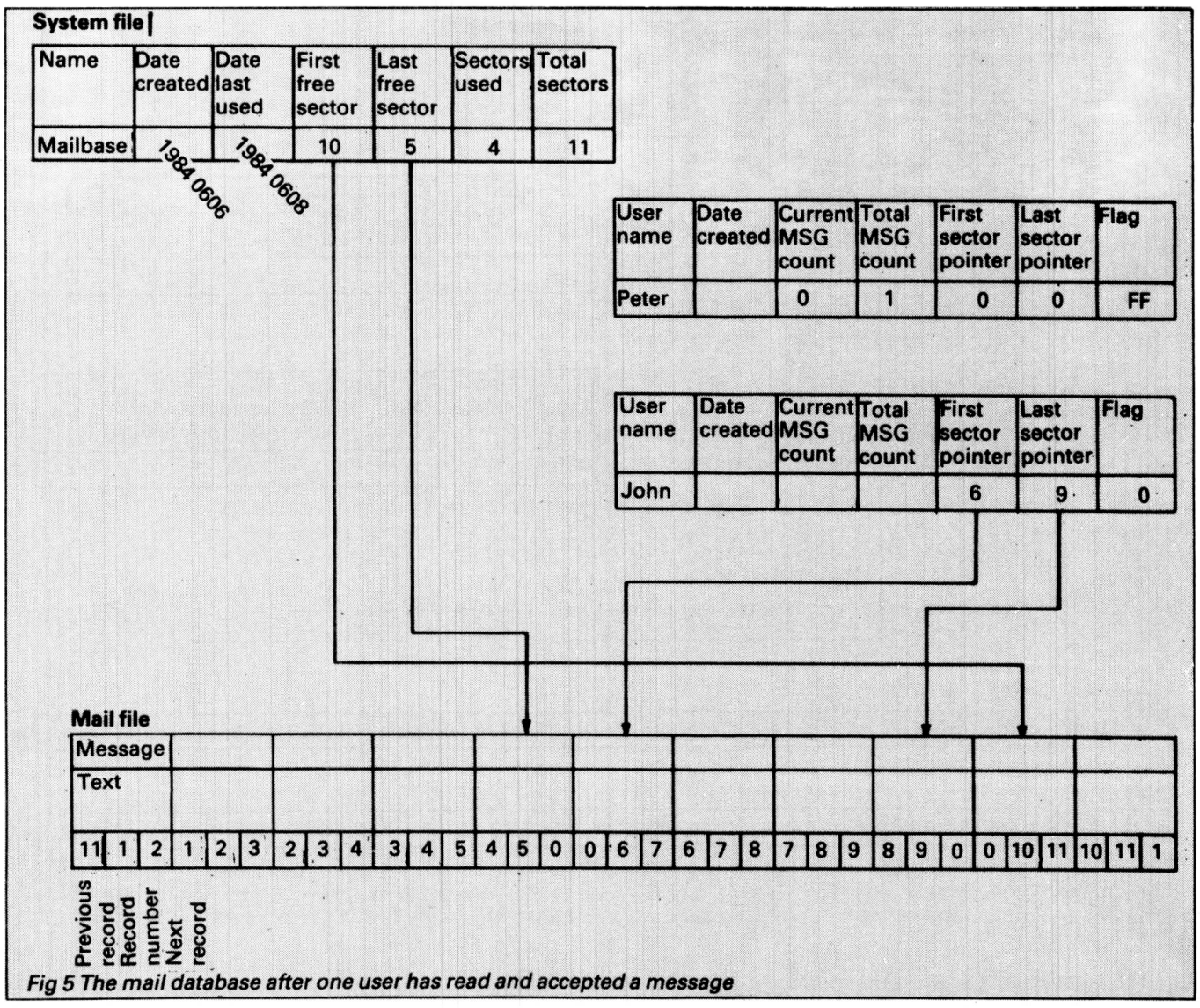


Fig 5 The mail database after one user has read and accepted a message

storage of messages, it creates what I call the 'sector availability sequence' (SAS) which is a way of tying sectors together so that they point to each other. The MAIL.DAT part of Fig 2 shows what a sector looks like as used for message storage. The first three bytes contain a pointer that points to the previous sector number if any or zero, if this is the first sector of the SAS or of a message.

The next 30 bytes are used to store the name of the message. Following that is the actual text, one line at a time. This is followed by a three-byte field containing the number of the actual sector, and another three-byte field that contains the next sector number if any or zero, if this is the last sector of the SAS or the last sector of the message.

Upon initialisation the pointers are sequential, starting from 1 up to the number specified. As no sectors are used (that is, no messages sent), the first free sector pointer of file SYSTEM-.SYS as shown at the top of Fig 2 contains 1, while the last free sector field contains 100, this being the last

Fig 3

```
1170 CN4=CN4-1                                          'of the message.
1180 IF NEX=0 THEN PRINT:PRINT:PRINT"-------------------------------------------
-------------------------":PRINT"All done":GOTO 1230
1190 PO=CVI(NEXTP$)
1200 LIN=LIN+1                                          'If the message is more than
1210 IF LIN=18 THEN PRINT:PRINT:PRINT:INPUT"Continue ?";CNU$:CLS:LIN=3:GOTO 1110

1220 GOTO 1110                                          '18 lines, then wait for key
1230 PRINT:PRINT:PRINT:PRINT                            'input to continue. When the
1240 INPUT" Accept the message (Y or N)";YE$            'message is finished, ask to
1250 IF YE$<>"Y" THEN CLS:LOCATE 15,25:PRINT"Message retained":GOSUB 2380:GOTO 2
30
1260 GET#2,RE                                           'accept it or not. If yes, then
1270 LSET POIN$=MKI$(0)                                 'update the user directory
1280 LSET POINTE$=MKI$(0)                               'pointers to zero and decrease
1290 CN3=CVI(CNT$)                                      'the current message counter.
1300 CN3=CN3-1
1310 LSET CNT$=MKI$(CN3)
1320 PUT #2,RE
1330 FR=CVI(FREND$)                                     'Update the sector pointers so
1340 LSET FREND$=MKI$(PO)                               'that the sectors freed end up
1350 GET #3,FR                                          'at the end of the availability
1360 LSET NEXTP$=MKI$(PO2)                              'list.
1370 PJ$=RECNO$
1380 PUT#3,FR
1390 GET #3,PO
1400 LSET NEXTP$=MKI$(0)                                'Zero the last sector's next
1410 PUT#3,PO                                           'sector pointer and update
1420 GET #3,PO2                                         'the sector counters of the
1430 LSET PREV$=PJ$                                     'system file as well as the
1440 PUT#3,PO2                                          'number of the first
1450 GET #3,CVI(FRESTR$)                                'sector available as pointed
1460 LSET PREV$=MKI$(0)                                 'to by the system file.
1470 PUT#3,CVI(FRESTR$)
1480 LSET PERCENT$=MKI$(CN4)
1490 PUT#1,1
1500 CLS:LOCATE 15,30:PRINT"All Done":GOSUB 2380
1510 GOTO 230
1520 GOTO 1610
1530 CLS:CLOSE
1540 END
1550 IF RE>20 THEN LOCATE 15,30:PRINT"No such user":GOSUB 2380:GOTO 710
1560 IF RE<20 THEN GOTO 640                             'If the user name is not there, show
1570 IF USE$="END" THEN 230 ELSE LOCATE 15,30:PRINT"No such user name":GOSUB 238
0:GOTO 710                                              'show error message
1580 IF RE>20 THEN LOCATE 15,30:PRINT"No such user":GOSUB 2380:GOTO 230
1590 IF RE<20 THEN GOTO 1040
1600 LOCATE 15,30:PRINT"No such user name : End of file":GOSUB 2380:GOTO 230
1610 K=1
1620 CLS:LOCATE 2,30:PRINT"User Directory"
1630 GET#2,k                                            'Show the user directory as long as the
1640 IF FLI$="FF" THEN PRINT:PRINT:INPUT" Ok ?";A$:GOTO 230     'flag is not FF
1650 PRINT"User name ";USER$;" Cnt=";CVI(CNT$);" Total cnt=";CVI(TOTCNT$)
1660 K=k+1:GOTO 1630
1670 CLS                                                'Come here to setup the system which starts by entering a
1680 LOCATE 15,30                                       'password
1690 INPUT" Enter Password please";ADF$
1700 IF ADF$="peter" THEN 1710 ELSE 230
```

System file

Name	Date created	Date last used	First free sector	Last free sector	Sectors used	
Mailbase	1984 0606	1984 0608	10	9	0	11

User name	Date created	Current MSG count	Total MSG count	First sector pointer	Last sector pointer	Flag
Peter		0	1	0	0	FF

User name	Date created	Current MSG count	Total MSG count	First sector pointer	Last sector pointer	Flag
John		0	1	0	0	FF

Mail file

Message																												
Text																												
11	1	2	1	2	3	2	3	4	3	4	5	4	5	6	5	6	7	6	7	8	7	8	9	8	9	0	0	10	11	10	11	1
Previous record			Record number			Next record																										

Fig 6 The mail database after both messages have been retrieved

Fig 3

```
1710 REM systems initialisation
1720 CLOSE
1730 CLS:LOCATE 15,20:PRINT"System initialisation - all previous data deleted"
1740 LOCATE 20,20:INPUT"Number of records ?";KJ          'Enter the number of
1750 OPEN "r",#1,"system.sys"                            'sectors to be used
1760 FIELD#1,8 AS SYSTE$,8 AS DATE1$,8 AS DATEL$,3 AS FRESTR$,3 AS FREND$,6 AS P
ERCENT$,4 AS TOTSEC$
1770 REM
1780 LOCATE 21,20
1790 INPUT"Please enter system name (less than 8 chars";NA$
1800 LSET SYSTE$=NA$
1810 LOCATE 22,20
1820 LSET DATE1$=DA2$                    'Enter the current date and set the
1830 LSET TOTSEC$=MKI$(KJ)               'total sectors to the count entered
1840 LSET FRESTR$=MKI$(1)                'and the free sector pointer to the
1850 LSET PERCENT$=MKI$(0)               'first sector of the availability
1860 LSET FREND$=MKI$(KJ)                'list. Set the sector used counter
1870 LSET DATEL$=DA$                     'to zero and the last date to the
1880 PUT #1,1                            'current date and update the file.
1890 CLS
1900 LOCATE 15,30
1910 PRINT"System initialized"
1920 CLOSE#1
1930 OPEN"r",#1,"mail.dat"               'Initialize the mail data base by
1940 FIELD#1,3 AS PREV$,30 AS PNAME$,80 AS TEXT$,3 AS RECNU$,3 AS NEXTP$
1950 REC=1
1960 CLS                                 'setting the message name to the string
1970 CNT=0                               'not-used and the message area to
1980 LSET PNAME$="Not-used"              'dots. The ensure that each sector
1990 LSET TEXT$=".....Not used yet.....
.....
2000 LSET PREV$=MKI$(CNT)                'has its sector number on it, a pointer
2010 LSET RECNO$=MKI$(REC)               'to the previous sector and a pointer
2020 LSET NEXTP$=MKI$(REC+1)             'to the next sector. Of course the
2030 PUT#1,REC                           'first sector has a previous pointer
2040 REC=REC+1                           'of zero and the last sector has a
2050 CNT=CNT+1                           'next sector pointer of zero.
2060 IF REC=KJ THEN 2090
2070 LOCATE 15,15:PRINT"Initialising data areas - stand-by  \\ Record no=";REC
2080 GOTO 2000
2090 LSET PREV$=MKI$(CNT):LSET RECNO$=MKI$(REC)
2100 LSET NEXTP$=MKI$(0):PUT#1,REC:CLS
2110 LOCATE 15,30:PRINT"Data area initialization finished"
2120 PRINT
2130 CLOSE #1
2140 REM user list                       'After initializing the data area, the
2150 OPEN "r",#1,"userlist"              'user list is done. The name is entered
2160 FIELD#1,30 AS USER$,8 AS DATEIN$,3 AS CNT$,3 AS POIN$,5 AS TOTCNT$,3 AS POI
NTE$,2 AS FL1$
2170 CLS                                 'and the pointers are updated as
2180 PRINT                               'required. All the pointers are set
2190 DF=1                                'to zero and the flag is set to 0 which
2200 C=1                                 'denotes the entry is valid. If the
2210 LOCATE 10,30:PRINT"User list initialization"        'name is the string
2220 LOCATE 20,10:INPUT"Enter user name or 'END' to exit";NA$
2230 LSET USER$=NA$                      'END then the user listing is done.
2240 LSET FL1$="00"
2250 LSET DATEIN$=DA2$                   'A maximum of 20 users are allowed.
2260 LSET TOTCNT$=MKI$(0)                'ALL THE POINTERS are reset and the
2270 LSET POIN$=MKI$(0)                  'process continues until the string
2280 LSET POINTE$=MKI$(0)                'END is typed in which in fact
2290 LSET CNT$=MKI$(0)                   'becomes the last entry with the flag
2300 IF NA$="END" THEN LSET FL1$="FF":PUT#1,C:GOTO 2350 'set to FF.
2310 IF C>19 THEN LOCATE 24,30:PRINT"Too many users":GOSUB 2380:CLOSE #1:RETURN
2320 PUT#1,C
2330 C=C+1
2340 CLS:GOTO 2210
2350 CLOSE #1
2360 CLS:LOCATE 15,30:PRINT"User directory done":GOSUB 2380
2370 CHE=1:GOTO 150
2380 FOR DLY=1 TO 1500:NEXT DLY                  'The delay routine waits a few
2390 RETURN                                      'seconds before continuing
2400 OPEN "r",#1,"system.sys"                    'The file definitions
2410 FIELD #1,8 AS SYSTE$,8 AS DATE1$, 8 AS DATEL$, 3 AS FRESTR$,3 AS FREND$,6 A
S PERCENT$,4 AS TOTSEC$
2420 OPEN "r",#2,"userlist"
2430 FIELD #2,30 AS USER$, 8 AS DATEIN$, 3 AS CNT$,3 AS POIN$,5 AS TOTCNT$, 3 AS
  POINTE$, 2 AS FL1$
2440 OPEN "r",#3,"mail.dat"
2450 FIELD #3,3 AS PREV$, 30 AS PNAME$, 80 AS TEXT$, 3 AS RECNO$,3 AS NEXTP$
2460 RETURN
```

sector number. Also, the total sectors used field is zero, while the total sectors available field is 100.

At this point, the system points to the part of the MAIL.DAT file that can be used for storing messages. As no messages have been entered, all the data file sectors are available for text storage. The user directories are initialised by entering the user's name and setting a usage flag to 00 instead of FF. You will notice that the user directories contain additional pointers as well as counters; these are all set to zero during initialisation.

Let's assume that we have a database with a maximum of 11 sectors (as defined upon initialisation), and that one message containing five lines has been sent to a user called 'peter' and another message, four lines long, has been sent to user 'john'. The situation is shown in Fig 4.

The bottom part shows a schematic view of the MAIL.DAT file with sectors and their pointers with the necessary numbers. The first sector's 'previous sector pointer' has a zero in it, meaning that this is the first sector in the message or list. Sector five has a 'next sector pointer' filled with zero, meaning the end of the message. As this message was sent to user 'peter', the first sector pointer field in the directory of 'peter' contains the number 1, denoting sector 1 and the first sector of the message. The last sector of this message is five and is shown as such in the directory. The same is used for the second message, except that it is four lines or sectors long and that it belongs to user 'john'.

The main file SYSTEM.SYS has the first free sector pointing to sector 10 while the last available sector points to sector 11: that is, there are two free sectors in the database.

'Although many facilities exist today to help the user type a letter. . . or obtain a list of groceries, few possibilities exist to enchance communications needs.'

How are all these pointers used? When the user wants to read a message allocated in directory 'peter', the system will read the first sector pointed to by the directory entry, that is '1', and shows it onscreen The 'next sector pointer' is used to get the next sector until it contains a zero which denotes the end of the message. If the reader of the message decides to accept it, the pointers are updated as shown in Fig 5.

The directory entry for the user 'peter' is set to unused by setting the flag to 'FF'. The current counter is reset while the pointers are set to zero since no messages are in the database for the user now. The available sector count in the SYSTEM.SYS file is increased by the number of sectors contained in the message just read (that is, increased by five) while the first free sector pointer still points to sector 10 as before. However, as the program puts the sectors of the last read message to the 'end' of the SAS, the last free sector pointer now points to sector 5. Notice that in order to keep the SAS continuous, the pointers have been updated accordingly with the 'next sector pointer' of sector 11 showing 1 and the 'previous sector pointer' of sector one displaying 11. The message for user 'john' is not touched during this updating operation.

If 'john' decides to read the message as well, the pointers are further updated as shown in Fig 6. All the sectors are available, although the sequence for using the sectors in new messages changes.

Although the extensive use of pointers makes the program difficult to track, its versatility and secure database arrangement compensates for the difference. The data in the database may not only be messages, but any other form of data that must be allocated to a specific user or keys. Also, the use of SAS in the database is an efficient means of allocating sectors for data, as well as ensuring that deleted or accepted data, in the case of the mail program, is still on disk.

Conclusion

The program does not contain any software to drive a machine's communications ports, as it is mainly intended to illustrate the techniques involved when dealing with electronic mail database design. Such software may be placed instead of the code used to get the text from the console as well as the code used to display the text. Additionally, better password protection and accounting code may be implemented for user versatility.

Many of the techniques shown in this program, especially in the case of the pointer handling, may be used in other forms of database types. Writing programs with pointers is not easy due to the large number of variables processed, however, the use of pointers in such applications permits extreme flexibility as well as additional protection in case of faults. This protection alone is worth the trouble—there is no worse error in a database than unexplained data loss.

Program notes: the listing in Fig 3 is for the IBM PC Basic but can easily be modified to run on other machines. The program uses random files which are available with most versions of Microsoft Basic. Please note that the LOCATE command is used on the IBM PC to place the cursor at the required row and column. **END**

Finding the way

Tackling algorithmic problems with your micro can be fun — Marcus Jeffery explains various methods of defining problems by using a calculation program and mathematical functions.

Imagine a number of plane figures, each made up of five equal-sized squares. These are the pentonimoes, 12 of which are shown in Fig 1, making up a 6 × 10 square. Now write a program to find all the possible ways of arranging the pentonimoes so that they form a 6 × 10 rectangle. Although writing the program may not be too difficult, the computation time is likely to be rather high with over 39916800 possibilities. This can be calculated by placing one of the 12 pieces, then one of the remaining 11, and so on, giving 11 × 10 × 9 × 8 × 7 × 6 × 5 × 4 × 3 × 2 × 1, written as 11! (factorial) possible solutions. This ignores the fact that each piece may be placed anywhere on the board and each may be rotated.

Problem-solving

Another problem with similar complexity is the Travelling Salesman Problem. Here, you are asked to plan the optimal route for a salesman who must visit a number of cities. For example, suppose you were given the map in Fig 2, with eight cities and the distances between them (Fig 3). Find the shortest possible route that passes once through all the cities and returns to the starting point. Obviously, because you have to eventually pass through all the cities, you can choose any starting point and still be sure of the shortest solution. If you now continue to measure all the possible routes and take the shortest, you're sure to get the best route. If you've done this fully, you'll have covered 7! (or 5040) different routes.

The program (Fig 4) will do all these calculations for you. Rather than having reams of output, PROCprint only outputs any information when it finds a route shorter than its previous shortest possible circuit. By covering all routes, this ensures that the final output is the shortest route.

Now imagine that there are 100 cities, instead of the eight in the example. This more likely situation gives 99 possible routes, which Fig 5 shows to be quite a few possibilities. Even the fastest computers would require days, or perhaps weeks, of computation for these larger problems. One way of avoiding this might be to always consider the nearest cities, but you'll soon discover that this does not guarantee the best solution. In fact, although other algorithms do exist for this problem, they are not much better than the method we have already used. It is thought that no efficient algorithms can ever be produced for this problem, but no-one has yet been able to prove this.

By working through the travelling salesman problem, we have been able to speculate that an optimal solution for 'a large number of cities' would take 'too long' to compute. This is, however, a little vague, and we really need a more general method for evaluating and comparing algorithms. To do this, we imagine that a particular algorithm is supplied with more and more inputs (cities in the above example) and measure the increases between the execution times. This rate of increase can then be used as a measure of the efficiency of the algorithm.

In the case of the travelling salesman problem, the route increases for 'n' cities can be shown by the function $f(n) = (n-1)!$. Thus, 24 routes would have to be considered for five cities, 120 routes for six cities, and so on. Other problems have functions with similar growth rates, such as 2^n and n^n, all of which can be said to have exponential growth rates. Other problems, where n doesn't appear as a factor of the exponent, are said to have polynomial growth rates. Typical examples of these are $5n$, n^n, n^3, and so on. If n is sufficiently large, any exponential-time algorithm will take longer to compute than an algorithm with polynomial time. In most cases, only polynomial-time algorithms are considered fast enough to implement for general applications. This system of classification has the added advantage of being independent of the machine the algorithm is run on.

Another problem, closely related to the travelling salesman problem, that can again only be solved using exponential-time algorithms, is the Hamiltonian Circuit. Consider the graph in Fig 6. The problem is to discover a path which travels through all the nodes once, finishing at the starting node. In this particular case it is very easy: the path 1,2,3,4,5,1 will do. Now try the slightly more complex case shown in Fig 7. If you finally give up, then I must tell you that no such circuit exists. This can easily be shown by naming the three top nodes of type A, and the five bottom nodes of type B. Then you'll realise that no node is directly connected to a node of the same type, so all routes must be of the form A to B, or B to A. We need to produce a circuit containing seven routes and finishing at a node of the same type as the start node, which is impossible. We can easily transform the Hamiltonian Circuit problem into the travelling salesman problem. Firstly, construct a 'complete graph' by connecting each point to every other point, then assign a cost to each line (the distance between the cities). The Hamiltonian Circuit with least cost is now the solution.

Let's consider a very similar problem: that of finding a route which traverses each line (as opposed to each point) of a graph exactly once, known as a Eulerian Path. A classic problem of this type is that of the Konigsberg Bridges (Fig 8). During the 18th century, the (then German) city of Konigsberg had a park built on the banks of a river. The banks were connected to two islands via the bridges shown in the diagram. The problem here is to decide whether or not a path exists which will cross all the bridges once and only once. The problem can be reduced to the graph given in Fig 9, since the size of the islands and the bridges does not really matter.

Again, the obvious method would be to list all the possible routes, starting from each of the four locations, and see if any of them met the requirement. This would be an exponential-time algorithm but would be sure of finding a route, if one existed. Unlike the previous problems, however, this one does have a polynomial-time solution. Euler was able to show that all graphs with the following conditions have Eulerian Paths:

(a) The graph must not be disconnected. In other words, it must be possible to travel from any point on the graph to any other point by following the lines of the graph.

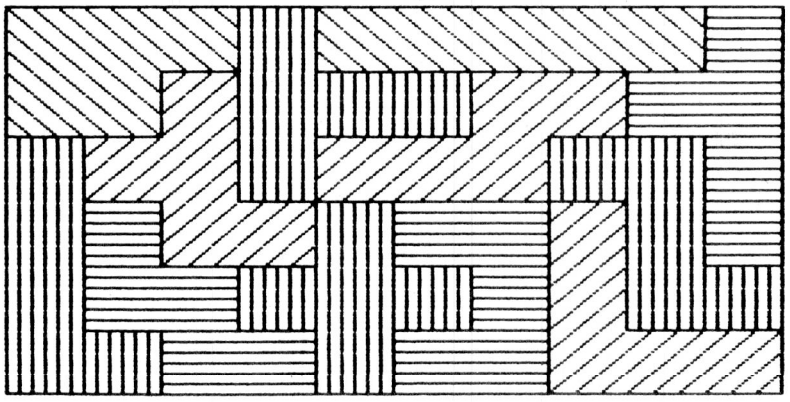


Fig 1 12 pentonimoes



Fig 2 A map showing the location of eight cities

Aberdeen						
420	Birmingham					
493	81	Bristol				
125	292	373	Edinburgh			
341	93	181	218	Liverpool		
503	105	115	378	202	London	
547	128	76	421	221	77	Southampton
319	130	211	194	99	193	245 York

Fig 3 Mileage chart

(b) Either all graph points must be at the junction of an even number of lines, or exactly two points must be connected by an odd number of lines.

It is clear that to have a Eulerian Path, it must be possible to reach all parts of the graph as specified in condition (a). If each point has an even number of lines, it is possible to use half of them to reach the point and the other half to leave it, thus forming a path. The exception to this is where two nodes have an odd number of lines, in which case they must be the start and end points. This explains why a graph containing a Eulerian Path must meet these requirements, but Euler was able to go further than this. He was able to prove that any graph meeting these requirements must have a Eulerian Path.

Conseqently, there is no solution to the Konigsberg Bridge Problem. However, if you were to take any one of the bridges away, then the graph meets the requirements and you should be able to find a path. Try testing the graphs given in Fig 10, which are of the common 'draw without lifting your pen from the paper' type.

The Turing Machine

In the 1930s a British mathematician, AM Turing, studied these and many other algorithms. His intent was not to solve them, but to investigate which problems could be solved, and which could not. Using an imaginary computing device known as the Turing Machine, he was able to show that there are some problems for which no algorithmic solutions exist. Other problems, he was able to divide into two groups. We have already seen these: those for which polynomial-time algorithms exist; and those which can (at present) only be solved by inefficient exponential-time algorithms. However, as we have seen, it is sometimes very difficult to assign a problem to one of these groups.

The hypothetical machine which Turing devised is known as a Deterministic Turing Machine. In essence, this can be regarded as a single processor. The machine, though very simple, was able to perform any calculations currently carried out by computers. Any problems which could be implemented using a polynomial-time algorithm on the Deterministic Turing Machine could also be computed in polynomial time on a computer. In our classification of algorithms, these are said to belong to the class P (for Polynomial).

Turing then devised a slightly different machine, known as a Nondeterministic Turing Machine. This machine is quite 'clever' in that if faced with a number of possible choices, it will always choose the correct one in order to solve the problem. In some ways, this could be considered to be a machine with an infinite number of parallel processors. Whenever the machine is faced with a choice, it merely gives each possibility to a different processor. In

```
  10 DIM Distance%(7,7),City$(7)
  20 :
  30 REM ** Read array values **
  40 :
  50 FOR I%=0 TO 7
  60   FOR J%=0 TO I%
  70     READ Miles%
  80     Distance%(I%,J%)=Miles%
  90     Distance%(J%,I%)=Miles%
 100     NEXT:NEXT
 110 :
 120 FOR I%=0 TO 7
 130   READ City$(I%)
 140   NEXT
 150 :
 160 DATA   0
 170 DATA 420,  0
 180 DATA 493, 81,  0
 190 DATA 125,292,373,  0
 200 DATA 341, 93,161,216,  0
 210 DATA 503,105,115,378,202,  0
 220 DATA 547,128, 76,421,221, 77,  0
 230 DATA 319,130,211,194, 99,193,245,  0
 240 DATA Aberdeen    ,Birmingham
 250 DATA Bristol     ,Edinburgh
 260 DATA Liverpool   ,London
 270 DATA Southampton,York
 280 :
 290 REM **** Main program ****
 300 :
 310 DIM Visited%(7)
 320 Best_Route%=9999
 330 PROCvisit(0,0,1)
 340 END
 350 :
 360 REM **********************
 370 :
 380 DEF PROCvisit(From%,Mileage%,Number%)
 390 LOCAL To%
 400 Visited%(From%)=Number%
 410 FOR To%=0 TO 7
 420   IF Visited%(To%)=0 THEN PROCvisit(To%,Mileage%+Distance%(From%,To%),
Number%+1)
 430   NEXT
 440 IF Number%=8 THEN PROCprint(Mileage%+Distance%(From%,0))
 450 Visited%(From%)=0
 460 ENDPROC
 470 :
 480 REM **********************
 490 :
 500 DEF PROCprint(Mileage%)
 510 IF Best_Route%>Mileage% THEN Best_Route%=Mileage% ELSE ENDPROC
 520 PRINT"======================="
 530 PRINT"Mileage: ";Best_Route%;"  Route is:"
 540 FOR I%=1 TO 8
 550   FOR J%=0 TO 7
 560     IF Visited%(J%)=I% THEN PRINT"  -->  ";City$(J%)
 570     NEXT:NEXT
 580 PRINT
 590 ENDPROC
```

Fig 4 The calculation program

```
933, 262,
154, 439, 441, 526, 816, 992, 388, 562, 667, 004,
907, 159, 682, 643, 816, 214, 685, 929, 638, 952,
175, 999, 932, 299, 156, 089, 414, 639, 761, 565,
182, 862, 536, 979, 208, 272, 237, 582, 511, 852,
109, 168, 640, 000, 000, 000, 000, 000, 000, 000
```

Fig 5 99 is a big number . . .

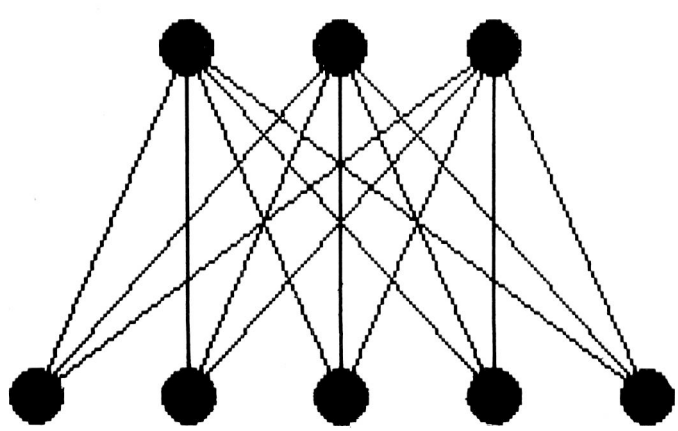


Fig 7 Does this graph have a Hamiltonian Circuit?

the end, one of the processors must find the correct solution, if one exists. For example, our travelling salesman, starting at Aberdeen, is faced with seven possible choices (the remaining seven cities). Each possibility is given to a different processor, which is then faced with six possibilites. These are also shared out, and so on, until all the possibilities have been considered. One of these processors will clearly find the optimum route because all possible routes will be considered. The problem can be completed in polynomial time on a machine of this type; thus, these problems are classified as NP (Non-deterministic Polynomial.

Unfortunately, a machine of this type could never actually be built. Although the example with eight cities would only need 5040 parallel processors, a computer capable of handling 100 cities would require more processors than there are atoms in the universe!

Based upon this classification (shown by the Venn diagram in Fig 11), it is clear that all problems in the class P are also in the class NP. In other words, all problems which can be computed in polynomial time on a deterministic machine could also be calculated on a nondeterministic machine. However, it is not necessarily the case that NP problems are also in the class P. If this were the case, then the classes P and NP would, in fact, be the same. Unfortunately, mathematicians have so far been unable to prove this one way or the other, and it is now generally thought that the two classes are indeed different. At first sight, Euler's Problem may have appeared to be in the class NP, but it has since been proven to be in the class P because it does have a polynomial-time solution. It may be that other problems, presently in the NP class, will also be found to lie in P.

Another subset of the NP class of problems is known as NP-Complete. It is often found that NP problems have some relationship to each other. For example, as we have seen, the travelling salesman problem could be regarded as finding the least-cost Hamiltonian Circuit on a graph where each point is connected to every other point.

Using a mathematical language known as Propositional Calculus, the mathematician SA Cook was able to describe the workings of a Nondeterministic Turing Machine. From this, mathematicians have been able to show that a number of NP problems are special in that they can all be converted to a common problem in propositional calculus. What's more, this conversion is in polynomial time. It follows from this, that if a polynomial-time solution to any of the NP-Complete problems could be found, then it could be used to solve all NP problems.

Solutions

This theory is all very clever, but not much help to the poor computer scientists who still have to implement these problems. Consequently, many methods of finding sub-optimal solutions have been developed. These are usually of two types, both of which have the advantage of being computable by polynomial-time algorithms.

The first type are those that guarantee solutions near to the optimal in all cases. For instance, the travelling salesman problem has already been demonstrated to lie in the class NP (unless you can prove differently, of course!), so a number of sub-optimal solutions are used. One technique is guaranteed to provide solutions which are no more than twice the optimum length. This process is shown in Fig 12, and consists of the following steps:

(a) Generate a Minimum Spanning Tree to connect the cities. This is done by connecting the closest cities, then the next closest, and so on, but a connection is only made if the city is not already connected to the graph.

(b) Each of these lines is then traversed in both directions to form a cyclic route.

The Minimum Spanning Tree, which is generated in polynomial time, is known to be shorter than the length of an optimum tour. This can easily be seen by finding the optimum tour (using the program in Fig 4), then omitting any one of the lines. This will form a spanning tree of shorter length, so the minimum spanning tree must be shorter than any possible tour. Consequently, traversing this tree in both directions will give a tour which is less than twice the optimum. The tour shown in Fig 12 (b) can then be further improved by taking short-cuts. This is done where cities are visited twice (that is, in both directions), where the two lines travelling in one direction can be reduced to one line which bypasses the city.

Techniques also exist which will give solutions to the majority of problems. This type of solution arises because in most practical cases the problems are not the worst cases. For example, if you were given the city layout shown in Fig 13, the shortest path is fairly obvious without having to work through the 15! possible routes. For large maps, one typical method is to divide the map into a number of territories, calculate a route for each, then join the territories. If, for example, a map contained 26 cities, an exhaustive search would be required to check 25!, or 1.55×10^{25} (approximately) possible routes. If this map were split into the areas, as shown in Fig 14, then an exhaustive search of each area would only have to analyse 3! + 4! + 3! + 4! + 3! + 3!, or 72 possible routes. Another algorithm is then known to connect the areas together in polynomial time.

Many other problems exist for which only NP solutions are known. How

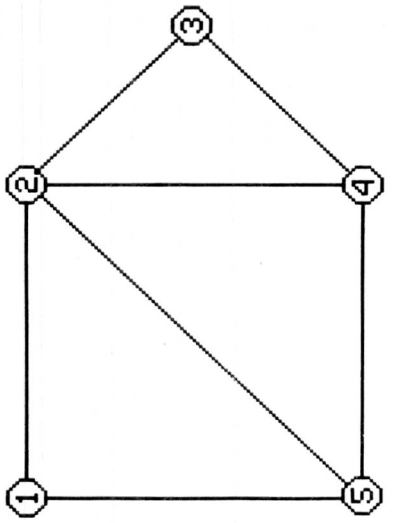


Fig 6 A Hamiltonian Circuit graph

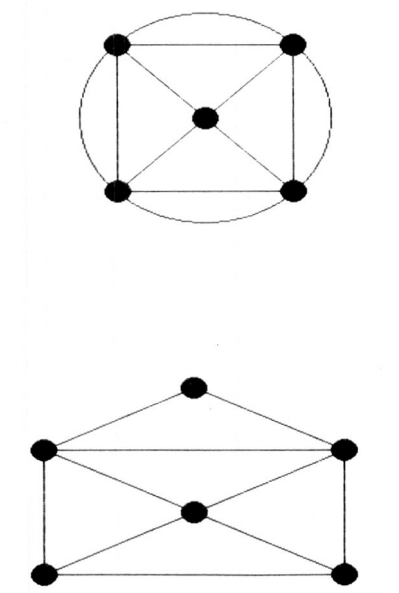


Fig 10 Graphs to test Euler's Problem

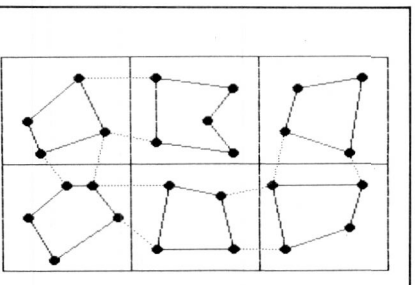


Fig 14 A map of 26 cities split into areas

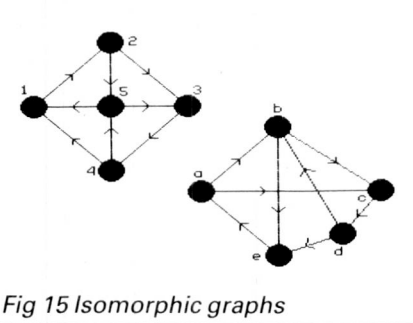


Fig 15 Isomorphic graphs

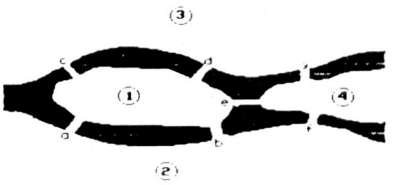


Fig 8 The Konigsberg Bridges

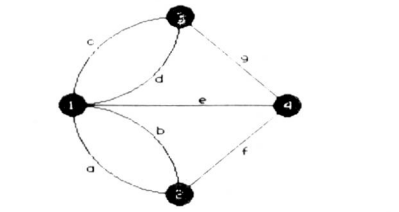


Fig 9 Euler's Problem

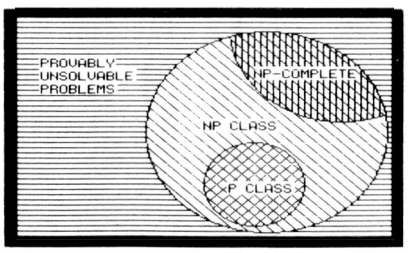


Fig 11 A Venn diagram

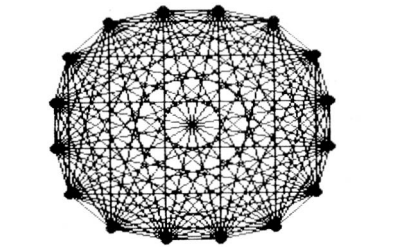


Fig 13 A city layout

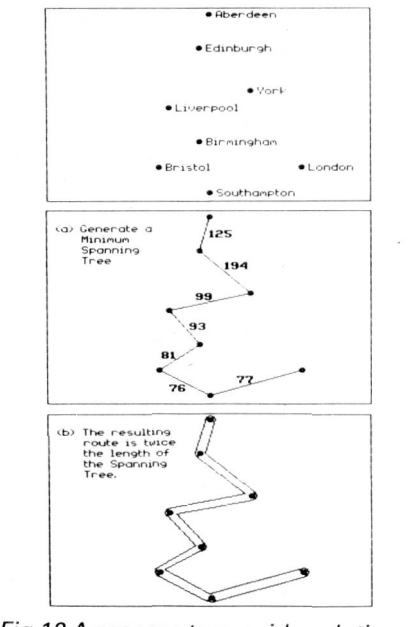


Fig 12 A process to provide solutions of no more than twice an optimum length

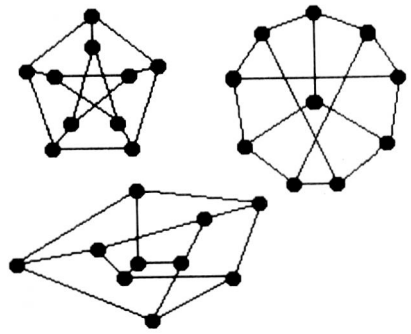


Fig 16 Are these graphs clearly isomorphic?

many colours are required to colour a given map, such that no two adjacent areas have the same colour? It is fairly easy to see if a map can be coloured by one or two colours, and it was known for many years that five colours were sufficient to colour any map. However, no-one has been able to produce a map requiring more than four colours, and it was recently proven that four colours were indeed sufficient. However, choosing between three and four colours is still an NP problem. Look back to the pentonimoes in Fig 1. They have been coloured using four shades, but can they be coloured using only three?

The Knapsack Problem involves placing a number of objects into a knapsack without exceeding the capacity of the knapsack. Each object has a weight and profitability; the idea being to find the best possible combination of objects which maximise the profit. The exhaustive solution would require picking each of the original objects, followed by any of the remaining objects, and so on.

Two graphs are said to be isomorphic if there exists a direct mapping between the points and lines in each graph. To see this more clearly, consider the two graphs shown in Fig 15. Although appearing dissimilar, they are isomorphic, and graph A can be transformed into graph B by changing the following points:

1 = c, 2 = d, 3 = e, 4 = a, 5 = b

It is possible to reduce this problem using some techniques. For example, if the graphs are isomorphic, then they must have an equal number of points and lines, and each point must have the same number of lines emanating from it. Many other techniques exist which will work with specific types of graph, but the best general solutions still take exponential time to compute. Is it clear that the three graphs shown in Fig 16 are isomorphic?

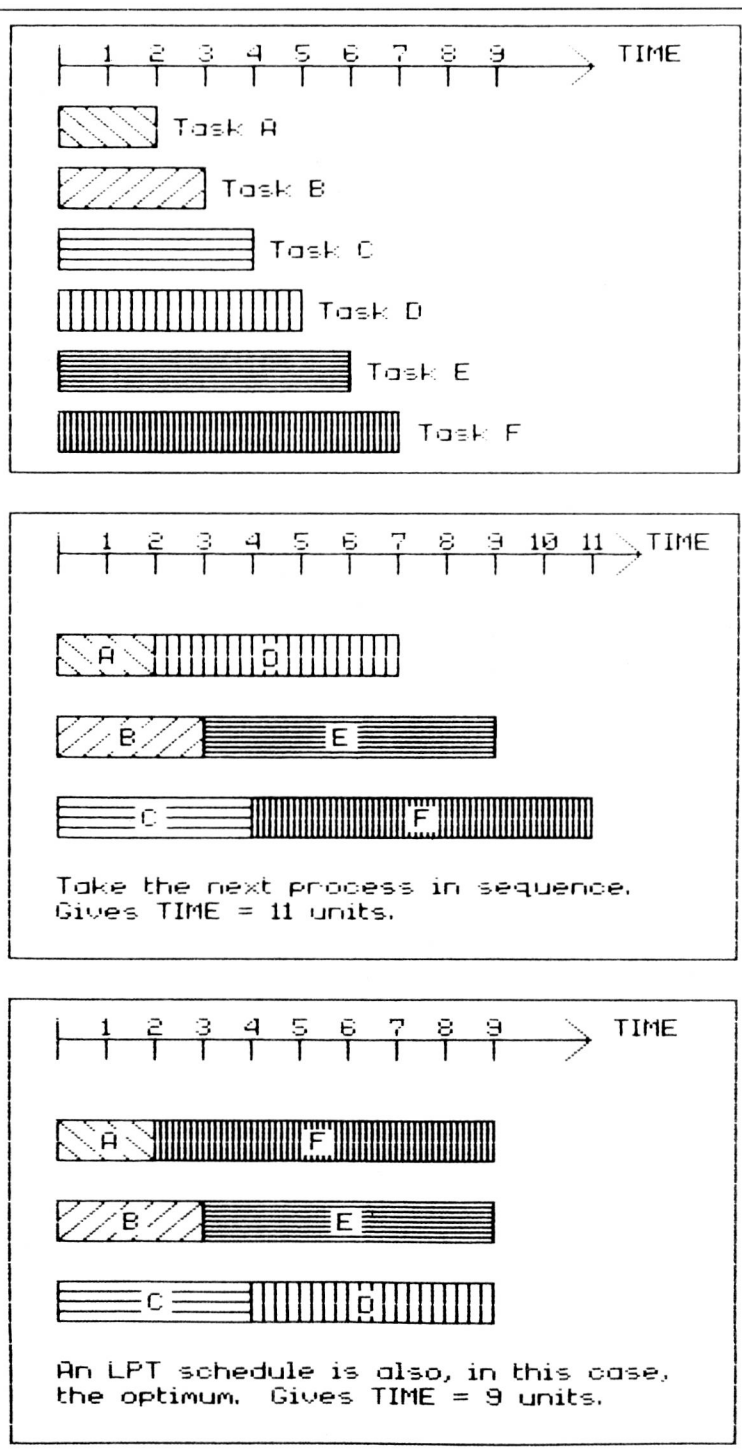


Fig 17 Tasks for a multi-tasking computer system with three processors

Conclusion

A multitude of other problems exist, but let's finish by considering a problem of particular interest to computer software designers.

Imagine a multi-tasking computer system with three independent processors, each of which is capable of handling any particular job. Imagine that the three processors are given the tasks shown in Fig 17. If, each time a processor became free, it just took the next available job in the queue, then the overall finish time would be 11 units. However, by using a system known as LPT scheduling (Longest Processing Time) the overall time can be reduced to nine time units, which in this case is also the optimum. Using the LPT rule, whenever a processor becomes free, it will always take the job with the highest processing time.

The LPT system will not always produce an optimum ordering but it can be implemented using a polynomial-time algorithm, whereas an exhaustive search would be in exponential time.

Many problems which may appear to be quite difficult can be solved using such techniques as Divide-and-Conquer, Dynamic Programming, Backtracking, and Branch-and-Bound. But some problems defy all the best efforts to find polynomial-time solutions. It is these, and especially those lying in the NP-Complete class, which pose the real questions. Is NP identical to P? END

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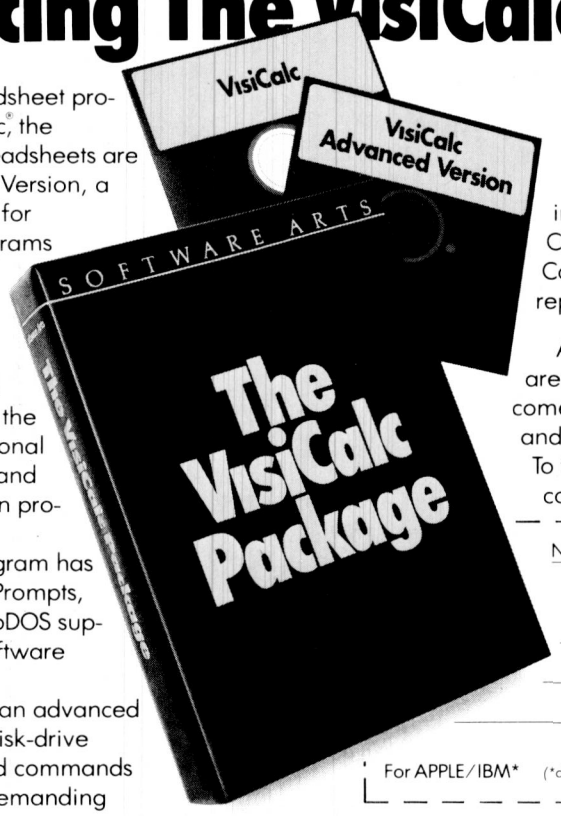

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Microsoft Word

Word, Microsoft's word processor, has at last found a machine to complement its very individual features — the Macintosh. But is it a perfect marriage? Kathy Lang finds out.

Among the packages available on the Mac, Microsoft's Word is rare in having been available for quite a while, rather than being specially written. Yet, in some respects, Word could be said to have been waiting for just such a machine to come along — many of its features are beyond the capacity of most hardware to provide a structure which will make them as appealing as they deserve. For example, Word provides the ability to use a wide variety of fonts and font sizes, and to display these on the screen, but few systems can match this functionality.

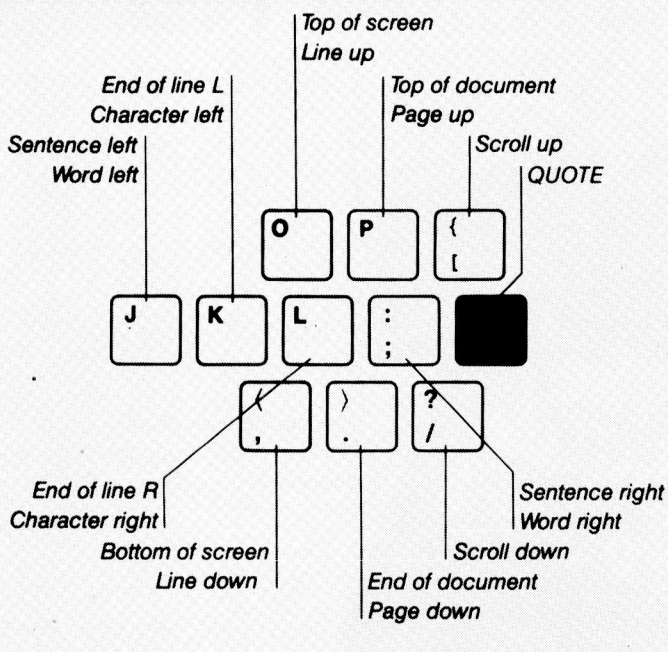
In other ways, the Mac might have some drawbacks as a word processing system: the keyboard has a very hard feel, more like an old-fashioned terminal; the screen is rather small for comfortable word processing; and there are no special function keys other than the mouse.

Editing

When you first load a document into Word, the display shows the main Word menu names across the top, and a conventional Mac window across the screen showing horizontal and vertical scroll bars plus the name of the document being edited. No ruler is displayed unless you request it, nor are there any indicators of horizontal or vertical position such as line number. The page number is shown, but may be innaccurate unless you have recently revised the pagination.

Unlike the majority of systems on which Word is available, the Mac has only the mouse with which to move the cursor—there is no conventional arrow key pad with the system. This could mean that professional touch-typists would spend a lot of time moving their hands from keyboard to mouse and back. To get round this, Word allows you to use a system of key combinations based on the Command Option keys; Fig 1 shows the table from the Word command key summary. Despite my years of acquaintance with the alleged horrors of WordStar control keys, I found it easier and quicker to use the mouse (except for scrolling long distances), but with practice the key layout should become familiar. No stickers are provided to aid memory. With either system, it is reasonably quick and easy to move the cursor (which Word calls the insertion position because it dictates where text will be inserted). If you prefer to overtype, you must first select the words to be overtyped, and then enter the replacement text.

This approach to text selection is used extensively to control the action of a variety of tasks — deletion, emphasis, copy, movement to another part of the document via the Clipboard, and so on; this can be done either with the command key combinations I have mentioned, or with the mouse. While I dislike the use of mice in a context where you are doing a lot of keyboard entry, it does provide a direct approach to movement, comparable with cursor controls in other environments, and it proved easier than I expected to locate



- **Hold down Option-Command and press the appropriate key for the insertion point or scrolling movement shown in black.**
- **Hold down Option-Command, press the QUOTE key, then press the appropriate key for the movement shown in red.**
- **Hold down Option-Command-Shift and press the appropriate keys to select text from the beginning insertion point to the end point.**

Fig 1 Keypad control keys

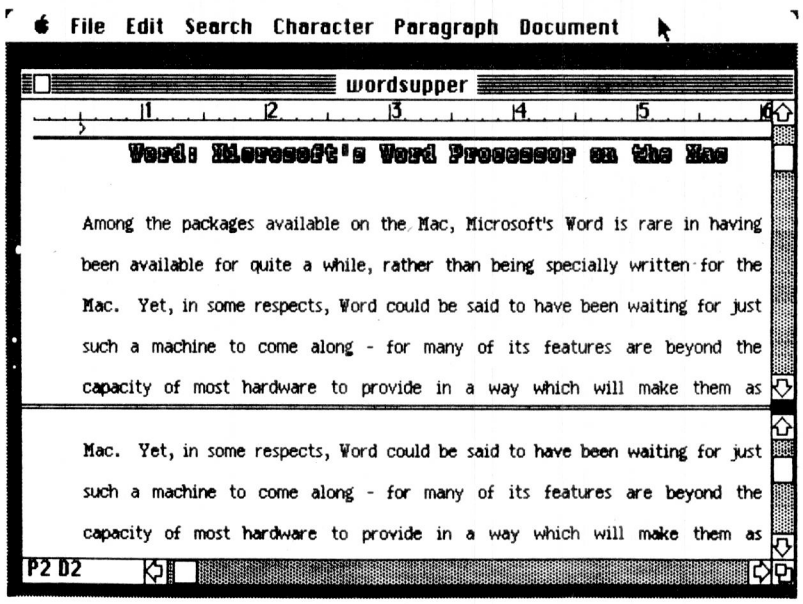


Fig 2 Display of two parts of same document, using split window

the cursor exactly. It also means that you can use one technique across the whole range of Mac packages.

The one thing which did annoy me about editing with Word keys — or rather with Mac keys — was the position of the SHIFT key. Haven't we suffered long enough from IBM's idiocy in placing it in defiance of the typewriter conventions? It's not Microsoft's fault — but it is something you should bear in mind when considering word processing on the Mac.

Word provides other editing features in a sensible, easily-used way. You can search for specified words or phrases, and replace them if necessary; you can choose to ignore case, to look for complete words only, and to replace just one or all of the matching strings of characters. To copy information between documents, one approach is to use the Clipboard, which is preserved between applications and between editing sessions, and can hold a lot of information — how much depends on the amount of space on your system disk. An alternative is to set up two windows, one containing the source document and the other the target, and copy between them, again via the Clipboard, but without the need to close your current editing session between marking and copying.

Word is reasonably forgiving of errors: for example, the most recent action can be reversed with the undo key, and a backup copy of each file will be kept automatically on request. Text which is cut (either for deletion or for copying elsewhere) goes into the Clipboard, from whence it can be retrieved if you find you have made a mistake, provided you have not subsequently done another cut since Clipboard can hold only one.

Word provides a glossary facility to store frequently-used text, so that it can be recalled using an abbreviated name. The procedure for recall is to type the name of the abbreviation and press COMMAND and BACKSPACE, so even with single-letter names it's not a procedure you would use for very short words. Nor did there seem to be a way to include Word command sequences in the glossary — it is strictly a text storage medium. On the other hand, display attributes, including font and emphasis, are not only stored with the abbreviation, as they should be, but also remain in force when recalled, until the previous setting is restored. I was doubtful as to whether that would be my preferred option. Probably the best approach would have been to allow a choice when the abbreviation is first entered into the glossary.

Text formatting

Word provides a good range of text formatting options, either by using a ruler or specifying margins and indents through 'dialogue boxes' (question-and-answer displays). If you use the dialogue route, you can specify formats in a variety of units — the default is inches and decimal portions thereof, but you can choose centimetres, point, or 10 or 12 pitch if you prefer. Formats can be preset before you start to type, or they can be changed later by selecting the text to be affected. Indents can be absolute, or relative to the most recent indent; you can indent just the first line of a paragraph, or have hanging indents with all but the first line indented. If you insert text into existing material, the paragraph will be realigned as you type. This is good for authors when creating text but not so good if you are editing from a printed draft, since the reformatting throws away the visual match between the printed and displayed versions.

Rulers and formats are stored with the document, and are automatically activated as you move between different parts of the document. It isn't usually possible to tell in advance what changes will take place, though, since Word doesn't automatically display rulers or show when they change, nor are other markers such as carriage returns at the ends of paragraphs automatically displayed. All these markers can be displayed if you wish — I left the ruler displayed so that I could anticipate changes of layout — but you can't really leave the display of carriage returns set, as with it comes the display of spaces that you've typed. You can inspect line endings as they are displayed; Word doesn't offer any help with hyphenation, but you can inset 'soft' hyphens to split over-long words.

Tables can be implemented using tab markers set in the ruler; tab characters are actually inserted into the text, so if you want to change the format of a table, all you need to do is select it, change the tab positions, and Word will do the rest. Tabbed fields can be left or right aligned, centred, or aligned on the decimal point for numeric fields. You would be most likely to feel the drawback of the narrow screen when typing tables: you can display six

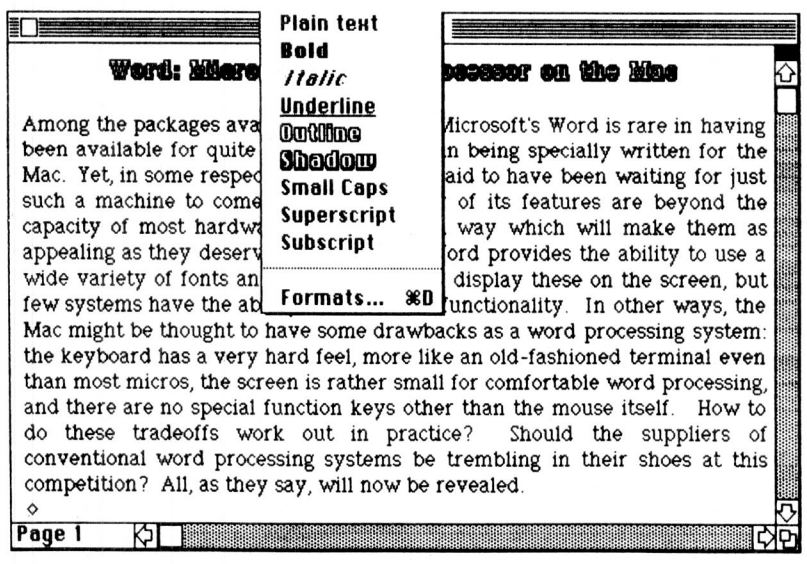


Fig 3 Pull-down menu of character styles



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inches worth of text, so for most ordinary documents the whole line would be displayed. But for wide tables, especially those to be printed on paper inserted sideways, part of the table would extend well beyond the width of the screen.

One of Word's strongest features is its ability to display and print text in a wide variety of character sets, with several different fonts for each set. These are displayed on the screen as they will print, as are emphasis (which includes bold, underlining, two forms of shadow print, and small capitals), justification, centring, and the layout features I've already mentioned. Indeed, Word is about as WYSIWYG (what you see on the screen is what you get on the printer) as it is possible to get. With such a wealth of goodies, it seems churlish to argue that you can take WYSIWYG too far, but it's true.

The trap into which Word falls is to include line spacing in its WYSIWYG approach — if you request double-spaced lines, then that is what you get on the screen. Given the limitations of a screen display, there is very little text shown. I got round this by using single-spacing until my document was complete, then changing to double-spacing before paginating, but that doesn't help much if you subsequently need to make further changes.

The line-spacing features themselves are also rather patchy. If you want either single or double-spaced text, then whatever font you use, Word will adjust the line heights correctly. If you need other spacings, you are on your own — you have to adjust the line height to an appropriate unit, taking into account the font(s) you were using. It's good that this capability exists — too many packages are getting 'bossy' in this area — but the provision of one-and-a-half spacing as a third option would save a lot of grief.

Pagination may be left until print time, or explicitly requested so that you can see where page breaks will occur. Word attempts to avoid widows and orphans by ensuring that you will not have just one line of a paragraph printed alone on a page, but this method cannot prevent headings being separated from text where a blank line intervenes. To avoid this, you can insert mandatory page breaks, or use instructions to 'keep the next n lines together'. Page-breaks are shown on the screen with remarkably discreet equal signs in the left margin — I found them quite hard to spot at first.

You can set up running headers and footers in your text, and change them at will; these may include page numbers which are updated automatically. Word copes with changes of page formats by separating your document into 'divisions', each with its own page formatting. You can have one for the whole document, or several within a document. Provisions for formatting within a division are very flexible. They include the ability to have true footnotes, which may be printed either on the same page as the reference or at the end of the division.

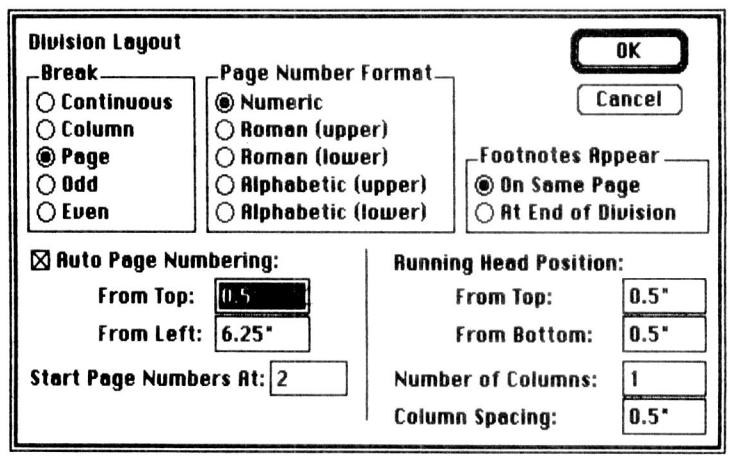


Fig 4 Dialogue box for layout of headers, footers and page numbering

Repeated text

The glossary features for handling abbreviations within documents should be adequate for most needs, where it is necessary to directly include the text in the document. For example, this feature could be used for standard contract work, such as conveyancing or personnel records. The ability to store such abbreviations, either for the duration of the session or permanently on disk, and to have a number of separate glossaries on disk, gives a reasonable degree of flexibility.

For repeated text of a different kind, Word has a mailmerge feature. This allows you to set up a standard document such as a letter, specify the points within it which are to vary according to the recipient, and merge this letter with a set of variables for each recipient. The information to be merged can be created within Word, or it can be brought in from outside, for instance from a file written by the File data management system reviewed on page 198 of this issue. You can include the ability to request information, such as a date, at the time the letter and data documents are merged, and you can specify the inclusion of other documents within the template. You can also include tests to give optional inclusion of parts of the template: for example, you might have varying degrees of severity in a letter requesting payment of overdue accounts, choosing the paragraph to use with a test for the length of time the debt was owing.

Goodies

The basic features Word provides are quite powerful, but there isn't a spelling checker, nor are there other, more esoteric, extras such as indexing. On the other hand, you can import pictures

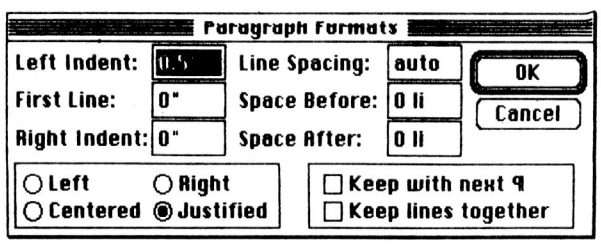


Fig 5 Paragraph formats dialogue box

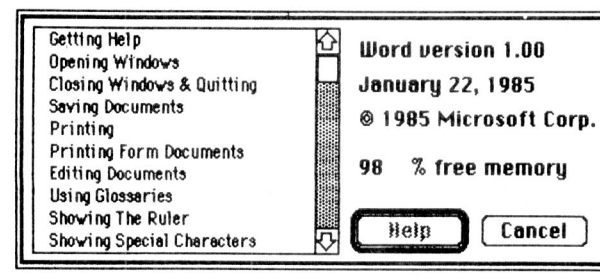


Fig 6 Part of the help menu

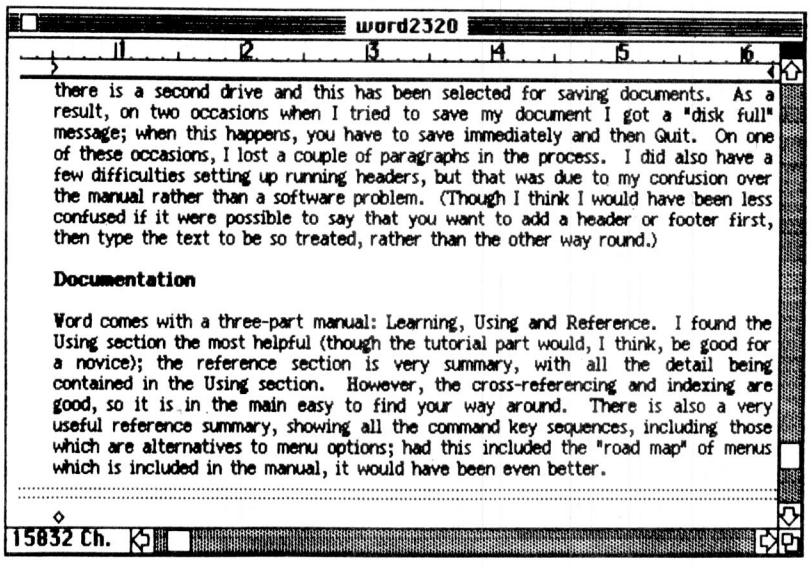


Fig 7 Text displayed, the diamond indicates end of document

and tables from Chart and Plan, and reports and sets of records from File. You can export text such as tables to other packages, and in File these can be incorporated as valid File records if you use the correct Word format.

In use

Word uses a combination of pull-down menus in the standard Mac mode, mouse movements, and command key sequences. In many cases, command key sequences can be used instead of menu options or mouse movements, so that touch-typists with good memories can keep their hands on the keyboard most of the time.

The marriage of hardware and software in handling character and font display is excellent. Indeed, in almost every respect except the lack of an index, Word with Mac would be an excellent combination with which to produce a book — and with a good printer, camera-ready copy could be of a very high standard. The Apple Imagewriter has three modes, fast draft, medium, and high-quality, and the high-quality output would probably be adequate for most requirements. It is also possible to attach a variety of daisywheel printers to Word on the Mac, including a Diablo model and Apple's own, but not, as yet, the IBM Quietwriter. The drawback with a conventional daisywheel would, of course, be that you would spend a lot of time changing daisywheels if you wanted to take full advantage of Word's ability to handle many different character sets and fonts.

The only area in which I had potentially serious problems was in the handling of work file space. The Word disk as distributed is very full; you can remove a few things like extra printer drivers, but unless you remove the Mac Finder with its attendant useful facilities, you can't get much free space on the Word disk. On a two-drive system this shouldn't matter, but Word uses the system disk for work files, even where there is a second drive and this has been selected for saving documents. As a result, on two occasions when I tried to save my document I got a 'disk full' message; when this happens, you have to save immediately and then quit. On one of these occasions, I lost a couple of paragraphs in the process. I also had a few difficulties setting up running headers, but that was due to my confusion over the manual rather than a software problem.

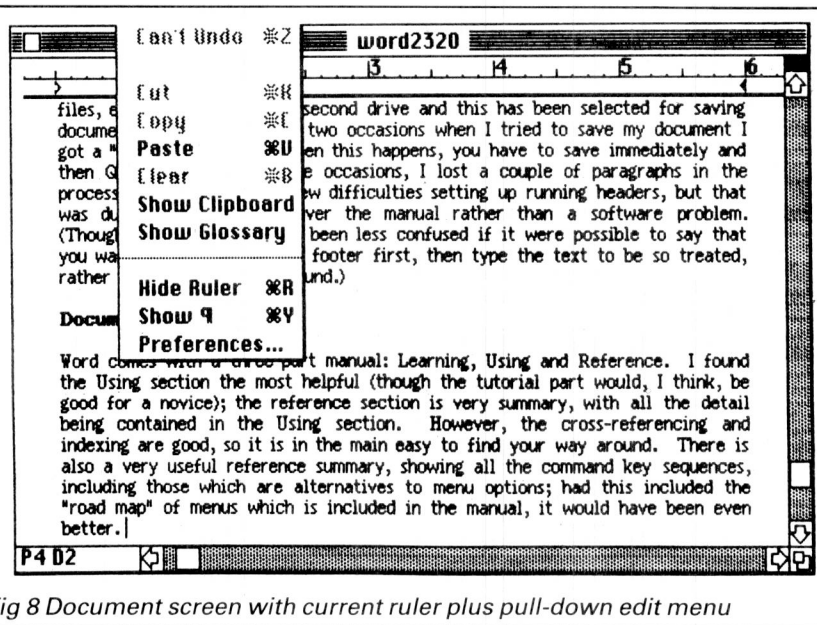


Fig 8 Document screen with current ruler plus pull-down edit menu

Documentation

Word comes with a three-part manual: Learning, Using and Reference. I found the Using section the most helpful (although the tutorial part would, I think, be good for a novice). The reference section is very summary, with all the detail being contained in Using. However, the cross-referencing and indexing are good, so it is, in the main, easy to find your way around. There is also a very useful reference summary, showing all the command key sequences, including those which are alternatives to menu options; had this included the 'road map' of menus which is included in the manual, it would have been even better. The onscreen help is good, and is provided in the usual Mac fashion of pull-down windows which overlay the current text. It is possible to move the help into a part of the screen where you can see it while you carry out the task — other suppliers please copy!

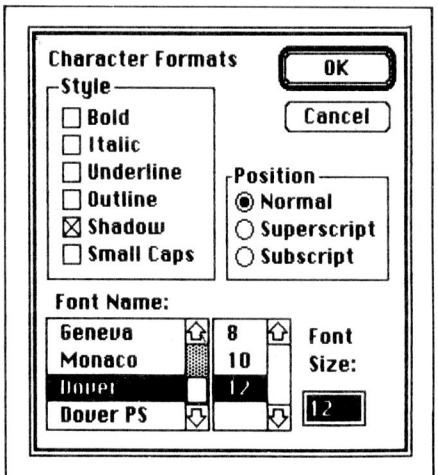


Fig 9 Character formats dialogue box

Conclusion

For professional word processing — by which I mean the production of long documents, tables and personalised letters, in contrast to occasional use for short letters — Word has a lot of advantages and few drawbacks. The chief of these is the lack of a spelling checker (you may also dislike the fact that it is copy-protected). For documents with a variety of character formats and fonts in particular, Word could be invaluable if your printer could cope, too. On the Mac, you would have to balance the excellent match of hardware and software as far as screen display, the neatness of the menu system and the direct pointing of the mouse is concerned, against the hard feel of the keyboard and the absence of function keys. END



SCREENTEST

Microsoft File

Kathy Lang looks at Microsoft File, a data management system for the Macintosh with a very visual approach.

In the months since the Macintosh was launched, a major criticism has been the lack of 'serious' business software. The announcement of the availability of four Microsoft packages for the Mac — File (data management), Word (word processing), Chart (business graphics) and MultiPlan (spreadsheet) could be expected to make some dent in those criticisms. I thought it would be informative to put the data management package through its paces in just the same way as I evaluate its competitors, in order to ascertain whether the accusation of 'executive toy' can be rejected once and for all. (Word is reviewed on page 194 of this issue.)

File stores each set of records in a single 'flat' file, with no direct connections between files. Each record in a file must have the same structure, but data is stored in variable length fields. (That means it uses only the amount of space needed to store the information actually present — you don't have to allow the maximum amount that might ever be needed. In fact, the news is better than that: you are not *obliged* to specify the field lengths at all.) Extensive use is made of the Mac's facilities for drawing on the screen, but these are exploited more by way of allowing you to alter File's initial predispositions than by the true paint-a-screen approach more common on conventional screens. Frequently-used fields can be indexed for fast access and permanent ordering, and the index is kept up-to-date. Records can also be sorted in other ways for display or printing, although sort order is not maintained when records change, or across sessions of using File. The reporting features are good, but do not include a letter-writer — you must link to Word for that.

Constraints

The major constraints and functions of File are shown in Fig 1. Within the limits of the functions it provides, File's constraints are very few. The maximum size of character field is a massive 32767; since, however, a data file cannot span a disk, the practical limits on field, record and file sizes will be the size of a disk (which must have space not only for the data file, but also for associated indexes). Data validation is limited to checking the type of data entered.

File creation and indexing

Data files are set up by specifying their format; the minimum to be specified for each field is the name and type. (You don't need to specify length of field — File has no concept of length in the conventional sense, in that you can hold any number of characters in any field up to the maximum of 32767, and the only thing you can vary is the number of characters *displayed*.) Field type may be character, number, date or picture — this last is usually used as an adjunct to the more usual data types rather than to store data itself, since the pictures such fields hold have to be imported from other packages such as MacPaint or Chart, and cannot be edited within File. For date fields, there are three options: the short option uses the American numeric convention of MM/DD/YY, the other two use three-letter abbreviations for the month name. Numbers may be shown in a variety of formats, including currency, percentage and scientific notation. Fields may also be computed from the values of others, using arithmetic operators and brackets. When you have finished setting up the record format and have left File, even if you have not yet entered any information, you can't change field types or make an existing field into a computed field. You can, however, add

File Edit Form Organize

PCWBT223

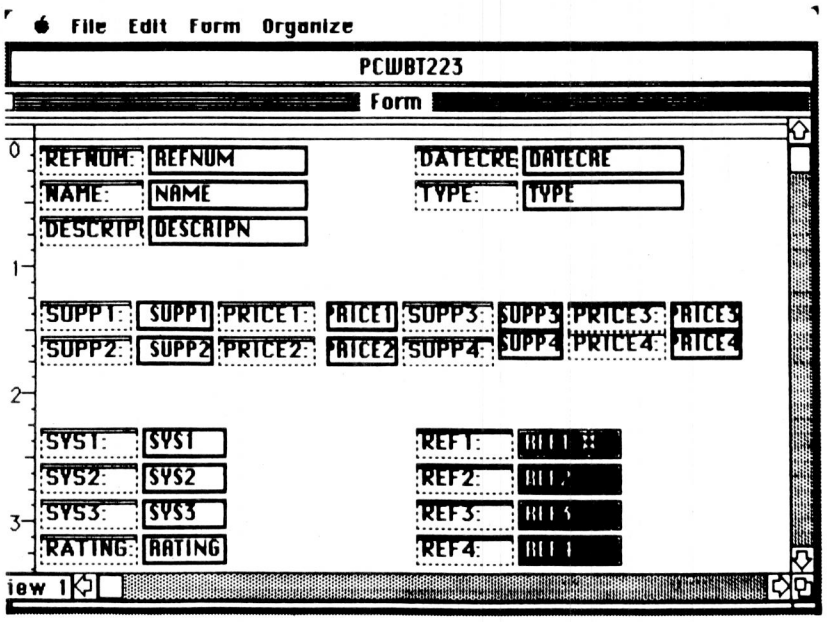
	REFNUM	ATEC	NAME	TYPE	SCR	SUPP1	PRICE	SU
1	24BAB		BAB	BAL		1,213	153	
2	24BAC		BAC	CAL		2,223	153	
3	24BAD		BAD	DAL		3,233	153	
4	24BAF		BAF	FAL		4,243	153	
5	24BAG		BAG	GAL		5,253	153	
6	24BAH		BAH	HAL		6,263	153	
7	24BAJ		BAJ	JAL		7,273	153	
8	24BAK		BAK	KAL		8,283	153	
9	24BAL		BAL	LAL		9,293	153	

Report

Preview ☐ Summary Report

Sort	Not Sorted				
Heading	REFNUM	NAME	TYPE	SUPP1	PRICE1
Field	REFNUM	NAME	TYPE	SUPP1	PRICE1
Grand					

A File record in List view plus a window showing a Report creation form



A File form; the shaded area is selected

or delete fields or alter their display formats, even after data has been entered, just by amending the record format.

You can, if you wish, specify a variety of display attributes for each field, as well as indicating that the field should be indexed. Initially, two record display formats are created for each data file: a List format showing one record on each line of the screen; and a Form which shows one record per screen. You may manipulate these and create others. Setting up a new data file is therefore very easy and very quick, provided you adhere to the standard approach.

Maximum file size	65,535 rec
Max record size (ch)	NS-at least 32767
Max no fields	1023
Max field size	32767
Max digits	NS
Max prime key length	NS
Special disk format?	N
File size fixed?	N
Link to ASCII files?	YF
Data types	N,C,D,Pic
Fixed rec structure?	Y
Fixed record length stored?	N
Amend rec structure?	Y
Link data files?	N
No data files open	NA
No sort fields	Nine
No keys	NS
Max key length (chars, fields)	NS
Subsidiary indexes kept up-to-date?	UTD
Data validation	Ave
Screen formatting	PAS,Def
Unique keys	No
Report formatting	PAS
Store calculated data	In
Total & statistics	Stats
Store selecn criteria	N
Combining criteria	A
>1 criterion/field?	Y
Wild code selection?	SW
Browsing methods	AF
Interaction methods	M
Reference Manual+	***
Tutorial Guide+	****
Reference card+	*
Online help+	****
Hot-line?	D

Fig 1 Features and constraints

Data input and updating

Data can be entered in either the List or the Form format. In either case, data entry is very similar to that used in more conventional systems — you use the TAB key to move from one field to another, entering data as you go. If you don't need to add data to every field, you can use the mouse to activate just those fields which you do need to enter. Finding a place to enter a new record into a large file could be rather tedious — according to the manual, you must scroll to the end of the data file. However, if you call up the Form view of a record and press BACKSPACE before anything else, you are presented with a blank record which is flagged 'new' in the margin. This isn't mentioned in the manual — I found out by accident!

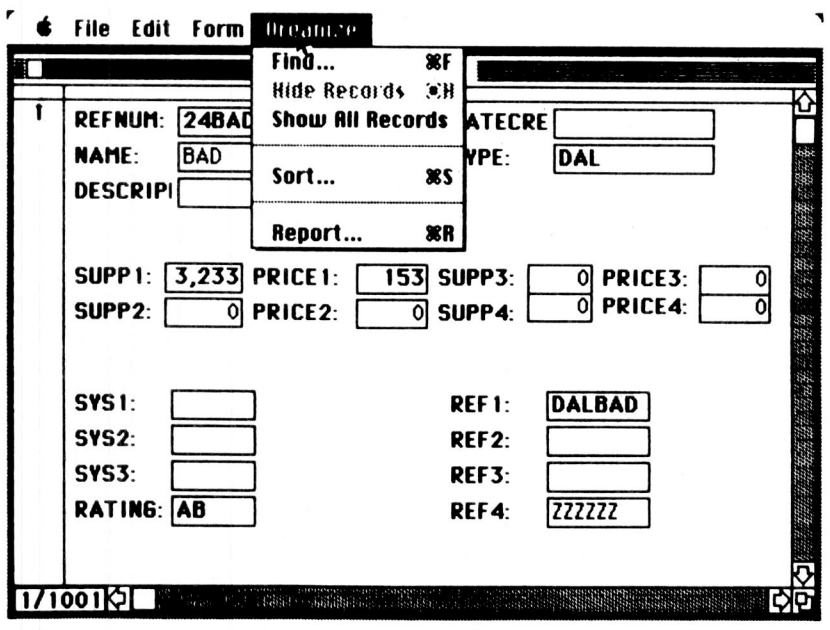
Where data is repeated, you can copy fields between records automatically; you can also cut or copy records into the Mac's Clipboard, and paste them into another part of the data file. The same approach is used to transfer records between files, either within File or to other packages such as Chart.

All data amendment is done directly from the keyboard — there don't seem to be any facilities for automatically updating records in a batch, for example to increase a group of prices by 10 per cent.

Screen display

File provides two kinds of format for displaying records on the screen when adding or amending information. The basic format is a List, with one record per line; this is used when the rather quaintly-named 'List Helper' is active. This is, of course, most useful for records with relatively small amounts of information, but File exploits the Mac facilities for manipulating the screen display in a way which enables you to get the most out of this approach.

The List format initially shows each field in the record, using the display length specified (or defaulted to) when the file was set up. You can modify the List by hiding individual fields in a separate area of the screen, by reducing the display of a field to just one or two characters or moving it 'behind' other fields, and by highlighting some fields but not others. The real power of these features, however, comes into force when you use them to manipulate the alternative display format, which shows one record per screen.



A File pull-down menu for retrieving sets of records



SCREENTEST

Initially, the one-per-screen form displays each field on one row, with the label preceding a box containing space for the data value. You can use the mouse to shorten or lengthen field name and value boxes, and move them around the field singly or in groups. Groups don't need to be contiguous initially, you can select several separate boxes to form a group. Field captions can be extended, and, if you have set them up in the Clipboard in advance, pictures from Chart or MacPaint can be imported to go with your field placings to aid the ultimate form-filler or just generally make the screen look more attractive.

You may have several display formats for different purposes, and each can display a different group of fields in a variety of ways. One of these formats will be saved with your data file and used whenever you request the Form view of your data, while the others need to be explicitly requested from the File pull-down menu. Switching between the Form and List views of your records can be done in several ways, mostly involving just a single key or mouse button depression. (The Form view you switch to should be the one saved with your data file. I had a problem with that — I originaly saved my data with a default Form format, and subsequently modified the form and saved it with my data file. Thereafter, when I loaded the data file it came up correctly with my own Form view, but when I switched to the List form and back I always got the default format of Form.)

Fields which are not to be displayed can be 'hidden', but there did not seem to be a way to prevent any user modifying the form to restore these hidden fields. You could not, therefore, use that method to provide partial access to a file containing a mixture of secure and public information.

Printed reports

Formatted reports can be printed, or displayed onscreen in Preview mode; you can have full reports which include data field values, or just summaries which contain totals and statistics — a very useful feature. Reports are formatted using similar features to those provided for organising your own screen formats. All the fields are displayed onscreen; you select those you want to print and use the mouse to drag them to the correct positions on the report. File can provide a count of records, plus average, minimum, maximum and standard deviation of numeric fields, as well as totals, and sub-totals by items which have been specified as sort fields. Sorting can take place as part of the reporting operation. Layout features include headers and footers, and the inclusion of page numbers and current date and time.

When you have set up a report format, you can save it alone (so that it can be used with more than one data file), with the data file, or jettison it. You can also save the complete report in a file for subsequent inclusion in, say, a Word document.

Selection & sorting

To find individual records or sets, you use the Find option from the Organise menu. Once checked, this displays a version of the record form onscreen, allowing you to enter values against which records are to be tested. You can test for a field being equal to or starting with a single value or with one of several values, for a field being less than, greater than or not equal to a single value, or within a range of values. Wild codes are available for both single characters and groups of characters. You can apply tests to several fields in the same selection operation, but you have no choice about how the tests are combined — every test must be passed for the record to be selected. File shows the number of records which pass the test, and then displays the first record of the set selected. Thereafter, until you activate the Select All Records option, all actions such as sorting operate on this subset of records.

'I spent hours playing with my forms and reports to get them "just right", and thoroughly enjoyed doing so.'

A file can be sorted on up to nine fields, in ascending or descending order. Sort order is maintained only for the current session, or until records are added or deleted; ordinarily, records are displayed in order on the first indexed field.

Calculation

Calculated fields are available when data is input, and you can aggregate values when reporting. Apart from these facilities, there are no special calculation facilities in File.

Advanced facilities

File does not provide the ability to set up permanent links between files, nor are there any programming-like features for tailoring the way the system works to particular applications.

Links with outside

File can read and write files in ASCII format, using a simple but fixed layout with a TAB character between each field and RETURN at the end of each record. You can import pictures from Chart and MacPaint, and spreadsheet tables from MultiPlan, and export records to these packages via the Clipboard. This is a scratchpad area which is normally entirely in memory, but which, if it gets too large, is written out partly to the system disk (although that may not help much — on my File disk, there was only 13k available). I couldn't discover what the precise limits on the size of Clipboard are: it would, of course, depend on how much memory your Mac has, as well as how much memory File uses. (On the 512k Mac I used, 88 per cent was free when File was loaded with a single record being viewed.)

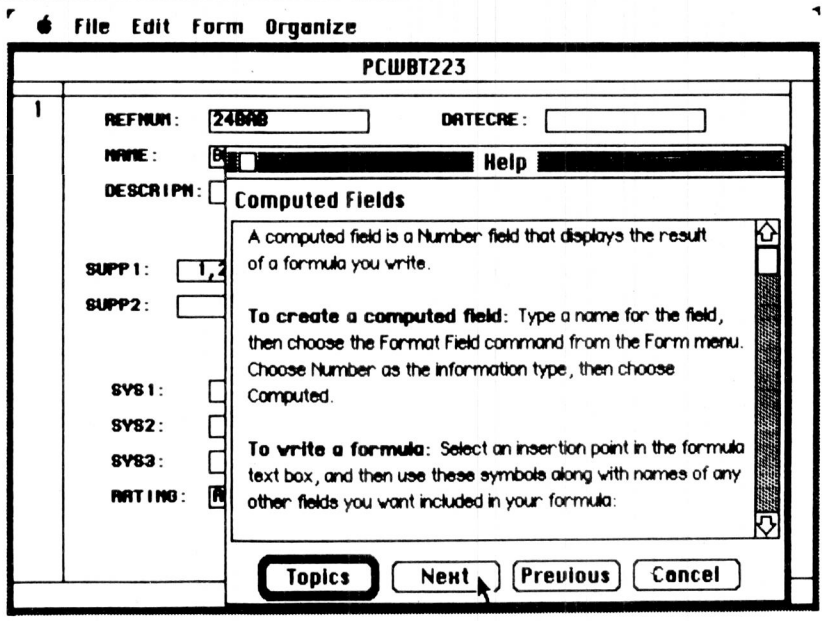
Information can be passed between Word and File either via the Clipboard, or through files. Reports can be saved in text files for inclusion in Word documents. Records saved in the standard export format can be merged with Word template documents to give personalised letters, and tables created in Word using tabs to separate columns can be imported into File data files.

BM1	Time to add one new record	Inst
BM2	Time to select record by primary key	4secs
BM3	Time to select record by secondary key	4secs
BM4	Time to access 20 records from 1000 sequentially on three-character field (same field as in BM2 key)	1min
BM5	Time to access record using wild code	30secs
BM6	Time to index 1000 records on three-character field	2mins
BM7	Time to sort 1000 records on five-character field	2mins 10secs
BM8	Time to calculate on one-field per record and store result in record	NP
BM9	Time to total three fields over 1000 records	2mins 45secs
BM10	Time to add one new field to each of 1000 records	Modify form

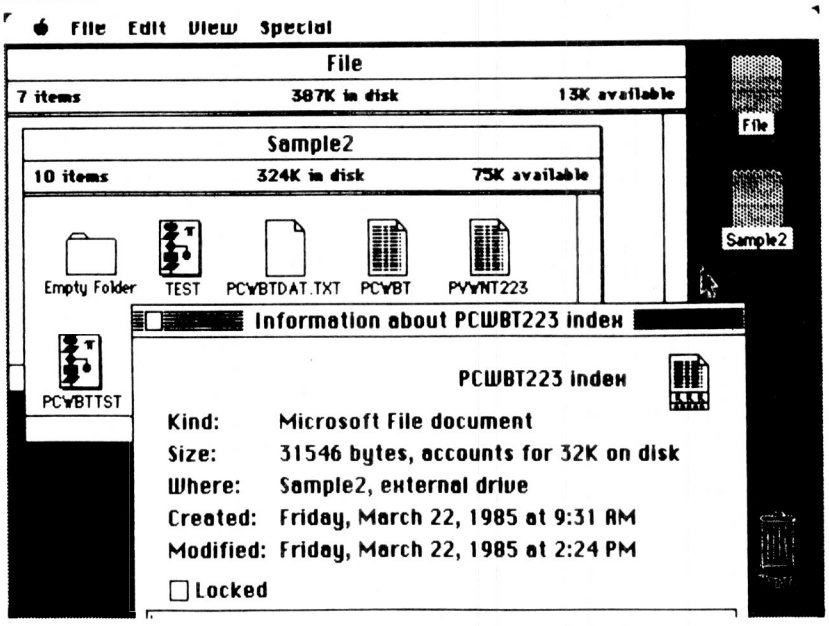
Time to import a file of 1000 records: 16mins 15secs

Notes: NT = Not tested NP = Not Possible + = including scrolling
Where two times are given, first is access to first record, second is access to each subsequent record

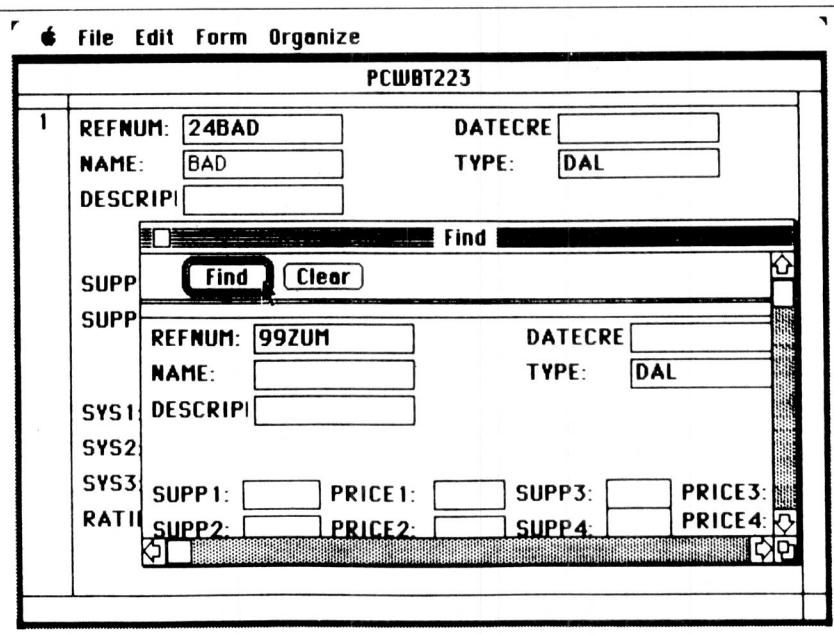
Benchmark times recorded on a Macintosh/F



A Typical File help screen



Three windows—the active window contains details of the index file



A File selection screen

User image

File exploits the Mac facilities quite thoroughly, and I've tried to describe how this is done while discussing the functions of the package. In some respects, though, this exploitation is patchy. When setting up and manipulating screen and report formats, the 'painting' features are excellent and imaginatively used: I spent hours playing with my forms and reports to get them 'just right', and thoroughly enjoyed doing so.

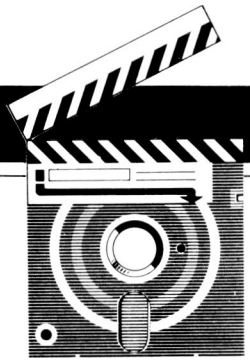
However, in most real applications, people spend far more time using forms than they do in designing them. When using the forms, there are fewer facilities and they tend to be more pedestrian. For example, scrolling through a set of records is an extremely common task. Doing this in List mode is quick and easy — you just use the mouse to move the scrolling arrows in the desired direction.

But in many applications, List would be used much less than Form because of the need to display a fair amount of information. In Form view, scrolling just moves around within the display of the one record. To move from one selected record to the next, the best way I could find was to select (with the mouse) the last field in the record and press the TAB key (which, within a record, advances the cursor one field), which seemed by comparison a rather clumsy operation. The difficulties I had with finding quick ways to add extra records reflect, I suspect, another aspect of the same problem — that features such as the laying out of forms and reports are more fun to design than the bread-and-butter basic record-handling features.

That said, the overall feel of the package will, I think, be attractive to people who like using icons and a mouse. But it is a mistake to think, as many do, that such an interface can do away with the need to consider your design before you start. Particularly when designing form and report layouts, I found a quite considerable learning curve to be involved — once I appreciated the principles, I became much faster and more accurate in my work.

In some respects, the Mac — and File — approach doesn't help as must as it might. For example, there is never any indication of how wide a field is (height is indicated by a ruler in the left margin, but width is ignored). Partly for this reason, and partly because of its physical nature, I found it quite hard to use the mouse as a precision tool for siting fields. (One of the advantages of the mouse in design work such as CAD is that it allows continuous movements, rather than the discrete movements to which cursor arrow keys are limited. But in form design work, much of the movement must be discrete.)

The lack of a gearing capability when using the mouse is also a serious



SCREENTEST

drawback to someone working in a limited space — the Mac may have a small footprint, but Mac plus mouse certainly do not! These criticisms must, of course, be balanced against the superiority of the 'draw' approach for most aspects of manipulating elements of forms.

As to the use of pull-down menus, I found the comparison with the approach of the Perfect II suite, which I reviewed last month using an IBM PC, fascinating. For my personal tastes, pull-down menus are extremely useful, but there is little to choose between the mouse and the use of cursor keys in selecting menu items. Since in File there are many occasions when you must use the mouse (and even where you can substitute a command sequence, you cannot see the menu without moving the mouse, whereas in most systems like Perfect you can display the menu and then use a single character key to activate an option), the advantages of the mouse for issuing commands have to be highly arguable for an experienced user. This is especially true where much of the work involves entering data through the keyboard, so that using the mouse involves taking your right hand well away from the main area of action. As far as data management applications are concerned, thus far I regard the case for the mouse to be Non Proven!

Package	Cost (£)	Summary
DMS+	195	Stripped-down version of Delta from same supplier — one file open at a time, no tailoring. Good letter-writer. Usable manuals, but no road map of menus. Separate set-up and execute (for example, in selection) tedious. Good value for money at this price.
File	190 (excl VAT)	Data management system designed to make good use of special Mac features, so very visual approach. Provides good basic data management features for single-file, fixed-format records, stored as variable length. Links to Word, Chart and MultiPlan.
Files & Folders	£295	Good value, easy-to-use package, with basic linked-file facilities (three open, eight linked). Good use of screen when setting up files. Good list and sort features; no letter-writer. Menu-driven, no tailoring or batch processing. Usable manuals, no road map.
Friday!	195	Simple, cheap, good-value package for single-file, fixed-format records. Drawbacks are clumsy approach in letter-writer and designing screen formats. Excellent tutorial manual and menu charts; reference manual is good used from screen manual.
Pearl	195	Economical storage of varying length records, multiple indexes allowed and kept up-to-date, paint-a-screen formatting for screens and reports (but no letter-writer). Entry screens can write to several files at once. Good manuals. Excellent value.
Perfect Filer II	149.95	An easy-to-use package for handling text information such as names and addresses, with good report and label formatting. Lack of calculations, and need to have editor or WP to construct formats, are serious drawbacks. WP and spreadsheet in same family

Comparison of similar data management packages

Summary

Supplier	Microsoft
Telephone	(07535) 59951
Cost	£190 (excl VAT)
System	Macintosh
Version reviewed	1.0
Type	N,S
Features	Single-file, fixed-format data management system using variable length records. Provides indexed retrieval, sorting, reporting and good form design features. Extra large fields permitted, but sorting limited to 5000 records on 128k system
Drawbacks	No letter-writer, no batch processing, no tailoring to provide fast access to frequently-used features
Ease of use	Mainly very good, making sensible use of the Mac's icons and mouse. Better in design phases than in execution

Documentation

File comes with a single manual in three main sections: Learning, Using File, and Reference. The manual is typeset, and bound in a spiral inner with card outer. There are plentiful illustrations of real screens, and the outer part of each page contains captions in heavy type giving clues about the material being described. The bulk of the material is in the Using section; the Reference section is not a comprehensive coverage of all the facilities, but a summary of each option with cross-references to the Using section. This concentrates heavily on the design features, and on using File through the List view of the data. As a result there were several functions that I just couldn't run to earth in the manual, and had to discover by much trial and error.

That said, the material which is provided is clear and well-written, although still not as well laid out as the main Macintosh manual, which I regard as a model of clarity and ease-of-use for browsers. (The index is better than File's, too — but at least the File manual does have an index!).

The approach in the Using section is to explain each feature in turn, and then to give a set of instructions on how to do the task with some example information. This 'Now do this' material is printed in much fainter type than the rest of the manual to visually indicate that it is optional material. This idea is better in conception than in execution — I found the fainter print very hard to read.

Conclusion

File, viewed as a data management system in competition with others in its price bracket rather than just as a Mac vehicle, provides a good range of basic features. These include quite adequate sorting, reporting and screen retrieval facilities, with excellent forms design. No letter-writer is included — for that you would need to use Word — nor are there any batch processing facilities, multi-file links or programming features. Data can be easily exchanged with the other products in the Microsoft family — Word, MultiPlan and Chart — to provide as great a degree of integration as most people will need, without imposing the penalties which closer integration usually incurs. END

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DBASE II	**239**	RRP 395	**–39%!**
WORDSTAR	**195**	RRP 295	**–34%!**
PAINTBRUSH	**95**	RRP 139	**–32%!**
CIS COBOL	**302**	RRP 425	**–29%!**
LOTUS 1-2-3	**304**	RRP 430	**–29%!**
OPEN ACCESS	**322**	RRP 449	**–28%!**
SYMPHONY	**413**	RRP 550	**–25%!**

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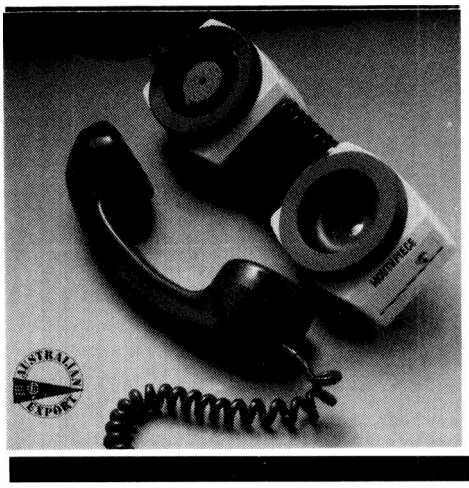
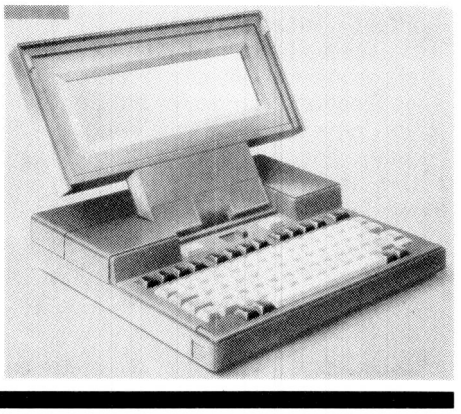


Powerful Portable Computer

Features of the Kookaburra portable computer from Time Office Computers include 6MHz 80 186 processor, 96k memory (expandable to 256k) with an additional 128k of internal ROM and a 16 line LCD screen and professional quality QUERTY keyboard.

Yet the equipment weighs less than 4kg and measures only 305mm x 280mm x 51mm. Rechargeable batteries give up to 8 hours continuous operation, or mains power may be used.



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SCREENTEST

PC Automator

Peter Bright looks at Direct Technology's PC Automator, a utility-cum-programming language which allows you to customise standard applications packages.

How many times have you sat in front of your favourite applications program and thought: 'Why does it need that stupid control sequence?' or 'How does this work?'

The problem with most applications programs is that there is no way of tailoring the way they work — you're stuck with what you are given.

A new product, called PC Automator from London-based Direct Technology, goes at least some of the way towards allowing you to customise standard applications programs like WordStar or Lotus 1-2-3. PC Automator runs on the IBM PC and close compatibles.

The technical term for PC Automator's ability to sit in the memory of the PC and run at the same time as another program is 'co-residency'. In effect, Automator steals RAM and processor time from the applications program, and sits between you and the applications program filtering what you type and what the program displays. The overall PC Automator system is made up of three separate modules — Learn, Remember and Do. Learn is a mini program generator, Remember is an intermediate code compiler, and Do is a co-resident intermediate code interpreter.

To program PC Automator, you first use Learn to generate a sequence of ACL (Automator Command Language) commands. Remember then compiles these commands into an intermediate code file which can be understood by Do, which in turn executes your commands. This may sound complicated, but is, in fact, extremely straightforward.

Learn

Learn is probably the flashiest part of the Automator system.

You load it into the system in the usual way by typing Learn at the system prompt. Once it is loaded, Learn sits quietly in a corner of memory noting what you are doing.

Due to Learn being co-resident, to all intents and purposes the system looks like it is empty, and you can load and run applications programs in the normal way. The only way to determine that Learn is in the system is that the cursor changes from underline to block mode.

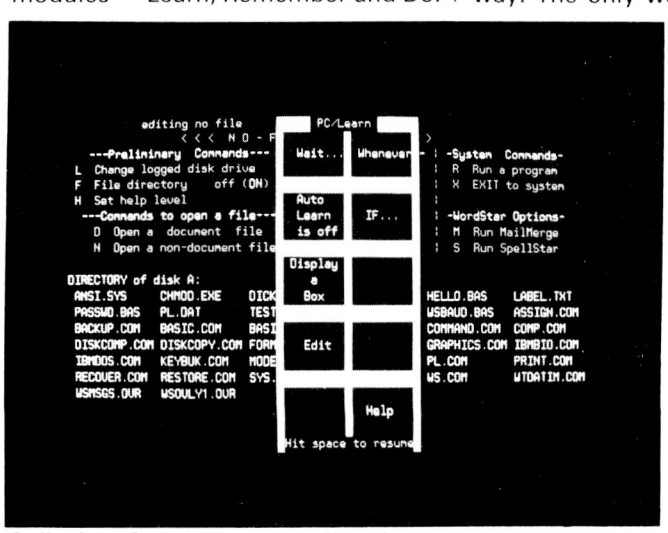
It is perfectly possible to have multiple copies of Learn sitting in memory at the same time. This can be useful for teaching the system how to use Learn.

To control Learn, you can toggle a menu display on and off by using the SCROLL LOCK and space bar keys on the keyboard. The menu is displayed on top of whatever you may have on the screen at the time, and commands are issued via the function key pad.

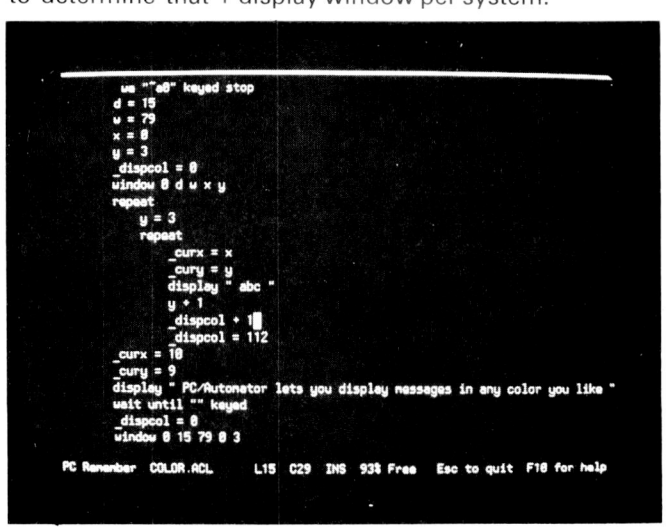
When Learn is first loaded, the commands available are WAIT, WHENEVER, AUTO LEARN, IF, DISPLAY A BOX, EDIT and HELP.

Probably the most-used function is AUTO LEARN. This makes a note of everything you key in and stores the sequence as Automator commands. You can toggle the Learn function on and off by pressing the f3 function key.

The Automator system makes heavy use of windows to define areas where data is to be read and written. You can have up to 19 input windows and one display window per system.



A display of the Learn menu functions



Remember mode allows use of Advanced ACL features

Learn makes it very easy for you to manipulate windows. Using the cursor keys you can shrink, expand and move windows to your heart's content until they are the right size in the right place.

Most of the Learn functions make use of windows. WAIT allows you to define up to six windows and wait for a specified event to occur in the window before proceeding. It can also wait for a certain amount of time or until particular keys are pressed.

WHENEVER allows you to specify an action to be taken when a particular event occurs. For example, I often type 'DIT' when I mean 'DIR', so I could set up a WHENEVER command saying 'Whenever I type DIT, replace it with DIR automatically'. This command is very useful, especially for handling any errors which may occur.

IF allows you to perform the IF..THEN..ELSE..ENDIF operations so beloved by Basic programmers. When you hit the IF function key, you can define up to eight windows in which to declare the text you want to match. You can then specify the operations you want Automator to perform if the If statement is true, or for the Else part of the operation. When you have finished the definitions, you hit the ENDIF key which finishes the operation.

The final building block for the Learn section is DISPLAY A BOX; this opens a window to display a message of your choice to help the user. As you create a system, Learn will turn your actions into a text file of Automator commands which can be edited using the edit function from the menu box.

Remember

The second segment of the Automator system is Remember, and is the only one of the three Automator segments which isn't co-resident. When you are running Remember, you can't have any other applications programs running at the same time.

Remember takes a text file containing Automator commands and compiles the commands into a form understood by the Do interpreter.

The text file containing the Automator commands can come from one of two sources. In most cases, it will have been generated by the Learn module. However, more advanced users can write their own programs from scratch using the editor provided with the Remember module.

Although it isn't as straightforward as using Learn, writing your own programs does allow you to use some of the more advanced features of the Automator Command Language (ACL) which are not available from Learn.

The syntax of ACL is similar in many ways to that of Basic. Although it is quite a simple command language, ACL does have a reasonable set of control structures including IF . . THEN . . ELSE . . ENDIF, REPEAT UNTIL and WHENEVER . . ENDWHEN. As ACL doesn't use line numbers, branching is done to labels. You can either branch to subroutines (CALL and EXIT) or you can GO (to) a label.

Windows are specified by using the WINDOWS command followed by values for window number, depth, width, and the column and row positions. When I was writing ACL programs, I found it easier to use Learn to define all the window positions rather than try to work them out by hand.

Many of Automator's features are geared to allow you to alter what is displayed on the screen of your PC, or to simulate keyboard entries in order to fool an applications program.

The DISPLAY command allows you to display strings on the screen. Using a combination of this and program control structures, you can build powerful programs which allow you to intercept the output from an applications program and replace it with your own. A good example would be if you didn't like a program's help description, you could trap the output and substitute your own.

The TYPE command inserts character strings directly into the keyboard buffer. As most applications programs read keyboard input from the buffer, you can fool it into thinking that you have typed in something when, in fact, it has been output from Automator. This single command can do as much as, if not more than, most Smartkey-type utility programs I have seen.

When you couple the DISPLAY and TYPE commands with the control structures available, you have an unprecedented level of control over your applications programs. For example, you could quite easily customise WordStar or Lotus 1-2-3 out of all recognition simply by interrupting the keyboard input and display, and making up your own Automator alternatives. The limitations tend to come from your lack of imagination, rather than from Automator itself.

Automator supports three kinds of variables — numeric, string and system. Although these are useful, for the most part they are limited in scope because of the lack of manipulation facilities built into the programming language. The exceptions are the system variables which allow you to gain information from the system.

The system variables -DAY, -MONTH, -SECS, -TIME and -YEAR allow you to access the system clock from within Automator. In addition, -CURX and -CURY allow you to read or write the cursor position. For example, A = -CURX would assign the X coordinate of the cursor to the variable A, while -CURX = 18 would move the cursor to X coordinate 18. This is helpful when you are playing with windows.

-DELAY allows you to specify how fast Automator enters data into the keyboard buffer when you use the TYPE command, which is very useful because some packages such as WordStar can only accept fairly slow keyboard input. DELAY gets around this by allowing you to output characters from Automator at a rate which is acceptable to the applications program.

Using -DISPCOL you can control the colour and brightness of the display from your program. Depending on the value from 1 to 255, you can set the foreground and background colours as well as underlining, flashing, and so on.

The final system variables are -ERROR, -STACK and -TIMEOUT. -ERROR and -TIMEOUT are used in conjunction with the WAIT command in the programming language. The value of -TIMEOUT governs how long the WAIT command will wait for something to happen before it gives up in disgust and generates an error. -ERROR allows you to trap unfulfilled wait errors, and, finally, -STACK allows you to play with the contents of the system stack.

The Do module

When you have written and successfully compiled your Automator program, you can run it by passing the compiled intermediate code file to Do.

Like the Learn module, Do is co-resident with whatever application program you are using. You can always tell that Do is in the system because the cursor rises and falls as if it's breathing. To run your program, type Do followed by the filename of your program: for example, Do Nothing.

Conclusion

Automator is one of the most useful pieces of IBM software I've come across in a long time. When I first saw the product, I thought it would be much like the SmartKey-type products which do little more than assign strings of characters to keys on the keyboard. Fortunately, this is not the case.

One of my major problems when reviewing Automator was that I stopped treating it as a utility and started to use it as a full-blown programming language to do things it was never designed for. It says a lot about the facilities provided that this was possible, and as long as you stay within the limitations you can do a great deal.

Beginners, especially, can produce useful applications using the Learn applications generator, while more adventurous types can dive straight into the program code.

The only time you might run into a problem is if you have a number of co-resident programs in the system as well as Automator. Desk accessory programs such as Spotlight, Sidekick, and so on, could compete for the same system resources as Automator, which could have some very strange effects.

Overall, I liked Automator a great deal. It allows you to do more than just assign strings to keys, and it works in a simple and straightforward way. END

Proceed with Logo

Harvey Mellar stresses the importance of variables, procedures and recursion in his introduction to this Teach Yourself Logo series.

Logo is becoming well known as a programming language in schools, but its success in this field has led to it being dismissed in some quarters as 'just turtle graphics' or 'just for kids'. This is a highly inaccurate view of a fascinating language, for while it is true that Logo is an ideal introductory language, it is also a powerful high-level language which is particularly suited to processing symbols rather than numbers.

Logo certainly began as an educational language, as did Basic. But whereas Basic came out of the Fortran-based scientific tradition and was designed to deal mainly with numbers, Logo comes from the Lisp artificial intelligence (AI) tradition and was designed to deal with more general symbols. The people involved with the early development of Logo in the late Sixties were also closely involved with AI research. They believed that AI had something to say about learning, and that Lisp-like languages were necessary if people were to write 'intelligent' programs. These languages were intended to be closer to the way in which people think than the more machine-oriented, high-level languages such as Fortran and Basic.

Imagine this scenario: an MIT (Massachusetts Institute of Technology) professor comes home after a hard day hacking at Lisp code in the AI lab, and meets his kids back from school. 'Hey Dad, we've been learning Fortran programming in our maths classes.' The MIT professor sees red, and begins to design a new language. Now this story has no historical truth, but I believe it does capture one of the ingredients that went into Logo's origins.

Logo was initially implemented on mainframes (there were only mainframes at that time). It was used in a variety of projects during the Seventies, mainly at MIT in the US and Edinburgh University here. The projects involved such things as teaching programming to young children, learning mathematics in secondary school, exploring mathematical modelling for physics and maths undergraduates, and teaching AI at undergraduate level.

A Basic interpreter could be fitted into a few kbytes of ROM, but a logo interpreter needed around 30k as well as a fair amount of room to run in. While Basic had been easily implemented on micros, it was only with the appearance of larger memories that Logo on micros became feasible. 1980 saw the first microcomputer versions, and a language that had previously been restricted to a few universities and research labs suddenly became widely available.

Today, most micros have at least one full version of Logo. A number of Logo dialects now exist, the three most widespread being MIT Logo (the original), LCSI Logo (LCSI is a company set up by ex-MIT people including Logo's founder, Seymour Papert) and Edinburgh Logo, the home-grown (but less popular) variety.

The turtle

Start up a Logo system and you'll be presented with a 'turtle' in the middle of the screen; this is usually a triangular shape, although this varies — on the Atari it is actually a turtle shape. The turtle is an 'object' with which we can communicate. You can give it simple commands to move across the screen — FORWARD 50, or to turn — RIGHT 90. The turtle carries a pen and it draws a line as it moves. You can tell the turtle to lift up the pen so that it does not draw on the screen (PENUP) or put it down again (PENDOWN). With these simple commands we can draw shapes onscreen.

If you make a mistake, such as misspelling a command, Logo will complain. The error messages are clear and to the point. Logo takes error-reporting very seriously: it is not an afterthought, but an important part of the whole system. The turtle was originally a robot that responded to the drawing commands. We've seen how to give the turtle simple commands, but communication should be two-way. The turtle can provide information about itself: where it is on the screen, whether the pen is up or down, and so on. Try the PRINT HEADING command — Logo prints out the direction in which the turtle is facing (measured in degrees, with 0 considered as straight up the screen). It is this metaphor of the turtle as a communicating object that lies at the heart of Logo's success as an introductory programming language.

If you practice drawing a few shapes with the commands I have mentioned so far, you will quickly meet the need for a method of repeating a sequence of commands. For example, repeating four times the commands FORWARD 40 RIGHT 90 will produce a square. In Logo, you could shorten this by writing REPEAT 4 [FORWARD 40 RT 90]. The number after REPEAT is the number of times you want the commands obeyed. The commands themselves are written out within square brackets, which are used in Logo to mark out a 'list'. A list is just an ordered collection of symbols: that is, words, commands and numbers (or even other lists).

Procedures

The commands I have presented so far are referred to as 'primitives'; they are part of Logo itself and are understood by the system as soon as it is loaded. Logo can also be taught new commands or procedures. You can define a procedure called 'square' by writing

```
TO SQUARE
  REPEAT 4 [FORWARD 40 RT 90]
END
```

You type this into a full-screen editor that is part of the Logo system. These editors vary slightly from machine to machine, so you will have to consult the manual as to how to use it.

We can now type SQUARE as a command, use SQUARE with other commands (for example, REPEAT 12 [SQUARE RT 30]), or even use it as a sub-procedure in the definition of other procedures:

```
TO TOWER
  REPEAT 4 [SQUARE FORWARD 40]
END
```

Logo treats these procedures exactly as if they were primitives (except that they will be forgotten when you switch off). The basic idea of programming in Logo is therefore one of extending the language by defining new procedures until it can deal with your problem. Forth and Lisp also have this type of 'extensibility'.

Some of the advantages of extensible languages include hiding nasty details within sensibly-named procedures, creating special environments for others to use (for example, for children's programming), and developing your programs in a top-down fashion.

Logo is an interpreted language (like Basic) so you can enter anything you

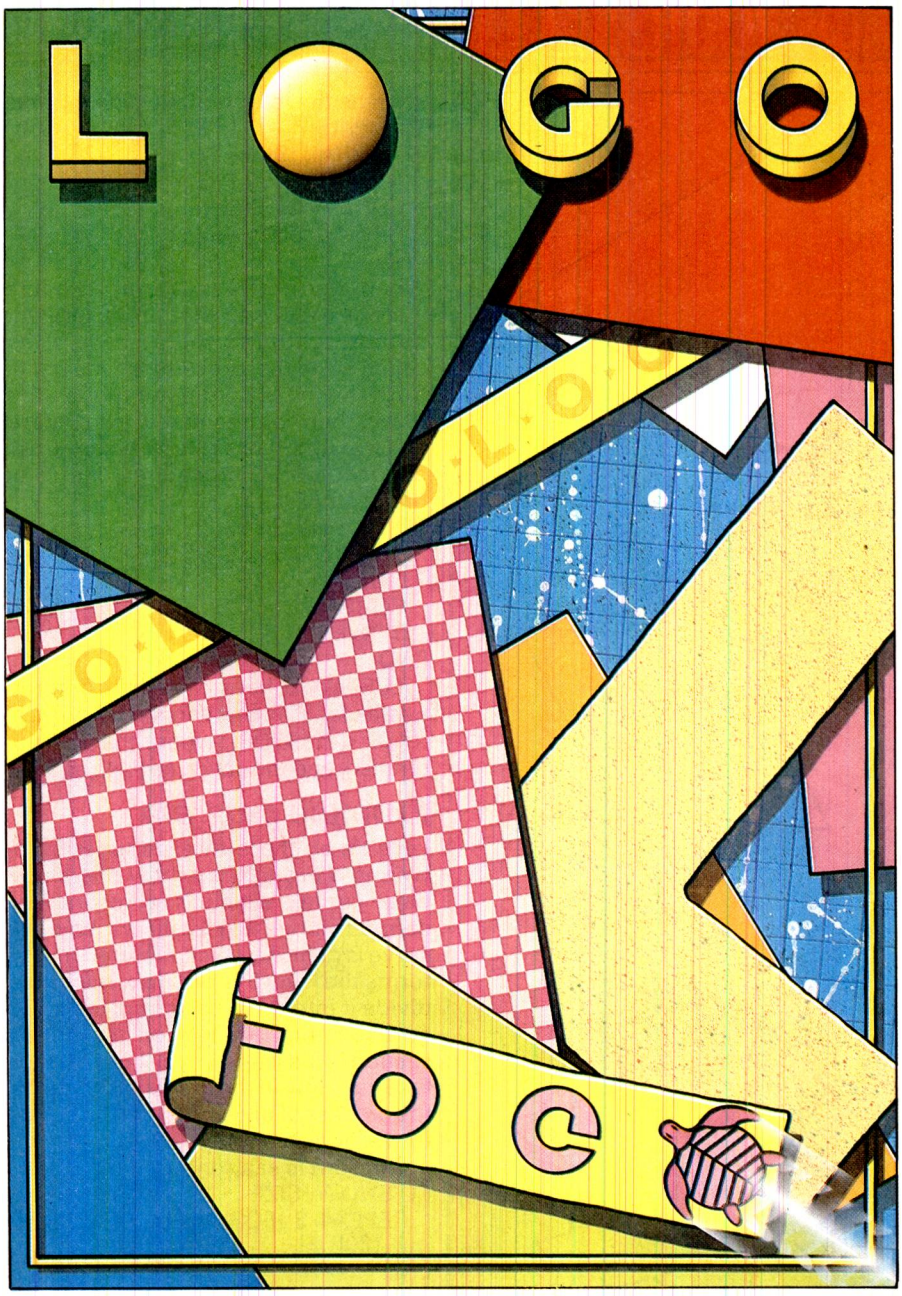


Illustration by Mark Watkinson

like into a procedure definition. When you ask Logo to obey that procedure it goes word by word through the procedure, obeying the primitive commands as it comes to them, or looking up the definitions of any sub-procedures and then running them. Only if a procedure is not present at the time when Logo wishes to run it will it complain: you can write your top-level procedures using lower-level procedures that you have not yet written.

While top-down design of programs is a good thing, you may be glad to learn that Logo is also open to other methods of use. The most interesting programs are not written top-down, or bottom-up for that matter, but rather 'middle-out' (that is, by writing a program to solve an interesting bit of the problem and then expanding, adding and refining). Most Logo programs are written that way.

Variables

The procedure SQUARE always draws a square of side 40 units. In this sense, SQUARE is rather like a primitive such as PENUP which only has one possible effect. Some other commands, such as FORWARD, are followed by a number which acts as an 'input' and determines the exact action to be taken. We can write a SQUARE-drawing procedure which requires an input in this way:

```
TO SQUARE: SIZE
   REPEAT 4 [FORWARD: SIZE RT 90]
END
```

To call this procedure we now type SQUARE 30 or SQUARE 60 in order to get squares of side 30 or 60 respectively. SIZE is called a 'variable' and it works in this way: whenever the procedure is called, Logo stores away the number following SQUARE in a 'box' and sticks the label SIZE onto it. Then, later, when Logo sees :SIZE, it finds the right box and replaces :SIZE by the value it finds there.

The variable used here is said to be 'local' to the procedure call: that is, as soon as the procedure has finished running, Logo forgets that it ever had a variable called SIZE. This way of using variables is very similar to the formal parameters in a Pascal procedure definition, but is rather unlike the way variables are used in Basic.

The reason for the colons (read them as dots) will be fully explained next month. For the time being, you can take it that a word with : in front of it must be the name of a variable. No : means that the word is the name of a primitive or of a procedure.

Recursion

```
TO DAILY.GRIND
   WORK
   SLEEP
   DAILY.GRIND
END
```

Here we have defined a procedure in terms of itself. This is called 'recursion' and is widely believed to be a highly mysterious process. Not so! Look at this definition of a square:

```
TO SQUARE :SIZE
   FORWARD :SIZE
   RIGHT 90
   SQUARE :SIZE
END
```

When you type SQUARE 40, Logo looks up SQUARE in its list of known words, and the turtle goes forward 40 units and turns right 90 degrees. Logo then sees that it must now do SQUARE 40, so it looks up SQUARE and the turtle goes forward 40, turns right 90, at which point . . . The procedure will run forever, so after it has drawn the square and is retracing its steps, you stop the turtle (CTRL-G stops Logo in almost all versions).

That's a fairly unusual way of drawing a square, but what about the 'square spiral' shown in Fig 1? Think about drawing this starting from the inside. The turtle must first do FORWARD 5 RIGHT 90, and then carry on with the rest of the spiral. But the rest of the spiral is almost the same as the whole spiral, if you see my point. I'm suggesting that this shape — a spiral beginning with length 5 — is made up of two parts, FORWARD 5 RIGHT 90, followed by a spiral beginning with length 10. So, in Logo:

```
TO SPIRAL :SIZE
   FORWARD :SIZE
```

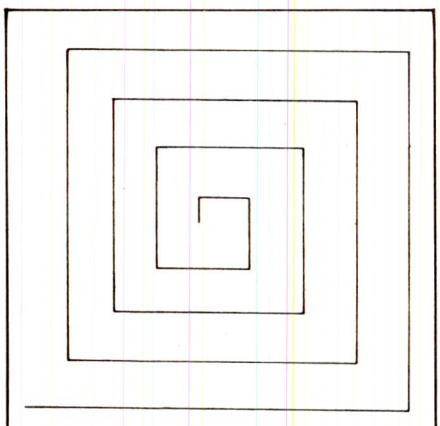


Fig 1 A square spiral

```
  RIGHT 90
  SPIRAL :SIZE + 5
END
```

In this case, it is natural to describe the shape in terms of recursion; any other description would be rather artificial.

In attempting to understand how this procedure works, bear in mind that each time SPIRAL is called, a new variable called SIZE is created. Each value of SIZE is known only to that particular procedure call. Think of each procedure call as producing a copy of the original procedure, complete with its own library of local variables.

The alternative to recursion is to use 'iteration', which is the name given to repeating chunks of code using WHILE/WEND, REPEAT/UNTIL and FOR/NEXT loops, or even GOTOs. In Logo, REPEAT is used for very simple situations, but otherwise recursion is usually used in preference to iteration.

Two objections are often raised to the use of recursion: firstly, that it is difficult; and secondly, that it uses a lot of computer memory. The reason many people find recursion difficult may simply be unfamiliarity. Some computer languages (most versions of Basic, Fortran and Cobol) do not have recursion, and even languages that do (Pascal) never really encourage its use. There are, however, a great many problems in computing that are most easily, and most naturally, expressed using recursion.

The problem over use of memory is a real one. Most versions of Logo alleviate this problem somewhat by efficiently implementing so-called 'end recursion' — that is, procedures in which the recursive call is in the last line. In this situation, recursion does not use any extra memory as it runs. It is often worth recasting procedures into an end recursive form if it is possible to do so.

The only way to get used to recursion is to use it. Turtle graphics is an ideal area in which to learn to think recursively. You may find it strange at first, but it won't be long before it is iteration that begins to seem slightly difficult.

Recursive procedures that carry on running until they are stopped by typing CTRL-G are of limited usefulness. A couple of recursive procedures from real life illustrate the solution to the problem of stopping:

```
TO ADJUST.SOUND
  IF LOUD.ENOUGH THEN STOP
  TURN.CONTROL
  ADJUST.SOUND
END
TO DRINK
  IF UNCONSCIOUS THEN FALL.OVER
    STOP
  SWALLOW.BEER
  DRINK
END
```

These are examples of 'stop rules' which are implemented using the familiar IF/THEN structure.

You can do exactly the same thing in Logo, so to stop the spiral program as soon as the length of the side exceeds 100, write:

```
TO SPIRAL :SIZE
  IF :SIZE > 100 THEN STOP
  FORWARD :SIZE
  SPIRAL :SIZE + 5
END
```

When Logo meets STOP in a procedure, it stops executing that procedure and returns control to the procedure that called it. If the procedure was called from the initial command mode ('top-level') then command returns to there.

Here is another example which draws a series of shrinking squares, one on top of the other:

```
TO TOWER :SIZE
  IF :SIZE < 5 THEN STOP
  SQUARE :SIZE
  FORWARD :SIZE
  TOWER :SIZE — 5
END
```

LCSI Logo uses a slightly different syntax for IF. In this version you write IF :SIZE < 5 [STOP], where the THEN is omitted, and the action is given as a list.

Example program

Let's tie all these threads together by writing a program to draw the 'snowflake curve', which is a recursively-defined curve. Fig 2 shows how the curve is defined: an equilateral triangle forms the level 0 curve. Take each side, divide it into three parts, and construct an equilateral triangle on the middle section. This is the Level 1 curve. Now take each line in the drawing and repeat the process of division to get the Level 2 curve, and so on.

The start is easy enough:

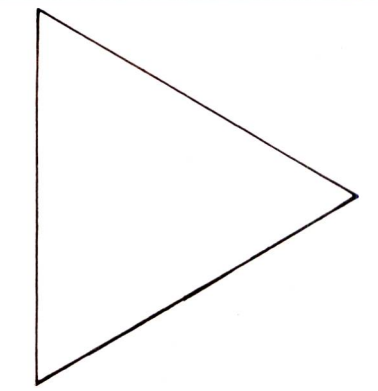
```
TO SNOW :SIZE
  REPEAT 3 [FORWARD :SIZE RIGHT
    120]
END
```

draws the level 0 curve, but you now need to replace the straight side (FORWARD :SIZE) with a more complex shape which is dependent on the level. You will need two inputs, one for the size and one for the level. Your second attempt therefore is:

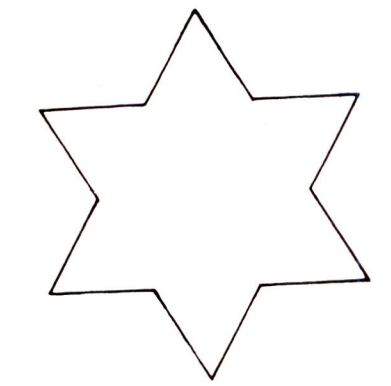
```
TO SNOW :SIZE :LEVEL
  REPEAT 3 [SIDE :SIZE :LEVEL RIGHT
    120]
END
```

As to drawing the side, if it is level 0 then it is simply a straight line. Otherwise it is made up of four sections, each of one lower level.

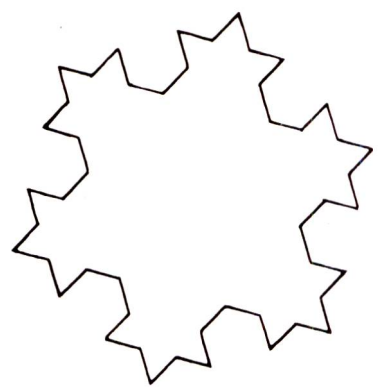
```
TO SIDE :SIZE :LEVEL
  IF :LEVEL = 0 THEN FORWARD
    :SIZE STOP
  SIDE ( :SIZE / 3 ) ( :LEVEL — 1 )
  LEFT 60
  SIDE ( :SIZE / 3 ) ( :LEVEL — 1 )
  RIGHT 120
  SIDE ( :SIZE / 3 ) ( :LEVEL — 1 )
  LEFT 60
  SIDE ( :SIZE / 3 ) ( :LEVEL — 1 )
END
```



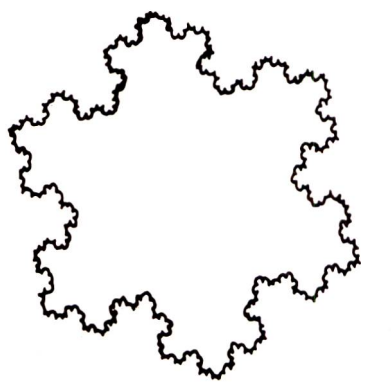
Level 1



Level 2



Level 3



Level 4

Fig 2 The gradual development of the snowflake curve

This is part one of a six-part series. END

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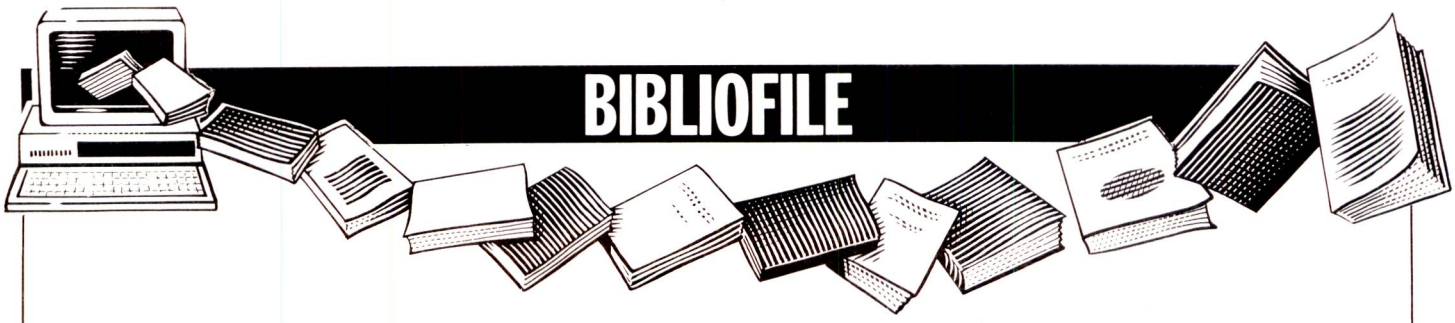

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Living computers stalk the Silicon Valley spys in this months selection of books. David Taylor dips into the realms of disbelief.



Alive, alive-o

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Publisher: Harvester Press
Price: £15.95

Fundamental questions are raised by this peculiar book including the question of whether computers are capable of appreciating any sort of morality. The question of whether computers will evolve sexual feelings, and the question of whether Geoff Simons, author of a previous thought-provoking tome *Are Computers Alive?*, is more or less off his chump.

I mean you do wonder. Mr Simons, chief editor at Manchester's National Computing Centre, is one who believes vehemently that computers are fast becoming a new type of living creature. Notwithstanding that he's well aware of all the fuzzily philosophical and semantic ifs and buts surrounding such a concept — What does living mean? What defines thought? — Mr Simons is himself such a live wire that he too easily gives the impression that computers are about to take over the Earth's unsteady reins *any minute*.

I was reminded, as I reeled through this book's ever more bizarre and fanciful predictions, of a day the BBC once persuaded me to spend in the company of Erich von Däniken. He, though superficially lucid and a best-selling author besides, tends to unsettle his audience by taking it as read that many of life's imponderables can be put down to the fact that, once upon a time-warp, Little Green Men looked in on us. For him it stands to reason that they'll shortly be back.

Von Däniken, some might suppose, has stepped over the thin dividing line between far-seeing conjecture and the nuthouse. Whereas Geoff Simons has (to date) only got periously close to the edge. What will happen in the next half century with computers, or with anything else — even supposing there *is* a next half century — is anybody's guess. Most of us prefer to get by *pro tem* on the assumption that we'll manage for the next dozen years or so and maybe think again after that.

Mr Simons is hell-bent on thinking through everything *now*. It is his technique of combining obscure academic references with hip, James Burkeian phrasing of sensationally ooh-er predictions which I find intensely irritating, for example 'It is highly

likely that computer organisms will evolve consciousness . . . but we should also remember that much important human information processing is unconscious: we can recall such unconscious (or semi-conscious) accomplishments as Poincare's identification of the transformations used to define Fuchean functions with those of non-Euclidean geometry and Kekule's formulation of the structure of the benzene molecule.'

Personally I could not, off hand, recall either one. It makes it hard to leap-frog alongside go-getting Geoff into believing that my PC is poised to go conscious, go unconscious, or come to that go and make a pot of tea off its own bat.

Call me a stick-in-the-mud realist, but I find life's hard enough, for the moment, getting to grips with DOS. 'We can speculate,' chunters on Mr Simons in an especially rich section on computers evolving feelings, 'on what emotion will be like in organisms able to process information at the rate of hundreds of millions of operations every second'.

We can indeed. Or we can speculate, for that matter, on whether pigs might fly. My point is that in either case, we ought perhaps to speculate yet again on where such extravagant speculation gets us. Apart, that is, from into print.

Floppy days are here again

Title: Disk Basic On Your Micro
Authors: Michael Chadwick & John Adrian Hannah
Publisher: Sigma Press
Price: £7.50

A happy hacker's starter for those moving over for the first time from cassettes to floppy storage and full of hints like don't leave disks out in the rain or write on their jackets with a biro.

You're shown how to file your friends' phone numbers or catalogue your books. You get 40-odd programs to fiddle about with — Basic tailored for BBC, VIC-20, Applesoft and MS-DOS machines — and potentially hours of fun if you're more absorbed by DIY than running off-the shelf applications. Nothing startling, but not bad for £7.50 if you've finished your homework.

Cloak and dagger

Title: Espionage in the Silicon Valley
Author: John D. Halamka
Publisher: Sybex
Price: £8.85

This is all very unsavoury stuff. In an all-American gee-whiz and pruriently chop-smacking fashion, it details a catalogue of hi-tech spy cases which have bedevilled California's Silicon Valley and given even hard-bitten FBI agents pause for thought.

Murder, bribery and extortion infest a text which, we're assured, is factually based but isn't half hoked up to keep out wide-eyed, open-jawed attention.

We get to meet James 'Jimo' Harper, whose alcoholic lover had access to classified security files and was prepared to pass on copies to Polish intelligence in exchange for well-stuffed plain envelopes.

Out of the woodwork comes Larry Lowery, a black-market chip dealer and generally nasty piece of work now awaiting trial on charges of bumping off a heroin addict who was scheduled to testify against him in a $3.2 million chip theft case.

And we get lots of smudgy pictures and Xeroxed letters to lend authenticity to a nauseously seedy tale — one which perhaps could have been sub-titled *Silicon Valley of the Dolls*. In a word: yerch.

Yet more DOS

Title: Running MS-DOS
Author: Van Wolverton
Publisher: Microsoft Press/Penguin
Price: £16.95

This Microsoft-with-Penguin paperback is handsomely produced, and more chattily accessible than IBM's pink ring-binderful. But as one who has hammered long and hard at the original manual anvil of PC-DOS, I wondered how much I might discover that I didn't already know. To which the answer proved to be, as Van Wolverton might put it, zilch.

Well over fifty PCs, aside from IBM's old stager, now use Microsoft's masterpiece (or a slightly tailored version of it) as their operating system. That looks like reason enough to do a primer. The only snag is, of course, that well over fifty PC makers have already done it and, in the case of the most universally known IBM version, done it comprehensively well.

So what's the point? Simplicity, modest Mr Wolverton says. His book skips the knottier passages of the senior manual and more succinctly arranges what you need to know to get applications up and running chop-chop. It assumes neither that you are, nor that you aspire to become, a programmer.

It says OK and let's go, straight into a lucid summary of the bare necessities of DOSsing down, then on into useful hints on how to get DOS to perform extra file-sorting functions or customised 'smart' commands (to make archives or give yourself personalised messages and prompts within DOS).

I found it pretty absorbing, despite the lack of surprises. Van Wolverton has an easy as well as authoritative style and makes a good job of those areas where the IBM manual is not at its best — describing EDLIN, for example, or getting together batch files.

I don't as a rule welcome manual re-writes when the original is half-way decent, but this one is sufficiently well produced and civilised in its approach to deserve a recommendation.

Does he like computers?

Title: Micros For Handicapped Users
Author: Peter Saunders
Publisher: Helena Press
Price: £5.95

There is a notorious approach, invariably well-meant but stupidly insensitive just the same, of talking down to the physically disabled as if they were all mentally handicapped too.

Hardly surprising, it is deeply frustrating for those suffering from physical misfortune, but whose wits are as sharp as anyone else's, to be treated as if they are only to be addressed via an interpreter. It is an attitude which the BBC (whose programmes for the handicapped are as a rule excellent) brilliantly parodied in a radio series called *Does he take sugar?*

In the case of the mentally handicapped, also, there is too often the public supposition that they can only ever be addressed in absurdly simplified or grotesquely coochy-coo terms — taking no account of the fact that mental handicaps vary enormously in their severity.

Perhaps for such reasons, the pleasures and benefits which the handicapped can quite obviously gain from mastering micros are widely underestimated. Scarcely any computing books address the possibilities with so much as an addendum, but this one, part of a commendable series from Yorkshire's Helena Press, does its best to combine encouragement for the idea of computing (with several very moving case histories) and hard information.

With an enormous amount of well-researched reference, it describes how the disabled can set about getting started or finding out more about what's available from specialist suppliers and agencies — like switches worked just by a blink, electropalatographs, Braille keyboards.

The main text is regrettably uneven (several writers are included) and, to an indefensible extent, it patronises the reader. 'What about the power supply?', we are for example asked, 'all those trailing wires and plugs and switches?'. Nevertheless this book is of course to be welcomed: the information content is high, the need for it even higher. Micro-computers can often readily provide the stimulation and fascination of which many disabled people feel in desperate need. As this book's foreword points out, it is the ability and not the disability which we should rightly concentrate on. END



TJ'S WORKSHOP

Our monthly pot-pourri of hardware and software tips for the popular micros. If you have a favourite tip to pass on, send it to TJ's Workshop, PCW, *62 Oxford Street, London W1. Please keep your contributions concise. We will pay £5-£30 for any tips we publish.* PCW *can accept no responsibility for damage caused by using these tips, and readers should be advised that any hardware modifications may render the maker's guarantee invalid.*

SPECTRUM EXTENDED BREAK

Are you a machine code dabbler with a Spectrum? Do you keep getting stuck in endless loops? If so the routine in listing one (or listing two if you don't have an assembler) should help. It 'extends' the function of the BREAK key so that it functions not only at the end of every Basic statement, but also every fiftieth of a second, even when executing machine code.

Z80 mode 2 interrupts are used to jump to the routine, which executes the housekeeping tasks (keyboard scanning and clock) normally undertaken by the Spectrum interrupt system, and then tests the BREAK key (using the ROM routine at 1F54 hex). If this is pressed, an error 'L BREAK into program' is caused by a jump to address 8 (Restart 8 resets both machine and floating-point calculator stacks, giving a 'clean' jump to Basic). The system is also returned to the usual, mode 1, interrupts, otherwise the routine tends to interrupt itself, with unpredictable results.

The two short routines at 65500 and 65510 decimal turn the mode 2 (extended) system on and off respectively. (NB: the system must be restarted, by USR 65500, every time it is used, since it is self-disabling.)

The routine can't cope with:
(i) Hardware crashes (an Interface I speciality!)
(ii) Any situation in which interrupts are disabled (most peripheral operations)
(iii) Any situation in which other mode 2 interrupts are set up (many machine code games)
(iv) Any situation in which the system variable ERR-SP is altered

Apart from these restrictions, it makes a very useful tool to have loaded, especially for debugging that latest machine code materpiece that will keep crashing!

P R Heesom

```
LISTING 1 : Z80 SOURCE CODE

                    ORG D9E1H
9DE1      INTERUPT:RST 56           FF
9DE2                PUSH AF         F5
9DE3                CALL 1F54H      CD 54 1F
9DE6                JR NC,BREAK     30 03
9DE8                POP AF          F1
9DE9                RETI            ED 4D
9DEB          BREAK:IM 1            ED 56
9DEE                RST 8           CF
9DEF                DEFB 20         14

                    ORG OFFDCH
FFDC      SWITCH-ON:LD A,15H        3E 15
FFDE                LD I,A          ED 47
FFE0                IM 2            ED 5E
FFE2                EI              FB
FFE3                RET             C9

                    ORG OFFE6
FFE6     SWITCH-OFF:IM 1            ED 56
FFE8                EI              FB
FFE9                RET             C9


LISTING 2 : BASIC LOADER

10 LET T=0
20 FOR X=55777 TO 55790:READ A:LET T=T+A:POKE X,A:NEXT X
30 IF T<>1976 THEN GOTO 100
40 LET T=0
50 FOR X=65500 TO 65507:READ A:LET T=T+A:POKE X,A:NEXT X
60 IF T<>1174 THEN GOTO 100
70 LET T=0
80 FOR X=65510 TO 65513:READ A:LET T=T+A:POKE X,A:NEXT X
90 IF T=775 THEN SAVE "INTERUPTS" CODE 55777,14:SAVE "INTERUPT2"
   CODE 65500,14:STOP
100 PRINT "Data error - recheck :":LIST 110
110 DATA 255,245,205,84,31,48,3,241,237,77,237,86,207,20
120 DATA 62,21,237,71,237,94,251,201
130 DATA 237,86,251,201
```

BBC UTILITIES

These procedures are all intended to be appended to BBC Basic programs by being *LOADed at address (TOP-2). Typing OLD will then incorporate the procedure into the program (see BBC *User Guide*, pages 402-403). Minor adjustments may be necessary for given applications.

Familiarisation with most of these procedures can be done with little more than a PROC call and an END. The procedures will work on Basic 1 and OS 1.2, and should work on both the BBC and Electron.

F Timer: adds together two items, on a 12-hour clock.The times must be in REAL format, with the minutes forming the decimal part, for example 8.45 + 0.15 = 9.15

P Error: error —handling routine, used to allow controlled abortion of program. Needs to be customised for particular applications, but can be used, for example, to close files, disable printers, return edit function, and so on. Also prints out the line at which the error occurred, allowing speedy editing and correction. Must be enabled by having ON ERROR PROCerror as (preferably) the first line of the program.

P Load: to get and validate the file name of an input data file. The file is then *LOADed at &3000, to allow data to be read using indirection (or possibly P. ReadIn). The address of the top of the data file is stored in 'memtop'. Could be modified fairly easily to save data to file in the same fashion.

P Keyscan: a keyboard scan routine that uses INKEY (0) to avoid holding up a program. Four parameters are required:
format% — selects valid characters to be read
x%, y% — TAB (x%,y%) print position
nchars% — the maximum length of the input line

The routine prints out the line input, and allows deletion of characters until RETURN is pressed, when the flag return% is set TRUE and the input is put into variable com$. The value of format% determines what inputs are allowed. A value of 0 reads any character from the keyboard, 1 turns lower-case letters to upper-case, and 2 allows numerics only. The routine must have variables initialised before use: com$=STRING$(255,""):wipe%=TRUE

S L Williams

```
30000 REM FNtimer
30010 :
30020 REM   [PROCEDURES]F.Timer
30030 :
30040 DEF FNtimer(oldtime,time)
30050 REM add times together in REAL format
30060 REM eg add 8.45' + 0.30' = 9.15'
30070 :
30080 LOCAL K%
30090 newtime=oldtime+time
30100 K%=newtime :REM store integer value
30110 mins=newtime-K% :REM get the mins
30120 IF mins >=0.595 THEN newtime=newtime+0.4
30130 K%=newtime :REM store integer value
30140 IF newtime>=12.595 THEN newtime=newtime-12 :REM 12 hour clock
30150 =newtime
```

Fig 1 F Timer program

```
30000 REM  PROCerror
30010 :
30020 REM   [PROCEDURES]P.Error
30030 :
30040 DEFPROCerror :REM error handling routine
30050
30060 REM Flush all buffers, Close Files
30070 REM and disable printer. Then print
30080 REM error line.
30090
30100 DIM char 10
30110 *FX4,0
30120 CLOSE#0 :REM close all files
30130 VDU3    :REM disable printer
30140 VDU7: PRINT'"ERROR! - Any key to continue" :A=GET
30150 VDU22,7
30160 REPORT: PRINT;CHR$131;"at line ";ERL
30170 IF ERR=17 THEN END  :REM allow escapes
30180 PRINT
30190 error$="L."+STR$(ERL)+CHR$10+CHR$10+CHR$13
30200 *FX15,1
30210 FOR I%=1 TO LENerror$
30220   A=ASC(MID$(error$,I%,1))
30230   $char="FX138,0,"+STR$(A)
30240   X%=char MOD 256
30250   Y%=char DIV 256
30260   CALL &FFF7
30270   NEXT
30280 END
30290 ENDPROC
```

Fig 2 P Error program

```
30000 REM  PROCload & PROCgetfile
30010 :
30020 REM   [PROCEDURES]P.Load
30030 :
30040 DEFPROCload
30050 REM Verify and *LOAD a file
30060 REM file is loaded at &3000 and reaches
30070 REM to "memtop"
30080 :
30090 DIM file 20
30100 PRINTTAB(0,20)SPC(30)
30110 REPEAT
30120   PROCgetfile :REM check filename
30130   file%=OPENIN(filename$)
30140   IF file%=0 THEN PRINTTAB(0,20);CHR$131;"File not found":VDU7:A=INKEY(200
)
30150   UNTIL file%<>0 :memtop=&3000+ EXT£(file%) :CLOSE£0
30160 REM now shove it to OSCLI
30170 $file="LOAD "+filename$+" 3000"+CHR$13
30180 X%=file MOD 256
30190 Y%=file DIV 256
30200 CALL &FFF7
30210 ENDPROC
30220 :
30230 DEFPROCgetfile :REM check filename
30240 REPEAT
30250   REPEAT
30260     PRINTTAB(0,20)SPC(30)
30270     VDU7:PRINTTAB(0,20);CHR$131;"Filename ";
30280     INPUT filename$
30290     UNTIL LEN filename$ <=9 :REM check length
30300   IF LEN filename$>7 AND MID$(filename$,2,1)<>"." THEN valid%=FALSE ELSE v
alid%=TRUE
30310   UNTIL valid%
30320 ENDPROC
```

Fig 3 P Load program

```
30000 REM  PROCkeyscan
30010 :
30020 REM   [PROCEDURES]P.Keyscan
30030 :
30040 DEFPROCkeyscan(format%,x%,y%,nchars%)
30050 REM scan keyboard for input line "com$"
30060 REM format% selects characters read -
30070 REM format%=0 gives "any key" read
30080 REM format%=1 gives "no lowercase" read
30090 REM format%=2 gives numerics only
30100 REM x% & y% are the input print positions
30110 REM nchars%= maximum length of input string
30120 :
30130 REM initialise with "com$=STRING$(255," ") :wipe%=TRUE" before use
30140 :
30150 LOCAL A,I%
30160 return%=FALSE
30170 IF wipe% THEN PRINTTAB(x%,y%);SPC(LEN(com$)+3) :com$="" :wipe%=FALSE ELSE
PRINTTAB(x%,y%);"? ";
30180 A=INKEY(0) :REM read any key
30190 IF A=-1 THEN ENDPROC
30200 IF format%=1 AND ( A>96 AND A<123 ) THEN A=A-32  :REM no lowercase
30210 IF format%=2 AND A<>13 AND A<>127 AND ( A<48 OR A>57 ) THEN ENDPROC
30220 A$=CHR$(A)
30230 IF A$=CHR$127 AND LEN(com$)>0 THEN com$=LEFT$(com$,LEN(com$)-1)  :REM dele
te
30240 IF A$<>CHR$127 AND A$<>CHR$13 AND LEN(com$)=nchars% THEN SOUND1,-15,150,2
30250 IF A$<>CHR$127 AND A$<>CHR$13 AND LEN(com$)<nchars% THEN com$=com$+A$
30260 IF A$=CHR$13 THEN return%=TRUE :wipe%=TRUE
30270 PRINT;com$;" ";:VDU8
30280 ENDPROC
```

Fig 4 P Keyscan program

MEMOTECH PANEL EXPANSION UTILITY

Anyone who has spent time roaming around their memory via the PANEL command will find this assembler program of much use, as it allows the disassembled code to be printed out by using the system variable FEXPAND.

A point to note is that this program is designed for use with the DMX80 printer; other printers may require a different bit check in the status routine (see your printer manual for further details). This program is executed (after typing RUN to reset the FEXPAND variables) by entering PANEL, then using the list command L to disassemble an area of RAM. Execution of the utility then requires only a press of the P key (make sure your printer is switched on!), and you get an instant hard copy.

For details of how to enter this program into your machine, see the assembler section of the Memotech manual.

Program notes

The program is label-driven and is totally independent of its position in memory, hence the lack of memory locations to the left of the assembler. Consequently, the program will run on any MTX regardless of its memory capacity.

This program was written by a member of the Memotech Owners' Club. Anyone wishing to enquire further about the activities of the club should send an SAE to: MOC, 23 Denmead Rd, Harefield, Southampton SO2 5GS. The annual subscription is £7. Any other Memotech submissions are always welcome.

Label explanations

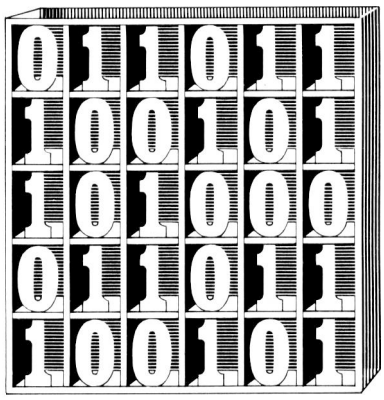
STRT-FINI : set system variable FEXPAND
PANEL : check for P key press
START : main program loop

Subroutines

LADDR : set VPD to VRAM read mode
DUMP : set screen width to 29 characters
LOOP2 : read screen and send to printer
BUFFER/STATUS : output to printer
LPRINT : cause line feed and carriage return
WAIT/LOOP1 : idle loop

```
;
; PANEL LPRINT DUMP
;
STRT:    LD A,£C3        : jump code for panel
                           extension
         LD (£FA9E),A
         LH HL,PANEL     ; address for panel extension
FINI:    LD (£FA9F),HL   ; set fexpand
PANEL:   CP £50          ; is key 'P'
         RET NZ          ; if so then continue
         LD A,14         ; screen lines
         PUSH AF
         LD HL,£1C00     ; start of name table in VRAM
         LD DE,40        ; skip to next screen line
START:   CALL LADDR      ; set up address for VRAM
                           read
         CALL DUMP       ; print out one line
         POP AF
         DEC A           ; keep line countdown
         CP 0            ; has it finished
         RET Z           ; finish routine after 14 lines
         PUSH AF
         ADD HL,DE       ; address of next screen line
         JR START        ; do until finished
LADDR:   LD A,L          ; set up VRAM address
         OUT (2),A       ; LS byte first
         LD A,H          ; now set MS byte
         OUT (2),A
         CALL WAIT       ; timing pause for VDP
         RET
DUMP:    LD B,29         ; set screen width for dump
LOOP 2:  IN A,(1)        ; read screen character
         CALL WAIT       ; pause
         CALL BUFFER     ; load printer buffer
         DJNZ LOOP2      ; get next character
         CALL LPRINT     ; LPRINT one line of the
                           screen
         RET
BUFFER:  OUT (4),A       ; latch char into printer buffer
STATUS:  IN A,(4)        ; is PTR ready
         AND £1          ; ready bit check
         JRNZ,STATUS
         CALL WAIT       ; pause for printer
         IN A,(0)        ; strobe data into printer
                           buffer
         CALL WAIT       ; pause
         IN A, (4)       ; reset strobe signal
         RET
LPRINT   LD A,10         ; line feed
         CALL BUFFER     ; send to printer
         LD A,13         ;carriage return
         CALL BUFFER     ; send
         RET
WAIT:    PUSH BC         ; pause for a period
         LD B,50         ; of time to allow
LOOP 1:  DJNZ LOOP1      ; the printer and the
         POP BC          ; VRAM to respond
         RET
```

SUBSET



David Barrow presents more documented machine code routines and useful information for the assembly language programmer. If you have a good routine, an improvement or conversion of one already printed, or just a helpful programming hint, then send it in and share it with other programmers. Subroutines for any of the popular processors and computers are welcome but please include full documentation. All published code will be paid for. Send your contributions to Sub Set, PCW, 62 Oxford Street, London W1A 2HG.

Z80 SOUNDEX

SOUNDEX from John Hardman of Welling (alias J500 H635 of W452) is a Z80 implementation of the 'Soundex' system — a fairly reliable method of coding inexact data which dates back to the US census of 1890. Incidentally, John doesn't think a computer was used at the time, and he is quite right, but the 1890 census does figure prominently in computing history nonetheless. It was the head count which killed the bookmark trade by introducing Herman Hollerith's punched cards to an unsuspecting world.

The Soundex system works by encoding names or similar data as a sequence of one letter and three digits, with truncation or zero padding as necessary. Encoding a heard name follows six rules:

1 Write the name as you think it is spelled.
2 Retain the first letter.
3 Ignore spaces, puntuation and non-codable letters.
4 Replace second and subsequent letters by their group code:
group 1: BFPV
group 2: CGJKSXZ
group 3: DT
group 4: L
group 5: MN
group 6: R
5 Delete consecutive repeat digits.
6 Truncate or append zeros to give a four character result.

The method produces identical codes for phonetically similar names, simplifying reference where idiosyncratic spelling can be a problem; for example:
code B650: Barney, Bernie, Bram, Brian, Bronwen.
code J500: Jamie, Jan, Jane, Jenny, Jimmy, Joan, John. Jean, Jemima, Jennie,
code J520: James, Janica, Johannes, Jonas.
code S363: Stewart, Stuart.
code T320: Thaddaeus, Thaddeus, Theodosius.

John suggests an ideal modern use for the system — dealing with telephoned orders or queries from existing customers. How often have you fumed at the time wasted in having to spell both your name and address on a peak-rated long-distance call? A quicker response is possible, preventing aggravation and keeping charges low, if customer accounts can be accessed by a Soundex code key formed from the received sound of the name and address. And, of course, a name spell request is out of the question when processing after-hours orders left on an answering machine.

DATASHEET 1

```
;*************************************************************
;* SOUNDX    Convert name to 4-character Soundex code.
;*************************************************************
;JOB         To encode a name or other word data as a one-letter,
;            three digit sequence where phonetically similar data
;            results in identical code.
;ACTION      WRITE '0000'. Reset write-pointer.
;            count = 0.
;            READ (upper-case) char.
;            IF char >= 'A' OR char =< 'Z' THEN:
;            [ REPEAT:
;              [ WRITE char.
;                count = count + 1.
;                IF count < 4 THEN:
;                [ lastchar = char.
;                  REPEAT:
;                  [ READ (upper-case) char.
;                    IF char <> term. THEN:
;                    [ tabcount = 6
;                      REPEAT:
;                      [ READ tabchar.
;                        IF tabchar = tabgroupterm THEN:
;                          [ tabcount = tabcount - 1. ] ]
;                      UNTIL tabcount = 0 OR tabchar = char.
;                      char = tabcount + '0'. ] ]
;                  UNTIL char <> lastchar OR char = term. ] ]
;              UNTIL count = 4 OR char = term. ]
;-------------------------------------------------------------
:CPU         Z80
:HARDWARE    Memory containing source data. RAM destination area.
:SOFTWARE    None.
;-------------------------------------------------------------
:INPUT       DE addresses 1st byte of source data.
;              Source must begin with a letter.
;              Source must terminate with null (00H).
;            HL addresses 1st byte of 4-byte destination area.
:OUTPUT      All registers unchanged.
;            Destination area contains Soundex code of source.
;            (If source begins with a non-letter character, then
;            code '0000' is returned in destination.)
:ERRORS      No check for destination overwrite of source.
:REG USE     DE HL
:STACK USE   12
:RAM USE     None.
:LENGTH      100 (77-byte code + appended 23-byte table).
:CYCLES      Not given.
;-------------------------------------------------------------
:CLASS 2     *discreet       *interruptable       *promable
:****--      *reentrant      -relocatable         -robust
;*************************************************************
;
SOUNDX PUSH DE              ;Save source and                D5
       PUSH HL              ;destination pointers.          E5
       PUSH BC              ;Save registers and flags       C5
       PUSH AF              ;for use in SOUNDX.             F5
;
       PUSH HL              ;Save destination pointer and   E5
       LD   B,4             ;use to set 4-byte destination  06 04
CLEARL LD   (HL),'0'        ;to '0000' by loop setting      36 30
       INC  HL              ;each byte to '0' in turn.      23
       DJNZ CLEARL          ;Repeat for four bytes.         10 FB
       POP  HL              ;Readdress destintion start.    E1
;
       LD   A,(DE)          ;Get 1st source character and   1A
       AND  0DFH            ;convert any lower case to      E6 DF
       CP   'A'             ;upper case. Test if a letter   FE 41
       JR   C,SXEXIT        ;within range 'A' to 'Z',       38 34
       CP   'Z'+1           ;exiting with code = '0000'     FE 5B
       JR   NC,SXEXIT       ;if it is outside the range.    30 30
;
STORE  LD   (HL),A          ;Store letter or code digit     77
       INC  HL              ;and index next dest. byte.     23
       INC  B               ;Count one byte done, then      04
       BIT  2,B             ;test if four done and          CB 50
       JR   NZ,SXEXIT       ;exit, complete if so.          20 29
;
SAVECH LD   C,A             ;Save last character or code.   4F
;
NEXTCH INC  DE              ;Index next source cnar.        13
       LD   A,(DE)          ;and get in A.                  1A
       OR   A               ;Test for source terminator     B7
       JR   Z,SXEXIT        ;and exit, complete if so.      28 23
;
       AND  0DFH            ;Else, ensure upper case.       E6 DF
       PUSH HL              ;Save dest. pointer & count     E5
       PUSH BC              ;and saved char. for use        C5
       LD   B,6             ;indexing 6-group table.        06 06
       LD   C,A             ;Save char. for table search.   4F
       LD   HL,SNDTAB-1     ;Address SOUNDX table.          21 lo hi
;
TABLP  INC  HL              ;Point to next table byte       23
       LD   A,(HL)          ;and get entry in A.            7E
       OR   A               ;Test for group terminator      B7
       JR   NZ,CMPRCH       ;and compare chars. if not,     20 04
;
       DJNZ TABLP           ;Repeat for next group but      10 F9
       JR   TLPOUT          ;end, A=0, if all six done.     18 06
;
CMPRCH CP   C               ;Compare with source char.      B9
       JR   NZ,TABLP        ;and try again if no match      20 F4
       LD   A,B             ;else A = group code 1 to 6     78
       ADD  A,'0'           ;as ASCII digit '1' to '6'.     C6 30
;
TLPOUT POP  BC              ;Restore last char. or code,    C1
       POP  HL              ;& dest. count and pointer.     E1
       CP   C               ;Compare code with last code    B9
       JR   Z,NEXTCH        ;and discard if the same.       28 DD
;
```

```
        OR    A             ;If A=0 then ignore source      B7
        JR    Z,SAVECH      ;character and process next,    28 D9
        JR    STORE         ;else write it and do next.     18 D0
;
SXEXIT  POP   AF            ;Restore flags and registers    F1
        POP   BC            ;used in SOUNDX.                C1
        POP   HL            ;Restore destination and        E1
        POP   DE            ;source pointers to start.      D1
        RET                 ;Exit SOUNDX, code found.       C9
;
SNDTAB  DEFM  'R'           ;Group code 6.                  52
        DEFB  0             ;Group terminator.              00
        DEFM  'MN'          ;Group code 5.                  4D 4E
        DEFB  0             ;Group terminator.              00
        DEFM  'L'           ;Group code 4.                  4C
        DEFB  0             ;Group terminator.              00
        DEFM  'DT'          ;Group code 3.                  44 54
        DEFB  0             ;Group terminator.              00
        DEFM  'CGJ'         ;Group code 2.                  43 47 4A
        DEFM  'KS'          ;                               4B 53
        DEFM  'XZ'          ;                               58 5A
        DEFB  0             ;Group terminator.              00
        DEFM  'BF'          ;Group code 1.                  42 46
        DEFM  'PV'          ;                               50 56
        DEFB  0             ;Group terminator.              00
;===============================================================
```

8086 DISPLAY MAINTENANCE

Our first code for the Intel 8086 (and its 8-bit databus stable mate, the 8088) comes from B J Clayton of Bexleyheath. SCNUPD is a routine to maintain a display which may be independent of the system, perhaps at the far end of a serial line.
The routine works by rapidly checking the ASCII codes in an update screen buffer (containing recent input) against those of a current screen buffer (present display state). On finding an updated character, it escapes from the repeating CMPSB instruction, calculates the character's line and column postion and outputs it to a display cursor subroutine, outputs the character's ASCII code to a display print subroutine and copies the character to the current screen buffer.

Having found one updated character, SCNUPD intelligently check the highly probable condition of an updated following character. In this case calculation and output of the cursor position is unnecessary. The secondary loop NCHAR, which needs only to change the character at each incremented cursor position, continues iteration until a non-updated character is found, when the quick buffer scan is resumed.

Z80 and 8080 programmers might look with envy at the two single-byte instructions which perform the quick buffer scan. The combined REPNZ: CMPSB operation executes in 11 + 22 * CX clock cycles (T states) with the following iteractive sequence:
1 Exit sequence if CX = 0.
2 Service an interrupt request.
3 Compare the memory bytes addressed by DS * 16 + SI and ES * 16 + DI, setting Overflow, Sign, Zero, Half-carry, Parity and Carry-result flags.
4 Increment or decrement SI and DI.
5 Decrement CX.
6 Exit sequence if Zero flag = 0 (bytes differ).

DATASHEET 2

```
;===============================================================
;= SCNUPD    Intelligent screen update.
;===============================================================
;JOB         To rapidly scan an update screen buffer for changes,
;           if found, update screen and current screen buffer.
;ACTION      Initialise count = characters
;           REPEAT:
;           [ REPEAT:
;             [ Compare buffer bytes and increment pointers.
;               Decrement count. ]
;             UNTIL bytes differ OR count = 0
;             IF bytes differ THEN:
;             [ Calculate screen cursor position from count.
;               Output cursor position.
;               REPEAT:
;               [ Copy updated byte to current buffer.
;                 Output updated byte, incrementing cursor.
;                 Compare buffer bytes.
;                 IF bytes differ THEN:
;                 [ Increment pointers.
;
;                   Decrement count. ] ]
;               UNTIL count < 0 OR bytes match. ] ]
;           UNTIL count < 1.
;---------------------------------------------------------------
;CPU         8086 / 8088
;HARDWARE    1920-byte current screen buffer in RAM.
;           1920-byte update screen buffer in RAM.
;SOFTWARE    PSNCSR - Routine to position cursor on screen with
;                     input AL = line number, AH = column number
;                     (home position is line 0, column 0).
;           OUTCH  - Routine to print ASCII character in AL to
;                    current cursor position and update cursor
;                    to next screen position.
;           (PSNCSR and OUTCH must not alter CX, SI or DI and
;           must be in same code segment as SCNUPD.)
;---------------------------------------------------------------
;INPUT       ES:DI addresses first character (low memory) of
;           current screen buffer.
;           DS:SI addresses first character (low memory) of
;           update screen buffer.
;           DF must be reset (0) for auto-increment in CMPSB.
;OUTPUT      Flags altered. All other registers unchanged.
;           Update characters output to screen and copied to
;           current screen buffer.
;           Screen cursor at last character changed + 1.
;ERRORS      If DF flag = 1 on input, then DI and SI are
;           decremented during CMPSB operation and memory below
;           the update and current buffers is compared.
;           No check is made for unprintable characters output
;           through OUTCH misaligning screen and buffers.
;REG USE     PSW ES:DI DS:SI
;STACK USE   12 + subroutine stack use.
;RAM USE     None.
;LENGTH      55
;CYCLES      The following example timings (a) to (d) are for the
;           8086 and include wait times only for instruction
;           fetches on entry and after sequence changes.
;           (a) no update (minimum time):
;                   42385,
;           (b) 1 character update:
;                   42648 to 42659 + PSNCSR + OUTCH,
;           (c) 1 full line update:
;                   49341 to 49352 + PSNCSR + 80 * OUTCH,
;           (d) full screen update:
;                   205738 to 205749 + PSNCSR + 1920 * OUTCH.
;---------------------------------------------------------------
;CLASS 2     -discreet      *interruptable      *promable
;-**-*-      -reentrant     *relocatable        -robust
;===============================================================
;
CLMNS   EQU   80            ;Screen line length.
TCHAR   EQU   CLMNS * 24    ;Screen total characters = 1920.
;
SCNUPD  PUSH  SI            ;Save update buffer pointer     56
        PUSH  DI            ;and current buffer pointer.    57
        PUSH  AX            ;Save primary accumulator,      50
        PUSH  CX            ;counter accumulator            51
        PUSH  BX            ;and secondary accumulator.     53
;
        MOV   CX,TCHAR      ;Initialise character count.    B9 80 07
;
QSCAN   REPNZ               ;Repeat following comparison    F2
                            ;decreasenting count in CX
                            ;until character count = 0
                            ;or compared bytes differ.
        CMPSB               ;Compare current buffer byte    A6
                            ;with update buffer byte and
                            ;inc or dec pntrs DI & SI.
;
        JZ    EXIT          ;End if no difference found.    74 25
;
        MOV   AX,TCHAR - 1  ;Calculate buffer position      B8 7F 07
        SUB   AX,CX         ;of differing update byte.      29 C8
        MOV   BX,CLMNS      ;Divide position by columns,    BB 50 00
        IDIV  BL            ;giving AL = row, AH = col.,    F6 FB
        CALL  PSNCSR        ;set print routine cursor.      E8 dL dH
;
        MOV   AL,[SI-01]    ;Get update character in AL.    8A 44 FF
;
NCHAR   SEG   ES            ;(Correct segment) copy new     26
        MOV   [DI-01],AL    ;char to current buffer and     88 45 FF
        CALL  OUTCH         ;send it to print routine.      E8 dL dH
;
        MOV   AL,[SI]       ;Get next update char and       8A 04
        SEG   ES            ;(correct segment) compare      26
        CMP   AL,[DI]       ;with current char. If no       3A 05
        JZ    QSCAN         ;change then do quick scan.     74 DE
;
        INC   SI            ;Else new char in AL, so        46
        INC   DI            ;bump buffer pointers and       47
        DEC   CX            ;dec character count. Exit      49
        JL    EXIT          ;if past buffers, else go       7C 02
        JMPS  NCHAR         ;copy and output new char.      EB EB
;
EXIT    POP   BX            ;Restore accumulators           5B
        POP   CX            ;used in SCNUPD.                59
        POP   AX            ;                               58
        POP   DI            ;Restore current and update     5F
        POP   SI            ;pointers to buffer start.      5E
        RET                 ;Exit, screen updated.          C3
;===============================================================
```

MODE FLAGS

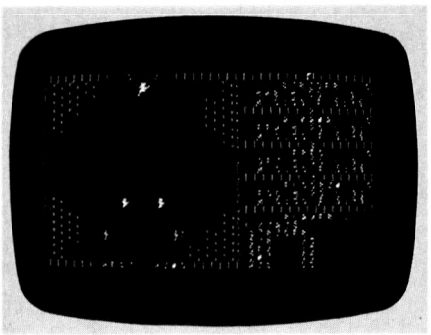
The 8086 has instructions which auto-increment or auto-decrement depending on the state of a direction flag DF. Like the decimal flag D, which causes the 6502 to perform binary or BCD arithmetic, the 8086 DF flag sets an operating mode which changes the meaning of some instructions.

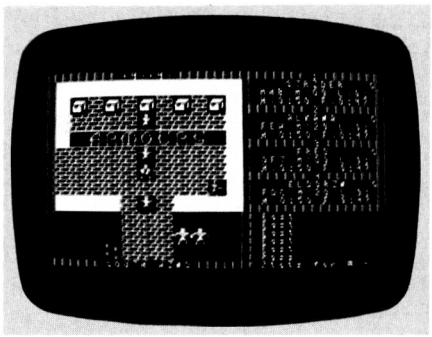
The unknown state of a mode flag can cause errors within stand-alone subroutines. Unless it is explicitly set or reset at the start of the routine, it becomes a necessary input condition. This may be fine when the subroutine is written to be an integral part of a complete program and the mode state is controlled. However, general purpose library routines — the Subset Class 1 standard — should operate correctly in unknown conditions and can only do that by controlling their own mode state. END

SCREENPLAY



Twice is not enough — the third episode in the Ultima story kicks off this month's selection of the best games around for the Atari, Commodore 64 and Spectrum. Stephen Applebaum is your intrepid fall-guy.





For a little peace . . .

Title: Ultima III: Exodus
Computer: Atari, Commodore 64 (and others from Softsel only)
Supplier: Softsel, US Gold
Format: Disk
Price: £49.95 (Softsel), £19.95 (US Gold)

Traveller, beware — something stirs in the land of Sosaria. The hard-earned peace, fought for many moons ago, has been shattered by a devouring evil. Once more the sound of Orc drums, banished from Sosaria with the fall of Mondain and Manax, has pierced the calm air, striking terror into the hearts of the happy and prosperous subjects of Lord British.

Little is known about the new protagonist. the only clues are the babblings of a fright-stricken old man, an incomplete cloth map and the word 'Exodus', scrawled in blood on the deck of a wrecked ship. As *you* are the chosen one, it is up to you to make sense of these cryptic clues and banish the evil from Sosaria forever.

The quest starts with the player defining a number of characters who will fight for Lord British. Up to 20 individuals can be selected from the five races that inhabit Sosaria: Human, Elf, Dwarf, Bobbit and Fuzzy.

When all the characters have been chosen, they can be divided up into groups of four. These 'parties' are far more reliable than a single, loner character as all the members are able to rely on each other, making them collectively stronger in battle.

The land of Sosaria is vast and contains many towns (usually the first stop-off point) where armour, weapons, food and other provisions can be bought, and snippets of information gained from some of the inhabitants. As well as the mostly friendly towns, a party is likely to stumble across one of the many dungeons dotted over the land.

For the most part a dungeon is depicted as a now-familiar 3D maze. Although they are dangerous places, and hold death for unwary travellers, the dungeons are often a source of help and players will have to visit them if they are to complete Ultima III.

The greatest problem facing the explorer are the other nasties that inhabit the land. Most of these will engage you in combat, so you have to make sure that all your characters are armed with either weapons or magic.

A battle is depicted by a special combat screen, showing both the player's party and their assailants. Skirmishes often involve hand-to-hand combat as well as spells being thrown back and forth.

If you see that one of your characters is going to die, it is best to restore the game and go back to your last saved position. Although this sounds drastic, it is a good idea because when a character is killed, the program wipes it from the playing disk completely, making you one man short. The only way to return the group to full strength is to restart the game from scratch.

Unfortunately, I can't describe the whole of Ultima III as it's such a complex adventure. I hope, however, that this small taster has been enough to whet your appetite for more.





Ethics? What ethics?

Title: Seaside Special
Computer: Commodore 64
Supplier: Task Set
Format: Cassette
Price: £6.90

Anarchical bad taste is the best way to describe Seaside Special, a game which unashamedly pokes fun at Maggie's cabinet — the one made up of MPs that is, and not the one containing Dennis' drinks.

On a moral level Seaside Special, which involves bumping off figures such as Norman Tebbit and Nigel Lawson with radioactive seaweed, might appear rather unethical, especially in the wake of the Brighton bombing. Taken for what it is, however, Seaside Special is nothing more than a great piece of surrealist fun, a kind of computerised *Spitting Image*.

Unfortunately, the game's writers do not have the affrontery of the *Spitting Image* team and have concocted a ludicrous *Invasion of the Body Snatchers*-type scenario so as not to cause

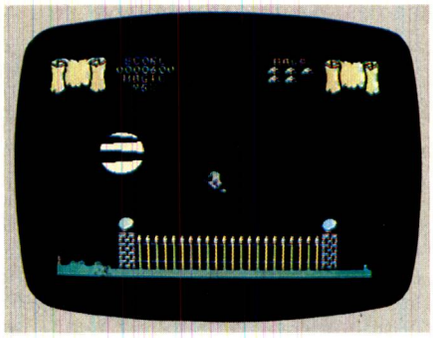
offence. The political caricatures are not in fact MPs at all, but Polytikians: alien clones intent on polluting the earth's seas with radioactive waste.

Seaside Special opens on Rotaway beach, once the quiet resort of Rothsay. Since the arrival of the Polytikians, the beach has become a radioactive wasteland and inhabited by a few boulders, the odd crab, a wobbly green thing and a patrolling soldier. As the sea gently washes in and out accompanied by a relaxing whooshing sound, it deposits clumps of irradiated seaweed onto the sand. Your task is simply to gather up at least 10 of these to use as ammo against the aliens.

Of course, the local fauna is none too happy with the situation. As a result you could be shot in the rocks by a soldier, poisoned by the wobbly green thing or just plain killed by overexposure to the polluted water. Subsequent levels include further dangers such as quicksand, a hungry albatross and more green things, all out to get your hide.

When you have enough ammo it's on to Downing Street for a showdown with the meanies. The display features the front of No 10 whose five windows open and close to reveal a famous (infamous?) face. Throwing seaweed at the Polytikians turns them different colours until they finally turn blue (blue, Tory. Geddit?) and die. While you're throwing your deadly flora the Polytikians happily hurl ballot boxes, missiles and a whole host of political cliches in an attempt to divert your aim. When the minions have been disposed of, Maggie herself appears, complete with blue rinse for the final conflict.





The witching hour

Title: Cauldron
Computer: Commodore 64, Spectrum 48K
Supplier: Palace Software
Format: Cassette
Price: £7.99

'Hubble, bubble, toil and trouble . . .' no, this isn't Shakespeare Corner, but rather a way of introducing Cauldron, an impressive new game from the creator of the much-hyped Evil Dead.

If you were disappointed with Richard Leinfellner's previous offering, and let's face it, most of us were, then Cauldron should change your mind about this young programmer's ability. Although it draws heavily on both Defender and Manic Miner, Cauldron's excellent graphics take it way out into a class of its own.

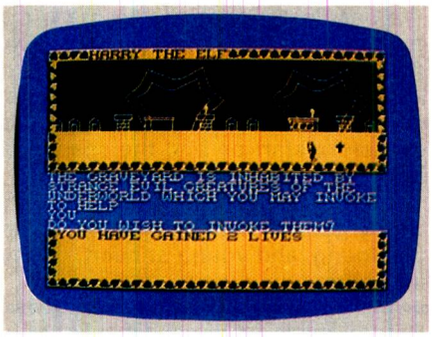
Cauldron begins outside a pleasant little cottage situated in an idyllic forest. Everything would be perfect if it were not for the bats, ominously flapping about above the trees, and the appearance of a witch at the cottage's front door. With the aid of a joystick the witch can be made to take flight on her broomstick and, darting through the night sky, embark on a quest to become the Halloween witch-queen.

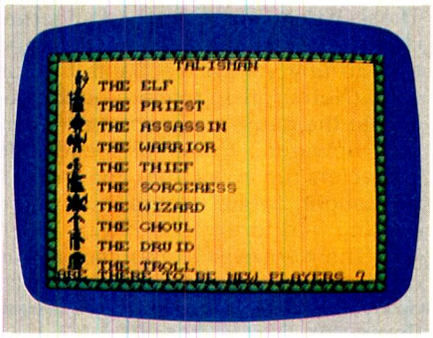
The only way our friendly hag can become queen is by gathering up six ingredients which, when mixed together in her cauldron, will defeat the reigning Pumpkin king. Unfortunately, all the bits and pieces needed to complete the spell are scattered throughout several underground caverns, all the entrances to which are locked. Luckily, the keys to open the doors have been dropped and are lying around, ready to be plucked by the nearest passing witch.

Unless you are a dab hand with a joystick, you will find Cauldron very difficult to master.

Below ground there are just as many hazards. To get to an ingredient our heroine must bounce from rock ledge to rock ledge, avoiding various flying objects which threaten to put an end to her dreams of holding a ghoulish court.

Cauldron is one of the few British games which is graphically on a par with some of the better software produced in the States. The witch looks impressive, zooming across a moonlit sky, while the house, complete with thatched roof and smoke wafting from its chimney, is a real joy to look at. I am looking forward to seeing Leinfellner's next game.





Crowning glory

Title: Talisman
Computer: Spectrum 48k
Supplier: Games Workshop
Format: Cassette
Price: £7.95

Talisman is Games Workshop's answer to Valhalla, and a great one it is too. Unlike its predecessor, Talisman is a multi-player game allowing up to four players, any number of which can be computer controlled, to compete in a magical battle of wits.

The simplicity of Talisman's scenario betrays just how difficult the quest itself is. But for those who like to know who is doing what to whom, here's a quick run-down of the story so far.

The old overlords have been overthrown and evil forces have once again taken over the land. The player's task is to locate the object, in this case the Crown of Command, that will thwart the nasties' dirty deeds.

Before setting out on the quest, each player must first select a character. There are 10 to choose from, ranging from an elf to a sorceress, each one having different abilities. If only one player is taking part, he can play the game as a straight adventure by selecting a single character. Alternatively, masochists can compete with up to three other computer-controlled personalities. I must warn you that this makes for a very difficult game, and should be avoided by novices.

In play, Talisman is virtually a mirror of Valhalla. The screen is divided into three windows. The top one displays the present location and any characters around at the time, while the middle and bottom windows give the condition of the character of the player whose go it is and detailed pictures of the objects present, respectively.

Another option, selected by pressing SPACE, enables a player to check at a glance the status of all the other characters. I found this useful for checking on their 'health' to see if they were weak enough to risk fighting. As well as the odd punch-up there are various tasks to be completed, puzzles to be solved and friends to be won over. Unfortunately, I did not get far enough into the game to find the Crown of Command, as I was constantly killed

off at an early stage.

Talisman is one of the better interactive adventure games for the Spectrum: the graphics are good and the action fast. The fact that it encourages players to actually talk to each other (gasp!) rather than being glued to some alien-zapping, joystick-thrashing, brain-mashing arcade game, can't be bad.



Time out

Title: World Series Baseball
Computer: Commodore 64, Spectrum
Supplier: Imagine
Format: Cassette
Price: £7.95 (Commodore), £6.95 (Spectrum)

If you are tired of playing American Football and Mr Wimpey leaves a bad taste in your mouth, take a look at World Series Baseball, a 'new' Imagine game based on our ancestral cousin's butch version of rounders.

WSB is for one or two players and should excite even the most weary games player. The playing area is displayed as a view overlooking a massive sports stadium dominated by a large video screen. A game starts with each team running onto the field and taking up their positions, either batting or fielding.

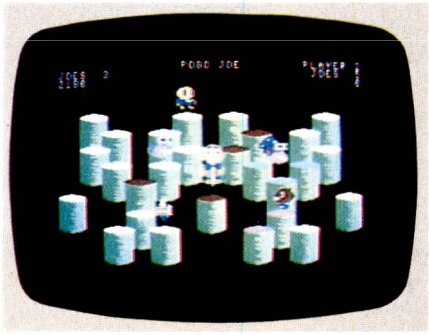
The player taking the part of the pitcher (bowler) can pitch a ball in one of eight ways, depending on the direction of the joystick. For instance, pushing the stick forward and pressing the fire button releases a 'high ball', while the opposite produces a low ball.

Once a player on the opposing team has decided to make a run, the fielder can try to get him out by throwing the ball to one of his team-mates who then touches the appropriate base with the ball. Of course, a player can also be caught out.

Batting is rather more difficult than fielding. When a ball is bowled to your man, the giant video screen shows an enlarged side-on view of the ball flying towards the batter. Even with this feature I still found myself either swinging the bat too early or too late, and generally missing the ball.

A nice feature is the 'crowd pleaser' sequence where a line of cheer-leaders, pom-poms and all, run onto the pitch sporting the colours of the home team. After a swift jig they run off to be followed by the two teams.

World Series Baseball is a game which should keep most people happy. I was disappointed with the unimaginative sound effects, but on the whole they were compensated for by the unusual display.



Bouncing babies

Title: Pogo Joe
Computer: Commodore 64, Atari + joystick
Supplier: Softsel
Format: Disk + cassette
Price: £24.90 (Commodore) £24.78 (Atari)

Pogo Joe is another Q*Bert-type game. No, wait . . . don't turn away, this one is really different . . . promise. Like old Bert, Joe's one enjoyment in life is bouncing around cylinder tops in order to change their colour. 'So what's different?' I hear you cry. Well, the major difference is the excellent screen display, and animation that is far superior to anything else along the same lines, the closest you are likely to come to true arcade quality.

As Joe pogos his way around the screen, several eggs appear amid an impressive explosion of white dust. These hatch into a host of different characters, ranging from toy spinning tops to tiny yellow elephants in blue suits. (Not surprising, when you consider that the game is aimed at six-year-olds upwards.) Some of these little characters run away from Joe and can be caught, while others hunt him, causing him to explode if they touch him. There are even a few mischievous critters which turn a cylinder back to its original colour when they land on it.

Transport tubes appear in some of the higher screens. These are black-topped cylinders which teleport Joe to another transport tube, avoiding all the monsters. Cylinders with green flashing tops, however, vaporise all the toys when Joe lands on them.

Although I only looked at the Commodore version, Pogo Joe is also available for the Atari. According to the manual the two versions are the same, except for the inclusion of a carniverous cylinder for Atari users.

A neat inclusion in the program is a menu which allows the player to 'customise' a game to a certain extent. That is, it can be set up for one or two players, with any of the 64 different screens chosen to start on and the speeds of both Joe and the toys defined.

Overall, Pogo Joe is an extremely classy game which should keep both the young, and young at heart, happy for hours.



Musical construction

Title: Rock 'n' Bolt
Computer: Commodore 64 + 1/2 joysticks
Supplier: Activision
Format: Disk, cassette
Price: £19.99, £10.99

Rock 'n' Bolt is a complex puzzle based around a building site. As Louie, a construction man, you have to face the challenge of erecting a 100-storey building. The only way to complete the job in quick time and so collect a nice fat cheque at the end, is to rush around with your blueprints, bolting the monolith together, girder by girder.

A practice mode has been included to allow you to take as long as you like. Harder levels have set time limits in which to complete a floor; any longer and Louie goes through a strange process of disintegration.

While fixing the girders together Louie can pick up a wage bonus by landing on gold bolts, or even gain an extra life by touching a green bolt.

Rock 'n' Bolt is a deceptively simple game on the surface. In play the story is very different, and it doesn't take long before you're sweating with the frustration of not being able to return to the lift to reach the next floor. If frustration leads you to give up Rock 'n' Bolt, just sit back and listen to the great music. It'll soon fire your enthusiasm. END



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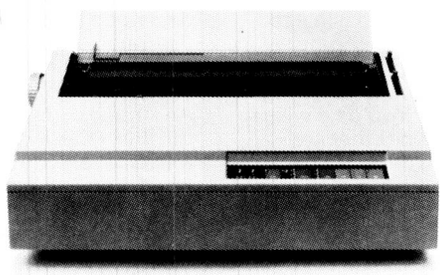

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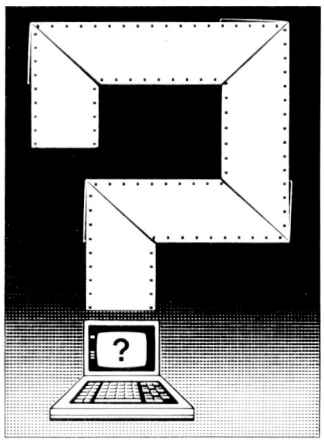
COMPUTER ANSWERS

Simon Goodwin takes his toolkit to your problems. The address to write to is Computer Answers, PCW, 62 Oxford Street, London W1.



Transatlantic power struggle

I am an American currently resident in Britain, and am looking at personal computers. One I have my eye on (the Wren) runs only on 240v power. If I return to the US, I will have to feed it 120v power, so I have two related questions.

Firstly is it possible to rig the 240-120b transformers I use for my American appliances here, to use a 240v computer there? Secondly, is there a single component in the power supply (for example, a transformer) which I might be able to replace in the US?
D E Netherton, London N3

The 'auto-transformers' which are used to convert 240v into 120v should be symmetrical components and thus work in either direction, but I suggest that you check this with a competent electrician in the US.

In theory you can convert most appliances to run on a different supply by changing the internal transformers, but this won't always be a simple one-step modification: modern computers use a variety of supply rails (generally including +12, +5, −5 and −12v), so you may need to replace a number of transformers. Make sure that the replacement components can provide the correct current as well as voltage. At worst, you may find that a specially-made composite transformer is used in the UK machine to generate a range of different outputs from one mains input. It might be hard to find an exact American equivalent.

There are a number of other points to be born in mind when you plan to take a British computer to the US. You shouldn't use a computer in the US unless it complies with FCC rules for radio interference. British law is much less strict, so most UK machines will need metal or conductive paint screening around the circuit board before they're legal.

Some computers derive timing signals from the UK mains, which alternates at 50Hz, so they'll run at a different speed (if at all) when connected to the 60Hz US supply. Likewise, British television sets and monitors refresh the screen 50 times a second, while their American counterparts expect to be refreshed at 60Hz. In many cases the signal is generated using a 'dual-standard' component, and only one connection need be changed to convert the display, but some machines need major alterations to cope with a 60Hz supply.

Telephone modems use different tones in Britain and the US, so you may find that communications equipment purchased here won't talk to Ma Bell. Again, dual-standard components are probably in there somewhere, but you'll have to find out how to let them know about their change of environment.

It is certainly possible to make a British computer work in the US, but there are lots of things that could go wrong in the process. You'd be wise to avoid machines that are unknown in the US, or you could run into maintenance problems after you get the hardware working. Battery portable machines are obviously going to make the crossing most easily, but you could still run into interfacing problems.

The Arabian way

Recently, you answered a request to provide information on a computer system running in Spanish. Are there any computers or dealers you can recommend for potential users wishing to work in Arabic? The ideal system my contacts require would run at the 220 voltage in the Far East, and be capable of presenting both English and Arabic visual displays.
Dr RP Newton, University College, Swansea

Most modern computers are capable of displaying Arabic characters, since they allow the character shapes to be redefined at the whim of the user. You draw the characters, dot by dot, with a character design program. Each new definition takes the place of a 'normal' letter or symbol, and you can chop and change between the two sets at will. The exact procedure will vary depending upon your choice of machine — appropriate instructions will accompany the character design program.

But this doesn't get around the problem of data entry, since you presumably need a 'backwards INPUT' routine to accept data entered from right to left. It shouldn't require too much work to implement such a feature, reading characters one by one from a keyboard with appropriate replacement legends.

Ramez Halaby & Co, of PO Box 147, Jeddah, Saudi Arabia, specialises in Arabic computer systems. It has advertised various conversion kits in back issues of *PCW* including an adaptor and keyboard called 'Arab RAM' for the Sinclair ZX81. This was described as 'the first Arabic Personal Computer in the world' when it appeared a year or so ago. Nearer home, An Arabic conversion kit for the IBM PC is available from Microware, 637 Holloway Road, London, for £600. Microware also offers an 'Arab Word Processor' package at the same price.

Hacking – the first steps

Where can I get some information about hacking, such as books on the subject, or are there any dealers who specialise in it? What equipment is needed?
D Trowsdale, Kingswinford, Dudley

Defining hacking is difficult these days. What began as a term of praise for an obsessive programmer has acquired a more restricted — and less complimentary — meaning. 'Hacking', as in communicating with other computer systems (with or without the consent of their owners), is a difficult hobby to break into. The hacking community is very tightly-knit, partly because of the strange hours you have to keep if you want to take advantage of the cheapest or least congested connections. Hackers carry out most of their communication — logically enough — by computer, so the best way to contact them is to join them! I don't know of any specialist hackers' shops — the hobby is probably too small and widely dispersed to make them economically viable. The only good book on hacking which I have seen is *The On-line Handbook* by Ray Hammond. It is published by Fontana, and is available for under a fiver from most bookshops.

Before you can become a hacker you need three pieces of equipment: a computer, to accept and display messages; a modem (short for MODulator DEModulator) to convert computer signals into a form which can be transmitted by telephone; and a telephone. A printer — of any kind — will also be very useful.

The computer and the modem generally communicate via the infamous RS232 interface. Low-cost modems sometimes plug directly into the computer without the need for such an interface, but this generally means a reduction in versatility. Similarly, the cheapest computers contain simplified RS232 interfaces which restrict the flexibility of your system. Look for a machine with an interface capable of sending and receiving simultaneously at two different speeds.

There are two types of modem — the acoustic coupler and the direct-connection model. The acoustic coupler is a simple microphone-and-speaker contraption which you fix to your telephone handset. It transmits and receive bleeps, and buzzes down the line.

Unfortunately, it also relays any other background noises in the room at the time, unless you jam it very carefully onto the handset, so the acoustic coupler can be rather unreliable. Direct-connection modems are more expensive but more reliable. They plug directly into the telephone circuit (you'll need one of the new rectangular BT sockets), and electronically generate the whistles and bleeps of computer communication.

Computers communicate at a variety of speeds: a serious hacker will need to be able to use 1200/75, 300/300 and 1200/1200 baud. The first figure refers to the speed of data reception, the second to the speed of transmission. The 1200/75 speed is used by Prestel; 300/300 is favoured by businesses and bulletin boards. These are electronic noticeboards, generally run by amateurs, through which hackers send and receive messages. At 1200 baud it takes about seven seconds to transfer a screenful of information.

To find out more, such as the phone numbers of bulletin boards, read the 'Networks' section of *PCW*. Like so many areas of computing, the only real way to find out about hacking is to try it. Once you have taken the plunge, as in any hobby, you will find lots of people eager to advise you further.

Colour the Atari

I have an Atari 600 XL, which has very nice graphics for the price. Unfortunately, the resolution in 16-colour mode is 80 × 192 — it's like painting with a brick!

Graphics mode 7 has a resolution of 160 × 96, which is a lot better because each dot is a near-perfect square. Unfortunately again, only four colours can be displayed at once. Is it possible to have 16 colours on screen at the same time, in mode 7 resolution?
Richard Donscombe, Denton, Manchester

The short answer to your question is No, but let's look at the Atari in a bit more detail.

The Atari 600XL is a re-styled version of the Atari 800, launched in 1979. When that machine first appeared it lacked the 16-colour modes — you were stuck with modes 0 to 8, giving five colours in text modes, and two or four colours for graphics. You also had five sprites, or 'player/missiles', and they could each be a different colour, so you could — in practice — get nine colours onto the screen at a time, although the sprites could only occupy a restricted area.

After a while Atari replaced one of the graphics chips in the 400 and 800 with a device called the GTIA, which had the extra 16-colour modes you mention. However, these were grafted onto the original design. For a long time they weren't documented, and there were restrictions on their use. Now they've popped up, officially, as modes 9 to 11 on the XL machines.

The problem is that Atari has only changed the GTIA chip to give 16 colours in new modes. ANTIC, the other graphics controller in the machine hasn't changed. ANTIC can only read 40 bytes of graphic information in the time needed for the TV display to scan from one edge of the screen to the other. To store 16 colours you need four bits, or half a byte, so you can only get 80 dots onto each line of graphics when using 16 colours. The hardware just can't read the data any faster.

This isn't a criticism of Atari — every micro design has this problem. Machines like the Memotech and Commodore 64 get around it by restricting the number of changes of colour on a line. On the Sinclair QL, the graphics controller can stop and start the processor to give itself more time to scan the display memory. In that case, with 512 dots on each line, each in one of four colours, the processor only gets a look-in 40 per cent of the time. Even a 68008 processor finds that something of a handicap!

You *can* increase the number of colours on an Atari if you use devious machine code, but it's quite hard work. About a year ago I produced some graphics for a Central ITV series, squeezing just over 100 colours out of a standard Atari, with a resolution of 160 × 192 — but it took me three months to do it in a flexible way. The trick is to write a program which changes the colours used by the Atari as the dot flies down the screen. Since the TV draws each line in about 1/20,000 second, your program has to be very efficient if you want arbitrary colours on each line, and you are still stuck with just four or five colours on a given line.

Which micro for Cobol?

Which micros can run CIS Cobol, I am using Micro Focus's version for my Computing A level at college and would find it helpful if I could program at home.
A Lake, Edenbridge, Kent

To the best of my knowledge, CIS Cobol is only available for machines with disks and an Intel-type processor (8080, Z80, 8088, and so on). This rules out a lot of home computers, which use other processors or non-standard disk systems. Any CP/M-80 or CPM-86 machine should run the system, although you might run into problems with lack of memory on a few home computers. A CIS Cobol compiler will set you back about £400.

Cobol is a standardised language, so it might be worth looking at another popular implementation for micros. RM Cobol for the TRS-80 is cheaper than Micro Focus's version, and seems to work just as well. You can pick up a TRS-80 system for next to nothing so it might be worth considering if you're determined to run Cobol at home.

BBC interfacing problems

I run a small business in Jamaica and decided to have it computerised. While I was in London, I purchased two BBC Model B computers with disk and printer interfaces, cables, colour monitors and Epson FX80 dot-matrix printers.

I am having problems interfacing the computers with the printers. Whenever a print command is to be executed, the CAPS LOCK and SHIFT LOCK lights come on and the computer stops execution.
Orlando Budoo, Jamaica, West Indies

The BBC Micro turns on the two lights whenever it has stopped because a buffer is full. In this case, characters are stored in a buffer before they are printed. Normally, the computer puts characters into the buffer and the printer takes them out, by signalling its readiness to the printer interface. In this case, the machine stops because the printer's signal is not getting through.

The fault could be in the printer hardware, the cable or the computer. Since you've bought two of each, and report no other faults, this explanation is unlikely. The BBC Micro software is perfectly compatible with the FX80, so we're left with one likely source of error — you.

Printer output on the BBC Micro can be routed to one of two interfaces — the serial (RS423, via a socket at the back of the machine) or the parallel (Centronics, via a more complicated socket under the keyboard). When you turn on the BBC Micro it expects to send printer output to the parallel port. If you've connected up the serial port, the machine will 'hang up' as you describe, since it will wait forever for a signal at the parallel port.

You can switch between the two ports with the command *FX 5. Type *FX 5,1 to select the parallel interface, or *FX 5,2 to select the serial one.

If you have a serial printer, you will probably need to select the correct speed for data transmission. Use the command *FX 8,N where N is a value between one and eight. Try each value of N until you find one that works. Again, the system will wait forever unless you use the correct speed.

If neither of these tricks work, you've got a hardware problem. Make sure that you haven't fiddled with the switches inside the printer, which tell it the data format it should expect. Try out the computer with any other printer you can lay your hands on. Test the printer with other computers. You should be able to isolate the fault to the printer, cable or computer.

This goes to show how important it is to have a system fully demonstrated before you buy it. Take note of any special commands used when the machine is set up, and always buy the exact hardware you've seen working.

Help for Aquarius

With reference to the letter 'Age of Aquarius?' from S Forster, *PCW* April, Mr G Leboff of Radofin Electronics would be pleased to aid you in your search for books and software for the Aquarius, and help with any queries.

Phone (01) 205 0044, or write to Radofin Electronics, Hyde House, The Hyde, London NW9 6LG. END

Unfortunately we can't answer questions on an individual basis, so please don't send a SAE with your query.

Calling Prestel

Peter Tootill dials up Prestel this month and looks at the facilities available to the micro user.

When you join Prestel (or Micronet 800) you will be given three things. An identity number, a password and a telephone number.

When you dial the number (often 618 or 612) you should hear the modem tone. Switch your modem on-line, and after a few seconds you should see a welcoming message from Prestel, and a request to enter your identity number. Some software (and some purpose-made Prestel terminals) can be pre-programmed with the number to save you having to remember it and type it in. The next thing you will be asked for is your password. Provided that all is well (you are allowed three attempts at entering the correct password) Prestel will welcome you by name and tell you when you last used the system. Or rather it will tell you when you last used the particular Prestel computer you are using now — the Prestel system consists of several independent computers which are managed by a central computer. The central computer keeps the other ones up to date by uploading new pages of information at frequent intervals.

If you have problems with strange characters at this stage, check your RS232 settings, one common cause of problems when calling Prestel is that you need to use seven data bits, even parity and one stop bit. This is different to most bulletin boards which are now using eight bits, no parity, one stop bit. This is used because it enables transfer of binary files using the Xmodem protocols.

At this stage you should see the Prestel main menu (Page 0) this contains ten items, but the exact contents vary. If you are a Prestel Microcomputing subscriber, you will normally go straight to the Prestel Microcomputing main menu. In either case you can always find your way to page 0 by pressing *0# on your keyboard.

In use

Once you have logged on, Prestel is fairly simple to use. It is based on menus, you select items from the menu by pressing the relevant number on your keyboard (there is no need to press return), you will be taken to the page in question. This may well be another menu, but you will eventually get to the information you are looking for.

Alternatively, if you know the number of a page that you want, you can go directly to it. Just press 'page-no#' (again there is no need for a carriage return — in fact ordinary Prestel keypads don't have a return key at all). So, if it is page 21 you want to read, press *21# (which, incidentally will lead you to a useful introductory lesson on using Prestel).

Information providers

There is a whole range of subjects on Prestel — everything from news and weather to air travel, from what's on at the theatre to government information. The contents are provided by many independent organisations, called 'information providers' or IPs. Each organisation pays Prestel a certain amount for the privilege and if it so wishes it is allowed to charge people to look at the information provided. These charges are added to your Prestel bill. You will find a small price tag at the top of each page stating how much it costs to view it. If a page does have a charge, the menu will tell you how much it is before you choose it. Around 60 per cent of the pages are free.

CUG's

Some areas are closed off by the IPs to form 'closed user groups' or 'CUGs'. These are areas where the IP will charge a subscription, (in addition to your Prestel subscription) or restrict access in other ways to allow only certain groups of people to look at them. Prestel Microcomputing (which includes Micronet 800 and other micro related IP's) is a CUG. It is the area that is of most interest to micro users, and is indexed from the Prestel main index on page 0. You are presented with a range of options which include news of the micro scene, information about computer clubs, an art gallery, software to download and a range of other items.

This area includes the Micronet 800 and Viewfax 258 sections, which are the two main commercial IPs dealing with micros. It also includes ClubSpot which is an area run entirely by amateurs

*0#	Mainmenu
*#	Repeats last page (can be used up to three times)
**	Cancel if you make a mistake
*00	Repeats current page (useful in cases of line noise, for example, free for chargeable pages)
*09	Repeats current page with any updates made during the viewing period (charged at same rate as the first time you saw the page)
*170#	What's new on Prestel
*1909#	Mailbox directory
*199#	Alphabetical index to subjects and IPs
*2#	The Prestel Gazette
*21#	How to use Prestel
*3#	Local information
*5#	Business information
*6#	Response frame guide
*7#	Mailbox — for sending messages to other users
*800#	Prestel microcomputing
*9#	Customer facilities
*90#	Leave Prestel
*92#	Check your current bill (on the current computer only)
*920#	Change your passwords
*930#	Check for messages to you
*931	Retrieve stored messages

Fig 1 Prestel commands

under the auspices of the ACC (the Association of Computer Clubs). The ACC has the distinction of being only amateur IP on the Prestel database, the pages are provided free of charge by Prestel because the information and facilities provided by the ACC are a big attraction to micro users.

Prestel is a very big database, and it is well worth browsing. If you do find anything of interest make a note of the page number, because it can be very difficult to find your way back. This is the main problem with Prestel, although there is a subject index, it can be very difficult to find what you want. A keyword search facility would be very useful.

National Mailbox

I said earlier that when you join Prestel you are given three things, well that should read four. You are also given an account number (sometimes called your 'systel'). This is a number that other people can use to send messages to you using the Prestel 'Mailbox' facility. This number is the one that you give to friends, and the one that will be published in the Prestel Mailbox directory, if you request it.

Your identity number and password should be kept secret, as anyone who uses them could run up a big bill for you.

If you have messages waiting for you, Prestel tells you this when you logon to the system, you just key 0 to read them. They can be stored, and re-read later at page 931. END

UK free networks

Bulletin Board	Phone Number	Notes
BABBS-Bath	(0225) 23276	300/300 baud rate; 9pm-8am weekdays, 9am-noon weekends; Atari-based system, ring-back system
BABBS-Felixstowe	(0394) 276306	300/300 baud rate; 24 hours daily; Apple users' group
BABBS TWO-Basildon	(0268) 778956	300/300 baud rate; 24 hours daily; Apple users' group with special area for queries to Apple UK
Bettisfield	(094875) 378	300/300 baud rate; 9pm-9am daily; remote CP/M system
Blandford Board	(0258) 54494	300/300 baud rate; 24 hours daily
CABB	(01) 631 3076	300/300 baud rate; 24 hours daily + 1200/75
CBBS SW	(0392) 53116	300/300 baud rate; 24 hours daily
CBBS Surrey (Woking)	(04862) 25174	1200/75 and 300/300 baud rates; 24 hours daily; jokes, jobs, reviews, news
CNOL Lancaster	(0524) 60399	300/300 baud rate; 24 hours daily; Clinical Notes Online service, mainly for medical users; works in conjuction with a database on the Datastar network
Computers Incorporated Newcastle	(0207) 543555	300/300 baud rate; 24 hours daily; primarily business-oriented
Forum 80 Hull	(0482) 859169	300/300 baud rate; 5-11.30pm weekdays, noon-11.30pm weekdays; Bell 103 standard, midnight-8am daily; international electronic mail, library for up/downloading
Forum 80 SPA	(0926) 39871	300/300 baud rate; 11pm-midnight daily; TRS-80 and Genie users' group
Forum 80 Wembley	(01) 902 2546	300/300 baud rate; 7-10pm weekdays, midday-10pm weekdays; electronic mail, library for downloading; ring and ask for Forum 80
Hamnet Hull	(0482) 497150	300/300 baud rate; 6pm-8am daily
Liverpool Mailbox	(051) 4288924	300/300 baud rate; 24 hours daily; electronic mail, program downloading, TRS-80 information; messages for *PCW* can be left on the board and will normally be read by us within 24 hours
Mailbox-80 W Midlands Stourport	(0384) 635336	300/300 baud rate; 6pm-8am daily
Manchester Open Bulletin Board	(061) 7368449	300/300 baud rate; 24 hours daily + 1200/75
MBBS-Mitcham	(01) 640 2617	300/300 baud rate; 10am-10pm Thursday and Sunday; BBC-based system with jokes, graffiti, electronic mail, and Atari and BBC sections
MG-Net CBBS London	(01) 399 2136	300/300 baud rate; 5-10pm Sunday; electronic mail, program downloading
Microweb Manchester	(061) 4564157	300/300 baud rate; 24 hours daily; *Micro User* magazine, mainly for BBC users
NBBBS-North Birmingham	(0827) 288810	300/300 baud rate; 24 hours daily
OBBS Manchester	(061) 4271596	300/300 baud rate; weekdays except 7pm-9pm, weekends except 10am-10pm
PIP-Sheffield	(0742) 667983	300/300 baud rate; 24 hours daily. Bell 103 midnight-8am daily
Southern BBS	(0243) 511077	300/300 baud rate; 8pm-2am daily; ring-back system (dial the number, let phone ring once, and then ring back); messages, downloading
Stoke ITEC	(0782) 265078	300/300 baud rate; 24 hours daily; remote CP/M system
TBBS London	(01) 348 9400	300/300 baud rate; 9am-7am daily
TBBS London Metro	(01) 341 7840	300/300 and 1200/75 baud rate (including Prestel compatibility); 24 hours daily; temporary number for the TBBS Nottingham system
WABBS-Worthing	(0903) 42013	300/300 baud rate; 24 hours daily; ring-back system (dial the number, let phone ring once, and then ring back); Atari-based

NEW GT systems

– three hard disc models

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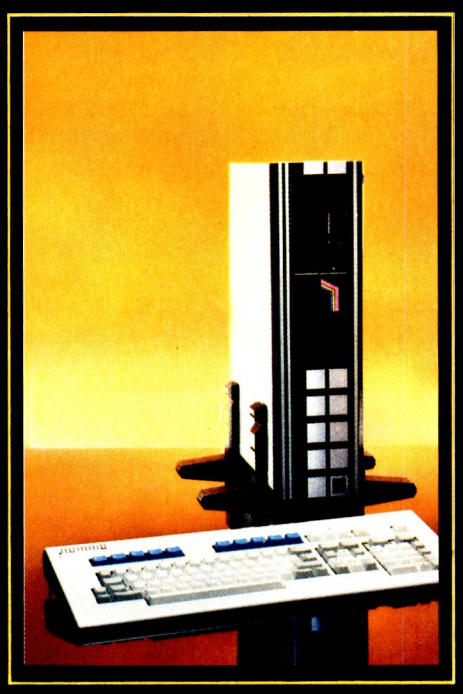
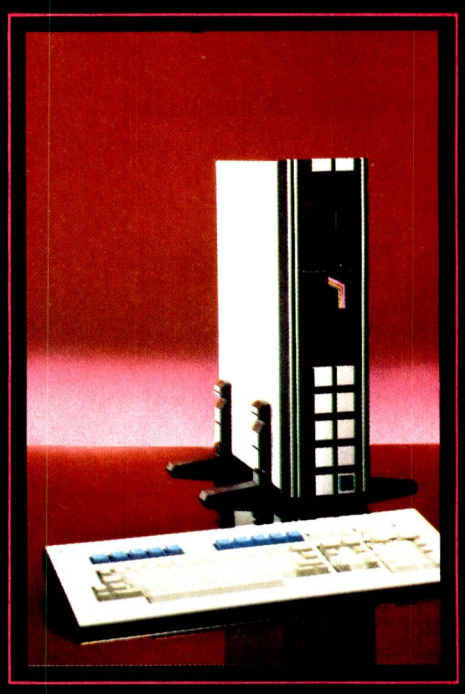


42MB +800K FLOPPY



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Epson RX80	£190.90 + VAT =	**£219.54**
Epson RX80FT+	£215.90 + VAT =	**£248.29**
Epson FX80	£329.90 + VAT =	**£379.38**
Epson RX100FT	£349.90 + VAT =	**£402.38**
Epson FX100	£427.90 + VAT =	**£492.09**
Epson LQ1500 NLQ	£895.90 + VAT =	**£1030.28**
Epson JX80 Colour	£449.90 + VAT =	**£517.39**
Canon PW1080A NLQ	£289.90 + VAT =	**£333.39**
Canon PW1156A NLQ	£365.90 + VAT =	**£420.79**
Canon PJ1080A Colour	£479.90 + VAT =	**£551.88**
Panasonic KP1091 (IBM) NLQ	£255.90 + VAT =	**£294.29**
Shinwa CPA80	£199.90 + VAT =	**£229.88**
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Newbury	POA	
Seikosha GP50S (Sinclair Spectrum)	£79.90 + VAT =	**£91.88**
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TRANSACTION FILE

Your chance to buy, sell or swap equipment.

● TANDY TRS80 model III, good condition, Basic, editor-assembler, speech synthesizer, software, sound amplifier, books and documentation, all boxed, leads, 80 micro magazines, all for £250 ono. Tel: 01-908 3748 after 6pm.

● ITT 2020 Apple system, DOS 3.2.1., two disk drives, green monitor, Epson MX80 printer, Basic compiler, games, DOS 3.3 to DOS 3.2.1. converter. £550. Tel: Northampton 22961 day, 770871 eve

● TORCH C/PM with 10Mb hard disk including Perfect Writer, Calc, Filer, d-Base II, sell complete for £2,995 ono. Tel: Gary on 630 8340 day

● TELETYPE, ASR33, 110 baud, 20mA loop, including a paper tape punch/reader, three manuals. In good working order. Ideal as a cheap printer, £60 ono. Tel: Trevor on Rickmansworth 776399 (eve).

● OSBORNE I required. 52 column, double density version. Tel: Dave on Aberdeen (025) 72491.

● WANTED. Portable micro with disk drive. Kaypro, Osborne I or similar. Tandy model 100 for sale, or P/EX for above with cash adjustment. Please write Sayers, 120 Birmingham Road, Redditch, Worcs.

● SINCLAIR QL for sale. Excellent condition, urgent sale. Accept £300 ono. Tel: (0292) 313132 (eve).

● RAIR BLACK BOX, six months old, CP/M 2×720k disks 64k. Epson MX100 132 column dot matrix printer. CIS Cobol, Wordstar, Mailmerge, £1,250 ono. Tel: (05827) 69297 after 7pm.

● IBM PC 320k, Quadboard, dual drives, etc, £1,500. Colour monitor and adaptor, £300. Basic compiler, £125. Wordstar Professional, £200. Best offers. Tel: 01-300 2253.

● TRS-80 model 3 micro, 48k, I-disk + high-res graphics board; CGP-115P colour plotter/printer, electrostatic data printer, all leads and manuals and software. Ideal home/small business system, £1,000 ono. Tel: (0966) 32521/33441 (Nigel). Must Sell!.

● WANTED BBC Z80 Second Processor, suite of books only. Will collect. Tel: Davis 01-474 0492 after 6pm.

● BBC B + DFS, speech synthesizer, Disc Doctor ROM, all manuals, very good condition and software and joysticks, £320.

● TEAC DSDD 40/80T drive, £200. Tel: Paul on 01-890 1313 ext 128 or 01-751 0280 fter 6pm.

● APPLE II Europlus, Hitachi B/W monitor, 16k language card, PAL colour card, disc drive (DOS 3.3), paddles, all manuals and leads, much sofware: Pascal, Bit copier, games etc, £530. Tel: Hartlepool (0429) 70755.

● COMPLETE SET *PCW* Vol 1.1 (June 1978) through Vol 7.9 (October 1984) 78 issues. Also one *PCW* binder. Any offers. Tel: Reading (0734) 698965.

● WANTED unbound VGC *PCW*sFeb 1978-Sep 1981. Pay 30p each; *PCW* show catalogues 1-6, pay £1 each. Must be good condition. Get rid of your old *PCW*s here! Tel: Northampton 890621.

● BBC expanded A + Acorn DFS, Teac disc drive + PSU, 128k solidisk, Chameleon, joysticks. Acorn + Bud (Atari), books external speaker, £650. Also £1,500 of sofware on disc. Tel: (021) 308 2467 after 7pm.

● MCP40 colour printer with Centronics interface, as new, £99. Also Memotech 512 micro with cassette recorder, £250, as new. Tel: (031) 552 3905 after 7pm.

● CBM 64 Datasette, joysticks, cartridges, 25 original games, including Zaxxon, Ghostbusters, Decathlon and Quo Vadis plus books. All boxed with manuals. In excellent condition, £190 ono. Tel: (0904) 425513.

● EPSON HX20. Charger, case, cassette drive, software, very good condition, £250 ono. Tel: Bordon (04203) 3033. Ask for Mr Von Oven.

● RADIO SHACK PRINTER DMP-110. Tractor and friction, 50cps. Nearly new, £195. And OKI80 Microline printer, good condition, £125. Tel: 01-981 6405 (day/eve).

● SHARP MZ-700. Built-in cassette recorder + games. Hardly used, 64k RAM. Cost £240, quick sale wanted so now £110. Tel: 51973 Weybridge, Surrey.

● TANDY TRS-80 Model I 48k. Expansion interface, Microplus disk drive, Epson TX-80B printer, Newdos, TRSDos, Scripsit, Superscript, Surge Protector, data separator, books, magazines, many extras and software, £330, Tel: Nunn 01-684 8775 (S. London).

● MULTIPLAN speadsheet for IBM PC. Never been used. Cost £140, yours for £70. Tel: Bob Gosport (0705) 523859.

● WANTED. IBM PC. Will consider anything from original 64k model to an 'AT'. Substantial cash available. Tel: (0670) 829215 (Northumberland) after 6pm or weekends.

● TRS-80 Model 1. Disk and cassette programs. Games, operating system, utilities, and business, includes Visicalc, Newdos, Microsoft Editor/Assembler, Corplan. Prices negotiable. No reasonable offer refused. Tel: (0727) 50727.

● FOR SALE. CBM 64 1541 disk. C2Ncassette, Simons Basic, Stack Light Pen, Vulcan joystick, many games. Also manuals, cost £750, sell for £300. Tel: Harrogate (0423) 67550 after 4.30pm

● SIRIUS SOFTWARE. DBase 2, Quickcode, Wordstar, Mailmerge, Proofreader, Supercalc, MS-Fortran, Programmers/Graphics toolkits + much more, boxed, £300. 512k RAM card with 128k, £100. Z80 card + CPM80, DBase 2, Quickcode, Wordstar, Mailmerge, £300. Tel: 01-723 9146.

● RARE BLACK BOX 256k. 5Mb hard disc including Hazletine Esprit terminal, Wordstar, Mailmerge, Fortran compiler. Cost new over £4,000, only £1,495 complete. Call Nigel on 01-630 8349.

● DISK DRIVES 5¼in pair D/S 80 track, £150. Also pair D/S 40 track, £130. Half height made by Epson. R Smith, 138 Holtye Road, East Grinstead, Sussex RH19 3EA. Tel: (0342) 313883.

● NEWBRAIN-A, complete, £100. Apple II+e, Titan accelerator II, complete, £250. Microsoft 280-system including CP/M, MBasic, utilities, £200. CIS-Cobol with animator, £300. Any reasonable offers. Tel: (021) 358 7572 (eves) between 7.30 and 10.30pm

● GEMINI 64k RAM, and EPROM boards. ASCII keyboard, Veko Eurocase GM805 Nascom disc interface and Polydos. Offers to P. Burgess on (051) 733 4752 evenings (Liverpool).

● APPLE II Europlus 64k. Two disc drives, colour card, language card, Z80 card, green screen, Apple toolkit, manuals, £550 ono. Tel: (0425) 617421 (eve).

● SHARP MZ80K (48k). Still in box. Two Basics, many other tapes and manuals, £200 ono. Tel: (0734) 29326.

● MAC FORTH Level 1, swopped for your MAC BCPL. Hardly used, with manual and original disk. Tel: Piers on 01-831 6781 ext 202 (London).

● ADVANCE 86A, 128k memory, IBM-PC-compatible, 8086 based, 9 months old and hardly used. Consider part exchange for decent printer or £300 ono. Contact David Lloyd, Trinity College, Cambridge.

● APPLE MAC, LISA/2, Apple 2C, Apple 2E, and all peripherals, Kaga monitor, £75. Apple 2C monitor, £87, plus software, extras. All unused, boxed as new, with full guarantee. Tel: Nigel on (0203) 503042.

● KAYPRO 2 twin-disk 9in monitor,CP/M, Wordstar, Word-Plus, Perfect Writer, Filer, Speller, Calc, Printer cable, used 3 months only, £750. Commodore RS232 I/F cable, £15, Commodore CN2 cassette, £20. Tel: Albert (Oxford) (0865) 54984.

● WANTED SHARP MZ-80K RS-232 interface card for I/O box. Also Xtal 3.1 Basic and hi-res graphics board. Good price paid. Tel: Bourne 425480 to Mr L. Panrucker. Will Collect.

● COMMODORE SX64 computer, with MPS 801 printer, Easyscript, Easy Stock, Future Finance, Audiogenic spreadsheet, joystick, Solo Flight, International Soccer and spare discs, £750 ono. Tel: Brighton 720384 evenings and weekends.

● MEMOTECH MTX 512 48k, 10 months old, boxed, VGC, factory modified for colour adjustment, plus user group mags, useful MC routines, £200. Tel: Windsor 58259.

● SIRIUS 1. 128kb, 2 × 1.2Mb drives, MsDos, CPM-86, MSDos, toolkit, Wordstar, Multiplan, Basic compiler, full documentation, £1,750. Epson MX100 printer, £300. Both very good condition. Offers considered. Tel: (0243) 826896 eves.

● DATA GENERAL DG one, £2,000, (cost £4,600+). Portable 512k RAM, twin 3½in drives (1.4Mb), plus 5¼in drive, flat screen, built-in modem, IBM compatible, "State of the Art", £2,000 ono. Tel: 01-328 6881 or 01-458 4610.

● EPSON PX8, plus Epson P40 portable printer, Wordstar, Calc, Cardbox, Scheduler, Basic plus Intext wp. Almost unused, gift December 1984. Manuals, boxes etc. RRP £984 + VAT, asking £800. Tel: 01-229 7037.

● NASCOM 2 with 32k RAM. NAS-Sys 3, Zeap, Debug, and Basic. In prof case complete with 9in monitor, £150. Also Centronics 737 dot matrix printer with RS232 or parallel, £100. Tel: Phil on (021) 429 9171.

● WHO TEACHES Snobol 4, Lisp or Prolog. Several weeks private instruction desired Summer 1985. Purpose: computer aided translation. Anywhere in UK. Some experience M-Basic. Claus Regge, Ebara 3-37-11, Nakano, Tokyo, Japan.

● SINCLAIR QL. Practically new, complete in original box, latest version, £290. Tel: 01-631 1872.

● APPLE II Europlus 64k. Excellent condition, £250. Tel: 01-631 1872.

● BBC MICRO with many extras including DFS for £350. Please Telephone for further detais. Also mint Epson FX80 for £275 including cable. Tel: Squid on 01-624 7460.

● BBC MODEL B OS1.2. As new, many games, £300 ono. Tel: Bookham 52091 after 6pm.

● TRS-80, Model I, Level II 48k. Expansion interface, twin disks, Centronics printer, software, books etc, £450 . . . will split. Tel: (0823) 480224.

● 12in APRICOT monitor (ACT), only three months old, £175. Brother HR15 with tractor feed unit, very light (home) use, 9 months old, £350, Tel: with offers Rob Crocker (0865) 57671.

● TANDY TRS 80 mono moniter, RES 384+ 224, £45 ono. Naspen word processor, VER 1.1 in 2 + 1k EPROMS, £20 ono. Tel: A. Harris on (07073) 23434 ext 3727 day.

● CNM 4040 D/Drive required. Reasonable price paid. Collect Sussex or Hampshire. Tel: (0243) 824948 evenings.

● MEMOTECH RS128 FDX. 2×500k drives, monitor. Complete CP/M system including software (Wordstar, Pascal, etc). Plus User Group memberships. Excellent condition, hardly used: Worth £1,400, sell for £1,000. Tel: (031) 557 3797.

● SANYO MBC 555 twin disc drive micro. Plus Wordstar, Spellstar, Infostar, Calcstar, Basic,etc, £599. Taxan Kaga RGB-III high resolution colour monitor, £299. Tel: Andy on 01-994 2938 evenings.

● APPLE II Europlus 64k. Twin disc drives, Centronics printer card, 80-column card, Z80 card, Wordstar, Mailmerge, dBase, Logo + games, £675 ono. Tel: Alva (0259) 60055.

● NEWBRAIN MODEL A, £50. Also model AD, £60. Technical manual, assembler and other software, plus tape recorders, offers. Tel: 01-889 3571 after 8pm and at weekends.

● APPLE II + 64k. With UHF, colour cards. Two full height drives, amber monitor, £645 ono, will split. Magicalc with manual, £50. Tel: Harpenden 3398 evenings.

● APPLE SOFTWARE ½ price: All Dos 3.3 with manuals, Multiplan spreadsheet, boxed, £80. Metacraft, Forth, £25. Graforth, £20. Toolkit, £15. Apple Mechanic, £10. Supergraphics, £10. three games, £10. Or £140 The Lot. Swaps/hardware considered. Tel: 01-289 4111 anytime.

● SHARP MZ-80K. With hi-res, 2/4 mhz switch, joystick, dual disk drives, I/O box, special monitor, 60 disks, 750 casssettes, over two thousand programs etc etc, will separate. Offers. Tel: Steve on 01-590 8165.

● SHARP MZ-700. With printer plotter, cassette, speech synthesizer. Software included:— Grid Bugs, Word Pro, Zen, Chess, Easidata, Raid and many more + books. Terrific bargain, price £220. Tel: Bob Carter anytime on Brighton 413952.

● CBM 2032 (32k-64k) computer. With full manuals, cassette drives (2). Software includes w/processor (printer can be included), £265. Good working order. Abbey & Lofting, Chartered Surveyors, 49 Old Christchurch Road, Bournemouth 26110.

TRANSACTION FILE ADVERTISEMENT FORM

All Transaction File ads must be submitted by readers on this form or a photocopy of this form. Maximum 30 words. Print one word per box, very clearly. Name, address and/or telephone number must be included in the 30 words. All ads must be accompanied by a flat fee of £2.50. Make cheques or POs payable to *Personal Computer World*. Ads accepted from private readers only. Ads cannot be repeated (unless sent in on another form) and we cannot guarantee to print an ad in any specific issue. Please help our typesetter to help you by printing your ad very clearly. Send your completed form to: Transaction File, *PCW*, 62 Oxford Street, London W1A 2HG.

Please find enclosed my cheque/PO for £2.50 for the following Transaction File ad.

TRANSACTION FILE

● TWO SHUGART SA800 standard mount 8in floppy disk drives, new, £295 the pair. High quality horizontal enclosure/power supply for two SA800R type drives. New (Ex Opus), £75. Tel: 01-451 0520.

● TI820 KSR high quality keyboard/dot matrix printer. American voltage (converter available), not working properly, £50. Tel: Bordon (04203) 7194.

● BBC MODEL B with Torch Z80 disk pack (2×400k), Z80(64k) second processor, Philips high-res monitor. Full set Perfect business software, discs, manuals, books etc. All equipment little used. Tel: (0385) 62357.

● APPLE II monitor, dual disc drives, language card, Z80 card, Pkaso printer card, Saturn 128k disc emulator, 80 column, lots of software, £950 the lot. May split. Tel: (0227) 452061 (Canterbury).

● BBC MODEL B. OS1.2 with 40/80track switchable single sided Teac disc drive. 16k sideways RAM. Voltmace joystick, lots of software + Wordwise, View, Disc Doctor, Spreadsheet, £550. Tel: 01-993 2572 (West London).

● APPLE EUROPLUS software; Wizardry I & II, £15; Appleword, £15; Dos 3.3 toolkit, £15; F.S.1, £5; Wizard and Princess, £5; manuals and books, £5; (take all for £50). Tel: Stamford (Lincs) 56708 (eves).

● BBC B 1.2 OS, plus DFS with View wordprocessing chip, double 200k 80 track disk drives, monochrome monitor, Juki 6100 daisywheel printer. Four months old, £995. Tel: Cambridge (0223) 811436 (eves).

● ATARI SOFTWARE. Utilities, languages, games. All on disk, no bootlegs. Also books and technical manuals. Approx 35 disks, 8 manuals, all as new. Tel: Ewen on Leicester 358899 for details.

● PAIR OF SONY 3½in 500k byte 300 RPM drives for sale. 5¼in pin compatible, £155. Will split, £80 each. Tel: (0734) 883220 after 7pm.

● SHUGART 801 8in floppy disc drive with OEM and service manuals. Hardly used. £100. Tel: 01-609 8282.

● TRS-80 Model 4. Twin 80k discs, 64k RAM, TRS Dos, 6×12in green screen monitor. Excellent condition, £650 ono. Wanted TRS-80 software. Good quality printer. Tel: Swansea 464253(eves).

● TANDY MODEL THREE. Twin disk drives, good condition plus TRS-80 disk system owners manual, TRS-80 Cobol compiler and 10 single sided 5¼in disks, £650. Tel: 01-732 5468 after 6pm.

● TANDY TRS-80 Model 4, 128k RAM, two drives, RS232C, 40 disks, Multiplan, Superscripsit, Profile, Visicalc, many programs, games, Dos's manuals + Model 6 line printer. Ideal system for small business, £950. Tel: (0306) 7114808.

● BBC B OS1.2, modem (Prdsm Nightingale with Commstar ROM) and 14in Decca colour monitor, cassette recorder, games and new computer desk. Very good condition. Will consider offers, £600. Tel: (0270) 820700.

● CASIO PB700. Unused, 1984/5 with manuals, case, Superbasic, memory fully expanded (48k) — three RAM cards, built-in multiline screen: The best pocket computer available without doubt — I own two! Just £125 ono. Tel: 01-527 5493.

● ICL PCI, 64k RAM, 5Mbyte fixed disc + 5¼in diskette. Kokusai monitor + keyboard, microline 82A printer, MBasic, word processor, database + games. Reasonable offers over £1,000. Tel: (0625) 28404 after 8pm or weekends.

● MAGAZINES, back numbers of various computing magazines for sale. Send s.a.e for details. Clarke, 68 Rock Lane, Stoke Gifford, Bristol BS12 6PG.

● TANDY MODEL I disk, 64k expansion, monitor, £299 for quick sale. Tel: 01-874 5365.

● AFFORDABLE RELIABLE PRINTING: Tandy CGP115 for colour printer/plotter. Surplus to requirements (I've upgraded to Microline), £100. Tel: (0936) 33300 (near Stoke-on-Trent). Works with BBC — includes leads.

● GENERAL ELECTRIC TERMINET-30. 132 column printer terminal, alpha numeric keyboard, integral dual datadrives for print file dumps and offline data preparation. Excellent condition, £250 ono. Tel: (0203) 443377 (Coventry).

● SHARP MZ-80A. Built-in green monitor and cassette. Perfect condition. Books, languages, assembler, m/code tools, games etc. Cost over £530, sell for £230 or nearest offer. Tel: (051 733 2449.

● SYSTIME CENTRONICS dot matrix printer, working, £100; Burroughs friction/tractor feed dot matrix printer, mechanism new with all accessories and full circuit diagram. Bargain for experimenter, £40. Tel: (0661) 843449.

● NASCOM 2. Cased with manuals and info, hardly used, £125; Crofton green screen monitor, £30; Soundmaster hi-res amber monitors, new and unused, £50. S100 64k RAM, £90. Tel: (0661) 843449.

● DELTADATA SYSTEMS RS232 terminal, many features, good order, £200; DEC Centronics dot matrix printer with stand, £100; DEC RKO5J hard disk drives (two), working order, £100 each, Tel: (0661) 843449.

● FOR SALE: HP41C Hewlett Packard programmable calculator. With card reader, printer, several ROM modules and all manuals. Tel: (0740) 21375 after 6pm.

DIARY DATA

Readers are strongly advised to check details with exhibition organisers before making arrangements, in order to avoid wasted journeys due to cancellations, printer's errors, and so on.

London	(Barbican), Business Telecom Exbn. Contact: Online Conf's Ltd, (01) 868 4466	21-23 May
London	(Bloomsbury Crest), Microfilm Exbn. Contact: Beta Exbns Ltd, (01) 405 6233	21-23 May
London	(West Hotel), International Videodisk, Optical Disk and CD ROM Conf & Exbn. Contact: Meckler Comm's, (01) 240 0856	24-31 May
London	(Earls Court), Business Computer Show. Contact: Reed Exbns, (01) 643 8040	4-6 June
London	(Kensington Exbn Centre), Computer & Peripherals Equip't Trade Exbn (COMPETA). Contact: Network Events Ltd, (0280) 815226	4-6 June
London	(Barbican), Office Automation Show & Conf. Contact: Cahners Exbns Ltd, (061) 832 4242	4-6 June
London	(Earls Court), Software Show. Contact: Reed Exbns, (01) 643 8040	4-6 June
London	(Novotel), Commodore Computer Show. Contact: Genesis PR Ltd, (01) 935 7777	7-9 June
London	(Olympia), European Unix User Show. Contact: EMAP Int Exbns Ltd, (01) 837 3699	12-14 June
Germany	(Stuttgart), Computing in Clinical Laboratories. Contact: Dr Trendelenburg, (0711) 2034 482	14-16 June

WRITING FOR PCW

Your chance to contribute to the magazine.

We're offering readers a chance to get rich (well, at least richer) and to influence what's published in the magazine — by writing for it. We welcome approaches from would-be writers, including those who have never appeared in print before. It's often users with practical experience who have the most interesting things to say, so don't worry if your prose is less than perfect, we can take care of the polishing.

If you have an idea for a feature write, with a brief synopsis, outlining the proposed structure and content. If your article is already written, then send it in for consideration. Remember to put your name and address on both the covering letter and the manuscript — along with a daytime phone number if possible. Manuscripts should be typed or printed out (dot matrix output is fine), in double-line spacing with ample margins top and bottom and on each side.

Any accompanying program listings should be supplied on disk or cassette,

WRITING FOR PCW

ideally with a printout as well. We'll try to return all submissions sent in with a suitable sae, but make sure you keep a copy of everything you submit as well.

Bear in mind that it's worth taking a look at the Back Issues advertisement to see what sort of things we have already published — after all there's no point in reinventing the wheel. And please be sure to tell us if you've contacted another magazine (perish the thought): it would be very awkward if the same article appeared elsewhere. Frankly, we're more likely to accept something which has been offered exclusively to us.

Finally, we do pay for published work — the rate is £65 per 1000 words, and payment usually follows about four-six weeks after publication.

LEISURE LINES

Brain-teasers from J J Clessa

Quickie

20 blackbirds are sitting on a fence. The farmer blasts them with his shotgun and kills three. How many live birds will be left on the fence?

Prize Puzzle

Short and sweet: find three positive numbers in arithmetical progression whose product is 11 (for the uninitiated, arithmetical progression means that the difference between successive numbers is constant). And please don't write in to say it can't be done.

Answers, please, on postcards only (letters are automatically disqualified) to *PCW* Prize Puzzle, June 85 Leisure Lines, 62 Oxford St, London W1A 2HG. Entries to arrive not later than 31 July 1985.

March Prize Puzzle

What a load of ball-bearings! There was quite a big response — over 250 entries to the ball-bearing problem, with cards from Iceland, Malta, the United Arab Emirates and the EEC countries.

The puzzle wasn't too difficult to solve by micro: the answer is 19,600 ball-bearings, which is the smallest triangular number that is also a perfect square. The winning entry came from B L Burton of Stoke-on-Trent. Congratulations, your prize is on its way

NUMBERS COUNT

Mike Mudge offers a clue to the mystery of the Riemann Hypothesis, and presents the winning solution to the theory of Normal Numbers.

The Moebius Function

Definition. The function of Moebius $\mu(a)$ is defined for all positive integers a by the equalities $\mu(a) = 0$, if a has a squared factor distinct from 1, $\mu(a) = (-1)^k$, where k denotes the number of prime divisors of a, and a greater than 1 has no squared factor distinct from 1. In particular, for a = 1 we assume that k = 0 and therefore take $\mu(1) = 1$.

a	1	2	3	4	5	6	7	8	9	10	11	12
$\mu(a)$	1	−1	−1	0	−1	1	−1	0	0	1	−1	0

Check: the sum of the values of $\mu(a)$ from a = 1 to 100 is 1.

Alternative definition: $\mu(1) = 1$, $\mu(p) = -1$, $\mu(p^n) = 0$ for n greater than 1, $\mu(mn) = \mu(m)\,\mu(n)$ when m and n are coprime; that is, m and n have no common factor other than 1. p denotes a prime.

This function is thus very easy to evaluate for isolated numbers whose factors are known, and attention has focused on its use to evaluate more complicated allied functions.

In 1884 J P Gram published $\mu(n)$ together with the sum:

$$S_n = \sum_{k=1}^{n} \mu(k) k^{-1}$$

for $n \leqslant 300$; subsequently Euler's conjecture that as n tended to infinity S_n tended to zero was rigorously proved.

The function:

$$M_n = \sum_{k=1}^{n} \mu(k)$$

has, however, attracted a great deal of attention. In 1897, F Mertens tabulated $\mu(n)$ and M_n for $n \leqslant 10000$; over the period 1897 to 1912, RD von Sternbeck tabulated M_n for all $n \leqslant 150000$, then in steps of 50 up to 500000, followed by 16 values chosen in the range from 600000 to 5000000. These tables were constructed with the hope of shedding some light on the problem, believed to be still unsolved, of the behaviour of M_n for sufficiently large n. This problem is intimately connected with the Riemann hypothesis, whose consequences are to be found throughout classical number theory.

The Moebius function is related to Euler's Totient Function (see *PCW*, May) thus: if $\phi(n)$ denotes Euler's Totient Function and

$$\Phi(n) = \sum_{v=1}^{n} \phi(v),$$

where it is known that $\Phi(n) = 3n^2/\pi^2 + o(n \log n)$ (order of n log n), then the sum of $\phi(v)$ is most easily calculated from the formula in Fig 1 where [x] denotes the largest integer not greater than x and M(x) denotes

$$\sum_{v \leqslant x} \mu(v)$$

that is, the generalisation of M_n in the obvious way. JWL Glaisher (1940) published tables of $\Phi(n)$ for n going from 1000 to 10000. It is interesting to note that $E(n) = \Phi(n) - 3n^2/\pi^2$ is positive for all $n \leqslant 1000$ except n = 820.

There are further topics, such as the theory of irreducible cyclotomic polynomials involving the Moebius function, but these are beyond the scope of this article.

Problem Tabulate the functions $\mu(n)$, S_n, M_n and possibly $\Phi(n)$, the latter to be calculated using the above formula.

Demonstrate the plausibility of the now-proven Euler conjecture referred to above, speculate on the behaviour of M_n, demonstrate the anomalous sign of E(n) at n = 820, and attempt an explanation.

Readers are invited to submit their program listings, output and hardware details together with their conclusions relating to this problem to Mike Mudge, 'Square Acre', Stourbridge Road, Penn, Nr Wolverhampton, Staffs WV4 5NF. (Tel: (0902) 892141). A suitable prize will be awarded to the 'best' entry received by the 1 September 1985. Criteria will include accuracy, originality and efficiency.

Please note that submissions can only be returned if a suitable stamped addressed envelope is included. Ex-

$$2\Phi(n) - 1 = \sum_{v=1}^{[\sqrt{n}]} \left\{ \left[\frac{n}{v}\right]^2 \mu(v) + M\left[\frac{n}{v}\right](2v-1) \right\} - M(\sqrt{n})[\sqrt{n}]^2$$

Fig 1

NUMBERS COUNT

panded reviews of previous problems, together with, subject to the approval of the contributor, copies of detailed programs from the prize winning entry may also be requested.

Prize-winner December

This topic produced a most interesting and varied response, including Tansoft Forth on an Oric Atmos and 'Homebrew' Forth on an Image 8.

A detailed study of the mth root of n in Z80 code, using the Zeus Assembler on a Spectrum, was particularly interesting. Fortran 77 on a CDC Cyber 180-810 appeared from Sweden, and Z80 code using a two-pass compiler on a ZX81 came from West Germany. A Spectrum, fitted with a 7608 voltage limiter, ran in Basic for 100 hours to duplicate the ENIAC result for pi.

This month's winner is Ronald B Shepherd of Cottingham, Humberside, who used Prospero ProPascal version zz 2.1 on a Sharp MZ80B (64k, Z80A, clock frequency 4MHz) with twin 5¼in floppy disks and printer. Ronald calculated e to 5000 digits (2000 in 54 minutes) and pi to 2000 digits (6¼ hours), and having written these to disk analysed them statistically. This analysis, including frequency, runs and serial test, was based upon the algorithms of WJ Kennedy and JE Gentle, *Statistical Computing*, 1980. The whole work was extremely well-documented with references, full listings and tabulated output. Suggestions for further work included the gap test and a study of the mth root of n using Newton's Method, together with the digital analysis of Euler's Constant, gamma.

A well-deserved prize is on its way to Humberside.

MICROCHESS

Kevin O'Connell watches the moves at the 1984 Dutch Computer Chess Championship.

In the 1984 Dutch Computer Chess Championship, played at the University of Leiden, the victor of 1983, Chess 0.5X, repeated its previous year's feat of winning all its games. Here is the game it won against the program that took second place.

White: Nona. Black: Chess 0.5X. Bogoljubow Defence

1	d2-d4	Ng8-f6
2	c2-c4	e7-e6
3	Ng1-f3	Bf8-b4+
4	Bc1-d2	Bd4×d2+
5	Nb1×d2	d7-d5
6	e2-e3	0-0
7	Bf1-e2	Nb8-c6
8	0-0	Bc8-d7
9	a2-a3	Qd8-e7

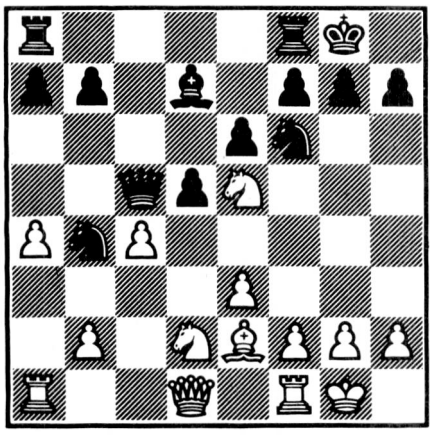
(Black has a sound but cramped position)

10	a3-a4?	

(This is a wasted move which creates a hole on the b4 square which Black should be able to exploit.)

10	. . .	Nc6-b4
11	Nf3-e5	c7-c5

(This frees Black's game.)



Black's game begins to open up.

12	d4×c5	Qe7×c5
13	Nd2-e4!?	

(An interesting idea. If 13 . . . Nf6×e4, 14 Ne5×d7 wins material, and if the black queen moves, then 14 Ne4×f6+ shatters Black's pawn defences in front of his king.)

13	. . .	d5×e4
14	Ne5×d7	Nf6×d7
15	Qd1×d7	b7-b6
16	Rf1-d1	

(It seems as though White has done rather well after all, having occupied the open d-file, but the light-squared bishop has very little scope.)

16	. . .	Nb4-c6
17	Kg1-h1	

(This is an irrelevancy, but 17 Qd4-d6 Rf8-d8 18 Qd6×c5 b6×c5 would only highlight the weaknesses created by White's tenth move. 17 Rd1-d6 would be even more distastrous after 17 . . . Nc6-e5 18 Qd7-e7 Rf8-c8 and Black wins a rook.)

17	. . .	Ra8-d8
18	Qd7-c7	f7-f5
19	Rd1-d7	Rd8×d7
20	Qc7×d7	e6-e5
21	Ra1-d1	f5-f4

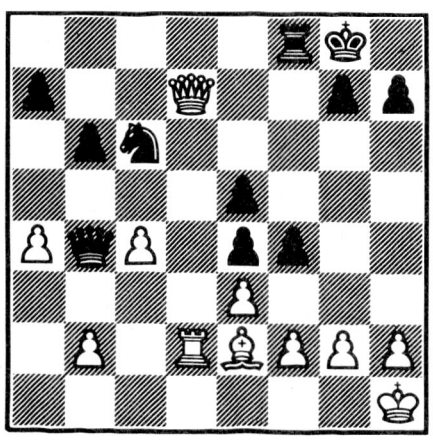
(White still has control of the d-file, but what can she (when first programmed, Nona was named after the then women's world champion, Nona Gaprindashvili) do with it? Meanwhile Black continues aggressively, succeeding in weakening the dark squares near White's king and in giving the rook more scope.)

22	Rd1-d5	Qc5-b4
23	Rd5-d2	

(Cutting off the black queen's access to e1.)

23	. . .	Nc6-d4!

(The white queen's access to a square (d2) is cut off in turn and to very great effect.)



White's position is looking desperate— Black starts the mopping-up operation.

24	Qd7-d5+	Kg8-h8
25	Rd2-d1	

(There is nothing better.)

25	. . .	Nd4×e2

(Black conducts the mopping-up operation which follows very efficiently.)

26	a4-a5	Qb4×b2
27	a5×b6	a7×b6
28	g2-g3	Ne2-c3
29	Qd5-d6	Rf8-g8
30	Rd1-d2	Qb2-b1+
31	Kh1-g2	f4×e3
32	f2×e3	Qb1-e1
33	Kg2-h3	Qe1×e3
34	Rd2-b2	Qe3-f3
35	Rb2×b6	Nc3-d1
36	Rb6-b2	

(A forlorn attempt to distract her opponent from mate in two, which was threatened by 36 . . . Nd1-f2+ 37 Kh3-h4 Qf3-g4 (or 37 . . . g7-g5.)

36	. . .	Nd1-e3
White resigns		0-1

(It is still mate in two (after 37 Qd6-g6 — anything else allows mate in one.)

ACC NEWS

Rupert Steele reports on the rumblings in the ACC Council, which now has a new chairman and fresh ideas for the ACC and its responsibilities. He also presents a round-up of the new clubs.

John Bone of Newcastle Personal Computer Society and Computer-Town! North-East has been elected as the new chairman of the Association of Computer Clubs in a contested election (in which I did not stand) at the recent meeting of the ACC Council, but I shall continue to write this column and to deal with correspondence from clubs arising from it. Other correspondence and telephone enquiries should be directed to John Bone.

At Council, there was considerable interest both in the insurance schemes that the ACC runs on behalf of the affiliated clubs, and the idea of a regional structure for the Association. Some delegates expressed an interest in acting as the ACC regional coordinator in their areas. Andrew Holliman is now in charge of this, and anyone interested should contact him at 5 Trinity Close, Balsham, Cambridge CB1 6DW or phone (0223) 893983. We all regard the establishment of a proper regional structure for the ACC as being important for the computer club movement as a whole.

Club News

It has become clear that in my concern to introspectively avoid looking only at London and the Home Counties, I have almost entirely ignored the whole area! This month's club news is therefore focused on these areas, starting with Surrey.

I am informed of the Croydon Apple User Group, which claims to have a pool of expertise extending to many fields, and to be anxious to meet new members. The secretary is Roger Laming of 1 Carlton Road, South Croydon, tel: (01) 681 6842.

Nearby is the rather larger Croydon Computer Club. among its activities are two ComputerTown! branches at Central Croydon and Norbury. Vernon Quaintance runs the Norbury branch, which meets from 9.30pm to 12.30pm at Norbury Junior Library, Breatrice Avenue, Norbury each Saturday morning. About 25 children attend each session, whose ages vary from about eight to 18. There is usually a range of micros available, typically the BBC, Apple, Commodore 64, Tandy TRS-80 and Sinclair Spectrum. While much of the introduction to the equipment is through games, there is a continuous Basic programming class. To find out more, just turn up one Saturday morning and join in.

The West Surrey Computer Club meetings are held on the second Thursday of each month at the Stoke Hotel, Guildford, with a BBC user group also meeting on the third Friday of each month at the Guildford County College of Technology. The meeting for 13 June will be about incompatibility and language differences, so if you can't work out why your program won't run on another micro (and you live near Guildford)—this is the meeting for you. The contacts are John Stokes on (0483) 38947 and Jan Spencer on (0483) 63512, or write to 52 Lindfield Gardens, Guildford GU1 1TS.

Are you near Camberley or Redhill? If so, there are a couple of contact points (I have no detailed information) for computer clubs. To contact the Camberley Computer User Club, ring David Crosby-Clarke on (0344) 771590, or write to him at 55 Robin Lane, Sandhurst, Camberley, Surrey GU17 8AU. In Redhill, contact TM Randall of the Foxbro GB Computer Club. I don't know if it welcomes non-Foxbro members, but if you are interested, write to 6 Copley Close, Redhill RH1 2BE.

In Sutton, A Close has written to me about SPECCY, a register for 48k Spectrum owners with young children. For inclusion on the register and further details about SPECCY, send your child's name, age (one-seven years) and address to A Close, 38 Homedale House, 3 Brunswick Road, Sutton, Surrey SM1 4DG.

In a rather different style, RP Young has written to me about the Dragon Computer Club. The idea is to run a postal club for Dragon users only, with a monthly newsletter and club discounts arranged with equipment suppliers. If you are interested, write to 37 Laburnam Court, Redehall Road, Smallfield, Surrey.

Dennis Frank Tomlin writes about his 'Play for Life' computer club, which is apparently concerned with life-affirming playthings including software and hardware for games. Dennis is on (01) 647 1861, or you can write to him at 78 Boundary Road, Carshalton, Surrey SM5 4AD. There appears to be some kind of social/political message connected with the club, but this is unclear.

Moving on to Sussex, Robert Cooke is secretary of the Eastbourne and District Computer Club. He can be contacted at 22 Selwyn Road, Eastbourne, Sussex BN21 1LR, and the club meets on the fourth Wednesday of each month at the St Aidan's Methodist Church Hall, Whitley Road, Eastbourne.

In Midhurst, West Sussex, there is the Midhurst and District Club. It meets on the second and last Thursday of each month at 'North Mill', the Grange Centre, Bepton Road, Midhurst, and welcomes members with any level of computing experience, especially those who wish to learn but have never liked to ask. Subscriptions are £3 a year plus a £1 a meeting for over 17s, children £1 a year plus 25p/meeting. For details contact Val Weston at 69 Petersfield Road, Midhurst, West Sussex, tel: Midhurst 3876, or call Robert Armes on Midhurst 3279.

From Sussex writes NL Rees of 12 Hayes Close, Ringmer, Lewes, East Sussex BN8 5HN, who is running a Casio Pocket Computer User Group. The idea is that Casio PC owners will be able to get in touch with each other locally to exchange programs and ideas; this will help correct his impression that there has not been a single program published for the Casio Pocket computer. If you are a Casio owner, why not drop him a line or call him on Ringmer 812475 to see how it's going?

In Hampshire, Kevin Weatherford, on Alton 87478, runs ACES (Alton Computing and Electronics Society). It meets at 7.30pm on the second Wednesday and last Friday of each month at the Alton Community Centre, and is planning to build a micro-mouse. Kevin's address is 'Sheen', Old Odiham Road, Alton, Hants GU34 4BW.

And winning this month's catchy acronym prize is BOGBUG, which is the Borough of Gosport BBC Users' Group. It currently meets on the second and fourth Thursday of each month in members' homes. Contact Graham Dubber at 128 Wych Lane, Gosport, Hants PO13 0TE, or phone (0329) 282221 (evenings). END

For a mention in this column or to let the ACC know about your club: Rupert Steele, 12 Philbeach Gardens, London SW5 9DY ((01) 370 0601).

For any other ACC business or to obtain the address of your local club: John Bone, 2 Claremont Place, Gateshead, Tyne and Wear NE8 1TL ((0632) 770036).

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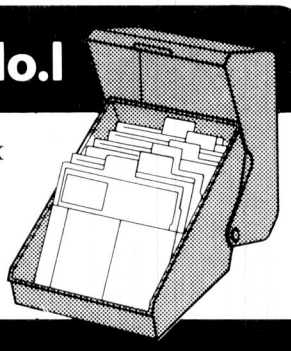

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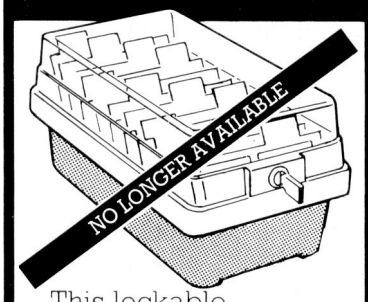

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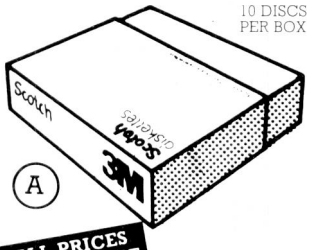

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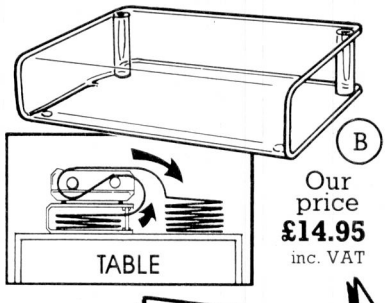

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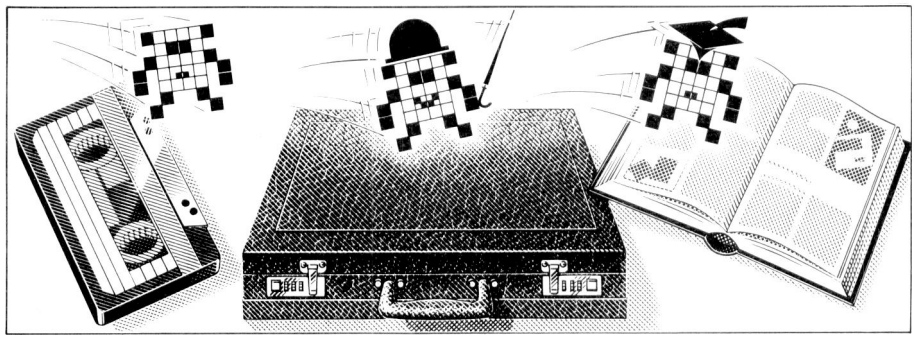

Nick Walker selects the best of readers' programs — for details on submitting your own, see the end of this section.

One of the frustrating things about artificial intelligence (AI) is the amount of memory even the most simple AI project consumes; this makes it almost impossible for the home micro owner to do anything useful. The Program of the Month is the best example I've seen of AI on a home micro. Written for the BBC with disk drives, the program recreates the classic experiment popular in the early days of AI on mainframes — a blocks world simulation. Despite its length, the program is an excellent starting point for dabbling with AI, especially natural language understanding.

Commodore 64 owners who also have an interest in electronics and logic circuits will like the logic simulator published this month. Not only does this allow you to enter logic circuits as truth tables, but it also lets you connect the design to the outside world via the user port. This means you could design a circuit, connect it as you would the real one, and test it making any changes before you put the circuit into hardwire.

Other programs include *PCW*'s first program for the Enterprise and two games — Nine Men's Morris for the Spectrum and a very professional version of Yahtzee for the Atari.

We would like to publish programs for the Memotech. If you have written any please send them in for consideration.

- *Games*
- *Scientific/mathematic*
- *Business*
- *Toolkit/utilities*
- *Educational/Computer Aided Learning*

Program of the Month
BBC Alpha
by Mark Needham

BBC Alpha is a version of the artificial intelligence blocks world simulation. By entering commands in natural language, the program will simulate the placing of blocks on a table; questions can then be asked about the arrangement. Although the program is long, it is well-written, easily modified, and a good introduction for those wishing to dabble with AI.

Due to the size of the system, it requires a Level 2 Basic 32k BBC Micro with at least one disk drive. If you have the Chatterbox II voice synthesiser, the conversation will also be spoken. Alpha's intelligence comes from a series of command lists stored as disk files and interpreted in Basic; these are easily customised to create your own vocabulary to talk to Alpha.

```
                    Alpha Running Instructions

The ALPHA system comprises of three programs :-

  1 - ALPHA ..... The main run time program, including the command
                  list interpreter, and all BASIC routines.

  2 - SETUP ..... The command lists creator. Three command lists
                  are used.

                  A) COMMAND - The main command list.
                  B) NOUN    - The noun evaluator list.
                  C) IOLIST  - The list to handle LOAD/SAVE/CLEAR.
                  All lists have comments after them in the listing,
                  these comments need not be typed in.

  3 - TMAKER ..... The Table maker creates all the other files needed
                  by ALPHA.
```

PROGRAM FILE

```
Type in all programs first and save on disk (drive 0). Then run SETUP & TMAKER.

The required files will be saved on the disk.

To run ALPHA type :-  CHAIN "ALPHA"

The screen is divided into three main areas.

Area 1 is for the user input, and consists of four lines at the top of the
screen. Full cursor movement is allowed, F0 will clear the whole area, and
F8 will insert a space at the cursor location. Press RETURN only after the
whole sentence has been typed in.

Area 2 is the object board. ALPHA handles 15 objects, 6 of which are on the
board at the start. 4 of the other 9 are displayed on the right of the screen.
It is possible to PUT one of the invisible objects on the screen.
For users with black and white TVs only, each block has a character on it,
which is the first letter of its colour. E.g. R for red, C for cyan.

Area 3 is ALPHA's talking area. All responses will be shown here. If the
CHATTERBOX II is enabled then ALPHA will speak the words as well as display
them. The command list is also displayed here. It can be slowed down by
pressing the COPY key. The command list can be disabled by typing :-

 DISABLE THE LIST   - This speeds up the processing slightly.



          MAIN SENTENCES SYNTAX:-


          (HELLO) (ALPHA) (,) MY NAME IS unknown

          (HELLO) (ALPHA) (,) PLEASE {command}

          (HELLO) (ALPHA) (,) (TELL ME) {question}



Adjectives

 Red,yellow,green,blue,cyan,magenta,white,round,square,cubic,circular
 and triangular.

Names

 Cube,circle,triangle. (Square cannot be used as an object name).

Example nouns

 1 - THE RED, TRIANGULAR OBJECT
 2 - AN OBJECT WHICH IS TO THE LEFT OF THE GREEN CUBE
 3 - A GREEN CUBE WHICH IS NOT UNDER A SQUARE OBJECT WHICH IS THE SAME COLOUR AS
     THE RED TRIANGLE
 4 - A RED AND CIRCULAR OBJECT

 The first object in a sentence is remembered and is then known as it.
 E.g.  PUT THE RED CUBE ON THE BOARD
       WHAT IS THE TO LEFT OF IT ?          - IT being the RED CUBE



Command Syntax

 PUT  { any noun } { preposition } { any noun }  - Put an object on the board
 MOVE { any noun } { preposition } { any noun }  - Move an object around
 REMOVE { any noun }                             - Remove an object from the board
 QUIT (( THE ) GAME )
 END  (( THE ) GAME )                            - e.g. QUIT  exits ALPHA
 STOP (( THE ) GAME )                            - or QUIT THE GAME  exits game only
 EXIT (( THE ) GAME )
 BYE                                             - Exits ALPHA
 FIND { any noun }                               - Locate object which is on the board
 MAKE { any noun } { adjective }                 - Change object's attribute(s)
 ENABLE  ( THE ) [ TALK / LIST ]                 - LIST - display of commands
 DISABLE ( THE ) [ TALK / LIST ]                 - TALK - Send words to CHATTERBOX II
 PLAY ( THE ) GAME                               - Start the game
 SAVE (( THE ) [ BOARD / GRID ])                 - Save the current board positions
 LOAD (( THE ) [ BOARD / GRID ])                 - Reload the board positions
 CLEAR (( THE ) [ BOARD / GRID ])                - Move all objects off the board

Question Syntax

 WHAT [ COLOUR / SHAPE ] IS { a noun }
 WHAT [ OBJECTS / BLOCKS ] ARE ( THERE ) { preposition } { a noun }
 WHAT IS ( THERE ) { preposition } { a noun }
 HOW MANY { adjective } [{ name } / OBJECTS ] ARE (THERE) { prep } { a noun }
 IS { a noun } { preposition } { a noun }

Definitions

 ( )             - Contents of brackets are optional
 [ ]             - Contents hold alternatives, separated by one or more /.
 { a noun }      - A specific object if ALPHA is to answer the question
                   correctly.
                   E.g. IS THERE A RED CUBE TO THE LEFT OF A YELLOW OBJECT ?
                   may give the wrong answer if there are more than one yellow
                   object on the board.
 { any noun }    - Can be any object. The PUT first object in the PUT command
                   must be off the board, the first in the MOVE command must be
                   on the board.
 { preposition }- E.g.  TO THE LEFT OF, THE SAME COLOUR AS Etc.
 { adjective }   - E.g.  RED, YELLOW, SQUARE, TRIANGULAR Etc
 { name }        - E.g.  CUBE, CIRCLE, or TRIANGLE.

Example Sentences

 HELLO ALPHA , MY NAME IS MARK
 PLEASE MOVE A RED CUBE ON TOP OF A GREEN CUBE
 FIND AN OBJECT WHICH IS THE SAME COLOUR AS THE CIRCLULAR OBJECT
 IS THE RED OBJECT WHICH IS THE SAME COLOUR AS THE CIRCULAR OBJECT ON TOP OF
   THE GREEN CUBE ?
```


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PROGRAM FILE

```
          NOUN SYNTAX:-


          (A/AN/THE) (name/OBJECT/BLOCK)

          (A/AN/THE) (name/OBJECT/BLOCK) preposition group

          (A/AN/THE) (adjective/AND/,) (name/OBJECT/BLOCK)

          (A/AN/THE) (adjective/AND/,) (name/OBJECT/BLOCK) preposition group

          (IT)
```

Playing the Game

The game that ALPHA can play is a version of noughts and crosses, but involves getting four of the same shape or colour in a row.
To win you must get at least four objects with the same colour in a row, in any direction. For ALPHA to win it must get four similar shapes in a row.
To make things fair, only three colours are used in the game, RED, YELLOW, and GREEN.

After each move ALPHA will check the board for winning lines and if someone has won, the game win end.

To start the game type :-

    PLAY THE GAME

You move first by typing :-

    PUT AN OBJECT ON THE BOARD

ALPHA will then move and tell you what it has done.

The Umms and Errs at the bottom of the screen are there to show that ALPHA has not crashed.

You can stop the game at any time by typing :-

    QUIT THE GAME

```
  890 REM   ****************************
  900 REM   *          ALPHA           *
  910 REM   *                          *
  920 REM   *   EXPERIMENT IN A.I.     *
  930 REM   *                          *
  940 REM   *    BY MARK NEEDHAM       *
  950 REM   *                          *
  960 REM   *  BBC MICRO 32K OS 1.20   *
  970 REM   *                          *
  975 REM   *     LEVEL 2 BASIC        *
  977 REM   *                          *
  980 REM   *  PLUS 1 DISK DRIVE (0)   *
  990 REM   *                          *
  992 REM   *     DO NOT RENUMBER      *
  995 REM   ****************************
  997 REM
 1000 MODE7:HIMEM=&6000:IN=&7C28:H$="FX229,1":PROCh:OBNUM%=15:CHAT%=0
 1010 F1=OPENIN("GETCOM"):CLOSE#F1:IFF1=0THENPRINT"NO FILES !!!":STOP
 1020 DIMW$(50),T$(15),N(15),A$(15),N$(15),P$(15),SH$(15):PROCb
 1030 FORY1%=1TO4:FORX1%=1TO8:?FNB(X1%,Y1%)=0:NEXT:NEXT:FORX%=1TOOBNUM%:IFX%<7A$
=STR$X%+"1"ELSEA$="00"
 1040 V1%=RND(7):V2%=RND(3):A$=A$+STR$V1%+STR$V2%+"A"+FNA(V1%,3):GOSUB14400
 1070 SH$(X%)=A$:IFX%<7THEN?FNB(FNX(X%,1),FNX(X%,2))=X%
 1080 NEXT:S$="RGYBMCW":MNSA=0:LI%=1
 1090 SEARCH$="TESTNULLPROCADDNSTR+CF%=INCWLOADFLAGXXXXSUBRXXXXTALKXXXXERR="
 1100 PRINTTAB(0,0)CHR$157CHR$129"Artificial Intelligence V1.0"TAB(0,5)STRING$(4
0,"-")
 1110 PRINTTAB(0,19)STRING$(40,"-")
 1120 PRINTTAB(0,24)STRING$(39,"-");:?&7FE7=45:GOSUB8000:PROCf:PRINT"MY NAME IS
ALPHA"''"WHAT IS YOUR NAME ?":PROCg
 1130 PROCn:GAME%=0
 2000 H$="LOAD GETCOM 7000":PROCh:PROCg:PROCe:PROCa:UN%=0:UN$="":R2D2=0
 2005 H$="LOAD WTAB 6000":PROCh
 2010 A=&C00:T$="":Y%=1
 2020 B$=W$(Y%):FORX%=0TOLENB$-1:A?X%=ASC(MID$(B$,X%+1,1)):NEXT
 2030 ?&72=0:?&73=&C:?&70=LENB$:CALL&7167:B=(?&7A+?&7B*256):IFB=61680PROCv:GOTO2
042
 2040 IFB<65535THEN2050
 2042 IFUN%=1 ER=7:GOTO6100:ELSET$=T$+"U001":UN$=W$(Y%):UN%=1:GOTO2070
 2050 C=&6800+(B-1)*4:FORX%=0TO3:T$=T$+CHR$(C?X%):NEXTX%
 2070 Y%=Y%+1:IFY%<=W THEN2020
 2100 H$="LOAD PREP 6000":PROCh
 2110 B=?&6000:A=&6001
 2120 FORY=1TOB:A$=$A
 2130 C=INSTR(T$,"W052"+A$):IFC<1THEN2150
 2140 T$=LEFT$(T$,C-1)+"P9"+FNA(Y,2)+MID$(T$,C+LENA$+4):GOTO2130
 2150 C=INSTR(T$,A$):IFC<1THEN2190
 2160 T$=LEFT$(T$,C-1)+"P"+FNA(Y,3)+MID$(T$,C+LENA$):GOTO2150
 2190 A=A+LENA$+1:NEXTY
 3000 WP=1:PROCf:CLS:NL=0:CF%=0:ER=0:LCOLD=0:AOLD=0:WRD%=0:OUT$="":R2D2=0
 3010 H$="LOAD C.COMMAND 6000":PROCh
 3020 H$="LOAD PREP1 7000":PROCh
 3030 A=&6000:A$=$A:LC=VAL(LEFT$(A$,4)):STACK=0:NAME$="COMMAND"
 3100 IFLC=LCOLD A=AOLD:A$=$A:GOTO3104 ELSEA=&6000
 3102 A$=$A:IFVAL(LEFT$(A$,4))<>LC A=A+LENA$+1:GOTO3102
 3104 IFNL=-1A=A+LENA$+1:A$=$A:NL=0:LC=VAL(LEFT$(A$,4))
 3105 A$=MID$(A$,5):IFLI%PRINT'FNA(LC,4)" - "A$;:REPEATUNTIL?&EC<>233
 3108 LCOLD=LC:AOLD=A
 3110 B$=LEFT$(A$,4):B=INSTR("EXITSTOPJUMP",B$):IFB>0G$=B$:GOTO5900
 3120 B=INSTR(SEARCH$,B$):IFB>=1B=5000+INT(B/4)*50:GOTOB
 3130 ER=4:GOTO6100
 5000 C$=MID$(A$,5,4):N=INSTR(C$,"?"):IFN<=0N=4 ELSEN=N-1
 5010 IFLEFT$(FNW(WP),N)=LEFT$(C$,N)G$=MID$(A$,9,4)ELSEG$=MID$(A$,13,4)
```

PROGRAM FILE

```
 5020 GOTO5900
 5050 T$(VAL(RIGHT$(A$,4)))="":G$="NEXT":GOTO5900
 5100 B=VAL(MID$(A$,5,5)):IFB>9999GOSUB B
 5110 G$="NEXT":GOTO5900
 5150 X=VAL(RIGHT$(A$,4)):T$(X)=T$(X)+P$:G$="NEXT":GOTO5900
 5200 C=VAL(MID$(A$,5,4)):IFFNW(WP)="U001"T$(C)=T$(C)+UN$ELSET$(C)=T$(C)+FNW(WP)
 5210 G$="NEXT":GOTO5900
 5250 CF%=VAL(RIGHT$(A$,4)):G$="NEXT":GOTO5900
 5300 WP=WP+1:IFWP>W G$=RIGHT$(A$,4):WP=W:WRD%=1:ELSEG$="NEXT"
 5310 GOTO5900
 5350 GOTO5510
 5400 IFER<>0G$=RIGHT$(A$,4)ELSEG$="NEXT"
 5410 GOTO5900
 5500 STACK=STACK+1:W$(STACK)=LEFT$(NAME$+STRING$(7," "),7)+FNA(LC,4)
 5510 LCOLD=0:AOLD=0:NAME$=MID$(A$,5):H$="LOAD C."+NAME$+" 6000":PROCh:A=&6000:A
$=$A:LC=VAL(LEFT$(A$,4)):GOTO3100
 5600 A$=RIGHT$(A$,4):IFVALA$<>0OUT$=OUT$+T$(9):GOTO5630
 5610 GOSUB9900
 5630 G$="NEXT":GOTO5900
 5700 ER=VAL(RIGHT$(A$,4)):GOTO5630
 5900 NL=0:IFG$="STOP"THEN6000
 5910 IFG$="EXIT"THEN6000
 5920 IFG$="NEXT"NL=-1:GOTO3100
 5930 IFG$="JUMP"G$=MID$(A$,5,4):GOTO5900
 5950 LC=VAL(RIGHT$(G$,4)):GOTO3100
 6000 IFSTACK=0THEN6100
 6020 NAME$=LEFT$(W$(STACK),7):LC=VAL(RIGHT$(W$(STACK),4)):A=&6000:A$=$A:LCOLD=0
:AOLD=0
 6030 STACK=STACK-1:H$="LOAD C."+NAME$+" 6000":PROCh:NL=-1:GOTO3100
 6100 PROCf:CLS:IFER=0THEN6200
 6110 H$="LOAD ERROR 6000":PROCh
 6120 A=&6000:C%=ER:REPEAT:A$=$A:A=A+LENA$+1:C%=C%-1:UNTILC%=0
 6130 PRINT"ERROR - "A$:GOTO2000
 6200 IFR2D2<>0MNSA=R2D2
 7000 IFOUT$=""OUT$="OK"
 7005 IFGAME%=0ORCF%=9999THEN7100
 7010 FL%=0:SRCH%=3:GOSUB19000:IFL%THEN7510
 7020 SRCH%=4:GOSUB19000:IFL%THEN7500
 7030 TP$=OUT$:GOSUB18000:IFOUT$=""OUT$=TP$ELSEOUT$=TP$+" , "+OUT$
 7040 CLS:FL%=0:SRCH%=3:GOSUB19000:IFL%THEN7510
 7050 SRCH%=4:GOSUB19000:IFL%THEN7500
 7100 CLS:A$="":IFCHAT%H$="LOAD WTAB 6000":PROCh:H$="LOAD GETCOM 7000":PROCh:H$=
"LOAD CHAT 6800":PROCh
 7105 X%=0:Y%=1
 7110 IFY%>LENOUT$THEN7200
 7120 B$=MID$(OUT$,Y%,1):IFB$<>" "A$=A$+B$:Y%=Y%+1:GOTO7110
 7130 GOSUB7700:IFLENA$+X%<39PRINTA$" ";:X%=X%+LENA$+1:ELSEPRINT'A$" ";:X%=LENA$
+1
 7140 Y%=Y%+1:A$="":TIME=0:REPEATUNTILTIME>10:GOTO7110
 7200 GOSUB7700:IFA$<>""ANDLENA$+X%<39PRINTA$;ELSEPRINT'A$;
 7210 IFCF%<>9999THEN2000
 7220 PROCc:H$="FX229,0":PROCh:STOP
 7490 GOTO2000
 7500 A$="W029":GOTO7520
 7510 A$="W051"
 7520 OUT$="":PROCw:A$="W043":PROCw:A$="W050":PROCw
 7530 GAME%=0:GOTO7100
 7700 IFCHAT%=0RETURN ELSEA=&C00
 7710 FORX1=0TOLENA$-1:A?X1=ASC(MID$(A$,X1+1,1)):NEXT
 7720 ?&72=0:?&73=&C:?&70=LENA$:CALL&7167:B=(?&7A+?&7B*256):IFB>=60000RETURN
 7730 C=&6800+(B-1)*9:A=&C00:X1=0
 7740 B=C?X1:IFB<>0ANDX1<9A?X1=B+128:X1=X1+1:GOTO7740
 7750 A?X1=1:A?(X1+1)=0:CALL&722A:RETURN
 8000 VDU28,0,18,39,6:CLS:A=0:FORX=1TOOBNUM%:A$=SH$(X)
 8010 CL=144+FNX(X,3):SX=FNX(X,1):SY=FNX(X,2):SH=FNX(X,4)
 8030 CC=ASC(MID$(S$,CL-144,1))
 8040 IFSX+SY>0THEN8500
 8050 IFA=4THEN8540
 8060 A=A+1:PRINTTAB(0,14-A*3);:GOTO8505
 8500 PRINTTAB(6+(SX-1)*4,14-SY*3);
 8505 ONSH GOTO8510,8520,8530
 8510 VDUCL,255,255,255,10,8,8,8,8,CL,255,CC,255:GOTO8540
 8520 VDUCL,254,255,253,10,8,8,8,8,CL,239,CC,191:GOTO8540
 8530 VDUCL,224,255,176,10,8,8,8,8,CL,254,CC,253
 8540 NEXTX
 8550 FORX=0TO12:PRINTTAB(4,X);:VDU151,255:NEXT:PRINTTAB(0,0)
 8560 RETURN
 9000 DEFPROCa
 9002 PROCc:CALL&701F:B=IN?159:IN?159=13:A$=$IN:IN?159=B:A$=A$+CHR$B:PROCb:PROCd
 9005 IFRIGHT$(A$,1)=" "REPEAT:A$=LEFT$(A$,LENA$-1):UNTILRIGHT$(A$,1)<>" "
 9007 IFA$=""THEN9002
 9010 FORX=1TO50:W$(X)="":NEXT:W=1
 9020 FORX=1TOLENA$:B$=MID$(A$,X,1):IFB$<>" "THEN9030
 9022 W=W-(W$(W)<>""):GOTO9060
 9030 IFB$=","ORB$="?"W=W-(W$(W)<>""):W$(W)=B$:W=W+1:GOTO9060
 9050 W$(W)=W$(W)+B$
 9060 NEXTX:IFW$(W)=""W=W-1
 9070 ENDPROC
 9080 DEFPROCp:IFP2>900NT%=1:P2=P2-900:ELSENT%=0
 9085 P1=&7000:REPEAT:X$=$P1:P1=P1+LENX$+1:P2=P2-1:UNTILP2=0:IFNT%=1X$=LEFT$(X$,
1)+"NOT("+MID$(X$,2)+")"
 9090 ENDPROC
 9100 DEFPROCb:VDU23,1,0;0;0;0;:ENDPROC
 9110 DEFPROCc:VDU23,1,1;0;0;0;:ENDPROC
 9120 DEFPROCd:PRINTTAB(31,0)CHR$136"WORKING":ENDPROC
 9130 DEFPROCe:PRINTTAB(31,0)STRING$(8," "):ENDPROC
 9140 DEFFNA(Z1,Z2)=RIGHT$(STRING$(Z2,"0")+STR$(Z1),Z2)
 9150 DEFPROCf:VDU28,0,23,39,20:ENDPROC
 9160 DEFPROCg:VDU28,0,24,39,0:ENDPROC
 9180 DEFPROCz(X):X%=(X MOD8)+1:Y%=(X DIV8)+1:ENDPROC
 9200 DEFFNW(X%)=MID$(T$,(X%-1)*4+1,4)
 9210 DEFFNX(X%,Y%)=VAL(MID$(SH$(X%),Y%,1))
 9220 DEFFNB(X1%,Y1%)=&CB0+(Y1%-1)*8+(X1%-1)
 9230 DEFFNC(Z1%)=(?FNB(FNX(Z1%,1),FNX(Z1%,2)+1)<>0)
 9300 DEFPROCh:H=&C00:$H=H$:X%=0:Y%=&C:CALL&FFF7:ENDPROC
 9350 DEFPROCn:H$="LOAD WTAB 6000":PROCh
 9360 A$="W001":OUT$="":PROCw:WRDA$=OUT$:A$="W002":OUT$="":PROCw:WRDTHE$=OUT$
 9370 A$="W003":OUT$="":PROCw:WRDIS$=OUT$:A$="W033":OUT$="":PROCw:WRDIT$=OUT$:EN
DPROC
 9400 DEFPROCi:LOCALZ1%:Z1%=0:X1%=1:Y1%=1
 9410 Z1%=?FNB(X1%,Y1%):IFZ1%=0THEN9440
 9420 X1%=X1%+1:IFX1%<9THEN9410
 9430 X1%=1:Y1%=Y1%+1:IFY1%<5THEN9410
 9440 ENDPROC
 9450 DEFPROCj(Z1%):?FNB(FNX(Z1%,1),FNX(Z1%,2))=0:SH$(Z1%)="00"+MID$(SH$(Z1%),3)
:ENDPROC
 9460 DEFPROCk(X1%,Y1%,Z1%):?FNB(X1%,Y1%)=Z1%:SH$(Z1%)=STR$X1%+STR$Y1%+MID$(SH$(
Z1%),3):ENDPROC
 9500 DEFPROCm(M3%):LOCALM1%,M2%
 9510 M1%=M3%:IFFNX(M1%,2)=4THEN9540
 9520 M2%=?FNB(FNX(M1%,1),FNX(M1%,2)+1):IFM2%<>0PROCm(M2%)
 9540 PROCi:PROCj(M1%):PROCk(X1%,Y1%,M1%):ENDPROC
 9600 DEFPROCv:B$="":A=&715A:FORX=0TO5:B$=B$+CHR$(A?X EOR15):NEXT:W$(Y%)=B$:ENDP
ROC
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PROGRAM FILE

```
 9900 IFA$=""RETURN
 9905 H$="LOAD WTAB 6000":PROCh
 9910 PROCw:H$="LOAD C."+NAME$+" 6000":PROCh:RETURN
10000 TN=0:RETURN
10100 TN=TN+1:RETURN
10200 N(TN)=1:IFFNW(WP)="W002"N(TN)=2
10210 IFFNW(WP)="W033"N(TN)=3
10220 RETURN
10300 A$(TN)=T$(VAL(RIGHT$(A$,4))):RETURN
10400 N$(TN)=FNW(WP):RETURN
10500 P$(TN)=FNW(WP):RETURN
10600 FORX=1TOOBNUM%:N(X)=0:A$(X)="":N$(X)="":P$(X)="":NEXTX:RETURN
10910 LI%=1:RETURN
10920 LI%=0:RETURN
11000 Z1=ASC(LEFT$(T$(2),1)):IFRIGHT$(T$(2),1)=CHR$255THEN11025
11005 IFFNX(Z1,2)=4THEN11010
11006 Y1%=?FNB(FNX(Z1,1),FNX(Z1,2)+1):IFY1%<>0PROCm(Y1%)
11010 Z2=ASC(RIGHT$(T$(2),1)):IFFNX(Z1,1)<>0ORFNX(Z1,2)<>0THEN?FNB(FNX(Z1,1),FNX
(Z1,2))=0
11020 X2=FNX(Z2,1):Y2=FNX(Z2,2)
11025 X1=1:Y1=1
11030 P2=VAL(MID$(T$(2),3,3)):IFP2>900 ER=1:RETURN
11035 PROCp
11040 IF?FNB(X1,Y1)<>0THEN111100
11050 IFEVAL(MID$(X$,2))=0THEN11100
11060 PROCk(X1,Y1,Z1):GOSUB8000:PROCf:RETURN
11100 X1=X1+1:IFX1<9THEN11040
11110 X1=1:Y1=Y1+1:IFY1<5THEN11040
11120 ER=8:RETURN
11300 M4%=ASC(T$(2)):IFFNX(M4%,2)=4THEN11330
11310 Y1%=?FNB(FNX(M4%,1),FNX(M4%,2)+1)
11320 IFY1%<>0THENPROCm(Y1%)
11330 PROCj(M4%):GOSUB8000:PROCf:RETURN
11500 XX=ASC(RIGHT$(T$(2),1)):IFLEFT$(T$(2),4)="W018"A$="A"+FNA(FNX(X%,3),3):GOT
O11550
11510 Y%=FNX(X%,4):A$="A008":IFY%=2A$="A010"
11520 IFY%=3A$="A012"
11550 GOSUB9900:RETURN
12000 A$=WRDA$:IFN(1)=2A$=WRDTHE$
12010 IFN(1)=3OUT$=OUT$+WRDIT$+WRDIS$:RETURN
12020 OUT$=OUT$+A$:A$=A$(1):GOSUB9900:A$=N$(1):GOSUB9900:OUT$=OUT$+WRDIS$:RETURN
12400 CF%=0:T$(3)="":T$(4)=""
12405 P2=VAL(MID$(T$(2),2,3)):PROCp
12410 X=ASC(MID$(T$(2),5)):IFX=255X=0
12412 X2=FNX(X,1):Y2=FNX(X,2):C2=FNX(X,3):S2=FNX(X,4):P1=X:X=0
12415 FORZ%=1TOOBNUM%:IFLEFT$(SH$(Z%),2)="00"ORZ%=P1 THEN12440
12417 IFT$(3)<>""ANDINSTR(MID$(SH$(Z%),5),T$(3))<=0THEN12440
12418 IFT$(4)<>""ANDVAL(MID$(T$(4),2))<>FNX(Z%,4)THEN12440
12420 X1=FNX(Z%,1):Y1=FNX(Z%,2):C1=FNX(Z%,3):S1=FNX(Z%,4):IFEVAL(MID$(X$,2))=0TH
EN12440
12430 IFX>0ANDCF%=0OUT$=OUT$+", "
12435 X=X+1:IFLI%PRINTSTR$X;
12437 IFCF%=0GOSUB12500
12440 NEXTZ%:IFX=0A$="W055":PROCw
12450 IFCF%=0THEN12490
12460 OUT$="":IFX=0A$="W040"ELSEA$="V"+FNA(X,3)
12470 PROCw
12490 H$="LOAD C."+NAME$+" 6000":PROCh:RETURN
12500 IF?&6000<>65H$="LOAD WTAB 6000":PROCh
12505 IFLENOUT$>200RETURN
12510 C%=0:A$=MID$(SH$(Z%),3,2):X%=1:REPEAT:IFLEFT$(SH$(X%),2)="00"ORX%=Z%THEN12
530
12520 IFMID$(SH$(X%),3,2)=A$C%=1
12530 X%=X%+1:UNTILC%=10RX%>OBNUM%:A$=WRDA$:IFC%=0A$=WRDTHE$
12540 OUT$=OUT$+A$:A$="A"+FNA(FNX(Z%,3),3):PROCw
12550 A$="N"+FNA(FNX(Z%,4),3):PROCw
12560 RETURN
12600 DEFPROCw:IF?&6000<>65H$="LOAD WTAB 6000":PROCh
12605 C=0:A=&6800:REPEAT:B$="":FORX%=0TO3:B$=B$+CHR$(A?X%):NEXTX%:A=A+4:C=C+1:UN
TILB$=A$
12610 A=&6000:REPEAT:A$=$A:A=A+LENA$+1:C=C-1:UNTILC=0:OUT$=OUT$+A$+" ":ENDPROC
14000 CF%=1:GOTO12405
14100 GAME%=1:GOSUB15900:GOSUB15800:RETURN
14200 GAME%=0:RETURN
14300 CHAT%=0:RETURN
14350 F1=OPENIN("CHAT"):CLOSE#F1:IFF1=0RETURN:ELSECHAT%=1:RETURN
14400 IFV2%=1A$=A$+"A008A009"
14410 IFV2%=2A$=A$+"A010A011"
14420 IFV2%=3A$=A$+"A012"
14430 RETURN
15000 IFGAME%THENER=9:RETURN
15005 Z%=ASC(T$(2)):X%=VAL(RIGHT$(T$(2),3))
15010 IFX%<BSH$(Z%)=LEFT$(SH$(Z%),2)+STR$X%+MID$(SH$(Z%),4,1):GOTO15060
15020 IFX%=BORX%=9X%=1:GOTO15050
15030 IFX%=10ORX%=11X%=2:GOTO15050
15040 X%=3
15050 SH$(Z%)=LEFT$(SH$(Z%),3)+STR$X%
15060 A$="A"+FNA(VAL(MID$(SH$(Z%),3,1)),3):V2%=VAL(RIGHT$(SH$(Z%),1))
15070 GOSUB14400
15100 SH$(Z%)=SH$(Z%)+A$:GOSUB8000:PROCf:RETURN
15500 IFGAME%THENER=9:RETURN
15510 ONCF%GOTO15600,15700,15800
15600 F1=OPENOUT("M.BOARD"):IFF1=0RETURN
15610 FORX=1TOOBNUM%:PRINT#F1,SH$(X):NEXT:CLOSE#F1:RETURN
15700 F1=OPENIN("M.BOARD"):IFF1=0RETURN
15710 FORX=1TOOBNUM%:INPUT#F1,SH$(X):?FNB(FNX(X,1),FNX(X,2))=X:NEXT:CLOSE#F1:GOS
UB8000:PROCf:RETURN
15800 FORX=1TOOBNUM%:IFLEFT$(SH$(X),2)<>"00"PROCj(X)
15810 NEXT:GOSUB8000:PROCf:RETURN
15900 FORX=1TOOBNUM%:V1%=RND(3):SH$(X)=LEFT$(SH$(X),2)+STR$V1%+MID$(SH$(X),4,1)+
"A"+FNA(V1%,3)
15910 A$="":V2%=VAL(MID$(SH$(X),4,1)):GOSUB14400:SH$(X)=SH$(X)+A$:NEXT:RETURN
16000 Z1=ASC(LEFT$(T$(2),1)):Z2=ASC(RIGHT$(T$(2),1)):IFZ2=255Z2=0
16110 P2=VAL(MID$(T$(2),3,3)):PROCp
16120 X1=FNX(Z1,1):Y1=FNX(Z1,2):C1=FNX(Z1,3):S1=FNX(Z1,4)
16130 X2=FNX(Z2,1):Y2=FNX(Z2,2):C2=FNX(Z2,3):S2=FNX(Z2,4)
16140 A$="W038":IFEVAL(MID$(X$,2))=-1A$="W032"
16150 GOSUB9900:RETURN
17000 P$="":Y=TN:IFCF%=1ANDTN>2THENER=2:GOTO17230
17005 IFTN=1ANDN$(1)="N004"ANDCF%=0P$=CHR$255:GOTO17230
17007 IFN(1)=3P$=CHR$MNSA:GOTO17230
17010 NP$=""
17020 FORX=1TOOBNUM%:IF(LEFT$(SH$(X),2)="00"ANDCF%=0)OR(LEFT$(SH$(X),2)<>"00"AND
CF%=1)THEN17190
17030 IFINSTR("W015W016",N$(Y))>0 THEN17050
17040 IFVAL(RIGHT$(N$(Y),3))<>VAL(MID$(SH$(X),4,1))THEN17190
17050 C=0:IFA$(Y)=""THEN17090
17060 Z=1:REPEAT
17070 IFINSTR(MID$(SH$(X),5),MID$(A$(Y),(Z-1)*4+1,4))<=0C=1
17080 Z=Z+1:UNTILC=1ORZ>LEN(A$(Y))/4:IFC THEN17190
17090 IFP$(Y)=""NP$=NP$+CHR$X:GOTO17190
17120 P2=VAL(RIGHT$(P$(Y),3)):PROCp
17130 X1=FNX(X,1):Y1=FNX(X,2):C1=FNX(X,3):S1=FNX(X,4)
17140 C=0:FORZ=1TOLENP$:Z1=ASC(MID$(P$,Z,1)):IFZ1=X THEN17170
17150 X2=FNX(Z1,1):Y2=FNX(Z1,2):C2=FNX(Z1,3):S2=FNX(Z1,4)
```

PROGRAM FILE

```
17160 IFEVAL(MID$(X$,2))C=1
17170 NEXTZ
17180 IFC=1NP$=NP$+CHR$X
17190 NEXTX:IFN(Y)=2ANDLENNP$>1THENER=6:Y=0:GOTO17230
17200 P$=NP$:IFNP$=""ER=2:Y=0:GOTO17230
17210 Y=Y-1:IFY>0THEN17010
17220 IFN(1)=1ANDLENP$>1P$=MID$(P$,RND(LENP$),1)
17230 IFR2D2=0R2D2=ASCP$
17240 RETURN
18000 OUT$="":A$="W029":PROCw:A$="W043":PROCw:FL%=1:R%=0:B%=0:N%=0:OB1$="":SRCH%
=3
18010 GOSUB18500:IFN%>=4THEN18060
18020 FL%=1:R%=0:B%=0:N%=0:SRCH%=4
18030 GOSUB18500
18060 L1%=1
18065 IFLEFT$(SH$(L1%),2)="00"AND((FNX(L1%,4)=R%ANDSRCH%=4)OR(FNX(L1%,3)<>R%ANDS
RCH%=3))THENA$="C001":GOTO18200
18070 L1%=L1%+1:IFL1%<=OBNUM%THEN18065
18075 L1%=1
18080 X1%=FNX(L1%,1):Y1%=FNX(L1%,2):IF?FNB(X1%,Y1%)=0ORINSTR(OB1$,CHR$L1%)>0THEN
18100
18085 IFY1%=4THEN18095
18090 IF?FNB(X1%,Y1%+1)<>0OR(X1%=(B%MOD8)+1ANDY1%=B%DIV8)THEN18100
18095 IF(FNX(L1%,4)=R%ANDSRCH%=4)OR(FNX(L1%,3)<>R%ANDSRCH%=3)PROCj(L1%):A$="C013
":GOTO18200
18100 L1%=L1%+1:IFL1%<=OBNUM%THEN18080
18110 OUT$="":RETURN
18200 PROCw:PROCk((B%MOD8)+1,(B%DIV8)+1,L1%):Z%=L1%:GOSUB12500
18210 IF(B%DIV8)+1>1THENA$="W011":PROCw:Z%=?FNB((B%MOD8)+1,(B%DIV8)):GOSUB12500:
GOTO18230
18220 A$="W012":PROCw:A$="W002":PROCw:A$="N004":PROCw
18230 GOSUB8000:PROCf:RETURN
18500 PRINT"Err";:FORL2%=0TO31:PROCz(L2%):X2%=X%:Y2%=Y%:IF?FNB(X2%,Y2%)<>0OR(Y2%
>1AND?FNB(X2%,Y2%-1)=0)THEN18550
18510 PRINT"r";:?FNB(X2%,Y2%)=99
18530 GOSUB19000:IFQ%>NXB%=L2%:NX=Q%:R%=A%:OB1$=OB$:PRINT"!";
18540 ?FNB(X2%,Y2%)=0
18550 NEXTL2%:PRINT:RETURN
19000 L%=0:Q%=0:OB$="":IFFL%=0PRINT"Umm";
19010 FORL1%=0TO31:PROCz(L1%):X1%=X%:Y1%=Y%:IF?FNB(X1%,Y1%)=0OR?FNB(X1%,Y1%)=99T
HEN19030
19020 IFFL%=0PRINT"m";
19025 ATTR%=FNX(?FNB(X1%,Y1%),SRCH%):GOSUB19040
19030 NEXTL1%:IFFL%=0PRINT
19035 RETURN
19040 M%=0:FORD%=0TO4:X$="":IF(Y1%>1AND(D%>0ANDD%<4))OR(D%=4ANDX%>5)OR(D%=0ANDX%
<4)THEN19110
19050 XD%=(D%<2)-(D%>2):YD%=-(D%>0ANDD%<4):NUM%=1:XP%=X1%:YP%=Y1%:M%=0
19060 XP%=XP%+XD%:YP%=YP%+YD%:IFXP%>80RXP%<1ORYP%>4ORYP%<1THEN19090
19065 IF?FNB(XP%,YP%)=99M%=1:GOTO19080
19070 IFFNX(?FNB(XP%,YP%),SRCH%)<>ATTR%THEN19090
19080 X$=X$+CHR$(?FNB(XP%,YP%)):NUM%=NUM%+1:GOTO19060
19090 IFFL%=1ANDM%=1ANDNUM%>Q%THENQ%=NUM%:A%=ATTR%:OB$=X$
19100 IFNUM%>=4L%=L%+1
19110 NEXTD%:RETURN
>
```

```
1000 REM   ***************************
1010 REM   *          ALPHA          *
1020 REM   *                         *
1030 REM   *   EXPERIMENT IN A.I.    *
1040 REM   *                         *
1050 REM   *    BY MARK NEEDHAM      *
1060 REM   *                         *
1070 REM   *  BBC MICRO 32K OS 1.20  *
1080 REM   *                         *
1090 REM   *  PLUS 1 DISK DRIVE (0)  *
1100 REM   *                         *
1110 REM   *  SPECIAL TABLE CREATOR  *
1120 REM   ***************************
1130
1140 HIMEM=&6000:A=&6001:B=0:C=&7000
1150 READ A$,B$
1160 IFA$="***"THEN1240
1170 REPEAT
1180   PRINTA$TAB(20)B$
1190   $A=A$:A=A+LENA$+1
1200   $C=B$:C=C+LENB$+1
1210   B=B+1
1220   READ A$,B$
1230   UNTIL A$="***"
1240 ?&6000=B
1250 PRINT"PREPOSITION TABLES CREATED"
1260 *SAVE PREP 6000 6FFF
1270 *SAVE PREP1 7000 7BFF
1280 PRINT"WORDS  &6000 - "FNA(A)
1290 PRINT"TOKENS &7000 - "FNA(C)
1300
1310 REM    ERROR TABLE CREATOR
1320
1330 A=&6000
1340 READ A$
1350 IF A$="***" THEN 1420
1360 REPEAT
1370   PRINTA$
1380   $A=A$
1390   A=A+LENA$+1
1400   READ A$
1410   UNTIL A$="***"
1420 PRINT'"ERROR TABLE CREATED"
1430 *SAVE $.ERROR 6000 6FFF
1440 PRINT"ERRORS &6000 - "FNA(A)
1450
1460 REM    CREATE SPECIAL WORDS
1470
1480 A=&6000:B=&6800
1490 READ A$,B$
1500 IFA$="***" THEN 1610
1510 REPEAT
1520   PRINTA$TAB(20)B$
1530   $A=A$
1540   A=A+LENA$+1
1550   FORX%=0TO3
```


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PROGRAM FILE

```
1560   B?X%=ASC(MID$(B$,X%+1,1))
1570   NEXTX%
1580   B=B+4
1590   READ A$,B$
1600   UNTIL A$="***"
1610 ?A=0
1620 *SAVE $.WTAB 6000 6FFF
1630 PRINT'"WORD TABLE CREATED"
1640 PRINT"WORDS  &6000 - "FNA(A)
1650 PRINT"TOKENS &6800 - "FNA(B)
1660 GOTO3060
1670
1680 REM    TABLE OF PREPOSITIONS
1690
1700 REM TO THE LEFT OF
1710 DATA "W005W002W007W020",Y(X1<X2)
1720
1730 REM TO THE RIGHT OF
1740 DATA "W005W002W008W020",Y(X1>X2)
1750
1760 REM ON TOP OF
1770 DATA "W012W009W020",Y((X1=X2)AND(Y1=Y2+1))
1780 REM UNDERNEATH
1790 DATA "W013",Y(Y1<Y2)
1800
1810 REM BENEATH
1820 DATA "W014",Y(Y1<Y2)
1830
1840 REM UNDER
1850 DATA "W010",Y(Y1<Y2)
1860
1870 REM THE SAME COLOUR AS
1880 DATA "W002W024W018W025",N(C1=C2)
1890
1900 REM THE SAME SHAPE AS
1910 DATA "W002W024W017W025",N(S1=S2)
1920
1930 REM ON THE LEFT OF
1940 DATA "W012W002W007W020",Y(X1<X2)
1950
1960 REM ON THE RIGHT OF
1970 DATA "W012W002W008W020",Y(X1>X2)
1980
1990 REM OVER
2000 DATA "W011",Y(Y1>Y2)
2010
2020 REM ABOVE
2030 DATA "W026",Y(Y1>Y2)
2040
2050 REM NEXT TO
2060 DATA "W044W005",Y(ABS(Y1-Y2)<2ANDABS(X1-X2)<2)
2070
2080 REM NEAR TO
2090 DATA "W045W005",Y(ABS(Y1-Y2)<2ANDABS(X1-X2)<2)
2100
2110 REM NEAR
2120 DATA "W045",Y(ABS(Y1-Y2)<2ANDABS(X1-X2)<2)
2130
2140 REM CLOSE TO
2150 DATA "W046W005",Y(ABS(Y1-Y2)<2ANDABS(X1-X2)<2)
2160
2170 REM AWAY FROM
2180 DATA "W047W048",Y(ABS(Y1-Y2)>1ORABS(X1-X2)>1)
2190
2200 REM FAR FROM
2210 DATA "W049W048",Y(ABS(Y1-Y2)>1ORABS(X1-X2)>1)
2220
2230 REM ON
2240 DATA "W012",Y(X1=X1)
2250 DATA ***,***
2260
2270 REM    TABLE OF ERRORS
2280
2290 DATA Syntax of Sentence
2300 DATA Object Not Found
2310 DATA Out of Words
2320 DATA Unknown Command in Command List
2330 DATA End of Command Line
2340 DATA More Than One Object
2350 DATA Only One Unknown Word Allowed
2360 DATA Impossible
2370 DATA Not in The Game
2380 DATA ***
2390 DATA A,W001,AN,W001,THE,W002,IS,W003
2400 DATA ARE,W004,TO,W005,MANY,W006
2410 DATA LEFT,W007,RIGHT,W008,TOP,W009
2420 DATA UNDER,W010,OVER,W011,ON,W012
2430 DATA UNDERNEATH,W013,BENEATH,W014
2440 DATA OBJECT,W015,OBJECTS,W015,BLOCK,W016,BLOCKS,W016
2450 DATA SHAPE,W017,COLOUR,W018
2460 DATA WHICH,W019,OF,W020
2470 DATA ",",W021,AND,W022,?,W023,SAME,W024,AS,W025
2480 DATA ABOVE,W026,HELLO,W027,MY,W028,I,W029,NAME,W030,ALPHA,W031
2490 DATA COMPUTER,W031,YES,W032,IT,W033
2500 DATA PLEASE,W034,TELL,W035,ME,W036,BYE,W037
2510 DATA NO,W038,THERE,W039,NONE,W040,LIST,W041,GAME,W042
2520 DATA HAVE,W043,NEXT,W044,NEAR,W045,CLOSE,W046,AWAY,W047,FROM,W048,FAR,W049
2530 DATA WON,W050,YOU,W051,NOT,W052,OK,W053,TALK,W054,NOTHING,W055
2540
2550 REM  ***  COMMANDS  ***
2560
2570 DATA PUT,C001,REMOVE,C002
2580 DATA MOVE,C003,QUIT,C004,END,C005
2590 DATA EXIT,C006,STOP,C007
2600 DATA FIND,C008,MAKE,C009,ENABLE,C010,DISABLE,C011,PLAY,C012
2610 DATA MOVED,C013,SAVE,C014,LOAD,C015,CLEAR,C016
2620
2630 REM  ***  QUESTIONS  ***
2640
2650 DATA HOW,Q001,WHAT,Q002
2660
2670 REM  ***  NOUNS  ***
2680
2690 DATA CUBE,N001,CIRCLE,N002,TRIANGLE,N003
2700 DATA BOARD,N004,GRID,N004
2710 DATA CUBES,N001,CIRCLES,N002,TRIANGLES,N003
2720
2730 REM  ***  ADJECTIVES  ***
2740
2750 DATA RED,A001,GREEN,A002
2760 DATA YELLOW,A003,BLUE,A004,MAGENTA,A005
2770 DATA CYAN,A006,WHITE,A007
2780 DATA SQUARE,A008,CUBIC,A009
2790 DATA CIRCULAR,A010,ROUND,A011
```

PROGRAM FILE

```
2800 DATA TRIANGULAR,A012
2810
2820 REM  ***  VALUES  ***
2830
2840 DATA ONE,V001,TWO,V002,THREE,V003,FOUR,V004
2850 DATA FIVE,V005,SIX,V006,SEVEN,V007,EIGHT,V008
2860 DATA NINE,V009,TEN,V010,ELEVEN,V011,TWELVE,V012
2870 DATA THIRTEEN,V013,FOURTEEN,V014,FIFTEEN,V015
2880 DATA SIXTEEN,V016,SEVENTEEN,V017,EIGHTEEN,V018
2890 DATA NINETEEN,V019,TWENTY,V020
2900
2910 REM  ***  END OF LIST  ***
2920
2930 DATA ***,***
2940
2950 REM   DECIMAL - HEX CONVERTER
2960
2970 DEFFNA(X)
2980 HEX$=""
2990 FOR Y=3 TO 0 STEP -1
3000 H=X DIV 16^Y
3010 HEX$=HEX$+CHR$(H+48-7*(H>9))
3020 X=X-H*16^Y
3030 NEXT Y
3040 =HEX$
3050
3060 PRINT''"CLEARING MEMORY ";:FORX=&7000 TO &7BFF:?X=0:NEXT X:PRINT
3070 OSBYTE=&FFF4:OSWRCH=&FFEE
3080 PRINT "CREATING MACHINE CODE ";
3090 FORX%=0TO2STEP2:PRINT'"PASS "+STR$(X%-(X%=0));
3100 P%=&7000
3110  [OPT X%
3120 .POSCUR LDA #31       \ Position cursor
3130         JSR OSWRCH
3140         LDA &72       \ X Position
3150         JSR OSWRCH
3160         LDA &73       \ Y Position
3170         CLC
3180         ADC #1
3190         JSR OSWRCH
3200         RTS
3210 .CLRIN  LDY #0        \ Clear input area
3220         LDA #32
3230 .CLOOP  STA (&70),Y   \ &70 Pointer to Screen
3240         INY           \ Location
3250         CPY #160
3260         BNE CLOOP
3270         RTS
3280 .START  LDA #&7C      \ Start of input routine
3290         STA &71       \ Set up Pointer to Screen
3300         LDA #&28
3310         STA &70
3320         LDA #0        \ Set up X & Y Positions
3330         STA &72
3340         STA &73
3350         STA &74
3360         JSR POSCUR
3370 .CHARIN LDA #145      \ Wait for key press
3380         LDX #0
3390         JSR OSBYTE
3400         BCS CHARIN
3410         TYA
3420         CMP #128      \ Check less than 128
3430         BCC JP0
3440         CMP #144      \ Check less than 144
3450         BCC MOVCUR
3460 .JP0    CMP #13       \ Return ?
3470         BNE JP1
3480         RTS
3490 .JP1    CMP #127      \ Delete ?
3500         BNE JP2
3510         JMP DEL
3520 .JP2    CMP #32       \ Space Bar ?
3530         BEQ CHAROK
3540         CMP #ASC","
3550         BEQ CHAROK
3560         CMP #ASC"?"
3570         BEQ CHAROK
3580         CMP #65       \ Check that range is ok
3590         BCC CHARIN
3600         CMP #91       \  64< char <91
3610         BCC CHAROK
3620         CMP #97       \  96< char <123
3630         BCC CHARIN
3640         CMP #122
3650         BEQ JP3
3660         BCS CHARIN
3670 .JP3    AND #95       \ Convert lower to upper case
3680 .CHAROK JSR OSWRCH    \ Print character if ok
3690         INC &72       \ Move X pos one
3700         LDA &72
3710         CMP #40       \ Check for end of line
3720         BNE JP4
3730         LDA #0        \ Move to next line down
3740         STA &72
3750         INC &73
3760         LDA &73
3770         CMP #4        \ Check for bottom line
3780         BNE JP4
3790         LDA #0
3800         STA &73
3810 .JP4    JSR POSCUR
3820         JMP CHARIN
3830 .MOVCUR CMP #140      \ Check for cursor movement
3840         BEQ LFT
3850         CMP #141
3860         BEQ RGT       \ Cursor right
3870         CMP #142
3880         BEQ DWN       \ Cursor down
3890         CMP #143
3900         BEQ UP        \ Cursor up
3910         CMP #128
3920         BEQ CL        \ Clear input area (F0)
3930         CMP #136
3940         BEQ INS       \ Insert character (F8)
3950         JMP CHARIN    \ Key no good
3960 .UP     LDA &73       \ MOve cursor up
3970         BEQ UPDATE    \ No move if at top
3980         DEC &73
3990         JMP UPDATE
4000 .DWN    LDA &73       \ Move cursor down
4010         CMP #3
4020         BEQ UPDATE
4030         INC &73
4040         JMP UPDATE
```


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PROGRAM FILE

```
4050 .LFT     DEC &72        \ Move cursor left
4060          BPL UPDATE
4070          LDA #39
4080          STA &72
4090          LDA &73
4100          BNE UP         \ if at start then go back
4110          LDA #3         \ up one line
4120          STA &73
4130          JMP UPDATE
4140          JMP UP
4150 .RGT     INC &72        \ Move cursor right
4160          LDA &72
4170          CMP #40        \ if at end then go down
4180          BNE UPDATE
4190          LDA #0
4200          STA &72
4210          LDA &73
4220          CMP #3
4230          BNE DWN
4240          LDA #0
4250          STA &73
4260 .UPDATE  JSR POSCUR     \ Position Cursor
4270          JMP CHARIN
4280 .CL      JSR CLRIN      \ Clear input area
4290          JMP START
4300 .DEL     LDA #0         \ Move all characters to the left
4310          LDX &73        \ including character at cursor
4320          BEQ DEL1
4330 .DELOP   CLC
4340          ADC #40
4350          DEX
4360          BNE DELOP
4370 .DEL1    CLC
4380          ADC &72
4390          CMP #0
4400          BEQ UPDATE
4410          TAY
4420 .DEL2    LDA (&70),Y
4430          DEY
4440          STA (&70),Y
4450          INY
4460          INY
4470          CPY #160
4480          BNE DEL2
4490 .DELEND  LDY #159
4500          LDA #32
4510          STA (&70),Y
4520          JMP LFT
4530 .INS     LDA #0         \ Move all characters to the right
4540          LDX &73        \ Including character at cursor
4550          BEQ INS1
4560 .INSLOP  CLC            \ The last Character is lost
4570          ADC #40
4580          DEX
4590          BNE INSLOP
4600 .INS1    CLC
4610          ADC &72
4620          CMP #159
4630          BEQ UPDATE
4640          STA &74
4650          LDY #158
4660 .INS2    LDA (&70),Y
4670          INY
4680          STA (&70),Y
4690          DEY
4700          DEY
4710          CPY &74
4720          BNE INS2
4730          LDA (&70),Y
4740          INY
4750          STA (&70),Y
4760          DEY
4770          LDA #32
4780          STA (&70),Y
4790          JMP UPDATE
4800 .VER1    LDA &71
4810          TAY
4820          EOR &76
4830 .VERLOP  STA (&7F),Y
4840          DEY
4850          BPL VERLOP
4860          LDA &42
4870          LSR 23388
4880          LSR A
4890          EOR &FE4B,X
4900          STA &7F
4910          BNE VER1
4920          RTS
4930                         \ The next routine searches the word table
4940                         \ and returns the number of the word.
4950 .SRCHWD  LDA #0
4960          STA &7B
4970          LDA #&60       \ Set pointer to &6000
4980          STA &79
4990          LDA #0
5000          STA &7A
5010          STA &7B
5020 .FSTART  LDA &7B        \ Start of Search loop
5030          STA &74        \ remember current position
5040          LDA &79
5050          STA &75
5060          LDA &7A
5070          CLC            \ increment pointer
5080          ADC #1
5090          STA &7A
5100          BCC FJP1
5110          INC &7B
5120 .FJP1    LDA #0
5130          STA &71
5140          TAY
5150 .FJP2    LDA (&7B),Y    \ Get next letter
5160          CMP #13        \ End of word ?
5170          BEQ FJP3
5180          INC &71
5190          JSR INCPTR
5200          CLC
5210          BCC FJP2       \ Jump back
5220 .FJP3    LDA &71        \ Compare two words
5230          CMP &70
5240          BNE FJP4
5250          LDA &78
5260          STA &76
5270          LDA &79
5280          STA &77
5290          LDA &74
```

PROGRAM FILE

```
5300          STA &78
5310          LDA &75
5320          STA &79
5330          LDY &71
5340          DEY
5350 .FLOOP1  LDA (&78),Y
5360          CMP (&72),Y
5370          BNE TEST1
5380          DEY
5390          BPL FLOOP1
5400          RTS             \ Word found
5410 .TEST1   LDY &70
5420          TYA
5430          EOR #&FF
5440          CMP #&FB
5450          BNE SNOK
5460          DEY
5470 .TEST2   LDA (&72),Y
5480          EOR #&F
5490          CMP TAB1,Y
5500          BNE SNOK
5510          DEY
5520          BPL TEST2
5530          LDA #&F0
5540          STA &7A
5550          STA &7B
5560          RTS
5570 .SNOK    LDA &76         \ Words not the same
5580          STA &78
5590          LDA &77
5600          STA &79
5610 .FJP4    LDY #0
5620          JSR INCPTR
5630          LDA (&7B),Y     \ Load next letter
5640          BNE FSTART      \ Zero marks end of list
5650          LDA #&FF        \ return &FFFF as word not found
5660          STA &7A
5670          STA &7B
5680          RTS
5690 .INCPTR  LDA &78         \ Increment pointer routine.
5700          CLC
5710          ADC #1
5720          STA &78
5730          BCC FINC1
5740          INC &79
5750 .FINC1   RTS
5760 .TAB1    EQUB &40
5770          EQUB &5D
5780          EQUB &4E
5790          EQUB &44
5800          EQUB &5F
5810          EQUB &4E
5820          EQUB &5C
5830 .TALK    LDA #0          \ Send a phoneme to the Box
5840          STA &FE62
5850 .TALK1   LDA &FE60
5860          AND #1
5870          BNE TALK1
5880          LDA #255
5890          STA &FE62
5900          STY &FE60
5910          LDA #192
5920          STA &FE6C
5930          LDA #255
5940          STA &FE6C
5950          LDA #0
5960          STA &FE62
5970          RTS
5980 .WORD    LDX #0          \ Send a whole word , a phoneme
5990 .WORD1   LDA &C00,X      \ at a time
6000          BNE WORD2       \ The word at &C00 must end with 04 00
6010          RTS
6020 .WORD2   TAY
6030          JSR TALK
6040          INX
6050          JMP WORD1
6060 ]
6070 NEXT
6080 REM   ADD UP ALL BYTES IN CODE
6090
6100 A=0:FOR X=&7000 TO P%-1
6110 A=A+?X
6120 NEXT X
6130 IF A<>74740 PRINT'"ERROR DETECTED - PLEASE CHECK":STOP
6140 *SAVE $.GETCOM 7000 7C00
6150 PRINT'"MACHINE CODE SAVED"
6160
6170
6180 REM   IF YOU HAVE NO CHATTERBOX PUT AN 'END' STATEMENT HERE
6190 REM   AND IGNORE THE REST OF THIS LISTING
6200
6210
6220 A%=&6800:PRINT'"CREATING CHATTERBOX WORDS";
6230 READA$:IFA$="**" THEN 6280
6240 REPEAT:IFINT(LENA$/2)<>LENA$/2THENPRINT'"ERROR - "A$:STOP
6250   A$=LEFT$(A$+STRING$(18,"0"),18)
6260   FORX=0TO8:A%?X=VAL(MID$(A$,X*2+1,2)):NEXT
6270   READA$:A%=A%+9:UNTILA$="**"
6280 *SAVE CHAT 6800 6FFF
6290 PRINT'"WORDS SAVED":END
6300
6310 DATA 20,2444,2951,1243,59,1331
6320 DATA 11074419,45074013,140617
6330 DATA 132409,15113352,533552
6340 DATA 2411,15113352111918
6350 DATA 2819111918,246336074217
6360 DATA 24633607421755,28452442
6370 DATA 2845244255,372009
6380 DATA 4224622323,481250,2440
6390 DATA 00,261133,00,552016,2643
6400 DATA 2463151535,27264553,1606,06
6410 DATA 112016,26624026
6420 DATA 4224160931752,490755,1217
6430 DATA 09451943,13070745,1619
6440 DATA 2806,5653,5447,562311
6450 DATA 45125517,362016,572640
6460 DATA 1107425517,1160,42455355
6470 DATA 154620,40392416,4059,461544
6480 DATA 4931,562417,530820,135808
6490 DATA 56291211
6500
6510 REM   ***  COMMANDS
6520
6530 DATA 091517,1407162240,162240
6540 DATA 08461217,074421,0742551217
```


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6550 DATA 55172409,40061133,162042
6560 DATA 0711202862,33125520862
6570 DATA 094520,16224033,552040
6580 DATA 455333,424560
6590 REM  ***  QUESTIONS
6600 DATA 572648,462317
6610
6620 REM  ***  NAMES
6630
6640 DATA 08252263
6650 DATA 55524262,17390626443662
6660 DATA 28232333,36391233
6670 DATA 0849222855,5552426255
6680 DATA 1739062644366255
6690
6700 REM  ***  ADJECTIVES
6710
6720 DATA 140733,36391911,49074553
6730 DATA 286231,162636071117 26
6740 DATA 55062611,480617,55084647
6750 DATA 4231631208,555242496259
6760 DATA 39324433,17390626443649 6259
6770 DATA 462411,5531,183919,402323
6780 DATA 400635,55124255,5507350711
6790 DATA 2017,110611,13070711
6800 DATA 196207350711,1348076235
6810 DATA 2952131911,4058131911
6820 DATA 401240131911,55124255131911
6830 DATA 5507350711131911,20171911
6840 DATA 110611171911,134607111319
6850 DATA **
6860
6870 REM   SAVE"TMAKER"
>



1000 REM   ***************************
1010 REM   *          ALPHA          *
1020 REM   *                         *
1030 REM   *   EXPERIMENT IN A.I.    *
1040 REM   *                         *
1050 REM   *    BY MARK NEEDHAM      *
1060 REM   *                         *
1070 REM   *  BBC MICRO 32K OS 1.20  *
1080 REM   *                         *
1090 REM   *  PLUS 1 DISK DRIVE (0)  *
1100 REM   *                         *
1110 REM   *  COMMAND LIST CREATOR   *
1120 REM   ***************************
1130
1140 MODE7:HIMEM=&6000
1150 PRINT"CREATING COMMAND LIST";:GOSUB1230
1160 *SAVE C.COMMAND 6000 6FFF
1170 PRINT'"CREATING NOUN LIST";:GOSUB1230
1180 *SAVE C.NOUN 6000 6FFF
1190 PRINT'"CREATING UTILITY LIST";:GOSUB1230
1200 *SAVE C.IOLIST 6000 6FFF
1210 END
1220
1230 A=&6000:READ A$
1240 IF A$="***" THEN 1350
1250 REPEAT
1260   IF LENA$>25 THEN A$=LEFT$(A$,25)
1270   REPEAT
1280     B=INSTR(A$," ")
1290     IF B>0 THEN A$=LEFT$(A$,B-1)+MID$(A$,B+1)
1300     UNTIL B<=0
1310   $A=A$
1320   A=A+LENA$+1
1330   READ A$
1340   UNTIL A$="***"
1350 PRINT'"LIST CREATED"
1360 PRINT"SIZE : &6000 - &"+FNA(A)
1370 IF A>&6FFF THEN PRINT"WARNING DATA LOST - USE TWO FILES"
1380 RETURN
1390 DEFFNA(X)
1400 HEX$=""
1410 FOR Y=3 TO 0 STEP -1
1420 H=X DIV 16^Y
1430 HEX$=HEX$+CHR$(H+48-7*(H>9))
1440 X=X-H*16^Y
1450 NEXT Y
1460 =HEX$
1470 REM ************************************************************************
1480 REM     THE MAIN COMMAND LIST.  (COMMAND)
1490 REM ************************************************************************
1500 DATA 0010 TEST W027 NEXT 0150   ' Hello
1510 DATA 0020 INCW 0100
1520 DATA 0030 TEST W031 NEXT 0050   ' Alpha / Computer
1530 DATA 0040 INCW 0100
1540 DATA 0050 TEST W021 NEXT 0070   ' Test for a comma
1550 DATA 0060 INCW 0800
1560 DATA 0070 JUMP 0200
1570 DATA 0100 TALK W027             ' Say "Hello"
1580 DATA 0110 TALK 0009             ' Say Users Name
1590 DATA 0120 EXIT
1600 DATA 0130 TALK W032             ' Say "Yes"
1610 DATA 0140 EXIT
1620 DATA 0150 TEST W031 NEXT 0200   ' Alpha / Computer
1630 DATA 0160 INCW 0130
1640 DATA 0170 TEST W021 NEXT 0200   ' Test for a comma
1650 DATA 0180 INCW 0800
1660 DATA 0200 TEST U??? NEXT 0205   ' Test for an Unknown word
1670 DATA 0201 INCW 0260             ' If nothing after it
1680 DATA 0202 JUMP 0900             ' must be users name
1690 DATA 0205 TEST W028 NEXT 0300   ' My
1700 DATA 0210 INCW 0800
1710 DATA 0220 TEST W030 NEXT 0900   ' Name
1720 DATA 0230 INCW 0800
1730 DATA 0240 TEST W003 NEXT 0900   ' Is
1740 DATA 0250 INCW 0800
1750 DATA 0255 TEST U??? NEXT 0900   ' Check for Unknown word
1760 DATA 0260 NULL 0009
1770 DATA 0270 STR+ 0009             ' Store name in T$(9)
1780 DATA 0280 JUMP 0100             ' Say "Hello"
1790 DATA 0300 TEST W034 NEXT 0320   ' Please
1800 DATA 0310 INCW 0800
1810 DATA 0320 TEST C??? 1000 NEXT   ' Check for any command
```

PROGRAM FILE

```
1820 DATA 0325 TEST W037 1000 NEXT   ' or Bye - and jump to process command
1830 DATA 0330 TEST W035 NEXT 0370   ' Tell
1840 DATA 0340 INCW 0800
1850 DATA 0350 TEST W036 NEXT 0380   ' Me
1860 DATA 0360 INCW 0800
1870 DATA 0370 TEST Q??? 5000 NEXT   ' Test for any question
1880 DATA 0380 TEST W003 5000 NEXT   ' or Is - and jump to process question
1890 DATA 0390 ERR= 0001             ' Syntax Error
1900 DATA 0400 STOP
1910 DATA 0800 ERR= 0003             ' Out of Words
1920 DATA 0810 STOP
1930 DATA 0900 ERR= 0001             ' Syntax Error
1940 DATA 0910 STOP
1950 DATA 1000 TEST C001 1200 NEXT   ' Put
1960 DATA 1010 TEST C002 1400 NEXT   ' Remove
1970 DATA 1020 TEST C003 1240 NEXT   ' Move
1980 DATA 1030 TEST C004 1900 NEXT   ' Quit
1990 DATA 1040 TEST C005 1900 NEXT   ' End          These are the commands
2000 DATA 1050 TEST C006 1900 NEXT   ' Exit
2010 DATA 1060 TEST C007 1900 NEXT   ' Stop         that Alpha Understands
2020 DATA 1070 TEST W037 1960 NEXT   ' Bye
2030 DATA 1080 TEST C008 1600 NEXT   ' Find
2040 DATA 1090 TEST C009 1700 NEXT   ' Make
2050 DATA 1100 TEST C010 1800 NEXT   ' Enable
2060 DATA 1110 TEST C011 1850 NEXT   ' Disable
2070 DATA 1120 TEST C012 2000 NEXT   ' Play
2080 DATA 1130 TEST C014 7000 NEXT   ' Save
2090 DATA 1140 TEST C015 7000 NEXT   ' Load
2100 DATA 1150 TEST C016 7000 NEXT   ' Clear
2110 DATA 1180 ERR=0
2120 DATA 1190 STOP
2130 DATA 1200 INCW 0800             ' Process Put Sentence
2140 DATA 1210 NULL 0002             ' Clear T$(2)
2150 DATA 1220 CF%= 0001
2160 DATA 1230 JUMP 1260
2170 DATA 1240 NULL 0002             ' Entry Point for Move command
2180 DATA 1250 INCW 0800
2190 DATA 1260 SUBR NOUN             ' Process Noun Subroutine
2200 DATA 1270 FLAG STOP
2210 DATA 1280 ADDN 0002             ' Store Noun number in T$(2)
2220 DATA 1290 CF%= 0000
2230 DATA 1300 TEST P??? NEXT 0900   ' Test for any preposition
2240 DATA 1310 STR+ 0002             ' Add it to T$(2)
2250 DATA 1320 INCW 0800
2260 DATA 1330 SUBR NOUN             ' Get second Noun
2270 DATA 1340 FLAG STOP
2280 DATA 1350 ADDN 0002             ' Store Noun number in T$(2)
2290 DATA 1360 PROC 11000            ' Perform BASIC Put / Move
2300 DATA 1370 EXIT
2310 DATA 1400 INCW 0800             ' Process Remove Command
2320 DATA 1410 NULL 0002
2330 DATA 1420 SUBR NOUN             ' Get Noun
2340 DATA 1430 FLAG STOP
2350 DATA 1440 ADDN 0002             ' Add Noun to T$(2)
2360 DATA 1450 PROC 11300            ' Remove object in BASIC
2370 DATA 1460 EXIT
2380 DATA 1600 INCW 0800             ' Perform Find
2390 DATA 1610 SUBR NOUN             ' Get Noun
2400 DATA 1620 FLAG STOP             ' Object is now Known as 'IT'
2410 DATA 1630 EXIT
2420 DATA 1700 INCW 0800             ' Make Command
2430 DATA 1710 NULL 0002
2440 DATA 1720 SUBR NOUN             ' Get Noun
2450 DATA 1730 FLAG STOP
2460 DATA 1730 ADDN 0002
2470 DATA 1750 TEST A??? NEXT 0900   ' Find any Adjective
2480 DATA 1760 STR+ 0002             ' and add it to T$(2)
2490 DATA 1770 PROC 15000            ' Perform in BASIC
2500 DATA 1780 EXIT
2510 DATA 1800 INCW 0800             ' Enable List
2520 DATA 1810 TEST W002 NEXT 1820
2530 DATA 1815 INCW 0800
2540 DATA 1820 TEST W041 NEXT 1835
2550 DATA 1825 PROC 10910.
2560 DATA 1830 EXIT
2570 DATA 1835 TEST W054 NEXT 0900
2580 DATA 1836 PROC 14350
2590 DATA 1837 EXIT
2600 DATA 1850 INCW 0800             ' Disable the List
2610 DATA 1860 TEST W002 NEXT 1870
2620 DATA 1865 INCW 0800
2630 DATA 1870 TEST W041 NEXT 1885
2640 DATA 1875 PROC 10920
2650 DATA 1880 EXIT
2660 DATA 1885 TEST W054 NEXT 0900
2670 DATA 1887 PROC 14300
2680 DATA 1888 EXIT
2690 DATA 1900 INCW 1960             ' End / Stop / Quit / Exit
2700 DATA 1910 TEST W002 NEXT 1920   ' Check for THE
2710 DATA 1915 INCW 0800
2720 DATA 1920 TEST W042 NEXT 1930   ' Check for GAME
2730 DATA 1925 PROC 14200            ' Stop the Game
2740 DATA 1927 EXIT
2750 DATA 1930 TEST W031 NEXT 0800
2760 DATA 1960 CF%= 9999             ' Bye - Bye
2770 DATA 1970 TALK W037             ' Say BYE
2780 DATA 1975 TALK 0900             ' Say Users name
2790 DATA 1980 EXIT
2800 DATA 2000 INCW 0800             ' Play Command
2810 DATA 2010 TEST W002 NEXT 2020
2820 DATA 2015 INCW 0800
2830 DATA 2020 TEST W042 NEXT 0900
2840 DATA 2030 PROC 14100            ' Start the game in BASIC
2850 DATA 2040 EXIT
2860 DATA 5000 TEST 0001 5200 NEXT   ' How          These are the questions
2870 DATA 5010 TEST 0002 5400 NEXT   ' What         that Alpha knows
2880 DATA 5020 TEST W003 6000 NEXT   ' Is question
2890 DATA 5090 STOP
2900 DATA 5200 INCW 0800             ' How question
2910 DATA 5205 TEST W006 NEXT 0900   ' Many
2920 DATA 5210 INCW 0800
2930 DATA 5215 NULL 0002             '
2940 DATA 5220 NULL 0003             ' Clear out T$(2..4)
2950 DATA 5225 NULL 0004             '
2960 DATA 5230 TEST A??? NEXT 5245   ' Check for an Adjective
2970 DATA 5235 STR+ 0003             ' and add it to T$(3)
2980 DATA 5240 INCW 0800
2990 DATA 5245 TEST N??? NEXT 5265   ' Check for a Name
3000 DATA 5250 STR+ 0004             ' and add it to T$(4)
3010 DATA 5255 INCW 0800
3020 DATA 5260 JUMP 5285
3030 DATA 5265 TEST W015 5280 NEXT   ' Check for OBJECT or BLOCK
3040 DATA 5270 TEST W016 5280 NEXT
3050 DATA 5275 JUMP 0900
```


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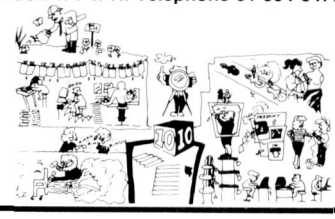

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PROGRAM FILE

```
3060 DATA 5280 INCW 0800
3070 DATA 5285 TEST W004 NEXT 0900   ' Are
3080 DATA 5290 INCW 0800
3090 DATA 5295 TEST W039 NEXT 5298   ' There
3100 DATA 5296 INCW 0800
3110 DATA 5298 TEST P??? NEXT 0900   ' Check for any Preposition
3120 DATA 5300 STR+ 0002
3130 DATA 5305 INCW 0800
3140 DATA 5310 SUBR NOUN             ' Get Noun
3150 DATA 5315 FLAG STOP
3160 DATA 5320 ADDN 0002             ' and add it to T$(2)
3170 DATA 5325 PROC 14000            ' Perform Count in BASIC
3180 DATA 5330 EXIT
3190 DATA 5400 INCW 0800             ' Perform What Command
3200 DATA 5410 NULL 0002
3210 DATA 5420 TEST W018 NEXT 5460   ' Check for COLOUR
3220 DATA 5430 STR+ 0002
3230 DATA 5440 INCW 0800
3240 DATA 5450 JUMP 5490
3250 DATA 5460 TEST W017 NEXT 5700   ' Check for SHAPE
3260 DATA 5470 STR+ 0002
3270 DATA 5480 INCW 0800
3280 DATA 5490 TEST W003 NEXT 0900   ' Check for IS
3290 DATA 5500 INCW 0800
3300 DATA 5510 SUBR NOUN             ' Get Noun
3310 DATA 5520 FLAG STOP
3320 DATA 5530 ADDN 0002             ' And add it to T$(2)
3330 DATA 5540 PROC 12000            ' Put Object in Words
3340 DATA 5550 PROC 11500            ' Get Attribute of Object
3350 DATA 5560 EXIT
3360 DATA 5700 TEST W015 5710 NEXT   ' Check for OBJECT
3370 DATA 5705 TEST W016 NEXT 5800   ' or BLOCK
3380 DATA 5710 INCW 0800
3390 DATA 5720 TEST W004 NEXT 0900   ' Are
3400 DATA 5730 INCW 0800
3410 DATA 5740 JUMP 5820
3420 DATA 5800 TEST W003 NEXT 0900   ' Is
3430 DATA 5810 INCW 0800
3440 DATA 5820 TEST W039 NEXT 5828   ' There
3450 DATA 5825 INCW 0800
3460 DATA 5828 TEST P??? NEXT 0900   ' Check for any Preposition
3470 DATA 5830 STR+ 0002
3480 DATA 5840 INCW 0800
3490 DATA 5850 SUBR NOUN             ' Get Noun
3500 DATA 5860 FLAG STOP
3510 DATA 5870 ADDN 0002
3520 DATA 5880 PROC 12400            ' Perform What in BASIC
3530 DATA 5890 EXIT
3540 DATA 6000 INCW 0800             ' IS Question
3550 DATA 6010 NULL 0002
3560 DATA 6020 TEST W039 NEXT 6025   ' There
3570 DATA 6022 INCW 0800
3580 DATA 6025 SUBR NOUN             ' Get Noun
3590 DATA 6030 FLAG STOP
3600 DATA 6040 ADDN 0002
3610 DATA 6050 TEST P??? NEXT 0900   ' Check for any Preposition
3620 DATA 6060 STR+ 0002
3630 DATA 6070 INCW 0800
3640 DATA 6080 SUBR NOUN             ' Get Noun
3650 DATA 6090 FLAG STOP
3660 DATA 6100 ADDN 0002
3670 DATA 6110 PROC 16000            ' Perform IS in BASIC
3680 DATA 6120 EXIT
3690 DATA 7000 LOAD IOLIST           ' Load IOLIST to Process SAVE /LOAD /CLEAR
3700 DATA ***
3710 REM ************************************************************************
3720 REM   LIST TO CHECK FOR AN OBJECT AND CALL ROUTINE AT 17000
3730 REM ************************************************************************
3740 DATA 0005 PROC 10000            ' Set number of objects to 0
3750 DATA 0008 PROC 10600            ' Clear out all object info
3760 DATA 0010 TEST W001 0025 NEXT   ' Test for A or THE
3770 DATA 0015 TEST W002 0025 NEXT
3780 DATA 0018 TEST W033 0025 NEXT   ' Test for IT
3790 DATA 0020 JUMP 0300
3800 DATA 0025 PROC 10100            ' Increment object number
3810 DATA 0026 PROC 10200            ' Save Object type A/THE/IT
3820 DATA 0027 TEST W033 0190 NEXT
3830 DATA 0028 NULL 0001             ' Clear T$(1)
3840 DATA 0030 INCW 0400
3850 DATA 0035 TEST A??? NEXT 0095   ' Test for adjective
3860 DATA 0040 STR+ 0001             ' Add adjective to T$(1)
3870 DATA 0045 INCW 0400
3880 DATA 0050 TEST W021 0070 NEXT   ' Test for comma or AND
3890 DATA 0055 TEST W022 NEXT 0090
3900 DATA 0060 INCW 0400
3910 DATA 0065 TEST A??? 0040 0300   ' Test for adjective
3920 DATA 0070 INCW 0400
3930 DATA 0075 TEST W022 NEXT 0085   ' Test for AND
3940 DATA 0080 INCW 0400
3950 DATA 0085 TEST A??? 0040 0300   ' Test for adjective
3960 DATA 0090 PROC 10300 0001
3970 DATA 0095 TEST W015 0110 NEXT   ' Test for BLOCK or OBJECT
3980 DATA 0098 TEST W016 0110 NEXT
3990 DATA 0100 TEST N??? NEXT 0300   ' Test for name
4000 DATA 0110 PROC 10400            ' Store object name
4010 DATA 0115 INCW 0200
4020 DATA 0120 TEST W019 NEXT 0200   ' WHICH
4030 DATA 0125 INCW 0400
4040 DATA 0130 TEST W003 NEXT 0300   ' IS
4050 DATA 0135 INCW 0400
4060 DATA 0140 TEST P??? NEXT 0300   ' Test for any preposition
4070 DATA 0150 PROC 10500            ' and store it
4080 DATA 0155 INCW 0400
4090 DATA 0160 JUMP 0010
4100 DATA 0190 INCW NEXT
4110 DATA 0200 PROC 17000            ' Find object in BASIC
4120 DATA 0205 FLAG STOP
4130 DATA 0210 EXIT
4140 DATA 0300 ERR= 0001             ' Syntax error
4150 DATA 0310 STOP
4160 DATA 0400 ERR= 0003             ' Out of words
4170 DATA 0410 STOP
4180 DATA ***
4190 REM ************************************************************************
4200 REM   LIST TO HANDLE SAVE / LOAD / CLEAR .
4210 REM ************************************************************************
4220 DATA 0010 TEST C014 0050 NEXT   ' Test for SAVE
4230 DATA 0020 TEST C015 0070 NEXT   ' Test for LOAD
4240 DATA 0030 TEST C016 0090 NEXT   ' Test for CLEAR
4250 DATA 0040 EXIT
4260 DATA 0050 CF%= 0001             ' Set Save Flag
4270 DATA 0060 JUMP 0100
4280 DATA 0070 CF%= 0002             ' Set Load Flag
4290 DATA 0080 JUMP 0100
4300 DATA 0090 CF%= 0003             ' Set Clear Flag
```

PROGRAM FILE

```
4310 DATA 0100 INCW 0140
4320 DATA 0110 TEST W002 NEXT 0130   ' Test for THE
4330 DATA 0120 INCW 0200
4340 DATA 0130 TEST N004 NEXT 0200   ' Test for BOARD or GRID
4350 DATA 0140 PROC 15500            ' Jump to BASIC routine
4360 DATA 0150 EXIT
4370 DATA 0200 ERR= 0001             ' Syntax Error
4380 DATA 0210 STOP
4390 DATA ***
4400
4410 REM   SAVE "SETUP"
>
```

Commodore 64 Logic Emulator

by B Candler

This program will be of great value to anyone who likes to experiment with logic circuits, and also should be useful for teaching purposes.

The user may enter a circuit consisting of gates and latches into the computer, to see what it does (or to see if it works as planned!). The concept of a logic emulator is not new, but this program is as far as I know unique in that the 'circuit' in the computer's memory may actually be connected to the outside world via the user port. For example, you may design a burglar alarm and connect it to the sensors which you are going to use. Changes in the circuit are easily done — without touching a soldering iron, of course — and the circuit may be saved to disk or tape for future reference.

The procedure to use this program is as follows:

1) Design your circuit on paper. You may use AND, NAND, OR, NOR and XOR gates (all may have one to eight inputs, except XOR), plus inverters, and D flip-flops which have a positive edge-triggered clock input and negative edge-triggered set/reset inputs. If you need other units (shift registers, counters) then these are easily built up from the basic circuit elements.

2) Number each gate or flip-flop (sequentially from one) and give each point in the circuit a number. The circuit points are numbered 0-4095; points 0-229 are displayed on the screen, and points 0-9 may be set to 0 or 1 under keyboard control.

3) Enter the circuit into the computer, using option 1 from the main menu. If you wish to tie an input to + or −, type '+' or '+VE', or '−' or '−VE' or 'GND' as appropriate when asked for an input point. If you wish to leave an output unconnected, type 'NC'.

4) To 'run' the circuit, use option 2. If you wish to connect the user port to your circuit, type a number from 0 to 7 (according to which bit of the user port you are interested in), followed by 'O' or 'I' (for output or input), and then the number of the circuit point which you wish to connect the user port to, then RETURN. Type 'S' when you are ready to start execution.

5) Circuit points 0-9 may be set to a '0' value using the top row of number keys (1 to 0), or set to a '1' value using the keys from Q to P. All other circuit points will be automatically updated, using the circuit data you have entered. The logic states of point 0-229, plus the user port, are continuously displayed as a table onscreen.

6) To stop, press F7. Pressing 'M' will now take you to the main menu, where you may edit, save, load, list or clear the circuit.

Note that the circuit data is *not* lost when the program is stopped and re-run, or even when other programs are loaded.

As stated, there are 4096 circuit points and there is 12k for storage of gates (each gate uses three bytes plus two bytes per input, or 13 bytes total for a D flip-flop) so huge circuits are possible, you could try designing your own computer using discrete logic!

```
5 IFFL=1THEN1350
10 IFPEEK(56)>80THEN          POKE56,80:CLR:GOSUB9500:goSuB 9###
20 DATA A5,C5,C9,03,D0,01,60,AD,01,DD,85,FB,A2,00,BD,E0,2225
21 DATA 5F,85,FC,BD,E1,5F,85,FD,A9,00,A8,46,FB,EA,90,02,2413
22 DATA A9,01,85,02,B1,FC,0A,29,03,85,02,91,FC,E8,E8,E0,1880
23 DATA 10,D0,DB,A2,00,86,FB,BD,F0,5F,85,FC,BD,F1,5F,85,2557
24 DATA FD,A0,00,B1,FC,18,F0,01,38,66,FB,E8,E8,E0,10,D0,2428
25 DATA E6,A5,FB,8D,01,DD,A5,C5,A2,00,DD,30,51,F0,17,E8,2378
26 DATA E0,14,D0,F6,F0,2E,31,51,32,57,33,45,34,52,35,54,1642
27 DATA 36,59,37,55,38,49,8A,4A,EA,85,FC,A9,60,85,FD,A0,2054
28 DATA 00,8A,A2,00,4A,90,01,E8,0A,85,02,B1,FC,0A,29,03,1507
29 DATA 85,02,B1,FC,A9,00,85,FD,A9,70,85,FE,A0,00,B1,FD,2217
30 DATA 29,07,D0,03,4C,44,51,85,02,B1,FD,4A,4A,4A,29,07,1319
31 DATA AA,E8,86,65,B1,FD,0A,A9,00,2A,85,64,A5,02,C9,07,1896
32 DATA D0,03,4C,A5,51,A2,00,C9,03,B0,01,E8,86,63,A0,01,1702
33 DATA B1,FD,85,61,C8,B1,FD,85,62,C8,B1,FD,85,FB,C8,B1,2912
34 DATA FD,85,FC,C8,A2,00,A1,FB,29,01,A6,02,CA,48,8A,4A,2108
35 DATA AA,68,E8,01,F0,07,E0,02,F0,06,25,63,2C,05,63,2C,1546
36 DATA 45,63,85,63,C6,65,D0,D2,A5,02,4A,B0,06,A5,63,49,1877
37 DATA 01,85,63,84,FB,A5,FD,18,65,FB,85,FD,A5,FE,69,00,2320
38 DATA 85,FE,A0,00,B1,61,0A,29,03,85,63,91,61,4C,9E,50,1535
39 DATA 38,3E,3B,09,08,0E,0B,11,10,16,13,19,18,1E,1B,21,432
40 DATA 20,26,23,29,A9,00,85,FB,A9,80,85,FC,A9,65,85,FD,2005
41 DATA A9,04,85,FE,A9,17,85,02,A9,0A,85,65,A0,00,B1,FB,1888
42 DATA 29,01,09,30,91,FD,E8,FB,D0,02,E6,FC,A9,02,A4,65,2106
43 DATA C0,01,D0,02,A9,16,18,65,FD,85,FD,A5,FE,69,00,85,2015
44 DATA FE,C6,65,D0,D7,C6,02,D0,CF,4C,09,52,A9,00,85,FB,2311
45 DATA A9,80,85,FC,A0,00,98,91,FB,C8,D0,FB,E6,FC,A5,FC,2916
46 DATA C9,70,D0,F0,60,A0,01,B1,FD,99,64,00,C8,C0,0D,D0,2314
47 DATA F8,A0,00,B1,6D,29,03,C9,02,D0,06,A9,01,85,64,D0,1764
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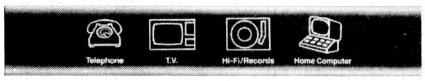

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PROGRAM FILE

```
48 DATA 1C,B1,8F,29,03,C9,02,D0,06,A9,00,85,64,F0,0E,B1,1610
49 DATA 8B,88,03,C9,01,D0,06,B1,8B,29,01,85,64,B1,65,0A,1412
50 DATA 20,03,05,64,91,65,A5,64,4A,A9,00,6A,85,61,B1,FD,1669
51 DATA 29,7F,05,61,91,FD,A5,64,49,01,85,63,A5,67,85,61,1737
52 DATA A5,88,85,62,A0,0D,4C,13,51,AD,01,DD,85,FB,A9,84,1929
53 DATA 85,FC,A9,04,85,FD,A9,08,85,FE,A9,18,46,FB,2A,A0,2224
54 DATA 00,91,FC,A5,FC,18,69,28,85,FC,A5,FD,69,00,85,FD,2277
55 DATA C6,FE,D0,E6,4C,00,50,A9,00,AE,01,5F,A0,00,20,BA,1863
56 DATA FF,AD,00,5F,A2,02,A0,5F,20,BD,FF,A9,FC,85,FB,A9,2392
57 DATA 6F,85,FC,A9,FB,AE,FE,5E,AC,FF,5E,20,D8,FF,60,A5,2723
58 DATA FB,85,65,A5,FC,85,66,A4,02,A2,00,B1,65,81,65,E6,2203
59 DATA 65,D0,02,E6,66,A5,66,CD,D9,5F,90,EF,F0,ED,AD,00,2460
60 DATA 5F,F0,DB,AD,D8,5F,85,65,AD,D9,5F,85,66,A2,00,A0,2314
61 DATA 14,A1,65,91,65,A5,65,C5,FB,D0,06,A5,66,C5,FC,F0,2412
62 DATA BD,A5,65,D0,02,C6,66,C6,65,4C,91,52,00,00,00,00,1567
90 K=24540:POKEK,0:POKEK+2,3
92 G$="AND[SPC]NANDOR[2SPC]NOR[SPC]XOR[SPC]INV.F/F."
95 NG=PEEK(K-2)+256*PEEK(K-1):PT=PEEK(K-4)+256*PEEK(K-3)
97 Z$="[HOME][13CD]"
98 FORK=0TO7:DR(K)=0:PT(K)=1000+K:NEXT
200 FD=0:PRINT"[CLR][RVS][SPC]COMMODORE 64 REAL-TIME LOGIC EMULATOR[2SPC]"
205 PRINTNG;"GATE";:IFNG<>1THENPRINT"S";
207 PRINT"[SPC]IN CIRCUIT"
210 PRINT"[CD]PLEASE SELECT:"
220 PRINT"[CD][3SPC]1. ENTER GATES"
230 PRINT"[CD][3SPC]2. EXECUTE CIRCUIT"
240 PRINT"[CD][3SPC]3. EDIT/DELETE GATES"
250 PRINT"[CD][3SPC]4. SAVE CIRCUIT"
260 PRINT"[CD][3SPC]5. LOAD CIRCUIT"
265 PRINT"[CD][3SPC]6. LIST GATES"
270 PRINT"[CD][3SPC]7. CLEAR CIRCUIT"
280 PRINT"[CD][3SPC]8. END"
290 GET A$:ON VAL(A$) GOTO 300,600,1360,1270,1320,960,297,299
295 GOTO 290
297 Q$="":INPUT"[CD]CLEAR CIRCUIT (Y/N)";Q$:IFQ$="Y"ORQ$="YES"THENGOSUB9000
298 GOTO200
299 PRINT"[CLR]";:END
300 PRINT"[CLR][RVS][SPC]ENTER GATES[28SPC]"
305 PRINT"GATE #";NG+1
307 IFFD=1THENPRINT"[CD][RVS]REPLACE MODE"
310 PRINT"[CD]PLEASE SELECT:"
313 IFFD=0THEN320
315 PRINT"[CD][RVS]1[OFF][SPC]AND[2SPC][RVS]2[OFF][SPC]NAND[2SPC][RVS]3[OFF]";
316 PRINT"[SPC]OR[2SPC][RVS]4[OFF][SPC]NOR"
317 PRINT"[RVS]5[OFF][SPC]XOR[2SPC][RVS]6[OFF][SPC]INV.[2SPC][RVS]7[OFF]";
318 PRINT"[SPC]F/F[SPC][RVS]8[OFF][SPC]SCRUB":GOTO400
320 PRINT"[CD][2SPC]1. AND"
330 PRINT"[2SPC]2. NAND"
340 PRINT"[2SPC]3. OR"
350 PRINT"[2SPC]4. NOR"
360 PRINT"[2SPC]5. XOR"
370 PRINT"[2SPC]6. INVERTER"
380 PRINT"[2SPC]7. D FLIP-FLOP"
390 PRINT"[2SPC]8. LOGIC EMULATOR MENU"
400 GET A$:V=VAL(A$):IFV<1ORV>8THEN400
403 IFV=8THENIFFD=0THEN200
404 IFV=8THENR=0:NS=NS-1:GOTO520
405 IFFD=1THENPRINT"[CD][RVS]";MID$(G$,V*4-3,4):GOTO415
410 PRINTLEFT$(Z$,V+6);"[RVS][SPC]";V;"[CL]."
415 IF V=7THEN540
420 IFFD=0THENPRINTZ$
425 PRINT"[CD]OUTPUT POINT";:OO=1:GOSUB8000:OO=0
430 R=1:GOSUB 9100:R=3
450 NI=7-V:IF V=5 OR V=6 THEN 470
460 NI=0:INPUT"[CD]NUMBER OF INPUTS (1-8)";NI:IFNI<1ORNI>8THEN460
470 FORK=1TONI
480 PRINT"INPUT POINT";:IFNI>1THENPRINTK;
485 GOSUB8000:GOSUB9100:R=R+2:NEXTK
490 Q$="":INPUT"[CD]OK";Q$:IFQ$="N"ORQ$="NO"THEN300
500 IFQ$<>"Y"ANDQ$<>"YES"THENPRINT"[2CU]";:GOTO490
510 POKE PT,(NI-1)*8+V:PT=PT+R:NG=NG+1
520 IFFD=1THENPT=PS-LL+R:NG=NS:P=P+R:H=INT(P/256):POKE252,H:POKE251,P-H*256
523 IFFD=1THENPOKE24320,0:POKE2,20-R:SYS21087
525 H=INT(PT/256):L=PT-H*256:POKE24536,L:POKE24537,H:POKEPT,0
530 H=INT(NG/256):L=NG-H*256:POKE24538,L:POKE24539,H:IFFD=1THEN200
535 GOTO 300
540 IFFD=0THENPRINTZ$
545 PRINT"[CD]Q OUTPUT POINT";:OO=1:GOSUB8000:R=1:GOSUB9100
550 PRINT"[↑R]":PRINT"Q OUTPUT POINT";:GOSUB8000:R=3:GOSUB9100
560 OO=0:PRINT"[CD]CLK INPUT";:GOSUB8000:R=5:GOSUB9100
570 PRINT"[CD]D INPUT";:GOSUB8000:R=7:GOSUB9100
580 PRINT"[3↑R]":PRINT"SET INPUT";:GOSUB8000:R=9:GOSUB9100
590 PRINT"[5↑R]":PRINT"RESET INPUT";:GOSUB8000:R=11:GOSUB9100
595 NI=1:R=13:GOTO490
600 PRINT"[CLR]"TAB(20);"[↑-]0[SPC]1[SPC]2[SPC]3[SPC]4[↑-]5[SPC]6[SPC]7[SPC]8[SPC]9";
602 PRINT"[3SPC]USER PORT[5SPC][3↑*][↑+][9↑*][↑+][9↑*][CU]";
604 FORK=0TO220STEP10:A=K:PRINT:PRINTTAB(16);
605 IFLEN(A$)<4THENA$=" "+A$:GOTO605
606 GOSUB9200:PRINT"[↑-][9SPC][↑-][8SPC]";
608 NEXTK:FORK=0TO960STEP40:POKEK+55335,PEEK(646):NEXTK
610 PRINT"[HOME][2CD][@A][3↑*][@R][↑*][@R][4↑*][@R][↑*][@S]"
620 FORK=0TO7
630 PRINT"[↑-]PB";CHR$(48+K);"[↑-]";CHR$(73+6*DR(K));"[↑-]";:A=PT(K):GOSUB9200
635 PRINT"[↑-]-[↑-]":NEXTK
640 PRINT"[@Z][3↑*][@E][↑*][@E][4↑*][@E][↑*][@X]"
650 PRINT"[5SPC]↑[2SPC]↑[3SPC][@Z]0/1"
660 PRINT"[2SPC]1/O[@X][2SPC][↑-]"
670 PRINT"[8SPC][@Z]CIRCUIT"
680 PRINT"[9SPC]POINT"
690 Q$="[HOME][17CD]"
700 FORK=1TO4:Q$=Q$+"[16SPC][CD][16CL]":NEXTK:Q$=Q$+"[4CU]"
710 PRINTQ$;"SELECT:":PRINT"[2SPC]0-7 (PORT)":PRINT"[SPC]OR S TO START"
720 PRINT"[SPC]OR M FOR MENU"
722 FORK=1TO4:PRINT"[14SPC]";:IFK<4THENPRINT
723 NEXTK
725 GETA$:IFA$<>""THEN725
730 GETA$:IFA$="M"THEN200
740 IFA$="S"THEN900
750 V=VAL(A$):IF(V=0ANDA$<>"0")ORV>7THEN730
760 PRINTQ$;"'I' OR 'O' ?";LEFT$(Q$,V+4);"[5CR][RVS][SPC][OFF][CL]";
770 GETA$:IFA$="I"THENDR(V)=0:PRINT"I":GOTO790
780 IFA$="O"THENDR(V)=1:PRINT"O":GOTO790
785 GOTO770
790 PRINTQ$;"CIRCUIT":PRINT"POINT?";LEFT$(Q$,V+4);"[7CR][4SPC][4CL][RVS][SPC][OFF][CL]";
800 L$=""
810 GETA$:IFA$=CHR$(13)THEN890
815 IFA$=CHR$(20)THENIFL$<>""THEN860
820 IFA$<"0"ORA$>"9"THEN810
830 IFLEN(L$)=4THEN810
840 L$=L$+A$:PRINTA$;:IFLEN(L$)<4THENPRINT"[RVS][SPC][OFF][CL]";
850 GOTO 810
860 IFLEN(L$)<4THENPRINT"[SPC][CL]";
870 PRINT"[CL][RVS][SPC][OFF][CL]";
```

PROGRAM FILE

```
880 L$=LEFT$(L$,LEN(L$)-1):GOTO810
890 A=VAL(L$):IFA)4095THEN790
895 PT(V)=A:PRINTLEFT$(Q$,V+4);"[7CR]";:GOSUB9200:GOTO710
900 PRINTQ$;"F7 TO STOP":PRINT"[CD][RVS]KEYBOARD":PRINT"[RVS]CONTROLS:"
905 PRINT"0123456789":PRINT"[10↑*]"
907 PRINT"1234567890[SPC]+[SPC]0"
908 PRINT"QWERTYUIOP[SPC]+[SPC]1";
910 DR=0:P=128:FORK=7TO0STEP-1:DR=DR+P*DR(K):P=P/2:NEXTK:POKE56579,DR
920 Q=PT:R=0:PT=24544:FORK=0TO7:IFDR(K)=1THENZ=24543:GOSUB9100:GOTO940
930 Z=PT(K)+24576:GOSUB9100
940 PT=PT+2:NEXTK:FORK=0TO7:Z=PT(K)+24576:GOSUB9100:PT=PT+2:NEXTK:PT=Q
950 SYS20480:GOTO710
960 PRINT"[CLR][RVS][SPC]LIST GATES[29SPC]"
970 Q$="":INPUT"[CD]SCREEN OR PRINTER (S/P)";Q$
980 IFQ$()"S"THENIFQ$()"P"THEN200
990 PRINT"[CD]PRESS SPACE TO PAUSE"
1000 IFQ$="P"THENOPEN4,4:GOTO1010
1005 OPEN4,3
1010 FORG=1TO7:F=0:GN=0
1020 P=28672
1030 GN=GN+1:V=PEEK(P)AND7:IFV=0THENNEXTG:GOTO1190
1035 GETA$:IFA$="[SPC]"THEN1240
1040 IF G=V THEN 1070
1050 IF V=7 THEN P=P+13:GOTO1030
1060 P=P+(PEEK(P)AND56)/4+5:GOTO1030
1070 IF F THEN 1110
1080 PRINT#4:PRINT#4,"[RVS]";MID$(G$,G*4-3,4)
1090 IFV<7THENPRINT#4:PRINT#4,"GATE# O/P. INPUT";CHR$(83+51*(V=6)):GOTO1110
1095 PRINT#4,"[12SPC][↑R][13SPC][3↑R][2SPC][5↑R]"
1100 PRINT#4,"GATE#[2SPC]Q[4SPC]Q[3SPC]CLK[28PC][DATA[SPC]SET[2SPC]RESET"
1110 F=1:A=GN:GOSUB9300
1113 IFV=7THENNI=4:GOTO1120
1115 NI=(PEEK(P)AND56)/8
1120 FORK=1TONI+2
1130 L=PEEK(P+K*2-1)+256*PEEK(P+K*2)
1140 IF L=24542 THEN PRINT#4,"[2SPC]+VE";:GOTO1170
1150 IF L=24540 THEN PRINT#4,"[2SPC]GND";:GOTO1170
1155 IF L=24543 THEN PRINT#4,"[3SPC]NC";:GOTO1170
1160 A=L-24576:GOSUB9300
1170 NEXT K
1180 PRINT#4:GOTO1050
1190 PRINT#4:CLOSE4
1200 PRINT"[CD]PRESS ANY KEY TO RETURN TO MENU"
1210 GETA$:IFA$()""THEN1210
1220 GETA$:IFA$=""THEN1220
1230 GOTO200
1240 IFPEEK(197)=60THEN1240
1245 GETA$:IFA$()""THEN1245
1250 GETA$:IFA$=""THEN1250
1260 GOTO1040
1270 PRINT"[CLR][RVS][SPC]SAVE CIRCUIT[27SPC]"
1280 GOSUB9400
1290 POKE24320,LEN(N$):POKE24321,DE
1300 IFN$()""THENFORK=1TOLEN(N$):POKE24321+K,ASC(MID$(N$,K,1)):NEXTK
1305 FORK=0TO3:POKE28668+K,PEEK(24536+K):NEXTK
1307 Q=PT:PT=24318:R=0:Z=Q+1:GOSUB9100:PT=Q
1310 SYS21047:GOTO200
1320 PRINT"[CLR][RVS][SPC]LOAD CIRCUIT[27SPC]"
1330 GOSUB9400
1340 FL=1:LOAD(N$),DE,1
1350 FL=0:FORK=0TO3:POKE24536+K,PEEK(28668+K):NEXTK:GOTO90
1360 PRINT"[CLR][RVS][SPC]EDIT/DELETE GATE[23SPC]"
1370 G=0:INPUT"[CD]GATE #";GN:IFGN<1ORGN>NGTHEN200
1380 PRINT"[2CD]SEARCHING":P=28672:IFGN=1THEN1430
1390 FORK=1TOGN-1
1400 Z=PEEK(P):IF(ZAND7)=7 THEN P=P+13:GOTO 1420
1410 P=P+(ZAND56)/4+5
1420 NEXTK
1430 G=PEEK(P)AND7:PRINT"[CU][RVS]";MID$(G$,G*4-3,4);"[5SPC][CD]"
1440 IFG=7THENNI=4:GOTO1455
1450 NI=(PEEK(P)AND56)/8
1455 I$="Q[4SPC][↑R][CD][CL]Q[SPC][CD]CLK[SPC][CD]DATASET[2SPC]RESET"
1460 FORK=1TONI+2
1462 IFG=7THENIFK>4THENPRINTLEFT$("[5↑R]",K*2-7)
1465 IFG=7THENPRINTMID$(I$,K*5-4,5),:GOTO1490
1470 IFK=1THENPRINT"OUTPUT:",:GOTO1490
1480 IFNI=0THENPRINT"INPUT",:GOTO1490
1485 PRINT"INPUT";K-1,
1490 L=PEEK(P+K*2-1)+256*PEEK(P+K*2)
1500 IF L=24542 THEN PRINT"[SPC]+VE":GOTO1540
1510 IF L=24540 THEN PRINT"[SPC]GND":GOTO1540
1520 IF L=24543 THEN PRINT"[2SPC]NC":GOTO1540
1530 A=L-24576:GOSUB9200:PRINT
1540 NEXT K
1550 PRINT"[CD]1. DELETE THIS GATE"
1560 PRINT"2. EDIT THIS GATE"
1570 PRINT"3. RETURN TO LOGIC EMULATOR MENU"
1580 GETA$:V=VAL(A$):ONVGOTO1600,1600,200
1596 GOTO1580
1600 LL=NI*2+5:POKE2,LL:H=INT(P/256):POKE252,H:POKE251,P-H*256
1610 POKE24320,V-1:SYS21087:FD=1:IFV=1THENPT=PT-LL:NG=NG-1:GOTO525
1620 PRINT"[3CU)";:FORK=1TO3:PRINT"[32SPC]":NEXTK
1625 PRINT"[3CU]RE-ENTER THE DETAILS OF THIS GATE"
1627 PS=PT:NS=NG:PT=P:NG=GN-1:GOTO310
8000 Z=-1:Y$="":INPUT Y$:IFY$="+"ORY$="+VE"ORY$="NC"THENZ=24543+(OO=0):RETURN
8010 IFY$="-"ORY$="-VE"ORY$="GND"THENZ=24543+3*(OO=0):RETURN
8020 Z=VAL(Y$):IFZ(00RZ>40960RZ=0ANDY$()"0"THENPRINT"MUST BE 0-4095":GOTO8000
8030 Z=Z+24576:RETURN
9000 POKE24538,0:POKE24539,0:POKE24536,0:POKE24537,112:SYS20876
9010 NG=0:PT=28672:POKEPT,0:RETURN
9100 H=INT(Z/256):L=Z-H*256:POKEPT+R,L:POKEPT+R+1,H:RETURN
9190 PRINT"[SPC]";
9200 FZ=0
9205 A$=MID$(STR$(A),2)
9210 IFLEN(A$)<4THENA$=" "+A$:GOTO9210
9220 IFFZ=0THENPRINTA$;:RETURN
9230 PRINT#4,A$;:RETURN
9300 PRINT#4,"[SPC]";:FZ=1:GOTO9205
9400 DE=1:T$="":INPUT"TAPE OR DISK (T/D)";T$:IFT$="D"THENDE=8:GOTO9420
9410 IFT$()"T"THEN9400
9420 N$="":INPUT"[CD]FILENAME";N$:IFN$=""THENIFT$="D"THEN9420
9430 RETURN
9500 PRINT"[CLR]READING M/C DATA - PLEASE WAIT[2CD]"
9505 RESTORE:P=20480:FORK=0TO42
9510 PRINT"[CU]";42-K;"[CL][SPC]"
9512 T=0:FORJ=0TO15:READZ$:L=ASC(Z$)-48
9520 R=ASC(RIGHT$(Z$,1))-48
9530 B=L*16+112*(L>9)+R+7*(R>9):T=T+B:POKEP,B:P=P+1:NEXTJ
9540 READCC:IFCC()TTHENPRINT"DATA ERROR, LINE";20+K:END
9550 NEXTK:RETURN
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```


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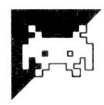
```
KEY TO BRACKETED SYMBOLS

[HOME]  HOME                        [RVS]   RVS ON (CTRL-9)
[CLR]   SHIFT+CLR                   [OFF]   RVS OFF (CTRL-0)
[CR]    CRSR RIGHT                  [SPC]   SPACE
[CL]    SHIFT+CRSR DOWN             [t*]    SHIFT+'*'
[CD]    CRSR DOWN                   [@R]    COMMODORE+'R'
[CU]    SHIFT+CRSR UP

[5SPC] = 5  x SPACE
[12tR] = 12 x SHIFT+'R'
[7CD]  = 7  x CRSR DOWN,        etc.
```



Spectrum Nine Men's Morris

by Arthur Lindon

Nine Men's Morris is a game for the Sinclair Spectrum 48k, and is based on the original two-player game which dates back to 1400 BC. Each player has nine counters, and the object of the game is to remove your opponent's counters by forming set patterns with your counters, called 'mills'.

The counters are placed on the board alternately; when all the counters have been placed, they can be moved by sliding to an adjacent point. To form a mill you need to get three of your counters in a straight line, and if this is achieved you can then remove one of your opponent's counters. A player who is reduced to two counters or who is unable to move loses the game.

```
  10 REM ************************
  20 REM     NINE MEN'S MORRIS
  30 REM by  Arthur Lindon  1985
  40 REM ------------------------
  50 BORDER 5: PAPER 7: CLS : POKE 23658,8
  60 IF  PEEK 65368 <> 60 THEN  GO SUB 1560
  70 PRINT  AT 2,8;"NINE MEN'S MORRIS"; AT 3,8;"==============
=="; AT 5,7;"DO YOU WANT TO SEE"; AT 7,6;"THE INSTRUCTIONS? Y/N"
  80 GO SUB 910
  90 IF i$="Y" THEN  GO SUB 1440
 100 DATA 1,1,6,10,1,15,22,1,24,4,4,9,11,4,15,19,4,21,7,7,12,12,
7,15,16,7,18,2,10,6,5,10,9,8,10,12,17,10,18,20,10,21,23,10,24,9,
13,12,13,13,15,18,13,18,6,16,9,14,16,15,21,16,21,3,19,6,15,19,15
,24,19,24
 110 DIM v(24): DIM y(24): DIM x(24)
 120 RESTORE 100: FOR i=1 TO 24
 130 READ v(i),y(i),x(i): NEXT i
 140 BORDER 5: PAPER 6: CLS : GO SUB 350
 150 DIM c(24): DIM m(24): LET b=9: LET r=9: LET cb=0: LET cr=0
 160 LET rnd= RND : IF rnd >= .5 THEN  GO TO 270
 170 REM ************************
 180 REM       BLUE'S TURN
 190 REM ------------------------
 200 PRINT  PAPER 1; INK 7; AT 19,0;"BLUE "; AT 19,27;"BLUE "; A
T 20,0;"TO GO"; AT 20,27;"TO GO": LET col=1
 210 IF b=0 THEN  GO SUB 680
 220 IF b>0 THEN  GO SUB 570
 230 GO SUB 970: GO SUB 1250
 240 REM ************************
 250 REM         RED'S TURN
 260 REM ------------------------
 270 PRINT  PAPER 2; INK 7; AT 19,0;" RED "; AT 19,27;" RED "; A
T 20,0;"TO GO"; AT 20,27;"TO GO": LET col=2
 280 IF r=0 THEN  GO SUB 680
 290 IF r>0 THEN  GO SUB 570
 300 GO SUB 970: GO SUB 1250
 310 GO TO 200
 320 REM ************************
 330 REM        DRAW BOARD
 340 REM ************************
 350 FOR i=1 TO 3
 360 PLOT 24*i+27,187-24*i: DRAW 192-48*i,0: DRAW 0,48*i-192: DR
AW 48*i-192,0: DRAW 0,192-48*i
 370 NEXT i
 380 PLOT 52,91: DRAW 47,0: PLOT 148,91: DRAW 47,0
 390 PLOT 123,163: DRAW 0,-47: PLOT 123,67: DRAW 0,-47
 400 FOR i=1 TO 24
 410 PRINT  AT y(i),x(i);"O"
 420 PRINT  AT y(i)-1,x(i)+1; CHR$ (64+i)
 430 NEXT i
 440 FOR i=1 TO 9
 450 PRINT  INK 1; AT 2*i-1,1;"A"; INK 2; AT 2*i-1,30;"A"
 460 NEXT i
 470 PRINT  INK 1; AT 0,0;"r-¬"; AT 18,0;"L_J"; INK 2; AT 0,29;"r
¬"; AT 18,29;"L_J"
 480 FOR i=1 TO 17
 490 PRINT  INK 1; AT i,0;"| "; AT i,2;" |"; INK 2; AT i,29;"| "; A
T i,31;" |"
 500 NEXT i
 510 PRINT  AT 20,10;"PRESS LETTER"
 520 RETURN
 530 REM ************************
 540 REM     PLACING COUNTERS
 550 REM ------------------------
 560 BEEP .3,10
 570 PRINT  AT 21,9;"OF DESTINATION"
```

PROGRAM FILE

```
 580 GO SUB 830: IF d>24 THEN  GO TO 560
 590 IF c(d) <> 0 THEN  GO TO 560
 600 LET c(d)=col
 610 PRINT  INK col; AT y(d),x(d);"A"
 620 IF col=1 THEN  PRINT  AT 2*b-1,1;" ": LET b=b-1: GO TO 640
 630 PRINT  AT 2*r-1,30;" ": LET r=r-1
 640 RETURN
 650 REM ************************
 660 REM     MOVE COUNTERS
 670 REM ------------------------
 680 PRINT  AT 21,9;" TO MOVE FROM "
 690 GO SUB 830: IF d>24 THEN  GO TO 760
 700 LET d0=d: IF c(d0) <> col THEN  GO TO 760
 710 PRINT  INVERSE 1; AT 21,9;"  TO MOVE TO  "
 720 GO SUB 830: IF d>24 THEN  GO TO 760
 730 IF c(d) <> 0 THEN  GO TO 760
 740 IF y(d)=y(d0) AND  ABS (x(d)-x(d0))= ABS (10-y(d))+(3 AND y
(d)=10) THEN  GO TO 770
 750 IF x(d)=x(d0) AND  ABS (y(d)-y(d0))= ABS (15-x(d))+(3 AND x
(d)=15) THEN  GO TO 770
 760 BEEP .3,10: GO TO 680
 770 LET c(d)=col: LET c(d0)=0
 780 PRINT  INK col; AT y(d),x(d);"A"; INK 0; AT y(d0),x(d0);"O"
 790 RETURN
 800 REM ************************
 810 REM     KEY INPUT(move)
 820 REM ------------------------
 830 IF  INKEY$  <> "" THEN  GO TO 830
 840 IF  INKEY$ ="" THEN  GO TO 840
 850 LET d= CODE  INKEY$ -64: IF d<1 OR d>26 THEN  BEEP .3,10: G
O TO 830
 860 IF d=25 THEN  LET col=3-col: GO TO 1350
 870 RETURN
 880 REM ************************
 890 REM     KEY INPUT(aux)
 900 REM ------------------------
 910 IF  INKEY$  <> "" THEN  GO TO 910
 920 IF  INKEY$ ="" THEN  GO TO 920
 930 LET i$= INKEY$ : RETURN
 940 REM ************************
 950 REM   CHECK FOR MILL (row)
 960 REM ------------------------
 970 LET dd=d: LET ddd=d
 980 IF  INT (dd/3) <> dd/3 THEN  LET dd=dd+1: GO TO 980:
 990 LET e=dd-2: LET f=dd-1: LET g=dd
1000 IF c(e) <> 0 AND c(e)=c(f) AND c(f)=c(g) THEN  GO SUB 1120
1010 IF d=26 THEN  GO TO 1080
1020 FOR i=1 TO 24
1030 IF v(i)=ddd THEN  GO TO 1050
1040 NEXT i
1050 IF  INT (i/3) <> i/3 THEN  LET i=i+1: GO TO 1050
1060 LET e=v(i-2): LET f=v(i-1): LET g=v(i)
1070 IF c(e) <> 0 AND c(e)=c(f) AND c(f)=c(g) THEN  GO SUB 1120
1080 RETURN
1090 REM ************************
1100 REM        CAPTURE
1110 REM ------------------------
1120 PRINT  INK col; FLASH 1; AT y(e),x(e);"A"; AT y(f),x(f);"A"
; AT y(g),x(g);"A"
1130 PRINT  AT 21,2;"OF ";"RED" AND col=1;"BLUE" AND col=2;" COU
NTER TO BE REMOVED"
1140 GO SUB 830: IF d=26 THEN  GO TO 1190
1150 IF c(d)=0 OR c(d)=col OR m(d)=1 THEN  BEEP .3,10: GO TO 114
0
1160 LET c(d)=0: PRINT  INK 0; AT y(d),x(d);"O"
1170 IF col=1 THEN  LET cr=cr+1: PRINT  INK 2; AT 19-2*cr,1;"A":
 IF cr=7 THEN  GO TO 1350
1180 IF col=2 THEN  LET cb=cb+1: PRINT  INK 1; AT 19-2*cb,30;"A"
: IF cb=7 THEN  GO TO 1350
1190 PRINT  AT 21,0;"                                "
1200 PRINT  INK col; FLASH 0; AT y(e),x(e);"A"; AT y(f),x(f);"A"
; AT y(g),x(g);"A"
1210 RETURN
1220 REM ************************
1230 REM   RESET MILL ARRAY
1240 REM ------------------------
1250 FOR i=1 TO 24: LET m(i)=0: NEXT i
1260 FOR i=1 TO 22 STEP 3
1270 IF c(i) <> 0 AND c(i)=c(i+1) AND c(i+1)=c(i+2) THEN  LET m(
i)=1: LET m(i+1)=1: LET m(i+2)=1
1280 LET e=v(i): LET f=v(i+1): LET g=v(i+2)
1290 IF c(e) <> 0 AND c(e)=c(f) AND c(f)=c(g) THEN  LET m(e)=1:
LET m(f)=1: LET m(g)=1
1300 NEXT i
1310 BEEP .02,20: RETURN
1320 REM ************************
1330 REM     FINISH GAME
1340 REM ------------------------
1350 PRINT  AT 21,0;"                                "
1360 PRINT  PAPER col; FLASH 1; INK 7; AT 19,26*(col=2);"WINNER"
; AT 20,26*(col=2);"WINNER"; FLASH 0; PAPER 6; AT 19,26*(col=1);
"      "; AT 20,26*(col=1);"      "
1370 PRINT  AT 20,10;"DO YOU WANT "; AT 21,8;"ANOTHER GAME Y/N"
1380 GO SUB 910
1390 IF i$="Y" THEN  GO TO 140
1400 STOP
1410 REM ************************
1420 REM     INSTRUCTIONS
1430 REM ------------------------
1440 CLS : PRINT """NINE MEN'S MORRIS"" IS A GAME   FOR TWO PLAY
```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PROGRAM FILE

```
ERS, ONE STARTING   WITH NINE BLUE COUNTERS AND THE OTHER WITH N
INE RED."
1450 PRINT : PRINT "THE STARTER IS SELECTED, AT      RANDOM, BY T
HE COMPUTER AND THE PLAYERS THEN, IN ALTERNATE       TURNS, PLACE
 COUNTERS ON THE    VACANT POINTS."
1460 PRINT : PRINT "THE OBJECT  OF THE GAME IS TO    FORM A MILL
OR MILLS. A MILL IS A ROW OF THREE ON A STRAIGHT     LINE. IF THI
S IS ACHIEVED THE   PLAYER CAN REMOVE ONE OF THE     OPPONENT'S C
OUNTERS. A PLAYER   REDUCED TO TWO COUNTERS  OR      UNABLE TO MO
VE LOSES THE GAME"
1470 PRINT  AT 21,15; INK 2;"PRESS ANY KEY": GO SUB 910
1480 CLS : PRINT "WHEN ALL THE COUNTERS HAVE BEEN POSITIONED, TH
E PLAY CONTINUES  BY SLIDING A COUNTER ALONG A    LINE TO THE AD
JACENT POINT,     PROVIDED THAT IT IS VACANT, WITHTHE SAME AIM O
F FORMING A MILL."
1490 PRINT : PRINT  INK 2;"AFTER FORMING A MILL THE COUNTERTO BE
 REMOVED MUST NOT BE PART  OF A MILL."
1500 PRINT : PRINT "IF A COUNTER IN A MILL IS MOVED,AS MAY BE NE
CESSARY IN NORMAL   PLAY, ALL COUNTERS IN THAT  MILLBECOME VULNE
RABLE TO CAPTURE."
1510 PRINT : PRINT "IT MAY BE NECESSARY TO WAIVE     THIS RIGHT O
F REMOVAL."; INK 2;" TO DO SO PRESS ""Z"""; INK 0;" THIS IS THE
 ONLY TIMEA TURN MAY BE MISSED."; INK 2;"   TO YIELD TO YOUR OPP
ONENT, AT ANY TIME, PRESS ""Y""."
1520 PRINT  AT 21,15; INK 0;"PRESS ANY KEY": GO SUB 910: RETURN
1530 REM ************************
1540 REM       GRAPHICS
1550 REM ------------------------
1560 RESTORE 1580: FOR i=0 TO 7: READ k: POKE  USR "a"+i,k: NEXT
 i
1570 REM A A
1580 DATA 60,126,255,255,255,255,126,60
1590 RETURN
1600 REM ************************
```

Atari Yahtzee

by Ken Hall

This version of the popular dice game Yahtzee is written for Atari 400/600/800 home computers. Very little needs to be said—all the instructions are within the program but the program shows all the capabilities of the Atari — redefined character sets, player/missile graphics, sound, and so on, making it very professional and great fun to play.

Type in listing 1 without the CLOAD at the end and make sure it works, add the CLOAD and save to tape. Then type in listing 2 and save it after listing 1 on tape. To play Yahtzee, rewind the tape and type CLOAD.

```
1000 GRAPHICS 0:POKE 710,18:POKE 712,178:POKE 752,1
1010 POSITION 12,9:? "[INV]              [INV]":POSITION
12,10:? "[INV] LOADING DATA [INV]":POSITION 12,12:? "[INV]
[INV]      [INV]    [INV]"
1020 POSITION 12,14:? "[INV] PLEASE  WAIT [INV]":POSITION
12,13:? "[INV]             [INV]"
1025 POSITION 12,11:? "[INV]              [INV]":POSITION
12,15:? "[INV]             [INV]"
1030 Z=124:Q=(PEEK(106)-8)*256:FOR I=0 TO 1023:POKE
Q+I,PEEK(57344+I):Z=Z-0.1:POSITION 18,12:? ;INT(Z);" ":NEXT I
1040 RESTORE 1060:FOR I=1 TO 43:READ ADDR:FOR J=0 TO 7:READ
C:POKE Q+ADDR+J,C:NEXT J:Z=Z-0.5
1050 POSITION 18,12:? ;INT(Z);" ":NEXT I
1060 DATA
32,254,254,254,238,254,254,254,0,40,254,190,254,254,254,250,2
54,0,48,254,190,254,238,254,250,254,0
1070 DATA
56,254,186,254,254,254,186,254,0,64,254,186,254,238,254,186,2
54,0,72,254,186,254,186,254,186,254,0
1080 DATA
128,124,238,238,254,254,254,124,0,136,56,248,56,56,56,254,254
,0,144,124,198,28,112,254,254,254,0
1090 DATA
152,254,28,120,28,206,254,124,0,160,220,220,220,220,254,28,28
,0,168,254,224,252,14,238,254,124,0
1100 DATA
176,126,224,252,238,238,254,124,0,184,254,14,14,28,60,120,120
,0,192,124,238,124,238,254,254,124,0
1110 DATA
200,124,238,126,14,238,254,124,0,8,255,255,255,255,255,255,25
5,255
1120 DATA
264,56,124,246,254,246,246,246,0,272,252,230,252,230,254,254,
252,0,280,126,224,224,224,254,254,126,0
```

PROGRAM FILE

```
1130 DATA
288,248,236,230,254,254,252,248,0,296,254,224,252,224,254,254
,254,0,304,254,224,252,240,240,240,240,0
1140 DATA
312,126,224,238,226,254,254,126,0,320,246,246,254,246,246,246
,246,0,328,124,124,0,124,124,124,124,0
1150 DATA
336,62,28,28,220,220,252,120,0,344,206,220,248,252,222,222,22
2,0,352,224,224,224,224,254,254,254,0
1160 DATA
360,198,238,254,254,238,238,238,0,368,230,246,254,254,254,238
,238,0,376,124,238,238,238,254,254,124,0
1170 DATA
384,252,238,238,252,240,240,240,0,392,124,238,238,238,254,124
,30,0,400,252,198,254,252,222,222,222,0
1180 DATA
408,126,224,124,6,254,254,252,0,416,254,124,124,124,124,124,1
24,0,424,246,246,246,246,254,254,124,0
1190 DATA
432,246,246,246,254,124,56,16,0,440,238,238,238,254,254,238,1
98,0,448,246,246,254,124,254,246,246,0
1200 DATA
456,238,238,124,56,124,124,124,0,464,254,30,60,120,254,254,25
4,0
2000 DIM Y$(21):Y$="Y[INV]A[INV]h[INV]t[INV]Z[INV]E[INV]e
[INV]BY[INV] [INV]ken hall[INV]":X=1:GRAPHICS 18:POKE
756,Q/256:FOR I=19 TO 1 STEP -1:POSITION I,6
2010 ? #6;Y$(1,X):SOUND 0,50,10,10:X=X+1:FOR W=1 TO 25:NEXT
W:SOUND 0,0,0,0:FOR W=1 TO 15:NEXT W:NEXT I
4040 FOR W=1 TO 2000:NEXT W
4050 GRAPHICS 0:POKE 710,18:POKE 712,178:POKE 752,1
4055 ? "          ***[INV] YAHTZEE [INV]***":? :? "A dice
game for up to four players"
4060 ? "All five dice can be rolled three     times.Any dice
can be held while the  others are";
4070 ? " rolled .Positions score -":? "1 to 6=Face value of
number selected"
4080 ? "3 KIND=3 the same-Face value scores":? "4 KIND=4 the
same-Face value scores"
4090 ? "F HOUSE=3 and 2 of any dice-Scores 25":? "S
STRT=1234,2345 or 3456-Scores 30"
4100 ? "L STRT=12345 or 23456-Scores 40":? "YAHTZEE=5 of any
dice-Scores 50"
4110 ? "CHANCE=Scores face value of all dice":? "If TOP TOTAL
is 63 or over a BONUS of 35 given .";
4120 ? " EXTRA YAHTZEEs may be put  in any of the LOWER
positions . It    scores 50 PLUS the position score."
4130 ? "Press numbers to HOLD dice,Press HOLD again to change
back dice.Press [INV]O[INV] to  re-roll.";
4140 ? "Use Joystick to select score  position and TRIGGER to
enter score."
4150 ? :? "      ***[INV] LOADING PART TWO [INV]***";
5050 POKE 764,12:CLOAD
```

```
30 GOTO 2000
40 FOR GO=1 TO 13:FOR PG=1 TO PL
60 Y=2:FOR J=1 TO 5:FOR L=0 TO 15 STEP 0.5:SOUND
0,100,10,L:NEXT L:POSITION X(PG)-5,Y:? "*":FOR L=15 TO 0
   STEP -1
65 SOUND 0,100,10,L:NEXT L:POSITION X(PG)-5,Y:?
"[INV]*[INV]":NEXT J:FOR TH=1 TO 3:POSITION 20,0:? "PUSH
trigg TO THROW";
80 IF STRIG(0)=1 THEN 80
90 GOSUB 300:FOR I=1 TO 9 STEP 2:IF DH(I)=0 THEN
D(I)=INT(RND(0)*6+1):RS$(I,I)=CHR$(D(I)+48)
95 NEXT I:GOSUB 400:IF TH=3 THEN 120
100 POSITION 20,0:? ;"0 or hold 1-2-3-4-5";:GOTO 1300
110 IF DH(1)=1 AND DH(3)=1 AND DH(5)=1 AND DH(7)=1 AND
DH(9)=1 THEN POP :GOTO 120
115 NEXT TH
120 POSITION 20,0:? ;"select THEN trigger";
130 S=STICK(0):IF STRIG(0)=0 THEN 500
135 IF S=15 THEN 130
```


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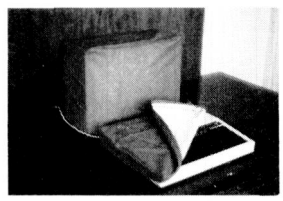

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PROGRAM FILE

```
140 POSITION X(PG)-5,Y:? " ":IF S=13 THEN Y=Y+1:IF Y>17 THEN
Y=2
150 IF S=14 THEN Y=Y-1:IF Y<2 THEN Y=17
160 POSITION X(PG)-5,Y:? "[INV]*[INV]":SOUND 0,50,10,10:FOR
W=1 TO 20:NEXT W:SOUND 0,0,0,0:FOR W=1 TO 20:NEXT W
170 GOTO 130
180 POSITION 0,0:? "                    ":FOR I=1 TO 9 STEP
2:DH(I)=0:NEXT I
190 NEXT PG
200 NEXT GO
210 GOTO 1800
300 K=0:FOR RO=1 TO 7:FOR I=1 TO 9 STEP 2:K=K+1:IF K>6 THEN
K=1
310 IF DH(I)=0 THEN POSITION 9+I,0:? CHR$(R(K))
340 FOR L=15 TO 5 STEP 0.5:SOUND 0,I+10*K,10,L:NEXT L:SOUND
0,0,0,0:FOR W=1 TO 3:NEXT W:NEXT I:NEXT RO:RETURN
400 FOR I=1 TO 9 STEP 2:IF DH(I)=0 THEN POSITION I+9,0:?
CHR$(D(I)+131)
420 NEXT I:IF D(1)=D(3) AND D(1)=D(5) AND D(1)=D(7) AND
D(1)=D(9) THEN POP :GOSUB 1200:GOTO 1230
430 RETURN
500 IF Y>7 AND Y<11 THEN POSITION 20,0:? #6;" INVALID
SELECTION";:GOTO 905
505 FOR I=1 TO 4:FOR D=1 TO 7 STEP
2:AS$=RS$(D,D):BS$=RS$(D+2,D+2)
510 IF RS$(D+2,D+2)<RS$(D,D) THEN
RS$(D+2,D+2)=AS$:RS$(D,D)=BS$
520 NEXT D:NEXT I
530
A=ASC(RS$(1))-48:B=ASC(RS$(3))-48:C=ASC(RS$(5))-48:D=ASC(RS$(
7))-48:E=ASC(RS$(9))-48
540 SC=0:P(Y,PG)=P(Y,PG)+1:IF P(Y,PG)>1 THEN 900
550 IF Y>=2 AND Y<=7 THEN W=Y-1:GOTO 800
555 IF YS=1 THEN YZ=0
560 IF Y=11 THEN IF YZ=50 THEN 700
570 IF Y=11 THEN IF (A=B AND A=C) OR (B=C AND B=D) OR (C=D
AND C=E) THEN SC=A+B+C+D+E:GOTO 670
580 IF Y=12 THEN IF YZ=50 THEN 700
590 IF Y=12 THEN IF (A=B AND A=C AND A=D) OR (B=C AND B=D AND
B=E) THEN SC=A+B+C+D+E:GOTO 670
600 IF Y=13 THEN IF YZ=50 THEN SC=75:GOTO 670
610 IF Y=13 THEN IF (A=B AND A=C AND D=E) OR (A=B AND C=D AND
C=E) THEN SC=25:GOTO 670
620 IF Y=14 THEN IF YZ=50 THEN SC=80:GOTO 670
630 IF Y=14 THEN IF (A+B+C+D=A*4+6) OR (A+C+D+E=A*4+6) OR
(A+B+C+E=A*4+6) THEN SC=30:GOTO 670
635 IF Y=15 THEN IF YZ=50 THEN SC=90:GOTO 670
640 IF Y=15 THEN IF A+B+C+D+E=A*5+10 THEN SC=40:GOTO 670
650 IF Y=16 THEN IF (A+B+C+D+E)/5=A THEN SC=50:GOTO 670
655 IF Y=16 THEN IF (A+B+C+D+E)/5<>A THEN YS=1:SC=0:GOTO 670
660 IF Y=17 THEN SC=A+B+C+D+E+YZ
670 IF SC>9 THEN POSITION X(PG)-1,Y:? SC:GOTO 680
675 POSITION X(PG)-1,Y:? SC
680 LSC(PG)=LSC(PG)+SC:POSITION X(PG)-1,19:? ;LSC(PG)
690 POSITION X(PG)-5,Y:? " ":TSC(PG)=USC(PG)+LSC(PG):POSITION
X(PG)-1,21:? ;TSC(PG):SC=0:YZ=0:GOTO 180
700 SC=YZ+A+B+C+D+E:GOTO 670
800 FOR I=1 TO 9 STEP 2
810 IF D(I)=W THEN SC=SC+W
820 NEXT I:IF SC<10 THEN POSITION X(PG),Y:? ;SC:GOTO 840
830 POSITION X(PG)-1,Y:? ;SC
840 USC(PG)=USC(PG)+SC:IF USC(PG)>62 AND B(PG)=0 THEN
USC(PG)=USC(PG)+35:B(PG)=1
850 POSITION X(PG)-1,9:? ;USC(PG):SC=0:GOTO 690
900 POSITION 20,0:? ;"  POSITION FILLED  ";
905 RESTORE 920:FOR I=1 TO 10:READ N:SOUND 0,N,10,10:FOR W=1
TO 25:NEXT W
910 NEXT I:SOUND 0,0,0,0:FOR W=1 TO 200:NEXT W:GOTO 120
920 DATA 91,0,121,128,121,108,121,0,96,91
1200 RESTORE 1220:FOR I=1 TO 14:READ N,W:SOUND 0,N,10,10:FOR
S=1 TO 3*W/16:NEXT S
1210 SOUND 0,N,10,5:FOR S=1 TO W/16:NEXT S:SOUND 0,0,0,0:NEXT
I:RETURN
1220 DATA
186,30,140,30,110,40,92,30,92,30,92,30,110,30,110,30,110,30,1
40,30,110,30,140,30,186,120,0,50
1230 YZ=50:POSITION 20,0:? #6;"                    ":FOR R=1
```

PROGRAM FILE

```
TO 7:POSITION 26,0:? ;Y$(1,R):SOUND 0,50,10,10
1240 FOR W=1 TO 25:NEXT W:SOUND 0,0,0,0:FOR W=1 TO 10:NEXT
W:NEXT R
1250 FOR II=1 TO 5:FOR I=0 TO 15:SOUND 0,35,4,I:FOR W=1 TO
2:NEXT W:POKE 708,I:NEXT I
1260 FOR I=15 TO 0 STEP -1:SOUND 0,35,4,I:FOR W=1 TO 2:NEXT
W:POKE 708,I:NEXT I:NEXT II:POKE 708,40
1270 FOR W=1 TO 200:NEXT W:GOTO 120
1300 PK=PEEK(764):IF PK=50 THEN POKE 764,255:GOTO 110
1310 IF PK=31 AND DH(1)=0 THEN DH(1)=1:DP=21:M=D(1):GOTO 1500
1320 IF PK=31 AND DH(1)=1 THEN DH(1)=0:DP=21:M=D(1):GOTO 1600
1330 IF PK=30 AND DH(3)=0 THEN DH(3)=1:DP=23:M=D(3):GOTO 1500
1340 IF PK=30 AND DH(3)=1 THEN DH(3)=0:DP=23:M=D(3):GOTO 1600
1350 IF PK=26 AND DH(5)=0 THEN DH(5)=1:DP=25:M=D(5):GOTO 1500
1360 IF PK=26 AND DH(5)=1 THEN DH(5)=0:DP=25:M=D(5):GOTO 1600
1370 IF PK=24 AND DH(7)=0 THEN DH(7)=1:DP=27:M=D(7):GOTO 1500
1380 IF PK=24 AND DH(7)=1 THEN DH(7)=0:DP=27:M=D(7):GOTO 1600
1390 IF PK=29 AND DH(9)=0 THEN DH(9)=1:DP=29:M=D(9):GOTO 1500
1400 IF PK=29 AND DH(9)=1 THEN DH(9)=0:DP=29:M=D(9):GOTO 1600
1410 GOTO 1300
1500 POKE 764,255:POSITION 20,0:? ;"
":N=200:POSITION DP-11,0:? ;" "
1510 FOR I=8 TO 0 STEP -1:SOUND 0,N,10,10:POSITION DP+I,0:?
CHR$(M+3);" ";:N=N-10:FOR W=1 TO 10:NEXT W
1520 SOUND 0,0,0,0:FOR W=1 TO 5:NEXT W:NEXT I:POSITION
DP+I,0:? ;" ":POSITION DP-21,0:? CHR$(M+3):GOTO 100
1600 POKE 764,255:POSITION 20,0:? ;"
":N=80:POSITION DP-21,0:? ;" "
1610 FOR I=0 TO 7:SOUND 0,N,10,10:POSITION DP+I,0:? ;"
";CHR$(M+131):N=N+10:FOR W=1 TO 10:NEXT W:SOUND 0,0,0,0
1620 FOR W=1 TO 5:NEXT W:NEXT I:POSITION DP+I,0:? ;"
":POSITION DP-11,0:? CHR$(M+131):GOTO 100
1800 IF TSC(1)>TSC(2) AND TSC(1)>TSC(3) AND TSC(1)>TSC(4)
THEN M$=A$:GOTO 1840
1810 IF TSC(2)>TSC(1) AND TSC(2)>TSC(3) AND TSC(2)>TSC(4)
THEN M$=B$:GOTO 1840
1820 IF TSC(3)>TSC(1) AND TSC(3)>TSC(2) AND TSC(3)>TSC(4)
THEN M$=C$:GOTO 1840
1830 IF TSC(4)>TSC(1) AND TSC(4)>TSC(2) AND TSC(4)>TSC(3)
THEN M$=D$
1840 GOSUB 1200:POSITION 0,0:? ;"[INV]winner[INV] is
";M$:POSITION 20,0:? ;"PRESS ANY key TO GO"
1850 IF PEEK(764)=255 THEN 1850
1860 POKE 764,255:GOTO 2020
2000 DIM
A$(6),B$(6),C$(6),D$(6),M$(6),USC(4),LSC(4),TSC(4),Y(4),X(4),
DH(9),D(9),R(6),B(4),Y$(7)
2005
R(1)=132:R(2)=133:R(3)=134:R(4)=135:R(5)=136:R(6)=137:Q=(PEEK
(106)-8)*256:Y$="YAHTZEE"
2010 DIM
P(17,4),RS$(9),AS$(1),BS$(1):X(1)=16:X(2)=23:X(3)=30:X(4)=37:
X=2
2020 GRAPHICS 0:POKE 756,Q/256:POKE 710,0:POKE 752,1:POSITION
14,1:? "[INV] Y A H T Z E E [INV]":POSITION 14,2
2030 ? "[INV]                [INV]":POSITION 14,0:? "[INV]
[INV]":POSITION 5,5:? "HOW MANY PLAYERS - PRESS 1 TO 4"
2060 PK=PEEK(764):IF PK=31 THEN PL=1:GOTO 2120
2070 IF PK=30 THEN PL=2:GOTO 2120
2080 IF PK=26 THEN PL=3:GOTO 2120
2090 IF PK=24 THEN PL=4:GOTO 2120
2100 GOTO 2060
2120 POKE 764,255:FOR I=1 TO PL:POSITION 3,5:? "PLAYER ";I;"
TYPE YOUR NAME IN NOT MORE";
2130 POSITION 3,7:? "THAN SIX LETTERs ,THEN PRESS RETURN"
2140 IF I=1 THEN POSITION 3,11:? "   PLAYER 1 = ";:INPUT A$
2150 IF I=2 THEN POSITION 3,13:? "   PLAYER 2 = ";:INPUT B$
2160 IF I=3 THEN POSITION 3,15:? "   PLAYER 3 = ";:INPUT C$
2170 IF I=4 THEN POSITION 3,17:? "   PLAYER 4 = ";:INPUT D$
2180 NEXT I:POSITION 15,21:? "[INV] GOOD LUCK [INV]":POSITION
15,20:? "[INV]            [INV]":POSITION 15,22:? "[INV]
[INV]"
2500 FOR W=1 TO 300:NEXT W:? CHR$(125):POKE 712,66:POKE
710,16:POKE 711,12
2510 POKE 752,1:DL=PEEK(560)+PEEK(561)*256:POKE
DL+3,64+7+128:POKE DL+6,7:GOSUB 6000:POKE 54286,192
2600 FOR I=1 TO 9 STEP 2:DH(I)=0:NEXT I:FOR I=1 TO
4:B(I)=0:USC(I)=0:LSC(I)=0:TSC(I)=0:NEXT I:FOR Y=2 TO 17
2605 FOR PG=1 TO 4:P(Y,PG)=0:NEXT PG:NEXT Y:YS=0
2610 POSITION 1,2:? "3 ONES":POSITION 1,3:? "3 TWOS":POSITION
```


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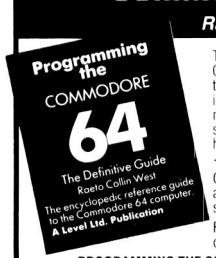

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PROGRAM FILE

```
1,4:? "3 THREES":POSITION 1,5:? "3 FOURS"
2620 POSITION 1,6:? "3 FIVES":POSITION 1,7:? "3
SIXS":POSITION 1,9:? "TOP TOTAL"
2630 POSITION 1,11:? "3 OFA KIND":POSITION 1,12:? "4 OFA
KIND":POSITION 1,13:? "FULL HOUSE":POSITION 1,14
2640 ? "S STRAIGHT":POSITION 1,15:? "L STRAIGHT":POSITION
1,16:? "YAHTZEE":POSITION 1,17:? "CHANCE"
2660 POSITION 1,19:? "BOT TOTAL":POSITION 1,21:? "FULL
TOTAL":POSITION X(1)-4,1:? ;A$
2700 FOR I=1 TO PL:POSITION X(I)-4,2:? "1s=":POSITION
X(I)-4,3:? "2s="
2710 POSITION X(I)-4,4:? "3s=":POSITION X(I)-4,5:?
"4s=":POSITION X(I)-4,6:? "5s=":POSITION X(I)-4,7:? "6s="
2720 POSITION X(I)-4,9:? "TT=":POSITION X(I)-4,11:?
"3K=":POSITION X(I)-4,12:? "4K="
2730 POSITION X(I)-4,13:? "FH=":POSITION X(I)-4,14:?
"SS=":POSITION X(I)-4,15:? "LS="
2740 POSITION X(I)-4,16:? "YZ=":POSITION X(I)-4,17:?
"CH=":POSITION X(I)-4,19:? "BT="
2750 IF I=2 THEN POSITION X(I)-4,1:? ;B$
2760 IF I=3 THEN POSITION X(I)-4,1:? ;C$
2770 IF I=4 THEN POSITION X(I)-4,1:? ;D$
2780 POSITION X(I)-4,21:? "FT=":NEXT I:GOTO 40
6000 RESTORE 4050:FOR I=0 TO 10:READ C:POKE 1536+I,C:NEXT I
6010 POKE 512,0:POKE 513,6
6020 RETURN
6050 DATA 72,169,178,141,10,212,141,26,208,104,64
```

Enterprise Analogue Clock

by E de Jons

Analogue Clock is a short utility for the Enterprise 64. The program puts an analogue clock on the screen complete with hour, minutes and sweep second hand. When run, you will be asked to enter the current hours, minutes and seconds. After this has been entered, a real-time clock will be displayed with a digital one underneath. To terminate, use the BREAK key.

```
100 PROGRAM "analogue_clock"
110 TEXT
120 SET BORDER 40
130 SET #102:PALETTE 40,70,83,83
140 INPUT AT 10,6,PROMPT "Number of hours ?     (1-23) ":AU
150 LET AU=INT(ABS(AU)):LET AU$=""
160 IF AU<0 OR AU>23 THEN 140
170 IF AU<10 THEN LET AU$="0"
180 LET AU$=AU$&STR$(AU)
190 INPUT AT 12,6,PROMPT "Number of minutes  ?  (1-59) ":AM
200 LET AM=INT(ABS(AM)):LET AM$=""
210 IF AM<0 OR AM>59 THEN 190
220 IF AM<10 THEN LET AM$="0"
230 LET AM$=AM$&STR$(AM)
240 INPUT AT 14,6,PROMPT "Number of seconds ?     (1-59) ":AS
250 LET AS=INT(ABS(AS)):LET AS$=""
260 IF AS<0 OR AS>59 THEN 240
270 IF AS<10 THEN LET AS$="0"
280 LET AS$=AS$&STR$(AS)
290 TIME AU$&":"&AM$&":"&AS$
300 OPTION ANGLE DEGREES
310 ENVELOPE NUMBER 1:0,63,63,1:0,-63,-63,69
320 SOUND ENVELOPE 1,PITCH 79.5,DURATION 70
330 SOUND ENVELOPE 1,PITCH 81,DURATION 70
340 SOUND ENVELOPE 1,PITCH 83,DURATION 70
350 SOUND ENVELOPE 1,PITCH 84,DURATION 70
360 SET VIDEO MODE 1
370 SET VIDEO COLOR 1
380 SET VIDEO X 30
390 SET VIDEO Y 25
400 OPEN #1:"video:"
410 SET VIDEO MODE 0
420 SET VIDEO COLOR 0
430 SET VIDEO X 8
440 SET VIDEO Y 2
450 OPEN #11:"video:"
460 SET #10:PALETTE 34,11,255,20
470 SET #11:PALETTE 81,255,81,81
480 SET #10:INK 2
490 PLOT #10:480,450,ELLIPSE 400,400,ELLIPSE 420,420,
500 SET #10:INK 1
510 PLOT #10:480,40,PAINT
520 SET #10:INK 3
530 PLOT #10:480,450,PAINT
540 DISPLAY #10:AT 1 FROM 1 TO 25
```

PROGRAM FILE

```
550 DISPLAY #11:AT 26 FROM 1 TO 2
560 SET BORDER 81
570 SET STATUS OFF
580 SET #10:INK 2
590 FOR S=31 TO 361 STEP 30
600 LET X=370*SIN(S):LET Y=370*COS(S)
610 LET S$=STR$((S-1)/30)
620 IF VAL(S$)>10 THEN LET X=X-(VAL(S$)-10)*15
630 IF VAL(S$)=10 THEN LET X=X-10
640 PLOT #10:470+X,460+Y,
650 PRINT #10:S$
660 NEXT
670 LET UA=480:LET UB=450:LET MA=480:LET MB=450:LET SA=480:LET SB=450:LET S=0
680 LET MC=VAL(TIME$(4:5))*6
690 LET UP=VAL(TIME$(1:2))
700 IF UP>12 THEN LET UP=UP-12
710 IF UP=0 THEN LET UP=12
720 LET UC=UP*30+MC/12
730 LET MX=SIN(MC)*320+480:LET MY=COS(MC)*320+450
740 LET UX=SIN(UC)*250+480:LET UY=COS(UC)*250+450
750 LET SEC=VAL(TIME$(1:2)):LET SC=SEC*6
760 LET MC=VAL(TIME$(4:5))*6
770 LET UP=VAL(TIME$(1:2))
780 IF UP>12 THEN LET UP=UP-12
790 IF UP=0 THEN UP=12
800 LET UC=UP*30+MC/12
810 SET #10:INK 3
820 LET SX=SIN(SC)*320+480:LET SY=COS(SC)*320+450
830 IF SEC=0 THEN
840 LET MX=SIN(MC)*320+480:LET MY=COS(MC)*320+450
850 IF MC/90=INT(MC/90) THEN
860 LET UX=SIN(UC)*250+480:LET UY=COS(UC)*250+450
870 IF MC=0 AND SEC=0 THEN LET S=UP
880 PLOT #10:480,450:UA,UB
890 END IF
900 PLOT #10:480,450:MA,MB
910 END IF
920 PLOT #10:480,450:SA,SB
930 SET #10:INK 2
940 PLOT #10:480,450:SX,SY
950 SOUND PITCH 10,DURATION 1,SOURCE 1
960 PLOT #10:480,450:MX,MY
970 PLOT #10:480,450:UX,UY
980 PLOT #10:480,450,ELLIPSE 10,10
990 PRINT #11:CHR$(30):TIME$:
1000 IF S>0 THEN
1010 SOUND ENVELOPE 1,PITCH 27,DURATION 70
1020 LET S=S-1
1030 END IF
1040 LET SA=SX:LET SB=SY
1050 LET MA=MX:LET MB=MY
1060 LET UA=UX:LET UB=UY
1070 DO
1080 LOOP WHILE SEC=VAL(TIME$(7:8))
1090 GOTO 750
1100 ! "@ E. de Jong,Netherlands"
```

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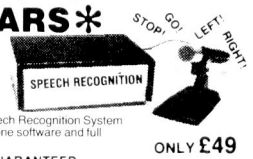

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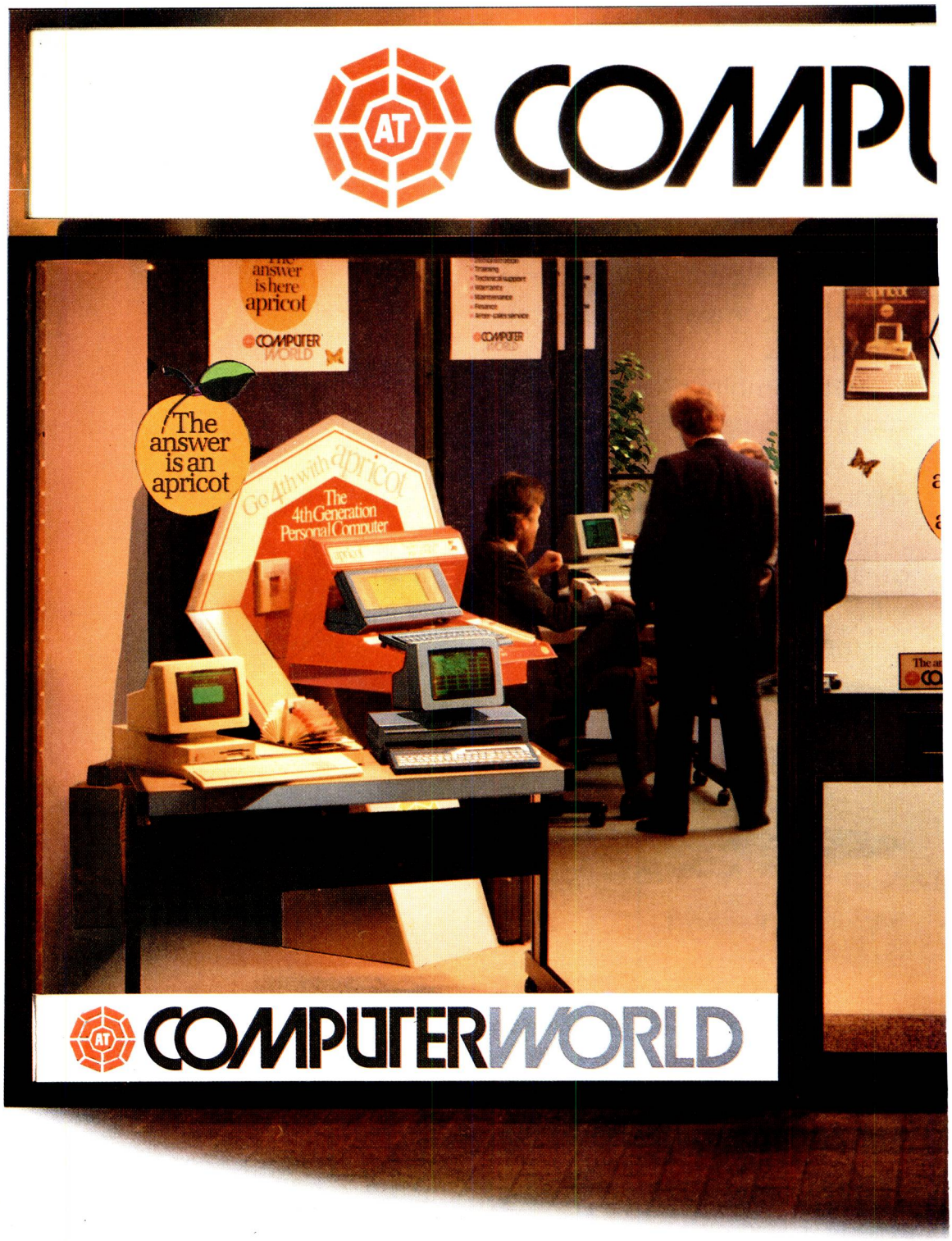

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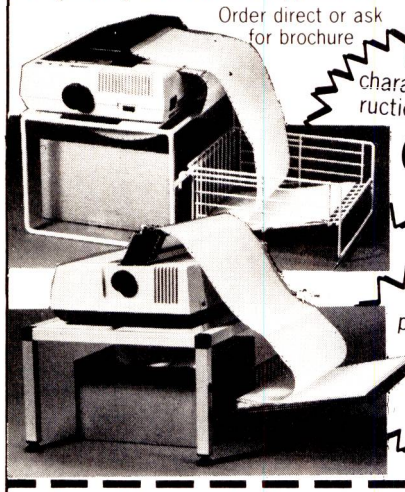

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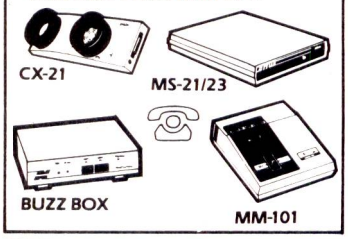

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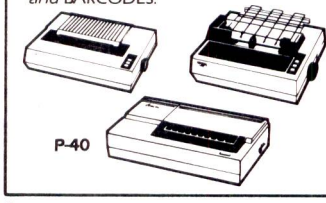

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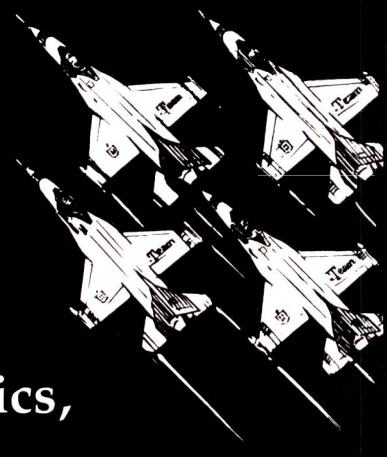

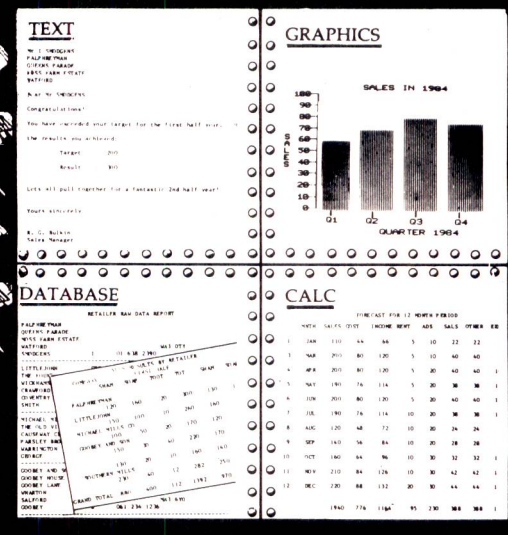

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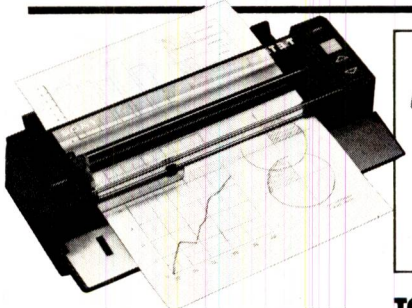

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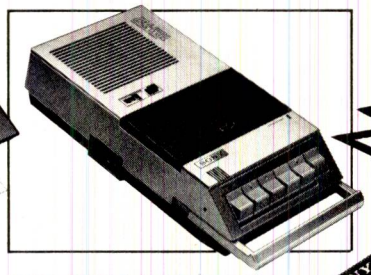

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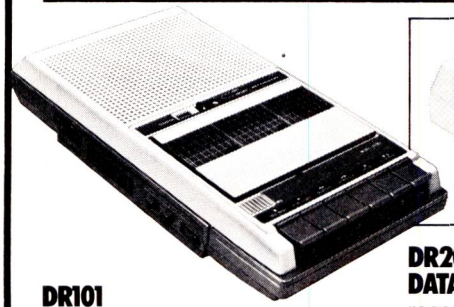
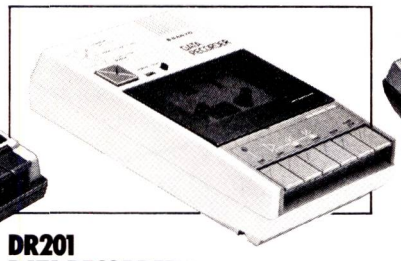


DR101 RECORDER Specifically designed for use with personal computers, with phase shift switch, speaker monitor and AC/DC operation.

£34.99



DR201 DATA RECORDER An AC only recorder styled for computer use with all controls conveniently placed on top of the machine for ease of use.

£34.99

JOYSTICK MJY 002 **£12.99**

SPECIAL OFFER!

SLIM 11 DATA RECORDER
MJY 002 JOYSTICK

Plus special software pack.
Total value over:

£50.00



FREE!

When you purchase the Sanyo MPC 100 Computer.

PRICES SHOWN INCLUDE VAT AND ARE CORRECT AT TIME OF GOING TO PRESS. E. & O.E.

FOR DETAILS OF YOUR NEAREST STOCKISTS AND OTHER MSX PRODUCTS, SEE FOLLOWING PAGES.

cognises the future potential of computer usage at home, both entertainment and practical purposes.

That's why household names famous for superb quality and value have selected MSX as the one system to become the computer industry standard. Axis bring you the best names in MSX at the best possible prices.

quality & choice...



TOSHIBA

Toshiba were the first to introduce MSX into the UK market. With their years of experience and their firm commitment to the home electronics industry, Toshiba recognise the potential of the computer in the home and have selected MSX as the realistic standard to work to.





HX-J400 JOYSTICK
£12.95

HX-P550 HIGH SPEED DOT MATRIX PRINTER Printing at 105 characters per second, for fast copies of all information, including graphics symbols. Ideal for word processing and programme listing. **£349.00**

140E MONITOR STYLE COLOUR TELEVISION
The perfect partner for the HX10, providing excellent picture and sound quality. **£189.95**

THE STAR VALUE TOSHIBA HX10

Offering superb facilities and outstanding value for the first time user or enthusiast. 64K Ram, 16 colour graphics, RF, video and audio connectors, plus ports for printer, disk drive and data recorder. **£279.95** (For money saving offer see panel)

HX-P570 PLOTTER PRINTER Easily connected to the HX10 through the printer interface. This printer features image and character plotting in 4 colours – red, green, blue and black – making it ideal for colourful graphs, pie and bar charts. Plotting speed is 285 steps per second. **£249.00**



SAVE £40

off the normal Axis price of the Toshiba HX10 Computer

PLUS 3 year guarantee
PLUS 3 Free software titles.
ALL FOR

£239.95

AXIS
AT HOME WITH TECHNOLOGY

DON'T FORGET TO ASK YOUR DEALER FOR DETAILS OF CREDIT FACILITIES, EXTENDED GUARANTEES, ETC. AVAILABLE ON CERTAIN ITEMS.

THE UNIQUE MSX SYSTEM ...unbeatable

The MSX System allows the experienced computer user to select, from a wide range of peripherals, all they need for any particular

SAVE OVER £100**



AXIS COMPLETE COMPUTING PACKAGE*

- **SANYO MPC 100** Computer
- **SANYO SLIM 10** Data Recorder
- **SANYO MJY 002** Joystick
- **SAMSUNG BT309K** B/W TV Monitor

PLUS £35 worth of software

ONLY £324.95

Normal Axis price £425.75

*Offers available only while stocks last **Axis Saving refers to previous advertised prices or recommended retail prices.

JVC

JVC invented the 'VHS' format for video recorders, so are well aware of the advantages of standardization.

They forecast MSX as the worldwide home computing standard and they see the video compatibility of their MSX as a key development path into the future.

THE SPECTACULAR HC-7GB



The HC-7GB personal computer from JVC is a new MSX machine designed for total compatibility between other MSX machines and all MSX software. A highly advanced 64K machine, the HC-7GB has three display modes offering RF, composite video and RGB outputs.

The HC-7GB MSX personal computer from JVC is the final word in home entertainment. **£279.00**

7255 GB 14" COLOUR TV MONITOR A fully remote controlled TV, ideal as a computer monitor or alone as a second TV. **£259.00**

HCJ 615 JOYSTICK £12.95

HC-R105 DATA RECORDER The stylish designed HC-R105 data recorder is an example of a machine produced to offer superb user convenience, exceptional performance parameters and reliable data transfer. The HC-R105 is a high speed machine giving very short access times to data. **£89.00**

FREE! JVC SOFTWARE PAC
WHEN YOU PURCHAS THE AMAZING HC-7GI COMPUTI

"SPECIAL FOR VIDEO ENTHUSIASTS"
Add your own titles to your video films with the Character Generator included in the JVC free software pack.

PRICES SHOWN INCLUDE VAT AND ARE CORRECT AT TIME OF GOING TO PRESS. E. & O.E.

FOR DETAILS OF YOUR NEAREST STOCKISTS AND OTHER MSX PRODUCTS, SEE PREVIOUS AND FACING PAGES.

application. But, in order to help those starting a new system, Axis have put together a special range of "Complete Package Deals" that contain everything needed to start in computing.

These "Complete Package Deals" are available to you at exclusive and unbeatable Axis prices.

package deals



SAVE OVER £115**

AXIS COMPLETE COLOUR PACKAGE*

- **TOSHIBA HX10** Computer
- **TOSHIBA 140E** Colour TV Monitor
- **TOSHIBA HX-J400** Joystick
- **SANYO SLIM 10** Data Recorder

PLUS Assorted Software (value **£9.95**)

*Offers available only while stocks last
**Saving refers to previous Axis advertised prices or recommended retail prices.

ONLY £399.95

Normal Axis price £517.75

AXIS BRINGS A GREAT DEAL TO THE INDEPENDENT DEALER

Axis is an organisation that brings you the best deals through your existing High Street dealer.

With an established reputation for personal service and care for their customers, Axis recommended dealers now bring you deals that no multiple can match.

Axis provide the resources to research and select high quality products and to make them available through the independent at unbeatable prices.

For "Exclusive Axis Deals" and the "Greatest Ever Care and Service", your nearest Axis recommended dealer is:

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BRISTOL C.J. FREEMAN & CO. LTD. 47, High St., Portishead Tel: 0272 848180

BEDFORDSHIRE

BEDFORD TAVISTOCK HI-FI LTD. 21, The Broadway Tel: 0234 56323

BERKSHIRE

SLOUGH C.F. LAKE LTD. 37, Stoke Road Tel: 0753 38287

WINDSOR SONICS HI-FI LTD. 58 Grove Road Tel: 07535 60716

BUCKINGHAMSHIRE

CHESHAM D.L. CHITTENDEN LTD. 59-61, The Broadway Tel: 0494 784441

HIGH WYCOMBE C.F. LAKE LTD. 117/118 Oxford Road Tel: 0494 28605

CHESHIRE

NORTHWICH NORDIS LTD. 39, Chester Way Tel: 0606 3691

CREWE ROY TOWNSEND SOUND & VIDEO 2-4 Victoria Street Tel: 0270 213276

CLEVELAND

STOCKTON N TEES MCKENNA & BROWN LTD. 81, High Street Tel: 0642 679995

DERBYSHIRE

DERBY STUART WESTMORELAND 67, St. Peter's Street Tel: 0332 367546

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DARLINGTON MCKENNA & BROWN LTD. 102, Bondgate Tel: 0325 59744

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EASTBOURNE CLEARVIEW RENTAL 215, Seaside Tel: 0323 21646

SEAFORD CLEARVIEW RENTAL 34-40, High Street Tel: 0323 898989

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GRAYS A.C.L. RADIO SERVICES LTD. 1, Northmall Tel: 0375 4666

ILFORD D. WOOLFMAN LTD. 76, Ilford Lane Tel: 01-478 1307

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ABERDEEN A & G KNIGHT 108, Rosemount Place Tel: 0224 630526

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WC1 HI-WAY HI-FI LTD. 67 Tottenham Court Road (Goodge Street) Tel: 01-637 9787

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BASINGSTOKE SEWARDS 18, Paddington House, Bedford Walk Tel: 0256 65665

KENT

GRAVESEND BENNETT & BROWN 181-183, Windmill Street Tel: 0474 52919

SHEERNESS BRITTAIN & HOBBS. LTD. 22-24, High Street Tel: 0795 665551

LANCASHIRE

PRESTON GOODRIGHTS LTD. 1, Friargate Tel: 0772 57528

BARNOLDSWICK HARRY GARLICK (TV CENTRE) 1, Church Street Tel: 0282 813309

BURNLEY HARRY GARLICK (TV CENTRE) 10, Howe Walk Tel: 0282 37118

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WIGSTON A.G. KEMBLE LTD. 63, Leicester Road Tel: 0533 881557

LOUGHBOROUGH STUART WESTMORELAND 33, Cattlemarket Tel: 0509 230465

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NORFOLK

NORWICH HUGHES TV & AUDIO 17-21, White Lion Street Tel: 0603 60935

NORTHERN IRELAND

NORTH BELFAST THE GRAMOPHONE SHOP 16 Donegall Square N Tel: 0232 240046

NORTH YORKSHIRE

YORK CUSSINS & LIGHT LTD. Kings Square Tel: 0904 55666

NOTTINGHAMSHIRE

NOTTINGHAM E.N.L. AUDIO VISUAL 116-118, Alfreton Road Tel: 0602 784015

STAFFORDSHIRE

STOKE-ON-TRENT ROY TOWNSEND SOUND & VIDEO 10, Trinity Street, Hanley Tel: 0782 289114

STRATHCLYDE REGION

SALTCOATS HARRIS OF SALTCOATS 104-106, Dockhead Street Tel: 0294 64330

SUFFOLK

IPSWICH HUGHES TV & AUDIO 42, Buttermarket Tel: 0473 215093

LOWESTOFT HUGHES TV & AUDIO 62, London Road North Tel: 0502 85611

SURREY

DORKING DORKING AUDIO SYSTEMS 23, South Street Tel: 0306 882897

W. GLAMORGAN

SWANSEA RADIO SUPPLIES SWANSEA LTD. 80 Gower Road, Sketty Tel: 0792 204140

WEST YORKSHIRE

HOLMFIRTH FRANK PLATT ELECTRICAL Victoria House, 24, Victoria Street Tel: 0484 682036

HALIFAX FRED MOORE LTD. 15-17, Southgate Tel: 0422 67763

BINGLEY SPENCER & HILL LTD. 133, Main Street Tel: 0274 565161

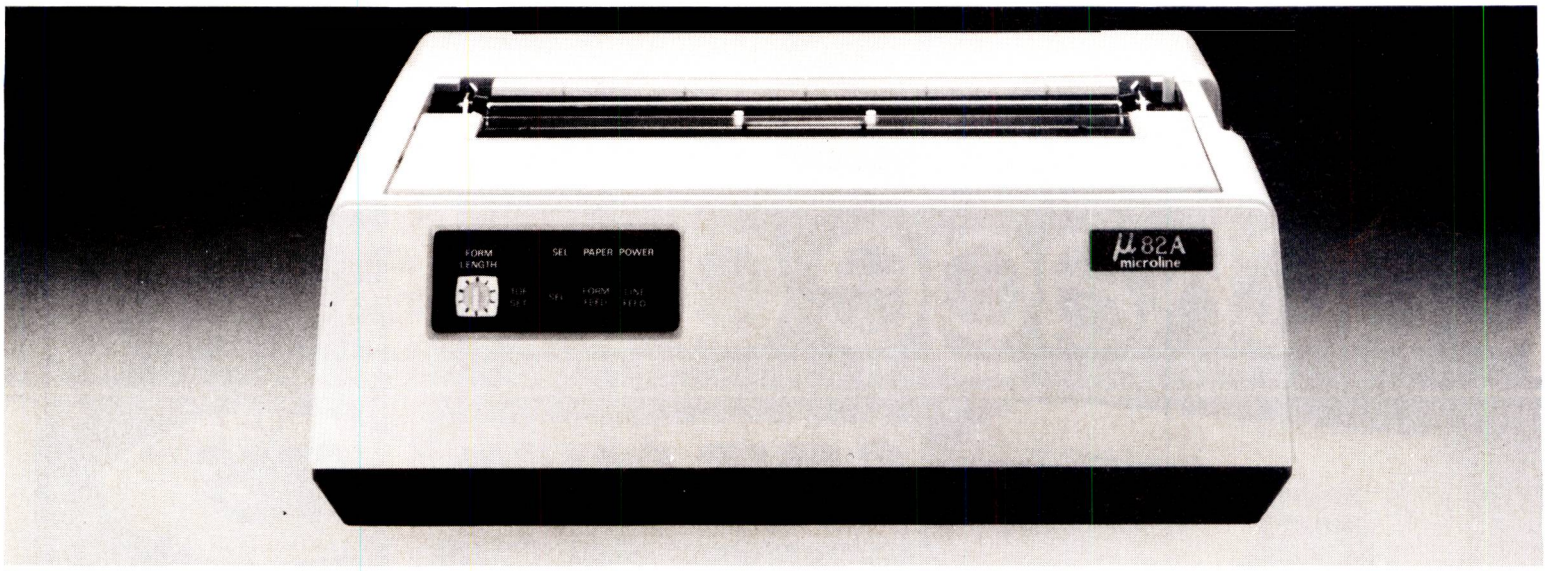
Demand for some MSX products means supplies are limited. Please phone your dealer to check that he has stock available.

Note: For your local stockists of particular products in this advertisement,

Ring Teledata 01-200 0200

DON'T FORGET TO ASK YOUR DEALER FOR DETAILS OF CREDIT FACILITIES, EXTENDED GUARANTEES, ETC. AVAILABLE ON CERTAIN ITEMS.

AXIS
AT HOME WITH TECHNOLOGY



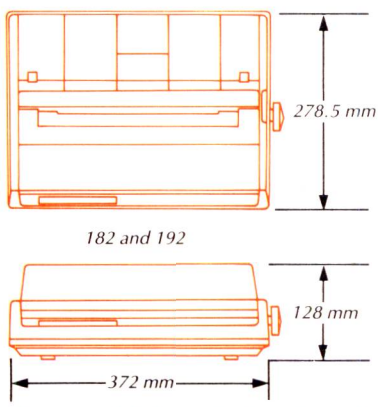
The MICROLINE 82A

FROM EXCELLENCE

THE NEW OKI

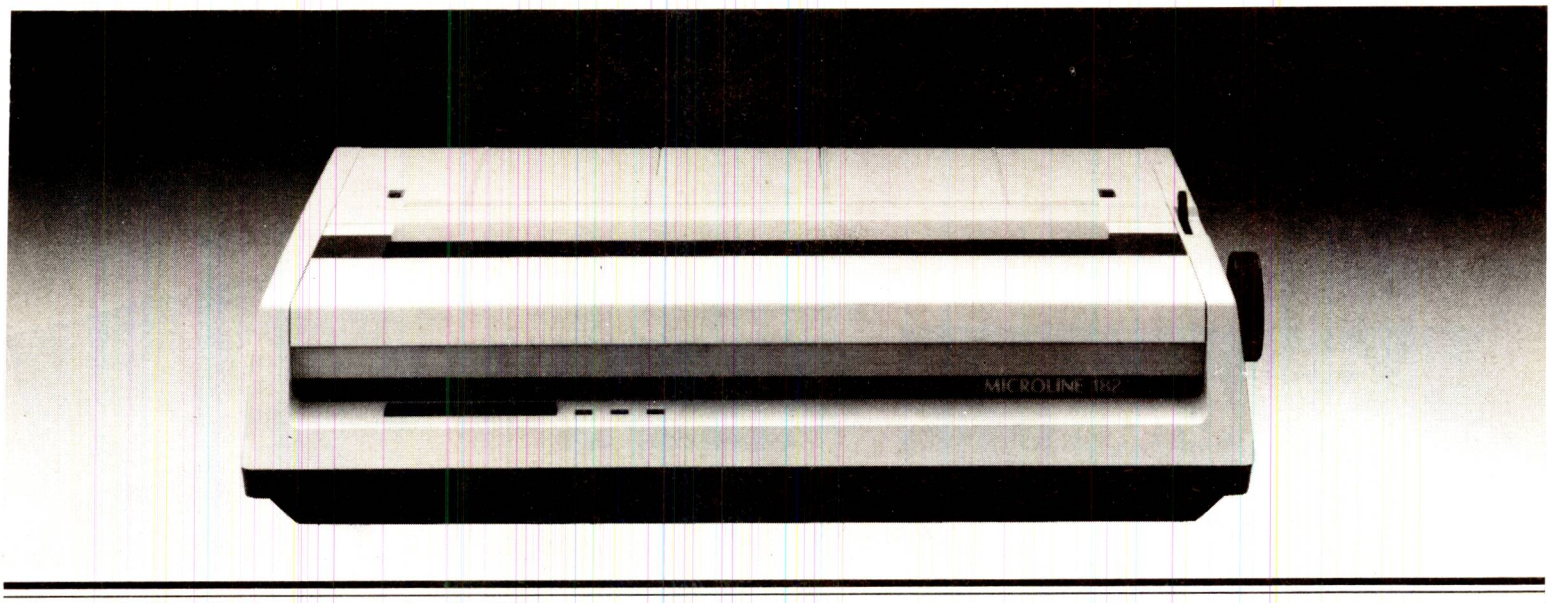
Above we show you two printers (to the same scale). On the left is the OKI MICROLINE 82A - one of the most successful standard dot matrix printers ever manufactured. On the right is the printer that will become the NEW standard for dot matrix printers - the new MICROLINE 182 - from OKI.

In the past OKI have always achieved excellence in their printer products - now we believe they've reached perfection! OKI's revolutionary design concept for the new Microlines sets hitherto unparalled standards of performance, styling - and price.



The dimensions of the larger Microline 193 are, length 524 mm, width 278.5 mm and height 128 mm. These dimensions do not include the platen and tractor unit.

The new MICROLINE 182 is the first of a whole new range of printers from OKI which fulfil all the requirements of today's printing needs. With operating noise level reduced to an almost unbelievable 58dB. and a print speed of 120 characters/second, listings, invoices and many other applications are all handled quietly, with upmost speed and efficiency. If your requirement is for high resolution computer graphics, the MICROLINE 182 will reproduce your screen images with a degree of accuracy never before seen from a matrix printer. True underlining, superscript and subscript are



The new MICROLINE 182 to the same scale as the 82A

TO PERFECTION MICROLINES

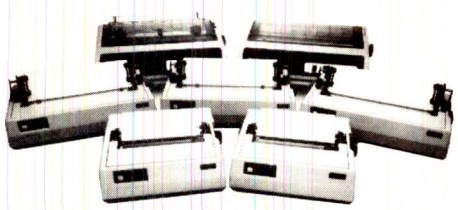
OKI IS O.K.

also incorporated as standard. In addition a new concept in ribbon design, allows a single action 'clean hands' operation.

But that's not all - complementing the new styling and incorporating even more features are the MICROLINE 192 and 193. Both have the same incredibly high specification as the 182 - PLUS

- Even faster throughput (160 cps)
- Correspondence quality printing
- Down line loadable character font memory - with battery back-up
- Operator selectable default settings.

OKI



X-DATA

A Subsidiary of **Dyneer** *Corporation*

X-DATA Ltd. 750/751 Deal Avenue
Slough Trading Estate Berks SL1 4SH
Tel: Slough, (0753) 72331 Tlx. 847728

The reputation of OKI MICROLINE printers was built on excellence of quality and reliability. The new Microlines are no exception - even higher quality, greater reliability and performance bring the new generation of OKI MICROLINE printers - to near perfection.

Contact your local dealer for more details of the new generation from OKI or contact us directly at the address below. Insist on perfection.... insist on OKI.

spectrum

Sinclair Flat Screen T.V.



- Pin sharp picture gives a bright, clear image almost anywhere, anytime.
- Powered from long life lithium batteries or via optional mains adaptor
- Receives UHF broadcasts anywhere (except France and Communist Bloc)
- Complete with intergral fold-away aerial; personal earphone and smart soft carrying case and battery.

Accessories:
Optional mains adaptor £7.95
Spare batteries, pack of 3 ..... £9.95

£99.95

Only £8 monthly with Spectrum Chargecard*. APR 29.8% (variable).

New Products!

Enterprise Computer

- RAM 64K expandable to 3.9 megabytes
- ROM 48K including BASIC cartridge expandable up to 3.9 megabytes
- Very sophisticated operating system, providing a dynamic memory management technique around a Z80A processor running 4MHz
- Built in word processor
- Graphics resolution up to 672 x 512, colours up to 256 on screen
- Stereo sound from 4 voices over 8 octaves
- Fully structured ANSI standard BASIC
- Keyboard, 68 full travel keys, space bar and built in joystick
- 2 external joystick ports, 2 cassette interfaces
- Parallel printer port, RGB monitor output
- Full expansion possible via a 64-way interface
- RS423 serial interface and built-in network for up to 32 computers
- Cartridge ROM bay, to 64K



£249.00

Only £11 monthly with Spectrum Chargecard* APR 29.8% (variable).

Mitsui Quick Data Drive for MSX Computers	£139.95
Mitsui Quick Data Diskette	£3.99
Cumana Electron Interface	£149.95 inc. VAT
Commodore Business Package	£549.95
Quendata DMP1100 Printer	£269.99
Juki 2200 Portable Typewriter/Daisywheel Printer	£343.83
Canon PW1080A Printer	£349.00
Elephant 5¼" Diskettes (IQ Box) from	£22.50
System 2000 Computer Desk and Monitor Bridge	£49.95



SAVE OVER £150

NEW!

Commodore 64 Business Package

- Commodore 64 Computer
- Commodore 1541 disc drive
- Commodore MSP 801 printer
- Plus "Future Finance" & "Easy File"

Spectrum Price £549.95

Only £23 with Spectrum Chargecard* APR 29.8% (variable)



Spectrum Price £308.50

SAVE OVER £50

Regular price if brought separately £359.87

Only £13 monthly with Spectrum Chargecard* APR 29.8% (variable)

"Super Value"

MSX Package

- Goldstar MSX Computer
- Mitsui quick data drive
- Power supply for quick data drive
- Two discs for quick data drive

Super Computer Offers from Spectrum



£349.95

BBC Model B

with built in Speech Synthesiser worth £50

Only £15 monthly with Spectrum Chargecard* APR 29.8% (variable).



£129.95

Sinclair Spectrum +

"Fantastic Value for Money"

- 48K RAM
- 8 colours
- 10 octave sound
- Professional keyboard

Only £8 monthly with Spectrum Chargecard* APR 29.8% (variable).

Spectrum 48K

Plus FREE! Software 6 Pack



£99.95

Only £8 monthly with Spectrum Chargecard* APR 29.8% (variable).

Atari 800XL Starter Pack



Includes:
- Atari 1010 data recorder
- Introduction to programming software
- Pole position game cassette
- Demonstration cassette

£129.99

Only £8 monthly with Spectrum Chargecard* APR 29.8% (variable).

Not all stores carry every advertised item, please phone before making a journey - prices correct at time of going to press E&OE

spectrum CHARGE CARD

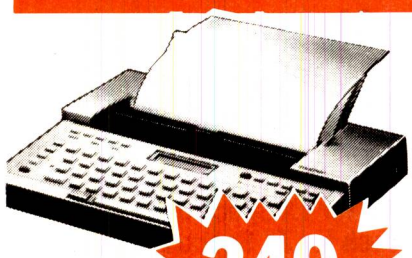
Up to £1000 Instant Credit

*There's up to £1,000 worth of Instant Credit available on a Spectrum Chargecard. See your local SPECTRUM dealer for written details (UK mainland only). Typical APR 29.8%.

Latest News

for up to date, information & offers from SPECTRUM - see PRESTEL page 600181 for details.

Super Value
Printers & Disc Drives
from Your Computer Specialist Nationwide



Brother EP-44 Printer/Typewriter

'Transforming Office Machinery', runs Brother's slogan - with these super-compact battery powered type-writers it's easy to see why.

- Top quality thermal head
- 4K of text memorise (3 A4 pages)
- Centering if required
- 15-digit LCD display for pre print corrections
- Line-by-line edit facility

£249.95

Only £11 monthly with Spectrum Chargecard*. APR 29.8% (variable)

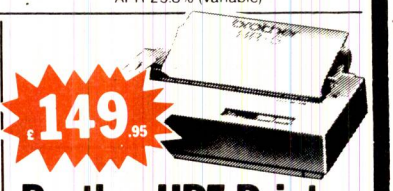


£199.95

Brother M1009 Printer

- 50 cps Bidirectional printing
- normal/enlarged/condensed/emphasized/Elite /superscript/subscript characters
- Centronics interface
- Optional RS232 Interface

Only £9 monthly with Spectrum Chargecard*. APR 29.8% (variable)



£149.95

Brother HR5 Printer with Commodore Cable

- Top quality Letter-quality daisywheel printing
- Between 13 and 18cps
- Bi-directional printing
- Tractor-fed paper or single sheets

Only £8 monthly with Spectrum Chargecard*. APR 29.8% (variable)



£199.00

Commodore 1541 Disc Drive

- 5¼ inch disc
- Expansion bus for other peripherals
- Built in disc controller and operating system

Only £9 monthly with Spectrum Chargecard*. APR 29.8% (variable)



£199.95

Amstrad 3" Disc Drive

- 3 inch disc drive
- Single sided, double density
- CPM & Logo
- Built in power supply
- Complete with interface

Only £9 monthly with Spectrum Chargecard*. APR 29.8% (variable).

Cumana Disc Drives



CSX 100 40 Track 100K SS	£124.95
CSX 200S 40/80 Track 100K SS	£159.95
CSX 400S 40/80 Track 100K SS	£189.95
CS 200S 40/80 Track SS with PSU	£192.95
CS 200D 40 Track DS with PSU	£169.95
CD 200 40 Track Dual Drive with PSU	£294.95
CS 400S 80 Track DS with PSU	£219.95
CD 400D 80 Track DS Dual Drive with PSU	£325.95
CD 800S Dual 40/80 Track DS with PSU	£414.95
Cumana 351 SS 40 Track 3½" Drive	£159.95
Cumana 354 DS 80 Track 3½" Drive	£229.95

Juki 2200 Printer

NEW!



£343.85

Electronic daisywheel typewriter with RS-232C or Centronics Interface for computer printer

- 10 cps
- 10/12/15 cpi pitch
- 12 inch paper width/9 inch print width
- Normal/decimal tabs

Only £15 monthly with Spectrum Chargecard*. APR 29.8% (variable)



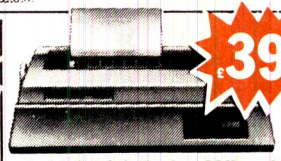
£269.99

NEW!

Quendata DMP 1100 Printer

- Bi-directional printing
- Normal/enlarged/condensed/Elite/characters
- Centronics interface
- Optional RS232 interface

Only £12 monthly with Spectrum Chargecard*. APR 29.8% (variable)



£399.00

Juki 6100 Daisy Wheel Printer

- 20cps (av. 18cps Shannon Text)
- 10/12/15 or Proportional character spacing
- Bidirectional friction-feed
- Tractor-feed or cut paper

Only £17 monthly with Spectrum Chargecard*. APR 29.8% (variable)

Opus Disc Drives



Opus 5401 100K SS 40 track	£149.95
Opus 5402 200K DS 40 track	£169.95
Opus 5802 400K DS 40/80 track	£199.95
Opus 5802D 2x400K DS 40/80 Track	£499.95

Entrepo Quick Data Drive



£79.95

- Quick operating system
- Extra blan microwafer and operating manual

Only £8 monthly with Spectrum Chargecard*. APR 29.8% (variable)



£139.95

'New Exclusive'

Mitsui Quick Data Drive for MSX

Also available

MSX Printer Lead	£19.95
MSX Monitor Lead	£3.95
MSX Quickshot I Joystick	£9.95

Only £8 monthly with Spectrum Chargecard*. APR 29.8% (variable)

Canon PW-1080A

NEW!

Dot Matrix Printer

- 160 cps
- Bidirectional printing in text mode
- Normal/enlarged/condensed/ condensed/enlarged/Elite/ Elite enlarged/characters
- Centronics interface
- Optional RS232 interface



£349.00

Only £17 monthly with Spectrum Chargecard*. APR 29.8% (variable)

Rotronics Wafer Drive



£129.95

- Versatile twin datadrive for the ZX Spectrum
- Twin 128K drives
- 16K, 64K or 128K Wafers

Only £8 monthly with Spectrum Chargecard*. APR 29.8% (variable)

Datafax Disc Interface



£79.95

Allows you to run 3-3½" or 5¼" disc drives on Spectrum or Spectrum Plus

Only £8 monthly with Spectrum Chargecard*. APR 29.8% (variable)

Spectrum Computer Centres have no connection whatsoever with the ZX-Spectrum Computer manufactured by Sinclair Research Ltd.

Computer Dealers

or prospective dealers. If you would like to know more about becoming a SPECTRUM APPOINTED DEALER on an exclusive area basis, please write to Bob Cleaver, Spectrum Group PLC, Hunting Gate, Hitchin, Herts. SG4 0TJ. Tel: (0462) 37171

More from Spectrum...

spectrum

Super Value Monitors & T.V.'s from Spectrum

Fidelity Prism Monitor
for use with the Sinclair QL



£199.95

Only £9 monthly with Spectrum Chargecard* APR 29.8% (variable).

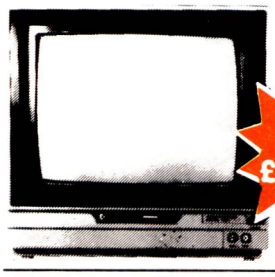
Fidelity CM14 Monitor



£199.95

Only £9 monthly with Spectrum Chargecard* APR 29.8% (variable).

Commodore 1702 Monitor



£230.00

- 14" colour, sound monitor
- PAL/RGB composite
- Tint and volume controls

Only £10 monthly with Spectrum Chargecard* APR 29.8% (variable).

Microvitech Cub
1451 Monitor for use with the QL



£275.00

Only £12 monthly with Spectrum Chargecard*. APR 29.8% (variable).

Microvitech Cub
452/1431 Monitor
Standard Resolution for BBC



£229.00

Only £10 monthly with Spectrum Chargecard*. APR 29.8% (variable).

AVT Monitors



£99.95

- Available in Green or Orange screen displays
- Glare or Non-Glare screens
- For office micros, or personal computers

Only £8 monthly with Spectrum Chargecard* APR 29.8% (variable).

Tatung 14" Colour T.V.

£234.95

- TV/RGB switchable
- 8 channels
- 14" tube

Only £10 monthly with Spectrum Chargecard* APR 29.8% (variable).

Sanyo CRT36 Monitor



£146.05

Only £8 monthly with Spectrum Chargecard* APR 29.8% (variable).

Super Value Accessories

Super Value Package for Spectrum
Currah Microslot for ZX Spectrum
Currah Microspeech for ZX Spectrum



- DK Tronics single port joystick interface
- Quickshot II joystick

SAVE OVER £5.00

£41.75

Only £8 monthly with Spectrum Chargecard*. APR 29.8% (variable).

Regular Price if brought Separately £46.85

Joystick Converter for CBM C16 Plus
Quickshot 2 Joystick

£12.95

Regular Price £15.70
SAVE £2.75

Only £8 monthly with Spectrum Chargecard*. APR 29.8% (variable).

DK Tronics Dual Port Interface for Oric Plus
Interceptor Joystick

£18.95

Regular Price £21.95
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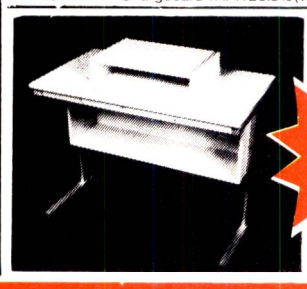

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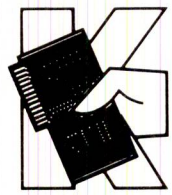

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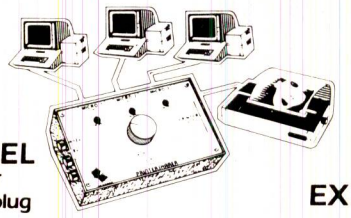

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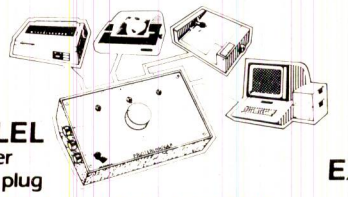

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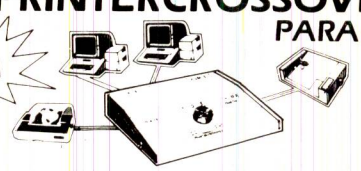

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2D	HR	D/side S or D Dens	48tpi 40Tr	26.00	25.00	24.00
1Q		S/side Q Dens	96tpi 80Tr	26.00	25.00	24.00
2Q		D/side Q Dens	96tpi 80Tr	31.50	30.50	28.50
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104/1D	HR	S/side D Dens	48tpi 40Tr	16.50	15.90	15.30
104/2D	HR	D/side D Dens	48tpi 40Tr	24.00	23.25	22.50
204/1D	HR	S/side Q Dens	96tpi 80Tr	24.00	23.25	22.50
204/2D	HR	D/side Q Dens	96tpi 80Tr	29.00	28.25	27.50
VERBATIM DATALIFE (5 Year Warranty)						
MD525-01HR		S/side S or D Dens	48tpi 40Tr	14.95	14.70	14.20
MD550-01HR		D/side S or D Dens	48tpi 40Tr	19.20	18.45	17.70
MD577-01HR		S/side Q Dens	96tpi 80Tr	19.20	18.45	17.70
MD557-01HR		D/side Q Dens	96tpi 80Tr	25.20	24.95	24.00
10 or 16 hard sectors at same price. Add £1.20 for library box.						
MEMOREX (5 year warranty)						
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3501	HR	D/side Q Dens	96tpi 80Tr	Prices		
5500HD		D/side H Dens 1.6MB	80Tr			
BASF 1D		S/side D Dens	48tpi 40Tr	10.99	10.50	10.00
BASF (Qualimetric) **** FREE Library Box with every 10 Disks ****						
1X	HR	S/side S Dens	48tpi 40Tr	14.10	13.70	13.30
1D	HR	S/side D Dens	48tpi 40Tr	14.70	14.20	13.70
2D	HR	D/side D Dens	48tpi 40Tr	18.65	17.90	16.65
1D/96	HR	S/side Q Dens	96tpi 80Tr	19.30	18.55	17.30
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CUMANA - Packed in Library Box						
2Q	HR	D/side Q Dens	96tpi 80Tr	16.45	15.95	15.45
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ACCESSORIES						
HCK5		Head Clean Kit with Fluid		14.90	14.50	14.00
LC5		5.25 EGLY Library case		1.90	1.80	1.70
LB40-5		ABA Lockable Box 40 Cap inc Disk Pen		13.50	13.00	12.50
LB50-5		ABA Lockable Box 50 Cap inc Disk Pen		14.75	14.25	13.75
LB90-5		ABA Lockable Box 90 Cap inc Disk Pen		16.50	16.00	15.50
VCK-5		Verbatim 5" Head clean kit		6.40	6.20	6.00
VCD-5		Verbatim 5" H/c disks (per 10)		12.50	12.30	12.10
DPEN		BEROL Quality disk pens (per 12)		5.25	5.00	4.75
DL-5		Disk Labels 100 (5 colours)		4.50	4.25	4.00
DM-5		Disk Mailers 4 disk cap (per 100)		21.00	19.50	18.50

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OM-D3440		S/side D Dens	80Tr	33.00	32.25	31.50
OM-D4440		D/side D Dens	80Tr	42.50	41.75	41.00
VERBATIM						
MF350		S/side D Dens	80Tr	34.00	33.25	32.50
BASF (Qualimetric)						
FD3.5		S/side 80Tr	(Boxed in 5's)	17.00	16.50	16.00
ACCESSORIES						
S10-3.5		SEE-10 Library Box		2.30	2.15	2.00
LB60-3.5		ABA Lockable Box 60 Cap inc Disk Pen		15.50	15.00	14.50

8" DISKS

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DD34-4001	D/side D Den		23.00	22.00	21.00
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1D	S/side D Dens		19.00	18.00	17.00
2D	D/side D Dens		22.00	21.00	20.00
ACCESSORIES					
LB40-8	ABA Lockable Box 40 Cap inc Disk Pen		16.50	16.00	15.50
VCK-8	Verbatim 8" Head clean kit		6.40	6.20	6.00
VCD-8	Verbatim 8" H/c disks (per 10)		12.50	12.30	12.10

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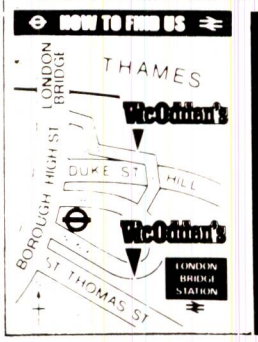

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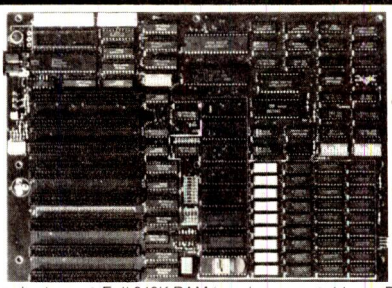

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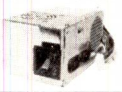

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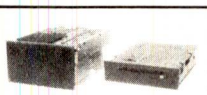

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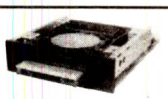

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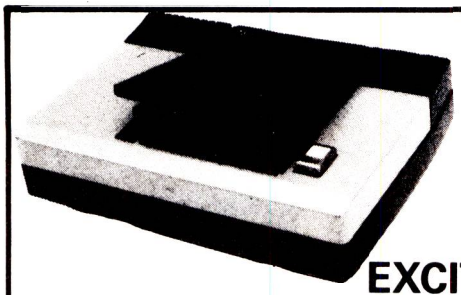

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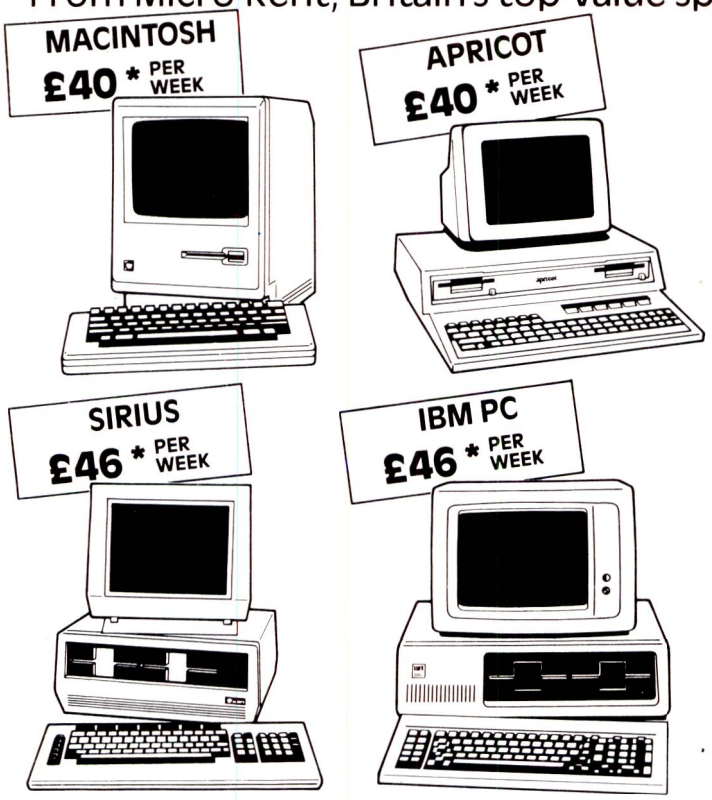

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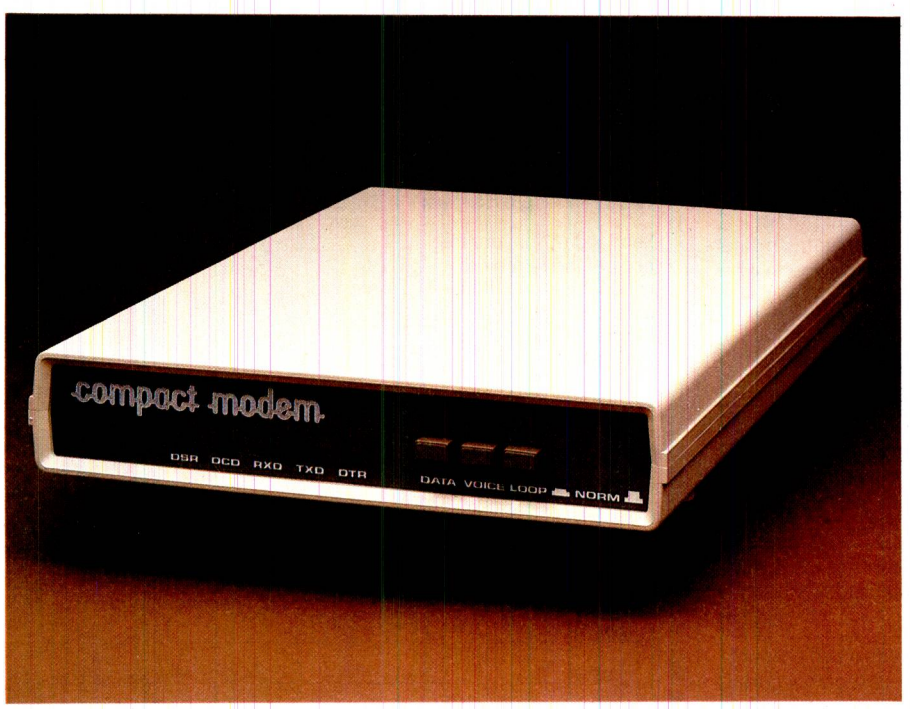

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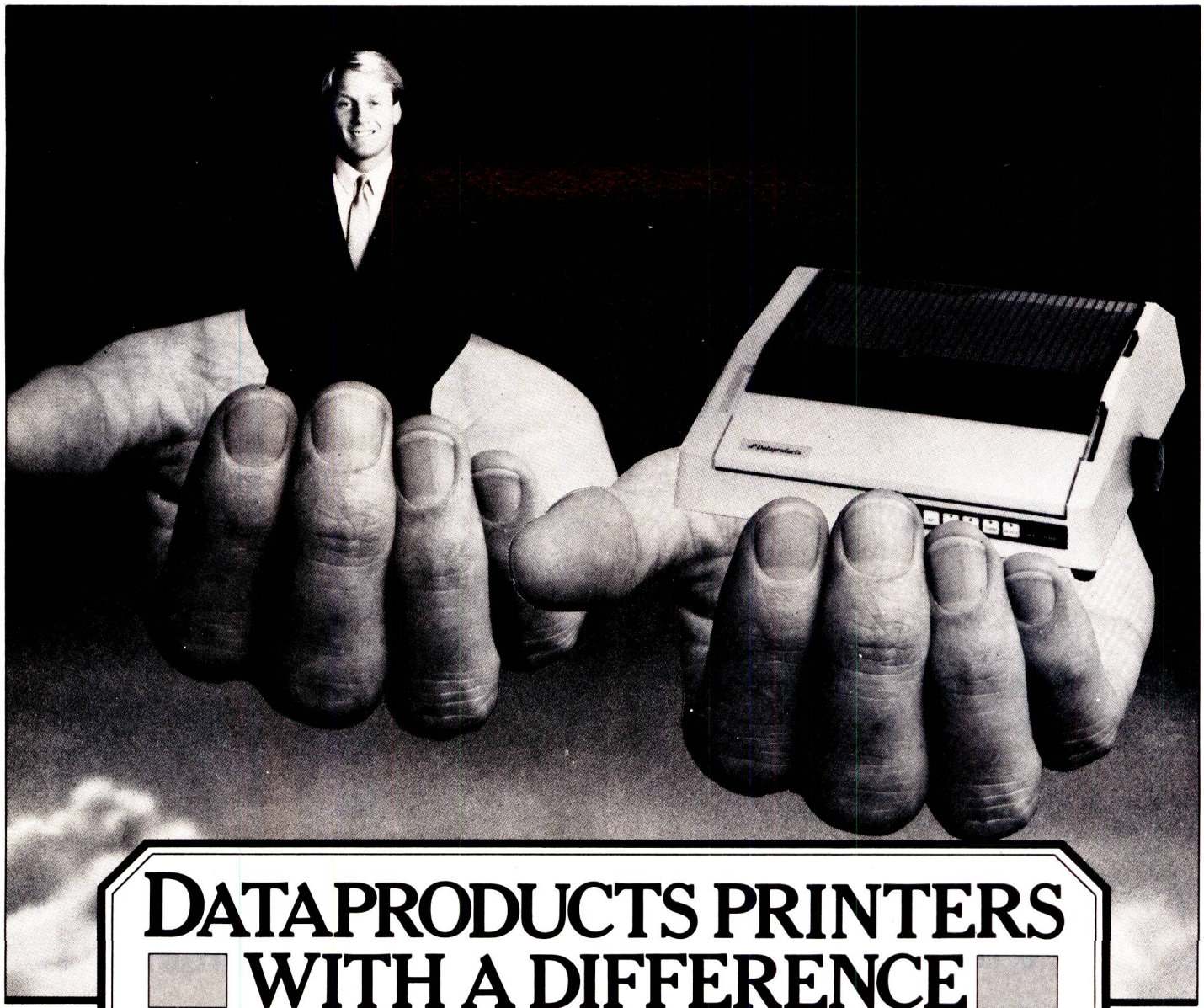

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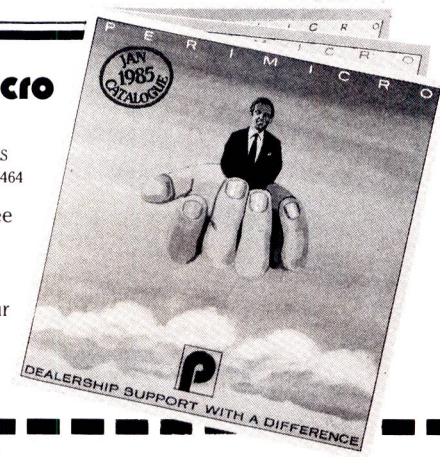

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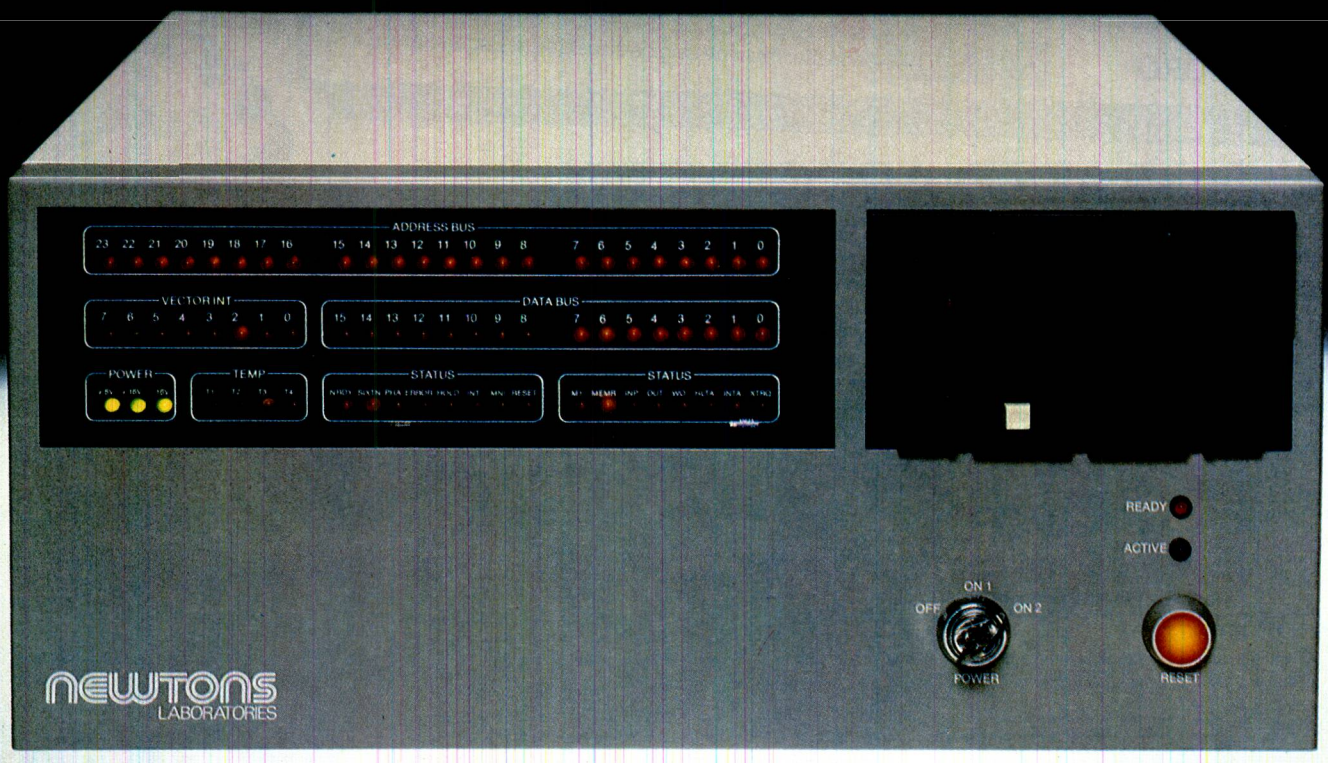

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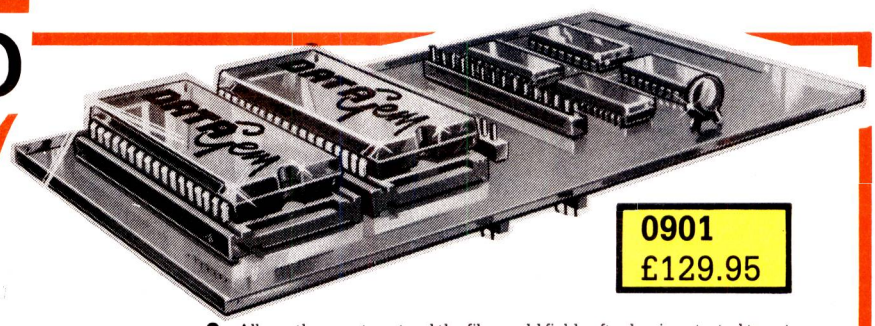

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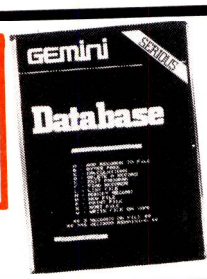

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WOULD YOU HAVE THE COURAGE TO JOIN Dateline

for friends, love or marriage?

If all your friends are married, you're not meeting anyone at work, you've moved to a new area or you are newly single again, joining Dateline is really just a sensible way of meeting lots of compatible people, and perhaps someone special ...

'Well, you've got to do something! — Clive and Sara

To Clive, without a wide circle of friends after his divorce, joining Dateline seemed 'logical', and to Sara, a single parent with little opportunity to make a social life, joining Dateline was simply a decision to 'do something about it'. When Sara first contacted Clive he was unavailable because he was already seeing another Dateline member regularly. Sara went out with a few other Dateline members, then Clive phoned her. Sara was quite taken with Clive on the phone — so much so that she invited him to her home for afternoon tea that weekend. 'When I met Sara I liked what I saw,' said Clive. 'We had tea and basically we started chattering, filling each other in on backgrounds, likes and dislikes.' Sara's two year old daughter, Helen, was also there and she was very taken with Clive. 'I watched her reaction,' said Sara. 'She thought he was wonderful. She sat on his lap from the moment he walked through the door. He seemed very truthful and open, and I thought he was very nice.' Clive drove away from that first meeting thinking what a very pleasant person Sara was. He had not made any arrangements to see her again, however, and he was also thinking how soon he could decently 'phone her to arrange another date without seeming too pushy. He decided to ring on the Tuesday, but Sara beat him to it — she phoned him on Monday! Sara and Clive's courtship started on their second date together. 'Halfway through the meal I began to think he was something special,' said Sara. 'Everything seemed to be there.' 'I was very attracted to Sara during that date,' said Clive, 'But I was determined not to rush into something and to really make sure of my feelings, but that happened very quickly over the next few meetings.' Clive proposed 'properly' — on bended knee — and Sara and Clive were married 5½ months after they first met. 'And the bride was numb with fear,' says Sara, laughing.



'The best thing I could have done.' John and Margaret — married.

As she was rather shy, one of Margaret's friends from work who had met and married someone through Dateline suggested she should join, and John joined as a last ditch effort to invigorate his social life before emigrating to South Africa. Both of them had quite a lot of dates with other people before they met. John laughs, 'I thought Margaret looked attractive, but I could see she was shy because she was blushing, so that gave me the upper hand straight away! We had such a lot in common, I definitely wanted to see her again.' It was virtually a case of love at first sight. 'I never really popped the question, we just sort of came to an understanding.' However, he did have to ask Margaret's parents permission to marry her. 'I was frightened to death. I sat there from 6.30 until 11.00 one evening, and then her father revealed he was half expecting a declaration anyway!' John and Margaret met in May and were married the following December. Now four years and two children later they still think joining Dateline was the best thing they ever did!

WHO JOINS DATELINE?

People just like you! Currently 2,000 people a month join Dateline, so you probably already know people who have used Dateline or met through Dateline.

People who join Dateline come from all over the country — from farms, villages, market towns and cities. The problems of meeting people are not confined to any particular locality. The backgrounds and occupations of Dateline members are equally varied — MP's, surveyors, solicitors, engineers, doctors, journalists, teachers, secretaries, stockbrokers, nurses, chemists, receptionists, bus drivers and even zoo keepers. Loneliness is classless. What all Dateline members have in common is an optimistic, positive attitude in tackling the problem practically. Meeting someone special is difficult, but after that the romance is easy.

WHY?

If the disco is not for you, your friends are all married, you don't meet anyone through work, you have just moved to a new area, or you are newly single again — just where do you begin? There really are very few ways you can meet the kind of people you want to meet. Dateline is simply the most honest and realistic way of being introduced to a wide choice of compatible partners. It also saves a lot of wasted time and expense!

HOW DOES DATELINE WORK?

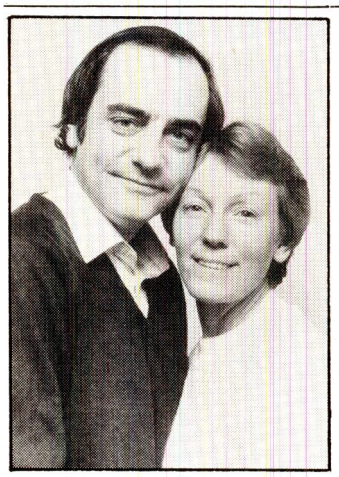
Forget fears of cold-hearted computers! ***You*** choose the sort of people you want to meet. When you join Dateline you will complete a very comprehensive questionnaire. Information from this will be locked into our computer memory, and the matching process, in which your data is compared with that of every Dateline member of the opposite sex, will begin. The most compatible matches will be found and their details forwarded to you. You will also be matched to other compatible people and they will contact you, and so a whole new social life begins.

Dateline has been finding friendship, love or marriage for tens of thousands of people since 1966.

IS DATELINE SUCCESSFUL?

Many thousands of couples like those on this page, have met and married through Dateline. The Dateline questionnaire is designed to match couples through many facets of physical type, personality and life-style; not just matching those who want to meet people similar to themselves, but those who also want to meet someone different.

If you think you would like to join the thousands of people all over the country who have been finding a new social life or love and happiness through Dateline, simply complete the questionnaire below. We will send you confidentially and completely free, full details about Dateline and how it works, and details of just one of the Dateline members who are compatible with you. Send to: Dateline Computer Dating, 23 Abingdon Road, London W8. Tel: 01-938 1011.



'It took about a week to fall in love' Margaret and Michael — married.

Within two weeks Margaret and Michael were talking about marriage. 'It might seem a little bit far-fetched, but we weren't prepared to settle for just anything to try to regain happiness. We both wanted something a little bit special, and thanks to Dateline, we've got it now.'

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☐ Fashion	☐ Classical music
☐ Pubs	☐ Art/Literature
☐ Sport	☐ 'Live' theatre
☐ Pets	☐ Science or technology
☐ Folk music	☐ Creative writing/painting
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☐ Cinema	☐ History/Archaeology
☐ Good food	☐ Conversation

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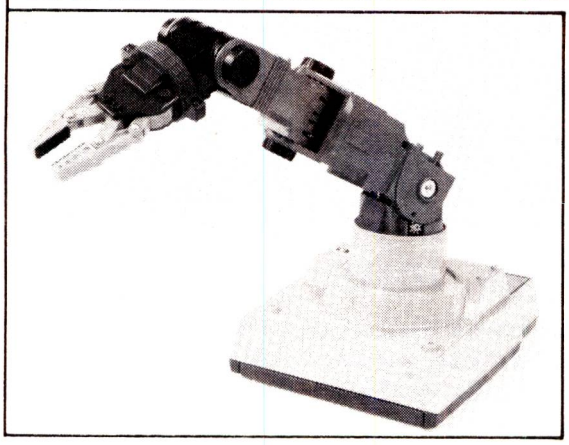

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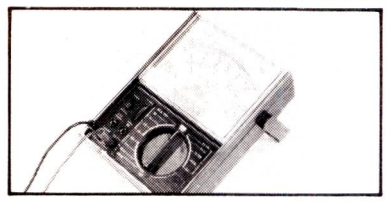

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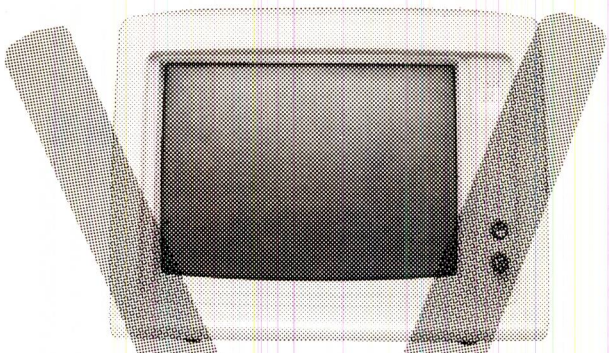

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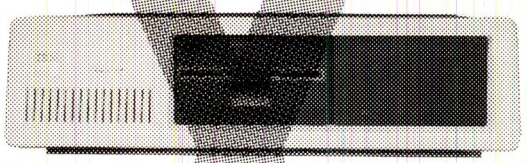

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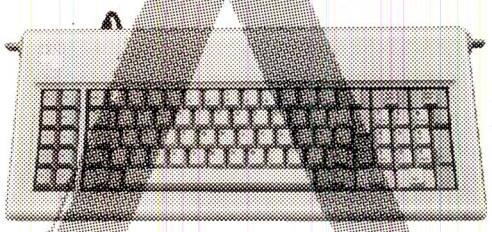

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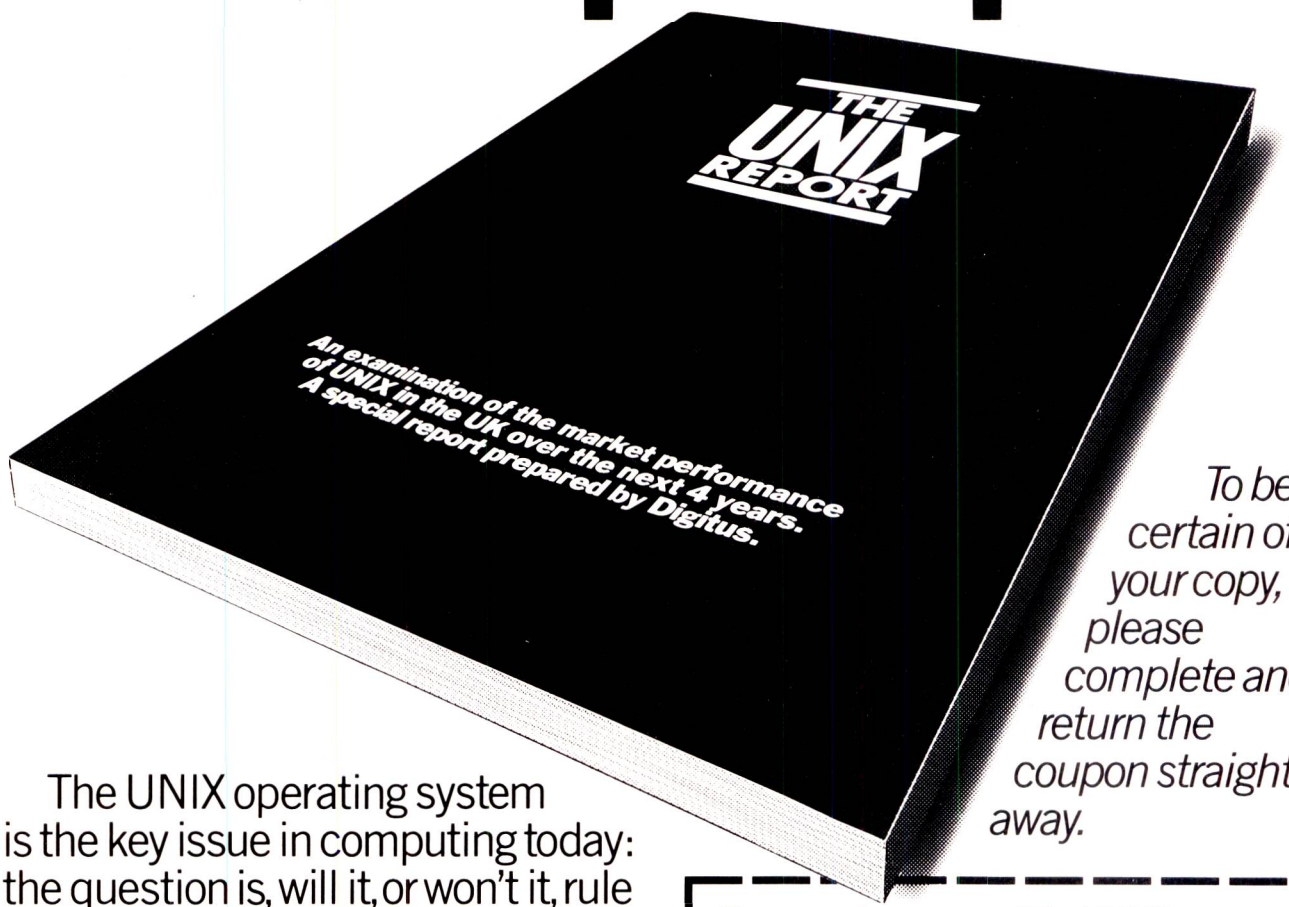

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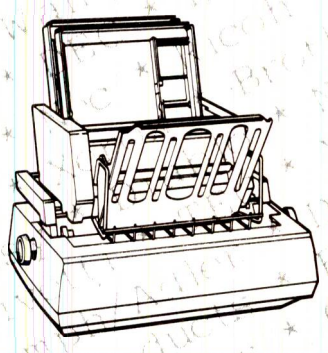

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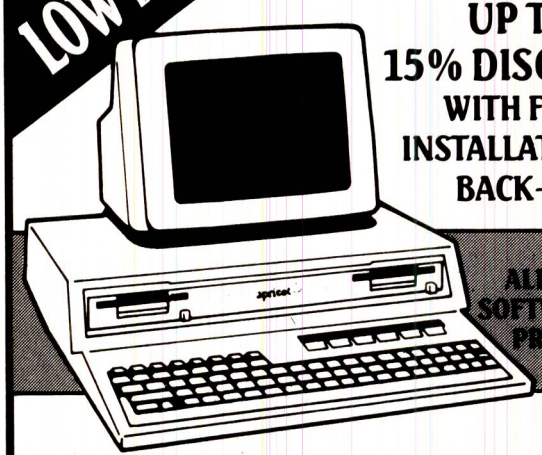

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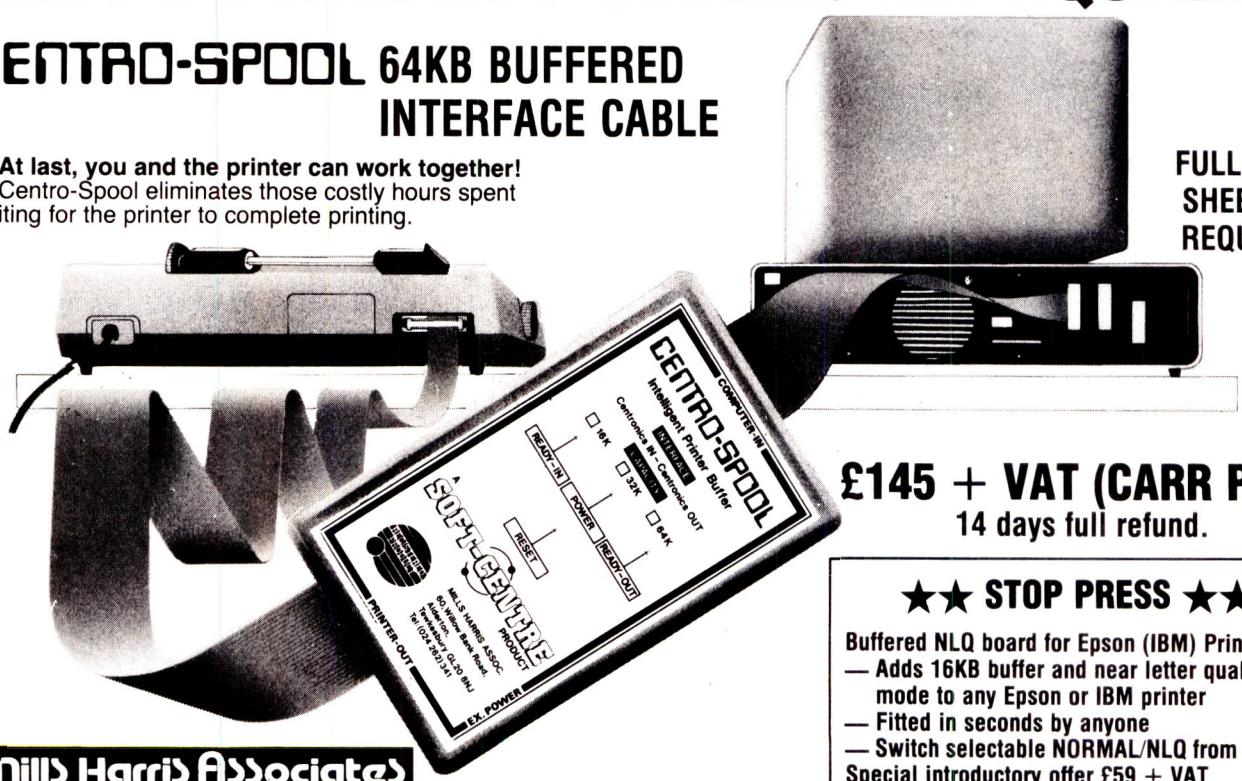

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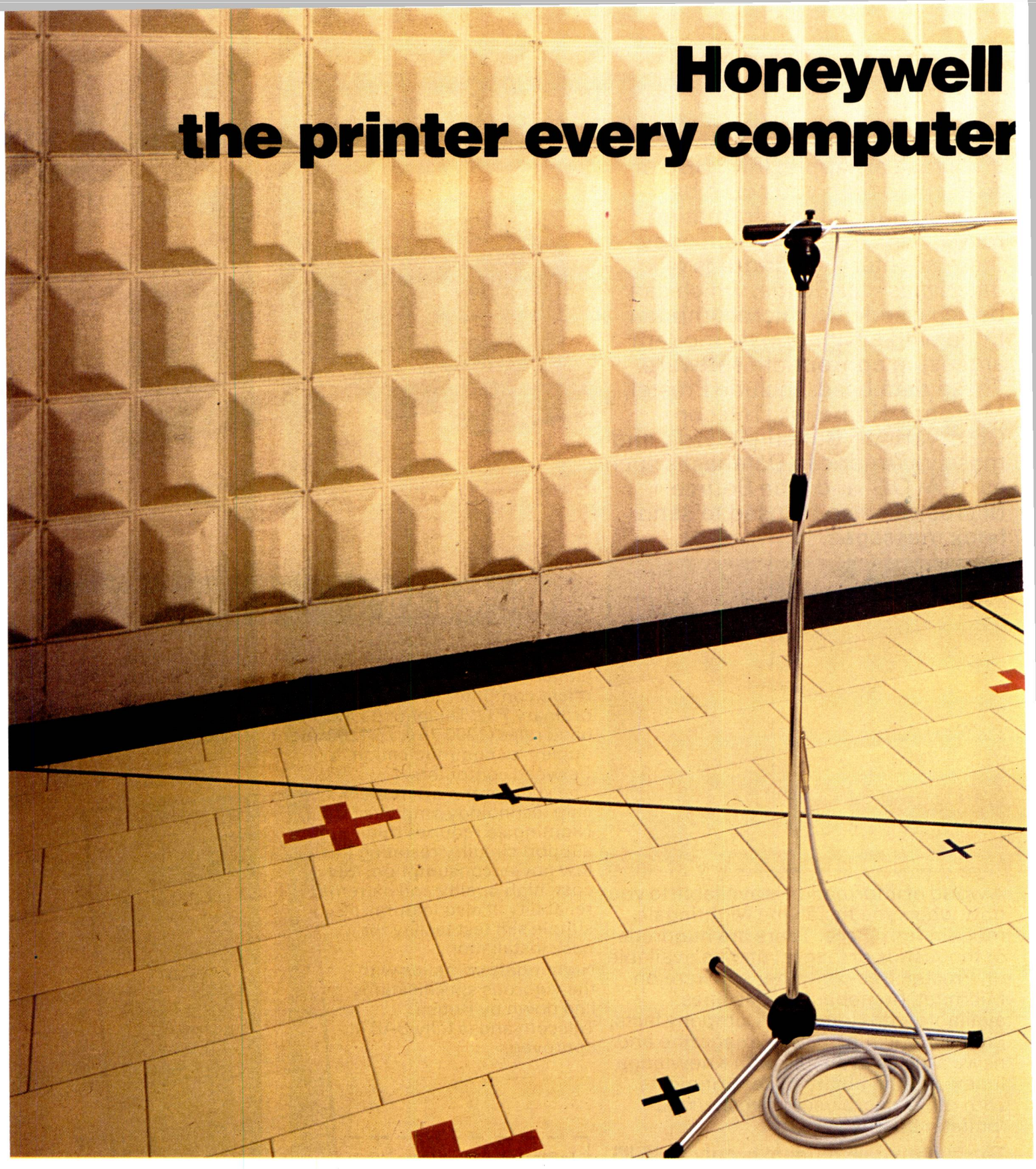

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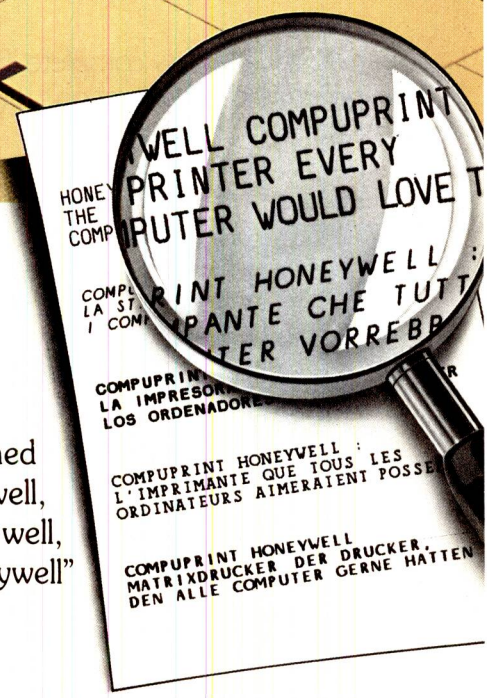

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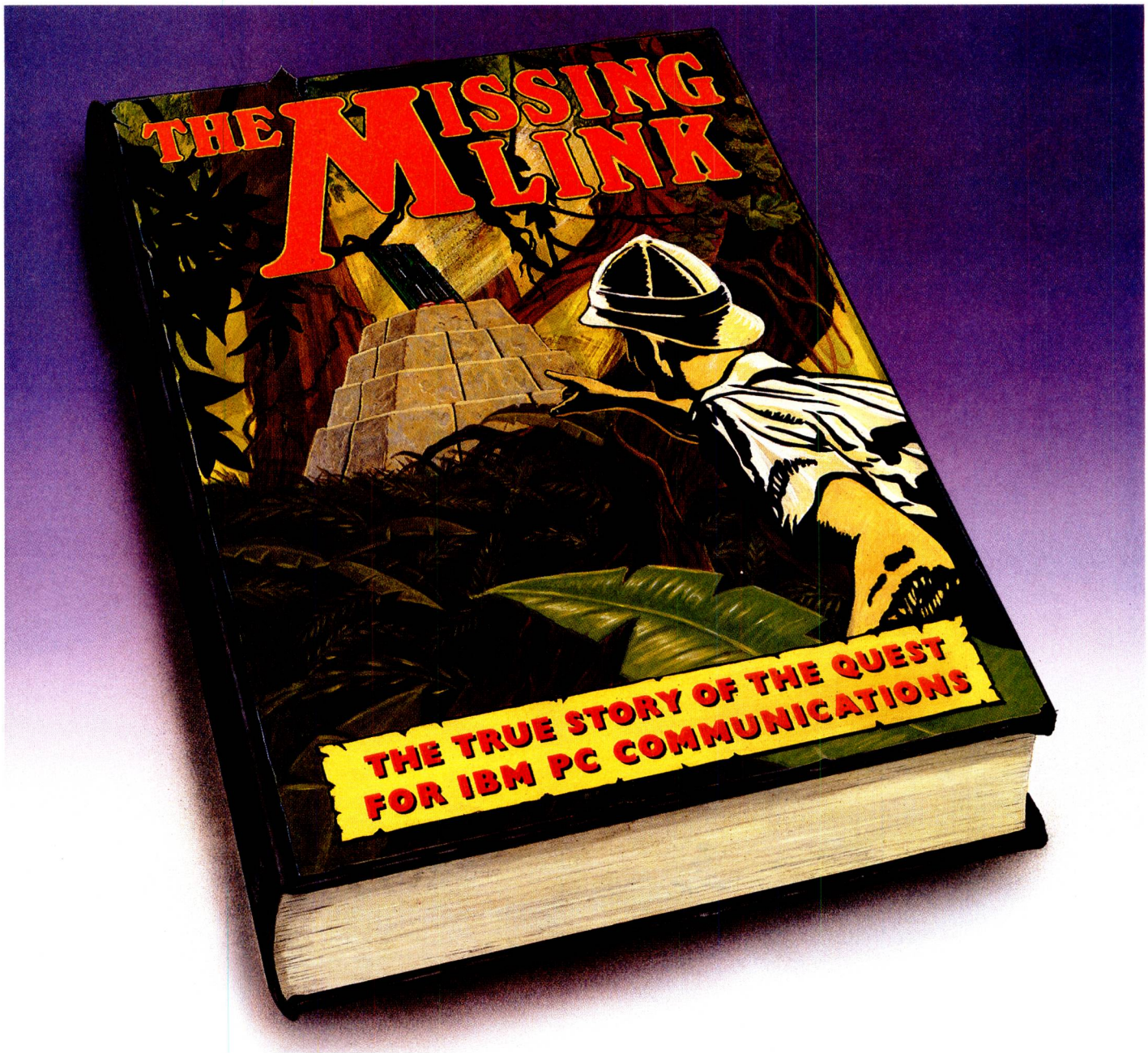

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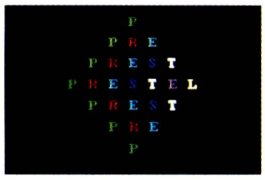

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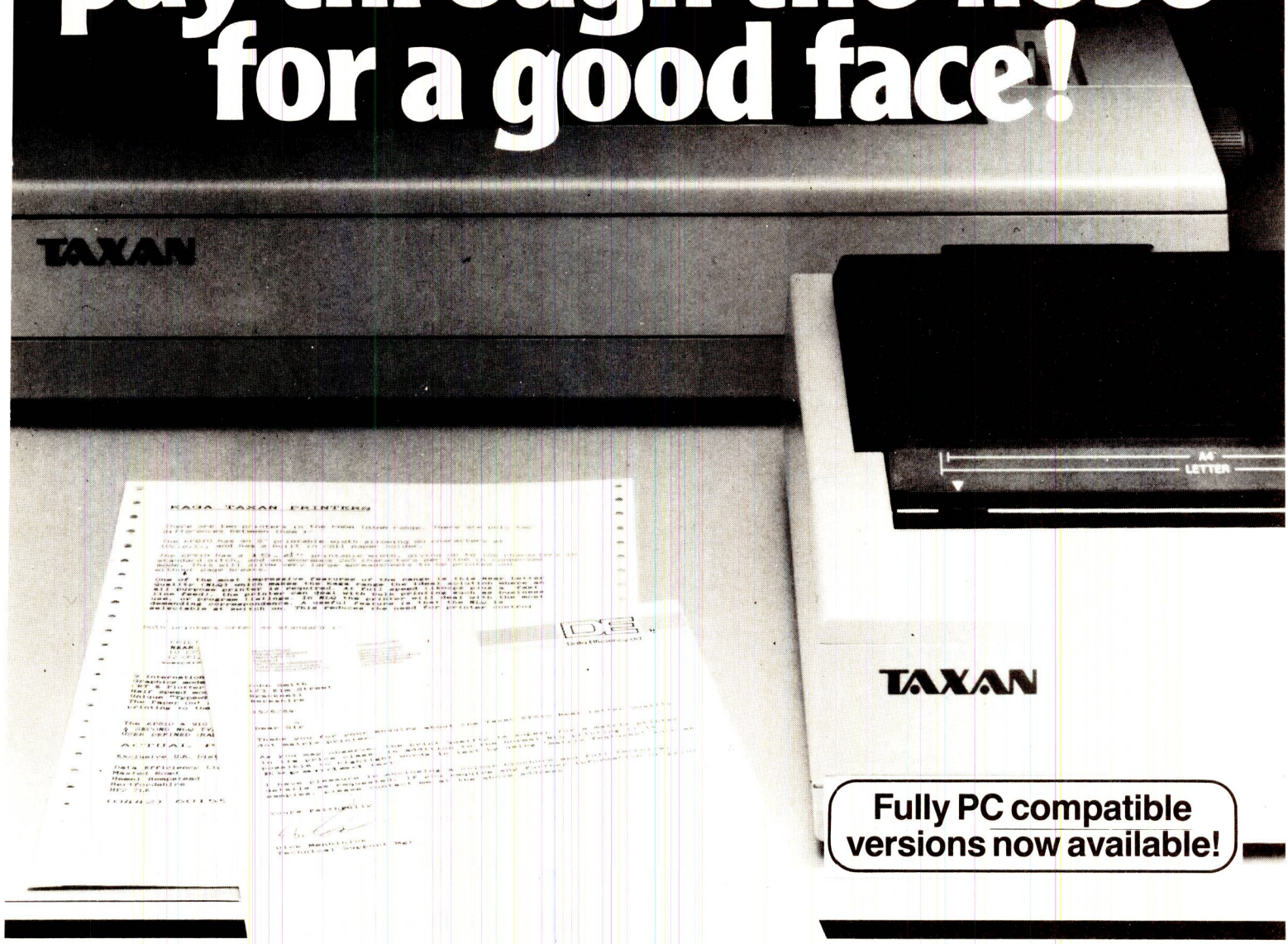

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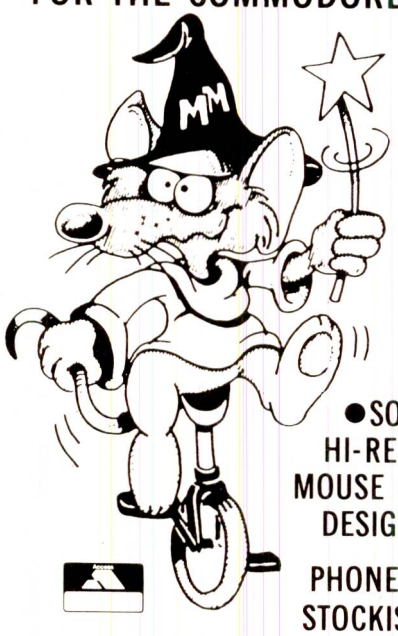

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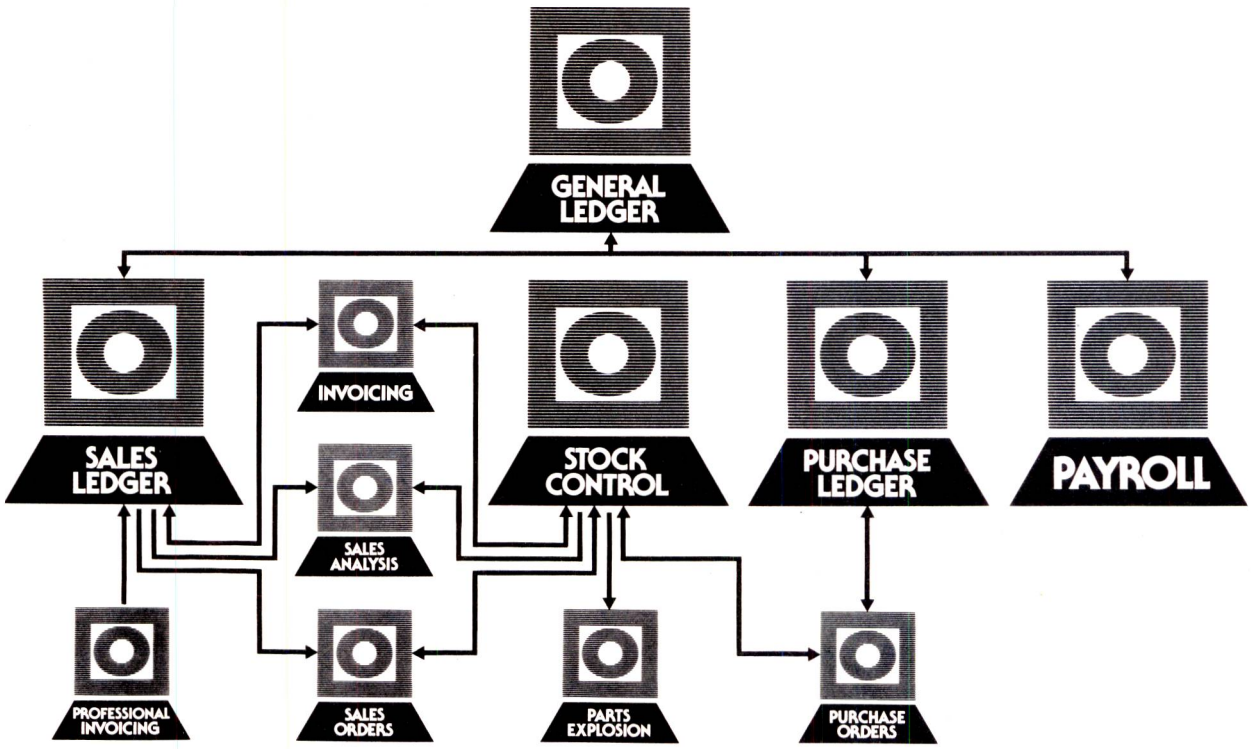

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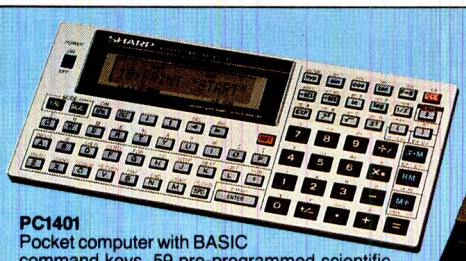

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	V-FILE	£295
	Btrieve	£245
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	SoftFocus Btree(source)	£ 90
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CHIP CHAT





The assorted* PCW *contributors and staff who appeared in the* 4 Computer Buffs *TV series have found some kind of fame in another magazine,* The Listener. *The review of the show begins: 'It will be recalled that Channel 4 was set up to cater for the needs of black, one-legged, Welsh-speaking homosexuals and other persecuted minorities. It was therefore predictable that Mr Isaacs and his colleagues would one day turn their attentions to the growing band of computer enthusiasts.' And it continues: 'Various spotty and bearded hackers were actually shown on camera.' In passing, Sinclair obviously agrees about the spots — the QL is being promoted alongside a medicine which promises to cure acne.

Those sporting the beards on TV included Guy Kewney and David Tebbutt. In case you don't recognise them, Guy is the grim-looking gentleman who looks as though he's leading a Nordic invasion, while David appears very pleased to be holding a board in each hand. And if you think these photographs are less than flattering, you should have seen the ones of our editor — but he's shredded those, negatives and all.

We're inviting readers to submit captions for either or both of the photographs. People in the industry eager to extract revenge for the ignominy ChipChat puts them through each month should note that only suggestions fit for publication will be considered. Entries, on the back of a postcard please, to ChipChat,* PCW, *62 Oxford St, London W1A 2HG.

Include your name and address as well in case you win the £10 prize, which goes to M de Roussier of Gerrards Cross for his March entry. That picture, you will of course recall, featured two Winalot dogs staring despondently at a micro. The winning suggestion was: 'Take a good look at the opposition, son — if they ever manage to house-train these beasts, we'll be out of business.' As this entry coincided with the day most of our micros decided to behave other than we wanted them to, some more house-training seems like a good idea. Perhaps we need a Barbara Woodhouse.

On the ball: proving that every cloud has a silver lining for a computer company, Sperry and Systemsolve are promoting a computer-based identity card service to 'beat the menace of hooligans at football matches' and 'restore the fortunes of soccer in Britain'. Step up the robot design, lads, and you might be able to give England a chance in the next World Cup.
Bridge of Sighs: one joke doing the rounds at the moment concerns the name of the next Acorn machine, now that the Olivetti connection has been established. Acornetto is the suggested title, although Cambridge's Silicon Fen isn't as attractive as Venice.
Star turns: following the Commodore 64 game Jack Attack (in loving memory of founding father and now Atari renegade Jack Tramiel) comes Super Pipeline II, featuring Sir Clive in a C5 at the end of the first level. Scorpio Gamesworld is reported to have enlarged on the same theme with its C5 Clive but this time keeping it in the family — the game runs on the Spectrum.
Punting: back in Silicon Fen, and still on Sir Clive, we hear the great man once invested in the TV show *Spitting Image*. Perhaps he should have invested more if he wanted to escape being lampooned, though doubtless he's not bothered by his puppet or its antics.

We also hear that Sir Clive is an avid reader of ChipChat — we're waiting for him to enter the caption competition before we believe this. And if you could spare the time, Sir, we'd also like to know if the American Timex machines are coming to the Continent. Could it be that Portuguese holidaymakers are in for a Sinclair surprise?
A-maze-ing: long before mice began to breed on desk-tops, home-brewed versions made their way around mazes. The next UK micromouse finals take place on the last day of the European Personal Robot Congress, which runs from 2-4 July at the London West Hotel. Having watched mice career around fairly simple mazes, it'll be interesting to see how they cope with the Japanese maze being flown in especially for the event. It's not clear whether ritual suicides will be in order for any mice which fail to rise to the challenge, but it will give competitors a chance to tune up for the August World Finals to be held in Japan with the assistance of the Japanese Science Foundation — showing that this is serious business as well as fun.
Ultimate goes to Hollywood: back-patting, fixed grins, and phrases such as: 'Didn't they do well' were once again the order of the day at this year's Golden Joystick Awards. The ceremony produced few surprises, with Ultimate being voted Software House of the Year and Knight Lore the best game. However, as is customary at these functions, not everyone was happy with the results. While it was all smiles and laughter above-board, downstairs in the gentleman's toilet the losers displayed a bitchiness more appropriate to Hollywood than home software.

Oh well, at least we can be grateful that the winners resisted thanking everyone from their great-grand-mother to the inventor of the silicon chip for their success.
Am I blue?: little-known music maker IBM, or 'Big Blue' as it's sometimes referred to in its more famous role of computer manufacturer, launched an expensive publicity campaign on the unsuspecting French earlier this year. Musical microchips were used in advertisements published in a French paper — open the page and the chip began to sing the praises of the PC. Reports that sales of ear plugs rose on the same day have not so far been confirmed.
We jest not: this year Wang promoted its office automation products at a show featuring 'Nell Gwynnes offering their wares, court jesters, bunting, banners and balloons'.

They're more sophisticated than that across the Atlantic. The autumn conference of the Office Automation Society is a 'total immersion workshop' being held 'in lecture rooms and cabana rooms surrounding the indoor pool and jacuzzi'. Meet you by the pool, Nell.
Following yonder star: not that it's likely, of course, but we've some good news just in case you should want to find out if you have any family connections with Ronald Reagan or his Irish ancestral home of Ballyporeen. The local priest has produced a database of the relevant records — dBasell is the package used and a Northstar Advantage the machine. **END**

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