

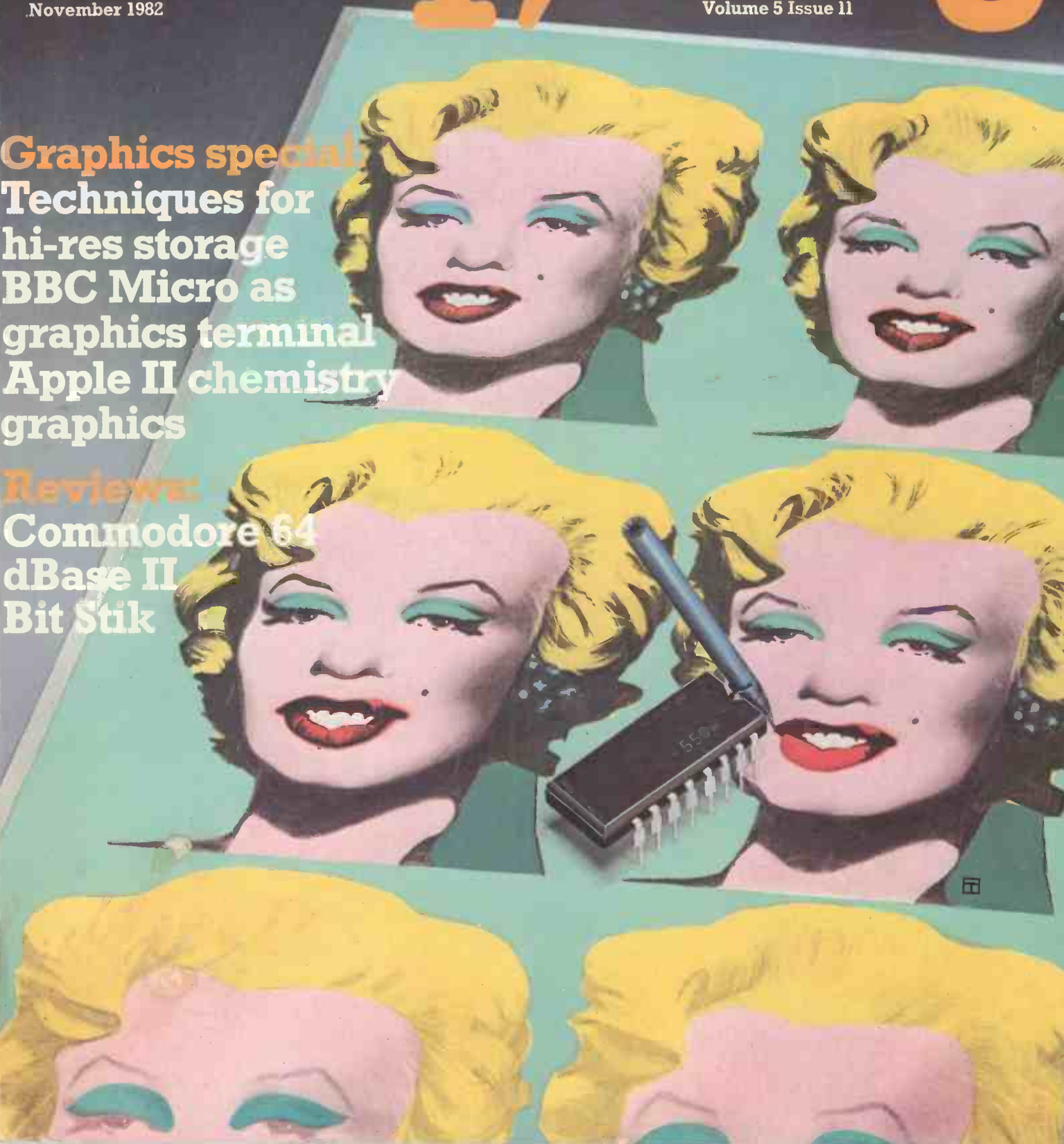
# Practical Computing

November 1982

Volume 5 Issue 11

**Graphics special**  
Techniques for  
hi-res storage  
BBC Micro as  
graphics terminal  
Apple II chemistry  
graphics

**Reviews:**  
Commodore 64  
dBase II  
Bit Stik



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High-resolution graphics —  
pages 86 to 114

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 no responsibility for any errors.

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\*\*\*\*\*THE NEW DBMS III (SERIES III OF THE WORLD'S FIRST 'TASK-ROBOT-PROGRAMS')\*\*\*\*\*

\*\*\*\*\*FEATURES\*\*\*\*\*

Mbasic & word-star compatible	3200 records per filename	12 online file architectures
1400 character record sizes	20 main/200 sub fields per record	240 fields using cross-referencing
mathematical scratchpad	field and record related formulae	cross-record calculations
record relational indexes	'Jump-to' any of 32000 records per file	'Jump-to' any record in 12 files
translateable to any language	random/binary/key/multiple field search	User-definable files/field words/sizes
User-definable reporting	'if-then' questioning	endless 'either-or' matching
field protection/classification	file protection/password entry	formulate/recall on selection criteria
sorts 'alpha or numeric' any window	speed of 50 records per 20 seconds	12 interrogation question types
either-or.same as.greater.smaller.	range match.not match.integer match	short filing output/audit trails

ONE OF THOUSANDS OF DIFFERENT TASKS ON WHICH THIS PROGRAM MIGHT BE EMPLOYED

DBMS'S MACROS WORK FROM THE MOMENT YOU INSERT THE 'TASK DISK' IN THE COMPUTER'S DRIVE

Simply design your file, give its fields your words, setup your report mask, and then enter your records. Switch to 'automatic drive' and formulate any task you wish the program to fulfill, the task is stored as a macro. Take a copy of the program on another 'task disk' and from then on, the task disk will function without a single key-stroke. Think of a number of such 'task disks' such as "stock-re-order reports"; "stock-valuation reports"; "sale-mail-shots"; "production-process-analysis"; "patient history analysis"; "research-analysis"; "budgetting"; "purchase/sales-analysis"; "personnel-file-analysis"; "vehicle-location control"; "librarian analysis"; "plus more?"

Last issue we showed an example of 'short-listing' of employees for a prospective job. Here is an example of a garage stock file and two reports it might generate. The record may look like this:

1 record number	(23)
2 part number	(fiat-grill 109)
3 location	(bin 44)
4 cost price	(29.00)
5 selling price	(38.00)
6 minimum stock	(5)
7 maximum stock	(12)
8 current stock	(3)
9 manufacturer	(Fiat motor company)
10 on order (qty)	(<9>{-

One report might be: select ??  
all records where the current stock is lower than the minimum stock. When found, subtract current from maximum, and produce a printed list of the manufacturer's name; part number; and re-order quantity. Update the record in field 10 with the quantity ordered.

Another report might be: select ??  
all records in the file; calculate the values of current stock multiplied by cost price for each record. Add the values together for every record at location London or Glasgow or Leeds and print a list of all such records showing stock values 'individual' and for the specific locations.

(next issue's example sale ledger)

DBMS II (WITHOUT MACROS) and DBMS III ARE FULLY IMPLEMENTED UNDER CPM-86 (tm) AND MS-DOS (tm) ie: <SIRIUS/VICTOR/IBM>  
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	-Superbrain 64K.Ram/10M disks	call.00
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	-Compustar 64K.Ram/320K disks	1995.00
	-Compustar 64K.Ram/700K disks	2495.00
	-Compustar 64K.Ram/1.5M disks	2895.00
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All computer prices include mbasic as standard. All prices marked £ are 8/16 bit machines

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NOTE CORVUS DRIVES WITH MULTIPLEXOR MAY NETWORK SIRIUS..SUPERBRAIN..CONCEPT..PET..VICTOR..IBM..

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	-DBMS II (database)	£395.00
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add 175.00 for cables, delivery & installation  
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Index		

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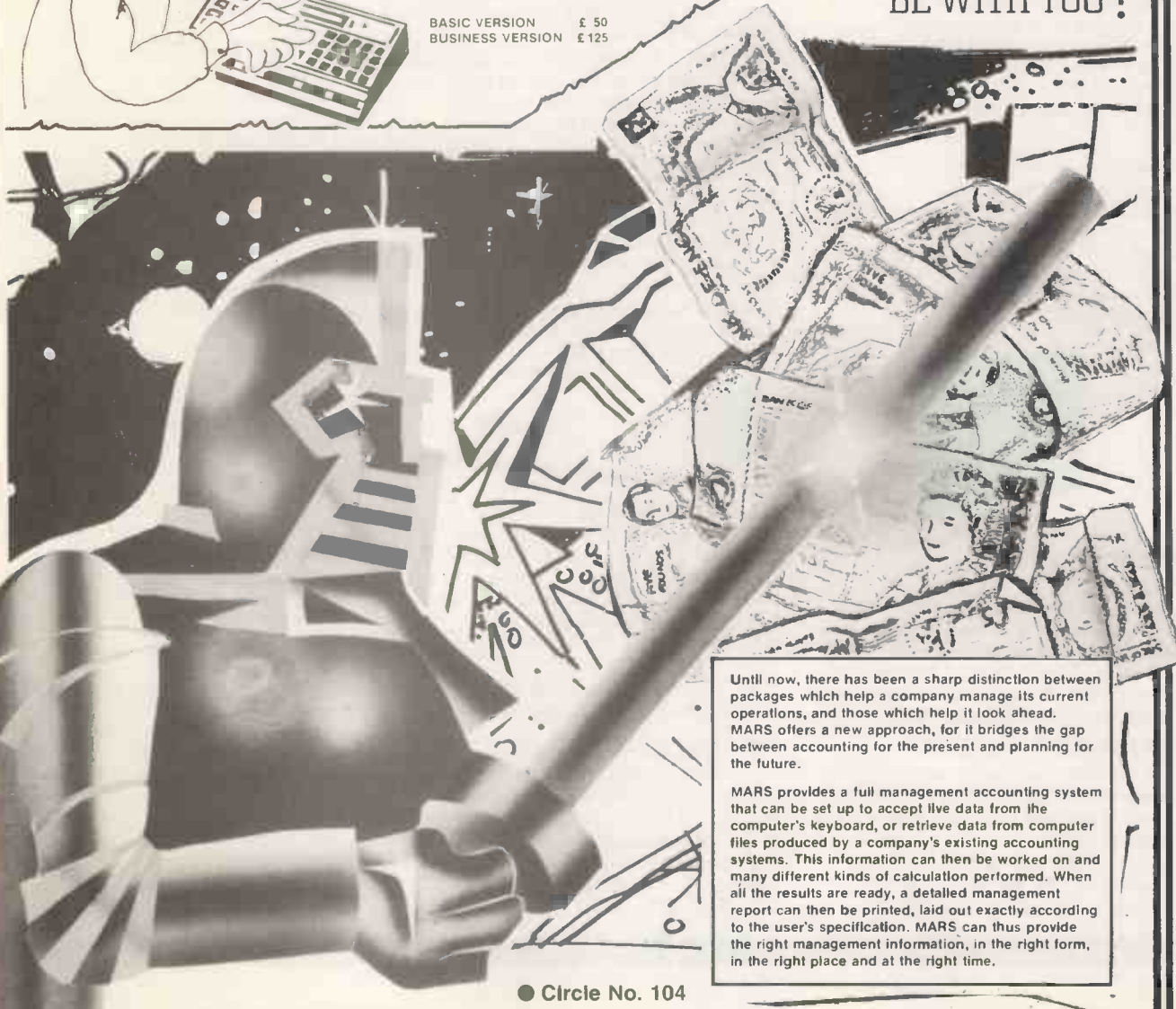
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Until now, there has been a sharp distinction between packages which help a company manage its current operations, and those which help it look ahead. MARS offers a new approach, for it bridges the gap between accounting for the present and planning for the future.

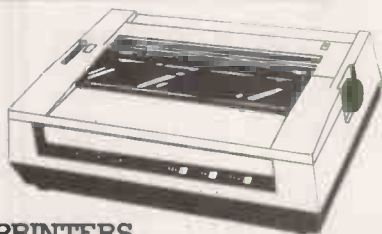
MARS provides a full management accounting system that can be set up to accept live data from the computer's keyboard, or retrieve data from computer files produced by a company's existing accounting systems. This information can then be worked on and many different kinds of calculation performed. When all the results are ready, a detailed management report can then be printed, laid out exactly according to the user's specification. MARS can thus provide the right management information, in the right form, in the right place and at the right time.

Trade  
Enquiries  
Welcome

● Circle No. 104

# ingenious!

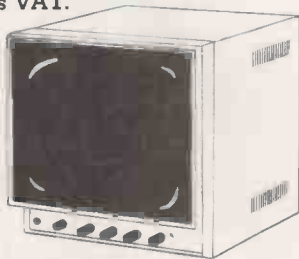
## Genie I and II accessories



### PRINTERS

The EG 3085 is quiet, fast and efficient. Printspeed is 100 characters per second and printing is bi-directional at 80 or 136 characters per line. Suitable for use with other systems, it has three tpestyles, adjustable pin or friction feed and single sheet or roll paper facilities. **£425 plus VAT.**

If you don't want to pay that much for a printer, consider the EG 603. It doesn't match the EG 3085 in certain areas, but you will still get 100 c.p.s. bi-directional, a range of character styles, forward and reverse feed and pin/friction feed, with 96 characters and 64 graphic patterns. **£235 plus VAT.**



### MONITORS

Available in 9" and 12" sizes, with white, green or amber display, Lowe A.V.T. monitors are sturdy, attractive, easy to operate and feature an easy view screen with smoked anti-glare display filter. Compatible with most popular micros on the market. **From £75 plus VAT.**

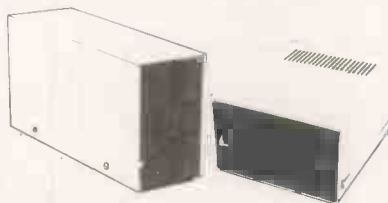
### EQUIPMENT COVERS

Beat the dirt, coffee spills and sticky fingers when your computer and monitor are not in use with these top quality black leather covers.

Genie CV1 **£5 plus VAT.**

12" monitors CV6 **£6.20 plus VAT.**

9" monitors CV3 **£4.20 plus VAT.**



### DISK DRIVES

If you want fast, reliable program storage, true random access file handling and access to many computer languages, we can meet your needs. The EG 400T provides storage of up to 184320 bytes per floppy disk and comes complete and tested, in a stylish colour matched cabinet. **£220 plus VAT.**

The EG 401 AT offers dual disk drive with 368640 bytes of useable storage and comes complete with a power supply ready to connect to an expander box. **£365 plus VAT.**

### DOUBLE DENSITY ADAPTOR

Allows the use of standard minidisk drives in double density, with virtually double the storage capacity. The EG 3021 is equally at home in the Genie or TRS-80 expander boxes.

A double density disk operating system will be needed, such as smallDOS provides. **£72 plus VAT.**



### EXPANDER BOX

The updated EG 3014 expander box allows for up to four disk drives with optional double density. It connects to a printer, or RS 232 interface, or S100 cards. Not bad value at **£190 plus VAT** (16K version) or **£200 plus VAT** (32K version)

\*The EG 3014 will work with TRS 80 by using the EG 3023 Tandy Adaptor.

### TECHNICAL MANUALS

Full technical details of Genie Hardware (all you ever wanted to know about Genie).

Genie I/II Technical Manual

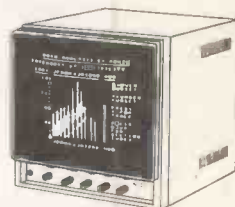
**£10 - No VAT.**

Expander and accessories (EG3014)

**£10 - No VAT.**

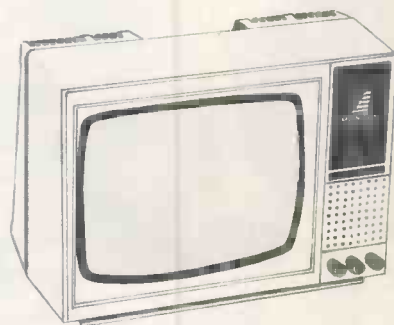
### smallDOS

Powerful, yet reasonably priced, the Genie smallDOS contains 21 library commands, 7 utilities, LBASIC, disk basic and bags of information, including a reference manual and 40 page beginners guide to disk usage. **£35 plus VAT.**



### HIGH RESOLUTION GRAPHICS

Increase graphic resolution capabilities on your Genie seventy-three fold with the LE18 HI-RES unit. It offers bit image graphics of 73,728 points, a resolution of 384 x 192, and uses a separate 16K of video memory to achieve its resolution. Graphics are intermixable with text or existing pixtel graphics, and animation, reverse video displays and use of programmable graphic characters are possible. **£86 plus VAT.**



### GENIE MONITORS

Two good performance, low priced 12" monitors, either to match your Genie or compatible with a wide range of other systems. Good resolution and band width and, of course, they free your television set for the other type of programmes you like to watch!

The EG 100 12" in black & white costs **£69 plus VAT.**

The EG 101 12" with green phosphor is **£79 plus VAT.**



## BUSINESS SOFTWARE

Specifically written for the Genie II computer, with disks and a suite of packages from the renowned house of DATA. The suite includes SALES LEDGER, PURCHASE LEDGER, PAYROLL and STOCK CONTROL. Each package is a very reasonable £175 plus VAT. Full details are available on request.



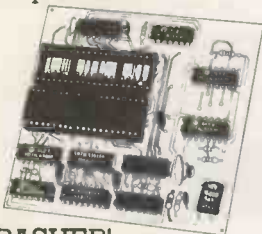
## SYSTEMS DESK

When a compact modular computer system like the Genie benefits from being used on a custom designed system desk. The SD-1 system desk is designed to accommodate a complete Genie System and has a special upper shelf to support the display monitor at the best level. The desk is flat packed for easy delivery and finished in attractive teak and charcoal colours. £81.40 plus VAT.

## STEREO MUSIC SYNTHESISER

Mozart and Beethoven might well roll over at this stereo music synthesiser. It can produce six simultaneous notes over the whole audio range and provide sound effects. The RED comes complete with a software compiler, full instructions and a demo tape.

It is simply plugged onto the Genie 50 bus and has two outputs for an audio amplifier. £51 plus VAT.



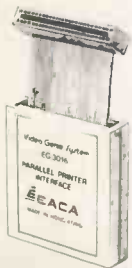
## EG 3203 ANDY-BASHER!

If you are a TANDY user, read on! The EG 3203 is bus converted to allow Genie peripherals to be used with Tandy Model computers. £18.40 plus VAT.

Just in case there might be a few strange souls who want to convert in the opposite direction, there is the 50/40 converter which generates a Tandy compatible 40 pin bus from a Genie.) £34 plus VAT.

## EG 3016 PARALLEL PRINTER INTERFACE

The EG 3016 is a simpler interface allowing a Centronics parallel compatible printer (EG 303, EG 3085) to be connected directly to the Genie keyboard without the need for an expander box. £38 plus VAT.



## BUS EXTENDER

A most useful accessory, allows two bus using devices to be connected simultaneously to the Genie - when using the Hi Res and expander for instance. £21 plus VAT.

## EP1, EP2, EP3

Genie I and Genie II have ROMS offering 13.5K Microsoft BASIC, of which the final 1.5K BASIC are custom written extensions contained in EPROMs.

You can change these as follows:

### EP1

Adds all Genie I software facilities to other Genies, lower case driver, machine language monitor, renumber facility, keyboard repeat and screen print.

### EP2

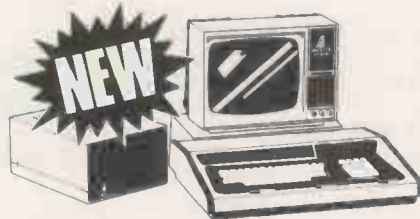
Has improved M.L. monitor, can load and save programs. Defined function keys (list, load, save etc.) for Genie II and lower case driver.

### EP3

Has HI-RES driver software with 10 extra HI-RES commands which prevent need to load HI-RES software from tape.

All at £12 plus VAT.

For Video Genie Systems, the LE-19 connects direct to the Genie bus and allows one of these EPROMs to be fitted externally. £26.50 plus VAT.



## NEW! A 64K CP/M computer for less than £1,000!

CP/Genie with single disk drive has 64K RAM, 13.5K ROM, comes complete with a 12" monitor, 64 x 16 screen format and operates under CP/M 2.2 supplied with machine. £999 plus VAT.

The dual disk version will cost £1,175 plus VAT.

Both are compatible with existing Genie I software and are supplied with the Genie SmallDOS. A breakthrough for Lowe Electronics customers that should not be missed.

**SPECIAL TECHNICAL GENIE HOT - LINE ON 0629 4995**  
for all your technical advice and service back-up on any aspect of the Genie system direct from the experts!

# LOWE electronics

Chesterfield Road, Matlock,  
Derbyshire DE4 5LE.  
Tel: 0629 4995.  
Telex: 377482 Lowlec G.

## Available now from your local GENIE dealer

AVON Microstyle, Bath, 0225 334659/319705.  
BEDFORD Conserve, Bedford, 0234 216749.  
BERKSHIRE P.C.P., Reading, 0743 589249.  
Castle Computers (Windsor), 07535 58118.  
BIRMINGHAM Ward Electronics, Birmingham, 021-554 0708. Consultant Electronics, Birmingham, 021-382 7247. A. E. Chapman and Co., Cradley Heath, 0384 66497/8. BUCKINGHAMSHIRE Photo Acoustics, Newport Pagnell, 0908 610625.  
CAMBRIDGESHIRE Cambridge Micro Computers, Cambridge, 0223 314666.  
CHESHIRE Hewart Electronics Macclesfield, 0625 22030. Mid Shires Computer Centre, Crewe, 0270 211086. CORNWALL A B & C Computers, 11 Brockstone Road, St. Austell, Cornwall, St. Austell 64463. CUMBRIA Kendal Computer Centre, Kendal, 0539 22559. DORSET Blandford Computers, Blandford Forum, 0258 53737. Parkstone Electronics, Poole, 0202 746555. ESSEX Emprise, Colchester, 0206 865926.  
GLOUCESTERSHIRE HAMPSHIRE Fareham Computer Centre, Fareham, Hampshire, Fareham, 231423. HERTFORDSHIRE Photo Acoustics, Watford, 0923 40698. Q Tek Systems, Stevenage, 0438 65385. Chrisalid Systems and Software, Berkhamsted, 04427 74569. KENT Swanley Electronics, Swanley, 0322 64851.  
LANCASHIRE Harden Microsystems, Blackpool, 0253 27590. Sound Service, Burnley, 0282 38481. Computercat, Leigh, 0942 605730. BEC Computerworld (Liverpool) 051-708 7100.  
LEICESTERSHIRE Kram Electronics, Leicester, 0533 27556. LONDON City Microsystems, EC2, 01-588 7272/4. Wason Microchip, N18, 01-807 1757/2230. Premier Publications, Anerley, SE20, 01-659 7131. NORTH EAST Briers Computer Services, Middlesborough, 0642 242017. General Northern Microcomputers, Peterlee, 0783 860314. HCCS Associates, Gateshead, 0632 821924. NOTTINGHAMSHIRE Midland Microcomputers, Nottingham, 0602 298281. Mansfield Computers, Mansfield, 0623 31202. East Midland Computer Services, Arnold, 0602 267079. Electronic Servicing Co., Lenton, 0602 783938.  
NORFOLK Anglia Computer Centre, Norwich, 0603 29652. Bennetts, Dereham, 0362 2488/9.  
OXFORDSHIRE Micro Business Systems, Whitney, 0993 73145. Pebbleglog Ltd. (Thame) 084421 5368. SCOTLAND Escó Computing, Glasgow, 041-427 5497. Edinburgh, 031-557 3937. Computer and Chips Ltd., St. Andrews, 0334 76206. Scotbyte Computers, Edinburgh, 031-343 1055. Victor Morris and Co., Glasgow, 041-221 8958. SHROPSHIRE Tarrant Electronics, Newport 0952 814275. SOUTH WEST Diskwise, Plymouth (0752) 267000. West Devon Electronics, Yelverton, 082 285 3434. Bits and Bytes, Barnstaple, 0271 72789. SUFFOLK Elgelec Ltd, Ipswich, 0473 711164. SURREY Catronics, Wallington, Surrey, 01-669 6700/1. Croydon Computer Centre, Thornton Heath, 01-689 1280.  
WALES Tryfan Computers, Bangor, 0248 52042. WEST MIDLANDS Allen TV Services, Stoke on Trent, 0782 616929. WILTSHIRE Everyman Computers, Westbury, 0373 823764. B & D Computing (Swindon), 0793 762449. YORKSHIRE Media 5 Ltd., Sowerby Bridge, 0422 33580. Advance TV Services, Bradford, 0274 585333. Huddersfield Computer Centre, Huddersfield, 0484 20774. Comprite, Bradford, 0274 668890. Superior Systems Ltd., Sheffield, 0742 755005. Photo Electronics, Sheffield, 0742 53865. Ebor Computer Services (York) 0904 791595.  
NORTHERN IRELAND Business Electronic Equipment, Belfast, 0232 46161. Brittain Laboratories, Belfast 0232 228374.

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# INTEREST FREE

## On Atari, VIC20, Commodore 64 and

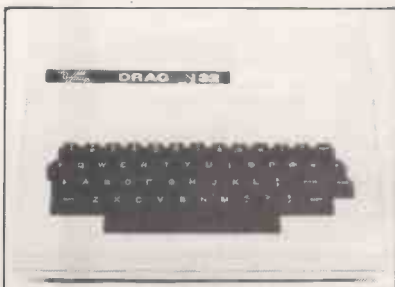
If your order contains over £120 worth of computer hardware apply now for interest free credit by telephoning: Mail-order: (0702) 552911. London Shop: 01-748 0926. Birmingham Shop: 021-356 7292. Southend Shop: 0702 554000 or write to P.O. Box 3, Rayleigh, Essex SS6 8LR.

You pay 10% down, then 10% per month for a further nine months (to nearest penny). Example: VIC20 Colour Computer. Cash Price £169.99. Credit terms: £16.99 down then £17 per month for nine months: Total £169.99. Credit quotations on request.

### THE NEW COMMODORE 64

The incredible new computer from Commodore comes with 64K RAM fitted! Plus 16 colours, hi-res graphics, 320 x 200 pixels, 40 columns by 25 lines, Z80 micro processor can be added — that means you can run CP/M software, 8 independently movable Sprites with collision detection, and a sound generator with 3 voices, 4 waveforms, envelope and filter to rival some dedicated music synthesisers. And all this at the most incredible price ever. (AF56L) Only £339.00

### DRAGON 32



The amazing new British computer with a full-travel standard keyboard, a 16-bit microprocessor, 32K RAM fitted (expandable to 64K and later to 256K!), 9 colours, hi-res graphics and Microsoft extended colour BASIC (the very best BASIC to learn with). It can be used with virtually any ordinary cassette recorder, it has a printer interface (Centronics-type), joysticks are available and it's incredible value for money. (AF57M) Only £199.50

### THE AMAZING ATARI COMPUTERS

- 4 Consoles Available:**
- Atari 400 with 16K RAM (AF36P) £249.95
  - Atari 400 with 48K RAM (AF37S) £319.00
  - Atari 800 with 16K RAM (AF02C) £499.00
  - Atari 800 with 48K RAM (AF55K) £590.00

★All above with BASIC & handbooks

- Other hardware:
- Cassette Recorder (AF28F) £50.00
  - Disk Drive (AF06G) £299.95
  - Thermal Printer (AF04E) £265.00
  - Epson MX80T Mk III (AF38R) £399.95
  - Epson MX80F/T Mk III (AF40T) £447.35
  - Printer Interface for 400 (AF41U) £59.95
  - Printer Interface for 800 (AF42V) £59.95
  - Interface Module (AF29G) £135.00
  - Versawriter (AF43W) £199.95
  - 16K RAM Module (AF08J) £55.00
  - 48K RAM Module for 400 (AF44X) £125.35
  - 48K Upgrade for 400 (AF45Y) £75.00
  - Floppy Disk (YX87U) £2.50
  - Le Stick (AC45Y) £24.95
  - Joystick Controllers (Pair) (AC37S) £13.95
  - Paddle Controllers (Pair) (AC30H) £13.95

For full details ask for our hardware leaflet (XH54J) SAE appreciated

#### JOIN THE U.K. ATARI COMPUTER OWNERS' CLUB

An independent users' group. Four issues of the club magazine for only £3.00! Address your subscription to Ron. Issue 1 of the club magazine featured a tutorial on character set redefinition and contained a collection of demonstration and games programs and lots more. Issue 2 featured a tutorial on player/missile graphics, an article about graphics on computers, a selection of members' contributions to the program library and much more.



### THE FINEST SELECTION OF ATARI SOFTWARE

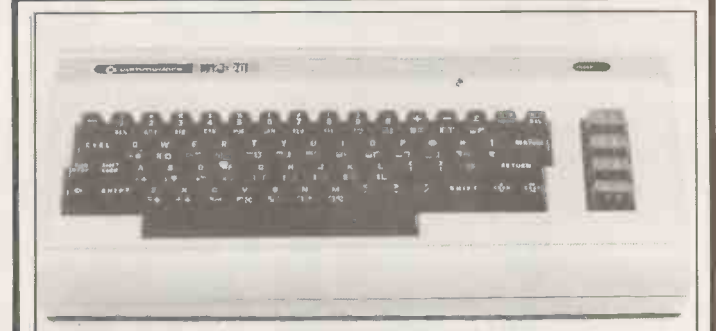
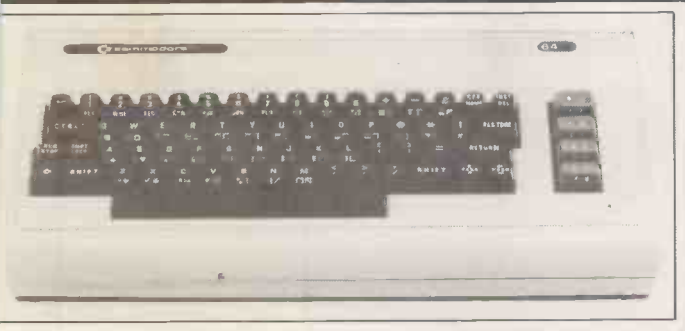
- |                                |                               |                         |                                 |                      |                        |                      |
|--------------------------------|-------------------------------|-------------------------|---------------------------------|----------------------|------------------------|----------------------|
| <b>Teach Yourself Programs</b> | Page Flipping                 | -1C-16K-BQ55K £11.95    | Rescue At Rigel                 | -1D-32K-BQ80B £22.45 | Curse Of Ra (Part 3)   | -1D-32K-BQ90K £14.95 |
| Conversational French          | Page Flipping                 | -1D-24K-BQ56L £11.95    | Datesstones Of Ryn              | -1C-32K-BQ22Y £14.95 | Analog Adventure       | -1D-32K-BQ33L £16.95 |
| Conversational German          | Sounds & Music                | -1C-16K-BQ04E £11.95    | Datesstones Of Ryn              | -1D-32K-BQ24D £14.95 | Adventure Land         | -1C-24K-BQ00A £14.95 |
| Conversational Spanish         | Sounds & Music                | -1D-24K-BQ05F £11.95    | Star Warrior                    | -1C-32K-BQ24B £28.95 | Pirates Adventure      | -1C-24K-BQ01B £14.95 |
| Conversational Italian         | Tricky Tutorials              | -3C-32K-BQ06G £59.95    | Invasion Orion                  | -1D-32K-BQ79L £28.95 | Mission Impossible     | -1C-24K-BQ02C £14.95 |
| Touch Typing                   | Tricky Tutorials              | -3D-32K-BQ07H £59.95    | Invasion Orion                  | -1C-24K-BQ23A £18.95 | Voodoo Castle          | -1C-24K-BQ03D £14.95 |
| States & Capitals              |                               |                         | Star Trek 3.5                   | -1D-32K-BQ81C £18.95 | The Count              | -1C-24K-BQ04E £14.95 |
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| Kids 2 (3 Programs)            | Text Wizard                   | -1D-32K-BQ09H £69.95    | Mission Asteroid                | -1D-32K-BQ84F £22.45 | Ghost Town             | -1C-24K-BQ08J £14.95 |
| Kids 2 (3 Programs)            | Mini Word Processor           | -1C-32K-BG08J £11.95    | Wizard & The Princess           | -1D-40K-BQ81Y £17.19 | Savage Island I        | -1C-24K-BQ09K £14.95 |
| Kids 2 (3 Programs)            | Mini Word Processor           | -1D-32K-BG09K £11.95    | Ulysses & The Golden Fleeces    | -1D-40K-BQ25C £21.79 | Savage Island II       | -1C-24K-BQ10L £14.95 |
|                                | Calculator                    | -1D-24K-YG50E £16.95    |                                 |                      | Golden Voyage          | -1C-24K-BQ11M £14.95 |
|                                | Graph-It                      | -2C-16K-YG51F £13.95    | Zork I                          | -2D-40K-BQ92A £20.64 | Soliporn Adventure     | -1D-40K-BQ93B £20.64 |
|                                | Statistics                    | -1D&P16K-YG52G £13.95   | Zork II                         | -1D-32K-BQ94C £29.95 | Deadline               | -2D-32K-BQ96E £34.95 |
|                                | Personal Financial Management | -3D-32K-BQ65V £49.00    | Alf-Baba & The 40 Thieves       | -1D-32K-BQ95D £29.95 | The Shattered Alliance | -1D-48K-BQ98G £29.95 |
|                                | Mortgage & Loan Analysis      | -1C-16K-BQ66W £13.95    | Temple Of Apsah (Part 1)        | -1D-32K-BQ94C £29.95 | The Battle Of Shiloh   | -1C-40K-BQ63T £29.95 |
|                                | Bob's Business                | -1C-32K-BG11M £9.95     | Temple Of Apsah (Part 1)        | -1D-32K-BQ86T £28.95 | The Battle Of Shiloh   | -1D-40K-BQ97F £29.95 |
|                                | Bob's Business                | -1D-32K-BG12N £9.95     | Upper Reaches Of Apsah (Part 2) | -1C-32K-BQ87U £14.95 | Energy Czar            | -1C-16K-YG53H £9.95  |
|                                |                               |                         | Upper Reaches Of Apsah (Part 2) | -1C-32K-BQ87U £14.95 | Kingdom                | -1C-8K-YG55K £9.95   |
|                                | <b>Adventure Games</b>        |                         | Upper Reaches Of Apsah (Part 2) | -1D-32K-BQ88V £14.95 | Space Shuttle Module 1 | -1D-32K-BG65V £19.95 |
|                                | Galactic Empire               | -1C-32K-BQ14Q £14.95    | Curse Of Ra (Part 3)            | -1C-32K-BQ89W £14.95 |                        |                      |
|                                | Rescue At Rigel               | -1C-32K-BQ21X £22.45    |                                 |                      | <b>Arcade Games</b>    |                      |
|                                |                               |                         |                                 |                      | Star Raiders           | -1E-8K-YG66W £29.95  |



# CREDIT

## Dragon 32 computer hardware

(Subject to approval which can take up to 48 hours) (APR = 0%)



### ATARI SOFTWARE continued

- Asteroids -1E-8K-YG60Q £29.95
- Space Invaders -1E-8K-YG70M £29.95
- Missile Command -1E-8K-YG64U £29.95
- Caverns of Mars -1D-16K-BQ69A £24.50
- K-Razy Shoot Out -1E-8K-BG63T £29.95
- K-Razy Kritters -1E-8K-BG51F £29.95
- K-Star Patrol -1E-8K-BG52G £29.95
- Pathfinder -1D-32K-BG33L £27.95
- Crossfire -1C-16K-BG22Y £20.64
- Crossfire -1D-32K-BG23A £20.64
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- Threshold -1D-40K-BG18U £27.54
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- Galactic Chase -1D-16K-BQ61R £19.95
- Race In Space -1C-16K-BQ35Q £14.95
- Race In Space -1D-16K-BG20W £16.95
- Space Chase -1C-16K-BG42V £10.95
- Space Chase -1D-24K-BG43W £12.95
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- Lunar Lander -1D-24K-BG16S £10.95
- Lunar Lander -1D-24K-BG49D £11.95
- Jumbo Jet Lander - Available November
- Submarine Commander - Available November
- Rasterblaster -1D-32K-BG35Q £22.95
- Shooting Gallery -1C-16K-BQ36P £14.95
- Shooting Gallery -1D-16K-BG19V £16.95
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- Matchracer -1D-16K-BG32K £23.95
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- Chicken -1D-16K-BG28F £21.90
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- Bug Attack -1C-24K-BG36P £23.95
- Bug Attack -1D-40K-BG37S £23.95
- Canyon Climber -1C-16K-BG44X £24.95
- Canyon Climber -1D-16K-BG45Y £24.95
- Mountain Shoot -1C-16K-BQ12N £10.95
- Haunted Hill -1C-16K-BG38R £16.95
- Haunted Hill -1D-16K-BG39N £19.95
- Time Bomb -1C-16K-BG40T £10.95
- Time Bomb -1D-24K-BG41U £12.95
- Tank Trap -1C-16K-YL34M £9.95
- Tank Trap -1D-32K-YL35Q £12.95
- Thunder Island -1C-16K-BQ37S £10.95
- Home Game Programs
- Scram -1C-16/24K-YG58N £17.50
- Basketball -1E-8K-YG61R £24.50
- Cypher Bowl -1C-16K-BQ20W £29.50
- Sunday Golf -1C-16K-BQ13P £10.95
- Darts -1C-16K-BQ42V £19.95
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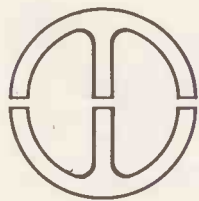
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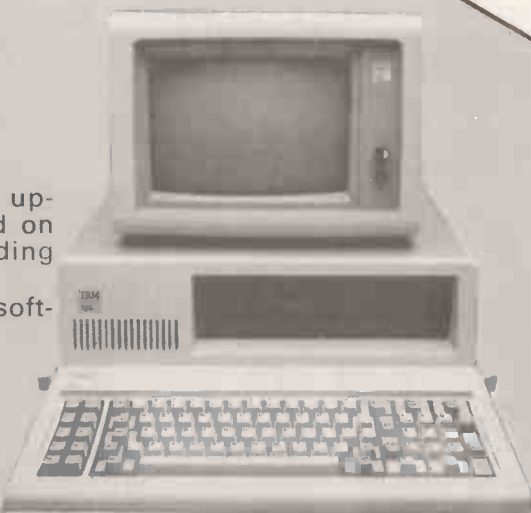


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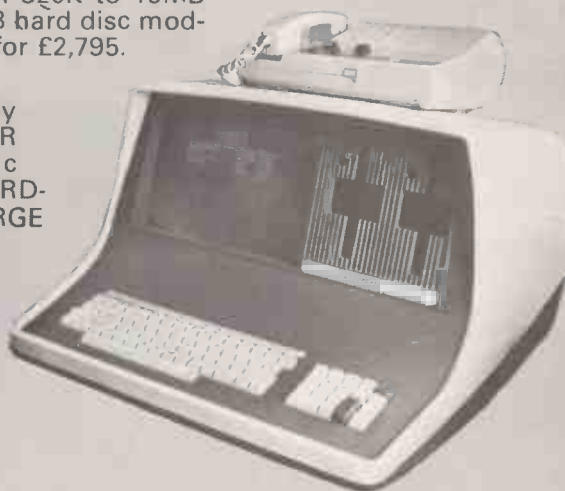
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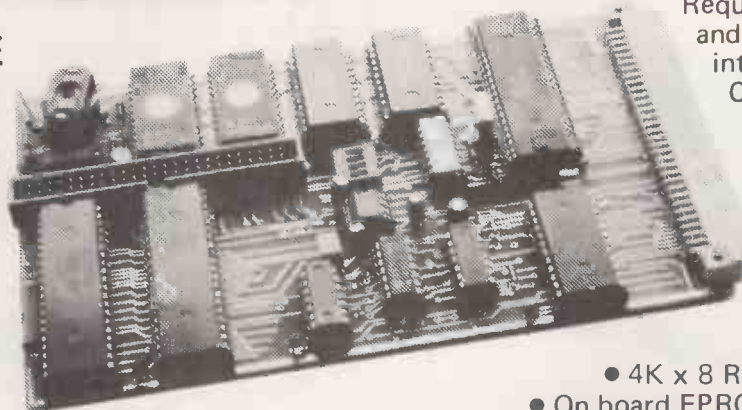
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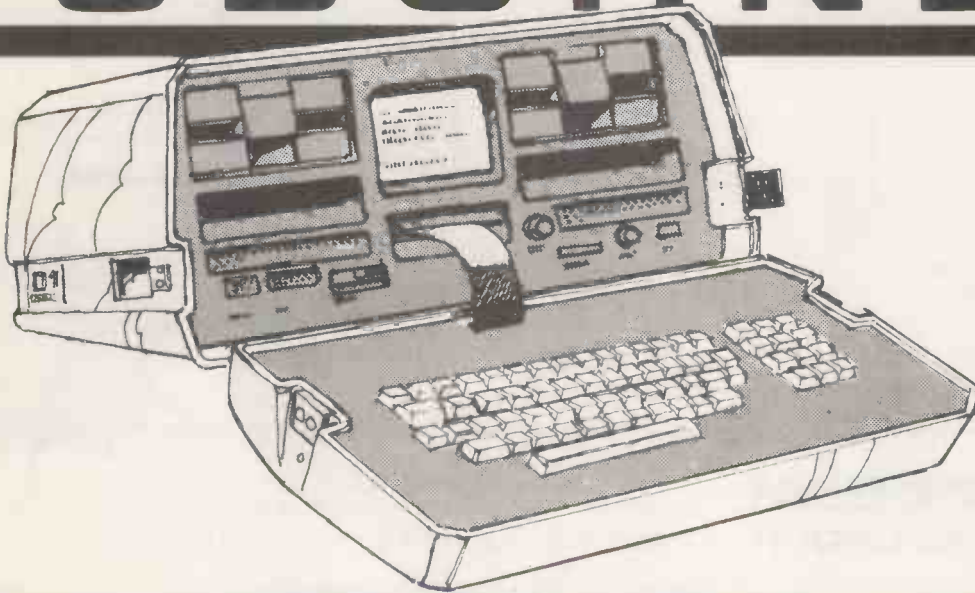
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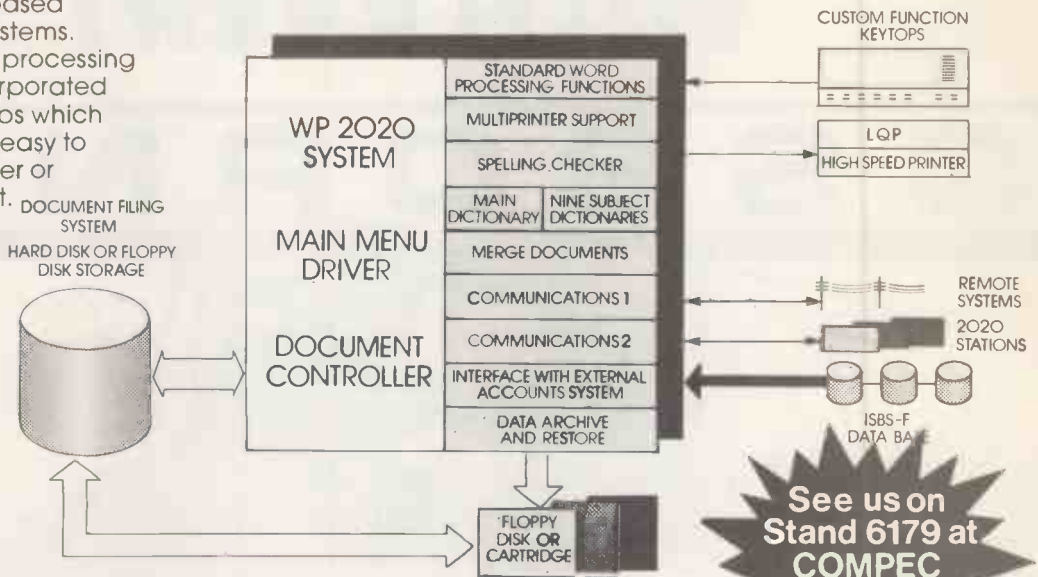
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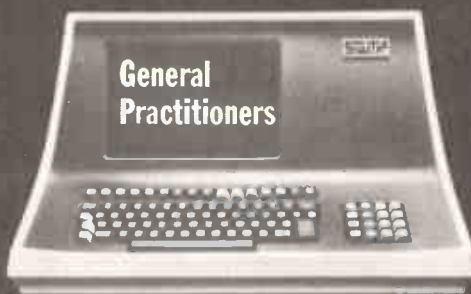
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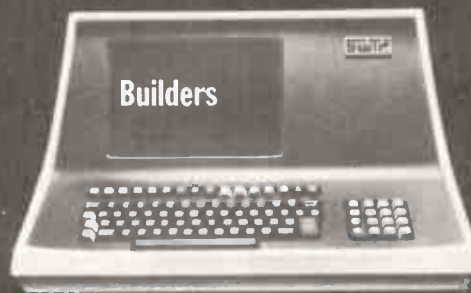
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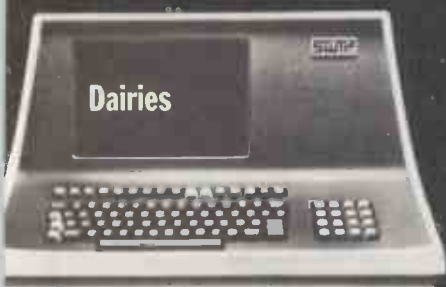
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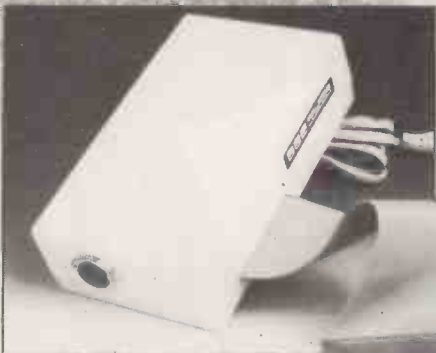
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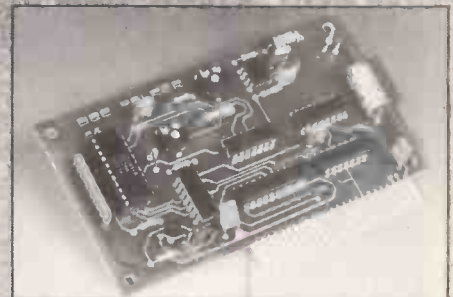


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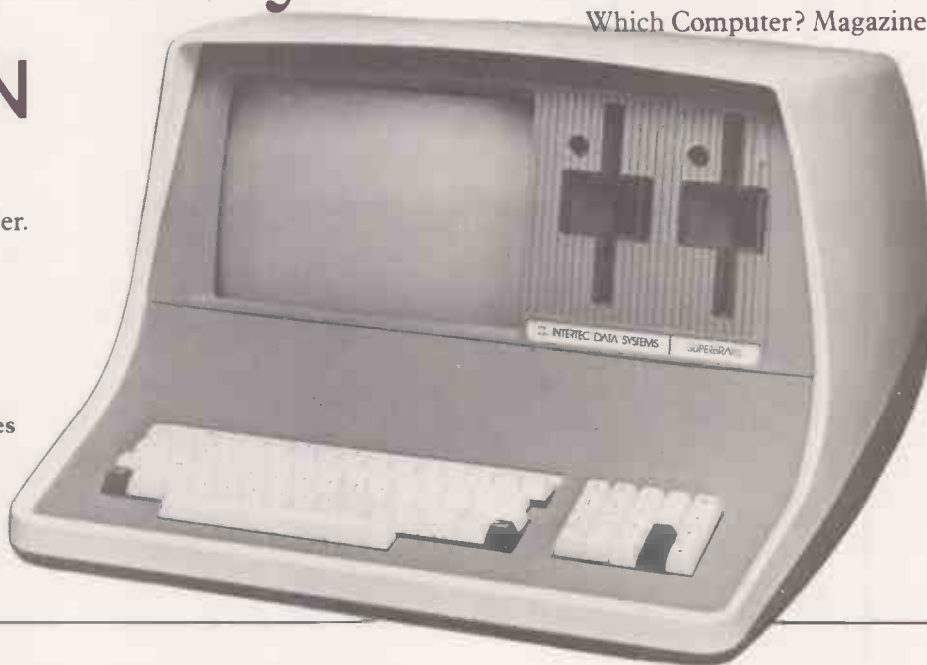
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These cassettes are inclusive of Library Case. For purchases of 10 or more cassettes please reduce the price by 10% and round it to the nearest penny e.g. C15 would cost 46p for 10 or more. Axon			
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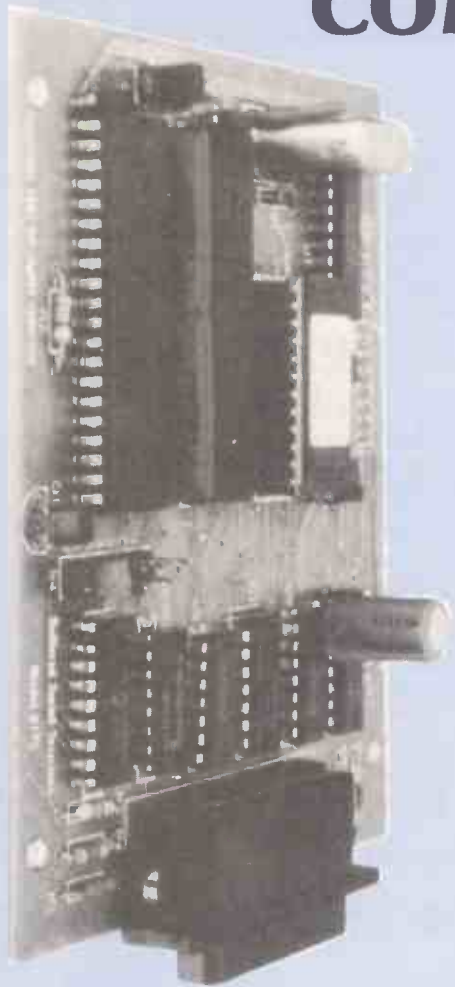
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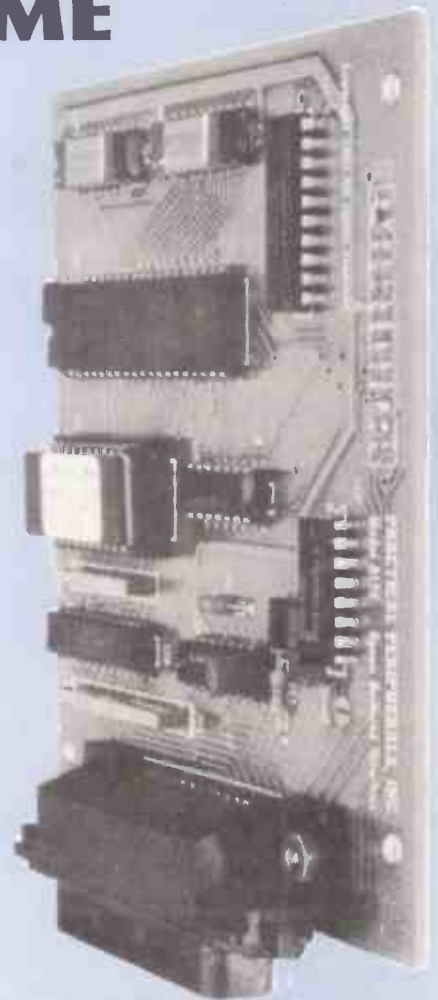
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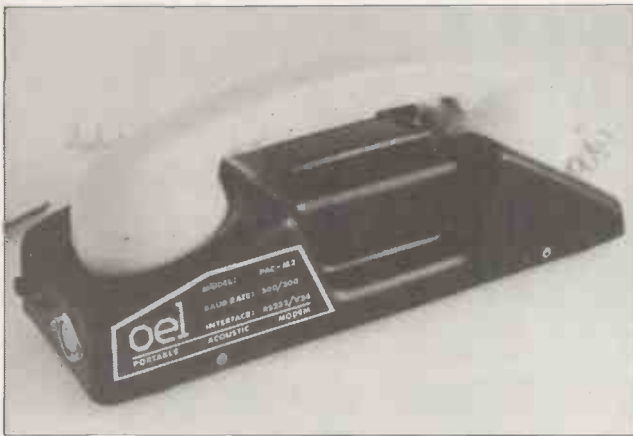
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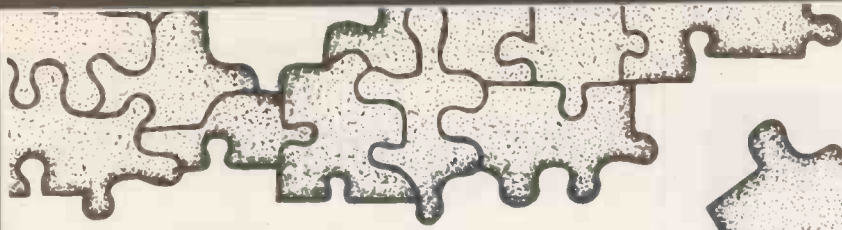
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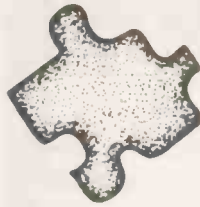
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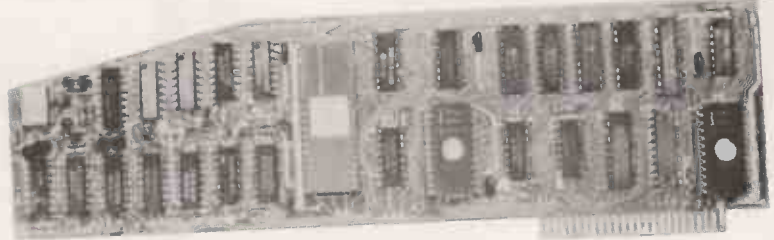
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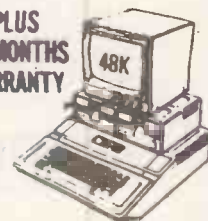
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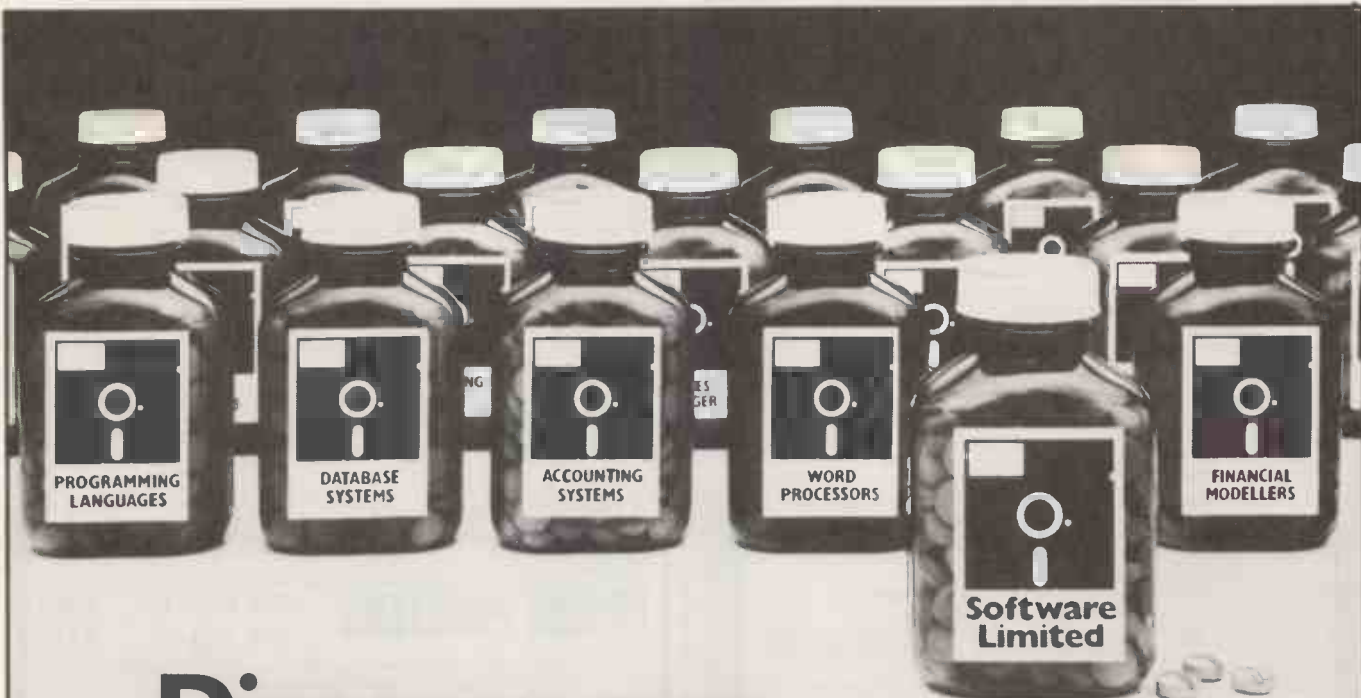
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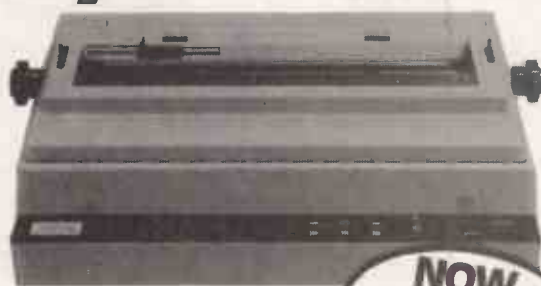
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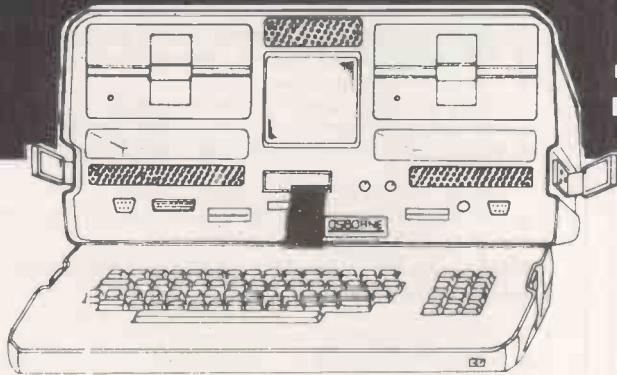
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Icarus have a new personal computer manufactured by Columbia Data Systems of the USA complete with its own software and hardware. It will also run all software and hardware produced for the IBM PC.

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That's before you switch it on.

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Appearances can be deceptive as a look at the credentials of the Columbia PC machine will tell you.

Operating system software is MS-DOS® or CP/M 86®.

Its 16 BIT 8088 hardware configuration provides 128 K RAM with parity, two RS-232 serial ports, Centronics parallel printer port, DMA controller, eight levels of interrupt, dual floppy disc system with one megabyte storage,

Winchester interface and eight expansion slots.

Not bad for the standard version.

## Examine your options

Columbia like to leave your options wide open. So they've included 256K RAM boards, 8087 arithmetic co-processor for high speed math functions, dual RS-232/RS-422 boards, and a Winchester disc based system.

The Columbia PC's expansion capability can easily accommodate just about any imaginable hardware configuration including one megabyte RAM and 10 megabyte disc.

## It's here now

And you know the other great thing about the Columbia PC? It's here now. Available off the shelf. And Icarus have a nationwide dealer network waiting to start deliveries.

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## EP4000

### EPROM EMULATOR PROGRAMMER



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2564\*, 2764\*, 2732A\*, 2732, 2532, 2716, 2516, 2758, 2508 2716(3), 2708, 2704

## P8000

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NEW  
PRODUCT

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## MIDAS S100 SYSTEMS

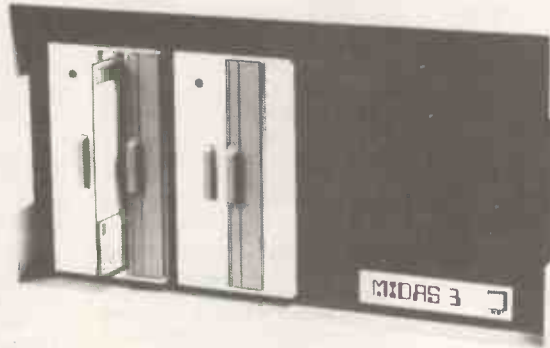
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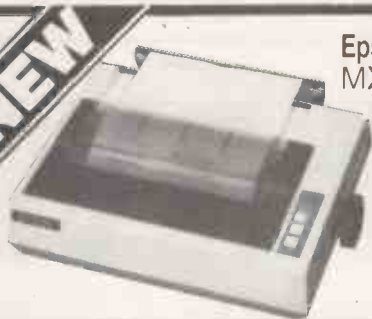


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# Preparing for a leap into the real world

IN THE DAYS when your editor was a real journalist, he had the doubtful pleasure of reporting an attempt to swim the Channel. The swimmer — an excessively pert teenager — climbed out of the water after an hour, complaining that it was wet and cold. The boat nearly sank on the way back and it was altogether not a jolly occasion. But for all that, I have always felt that I had, in a sense, swum the Channel. George III had the same feeling about the battle of Dettingen, even though, strictly speaking, he was not among those present on that historic day.

Journalists are always prey to this feeling that they do something more than report what they can see of what goes on around them: they get to think that they are the action. This slightly swollen-headed feeling is reinforced by all the bystanders who can see even less of what is happening, and have to rely on journalists to tell them what they think the event is.

This is bad enough in real journalism where one is reporting things anyone can see happening like Channel swims, wars, plagues, famines and the infidelities of TV stars. It is much worse in computing where most of the "action" is completely notional: ABC Ltd reports multi-million-pound deal with EFG Ltd; "Ideal for any purpose" announces Managing Director H; "PQR computer selling at the rate of 30,000 a month" boasts XYZ Ltd.

At first one tries to check up on this stuff. It appears that neither ABC nor EFG have more than two visible pennies to rub together. H's product is ideal for any purpose unless you want it to do something, and if XYZ is selling so many of what it claims to be selling why do we not fall over them at every street corner? After a while one gives up trying. Most of it is obviously rubbish, but what the hell. A little while later the knowledge that most of it is rubbish begins to fade, and you begin to believe this farago of press releases.

After three-and-a-half years of voyaging this ocean of froth, your editor is about to grease himself all over and leap in to try his luck as a swimmer. In short, this will be the last *Practical Computing* to appear with my name on the masthead. The editorial bridge will be manned henceforth by Jack Schofield, an amiable fellow with a strong stomach, a passion for micros and long experience of the hi-tech marketplace. No doubt he will wonder, as he looks down from his immaculate deck, why this man keeps being bitten by sharks, gulping water, beating back mermaids and the like, while his competitors are all — so they say — swimming effortlessly along at 40 knots.

The truth is that there is a great gap between the journalist on the deck and the swimmer in the water. The journalist fixes his gaze upon the horizon and shouts excitedly about passing tankers, buoys, whirlwinds and foreign landfalls. The swimmer has to contend with waves that get up his nose, oil slicks, and floating beer cans that try to smash his dentistry.

To put the matter more directly, the computer market as reported and the computer market as lived bear very little relationship to each other. The missing link is provided by the end-users, the people who buy computers and keep the whole balloon in the air. What do they want, what do they need, and what can they be persuaded to buy?

In the real world, while XYZ is boasting about 30,000 sales a month, everyone with a real, live customer is a rarity, likely to be trampled by colleagues and competitors in the rush. The customer, poor soul, has trudged his way to our doorstep through a blizzard of announcements, press

releases, world-beating scoops and the like. To arrive there at all requires strength of mind and firmness of purpose, for we provide precious little help — or rather we offer so much that none of it is helpful. Recently I have turned customer, standing on the street corner with a sheaf of readies in my hand, trying to buy a hard-disc multi-user system. In view of the number of such items advertised in these and other pages, the transaction seemed in prospect no more difficult than paying income tax. Well, you would be surprised how many people are quite startled and affronted when you try to buy their products: "I know we advertised it, but why do you want to buy it?" They become quite suspicious and ask several searching questions. It is staggering how many people spend large sums on advertising wares they appear to have no means or intention of supplying.

Still, this is an old topic for these pages, and indeed by Christmas I expect I shall be answering the phone with equally indignant yelps against people with the temerity to buy my own wares. The problem is that it takes two to make a market: a competent seller and a competent buyer. Either one alone beats the air, and this is why our own market is in not too good shape. There are some reasonably capable sellers, but very few knowledgeable buyers.

The plain fact is that you cannot understand computers well enough to buy them and use them unless you put in a lot of hard work. Alexander the Great asked if there was a royal road to geometry: there was not in his day and there is no royal road to computing now. A lot of people still have to bend their minds before we have a real industry. Happily, this fact is beginning to sink in. There are some magazines whose premise is that you do not have to understand computers in order to manage them properly. Yet one of them recently ran its first article on learning to program — a change of heart that may portend a complete change of tack.

There was, a year ago, a great passion for program generators among the more hopeful. It seemed to us then — and still does — that the problem with computing is not learning a language but learning to think in a computer-like way. In traditional terms, people have to learn to be their own systems analysts, despite the hard fact that systems analysis was always one of the highest-paid branches of the big-computing industry because it is the hardest work. Real life is difficult enough to analyse and pin down firmly enough to compute even when you have the services of platoons of professionals; when it is your own real life you have to analyse as it happens, the job is too much for most of us.

I would venture to predict that the training sector will continue to do gold-rush business for people do realise they do not understand and are anxious to do something about it. Meanwhile the "real" micromarket will just chug along until the first waves of Sinclair-hardened teenage veterans storm ashore, ready to analyse their elders' businesses into the computerate millenium — or bankruptcy. This unfashionable point of view may be at odds with all the received predictions for growth in the industry — and I hope, for my own sake, that I may be wrong — but the look of pathetic bafflement that comes over the average punter's face when you try to explain the simplest thing makes me believe that it will be a long time yet before he entrusts something as precious as his livelihood to our tender silicon tentacles. Until he does, our industry will not fulfil the heady predictions its fans like to make.

Peter Laurie

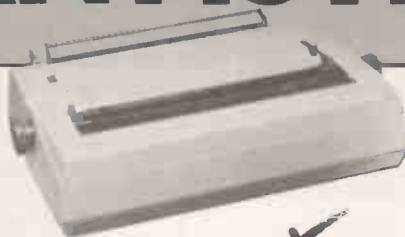
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May Issue: Careers, Bomber, Chords, Spiral and more. Plus articles on Graphics, Writing Games Programs and Using the Assembler.

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PRACTICAL COMPUTING November 1982



**Our Feedback columns offer readers the opportunity of bringing their computing experience and problems to the attention of others, as well as to seek our advice or to make suggestions, which we are always happy to receive. Make sure you use Feedback—it is your chance to keep in touch.**

## Hexad correction

IN MY HEXAD program page 142 of the August issue there were some mistakes. I know how infuriating it can be to type in a program only to find it will not run. This usually gives rise to criticism of the magazine concerned, but in this case the mistakes were entirely my fault. The corrected lines are:  
 2030 POKE Y, INT(PEEK X/16) + 28  
 2040 POKE Y+1, PEEK X-INT(PEEK X/16)\*16+28  
 2060 LET Y=Y+3

The accompanying text is not very clear. The disassembly program Pokes the hex into the second line of the program, so if the machine code is being placed above RAMtop the first line should be a Rem and the hex will be placed in the lines after that. The sixth line from the end of the article should read:

```
LET Y=Y+2.
```

Paul Morriss,  
Lincolnshire.

## Machine intelligence

IN HIS ARTICLE on machine intelligence in the August issue, Mike Costello rightly complains that "there are plenty of routines to sort numbers in arrays, but routines to start with sorted numbers and mix them up are a rarity". Unfortunately the routine he presents to do the job with its two extra arrays, one double sized, uses up more space and more time than necessary in attempts to fill occupied locations in the array, and for copying it back when done.

This quick one-pass shuffling procedure, written in Comal-80 moves through the array exchanging the current item at each location with one of the remaining items which have not yet been placed — including itself — chosen at random.

### Machine intelligence.

```
0001 //-- SHUFFLING PROGRAM;
0002 // BY R.S.FORSYTH (IN COMAL) 1982
0010 DIM A(100)
0050 ZONE:=4
0100 // MAIN LINE:
0110 FOR N:=1 TO 52 DO
0120 A(N):=N
0125 NEXT N
0128 // CARDS NOW ORDERED.
0200 EXEC SHUFFLE(A,52)
0250 // CARDS NOW DISORDERED.
0300 FOR N:=1 TO 52 DO
0330 PRINT A(N),
0333 NEXT N
0999 //
1000 PROC SHUFFLE(REF V<>,N) CLOSED:
1001 // SHUFFLES V(1..N)
1010 FOR J:=1 TO N-1 DO
1020 P:=INT(RND(0))*(N-J+1)+J
1022 // P SHOULD BE BETWEEN J .. N
1050 // SWAP V(J) WITH V(P):
1055 T:=V(J); V(J):=V(P); V(P):=T
1060 NEXT J
1075 ENDPROC SHUFFLE
```

Four sample runs on a 2001 Pet show that it works.

Costello also makes a couple of misleading claims about artificial intelligence which ought to be set right. Though he says that AI programs "are usually written in assembly language", they are almost invariably in Lisp or Prolog, which casts doubt on his related assertion that "Basic is a suitable language for most AI applications". It is also doubtful whether "weighting factors" are a feature of AI theory, for he does not fully explain the term; if they are, they are hardly a major one.

Richard Forsyth,  
London N11.

## Horses for courses

I REALLY HOPE that there are not too many *Practical Computing* readers who are "asking why they should buy Apples at £1,500 when the Spectrum with Microdrives gives the same performance for £300", as suggested in the otherwise excellent Editorial in the August issue. There is surely no real comparison between a Spectrum and an Apple II — or between the Spectrum and the BBC Micro, for that matter, a comparison which often seems to be made.

There is no doubt that Clive Sinclair has made a massive contribution both to computer literacy and to the hi-tech end of British industry, and he deserves hearty congratulations on these counts. The ZX series of micros has opened wide computing vistas to non-professionals, offering an "introduction to computing", as the Spectrum's advertising matter puts it. Many new micro users must catch the bug with a ZX and then trade it in later for something more up-market.

The ZX series offers a cheap alternative for people who are attracted by the idea of owning a computer, and work out what they want it for after they have got it home. Very few other computers either cover this market effectively or are manufactured with that market in mind. Although it may not originally have been the case, the majority of Apple buyers today probably have an application in mind and are looking for the right machine for the job. The BBC Micro appears to be aimed at those who seriously want to learn about micros and need a machine which will grow with them more or less indefinitely.

The Spectrum is not suitable for either of these purposes. Like the ZX-80 and ZX-81 before it, the Spectrum scores entirely on "power-for-money value".

They are not nice machines to use whatever gala possibilities might be locked away in the chips. If you have ever seen a typewriter, let alone a computer, you will wonder whether you will ever get used to those horrible little keys, not to mention the mental acrobatics required to access a given function.

The Spectrum is also very slow — up to eight times slower than the BBC Micro with its more sophisticated Basic. While speed may not be everything in educational applications, pity the poor student who wonders whether the program crashed during a For-Next loop, or the programmer trying to debug a recalcitrant nested routine.

The Spectrum is simply not in the same market as an Apple or a BBC Micro. If you are serious about computers do not start with a Spectrum, with or without Microdrives. If you might be serious, but just do not know yet, or if you want a micro to play with for its own sake then there is no better place to start than the Spectrum. You can afford to risk £125 to find out. You will learn a great deal from the machine, including when to change to an Apple or whatever when, and if, the time comes.

Richard Elen,  
London NW6.

## Finnish Micromouse

SIX MICE arrived in Oulu for the Finnish finals of Micromouse competition on 6 August. Tampere University of Technology swept the board with Manse 3, which took first place, and runner-up Minitaurus.

Place	mouse	time	owner
1	Manse 3	0.31	Tampere University of Technology
2	Minitaurus	1.32	Tampere University of Technology
3	Mousterix	4.03	University of Oulu
4	Jukka	4.23	University of Oulu
5	Mike	—	Kari Oikkonen, Lappeenranta
6	Hal	—	Levanto family, Espoo

The starting corner was chosen at random. Mousterix and Jukka got time only at the first run, due to some problems in software and reliability. Mike could not find the centre of the maze, and Hal did not move in the maze at all. Manse 3 and Minitaurus worked perfectly throughout.

Minitaurus showed roughly the same performance as in Paris, while Hal made

(continued on page 47)





# Not all printers are as advanced as they're cracked up to be.

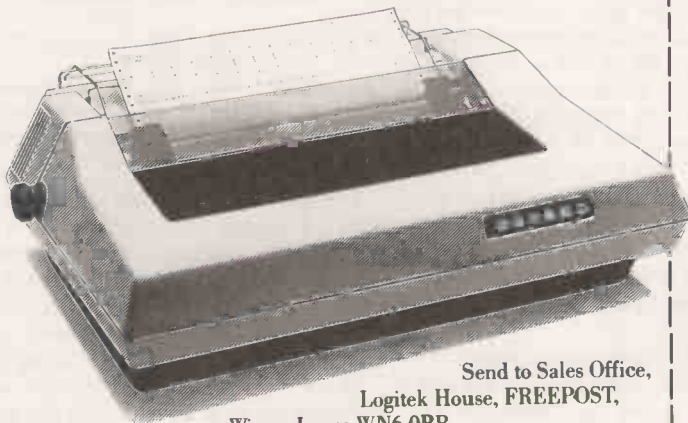
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PRACTICAL COMPUTING November 1982



(continued from page 45)

an impression with its ability to understand spoken commands. Unfortunately for Hal there were no prizes for virtuosity and only Mouserix will join the Tampere pair at the European finals.

**Julia Hartikainiu,**  
Oulu,  
Finland.

## Improved password

ADRIAN HILL's password system in August's *Practical Computing* is an ingenious first line of defence, but a quick session with DDT soon reveals the password. There is, however, a serious fault, though one which is easily corrected: Close adds 32 to the ASCII code of all the characters in the file name while Open only subtracts 32 from codes over 90, that is those higher than capital Z.

Thus for example the character 1 becomes Q on closing, but it does not revert on opening, with obvious disadvantages; worse is [, a valid if unusual file name, which is permanently transformed to " ; " a character which CP/M will not recognise and Ren will not change.

The solution is to restrict the activities of Close and Open to alphabetic characters only by inserting some checks after label SubLP1 and before ADI or SUI, as the case may be, in each program. In Close you need  
CPI 41H, JM NOSUB, CPI 5AH, JP NOSUB.  
In Open, replace CPI 5AH with CPI 60H, then add

CPI 7AH, JP NOSUB

**J C Stopes-Roe,**  
London N4.

## Louder Spectrum

COMPLAINTS about the Spectrum's poor sound volume are frequent, but there is an easy way to improve it:

Eject the cassette.  
Extract the ear plug.  
Press Play.

When played through the recorder the volume is at least three times louder than the Spectrum's own output.

**Keith Paterson,**  
Newmarket,  
Suffolk.

## Cheap peripherals

I WOULD LIKE to connect peripherals designed for the ZX-81 to my Sharp MZ-80K. The only problem is that I cannot find details of the connections of a ZX-81 so that I can modify the equipment to suit my own machine. Can any reader provide the necessary details?

**John Cray,**  
Garelockhead,  
Strathclyde.

## Secure codes

THE FEATURE by Muriel Gilligan on codes and ciphers — *Practical Computing*, September 1982 — was most interesting and highly relevant to practical

computing. Breaking ciphers produced by the German Enigma machines gave the Allies considerable advantage during the Second World War. The ciphers produced were so complex because the alternative alphabet was change for every letter by a complicated mechanical rerouting of electrical signals. Though easily decoded by a similar machine correctly set up it was almost impossible to decipher by other means.

The same technique is now easily applied between two computers of the same type since the random-number generator in micros is really pseudo random: it produces a series of numbers which will eventually repeat, though the length of the series before this happens can run into millions. In normal use this characteristic is regarded as a defect, and much ingenuity is expended in overcoming it, but for the purpose of enciphering data it is extremely useful.

So long as the seed number is known to both parties, it is possible to encrypt text very simply. If a loop is put in the program after a certain number of letters to cause "x" numbers from the random generator to be skipped you have a cipher which makes that from an Enigma machine look simple.

**John Cowie,**  
Dalgety Bay,  
Fife.

## Sharp exchange

ALTHOUGH LESS VERSATILE than the latest home computers, the sound generator of the Sharp MZ-80K is capable of some entertaining effects which can greatly improve a program. The manual offers no advice on controlling the sound generator, but I have compiled a set of sound effects which I would be happy to copy to any readers who send a cassette for the purpose, together with 20½p in stamps for postage. Although not essential, a swap program would be much appreciated.

**D E Loveseed,**  
38 South Parade,  
Bramhall,  
Stockport,  
Cheshire SK7 3BJ.

## Thank you

A SHORT WHILE AGO I bought a second-hand Trend 800 printer at a very good price. I then wrote to Trend asking if I could be supplied with a workshop manual for the printer so that I could do some work on it. A few days later I received a telephone call from one of Trend's engineers to arrange for him to check the printer out.

Having travelled up from Bristol, he checked and set up the printer for me. The result is a very good printer which is now in excellent condition. All this because I asked for a workshop manual — and the bill came to a total of £0.00p.

I do not think that many firms provide

this service and in my book this puts Trend at the top.

**Ian Sargent,**  
Swindon,  
Wiltshire.

## WordStar trick . . .

DAFYDD EVANS and other WordStar users who have difficulty in underlining spaces as well as characters — see page 37 of the August issue of *Practical Computing* — may be interested to know that yet another technique for achieving this objective is given in the Micropro WordStar training guide. It involves typing Control-P and Return at the end of the group of words to be underlined; a series of underline characters, ASCII 5F, is then typed in the normal way where underlines are required with a carriage return at the end.

While the procedure may sound tedious, it is in fact both quick and easy to do as it follows normal typing practice.

**P L McIlmoyle,**  
Twickenham,  
Middlesex.

## . . . if you want it

I TOO use WordStar and am impressed by its capabilities. I am glad that it does not underline spaces indiscriminately since this would give text an even more peculiar look. You can easily overcome the problem of underlining spaces in underlined text by typing the standard underline character in such places.

WordStar quite sensibly will only underline a character. On my printer, a Qume 5 using a Gothic 12 daisywheel, the phantom space control PF and phantom rubout control PG print the £ and ¼ symbols respectively. It is unfair to lay the blame for this at MicroPro's door since it obviously relates to the configuration of the system in use — hence MicroPro's advise to contact the dealer who supplied the equipment.

**John Lewis,**  
Oxford.

## Rights and wrongs

INDUCTION is induction and to try and distinguish between different types of induction seems fruitless. Those interested might find some helpful contributions in the collection of readings *Scientific Revolutions* edited by Ian Hacking, published by Oxford University Press.

It is asserted by Carl Zetie on page 37 of the October issue that

10 A = 1

is a correct program, and with goodwill I might believe so. Without goodwill I do not believe this program is correct: it produces an error on the ZX-81, no Let; and another error appears when it is run on the Atom, no End. I therefore ask for a proof that this program is correct.

**Boris Allan,**  
Stockport,  
Cheshire. ☐

# Spectrum's delays

SINCLAIR RESEARCH entered the record books with the success of the ZX-81, a micro which has now sold half a million worldwide. Sales were pushed above this magic number after the price was reduced to £49.95 including VAT and the range and number of retail outlets was considerably enlarged.

Yet the success of that machine is thrown into deep contrast by the supply difficulties associated with the newer ZX Spectrum. At the time of going to press the expected delivery date for newly ordered Spectrums is January 1983 — a delay of around three months from receipt of customers' orders.

The offer of a £10 voucher which may be spent on Sinclair Research hardware or software has been made to those would-be buyers who are patiently waiting. Further com-



Sinclair and his latest micro — customers face a long wait.

pensation will come in the form of the size of the range of available software, which in-

cludes games, educational and even some serious applications programs. □

# Coming events

## Expert Systems

An intensive one-day course with a practical emphasis will take place at the Polytechnic of North London, London N7 on Monday December 20, 1982. Further details from Richard Forsyth, Department of Maths, Statistics and Computing, Polytechnic of North London. Telephone: 01-607 2789 extn 2316.

## IT Year Conference

Two-day conference on information technology at Barbican Centre, London on December 8-9, 1982. Participation is by invitation only; for an invitation contact The IT'82 Conference, Online Conferences Ltd, Argyle House, Joel Street, Northwood Hills, Middlesex HA6 1TS. Telephone: Northwood (09274) 28211.

## Localnet '83 (Europe)

A conference on local network systems will be held at the Royal Lancaster Hotel, London on March 8-10, 1983. Further details from Online Conferences. Telephone: Northwood (09274) 28211.

## Computer convention

Conferences, exhibitions and workshops on the application of information technology to business, education and engineering make up this event at the North-East London Polytechnic, Barking Precinct, Longbridge Road, Dagenham, Essex on November 15-19, 1982. For details contact J G Smith. Telephone: 01-590 7722 extn 2062. □

# Eyes for the micro

VISUAL RECOGNITION hardware is becoming less expensive. For under £2,000 Digithurst has brought out a system suitable for use with the Apple, Acorn, the BBC Micro or Commodore Pet with high-resolution graphics card. Other interfaces will be available.

The system consists of a camera and interface box. The camera scans the object in its field of view and a 128-by-128 bit image is sent back to the host computer. The image can be stored in 2K of memory, where user software can get to work on it. Simple routines could be used to reformat it for printing or display, or to compare it with a previous image. More sophisticated software could facilitate practical applications such as quality control in manufacturing or visual sensing for robotic systems. More details from Digithurst Ltd, Leaden Hill, Orwell, Royston, Hertfordshire SG8 5QH. Telephone: Cambridge (0223) 208926. □

# Full-scale APL

THE PROGRAMMING LANGUAGE APL has an enthusiastic following in the world of mainframe computing, but until now no full implementation has been available to run under CP/M.

Viz-APL, from a company called Inner Product, conforms to the proposed ANSI standard and closely matches the IBM definition of APL. It runs on Z-80 based CP/M systems and is available now, costing £360.

The problem APL implementers face on eight-bit systems is the limited address space available, typically 64K. Viz-APL overcomes this by using a virtual-memory management technique. The user can assume a workspace of up to 1Mbyte; providing the on-line disc capacity is available the software arranges for the appropriate chunk of workspace to be in memory when needed, swapping out the least-used chunk to make room for it. Obviously paging the contents of memory to and from disc takes time, so this approach will work best on hard-disc systems.

APL adherents claim it is possible to develop programs very rapidly in the language. It is particularly suited for applications which change rapidly, such as forecasting and modelling, and APL can be used in the style of a sophisticated and ultra-powerful Visi-Calc. APL's somewhat bizarre mathematical notation has to be learnt before you can use it, but APL programs are very compact.

Further details on Viz-APL from Inner Product, Eagle House, 73 Clapham Common South Side, London SW4 9DG. Tel: 01-673 4047. □

# Home health advice

IF YOU MISS the Radio Doctor you will be pleased to learn about the Home Doctor Series, which Eastmead Computer Systems, say is an "Exciting breakthrough in home-health advice". The series consists of six cassettes, each containing about 18 programs.

The subjects range from Basic Medicine to 101 Home Nursing Tips. While aimed at

home-computer owners, the programs could equally well be used in schools and for health education in factories, etc. You need a Vic-20 to run them, though Sinclair versions are in preparation.

Eastmead Computer Systems, Eastmead House, Lyon Way, Camberley, Surrey GU16 5E2. Telephone: Camberley (0276) 682041/2. □



# HP joins portable battle

1983 LOOKS LIKE being the year of the truly portable computer. Following the announcement of the £500 Epson HX-20 portable computer which was reported in last month's issue, the giant instrument, minicomputer and calculator manufacturer Hewlett-Packard has launched its own portable computer. The HP-75C weighs under 2lb, is scarcely bigger than a reporter's notebook and can run for 30 hours off its own internal batteries while in its maximum power mode.

The price of £694 for the cheapest model seems expensive, but it will sell on the basis of the Hewlett-Packard name and its worldwide strength in the scientific and engineering community. HP is a \$4 billion turnover company which has already sold over half a million HP-41C programmable calculators, which the company now prefers to call a hand-held computer. The new machine will be available immediately from HP dealers.

The HP-75C portable computer looks very like a large calculator, with its 32-character LCD display and generally unobtrusive design. But inside is an eight-bit custom HP processor chip, 16K of RAM expandable to 24K, and 48K of ROM containing an extensive operating system and Basic. The Basic can cope with very large numbers, with exponents in the range of plus or minus 499, displaying 12 significant-digit precision.

The keyboard uses calculator-style click keys in a QWERTY layout, spaced more closely than on a typewriter. All keys can be soft-



ware defined to customise the machine to a particular application, and provision is made to accept clip-on keyboard overlays. There are three slots beneath the lower edge of the keyboard for 16K plug-in ROM modules, which could neatly hold the customising applications software.

Mass storage takes the form of hand-pulled cards which hold 1.3K. The advantage of this approach over the higher-capacity microcassette drive — as used on the Epson — is that the unit is very compact, and reading and writing the cards consumes very little

power. The unit is located to the right of the space bar.

The built in date-time clock can be used with the programmable bleeper to signal appointments, or can be used to time real-world events or set programs running. The operating system can handle several programs in memory at the same time — as many as the available memory permits.

The machine is fitted with the two-plug Hewlett-Packard Interface Loop, a low power consumption network interface which can accommodate up to 30 devices. The HP-85C can be connected via the loop

to plotters, printers, HP instrumentation, TVs or monitors connected via the HP video interface unit, or HP Series 80 computers. In this way the HP-75C can function as part of a larger system.

Not much ready-written software is available at present. HP is providing a series of solution books and will be covering the commonest generic applications such as statistics, finance and maths but appears to be relying on the user community to produce the bulk of the applications software.

There is no disguising that the HP-75C is an expensive computer which looks like a calculator, but neither fact should deter the sophisticated engineering or scientific user — the people at whom the machine is clearly aimed. HP believes that portable computers will be the fastest-growing segment of the computer market.

More details from Literature Section, Hewlett-Packard Ltd, King Street Lane, Winnersh, Wokingham, Berkshire RG11 5AR. Telephone: Reading (0734) 784774 ext 2084. □

## Fast 256K pseudo-disc

AS THE COST of RAM chips falls, products which emulate discs in RAM memory can be expected to become a very popular way of enhancing the performance of computer systems. Writing to and from RAM is very much faster than accessing a disc, particularly a floppy disc, so any application which involves frequent trans-

fers of data between disc and memory should benefit. Obvious examples are database programs and programs using high-resolution graphics screen images held on disc. The user will only have to remember to copy to a real disc at the end of each session, since RAM loses its contents when the power is turned off.

The Basram card provides 256K of pseudo-disc space for the Apple II, and is compatible with DOS 3.3, Pascal and the Z-80 Softcard. It costs £470. Once the card is plugged into peripheral slot 5, any Dos command addressed to that slot will execute exactly as if a floppy were present — but more quickly. The ordinary Apple Copy utility is used to transfer the contents of Basram from and to disc at the beginning and end of sessions.

Basram is manufactured by Basis, the German company which produces the Apple II plug-compatible machine the Basis 108. Details of both products are available from Community Computers, 34 Dragon Street, PO Box 3, Petersfield, Hampshire GU32 2ER. Telephone: Petersfield (0730) 87567. □

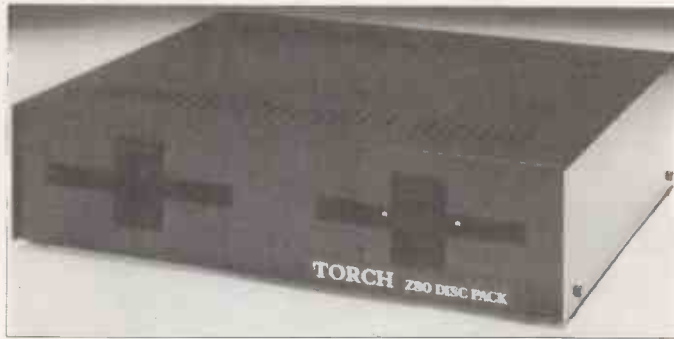
The interactive computer keyboard is a simple device which may be placed over the QWERTY keyboard of most microcomputers. Its purpose is to allow the micro's keyboard to be used by anyone, no matter how inexperienced. A selection of up to nine keys, each with large easy-to-read captions, turns the daunting computer keyboard into an extremely simple control panel. With keys labelled Yes, No or Maybe, complex diagnostic information can be obtained from the general public. The keyboards are already in use in hospitals to test handicapped patients. Further details of the interactive computer keyboard can be obtained from MS Electronics Marketing, 41 Palace Road, Bromley, Kent. Telephone: 01-464 3074. □



# Torch discs for BBC Real-time clock

THE TORCH Z-80 based disc unit for the BBC Micro turns this powerful home micro into a "real" computer system capable of running CP/M software. The unit is easily installed and contains a Z-80 processor board with 64K of RAM, two 400K floppy-disc drives and the Torch CPN operating system, enabling BBC Micro owners to access the large range of CP/M software.

The operating system is stored in two ROMs which contain all the disc- and file-handling commands. The system comes with complete documentation plus a disc containing utilities and demon-



stration software. The cost is a crippling £995, but then all is contained within the one box.

Further details from Torch Computers. Telephone: Cambridge (0223) 841000. □

VARUNA's REAL-TIME clock is designed to fit inside the case where its on-board battery back-up enables continuous operation for up to six months, without the host computer being switched on. The device allows immediate readout of tenths of seconds, seconds, 10s of seconds, minutes, 10s of minutes, hours, 10s of hours, day of week, days, 10s of days, months and 10s of months. Ready built it costs £40. Varuna Electronics, Horsell Park, Woking, Surrey. □

## Versatile printer

THE DAISY SYSTEMS M-45 printer has been designed so that it can be used with a large number of computer systems — anything from a mainframe to a mini or a micro. The change is effected by swapping a simple plug-in interface unit. The M-45 features a long-life hammer assembly which the manufacturer claims will last up to three times as long as a conventional daisywheel print head.

The print speed is 45 characters per second with proportional spacing; for plotting there is a resolution of 5,760 points per square inch. The M-45 costs £1,380; for details contact David Lyon, Peripheral Hardware Limited, Solihull, West Midlands. Telephone: 021-745 3033. □

## New products in brief

### Sirius Forth

KUMA COMPUTERS has announced Fig Forth 1.1 for the Sirius 1 operating under CP/M-86. It includes an incremental compiler, text editor and virtual-memory system, with a floating-point option promised for "the very near future". The price: £185.

Kuma Computers, 11 York Road, Maidenhead, Berkshire SL6 15Q. Telephone: Maidenhead (0628) 71778.

### TRS/Genie Electric NoteBook

SOUTHERN SOFTWARE has announced a new relational database manager for the TRS-80 Models I and III or Video Genie. It is called Electric NoteBook and costs only £69.95. Keyed retrieval and update is supported on all fields via interactive displays, and final presentation of the data is by user-defined reports.

For further information on the Electric NoteBook contact Southern Software, PO Box

39, Eastleigh, Hampshire S05 5WQ.

### Victor 9000 Tabs

TABS has standardised its well-known accounting system on the new Victor 9000 16-bit micro from DRG. This is hardly a surprise, as Tabs was already available for the almost-identical Sirius 1.

Victor Ltd, Sopers House, Chantry Way, Andover SP10 1PE. Telephone: Andover (0264) 58933.

### Fortune 32:16 micro

THE FORTUNE 32:16 is a new microcomputer using the Motorola MC-68000 chip, a 32-bit processor with a 16-bit data path. It runs the Unix operating system and can support up to 16 users, though it is likely to be used most often as a single-user multi-tasking micro.

As its first U.K. distributor, Fortune has appointed IBR Microcomputers of Unit 7, Suttons Industrial Park, Lon-

don Road, Earley, Reading, Berkshire.

### Apple abstracts

FOR THOSE who find it hard to keep up with all the articles published about the Apple, Parjon has introduced Apabs, an abstracts service. It provides a full reference, a short summary, and a "star" marking for each piece. Apabs is available as a printed publication and on disc from Parjon, 14 Broadway, London SW1H 0BH.

### Select on Xerox 820

THE EXCELLENT Select word processor is now available in "United Kingdom English" for the Xerox 820 Model II micro. Select Information Systems also has French and Norwegian versions, and is working on German, Spanish, Italian, Danish, Swedish, Finnish and Dutch. Select Information Systems, 919 Sir Francis Drake Boulevard, Kentfield, California 94904. □

At the same time as launching the new portable HP-75C, Hewlett-Packard has brought out a totally new product for the well-defined desk-top personal-computer slot.

The HP-86 runs all HP's Series-80 software as well as CP/M products. Based around an eight-bit custom HP CPU, the system has 64K of user-available RAM, expandable to 0.5 Mbyte. It has a choice of 9in. or 12in. screens displaying 80 by 24 characters or 544-by-240 point graphics; its many disc options start with a new 270K 5.25in. floppy drive. Software packages available include a graphic enhanced version of VisiCalc and a comprehensive graphic presentation pack for use with HP plotters. An HP-IB interface is built in, and the Hewlett-Packard Interface Loop as used on the HP-75C is also available. Start price for the HP-86 is £1,252, making it the lowest-price HP desk-top model. □





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- Pips is indisputably a unique breakthrough in operator convenience. And

typical of Sord's total awareness of consumer needs.

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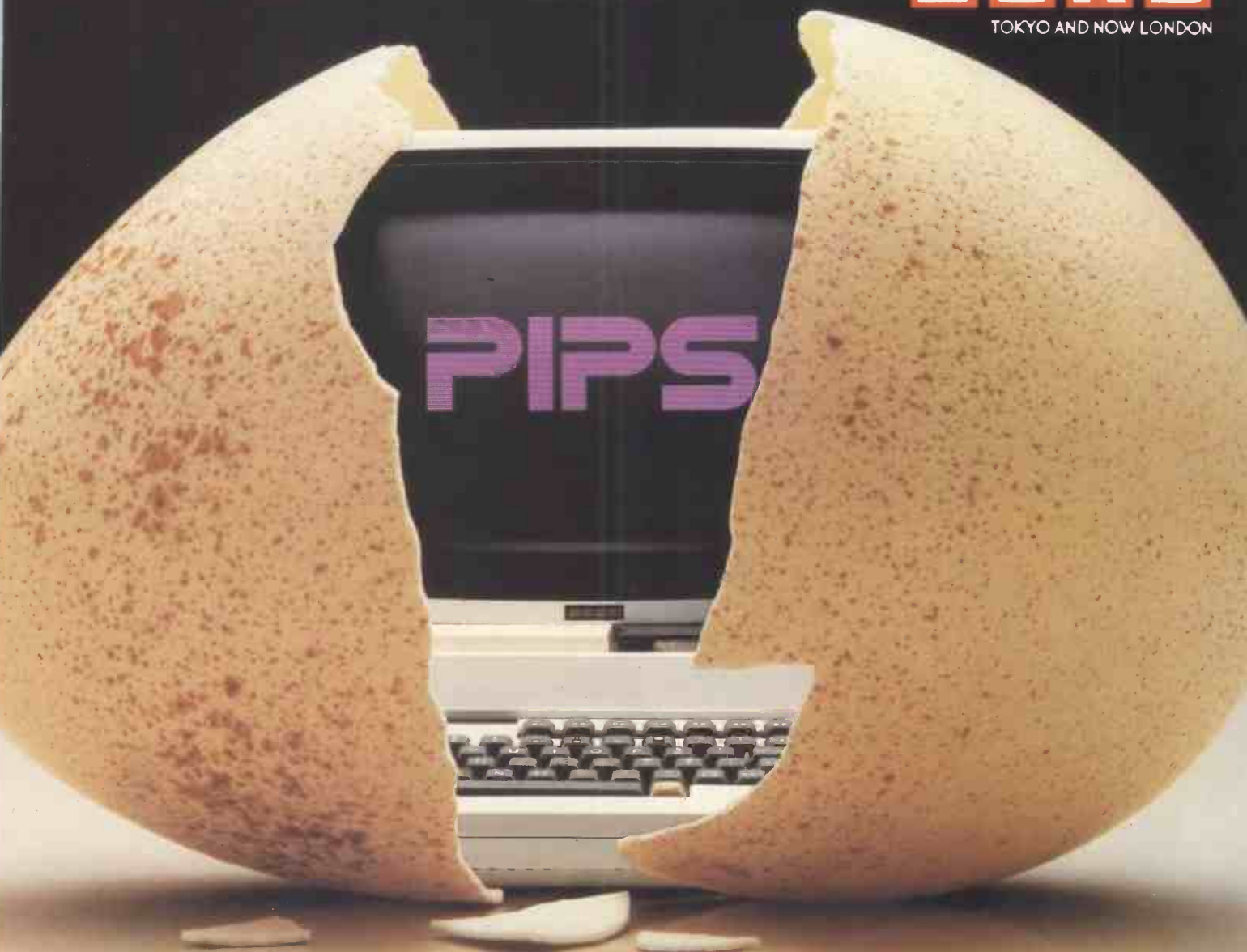
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# The new generation that interfaces with most microcomputers

Mannesmann-Tally's new MT100 series of matrix serial printers for microcomputers is now available from local computer shops and suppliers.

MT100 series printers are utterly reliable. They're a new generation of Europrinters made in West Germany with full technical and service back-up from our headquarters here in the UK.

They give high performance at a very reasonable price. Ideal for professional businesses. Or educationists. Or enthusiasts who value the latest technology.

## Two basic models – MT120 and 140

Main difference is in column width. The MT120 is the 80 columns version whilst the 140 features 132 columns.

Both models come in three variants giving a range of standard features which normally are beyond the scope of microcomputer orientated printers.

9 x 7 matrix, 160 cps high speed output – often doubled by microprocessor control choosing shortest possible print path in either direction.

Selectable 18 x 40 matrix for **high definition correspondence quality**.

10 different character sets, 96 characters each.

OCR A and B character fonts using 9 x 9 matrix.

Four different character pitches between 10 and 20 cpi, each of which can be printed in double width.

Two colour printing.

All MT100 series printers are small, quiet and highly versatile. End user prices start at £390.

For further pricing and availability **use the MT100 hotlines on Reading (0734) 586446/7/8** or look in at your computer shop. Alternatively write to us for full details.



# MANNESMANN TALLY

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The Strobe 100 plotter costs under £600 and interfaces to all the common microcomputers. It plots with a resolution of 500 points per inch on the A4-size paper or overhead projector transparencies, using colour pens. Software is available to do business graphics, including one package to interface with VisiCalc and other DIF-format files. Apple II and III, Commodore Pet, Tandy, Osborne, S-100 and RS-232 interfaces are available now. For further information on the Strobe 100 plotter contact the U.K. distributor, Data Efficiency, Maxted Road, Mayland Avenue, Hemel Hempstead, Hertfordshire HP2 7LE. Telephone: Hemel Hempstead (0442) 63561. □

## Sirius software

COINCIDING WITH its television advertising campaign in which a robot mutates into a woman, ACT Sirius has brought out a catalogue designed to show that plenty of software exists for its 16-bit machine. ACT claims to have sold over 3,000 systems and is clearly going all out to establish a strong user base before the IBM Personal Computer arrives officially in the U.K. — though the date for this event seems to have slipped quietly from September 1982 to an indefinite time in the future.

The Sirius catalogue *Exhibit One* lists both ACT's own range of applications software and over 50 products from independent suppliers. Copies from ACT (Sirius) Ltd, Freepost, Halesowen, West Midlands B63 3NT. Telephone: 021-501 2284. □

## Unix OS at root of new name

CDS COMPUTERS LTD IS SO taken with the Unix operating system that it has changed its name to Root Computers Ltd. Although the connection will be obscure to many, Unix buffs will know that Root is used when developing or running program modules. Many industry commentators predict a bright and rosy future for Unix.

Root was the first U.K. company to be granted a licence for the Unix System III operating system and is now established as one of the world leaders in this field.

Root Computers Ltd, Saunderson House, Hayne Street, London, EC1A 9HH. □

## Date is set for Northern fair

PERSONAL COMPUTER enthusiasts in the Greater Manchester and Merseyside area are to have their own computer exhibition, the Northern Computer Fair, which is being held at Belle Vue, Manchester from November 25-27. More than 60 companies have already booked space at the show, which will be the largest exhibition specifically designed as a showcase for personal computers, home computers and small business systems, to be held in the North-West.

The exhibition will feature a wide spectrum of equipment ranging from the Dragon 32, the attractive colour computer recently introduced by Mettoy at just under £200, up to the powerful Sirius 16-bit computer with Pulsar software which has been widely advertised on TV, from Raven Computers of Bradford.

A number of computer clubs and user groups includ-

ing the Manchester Computer Club, the Manchester Acorn User Group and the Tangerine Users' Group will be participating in the Northern Computer Fair to provide advice for those who are just starting to get to grips with personal computers. On a more professional basis the National Federation of Microsystems Centres, a body whose activities are co-ordinated by the National Computing Centre, will be providing advice for business and professional people on the introduction and use of microcomputer systems.

A £50,000 promotion budget which includes TV advertising on Granada and the new ITV Channel 4 will publicise the Fair.

The exhibition is sponsored by *Practical Computing* and *Your Computer* and we look forward to welcoming you to our show. Remember to clip the half-price admission coupon which you will find in

## Checkmate to Boss

IN A RECENT competition the Vic-20 chess program Boss confounded the opposition. Set at a level of skill where the average response time was 60 seconds, the Vic-20 game managed to beat Sargon II on the Apple II, Petchess, and Chessmaster on the Texas TI-99/4A.

The game is available as a cassette and requires a minimum of 8K expansion. There are 10 levels of play, giving response times between a lightning one second — which is very easy to beat — to a funereal nine hours, for which

most people do not have the time or patience. The computer will indicate how many moves ahead it is considering, and the number of moves until mate.

Castling, queening and *en passant* are all implemented in a standard way. There is a wide range of "book" openings and the graphics are excellent. Boss is available from Audiogenic or through the nationwide network of Vic dealers at £14.99, inclusive of post, packing and VAT. Audiogenic Ltd, PO Box 88, Reading, Berkshire. □



Flashback to April and the highly successful Earls Court Computer Fair.

the advertisement pages of this issue.

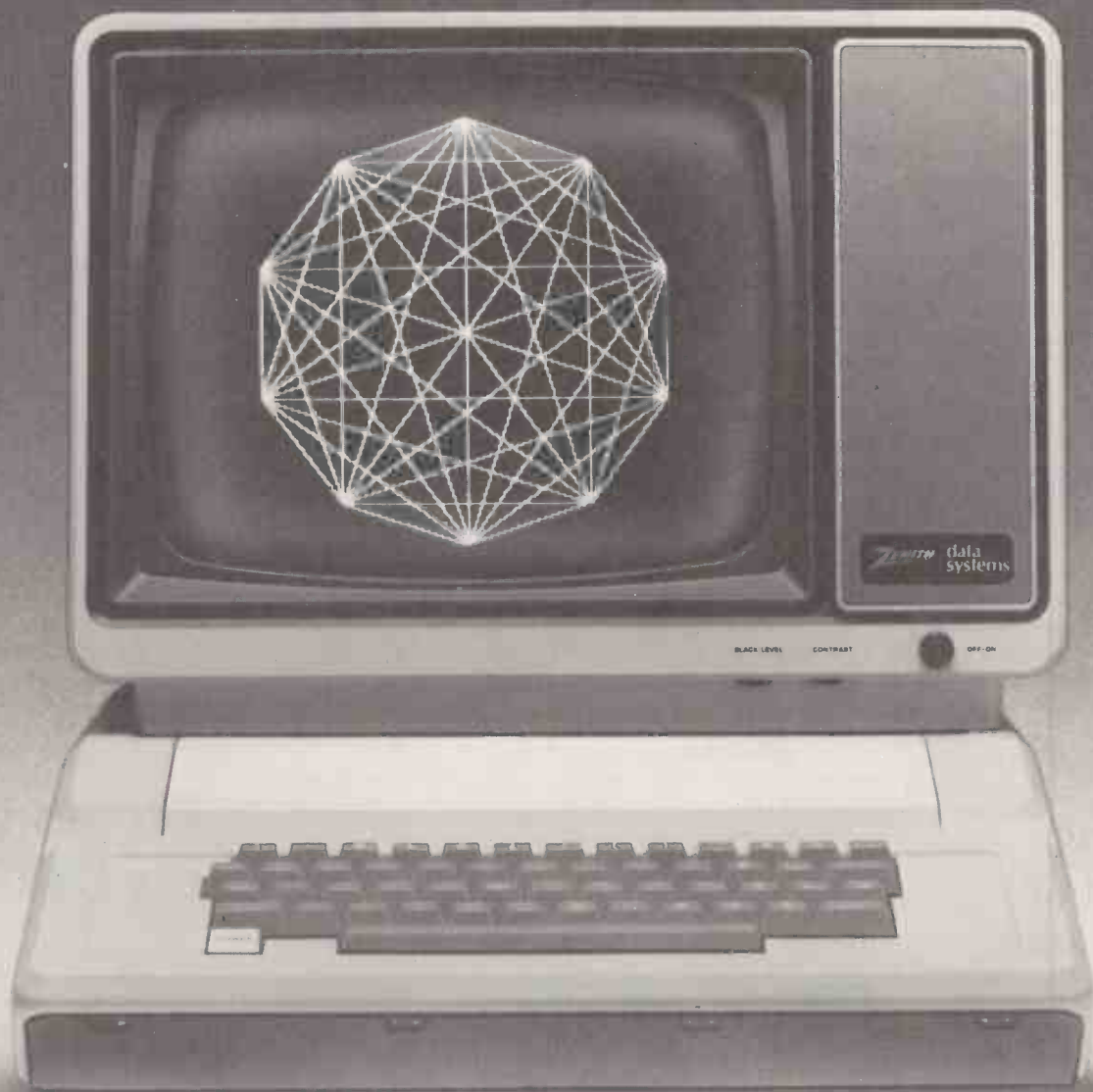
For further information about the Northern Computer Fair, including stand availability and party rates, contact IPC Exhibitions on 01-643 8040. □

## Biosis now on CP/M

BITS is a new information distribution service designed for use with desk-top computers. It consists of regular deliveries of diskettes containing indexed citations or abbreviated text selected from Biosis, the world's largest English-language life-science information service. The records are chosen according to criteria laid down by the user.

To be able to use Bits, the recipient needs a Z-80 based CP/M computer, 48K user memory and two disc drives using 5.25in. or 8in. single-density floppies. The cost is calculated on a charge for the floppy discs used. For further details contact Biosciences Information Service, 2100 Arch Street, Philadelphia, U.S.A. □

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# Torch: a tool for the 80s?

In a market overflowing with Z-80 based CP/M business machines the Torch stands apart. Bill Bennett reveals the background to this adventurous British micro.

THE STORY behind the Torch computer starts some years ago when Martin Vlieland-Boddy and Peter Harris, the two partners now at the top of the Torch tree, were working as management consultants. Their work consisted of applying to the world of high technology the skills they had learnt in a previous incarnation as chartered accountants. This experience led to the formation of Climar, a new company mainly concerned with writing applications-software packages. At the same time they engaged in a number of other businesses, including marketing the Acorn Atom microcomputer in Canada.

It was this fringe activity which proved decisive, as it gave the company some solid links with one of the U.K.'s top microcomputer manufacturers. After some time spent in the microcomputer business, and some extensive market research, the directors of Climar realised that there was a gaping hole in the microcomputer market: the Torch is the product to plug this gap.

## Influential link

A new company, Torch Computers Limited, was formed to manufacture the new machine, and among the directors were Chris Curry and Hermann Hauser of Acorn. Their role was short lived, as the contract for the BBC Micro provided them with more than enough work elsewhere. The computer was to have been based on hardware designed and built by Acorn, but this was another plan that had to be modified.

The original design was developed by Acorn into the popular BBC Micro while Torch, working along parallel lines, decided to standardise on the BBC model B, adding a Z-80 board and a number of other refinements. Interaction between Torch and Acorn remains much stronger than a supplier-OEM relationship: Torch supplies Acorn with a floppy-disc unit for the BBC Micro, and the firm also designed the ULA-based system, known as the tube, for communicating between processors.

Torch also makes the card carrying the extra Z-80 processor for the BBC Micro,

as well as an operating system which is rather cheekily named CPN. As you might expect, CPN is a version of that other ever-popular but less than perfect operating system. Though 6502 based, it maintains full compatibility with the Digital Research product, even to the point of allowing WordStar to run.

Both Harris and Vlieland-Boddy see the market as being the most important factor regarding their main product. To this end the Torch micro incorporates much fairly new technology, but nothing that is not tried and tested. What is remarkable about the Torch is the way that the component parts are put together: in the best engineering tradition, the Torch simply amalgamates existing state-of-the-art components in a new and exciting way.

In essence the Torch is a twin-processor computer with sophisticated communications facilities. To develop the machine the company just went along the road to Cambridge University's computer science department where it picked out all the brightest young prospects. Most of them were signed up to Torch before they took their finals.

The company operates from a converted period building in the flat countryside a couple of miles outside Cambridge. Proximity to the learned city is important, for the microcomputer pond is very small and most of its big fish swim in the waters around Cambridge. Not only is there a wealth of industrial talent in the area — with names such as Sinclair Research, Acorn, and the Altwasser-Vickers Jupiter project, to mention a few — but also a collection of some of the best academic brains in the computer world. Add that to a fast link to London and you have the ideal environment for a company building a new micro.

The fact that Torch is based in a village, not in the city itself, is a reflection of that part of the company's philosophy which has led to high-powered communications facilities being a standard feature of the computer. The Torch contains a Modem within its case; it has already been granted full British Telecom approval and can be connected straight

into the international telecommunications system.

Once patched into the telecoms network, the user has access to all kinds of services including Prestel and viewdata — the relevant adaptor being an integral part of the Torch — and Teletex, the new international data communication standard. The new British Telecom Gold service will link the Torch to a huge mainframe computer providing access to software and an electronic mail service.

## Networks and bleepers

Two Torches can communicate directly over the telephone, the incoming messages being received by a background processor and stored. At present, a bleeper tells the user that a message is being received, though it will be replaced in the very near future by the reassuring voice of BBC newsreader Richard Baker. For networking fans there is an Econet port as well, allowing local networking of up to 256 stations. It is fairly slow, but it does have the advantage of being very cheap. The phone-up facility can be automated so that an operator can sign off after a busy day's work, and while he or she is at home in front of the television the Torch is beaver away phoning up all and sundry at off-peak rates.

The telephone messages and all other input/output functions are handled by the 6502 background processor on the BBC board. It is in this area that the CPN sits, leaving the best part of 64K on the Z-80 board free for programming and data storage. The 635K in this area compares with a typical 26K left for programs in a typical CP/M system. In this area, one or more applications programs could be used or the user could write custom software in either the up-and-coming BBC Basic or the more common MBasic.

The Torch is set to change the way that business is done. The dealer network itself has standardised on the machine, and orders are placed on the system over the telephone. The popular phrase for the opportunity presented by this machine is "telecommuting": maybe the Torch is the tool for the 1980s, the first real telecomputer. M

# INNOVATIVE TRS 80-GENIE SOFTWARE

*from the professionals*

## SMAL-LDOS™

LDOS is an advanced and sophisticated disk operating system for the TRS-80 Models I and III, the original Video Genie, the Genie I and Genie II. It comprises some 113K of code. It was over a year in development and cost in excess of ¼ million dollars to write. It contains an advanced Disk Basic Interpreter enhancement, a complete Job Control Language compiler and many other features.

Obviously it is also complex. This is why it is accompanied by some four hundred pages of manual. It is not the best system for beginners.

On the other hand, LDOS contains so many important features that if a person is just starting out with disks he should be aware of them and, if you like, raised in the right habits. Presently available lower cost disk operating systems are all "first generation" and are primitive. Indeed, they tend to train a person in the wrong direction.

For those people who are either just starting with disks or who wish to get an insight into a full scale first quality disk operating system, smal-LDOS has been produced. It is a sub-set of LDOS and has a manual of 160 pages. It is not an exaggeration to say that it contains most of the advantages of LDOS but still maintains an utter simplicity in use. It is, if you will, a sampler for the main system.

It is also, to the best of our knowledge, the first DOS for these machines that can be upgraded to the larger version at a very reasonable cost. This is because with every smal-LDOS is supplied a coupon to the value of £15. This is redeemable against the purchase of a brand new full LDOS. There are only two stipulations. The first is that the redemption must be through us, not one of our dealers, and secondly the coupon can only be used for the purchase of an LDOS.

Smal-LDOS contains 21 Library Commands, 7 Utilities, 2 Device Drivers or Filters, and Disk Basic as follows:

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AUTO	FILTER	RUN
CLOCK	KILL	SET
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DATE	LIST	TIME
DEVICE	LOAD	VERIFY
BACKUP	HITAPE	RDUBL
CONV	PDUBL	REPAIR
FORMAT	PR/FLT	KKI/DVR
LBASIC		

For those of you not familiar with the features mentioned above, a brochure is available on either or both smal-LDOS and LDOS. On the other hand you may wish to order immediately, in which case:

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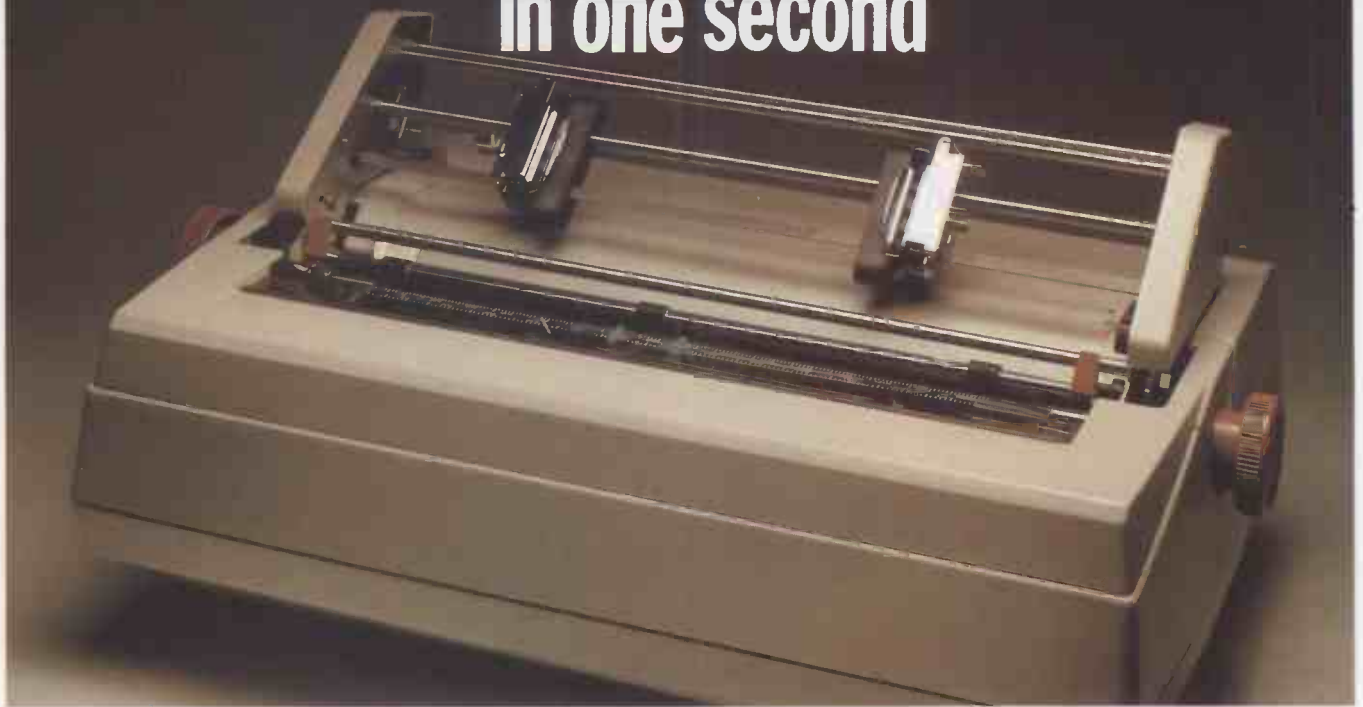
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AUTO BIDIRECTIONAL	Yes	No	No	No	<b>Yes</b>
AUTO LOGIC SEEKING	Yes	No	Yes	No	<b>Yes</b>
PROPORTIONAL PRINT CAPABILITY	Yes	Yes	Yes	No	<b>Yes</b>
EXTENDED CHARACTER SET	No	No	Yes	Yes	<b>Yes</b>
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The above information was gathered from distributors and abstracted from their current literature. Prices shown are those advertised at the present time.

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# COMMODORE 64

Jack Schofield takes a look at the 64K "SuperVic", expected to go on sale at under £350.

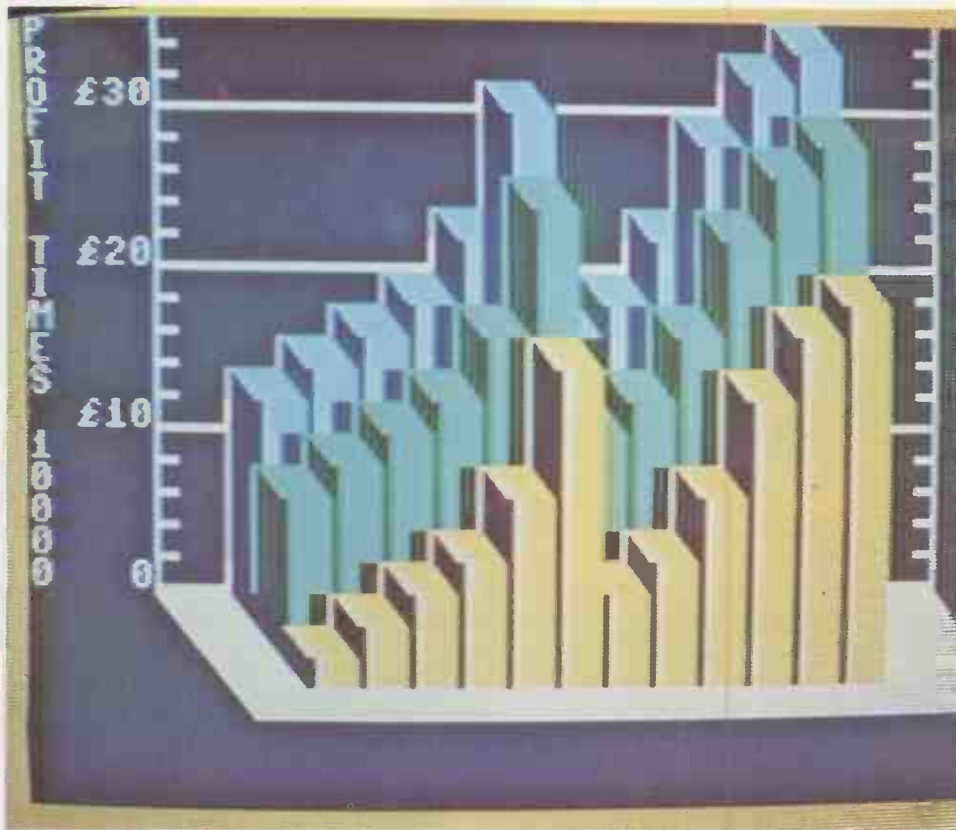
THE 40-COLUMN Vic has been rumoured for some time and, in a way, this is it. A much more powerful machine than the Vic, the Commodore 64 has many sound and graphics features which challenge the Atari 400 and 800 micros in the home-computer field.

The Commodore 64 uses a new chip, the MOS 6510, which has an internal architecture identical to the 6502, but offers better memory-addressing capabilities. It is designed to take a Z-80 as a second processor, providing a 64K machine capable of running CP/M for under £450.

The similarities to the Vic-20 are clear: the Commodore 64 fits in the same case, though it is a different colour, and the keyboard appears to be identical though the keys themselves are more comfortable to use. The layout of the I/O ports is also similar, but the 64's cartridges are much smaller than the Vic-20 versions and are not interchangeable with them. The 64 runs Basic 2.0, which seems to be the same as the Vic-20 language, but its 25-row by 40-columns screen format is different from the Vic's so the colour graphics and sound Pokes are not the same.

The most immediate difference is obvious on powering up. Instead of a measly 3.5K, the Commodore 64 offers 38,911 bytes free to Basic plus 20K of ROM. It is quite a way short of the 64K promised by the name, but more RAM is

Vic-20 users will recognise the 64's case, though it is a darker colour.



available through the use of a banked-memory system. The ROM overlays further areas of RAM, which can be accessed by changing the memory configuration. For example, by switching out Basic it is possible to free 52K of RAM for use with machine code or with other languages loaded from tape or disc. You can achieve 60K of RAM if you are prepared to lose all the I/O drivers.



The Commodore 64 has movable object blocks or "sprites" like those of the Texas Instruments TI-99/4A or the player-missile graphics of the Atari micros. A sprite is a predefined shape that can easily be moved relative to the background and to other sprites. According to the setting of priority registers, sprites can move in front of or behind other sprites and other screen contents, including text. A "hit register" can be set to detect collisions.

Where the Atari offers four eight-bit-wide players and four two-bit missiles, the Commodore 64 offers eight sprites, each constructed as a 24-by-21 dot array, that is three bytes wide. By programming in machine code you can have up to 256 sprites.

The Commodore sprites can be in two colours; three colours are available if you are prepared to accept reduced definition. The Atari system only permits a single colour for its sprites.

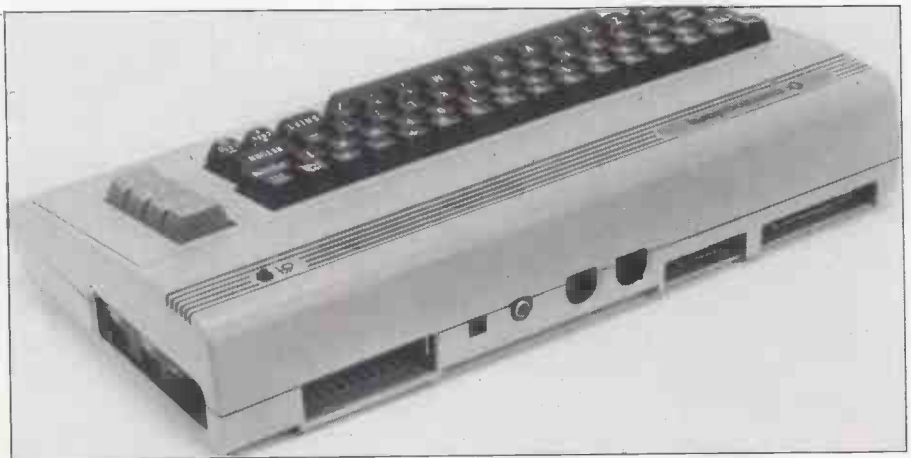
The Commodore 64 offers far more graphics facilities than the Vic-20 thanks to two new video interface chips, numbered 6566/6567, which will access up to 16K of RAM for screen-display information on a 320-by-200 pixel memory-mapped screen. The 16 colours which it can display simultaneously can be accessed from the keyboard, as on the Vic-20, or by Pokes.

Perhaps it is stretching it a little to say



## Specification

**Microprocessor:** MOS 6510  
**Memory:** 64K RAM, 20K ROM; 38K RAM available to Basic  
**Keyboard:** QWERTY with 62 keys including four function keys  
**Display:** TV or monitor, 40 columns x 25 lines; high-resolution mode 320 x 200 pixels  
**Sound:** Three voice-synthesiser with nine-octave range  
**Language:** Commodore Basic 2.0  
**Ports:** Serial and parallel ports, two joystick ports, one ROM cartridge slot  
**Dimensions:** 404 x 216 x 75mm.  
**Weight:** 1.82kg. (4lb.)



The I/O ports are similar to the Vic's, except for the smaller cartridge slot.

there are 16 colours: you can Poke 16 numbers — 0 to 15 — into the colour locations, but the resulting colours include black, white and three shades of grey. The remaining 11 colours include two reds, two blues and two greens, there being a light and a dark version in each case. The Basic installed on the Commodore 64 is desperately lacking in commands for high-resolution drawing on the screen. If you want to draw a line you have to plot it bit by bit and Poke it in. There are no useful commands like Plot, DrawTo, Circle and Fill, or Paint.

When it comes to sounds, however, the Commodore 64 offers quite a lot, thanks to a new chip, called Sid — the 6581 sound interface device. Where Atari's Pokey chip offers four voices and a three-octave range, Sid provides three voices and a nine-octave range. Further, the

Commodore 64 offers ADSR control of sound, like a synthesiser. ADSR is shorthand for the way the actual sound envelope is controlled — Attack/Decay, Sustain/Release — and by using its facilities it is possible to simulate various instruments quite well.


The limitation to the sound facilities is that, again, they are controlled by Pokes, and a lot of control means a lot of Pokes. The sample sound program in the User's Guide uses no fewer than nine, plus a delay loop, to play one note. There are separate Pokes for the volume, attack/delay, sustain/release, choice of high- or low-frequency range, pitch and waveform, and then three Pokes are used to turn it off. Once set up, each note only requires two Pokes, but it is nevertheless an incredibly tedious system compared to the Sound statements provided by other

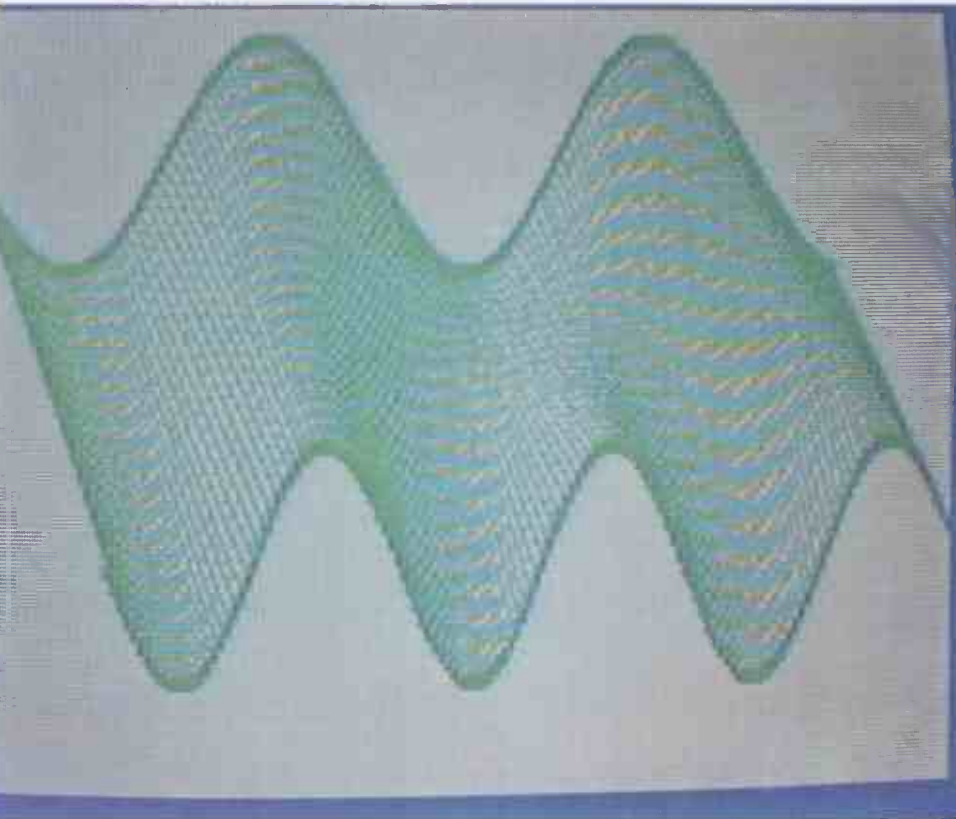
machines. It is likely that Commodore will offer an extended Basic on cartridge to provide the extra commands to deal more elegantly with colour and sound, but surely it would have been better to provide it in the first place.

The Commodore 64 uses the same peripherals as the Vic-20, including the special cassette recorder, disc drive, Modem and printer. The disc requires an extra ROM to upgrade it for use with the 64. The 64 has two eight-bit ports for use with joysticks, etc., as on the Vic-20, and the slot for ROM cartridges. Commodore says it is planning an IEEE-488 cartridge for this slot to enable the use of Pet peripherals including hard discs. The remaining ports are a cassette-interface port, a serial-interface port and an eight-bit parallel user port.

Though Commodore is still hard at work on software, it already has the Easy Script word-processing program running from disc, and is planned to release it as a ROM cartridge. An electronic spreadsheet like VisiCalc is also promised. Most of the Vic-20 games can also be expected to appear fairly soon after the launch of the 64. The 64 may look like a home/games machine — and it is — but the full keyboard, large memory, cheap Z-80 processor and low price must make it very attractive to the small business user: Commodore is working on business software too.

## Conclusions

- The Commodore 64 was designed primarily to try to compete with the top-selling Atari computers in the U.S., yet its U.K. advertising campaign indicates that it is to be aimed at business users too.
- When it comes to games, the Atari machines have the huge advantage: it will be many years before the Commodore 64 can compete on the quality or quantity of available software — if it ever can.
- The Commodore 64 is the first micro for some time to try to cater to both games players and business users. It has the potential to be a huge success, but in a rapidly diverging market it could just disappear down the crack. 





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WHAT THE PROFESSIONALS LOOK FOR IN A HOME COMPUTER	
Feature	Texas Instruments TI 99/4A
Microprocessor	TMS 9900 16 BIT
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Languages	TI-BASIC (built-in), extended BASIC, UCSD-PASCAL, TI-LOGO, Assembler
Memory	16K RAM standard-expandable to max ROM/RAM of 110K
Keyboard	Full size, standard typewriter style
Software	1000 programs to choose from worldwide
Solid State	Yes
Speech Capability	

## TEXAS INSTRUMENTS



Peter Wood examines a database manager for the professional programmer.

# dBASE II

COMPUTER PURISTS will tell you that a true relational database-management system can only be implemented on a mini or mainframe computer. Silicon Office was one of the first packages we reviewed that proved otherwise and now we are finding many more sophisticated programs being produced for micros.

One such is dBase II from the Californian software house Ashton-Tate. It is another example of professional software running on a microcomputer, this time for the ubiquitous CP/M. Yet dBase II takes a far more conventional line to true programmability than Silicon Office, being more a programmer's tool than a lay user's system designer.

Obviously, anyone entering the world of computer systems design would be well advised to study systems analysis before launching into heavy programming, but with many high-level systems such as dBase II an understanding of programming techniques and syntax is a prerequisite.

With Silicon Office you can produce a reasonable result after a moderate effort. On the other hand, with dBase II you have to know what you are doing, but when you use it the results can be excellent. In general, CP/M users have to be more computer aware than users of other micro systems, learning early about directories, different file types, and so on.

The dBase II package requires an 8080, 8085 or Z-80 based microcomputer with a minimum of 48K of RAM, CP/M 1.4 or 2.X, one or more floppy-disc drives, an 80-column VDU and an optional printer. The well-written manual explains that up to 65,535 records per file are possible, with up to 1,000 bytes per record. Each record may contain a maximum of 32 fields, of up to 254 characters in length.

Obviously, one or more of these criteria may constrain the others. The index key may be up to 100 bytes long which may be something of an overkill, but it is nice to know that you are unlikely to hit any restriction on key length. Various other parameters are also specified, and all through the early pages of the manual users are very sensibly prompted to make back-up copies of their program discs.

The manual is divided into two sections, the first being a tutorial guide written by "a first-time user who has limited data-processing experience". The second part is a reference work, written by Wayne Ratliffe, the author of the program. This presentation technique, which is similar to that used by Silicon

Office, undoubtedly points the way for the documentation of future software products. A very readable explanation of databases forms the first part of the manual, giving new users an insight into the difference between simple file-handling systems and true database-management programs; the differences between hierarchical and relational systems is also explained.

Six different file types are used by

dBase II for the manipulation of its data: .dBF database files store the data; each file can contain up to 65,535 records. .FRM report-form files are automatically created by Report, and contain headings, totals, column contents, etc. .CMD command files contain a sequence of dBase II statements for repetitive operation of frequently used functions. .NDX index files are automatically created by the Index command.

(continued on page 63)

Table 1.

#### Creation of files

Create — creates new structured database files.  
Copy — copies existing databases to create copies.  
Modify — alters database structures.  
Report — creates a report-form file.  
Save — copies the memory variables to disc.  
Index — creates an index file.  
Join — outputs the join of two databases.

#### Addition of data

Append — adds data at end of a file.  
Create — allows addition of data at creation.  
Insert — inserts data into a file.

#### Editing data

Change — edits columns of fields.  
Delete — marks records for deletion.  
Edit — alters specific fields in a database.  
Pack — removes records marked for deletion.  
Recall — erases mark for deletion.  
Replace — replaces data fields with values.  
Read — replaces data from user-defined full screen.  
Update — allows batch updates of a database.

#### Data display commands

@ — displays user-formatted data on VDU or printer.  
Count — counts the number of records that meet some conditional expression.  
Display — displays records, fields and expressions.  
Read — displays data and prompting information in full-screen mode.  
Report — formats and displays a report of data.  
Sum — computes and displays the sum of an expression over a group of database records.  
? — displays a single expression.

#### Positioning commands

Find — positions to record corresponding to a key on indexed files.  
Goto — positions to a specific record.  
Locate — finds a record that fits a condition.  
Skip — positions forwards or backwards.

#### File-manipulating commands

Append — appends dBase file or files in system data format, SDF.  
Copy — copies databases to other databases or SDF files.  
Delete — deletes files.  
Do — specifies a command file from which subsequent commands are to be taken.  
Select — switches between Use file.  
Sort — creates a copy of a database which is sorted on one of the data fields.  
Use — specifies the database file to be used for all operations until another Use is issued.

#### Memory variable commands

Accept — stores a character string into memory variables.  
Count — stores count into memory variables.  
Display — displays memory variables.  
Input — stores expressions into memory variables.  
Restore — retrieves sets of stored memory variables.  
Save — saves the memory variables in a file.  
Store — stores expressions into memory variables.  
Sum — stores sums into memory variables.  
Wait — accepts a single keystroke into a memory variable.

#### Command-file commands

Accept — allows input of character strings into memory variables.  
Cancel — cancels command-file execution.  
Do — causes command files to be executed and allows structured loops in command files.  
If — allows conditional execution of commands.  
Else — provides an alternate path of command execution within If.  
EndDo — is a terminator or a Do-While command.  
EndIf — is a terminator for an If command.  
Input — allows input of expressions into memory variables.  
Loop — skips to beginning of Do-While.  
Return — ends a command file.  
Set — sets dBase control parameters.  
Wait — suspends command-file processing.

#### Device-controlling commands

Eject — ejects a page on the printer.  
Erase — clears the VDU screen.

# THE PROFESSIONALS' CHOICE

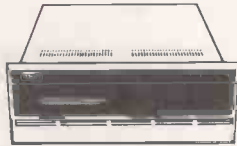
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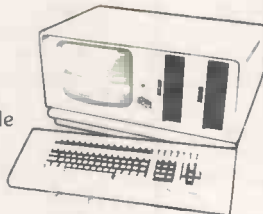
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**Figure 1.**

```

Create
ENTER FILENAME: MoneyOut.
ENTER RECORD STRUCTURE AS
FOLLOWS:
FIELD NAME, TYPE, WIDTH, DECIMAL
PLACES.
001 Client,C,4
002 JobNumber,C,3
003 Bill Date,C,6
004 Supplier,C,20
005 Description,C,10
BAD NAME FIELD
005 Descrip,C,10
006 Hours,N,6,2
007 Emp:Nmbr,C,2
008 Amount,N,9,2
009 Bill:Nmbr,C,6
010 Check:Nmbr,C,5
011 Check:Date,C,6
012
INPUT DATA NOW?
    
```

(continued from page 61)

.MEM memory files are used to store the results of computations, constants or variables.

.TXT text output files may be used to dump anything from the VDU on to disc.

When first starting up the system, you must tell the program which version of CP/M you are using. CP/M 1.4 is the default; a Submit must be executed if 2.2 is used. Once this has been done, a program called Install is run in order to specify the type of terminal being used with the system, how macros are to be flagged, and whether the error-correction dialogue is to be used. Simply typing

dBase

runs the program. An optional date may then be entered, which can be used to log all updates and changes, and could provide a useful audit trail if required.

The dBase commands may all be shortened to four letters, but if used in long form must be spelt correctly. The commands fall into the nine classes shown in table 1.

After setting up sample files, following the tutorial manual for guidance, dBase II was given its first real task: to create a file, using the Create command. In essence the file performed a job-costing function, with projects for individual clients identified by a three-character client code and a three-digit job number.

After Create was entered, the program responded with a request for a file name, which could be up to eight characters long — a standard CP/M limitation. In accordance with the guide's advice, the file was called MoneyOut; the program duly created a file called MoneyOut.DBF.

You are then invited to enter the record structure, field by field, specifying the field name of up to 10 characters; type, which may be C for character, N for numeric or L for logical true or false; width, to a maximum of 254; and number of decimal places. After specifying 11 different fields, pressing Return on the 12th field terminates the routine.

The program then asks if you wish to enter data into the file, to which, again being prompted by the manual, we replied N for no. The file was then ready for use.

Figure 1 shows the dialogue that takes place during this procedure. At field number 5, there is a "deliberate" error, producing an error message due to an over-long field name.

The dBase package allows the use of two active files at the same time, nominated "primary" and "secondary", which may be switched using the Select command. The structure of any file may be checked by means of the command Display Structure, which will show the field names, etc., as specified above. Using Modify, the structure may be altered in any way, fields being deleted, added or altered. This command destroys any data in the file, but this problem can be overcome by simply copying the file before modification and later transferring the appropriate data across. A large selection of control functions are available while in Modify mode:

Ctrl-X — moves the cursor down to the next field.

**Figure 2.**

```

RECORD NUMBER :00001

CHECK:DATE      :
CHECK:NMBR      :
CLIENT          :
JOB:NMBR        :
NAME            :
DESCRIP         :
AMOUNT          :
BILL:DATE       :
BILL:NMBR       :
HOURS           :
EMP:NMBR        :
    
```

Ctrl-E — moves the cursor back to the previous field.

Ctrl-D — moves the cursor ahead one character.

Ctrl-S — moves the cursor back one character.

Ctrl-G — deletes the character under the cursor.

Rubout — deletes the character to the left of the cursor.

Ctrl-T — deletes the field where the cursor is and moves all the lower fields up.

Ctrl-Y — clears the current field to blanks, but leaves all fields where they were.

Ctrl-N — moves fields down one position to make room for insertion of a new field at the cursor position.

Ctrl-Q — quits Modify without making the changes.

Ctrl-C — changes the structure on disc then quits.

Having created the database file and made any necessary modifications, you may then enter data. For example, typing

```
USE MoneyOut
```

followed by

```
APPEND
```

displays the field names, specified earlier,

with colons indicating the start and finish of each field. Trailing zeros, such as those in the Amount field are automatically filled after an integer is entered. Figure 2 shows a typical screen layout at this stage.

Records within a file may be examined using either the List or Display commands. List will show all the records, scrolling continuously; Display All performs a similar function, but will pause every 24 records waiting for a key depression.

A more powerful feature is the ability to use conditional expressions in conjunction with the Display command. For example,

```
DISPLAY ALL FOR Amount > 50 .AND.
```

```
Bill:Date <'110180' OFF
```

will display only those records with a value greater than 50 in the amount field, and a date earlier than 110180 in the Bill:Date field. The operands applicable to this type of command can become quite complex and are extremely powerful.

The contents of any field within a record may be altered using the Edit command. You enter the record number, field number or name and the new value of that field. If full-screen editing mode is on, the entire record is displayed; the cursor can be moved around the screen and any changes required may be made.

Records may be marked for deletion — which is accomplished via the Pack command — by use of Control-U. Movement to the next record in the file is performed by Control-C, or to the previous record by Control-R. Control-Q aborts full-screen editing mode without saving the changes made, while Control-W exits after making the changes.

Insertion at a specific point in the file may be carried out by Insert, which inserts the record just after the current record, or Insert Before to insert just before the current record. Conditional Delete and Recall are both catered for. Deletion only causes the program to

(continued on next page)

**Table 2.**

**Arithmetic operators**

```
( ) parentheses for grouping
* multiplication
/ division
+ addition
- subtraction
```

**Relational operators**

```
< less than
> greater than
= equal to
<= less than or equal
>= greater than or equal
```

**Logical operators**

```
.NOT. Boolean Not
.AND. Boolean And
.OR. Boolean Or
$ substring logical operator
```

**String operators**

```
+ string concatenation.
- string concatenation with blank squash.
```

(continued from previous page)

ignore the "deleted" record, and does not remove the data; Restore can, therefore, recover apparently deleted records, providing that a Pack instruction — which does remove deleted records — has not been executed.

Expressions within dBase II may use four different items: variables, which are most commonly field names; constants, which may be literal constants such as 3 or 7 or the logical operators T (true) or F (false); the operators, shown in table 2; or the functions shown in table 3.

Data from one file can be inserted into the records of another file via

```
APPEND FROM [filename]
```

which adds the records from the named file to the file in use for all fields with the same name in both files. Data from one file may also be either added to identically named fields in another, or be used to replace them, using the command

```
UPDATE FROM [database] ON [key] ADD [field list]
```

OR REPLACE [field list]

This update will only occur if the key fields in both records are identical.

The Join command allows the combination of two databases to be output into a third file, dependent on specified conditions. For example,

```
JOIN TO NewFile FOR P.Part:Nmbr=Part:
Nmbr;FIELD Customer, Item, Amount, Cost
will read each record from the primary
file and compare it with every record in
```

Table 3.

```
# record number
* deleted record, true if current record
has been deleted
EOF end of file, true when Eof is met
Int provides the integer of a number
Val yields the numeric value of a string
Str converts a value into a string
Len returns the length of a string
$ works like Mid$ in Basic
@ locates the start position of a specific
string within longer string
! converts all lower-case characters in a
string to upper case.
CHR yields the ASCII character equivalent
of the specified number
& macro substitution function; when used
in front of a memory variable name, the
program replaces the name with the
value of the memory variable, providing it
is character data.
```

the secondary file. When a match is found, a record is created in the third file with, in this case, four fields containing the data from the two joined files.

According to the manual, it is also possible to read and write files for use by other systems such as Basic, Fortran, Pascal and PL/1. The process utilises the CP/M standard data format, SDF, or Delimited format. Append is used to read these files, and Copy to write them:

```
Sorts are conducted in either ascending
or descending order, using the command
SORT ON [fieldname] TO [filename]
```

The default is ascending order, but may be overridden by specifying Descending. A multi-level sort is possible by using

several temporary files in the various stages:

```
USE MoneyOut
SORT ON Bill:Date TO TempOne
USE TempOne
SORT ON Job:Nmbr TO TempTwo
USE TempTwo
SORT ON Client TO TempThree
The final file TempThree can then be
renamed MoneyOut, if required.
```

Indexing can be accomplished by the command

```
INDEX ON [key] TO [index filename]
which creates a file with a new name and
the extension .NDX. The key may be up
to 100 characters long, and can provide
an excellent alternative to sorting. Re-
sults identical to those produced by the
Sort example can be achieved by simply
saying
INDEX ON Client + Job:Nmbr + Date TO
MoneyOut
```

## Conclusions

- dBase II is a relational database-management system running under CP/M.
- It is suitable for use by professional programmers and system designers; it is not recommended for beginners.
- Once its principles have been grasped dBase II can be used as a high-level programming language, with correspondingly limitless applications.
- dBase II is available in the U.K. at £457 plus VAT from Encotel Systems, 7 Imperial Way, Croydon, Surrey CR0 4RR. Telephone 01-680 6040. □

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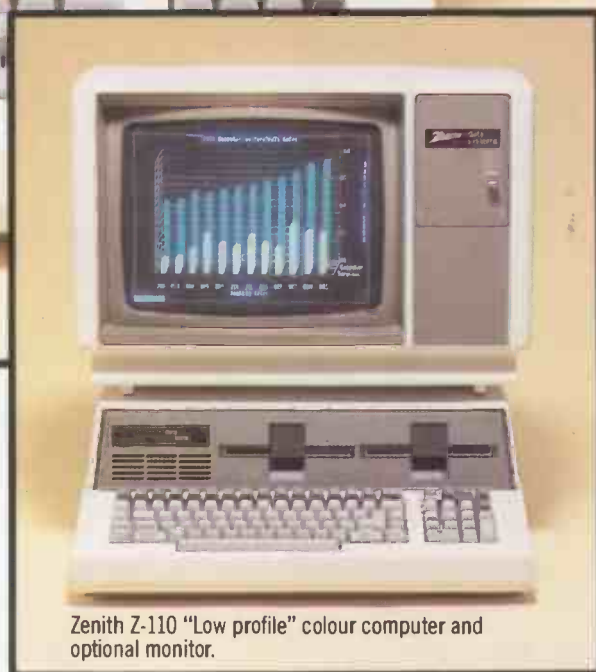
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Robocom's software and its joystick controller promise interactive colour graphics on an Apple II. David Watt puts you in the picture.

# BIT STIK

DESCRIBED AS an interactive graphics input and control device for use with the Apple II, Bit Stik is a small, black plastic unit shaped rather like a futuristic armoured vehicle out of *Star Wars* or *Starship Galactica*. The complete system required includes a 48K Apple II with 16K RAM extension, two disc drives and an Apple colour monitor. A plotter such as the Calcomp 81 is a valuable addition. It is also possible to use Bit Stik in conjunction with the Apple Graphics Tablet and an Epson MX-80 printer which has a graphics option.

The joystick is mounted in a large dome, and in addition to the normal x,y movement the stick may also be rotated. A roughly textured pad at the front of the unit provides support for the heel of your hand. Six holes in the base of the unit provide access to adjustment screws used for setting the range of movement of the joystick so that it corresponds to the movement of the cursor on the monitor. Since individual Apple II machines each require slightly different adjustments the values cannot be preset, but no further adjustment should be needed once the Bit Stik has been trimmed for a particular computer.

To use Bit Stik insert the master disc in drive 1; once the Bit Stik software has been loaded you are asked to insert a library disc in drive 1 and a work disc in drive 2. When Return is pressed the program clears the screen and displays a menu of commands down the right-hand

## Figure 1. Main menu options.

Draw — Display drawing palette and control drawing functions.  
 Paint — Display paint palette and colour fill areas of page.  
 Trace — Input via graphics tablet.  
 Erase — Erase elements of a drawing.  
 Find — Locate end points of lines.  
 Move — Move a picture unit.  
 C & LT — Change the colour and line type of the drawing.  
 File — Save the drawing on a library disc.  
 Copy — Select a picture unit from the library disc and copy to the drawing.  
 Zoom — Select a portion of the drawing and enlarge to fill the screen.  
 Page — Redraw the complete picture at the original scale.  
 Full — Clear the menu to allow drawing on that portion of the screen.  
 Digit — Display the digit menu.  
 I/O — Display the input/output menu for storing or manipulating files on the work disc.  
 Misc — Miscellaneous menu; for text, storing a zoomed area, or starting a new session.  
 Wipe — Clear the page and new data from memory.

side and the Draw palette along the bottom. Figure 1 shows the 16 options available on the menu. A small cross represents the position of the cursor, which moves as you move the Bit Stik cursor. The number of bytes of memory left unused is displayed in the bottom right-hand corner; the starting value is 8,192.

A consistent pattern of use has been designed for the Bit Stik. Pressing the red button to the top left of the Bit Stik dome initiates actions such as drawing a line, painting an area on the screen or selecting a picture unit from the library disc. The left-hand white button below the dome is used for selecting items from the menu or setting the start point of a line, indicated by a diagonal cross known as the origin cursor. The button in the bottom right-hand corner is used for a variety of other tasks; you exit from certain options by pressing both white buttons together.

The Draw palette, presented at start-up and whenever the Draw option is selected, allows you to draw straight lines, arcs or circles; select one of six colours, green, purple, white, black, orange or blue; or use solid lines or one of three different types of dotted lines. The palette also includes a special feature called Nibs, which draws broad lines.

When Nibs is in use the cursor changes to a line the width of the nib; the size can be changed by rotating the knob of the Bit Stik. Nibs can be either solid or dotted, and some interesting moiré patterns can be produced using dotted nibs. Nibs can also be used for drawing bar charts or block lettering, particularly when combined with the use of locks. To draw a line, plant the origin cursor by pressing the left-hand button to position the cursor to the end of the line, then press the red button at the top of the Bit Stik.

When using the Arcs feature a direction first has to be defined by planting the origin cursor twice, using the left-hand white button. The path from the first plant to the second defines the direction. You then move to another point and press the red button, which causes a circular arc to be drawn starting in the prescribed direction and going round to the last point. With a little practice this becomes very easy to use, and it is possible to produce some interesting designs with it.

As the picture is built up each element is stored internally. Individual elements



can be located with Find and erased with Erase. The entire picture may be redrawn by selecting Page. The Stream option in Draw mode allows you to draw lines continuously, following the cursor. To use it you have to hold down the two left-hand buttons, moving the joystick with your right hand. There is a tendency to produce rather wobbly lines using Stream unless you have a very steady hand or you use a scale window. Stream also uses up a lot of memory.

Scale windows are obtained by pressing the right-hand button: while it is held down the boundary of the window flashes and the size may be adjusted by rotating the knob of the joystick. When the button is released the window stops flashing and the cursor becomes confined to the limits of the window, so large movements of the joystick become small movements of the cursor to facilitate precision drawing.

The Paint option on the main menu displays a different palette of 16 colours with which to fill areas on the screen with selected colours. Paint works by addressing the video RAM, starting from the cursor position and turning all points to the selected colour until a boundary is reached. Unwanted effects can occur when two adjacent areas are painted and vertical lines are not always displayed in the colour expected. For instance, white lines may also be displayed as green or purple lines. The data is stored internally in the correct form so diagrams are plotted or printed in the expected colours. When using Paint it is essential to ensure that the area selected is completely enclosed; colour will leak through the minutest gap and fill the entire screen.

The Trace option, which can only be used if you have a graphics tablet on the system, allows you to trace a picture in the same fashion as using Stream by following the line with the stylus.



**Bit Stik's Zoom command overcomes the low resolution of the Apple monitor by allowing successive enlargement of complete pages.**

Alternatively, you can use the buttons on the Bit Stik to set the origin cursor and draw lines, arcs or circles as normal.

The library disc is used to store picture units, which may then be copied back from the library to build a new picture. Picture units are displayed as scaled-down versions of the picture not just named files, so it is easy to recognise and select any desired item. Each library disc contains three indexes, the first containing 64 picture units and the other two 16 each.

Only new data may be stored as a picture unit; picture units which have previously been copied from the library disc cannot be stored unless they have been specially loaded as new data using the appropriate option from the I/O menu. The work disc is used to store copied picture units, complete pictures or screen images. Pictures and screen images may then be plotted or printed.

The File option is used to save picture units on the library disc, and Copy loads a picture unit and copies it into your picture. You can use Copy to position the picture unit where you like, draw it to any scale, rotate it or change the ratio of the x- and y-axes. Multiple copies of the same picture unit can be made if you wish.

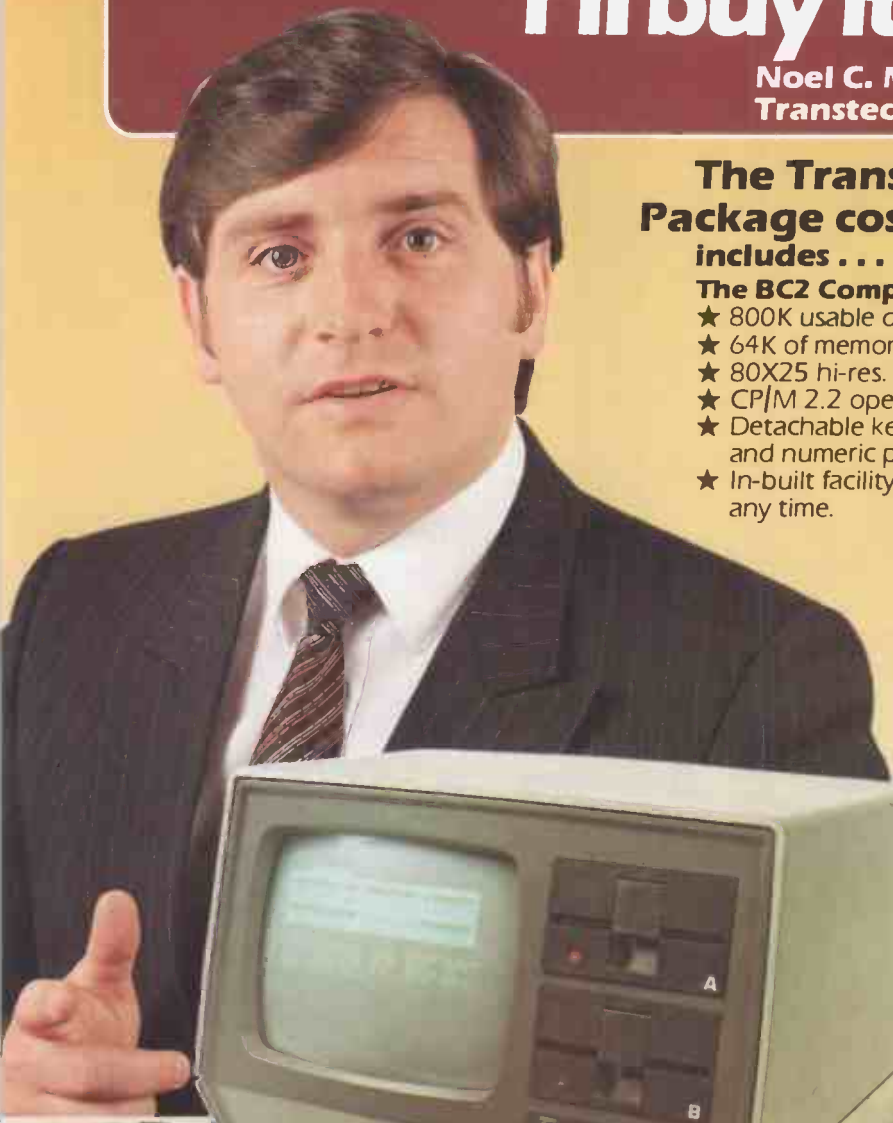
Graphics systems on micros suffer from the poor resolution available on typical monitors or TV sets; the Apple II is no exception with a resolution of 256 by 192 pixels. The Bit Stik Zoom feature avoids this problem by allowing a portion of the screen to be selected and expanded to full-screen size so that fine detail may be drawn in. Pages are plotted to the full resolution of the plotter, even though some detail may be too small to be seen on the screen when the whole page is displayed. Zoom will go down to display an area  $\frac{1}{120}$  the size of the original screen. A clipping algorithm works out if particular items are within the current

*(continued on page 69)*



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(continued from page 67)

view window or are too small to be displayed.

The Page command is used to return to the base scale. Alternatively, two Zoom windows can be stored using the Zoom store options from the Misc menu and used to Zoom to a particular portion of the drawing in a single operation.

The New Session option from the Misc menu erases the data and picture units on the display whereas Wipe only erases data, not picture units. It is available only from the Misc menu to ensure that it cannot be selected accidentally, though it is unclear why Wipe should be available from the main menu and not New Session.

The Text command allows you to input boxes of text or labels to the system and store them at any desired scale or location. Upper- or lower-case text can be displayed by the Bit Stik software, but when you type in the text the Apple II will only display in upper case. The Bit Stik defaults to lower-case input; pressing Escape displays characters in inverse video on input and converts to upper case when they are displayed or plotted by the Bit Stik software. When the text is too small to be displayed by the screen a block of dotted lines is displayed instead, but it will still be plotted correctly. Robocom provides a data sheet as documentation with one of the library discs, which illustrates very well what can be done with text on the system.

## Isometric grids

The Digit menu allows you to set various parameters giving precision manipulation of the Bit Stik. It is split into three main groups: the Scale, Compression and Rotation group; Locks; and x,y display. The Scale, Compression and Rotation options allow you to preset particular values for use with Copy, Zoom or Move.

An x-lock and y-lock can be set to lock specific points along the x- or y-axis to which you can move the cursor; the angle locks define lines going through the origin cursor at the required angle. They can be used in combination to set up orthogonal or isometric grids which can



The Bit Stik controller includes three buttons as well as the joystick; a power-on light occupies the top-right position.

be used for drawing circuit diagrams, room layouts, designing brochures, etc.

The x,y display just provides a continuous readout of the position of the origin cursor and the dynamic cursor. Isometric grids are quite slow to display with the current version of the software and Robocom is developing an improved version in which the software still in Basic is converted into machine code. The next version of the software should also incorporate improvements to some of the menus, in particular the Digit menu which is quite difficult to use at first.

Locks can also be used with Copy, Zoom or move. The digit menu provides you with some very powerful facilities, though some are excessively complex and obscure. Normally if you want to retrieve two different pictures from the library disc you have to select Copy, select the first picture unit and then draw the picture at the required place on the screen. Then you have to exit from the Copy function by pressing the two white buttons before you can repeat the process to retrieve the second picture. Setting the locks correctly allows you to select new picture units while remaining in the Copy function, which is much simpler.

## Picture plotting

To plot pictures place the plotter software diskette on drive 1 and the work disc with the pictures stored on it in drive 2. Plotter commands are grouped in four sections: selecting a page for plotting; displaying the page or a portion of the page; setting dimensions, colours, and line types; and plotting the page or clearing the system for a new plot. The Zoom locked command allows you to select views based on a standard grid.

The Dimension command displays a sub-menu which allows you to set the height and width of the page when plotted. Alternatively you may set the dimension of eight points: if you used an eight by eight square grid to design a page, assigning a scale of 1ft. to the side of a grid square, setting the dimension of

eight points equal to one centimetre plots the page at a scale of 1cm:1ft.

Linetype facilitates three additional line types in addition to the four standard types. Assign Colour allows the six Bit Stik colours to be assigned to pen 1, pen 2 or null to allow for use with twin-pen plotters such as the Hewlett-Packard HP-7470A. The Plot commands allow you to position and scale the page relative to the paper on the plotter by displaying a grid representing the plotter bed and boxes showing the position of previous plots. The simple Plot command allows complete freedom to plot the page by manipulating the joystick whereas Plot Locked locks the page on to a grid. The plot may then be drawn one-half, one-quarter or one-eighth the size of the full plotter page, for example, and positioned according to the grid points.

A reference manual and a booklet entitled *Quickdraw* are provided with the system. *Quickdraw* provides an introductory tutorial to the system and provides plenty of interesting tips on using the system. It is clearly aimed at those people who want to experiment with the system without wading through the full reference manual.

## Conclusions

- The Bit Stik is a very flexible system and great fun to use. Applications include preparation of artwork, business graphics, technical drawing, room and office layouts, cartography and circuit design. It is very reasonably priced for those who already have an Apple II and expansion card.

- The ability to copy and manipulate stored picture units from a library disc makes it simple to build up complex designs, particularly when used in combination with a grid lock. Picture units can be amended by loading them as new data then refileing them on the library disc when changed. The ability to scale elements of a picture to any size and to zoom in on them is particularly useful.

- The menus of the present version call on you to select items from the I/O and Misc menus by keying in numbers from the Apple keyboard and it is awkward to switch continually from the Bit Stik controller to using the computer. Robocom is working on a modified version which allows options to be selected using the Bit Stik itself.

- The number of buttons on the controller is excessive and it is inconvenient to have to press two buttons simultaneously for certain operations.

- The Bit Stik controller and software cost £245 plus VAT and are supplied by Robocom, CIL Building, Goodwin Street, London N4. Telephone 01-263 3388.

- To realise the true power of the system you need a plotter which can cost anything from £1,000 for the HP-7470A to £3,000 for the Calcomp plotter.

### Plotter commands.

Page commands	— Load page Change work disc Catalog work disc
View commands	— Display page Zoom Zoom locked
Control commands	— Dimension Assign line type Assign colour
Plot commands	— Plot Plot locked New plot page



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RAM is fast and discs are slow: Chris Bidmead looks at two products which speed up CP/M floppy-based systems.

# SDS and MICROCACHE

NOW THAT the mini-Winchester is establishing itself in the drive slots of so many business computers, dual floppy-disc machines are beginning to take on a slightly archaic look. One trusty office workhorse of our acquaintance runs this risk: though a long way from being put out to grass, it is an S-100 bus 5.25in mini-floppy machine designed in 1978 and due, to say the least, for an upgrade.

Remove the cover and the empty slots grin up at you from the sparsely populated 18-slot motherboard. The joke they are grinning about is the cost in time rather than money of the expansion they invite. To plug in a hard-disc controller with a Winchester at the end of it would be cheaper — though not all that much cheaper — than buying a new Winnie-based machine. But writing and debugging the new Bios for it could easily take a Christmas-sized bite out of the working month.

There is another expansion route that occurred to its proud owners when they first discovered that the memory is bank-switchable. You will need to know something about bank switching to appreciate the problem: briefly, the eight-bit Z-80 can only directly fetch and carry data and instructions from a 64K patch of memory. In 1979 that seemed an entire universe but now, with 256K S-100 boards on sale in the U.S. for around \$700, the Z-80's kingdom seems to have shrunk to the size of a street corner.

The eight-bit architecture, however, also allows piping data a byte at a time in and out of ports. The most common use of this technique is for fetching and carrying data from consoles and printers, but there are also some internal system possibilities. Bank-switching architecture allows the processor to manipulate otherwise separate chunks of memory as if they were pages in a book, flicking through from one to another and back again by the simple trick of sending a special code byte denoting the required bank to a particular port reserved for the process.

By filling up the empty slots with additional memory boards you should, in theory, be able to build up a super-powerful computer. In practice, a horrendous software effort is required to make all the additional memory smoothly available to the system by switching the banks in and out at the right time.

Some manufacturers have since been taking that route in an attempt to wring the utmost from eight bits as the 16-bit machines loom larger. The PBM-1000 — reviewed in the May 1982 *Practical Com-*

*puting* — is one example of extended memory addressing on a Z-80 processor. Yet because the software involved is strongly hardware related there is no easy way of feeding the same vitamins to the old S-100 workhorse.

At this point a firm called Microcosm stepped on to the scene with a product called Silicon Disk. It promised to tame bank-switchable memory, pulling it into line with CP/M's somewhat limited world view by disguising it as a disc. The idea of hypnotising the operating system into this useful delusion was not new but Microcosm was the first to make it work on micros, having pulled off the difficult trick of making the package both self-contained and portable between CP/M machines. Whatever the hardware, as long as it could switch banks while retaining a small area of common memory then Silicon Disk could easily be adjusted to run on it.

## Instant access

It works exactly as promised: with the addition of a couple of extra boards, alongside drives A and B there suddenly appears a new, invisible, silent and incredibly fast drive C with a respectable capacity of 128K. Put an assembler, a linker and a loader on to the Silicon Disk System, SDS, and the gain in speed over the somewhat stately Micropolis drives is considerable. Alternatively you can transfer the WordStar overlay files WSOvly1.Ovr and WSMsgs.Ovr across to the new "drive", and see how all the functions become instantly available, with none of the old pause-click-grind between hitting a control key and being offered the relevant help sheet. WordStar becomes a coherent whole which accesses the disc only when you need to transfer text.

There is a problem with the 1K of common memory SDS demands. The review hardware offers what the documentation calls a 1K "scratchpad area" which at first sight seems beautifully placed for the job. Unfortunately on the review system parts of this playground

were pre-empted by various Proms as stack and storage areas, and the resulting disagreements about whose bytes were whose occasionally produced spectacular scenic effects on the screen, accompanied by hammering sounds from the drives.

Microcosm has obviously been having similar thoughts on the business of having to decide in advance what files will be needed on the fast disc. What is needed is an "intelligent" version that always happens to have handy in fast memory the very sectors you are about to access. Microcosm's solution draws heavily on coding techniques developed for Silicon Disk. It is sufficiently different to be regarded as a different product and has been dubbed MicroCache.

The name "cache" clearly suggests the idea of a section of memory where data is reorganised for consumption by some other part of the system. In mainframes and minis a cache is frequently used to buffer transfers between main memory and the processor, but on a micro, where the memory architecture is relatively straightforward, this kind of cache is unnecessary. Yet because of the small memory size, disc accesses on a micro are relatively frequent: armed with its experience with Silicon Disk, Microcosm has set about developing a cache between the disc and the processor.

Booting the MicroCache system disc automatically pulls in a routine called Cache.Com, which in turn accesses a file called Cache.Dat where the variables for its particular arrangement of banks are stored. Directories on both discs instantly slide up on to the screen with no need to trouble the drives; WordStar overlays stow away on board and come up like greased lightning when you call; and warm boots return you to CP/M's command line at something approaching the speed of light — see table 1.

Conventionally, CP/M's relationship with the disc drives in its charge is somewhat ponderous. To access the file you need, CP/M has to find the correct magnetic read-write head, wind that head

(continued on next page)

Table 1. Time in seconds to load a standard 35K text file into WordStar and move the pointer from start to finish, back again, and from start to finish again.

	Load	ST→Fin1	Fin→ST	ST→Fin2	Average
No cache	16.55	57.28	21.20	20.91	26.29
72K MicroCache	9.98	48.83	7.63	5.34	13.74

Weighted average improvement of cache access over no cache is 91 percent.

Loading the file and making the first movements through it, creating a temporary file called EdBackup.\$\$\$, are special activities. Column 4, ST→Fin2, most nearly represents the dynamics of file handling while working on the text, and this column has consequently been given a 3:1 weighting in calculating the average.

(continued from previous page)

to the edge of the disc to look at the directory track, and use the information it reads there to guide its trip back into the interior to the tracks and sectors it needs.

MicroCache makes its first big short cut by pulling the whole directory into memory at one time and keeping it there. That done, the initial trek out to the edge of the disc is no longer necessary; access to the copy in cache becomes an instant substitute. Fetching the next sector of the disc called for by the system has to be done in the conventional way, of course, by moving the head to the calculated track and waiting to pounce on the right sector when it comes spinning round. But instead of just delivering the data up to CP/M, MicroCache hides away a copy of that sector in one of its banks. Every time CP/M calls for information from the disc, MicroCache first checks its "bank account" to see if it has the appropriate sector squirreled away somewhere. If it has, it lets the disc drive sleep on and fills the order itself. By substituting a RAM-to-RAM transfer for a disc-to-RAM transfer the process becomes hundreds of times faster.

### Guaranteed speed-up

The practical effect depends on the amount of banked-off memory you are able to supply. MicroCache acknowledges a limit of 1MByte of additional memory, but even by adding a mere 16K the speed improvement becomes impressive. This modest expansion easily accommodates the directories of the two disc drives, guaranteeing the first phase of the speed-up. With more memory the number of sectors in current use increases and there is a greater chance that the next sector you need will be in it.

When the memory you have added to the system becomes filled with floating sectors, MicroCache has some important decisions to make. Will the next sector brought in from disc deserve a place in cache, and if so which sector should be dispensed with to make room for it?

MicroCache responds to the first question by assuming that the answer is yes. If you wish, you can use a MicroCache utility called Lock.Com to ensure that important files are not replaced in the cache by sectors you call on later. Provided the cache is not filled with locked-in files, new sectors will always be housed. The big decision MicroCache has to make is which sectors shall be ousted.

The decision is based on a count of which sectors have been used most recently, with a weighting given to those used most frequently. In practice this means that while you are still using your compiler Whizzer.Com and its overlays Whiz.001 and Whiz.002, repeated runs will tot up a heavy score for the compiler sectors. The various source files you process with the compiler will not score as

heavily, so source file sectors will be the first ones for the chop when room has to be made for more, and the compiler sectors tend to remain in residence. As soon as you switch out of the compiler and start to use WordStar and its associated files, the compiler sectors will stop scoring and will, when the time comes, be ousted in their turn.

### Track buffering

This approach is different from the system used by some hardware manufacturers to boost disc speed, though the word "cache" may appear in the proprietary name they use. Ithaca, for example, sells a hardware-dependent cache Bios to run with its Pascal Development machine; it is a track buffer that works to rather simpler rules. When asked to fetch a particular sector, it reads off the whole track and hides the unwanted sectors away in RAM, assuming that they are going to be needed as well.

Mini-floppies typically swap their CP/M sectors in and out two at a time, and usually not in numerical sequence. This departure from arithmetic progression, the "skew factor", varies between implementations. The MicroCache track buffer has to be tailored to these idiosyncrasies by setting up sector tables to match the way your particular drives work. But unless you get this exactly right the process of track buffering can actually slug the system. The manual recommends you set up the system without track buffering, and add the refinements later when you have time to sit in judgement with a stopwatch over some comprehensive twiddling with the cache data file.

Though most of the discussion so far has been about reading from the disc, the cache idea is also capable of great feats of wizardry in the writing department. Instead of holding everything up to put a paltry sector to bed simply because the applications program requires it, a comprehensive cache system would store it somewhere in RAM until it had enough contiguous sectors to make the effort of writing a complete track worthwhile.

Such an arrangement is called "deferred writes", and MicroCache provides the option of using it in a limited way through the track buffer. Unless your discs are in standard 128-byte sectors there is little advantage to be gained in using the facility. Microcosm is planning for later versions of MicroCache to be able to show a definite speed improvement over the blocking-deblocking normally used in mini-floppy CP/M.

MicroCache has one useful trick to make sure it is not wasting time during writes. Before writing a sector, it makes a comparison with the same sector as read from the disc and if they are identical it very sensibly skips on to the next task. Fully implemented deferred writes would certainly give an additional boost to the system. Microcosm's caution in proceed-

ing with the idea stems from the unpleasant things that can happen if the operating system is fooled into thinking it has tucked sectors safely away on the oxide when in fact they are still swimming around in RAM.

As it stands, MicroCache is very safe to use and the only opportunity for misadventure arises when you change discs. Because the directory is held in RAM, if you swap discs without telling the operating system, subsequent reads will produce garbage and subsequent writes will make a complete mess of the data already recorded. MicroCache therefore comes with a simple utility called DskReset that should be run between changing drives. It logs off the drive named as a parameter by forgetting the directory; any subsequent call to that drive will begin by rereading the directory, thus updating the operating system's sector map. Microcosm promises a new version of the software that detects disc changes automatically and makes the necessary adjustments without having to run DskReset.

One annoyance is DskReset's refusal to acknowledge that CP/M drives are called A:, B: and so forth. It accepts upper- and lower-case drive names but will not let you tack on the colon, which really ought to be optional. Another is the fact that MicroCache's data file has to be set up by editing assembler source code and trotting it through the unfriendly paces of ASM, DDT and Save. Otherwise there is precious little for a reviewer to be rude about in the package.

The manual, like that for Silicon Disk, is well presented and clearly written but it contains far too much about the possible applications of the software. With packages as transparent as these a manual should say what little there is to say and leave the question of applications to the user.

### Conclusions

- MicroCache and Silicon Disk are simple ways to make use of extra banks of memory on CP/M or MP/M systems. Silicon Disk needs 1K of common memory, while MicroCache uses only 0.5K of common memory; the rest of the code is banked out. They are two of the most generally useful software packages we have seen for a long time.

- MicroCache is more generally useful as it makes its own dynamic decisions about the disc data to keep handy in RAM. Data has to be transferred explicitly under Silicon Disk.

- Either program can be run on any Z-80 hardware, provided it can accommodate bank switching. MicroCache will also run on the 8080 or 8085 processors.

- Programs like WordStar that make heavy use of discs operate at nearly double the speed under MicroCache. Disc and drive wear should also be considerably reduced.





ZX Spectrum

<b>BLUE</b> EDIT	<b>RED</b> CAPS LOCK	<b>MAGENTA</b> TRUE VIDEO	<b>GREEN</b> INV. VIDEO	<b>CYAN</b>	<b>YELLOW</b>	<b>WHITE</b>	<b>BLACK</b> DELETE
1 !	2 @	3 #	4 \$	5 %	6 &	7 ' ^	8 ( )
<b>TRF FN</b>	<b>FN</b>	<b>LINE</b>	<b>OPEN #</b>	<b>CLOSE #</b>	<b>MOVE</b>	<b>ERASE</b>	<b>POINT</b>
<b>SIN</b>	<b>COS</b>	<b>TAN</b>	<b>INT</b>	<b>RND</b>	<b>STR\$</b>	<b>CHR\$</b>	<b>CODE</b>
Q <=	W <>	E >=	R <	T >	Y AND RETURN	U OR IF	I AT INPUT
<b>ASN</b>	<b>AC-S</b>	<b>ATN</b>	<b>VERIFY</b>	<b>MERGE</b>	<b>ABS</b>	<b>SQR</b>	<b>PEEK</b>
<b>READ</b>	<b>RESTORE</b>	<b>DATA</b>	<b>SGN</b>	<b>THE</b>	<b>G</b>	<b>H</b> ↑ GOSUB	<b>POKE</b>
A STOP NEWJ	S MOV S-4/E	D STEP DIM	F TO FOR.	V /	G	J - LOAD	O ;
<b>LN</b>	<b>EXP</b>	<b>LPRINT</b>	<b>LLIST</b>	<b>BIN</b>	<b>CIRCLE</b>	<b>VAL \$</b>	<b>OUT</b>
Z :	X E CLEAR	C ?	V	*	<b>IN KEYS</b>	<b>SCREEN \$</b>	<b>USR</b>
<b>BELEP</b>	<b>INK</b>	<b>PAPER</b>	<b>FLASH</b>	<b>BRIGHT</b>	<b>OVER</b>	<b>INVERSE</b>	<b>LET</b>
CAPS SHIFT	STOP NEWJ	COPY	FLASH	BRIGHT	OVER	INVERSE	L =
							ENTER
							BREAK SPACE

# Sinclair ZX Spectrum

**16K or 48K RAM...  
full-size moving-  
key keyboard...  
colour and sound...  
high-resolution  
graphics...**

**From only  
£125!**

First, there was the world-beating Sinclair ZX80. The first personal computer for under £100.

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Now there's the ZX Spectrum! With up to 48K of RAM. A full-size moving-key keyboard. Vivid colour and sound. High-resolution graphics. And a low price that's unrivalled.

## **Professional power— personal computer price!**

The ZX Spectrum incorporates all the proven features of the ZX81. But its new 16K BASIC ROM dramatically increases your computing power.

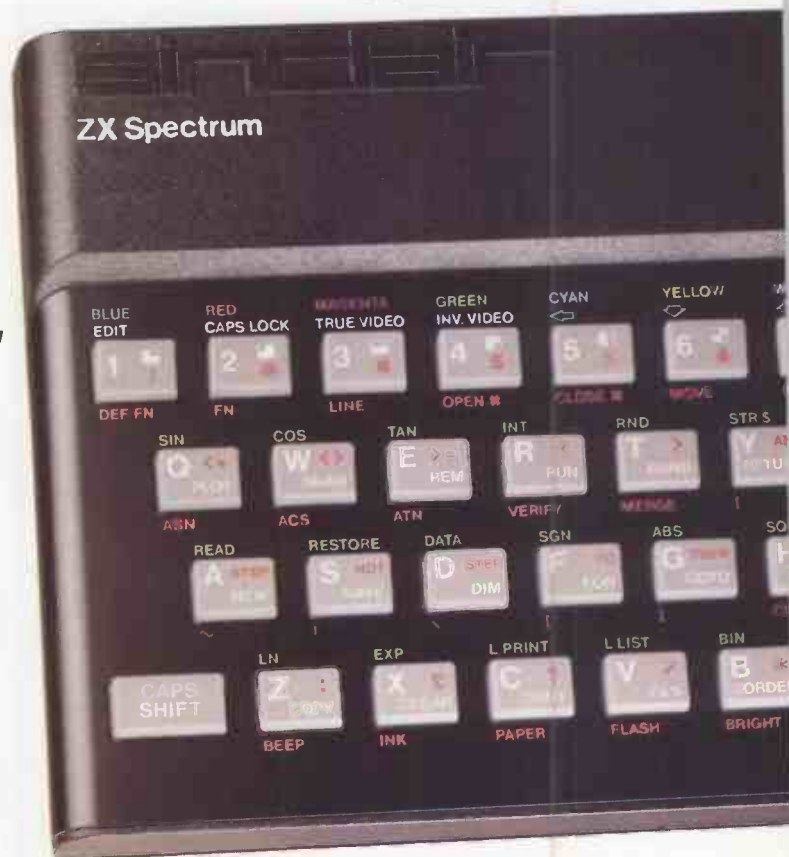
You have access to a range of 8 colours for foreground, background and border, together with a sound generator and high-resolution graphics.

You have the facility to support separate data files.

You have a choice of storage capacities (governed by the amount of RAM). 16K of RAM (which you can upgrade later to 48K of RAM) or a massive 48K of RAM.

Yet the price of the Spectrum 16K is an amazing £125! Even the popular 48K version costs only £175!

You may decide to begin with the 16K version. If so, you can still return it later for an upgrade. The cost? Around £60.



## **Ready to use today, easy to expand tomorrow**

Your ZX Spectrum comes with a mains adaptor and all the necessary leads to connect to most cassette recorders and TVs (colour or black and white).

Employing Sinclair BASIC (now used in over 500,000 computers worldwide) the ZX Spectrum comes complete with two manuals which together represent a detailed course in BASIC programming. Whether you're a beginner or a competent programmer, you'll find them both of immense help. Depending on your computer experience, you'll quickly be moving into the colourful world of ZX Spectrum professional-level computing.

There's no need to stop there. The ZX Printer—available now—is fully compatible with the ZX Spectrum. And later this year there will be Microdrives for massive amounts of extra on-line storage, plus an RS232/network interface board.



## **Key features of the Sinclair ZX Spectrum**

- Full colour—8 colours each for foreground, background and border, plus flashing and brightness-intensity control.
- Sound—BEEP command with variable pitch and duration.
- Massive RAM—16K or 48K.
- Full-size moving-key keyboard— all keys at normal typewriter pitch, with repeat facility on each key.
- High-resolution—256 dots horizontally x 192 vertically, each individually addressable for true high-resolution graphics.
- ASCII character set—with upper- and lower-case characters.
- Teletext-compatible—user software can generate 40 characters per line or other settings.
- High speed LOAD & SAVE—16K in 100 seconds via cassette, with VERIFY & MERGE for programs and separate data files.
- Sinclair 16K extended BASIC— incorporating unique 'one-touch' keyword entry, syntax check, and report codes.



# am



## RS232 / network interface board

This interface, available later this year, will enable you to connect your ZX Spectrum to a whole host of printers, terminals and other computers.

The potential is enormous. And the astonishingly low price of only £20 is possible only because the operating systems are already designed into the ROM.

# ZX Spectrum

Available only  
by mail order  
and only from

# sinclair

Sinclair Research Ltd,  
Stanhope Road, Camberley,  
Surrey, GU15 3PS.  
Tel: Camberley (0276) 685311.

## The ZX Printer - available now

Designed exclusively for use with the Sinclair ZX range of computers, the printer offers ZX Spectrum owners the full ASCII character set - including lower-case characters and high-resolution graphics.

A special feature is COPY which prints out exactly what is on the whole TV screen without the need for further instructions. Printing speed is 50 characters per second, with 32 characters per line and 9 lines per vertical inch.

The ZX Printer connects to the rear of your ZX Spectrum. A roll of paper (65ft long and 4in wide) is supplied, along with full instructions. Further supplies of paper are available in packs of five rolls.



## The ZX Microdrive - coming soon

The new Microdrives, designed especially for the ZX Spectrum, are set to change the face of personal computing.

Each Microdrive is capable of holding up to 100K bytes using a single interchangeable microfloppy.

The transfer rate is 16K bytes per second, with average access time of 3.5 seconds. And you'll be able to connect up to 8 ZX Microdrives to your ZX Spectrum.

All the BASIC commands required for the Microdrives are included on the Spectrum.

A remarkable breakthrough at a remarkable price. The Microdrives are available later this year, for around £50.



## How to order your ZX Spectrum

BY PHONE - Access, Barclaycard or Trustcard holders can call 01-200 0200 for personal attention 24 hours a day, every day. BY FREEPOST - use the no-stamp needed coupon below. You can pay by cheque, postal order, Barclaycard,

Access or Trustcard.

EITHER WAY - please allow up to 28 days for delivery. And there's a 14-day money-back option, of course. We want you to be satisfied beyond doubt - and we have no doubt that you will be.

To: Sinclair Research, FREEPOST, Camberley, Surrey, GUI5 3BR. Order

Qty	Item	Code	Item Price £	Total £
	Sinclair ZX Spectrum - 16K RAM version	100	125.00	
	Sinclair ZX Spectrum - 48K RAM version	101	175.00	
	Sinclair ZX Printer	27	59.95	
	Printer paper (pack of 5 rolls)	16	11.95	
	Postage and packing: orders under £100	28	2.95	
	orders over £100	29	4.95	
				Total £ _____

Please tick if you require a VAT receipt

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# ZX Spectrum software: how good and how soon?

The ZX Spectrum uses an enhanced version of Sinclair BASIC, fast becoming a world standard, and unlikely to be superseded. Unique features, such as one-touch keyword entry and syntax check and report, are increasingly attracting software originators.

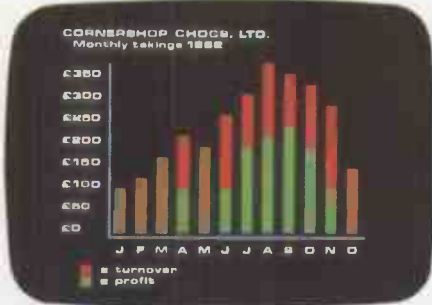
Building the software library is already far advanced, and a complete catalogue will be available in the next few months. Subjects will include sophisticated games, education, 'housekeeping', and business management. The more complex packages can, of course, be used to their best advantage with the full 48K RAM version of the ZX Spectrum.



The Sinclair ZX Spectrum can handle sophisticated games programs with high-resolution colour graphics and sound.



This major advance in computer technology maintains Britain's world-beating position in the field of personal computers.



A range of business software will soon be available, covering both specific applications (eg stock-control and payroll) and general business management systems (eg matrix models).



This second generation of Sinclair personal computers demonstrates continuing commitment. Advanced technology made the ZX80/81 family a price breakthrough; advanced technology makes the ZX Spectrum a breakthrough in price and performance.

## Elegant, effective, unique—the ZX Spectrum design.

**'Less than half the price of its nearest competitor – and more powerful.'**

'These two pictures show how it's done. On the right is the PCB from the BBC Model A Microcomputer. On the left is the PCB from the ZX Spectrum.

'It's obvious at a glance that the design of the Spectrum is more elegant.

What may not be so obvious is that it also provides more power.

'The ZX Spectrum has more usable RAM, and higher maximum RAM.

'It offers twice as many colours on the screen at any one time, plus a colour brightness control. It also offers user-definable graphics.

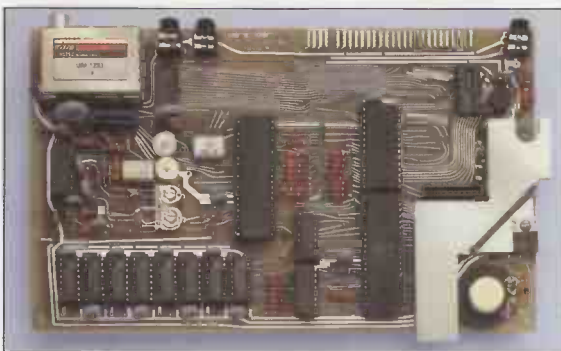
'It has data transfer rate 25% faster,

supported by a VERIFY facility.

'And it employs a dialect of BASIC (Sinclair BASIC) already in use in over 500,000 computers worldwide.

'We believe the BBC make the world's best TV programmes – and that Sinclair make the world's best computers!'

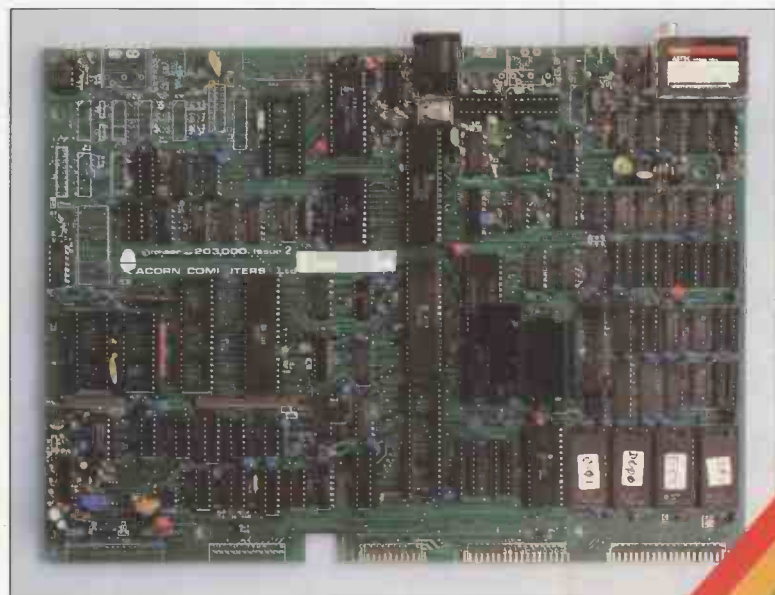
—Clive Sinclair



Above left: internal layout of Sinclair ZX Spectrum.

Right: Internal layout of BBC Micro Model A.

The illustrations are to the same scale, and demonstrate the rate of advance in microcomputer design. The ZX Spectrum uses just 14 chips to provide more power and more user-available RAM.



# sinclair ZX Spectrum

● Circle No. 162



# Preview: COMPEC '82

This year's show is at London's Olympia from November 16-19.



Portable micros feature strongly at Compec, including Epson's HX-20 (left) and the Grundy NewBrain.

COMPEC has established itself as the major computer exhibition for the business user, and this year's show promises to be bigger and better than ever. Nearly 60 companies will be taking part for the first time, bringing the total number of exhibitors close to 400.

They range from the leading manufacturers of minicomputers, including Digital Equipment and Data General, to well-known microcomputer firms such as Apple, Atari, Acorn and Sinclair. The strong overseas representation includes Finland's largest computer manufacturer Nokia, Norway's Norsk Data, and Japanese firms such as Fujitsu, Hitachi and Sord.

Again Compec features a special Software Village in the Polygon Hall, where

DRG's Victor 9000 is one of many 16-bit machines making their British debut.



firms like Tabs, Vector International and Lifeboat Associates will be demonstrating their products.

The 1982 show offers the chance to explore two of the most fascinating areas of hardware development — 16-bit micros and portable machines. Most of the new 16-bit micros will be on display: DRG's Victor 9000 which is a version of the Sirius 1, an IBM Personal Computer work-alike known as the Columbia Micro, the Fortune 32:16, and the Olivetti M-20 — to name but a few.

Nippon Univac is expected to launch a new range of four 16-bit micros at the show. The top model will have a 640-by-400 pixel high-resolution screen with eight colours. It will run CP/M-86 and MS-Dos, and offer 8in. or 5in. double-sided double-density floppies. It is also expected to compete with the IBM micro on price. Hitachi is expected to show its own 16-bit personal micro with 256K RAM and a 15-colour display. And finally, Alpha Microsystems plans to show its 16-bit multi-user micro the AM-1000, which has a built-in 10Mbyte Winchester disc, and uses a video cassette recorder for back-up instead of floppies.


After the excitement generated by the Sharp/Tandy and Casio pocket computers, the race is on to produce a full-featured portable micro. Two which will be worth seeing at Compec are the NewBrain from Grundy Business Systems and a new Hewlett-Packard, the 75C. Both have one-line displays but no built-in program- and data-storage facilities. Then there is the Osborne 1, which has

two floppy-disc drives and a built-in screen, but is not exactly pocketable.

Perhaps the most interesting of the portables will be Epson's new venture. The first computer from this well-known printer manufacturer is the HX-20, a 16K machine with a four-line LCD screen display. The maximum screen area is 255 columns by 255 rows, and though you cannot see it all at once it should be usable for word processing, using the full typewriter-style keyboard. There is a microcassette recorder for storage, and a 24-column dot-matrix printer built in. With all these features, the Epson HX-20 is about the same size as this magazine, though rather thicker.

As well as micros and minis, a wide range of peripherals will be on display at Compec, including graphics and colour terminals, VDUs, dot-matrix and daisy-wheel printers, Modems, and hard- and floppy-disc drives.

As one of the magazines sponsoring the exhibition, *Practical Computing* will have a stand where you can buy recent back numbers — until they run out — and binders ditto. You may even stumble over a member of the editorial staff, so watch where you put your feet.

Compec will be held at Olympia, London W14 from Tuesday November 16 to Friday November 19. Opening hours are 10am to 6pm (4pm on Friday), and admission costs £3 at the door. Advance tickets are available until October 29 by sending £1.50 to Compec Tickets, IPC Exhibitions Ltd, Surrey House, Throwley Way, Sutton, Surrey. 



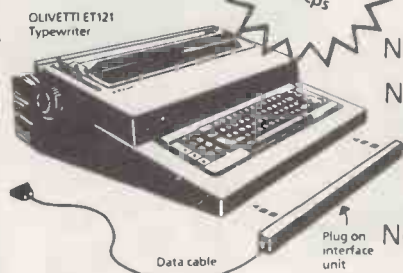
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- New ● PLUG-ON unit. (30 seconds or less to fit or remove)
- RS232C Specification (TX & RX)
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- Simple to use TEXT-EDITOR
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- Printer Pause/Resume Key
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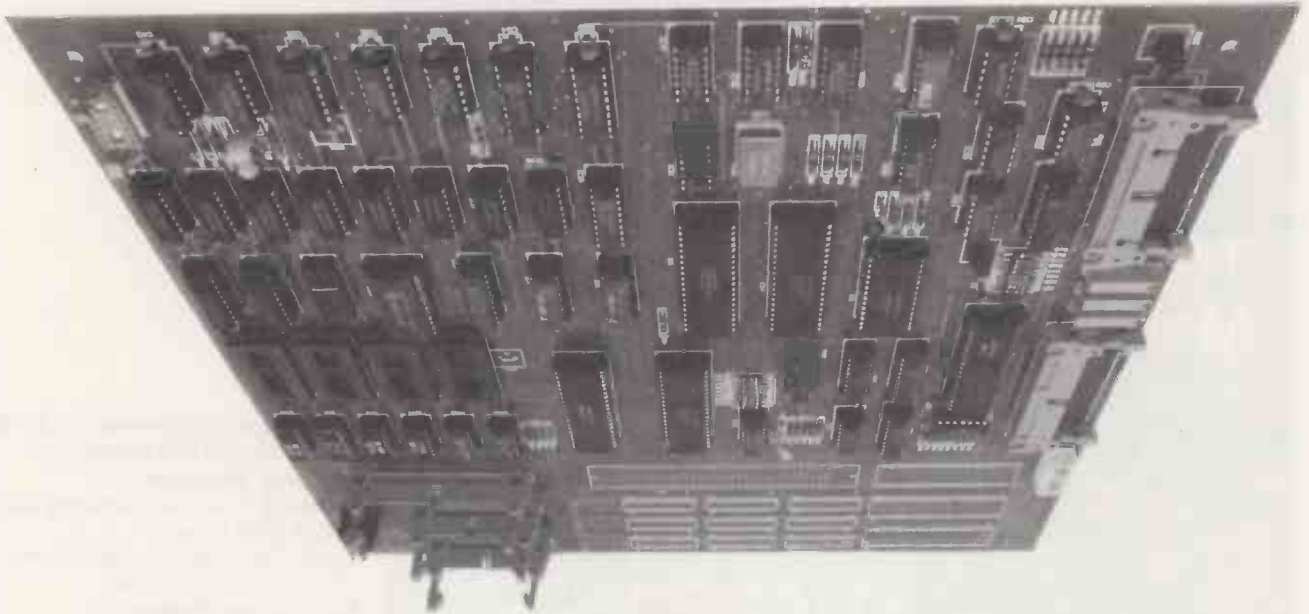
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**FACT** Ricoh Flowriters can assume the characteristics of any popular 'intelligent' printer and plug into any hardware configuration.

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For intelligent printing that frees the host computer and gives you exceptional print quality and speed, find out more about the Ricoh Flowriter – the printer that knows it's a computer, yet costs the same as those that aren't!



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The RP1600 Flowriter



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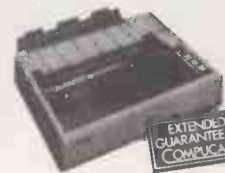


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# Using the BBC Micro as a colour-graphics terminal

NO MICROCOMPUTER SYSTEM meets everybody's ideal specification, but the BBC Micro has an impressive array of graphics functions, including full-colour display, and a variety of modes combining text and graphics. For the model B these include:

- Mode 0 640 by 256 two-colour display and 80 by 32 text
- Mode 1 320 by 256 four-colour display and 40 by 32 text
- Mode 2 160 by 256 16-colour display and 20 by 32 text
- Mode 3 80 by 25 two-colour text
- Mode 4 320 by 256 two-colour display and 40 by 32 text
- Mode 5 160 by 256 four-colour display and 20 by 32 text
- Mode 6 40 by 25 two-colour text
- Mode 7 40 by 25 teletext display

The language used is an extended Basic with structured features. The majority of users find the overall power such an advance on earlier machines that it can be forgiven for not being fully structured.

The BBC Micro can act as a colour-graphics terminal for a CP/M system in a symbiosis which can be extended to using the CP/M system as a disc storage unit for the BBC Micro. The graphics feature of the BBC machine can be driven by Basic keywords as VDU commands and by codes that can be transmitted by other systems. Although these would normally be conveyed through the "tube" — the term used by Acorn to describe the bus designed for connection to other micros — they can also be sent via the RS-423, the standard serial port.

Software can therefore be developed to allow the BBC Micro plus monitor to be used as a graphics terminal to another micro. Using the BBC Micro as a terminal the BBC colour graphics can be added to the host micro's other functions; the BBC screen editor is retained as well as its high-resolution graphics features. The configuration gives access to the variety of, say, CP/M software plus the versatility

Figure 1. BBC Micro graphics codes.

Decimal	Hex	CTRL	Bytes	Meaning	Basic Keyword
0	0	@	0	does nothing	
1	1	A	1	send next character to printer only	
2	2	B	0	printer on	
3	3	C	0	printer off	
4	4	D	0	separate text/graphics cursors	
5	5	E	0	join text/graphics cursors	
6	6	F	0	enable VDU drivers	
7	7	G	0	make a short beep	
8	8	H	0	backspace cursor one character	} cursor control
9	9	I	0	forward space cursor one character	
10	A	J	0	move cursor down one line	
11	B	K	0	move cursor up one line	
12	C	L	0	clear text area	CLS
13	D	M	0	move cursor to start of line	
14	E	N	0	page mode on	
15	F	O	0	page mode off	
16	10	P	0	clear graphics area	CLG
17	11	Q	1	define text colour	Colour
18	12	R	2	define graphics colour	GCol
19	13	S	5	define logical colour	
20	14	T	0	restore default logical colours	
21	15	U	0	disable VDU drivers	
22	16	V	1	select screen mode	Mode
23	17	W	9	reprogram display character	
24	18	X	8	define graphics window	
25	19	Y	5	plot m,x,y	Plot Draw Move
26	1A	Z	0	restore default windows	
27	1B	[	0	does nothing	
28	1C	\	4	define text window	
29	1D	]	4	define graphics origin	
30	1E	^	0	home text cursor to top left	Tab (0,0)
31	1F	—	2	move text cursor to x,y	Tab (x,y)
127	7F		0	delete	



of the stand-alone BBC Micro. Thus the BBC Micro provides the software designer with a low-cost micro with a high-resolution colour-graphics processor on board which can be driven via a simple serial port, the default I/O with most language systems.

Once within CP/M, Basic is no longer a restriction and advantage can be taken of the richness of CP/M software to drive the BBC Micro. In particular, Pascal can be implemented on a standard CP/M system such as the Comart Communicator CP-100.

The BBC Micro, like most micro-computers, uses the ASCII code system to represent the alphanumeric character set. In Basic the Print statement sends the ASCII code of the chosen character down the output channel, OSWRCH, to the





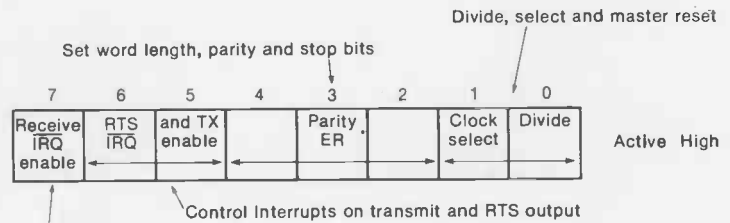
The versatility of CP/M can be combined with the BBC Micro's graphics capabilities to give you the best of both systems. John Ferguson and Tony Shaw show how it's done.



6850 ACIA occupies two memory locations — FE08 and FE09

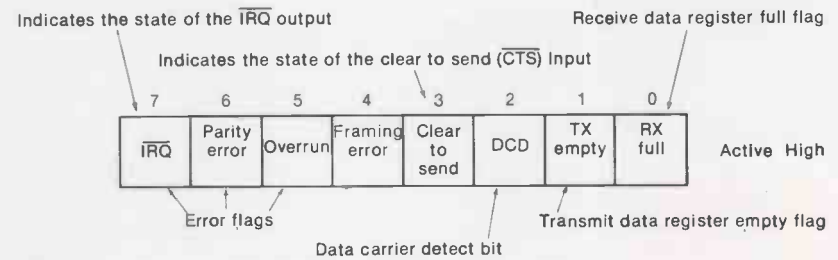
Address	Write operation	Read operation
FE08	Control register	Status register
FE09	Transmit data register	Receive data register

Control register



"1" enables Interrupts for received characters

Status register



Serial processor occupies one memory location FE10

Operates the cassette motor ('1'on/'0'off)

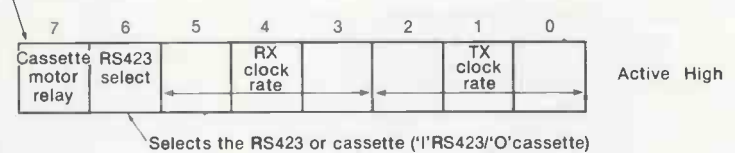


Figure 2. 6502 ACIA and serial processor registers.

display. The CHR\$ function allows the ASCII code to be passed directly on a Print statement, for example:

```
PRINT CHR$(65)
```

is the same as

```
PRINT "A"
```

A useful feature of the BBC Micro is the keyword VDU which combines the Print and CHR\$ functions. Hence

```
PRINT CHR$(65)
```

could be written as

```
VDU 65
```

meaning send the code 65 down the output channel to OSWRCH.

The colour-graphics and display-formatting commands are driven in exactly the same way. The ASCII codes between 0 and 31, often called control codes, are given special jobs in the BBC Micro. They act as software switches enabling

the various display and graphics routines. Hence all the Basic keywords used to control the display have their equivalent VDU statement or list of codes — see figure 1.

The first code after the VDU statement, say the first byte sent down the output channel OSWRCH, selects the desired display function. The operating system then knows how many more bytes are required to complete the instruction. Mode selection only requires one byte after the code whereas redefining the shape of a display character requires nine.

The BBC Micro used code-driven graphics that can be accessed through the normal output channel, OSWRCH. It follows that these codes could originate from any high- or low-level language and

could be delivered to OSWRCH from outside the machine using any of the interfaces available, such as the tube, 1MHz bus, user port or RS-423.

The model B machine contains all the circuitry required for a bidirectional RS-423 +/-5V serial port. At the heart of the interface is a 6850 asynchronous communications interface adaptor, ACIA. A second device, an uncommitted-logic array known as the serial processor, supports the ACIA by providing a programmable baud-rate generator together with the circuitry required to drive an audio-cassette recorder. From Basic the ACIA and the serial processor are configured using the \*FX commands. However, to obtain control of both these devices in a machine-code program the

(continued on page 89)

# comart communicator

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```

10 MODE0
20 DEBOUNCE=&0080
30 OSASCI=&FFFE3
40 OSWRCH=&FFEE
50 CONTROL=&FE08
60 PORT=&FE09
70 VIDPROC=&FE10
80 OSBYTE=&FFF4
90 FOR N=0 TO 2 STEP2
100 PX=&0000
110 OPTN
120 LDA #&64:STA VIDPROC:SET BR CLOCK
130 LDA #&03:STA CONTROL:RESET ACIA
150 LOOP LDA #&56:STA CONTROL:START COM
155 LDA#&80:STA DEBOUNCE
160 IN,
170 LDA CONTROL:ROR A:BCC KEY
180 LDA #&16:STA CONTROL:STOP COM
190 LDA PORT:JSR OSWRCH:GET AND DISPLAY
200 JMP LOOP
210 KEY
212 DEC DEBOUNCE:BNE IN
215 LDA #&16:STA CONTROL:STOP COM
220 LDA #&D2:STA &FE4E ;ENABLE INT
230 LDA #&81:LDX #0:LDY#0:JSR OSBYTE
240 LDA #&52:STA &FE4E ;DISABLE INT
250 TYA:BNE LOOP ;NO KEY FOUND
290 TXA:STA PORT ;GET AND TRANS
300 JMP LOOP
310+
320 NEXT N
330 CALL&0D00
    
```

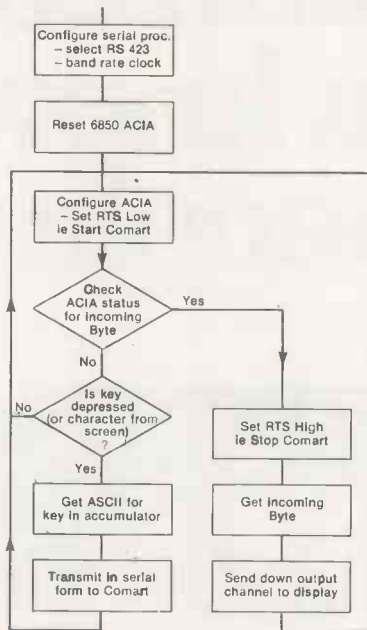


Figure 3. Terminal simulation program and flow diagram.

(continued from page 87) information shown in figure 2 is essential.

Only a short machine-code program is required to configure the BBC Micro as a serial terminal. Figure 3 gives a flow diagram and a program listing for one solution where the BBC Micro is configured to operate at 9,600baud in the full duplex mode. After setting up the serial processor and the 6850 ACIA the program enters a polling loop that checks the ACIA status register and the keyboard. The operating-system subroutine Osbyte scans the keyboard, looking for a depressed key. If a keystroke is detected its ASCII code is transferred to the serial output port and transmitted to the Comart. Any incoming serial character is sent down the BBC's output channel, OSWRCH, to the display.

The execution time of OSWRCH will depend on the task it is asked to perform: plotting triangles takes much longer than displaying alphanumeric characters. Therefore until OSWRCH's task is com-

plete no more characters should be transmitted by the Comart. To achieve this the program operates a partial handshake between the two machines, driving the Ready to Send, RTS, output from the BBC Micro and controlling the Comart through its Clear to Send, CTS, input. It may be necessary to alter two small links on the Comart CPU card to enable the CTS input. Figure 4 shows details of the link positions and of the interconnection between the machines.

The 6850 ACIA has been configured to receive eight bits of data in the serial package from the Comart. Although a seven-bit code is sufficient when transmitting the standard ASCII character set, the code-driven graphics in the BBC machine requires numbers between 0 and 255 to represent data in some of the VDU commands, for example, displacements in the Plot command; boundaries in the graphics window definition.

The BBC Micro has been transformed into a terminal to the CP/M system so the

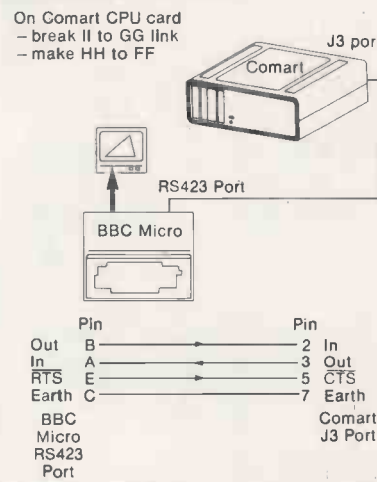
usual CP/M commands can now be typed in. It is possible to load Microsoft Basic into the CP/M system and run programs — see listing 1. While running Basic programs on the CP/M system control characters can be printed to the BBC Micro exactly as to a normal terminal. Thus  
PRINT CHR\$(10)

sends a Control-J character to the terminal. The character normally instructs the terminal to execute a line feed.

The BBC Micro can now be considered to be a high-resolution colour-graphics terminal. Since all the graphics routines are resident and are driven by control codes there are no restrictions on which languages can be used to drive it. The Cobol Display verb could be used to drive the BBC Micro. It would be a great advance over other graphics systems which are normally driven from Fortran or Basic, neither of which is particularly suited to data-processing applications.

As well as Cobol the machine could be driven from Basic, Fortran, C, Forth, Z-80 assembler. Pascal or any other language. Pascal has already proved its worth in teaching programming techniques associated with large-scale programming. Its structure allows more and more com-  
(continued on page 91)

Figure 4. Connecting BBC Micro to CP/M host computer.



Listing 1. Example program driving BBC graphics from MBasic-5.

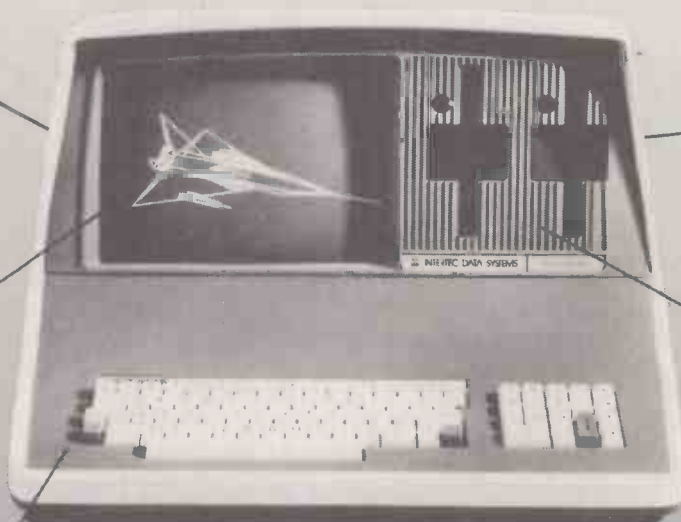
```

10 MODE=2: GOSUB 8050
15 PRINT CHR$(28);CHR$(0);CHR$(31);CHR$(19);CHR$(31)
17 FOR N=10 TO 60 STEP 5
19 L=0:GCOLOUR=8:GOSUB 8100
20 L=3:GCOLOUR=INT(14*RND(1))+129:GOSUB 8100:PRINT CHR$(16)
22 T=4:X=280+N:Y=350+N:GOSUB 8000
26 RESTORE
30 FOR I=1 TO 29
40 READ T,Q,R
50 X=50+Q
60 Y=150+R
70 GOSUB 8000
80 NEXT I
90 NEXT N
100 PRINT CHR$(28);CHR$(5);CHR$(7);CHR$(14);CHR$(2)
110 FOR T=0 TO 30
120 PRINT" HI - RES "
125 PRINT" GRAPHICS "
130 NEXT T
140 PRINT CHR$(28);CHR$(4);CHR$(27);CHR$(15);CHR$(23)
150 FOR T=0 TO 10
152 FOR B=0 TO 100:NEXT B
153 PRINT" ":PRINT" "
155 PRINT" HI - RES "
160 PRINT" GRAPHICS "
170 NEXT T
180 GOTO 15
1000 END
1010 DATA 1,-2,0,1,0,2,1,2,0,0,1,0
1020 DATA 1,0,-2,1,2,0,1,0,2,1,-2,0,0,3,-2
1030 DATA 1,0,2,1,1,-1,1,1,1,0,-2,0,1,0
1040 DATA 1,0,2,1,2,0,1,0,-2,0,-2,1,1,2,0,0,1,-1
1050 DATA 1,0,2,1,2,0,1,0,-1,1,-2,0,1,2,-1,0,2,2
1060 DATA 1,0,2,0,-1,0,1,2,0
8000 REM PLOT STATEMENT T, X, Y
8002 IF X<0 THEN X=65536+X
8003 IF Y<0 THEN Y=65536+Y
8010 XH=INT(X/256):XL=X-256*XH
8015 YH=INT(Y/256):YL=Y-256*YH
8020 PRINT CHR$(25);CHR$(T);CHR$(XL);CHR$(XH);CHR$(YL);CHR$(YH)
8030 RETURN
8050 REM MODE SELECT
8060 PRINT CHR$(22);CHR$(MODE)
8070 RETURN
8080 REM TEXT COLOUR TCOLOUR
8090 PRINT CHR$(17);CHR$(TCOLOUR)
8095 RETURN
8100 REM GRAPHICS COLOUR L,GCOLOUR
8110 PRINT CHR$(18);CHR$(L);CHR$(GCOLOUR)
8120 RETURN
    
```

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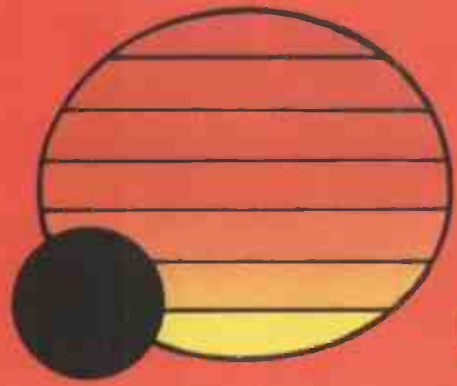
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### The BBC Microcomputer System

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The BBC Microcomputer can genuinely claim to satisfy the needs of novice and expert alike. It is a fast, powerful system generating high resolution colour graphics and which can synthesise music and speech. The keyboard uses a conventional layout and electric typewriter 'feel'.

You can connect directly\* to cassette recorder, domestic television, video monitor, disc drives, printers (dot matrix and daisy wheel) and paddles. Interfaces include RS423, inter-operable with RS232C equipment, and Centronics. There is an 8-bit user port and 1MHz buffered extension bus for a direct link to Prestel and Teletext adaptors and many other expansion units. The Econet system allows numerous machines to share the use of expensive disc drives and printers.

BASIC is used, but plug-in ROM options will allow instant access to other high level languages (including Pascal, FORTH and LISP) and to word processing software.

A feature of the BBC Microcomputer which has attracted widespread interest is the Tube, a design registered by Acorn Computers. The Tube is unique to the BBC Microcomputer and greatly enhances the expandability of the system by providing, via a high speed data channel for the addition of a second processor. A 3MHz 6502 with 64K of RAM will double processing speed; a Z80 extension will make it fully CP/M\*\* compatible.

The BBC Microcomputer is also at the heart of a massive computer education programme. The government has recommended it for use in both primary and secondary schools. The BBC Computer Literacy Project includes two series of television programmes on the use and applications of computers.

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\*Model A has a limited range of interfaces but can be upgraded to meet Model B specification.

\*\*CP/M is a registered trade mark of Digital Research.

The BBC Microcomputer is designed, produced and distributed in the UK by Acorn Computers Limited.





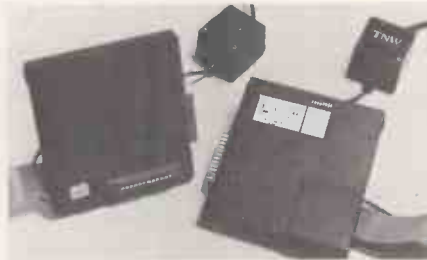
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# Store the lit ignore all

Conventional methods of storing high-resolution pictures are but clumsy. Yet by retaining only the lit pixels, you can save both time and space. Graham Kirkwood shows where the space required is proportional to the number of lit pixels.

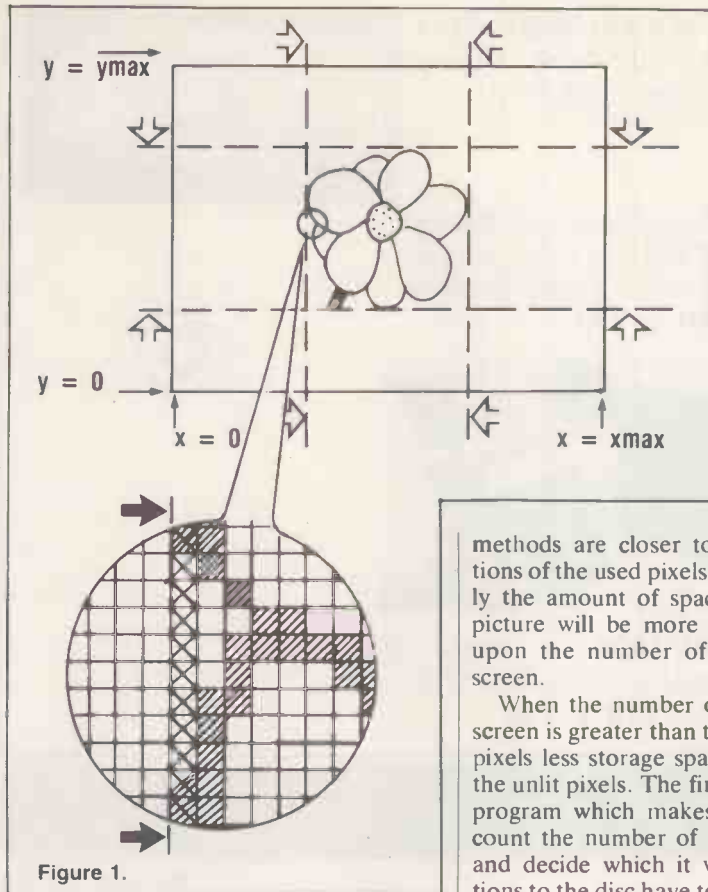


Figure 1.

TO STORE AN average high-resolution picture about 8K will be used, and only about a dozen pictures will fit on to a single-density mini-floppy disc. Considering how much program could be fitted into an equivalent space, when the picture could even be a blank screen, there is surely some scope for improvement.

Reducing the amount of space needed to store a picture can also lead to a significant reduction in the time needed to read the picture, especially if it is held on a slow medium such as cassette. Unfortunately the storage of a picture will always take longer than the conventional storage routine because the more efficient techniques have to look at each pixel on the screen more than once. As the amount of storage saved increases, the routines for storing and reading the pictures inevitably become slower and more complicated; so a compromise must be made between space saving and speed.

The standard way that manufacturers use for storing high-resolution pictures is to copy the area of memory that holds the picture directly on to the disc. The state of any pixel on the screen is independent of its neighbours, so every pixel would have to be stored separately.

However, more advanced storage systems will store the "lit" pixels and ignore the large areas of "unlit" pixels. When reading a picture from a disc stored under such a format the computer must first switch off all the pixels on the screen. In effect, rather than making a list of the states of each pixel, the improved

methods are closer to storing the positions of the used pixels only. Consequently the amount of space used to store a picture will be more or less dependent upon the number of lit pixels on the screen.

When the number of lit pixels on the screen is greater than the number of unlit pixels less storage space is used to store the unlit pixels. The first step in a storage program which makes use of this is to count the number of lit and unlit pixels and decide which it will store. Instructions to the disc have to be written so that the reading program will know which have been stored.

Many pictures do not make use of the full screen but are drawn in the middle, leaving a lot of unused space around the border of the screen. The framing technique is designed to reduce the amount of empty border stored on the disc. It works by putting a close-fitting frame around the figure on the screen, writing the size

and position of this frame to the disc, and then copying the contents of each pixel within this frame to the disc.

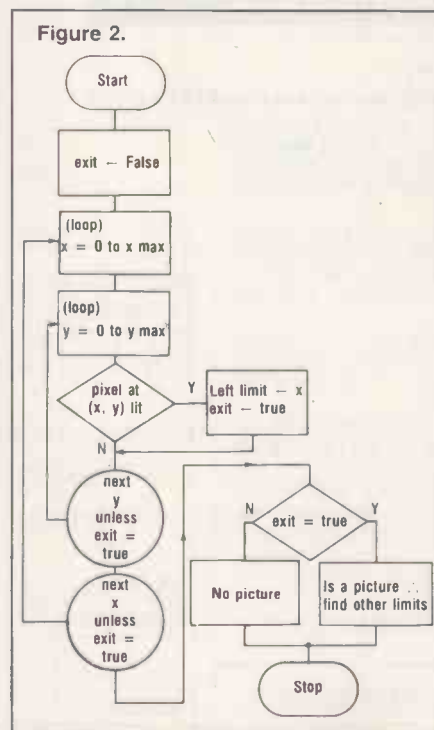
The amount of space used by this technique will obviously vary with the size of the frame, and making predictions of the number of pictures that you can store on a disc is difficult. Also, if the disc is full, one picture cannot necessarily be replaced by another if the new picture takes up more space than the old one. The problem does not arise with the traditional storage method, where the space requirements are constant.

Unfortunately the technique puts a single frame around any lit pixels on the screen. If only the bottom-left pixel and the top-right pixel on the screen are switched on, the frame will still cover the full area of the screen. Consequently it uses slightly more storage than the traditional method, allowing for the frame size and position to be stored. This is the worst case possible using a framed storage method; with most usual pictures a good saving in storage is achieved, considering the simplicity of the technique.

The awkward part is putting the frame into the correct position. It is done by working from each of the four sides, one at a time, and checking each row of pixels parallel to the sides. You gradually work inwards until a row is found which has a lit pixel within it — see figure 1. Then the position of each of these frame sides can be stored and the area within copied.

An empty screen is normally detected when the first side of the frame is moved off the opposite side of the screen, having failed to find any lit pixels. To overcome this a special value for each of the frame side positions is used when writing an empty screen to the disc — a negative value, for example.

An unmodified reading program could use default values for the frame side positions. When the first side of the frame moves off the screen the positions of each frame side would be adjusted to point to a small one-pixel box anywhere on the screen. The storage routine would then proceed as though it had enclosed a







# pixels others

olution pictures are reliable  
ositions of used pixels you can  
oks at storage strategies  
the number of lit pixels.

real picture, but it would only copy this single pixel to the disc.

The basic flowchart for the framing part of the program is given in figure 2. A better way of finding the limits of the picture is to look at each pixel separately; if it is lit then the co-ordinates of the pixel are compared to the current values for the picture limits. If it exceeds any of them then the limits are updated as appropriate. Figure 3 shows a flowchart for this method.

Row storage deals with the picture one row at a time. In a typical picture most of the drawing is somewhere in the middle of the screen — see figure 4. In any one line taken from it, such as in figure 4b, there is likely to be a large number of unused pixels on either side of the centrally placed used pixels.

The theory behind row storage is that it should be possible to save a lot of space if only the used part of the row is stored, having specified whereabouts on the line it started. For each row the computer starts by counting how many unused pixels there are to the left of the first used one, then it counts the unused pixels to the right of the last set one. Then the number of pixels in the used part of the row is calculated by subtracting from the line length the total number of unused pixels. Finally the computer stores the

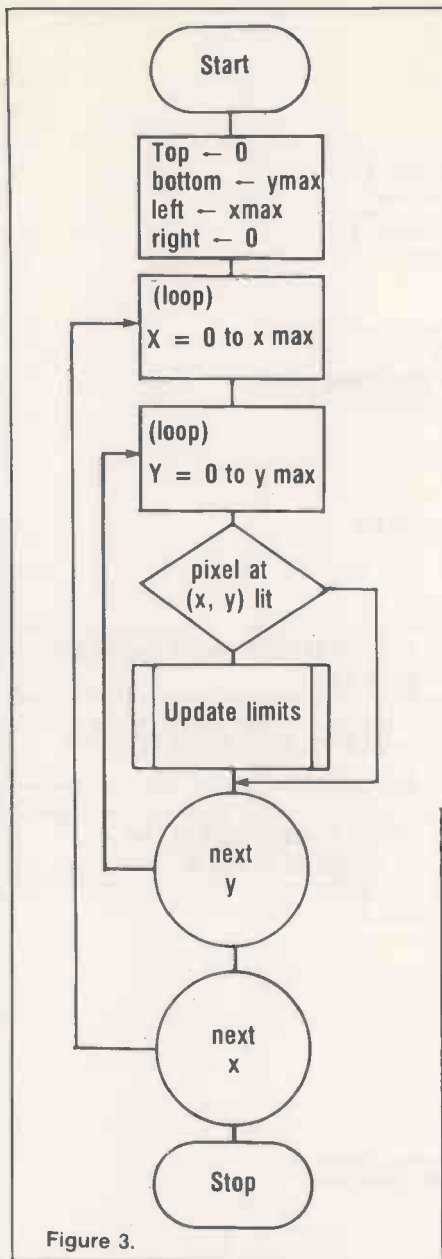
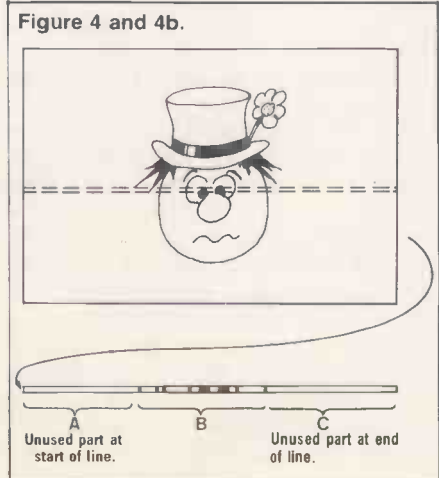
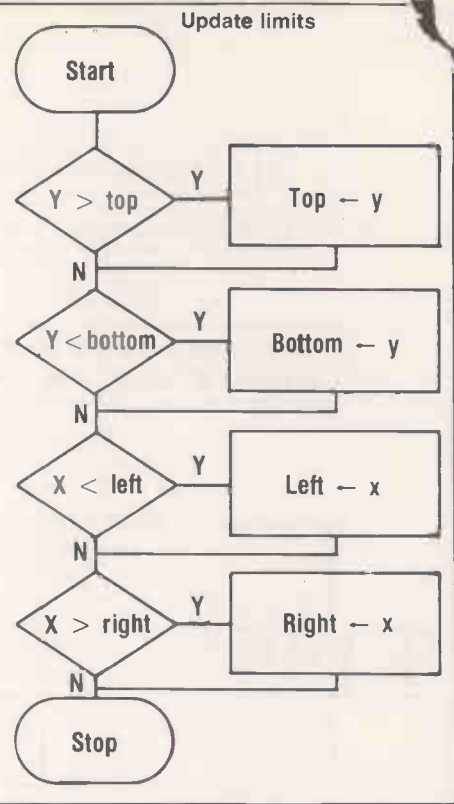


Figure 3.

number of unused pixels before the used part, the length of the used part, followed by a number of bytes containing the used portion of the line.

Problems with row storage start when you come across empty rows. One solution is to have top and bottom cursors as for framed storage but this does not help when there are unused rows in the middle of the picture. When they are present it is best to use a special value for the start position of the picture, which the reading routine will recognise as indicating an empty line. Figure 5 shows the flowchart for this technique and figure 6 illustrates how the storage saving is made around the border of the picture. It is easy to see from this the increase in the saving compared to the framed method. However, a lot of extra information must be written to the disc or tape which is not needed in framing.

Row storage is like framed storage with flexible cursors either side of the picture



and solid cursors above and below it. They eliminate the need for storing the empty border around the periphery of the figure; so if you have a picture with only a small border but a lot of unused space inside it neither row nor framed storage will be much use. In such situations a method is needed which finds unused areas no matter where they are in relation to the borders of the screen.

Block storage splits up the screen into small squares. Each square is stored independently, but only if there are pixels set within it.

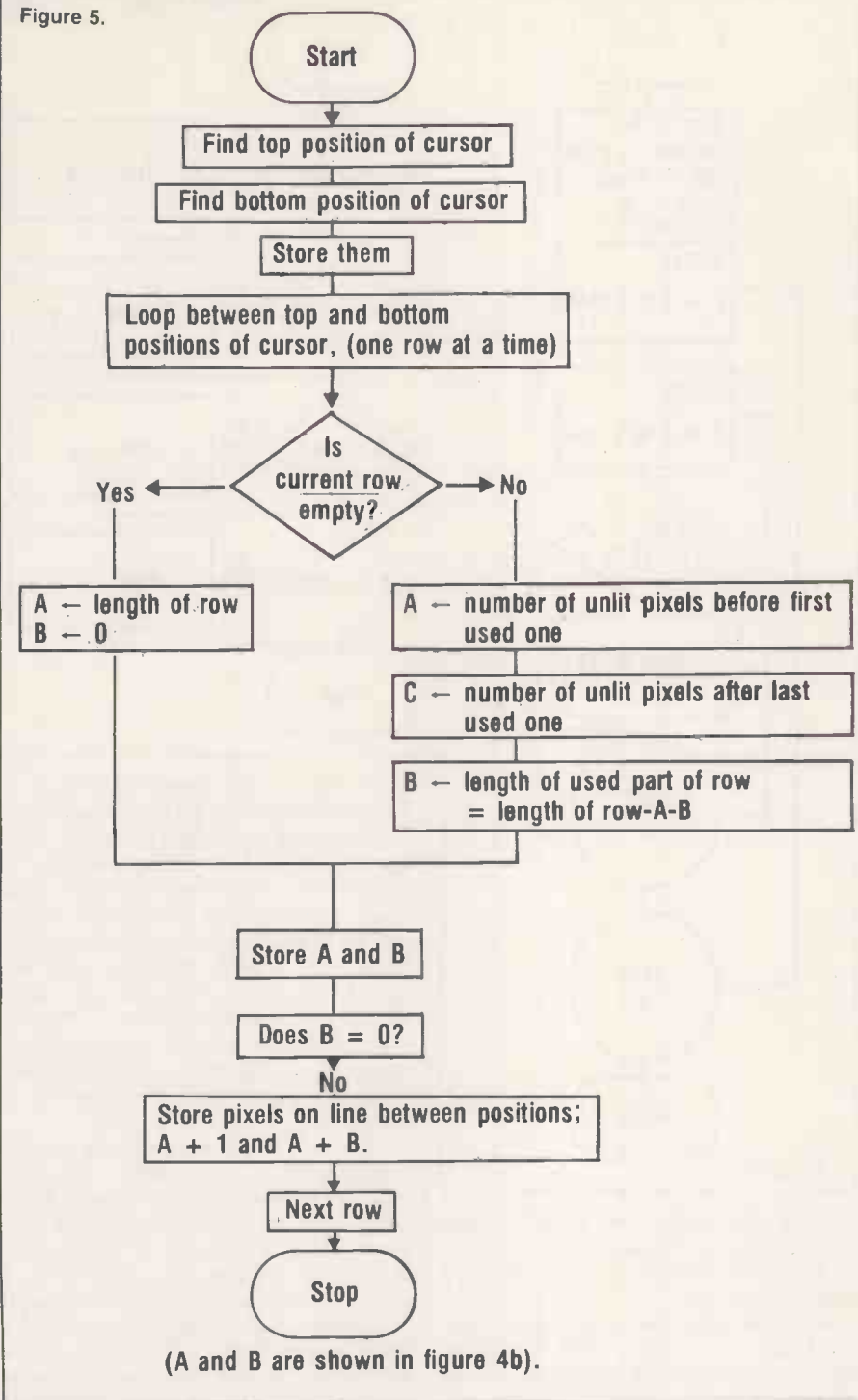
Figure 7 shows an example picture already divided into squares. The computer scans each square in turn to determine whether any of the picture falls inside it. If the square is found to be empty the program goes on to the next square. If the square is used it is stored.

In practice it is slightly more complicated: although the squares used by the picture are stored, the reading routine does not know where to put them when reloading the picture. After each square has been scanned once, the storing routine writes a 1 or a 0, depending on whether the square is used or empty. This is followed by the contents of the square, if any. Looking at the storage media as a line of bits it might appear as in figure 8.

The reading and writing routines must work on exactly the same storage structure or you will end up with total gibberish. The data is insecure under this format: if the state of the bit specifying whether the block was used or unused is altered, then all the information following it is corrupted. For example, if a bit

(continued on next page)

Figure 5.



(continued from previous page)

specifying an empty block is changed to show a used block, then the next bit — previously showing the state of the next block — is taken as the first pixel to be transferred to the screen, and so on.

The easiest way around this is to write the block-specifying character a number of times, typically five or seven. An odd number is necessary so that the reading routine can make a majority decision as to what follows.

One of the constraints imposed by simple blocking is that all the blocks have to be the same size, which because of the square graphics grid must be rectangular.

The unused spaces in any graphics picture are pretty random in shape. So if a random unused point on the screen is picked, there is no way to predict where the closest used pixel is. Conversely if the current pixel is unused the chances of reaching a used pixel increase as you move away from it. It follows that the ideal block shape is a circle, but since only rectangles are used the best shape seems to be a square.

The size of the blocks determines what the maximum storage saving will be. With numerous small blocks the chances of each block being empty will be good but there will be a lot of extra block-

specifying bits which have a fixed storage requirement. Conversely by using fewer but larger blocks the fixed storage requirements are reduced by cutting down on the number of block-specifying bits. The chances of having an empty block are reduced, but whenever there is an empty block the storage saving is very good.

It is surprising how many pixels will fit into what appears to be a very small area when mapped out on the screen. On a screen measuring 300 by 250 pixels there is enough space for 750 blocks each holding 100 pixels. These square blocks would have sides of about 0.25in., but for each of these 750 blocks you will need to use some bits to specify whether the block is used or not. Fortunately there are always enough empty blocks to bring the net storage requirements below that of the traditional method.

There is not really any accurate way to work out manually the best block size. The most effective way to find it is by writing a program and then modifying the block size until a reasonable overall storage reduction is achieved. Square blocks with sides measuring somewhere between 10 and 30 pixels may be used as a guideline. But it might be worth going down to sides of two pixels. The more blocks there are the more constant the storage reduction will be. So to use the routine for general-purpose storage it is better to keep the blocks quite small.

One difficulty common to writing block-storage programs is knowing what to do when the blocks cannot cover the screen, leaving a small border on two of the sides — see figure 9. The best approach is to use a grid of blocks that is slightly larger than the screen. Any points outside the screen are assumed to be empty. Using this method the reading and writing routines stay simple, and there is very little extra storage needed because these partially used blocks have fewer points actually on the screen. Those off the screen are empty so there is a lesser chance of them actually being used.

Intelligent blocking is a development which allows the program to find the best block size for itself. As the block size is no longer constant it will have to be stored before the picture. There is no need to store the number of blocks horizontally and vertically on the screen because this can easily be calculated by the reading program. The way to change the number of bits given over to the block specification part, BSP, can be stored as well. Alternatively this can be left to the reading program to work out from some predefined protocol such as a table relating BSP size to the size of each block.

The storage routine is given a number of different block sizes that it may use; how many depends upon how long you are prepared to wait for a picture to be stored. It then calculates how many bits it

(continued on page 105)



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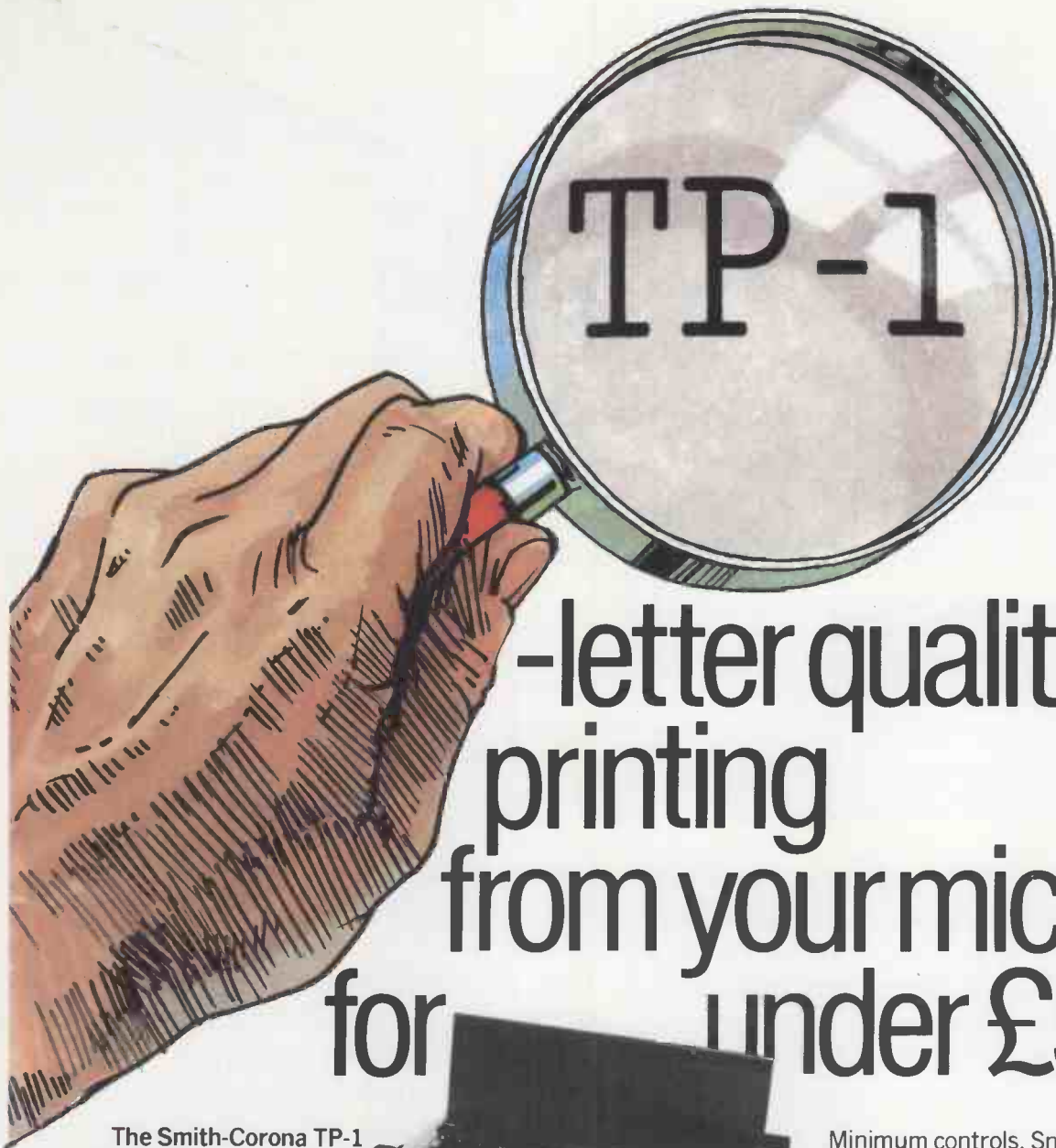
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needs to store the picture using each size before selecting the best one to use.

For each block size the program does the first part of the block-storage routine where it counts the number of blocks that it will have to store. Then it works out the total storage requirement by multiplying this number by the number of pixels in each block and then adding the space taken up by the BSPs, found by multiplying the number of bits per BSP by the number of blocks on the screen.

Small blocks behave very much like pixels; groups of them occur used or unused. So if these smaller blocks are put into larger ones there should be extra benefit as single blocks reduce the storage requirements. These blocks could always be put into other blocks, and so on, until there is one big block covering the whole screen. To store an empty screen, the block-specification part for the single very big block would show it to be empty so the space taken to store the picture, excluding file headers, etc., would be less than a byte.

If each block is square and has four smaller blocks within it the length of the sides of each block must be a power of 2. At the lowest level, this ensures that the blocks have side lengths of one pixel, though it is probably not the most efficient format. With most microcomputers you will need to use an initial block size of 512 by 512 to cover the screen as the resolution is always greater than 256 on one of the axes.

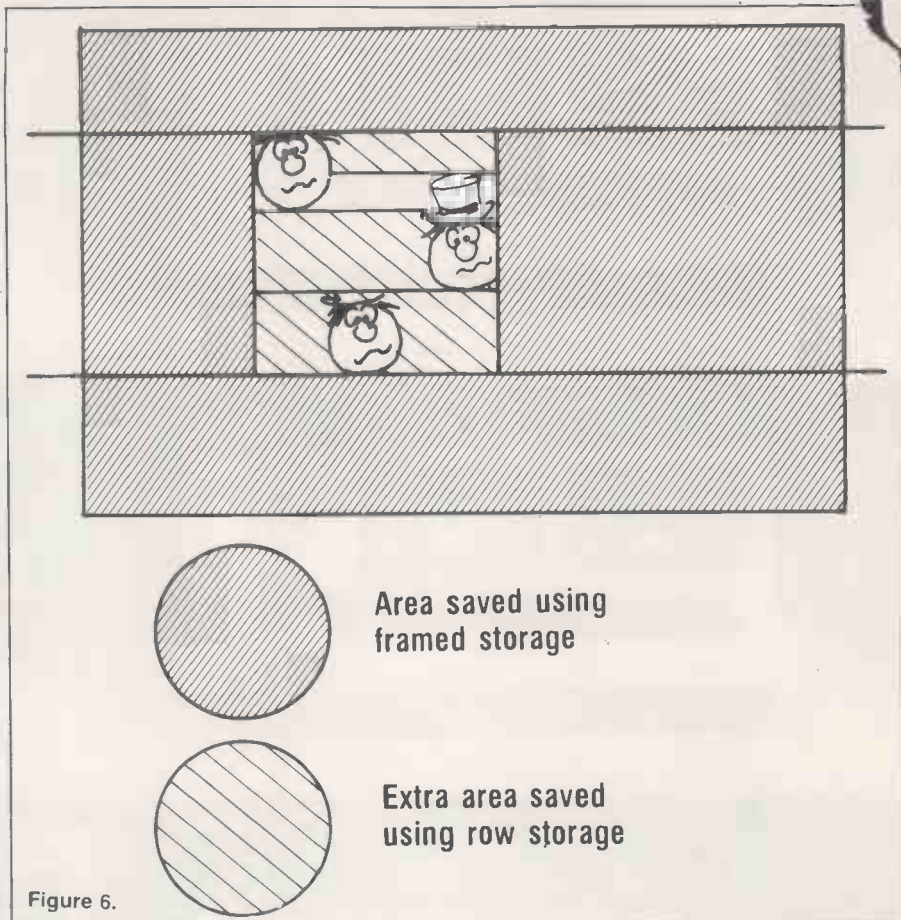
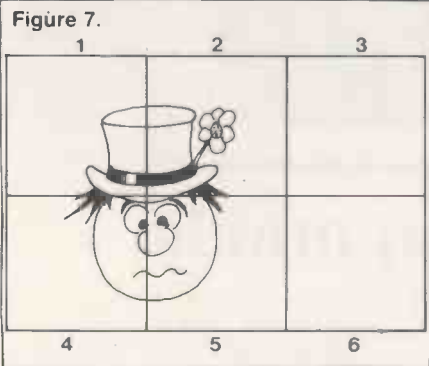


Figure 6.



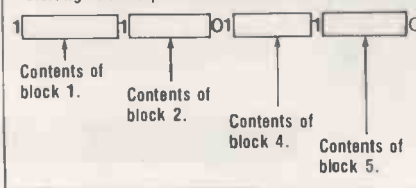
Since the screens are not square a large part of this initial block will lie outside the graphics area, as in figure 10. Yet as all the parts off the screen are assumed unused, for a typical size of 320 by 240 only 37 bits will be wasted using the outside initial block.

The various levels of blocks in the program make the storage process quite difficult to understand. Figure 11 shows how a very simple picture on a square screen would be stored. The initial block has sides of four pixels and the program looks at blocks within blocks in the order top-left, top-right, bottom-left, bottom-right.

The same process is repeated over and

Figure 8.

Assuming that the squares are scanned left to right starting at the top left hand corner of the screen.



over again at each level, making the program ideal for a recursive solution. Only the block size and position differs at each stage and this can be catered for with three parameters which are passed

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Figure 9.

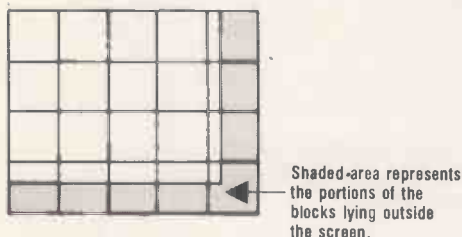
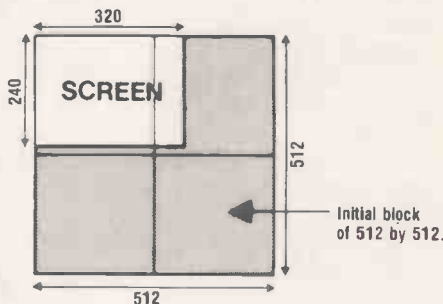
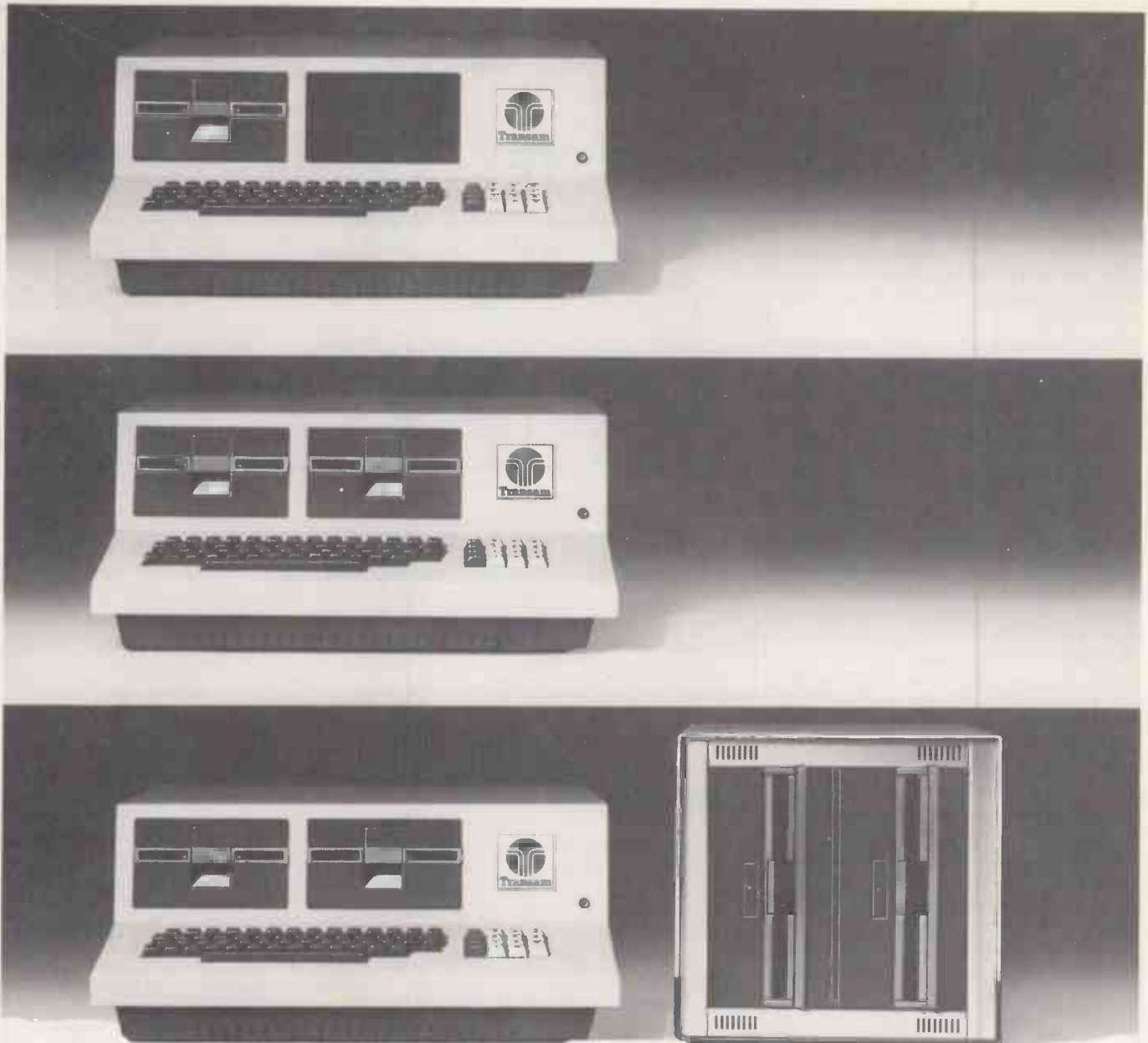


Figure 10.



The shaded area shows the large amount of space wasted using multiple blocking, however this 'waste' only occupies about 5 or 6 bytes during storage.



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down from the level above. The parameters specifying the position of the block give the x- and y-co-ordinates of the extreme bottom left-hand pixel in the block. As these blocks are square you only need give the length of one of the sides which is the other parameter.

When the subroutine calls itself, new variables are formed, totally independent of those at other levels even though they have the same names. Though this is normally a stumbling block when Basic is used, it is readily illustrated by the simple Pascal listing of the recursive procedure in figure 12.

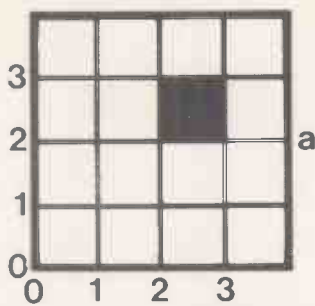
The storage is initiated by a call to this procedure from the main Pascal program which, for the simple example in figure 11, would be:

```
doblock (4,0,0)
```

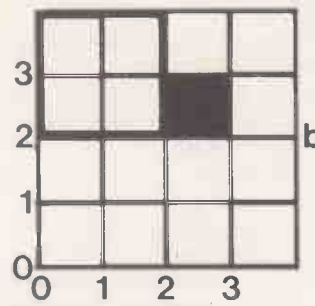
On entering the procedure four variables are created: blocksize is given the value 4, cornerx becomes 0, and cornery becomes 0; the remaining variable has space reserved for it.

The procedure starts by using a function called Blockempty. It scans the entire area of the current block and returns the Boolean value "true" only if there are no pixels set inside the block. If this is the case the procedure stores a 0 and ends at this level. The variables set up inside it are then disposed of.

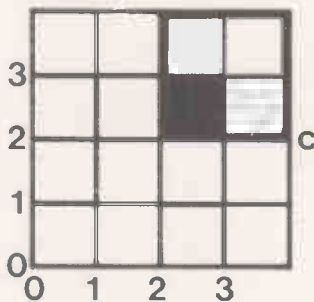
(continued on next page)



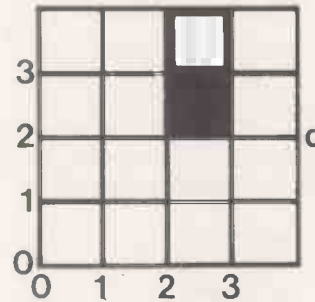
The program scans the current block  
Finds a set pixel  
Stores a 1 to show that the block is used  
Not at lowest level so checks each block within itself



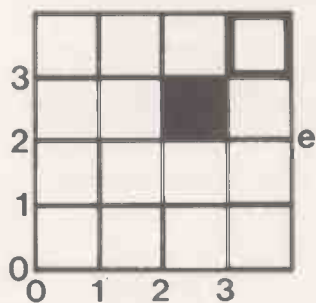
Scans first block  
Finds nothing  
Stores 0 to show block is not used  
No need to check lower levels



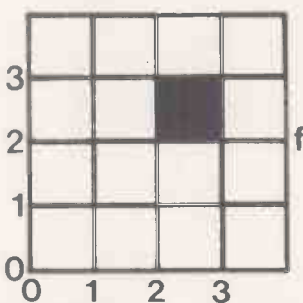
Scans second block  
Finds a set pixel  
Stores a 1 to show block is used  
Not at lowest level so checks each block within itself



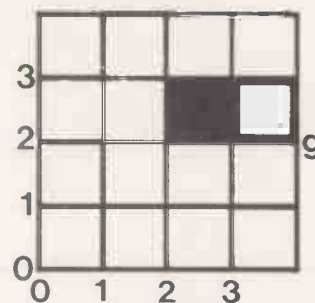
Scans first block  
Finds nothing  
Stores 0 to show block is not used  
No need to check lower levels



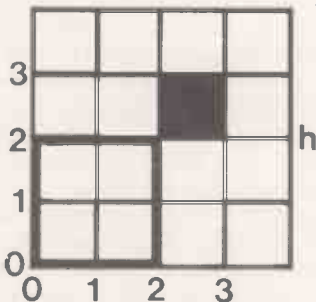
Scans second block  
Finds set pixel  
Stores 1 to show block is used  
At lowest level — side length of block is one pixel — so cannot go to a lower level



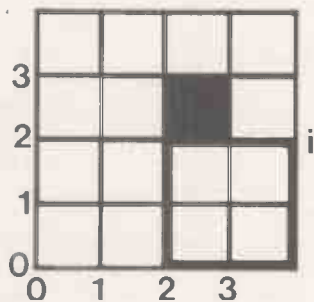
Scans third block  
Finds set pixel  
Stores 1 to show block is used  
At lowest level so cannot go lower



Scans fourth block  
Finds nothing  
Stores 0 to show block is not used  
No need to check lower levels  
Last block at this level so goes up a level



Scans third block as 'this level'  
Finds nothing  
Stores 0 to show block is not used  
No need to check lower levels



Scans fourth block  
Finds nothing  
Stores 0 to show that block is not used  
No need to check lower levels  
Last block at this level so goes up a level

On return to initial level:  
No blocks left at this level  
Highest level, so finish  
Total storage by this new method: nine bits  
Total storage by conventional method: 16 bits

Figure 11. Multiple blocking.

Figure 12.

```

procedure doblock(blocksize,cornerx,cornery:integer);
var smallblock :integer;
begin
  if blockempty(blocksize,cornerx,cornery)
  then store (0)
  else begin
    store (1);
    if blocksize > 1
    then begin
      smallblock:=blocksize/2;
      doblock(smallblock,cornerx,cornery+smallblock);
      doblock(smallblock,cornerx+smallblock, cornery+smallblock);
      doblock(smallblock,cornerx,cornery);
      doblock(smallblock,cornerx+smallblock,cornery)
    end
  end
end;

```

Figure 13.

```

procedure readblock(blocksize,cornerx,cornery:integer);
var thing,smallblock :integer;
begin
  read(thing);
  if thing=1
  then begin
    if blocksize=1
    then plotpixel(cornerx,cornery)
    else begin
      smallblock:=blocksize/2;
      readblock(smallblock,cornerx,cornery+smallblock);
      readblock(smallblock,cornerx+smallblock, cornery+smallblock);
      readblock(smallblock,cornerx,cornery);
      readblock(smallblock,cornerx+smallblock,cornery)
    end
  end
  else clearblock(blocksize,cornerx,cornery)
end;

```

(continued from previous page)

If the Blockempty function returned the value "false" a 1 is stored and the program has to go down to the next level, if it can. It checks to make sure that the current block is not a pixel, and if it is the procedure finishes. As long as the length of the sides is greater than 1 it will proceed to the next level, where the length of the sides is half the current value.

It starts by calculating this value

small block: = blocksize/2

Then it has to repeat the Doblock procedure for each of the four blocks inside the current one.

Although the workings behind this program appear complicated the only difficult part is coming to grips with the concept of recursion. An added benefit with the recursive solution is the size of the program: you should be able to fit both string and reading programs into the space occupied by any of the other pro-

grams which have been described so far.

A Pascal listing for the reading program is given in figure 13. It is virtually identical to the storage routine, so if space is at a premium they can easily be merged. Like the storage program the routine is initiated by a call from the main program. For the simple case in figure 11 this would be

readblock (4,0,0)

The variable "thing" is the bit value read in from the storage device; the procedure "clearblock" switches off all the pixels in the current block.

One useful development of multiple blocking is to use a process where the number of blocks within blocks can be made dependent upon the level. This allows the initial block to be made rectangular so that it fits the screen much better than the previously adopted square. Moreover it makes it possible to experiment with different numbers of blocks at each level, which is particularly

useful since most space in multiple blocking is used up in higher levels.

The storing and reading programs would need to be substantially modified to cater for these variable blocks. A global array would be set up to hold all the side lengths — for both x- and y-axes — at each level. The parameters passed between the doblock procedures would be the position of the block, as before, and the current level of the procedure, allowing the procedure to determine what block dimensions to use by looking at the array. As there is a different number of blocks inside each block at each level you would have to use a pair of loops in the part of the procedure where the internal blocks are called.

Defining a pixel as used or unused, lit or unlit is fine for a computer where you only have the background and one plotting colour to deal with, but what if you have a number of different colours to store? The first step in storing a colour picture is to decide on a binary code for each colour and store the code for the selected background. It is best to store separately the plotted part of each colour as though each colour were on a separate screen. Alternatively you can assign to each pixel a fixed number of bits on the storage media and store a colour code rather than the single bit saying whether the pixel is on or off. Unfortunately this can only be used with traditional, framed and row storage.

Treating each colour as though it is on its own screen allows the storage program to take each plotted colour one at a time, after storing the background colour, and store it as though the pixels which matched the colour are lit, while all the others are unlit. There is an obvious disadvantage in the storage program having to repeat the entire storage process for each colour, though it cannot easily be avoided.

Extra storage saving can arise from the way colour is often used in "lumps" to give the picture areas of colour. Row- or frame-storage techniques are particularly effective at dealing with this situation. In one modified form of multiple block storage an extra bit is used after the block-specification part to show whether the whole area of the block is filled with the current plotting colour. If it is, then there is no need to go to lower levels. The storage reduction is, as usual, dependent on the pictures, but a general guideline to follow is that the larger the areas of colours the better the saving.

Each of the available storage methods has its particular good and bad points, and to minimise the bad points it may be worth trying to combine two or more. For example, you can frame the picture and then store whatever is in the frame, using multiple blocking. Alternatively you could try splitting the screen up into blocks and using the frame technique inside each block. □



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6. 62 predefined graphic characters plus





business, educational, home and leisure software.

11. A second processor option using the Z80 gives the Commodore 64 the ability to support CP/M.<sup>®</sup>

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CP/M <sup>®</sup> Option (over 1000 packages)	YES	YES
External ROM cartridge slot	YES	NO

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full alpha numerics with upper and lower case letters, all available directly from the keyboard and displayable in normal or reverse video in any of 16 colours.

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8. The dedicated video chip allows the use of high resolution multi-coloured "Sprites" (moveable object blocks). Sprites can be moved pixel by pixel, independently of anything else on the screen.

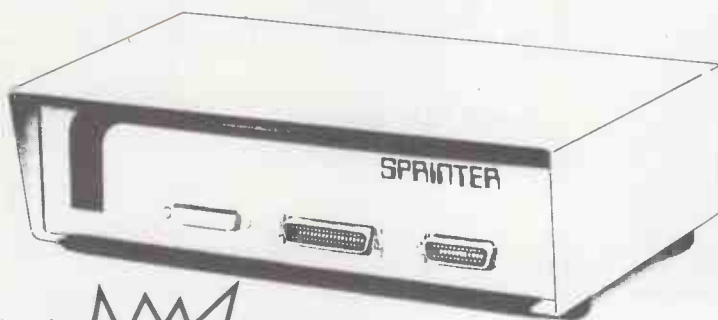
9. Sprites can also be set up in 8 "layers" giving full 3 dimensional effects with, if required, automatic collision detection between sprites and any other screen object.

10. Machine bus port will accept ROM cartridges for many applications, including

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# Shapes of molecules to come

From the structure of any molecule it is possible to work out its shape without needing to synthesise it first. David Brown's program shows how.

THE SUCCESS of modern drugs is due in part to the efforts of chemists in designing specific molecules to hinder the growth of dangerous bacteria or viruses. One of the key characteristics is the molecule's shape and though molecules are far too small to be seen clearly, even under a powerful microscope, their shape can be deduced from the arrangement of the atoms from which they are built up.

This program for the Apple II is designed to show the shape of any molecule, given its proposed structures. The atoms in real molecules are not static, but are continuously vibrating through up to one-quarter of the distance between atoms, and this is also provided for in the program.

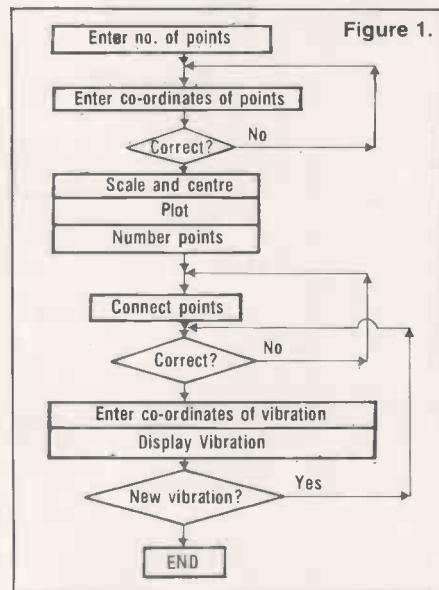
The fully commented program takes up most of the 22K of memory between the top of page 1 high-resolution graphics, location 16384, to the bottom of the disc operating-system area, location 38400 of a 48K Apple II. Its general features are shown in flowchart form in figure 1.

It is necessary to label each point after plotting so that the correct points are joined together. This cannot be done  
*(continued on next page)*

```

10 REM GRAPHICS MOLECULAR VIBRATIONS 6/9/81 DRB
20 REM AVOID HGR COMMAND OVERWRITING PROGRAM
30 HIMEM: 49151
40 LOMEM: 16384
50 PRINT "HOW MANY ATOMS IN THE MOLECULE"
60 INPUT J:J = J - 1
70 P = 8: REM EACH VIBRATION DIVIDED INTO EIGHT PARTS; NB P=4,0=2 GIVES A
    MUCH FASTER, BUT JUMPIER VIBRATION
80 Q = 1: REM AMOUNT BY WHICH M IS INCREMENTED EACH TIME
    EACH PART OF THE VIBRATION IS PLOTTED
90 R = 4: REM VALUE OF M AT WHICH THE VIBRATION CHANGES DIRECTION
100 M = 0: REM INITIAL VALUE IS FIRST INCREMENT OF M (M IS A COUNTER FOL
    LOWING THE PROGRESS OF THE VIBRATION
110 XAX = - 1000:YAX = - 1000:YI = 1000:XI = 1000: REM SET INITIAL MAX
    AND MIN VALUES OF X AND Y
120 DIM X(J): DIM Y(J): DIM XX(J): DIM YY(J): DIM I (J): DIM NX(J): DIM NY
    (J): DIM VX(J): DIM VY(J)
130 DIM NO(J),MO(J)
140 DIM M(J): DIM N(J): DIM BX(J): DIM BY(J)
150 DIM CY(J): DIM CX(J):
160 DIM A(25)
170 PRINT : PRINT : PRINT "TYPE IN THE X,Y COORDINATES, SEPARATED BY A CO
    MMA, OF EACH POINT IN TURN": PRINT
180 PRINT "3 DECIMAL PLACES IS AMPLE"
190 PRINT : PRINT "START A NEWLINE FOR EACH PAIR OF COORDINATES": PRINT
200 FOR I = 0 TO J: INPUT X(I),Y(I):Y(I) = - Y(I):
210 REM THE 0,0 COORDINATES ARE AT THE TOP OF THE SCREEN ON THE APPLE!
220 REM FIND MAX AND MIN VALS OF X,Y FOR SCALING PLOT
230 IF X(I) > = XAX THEN XAX = X(I)
240 IF X(I) < = XI THEN XI = X(I)
250 IF Y(I) > = YAX THEN YAX = Y(I)
260 IF Y(I) < = YI THEN YI = Y(I)
270 NEXT I
280 PRINT : PRINT "WOULD YOU LIKE TO REPEAT ANY POINT?": GET ANS*:
290 IF ANS* = "N" THEN 340
300 IF ANS* = "Y" THEN TEXT : FOR I = 0 TO J: PRINT "NUMBER = "; (I + 1),X
    (I), - Y(I): NEXT I
310 PRINT : PRINT "WHICH NUMBER?": INPUT NO
320 NO = NO - 1
330 PRINT "COORDINATES?": INPUT X(NO),Y(NO):Y(NO) = - Y(NO): GOTO 280
340 REM FIND SCALEFACTOR AVOID ZERODIVIDE
350 IF YAX = YI THEN YSC = 140 / (XAX - XI): GOTO 390
360 IF XAX = XI THEN XSC = 80 / (YAX - YI): GOTO 410
370 YSC = 80 / (YAX - YI)
380 YSC = SGN (YSC) * YSC
390 XSC = 140 / (XAX - XI)
400 XSC = SGN (XSC) * XSC * 1.5: REM THIS SCALEFACTOR SHOULD 3/4 FILL T
    HE SCREEN
410 IF YSC > = XSC THEN SC = XSC
420 IF YSC < = XSC THEN SC = YSC
430 REM MOVE PLOT TO 140,95
440 XPLUS = 140 - (SC * (XAX + XI) / 2)
450 YPLUS = 95 - SC * (YAX + YI) / 2
460 REM CALCULATE X,Y FOR PLOT
470 FOR I = 0 TO J
480 BX(I) = XPLUS + SC * X(I)
490 XX(I) = INT (BX(I))
500 BY(I) = YPLUS + SC * Y(I)
510 YY(I) = INT (BY(I))
520 REM **PRESERVE X,Y COORDINATES IN CX,CY **
530 CX(I) = BX(I):CY(I) = BY(I)
540 NEXT I
550 HGR : HOME : HCOLOR= 7: REM SET GRAPHICS CLEAR TEXT MOVE PROMPT : VT
    AB 24
560 FOR I = 0 TO J
570 HPLT XX(I),YY(I)
580 NEXT I
590 GOSUB 1140
600 VTAB 24: REM PROMPT AT BOTTOM OF SCREEN
610 PRINT "HOW MANY BONDS ARE THERE"
620 INPUT K:K = K - 1
630 REM ESTABLISH CONNECTIONS BETWEEN ATOM POSITIONS
640 PRINT "TYPE IN THE ATOM NUMBERS BONDED TOGETHER, IN PAIRS, SEPARATED
    BY COMMAS"
650 FOR I = 0 TO K
660 INPUT NO(I),MO(I):M(I) = MO(I) - 1:N(I) = NO(I) - 1
670 POKE - 16297,0: POKE - 16304,0: REM HIGH RESOLUTION GRAPHICS BACK
    ON REPLOTTING CONNECTIONS
680 HCOLOR= 7: REM PLOT ATOM CONNECTIONS
690 HPLT XX(N(I)),YY(N(I)) TO XX(M(I)),YY(M(I))
700 NEXT I
710 VTAB 24
720 PRINT "WOULD YOU PREFER TO REPLOTT THESE CONNECTIONS?": GET ANS*
730 IF ANS* = "Y" THEN TEXT : PRINT "Y-REPLOTT, 0-END, SPACEBAR-C
    ONTINUE": PRINT : FOR I = 0 TO K: PRINT NO(I),MO(I): NEXT : GOTO
    640
740 REM RESET ORIGINAL VAL
    UES TO VARIABLES AFTER FINISHING A VIBRATING SET OF COORDS SO MORE VI
    BES CAN BE INPUT
750 FOR I = 0 TO J
760 BX(I) = CX(I):BY(I) = CY(I)
770 NEXT I
780 IF ANS* = "0" THEN TEXT : PRINT "TO ENTER NEW COORDINATES TYPE RUN
    ": END
    
```

*(listing continued on next page)*





(continued from previous page)

from the keyboard of the Apple II — you have to use a shape table, which codes the shape as a binary file and loads it into memory before loading the Basic program. The Basic program then calls the shape using the Draw command.

This program avoids binary files and most of the hexadecimal arithmetic by coding the numbers to be Drawn on the graphics screen as decimal Data statements at the end of the program. You must first tell the Applesoft interpreter the location of the shape table in mem-

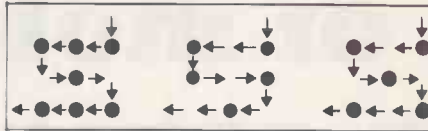


Figure 2.

ory. The starting address for short machine-language programs recommended for the Apple, 768 or \$300, is Poked into locations 232 and 233, \$E8 and \$E9, in line 1150.

The shapes are then Poked into memory at location 768 and the following 25

locations in line 1160 using the Data statements at the end of the program. The first Data statement, line 1440, contains the information that three shapes are to follow, the first starting at the eighth address further on, the second at the 14th and the third at the 20th.

Lines 1450, 1460, and 1470 contain the shapes I, V, and X to allow roman numbers to be output to the graphics screen. The vector diagrams in figure 2 are first represented in binary form, which is then converted into its decimal equivalent. Each number in these Data statements describes two vectors; five numbers are therefore sufficient to describe the 10 vectors which comprise each roman number. To facilitate checking, the vectors are the same for each number; the differences lie in whether a dot is plotted or not at the start of each vector.

The first number of each shape definition is 58, which describes a downward vector with "no plot" at its origin. It is followed by a left vector with "plot a dot" at its origin for all three shapes in figure 2. This corresponding binary code is

- 10 — downward vector
- 0 — do not plot
- 11 — leftward vector
- 1—plot

The binary numbers are now strung together, working from right to left, starting with the downward vector, that is

111010

which works out to  $32+16+8+0+2+0$ , equal to 58.

These shape definitions are used in the program following line 1180: Draw 1 outputs an I to the graphics screen, Draw 2 a V, and Draw 3 an X. The logic for converting decimal numbers to roman is particularly tedious because there is no block If construction in Applesoft Basic.

The program has to scale the plot to fit the 280 by 192 points of the high-resolution screen and centre it. The origin, co-ordinates 0,0, is at the top left-hand corner instead of the conventional bottom left-hand corner of the screen. HGR, line 550 sets the graphics mode, but leaves four lines of text at the bottom for input data. The points are plotted by line 570 and labelled by line 590; the connections between the points are plotted by line 690.

The Pokes on line 670 reset the graphics mode without clearing the screen, which HGR would do, to enable the connections to be replotted if an input data error has been noticed. The new positions for the vibrations are calculated by lines 880 to 890.

The Poke on line 850 removes the four text lines at the bottom of the screen to make room for the movements. The screen is also cleared by the Call on the same line to remove the labels. Line 1040's Peek command checks whether a key has been depressed so that a new vibrational mode may be input or the program ended.

(listing continued from previous page)

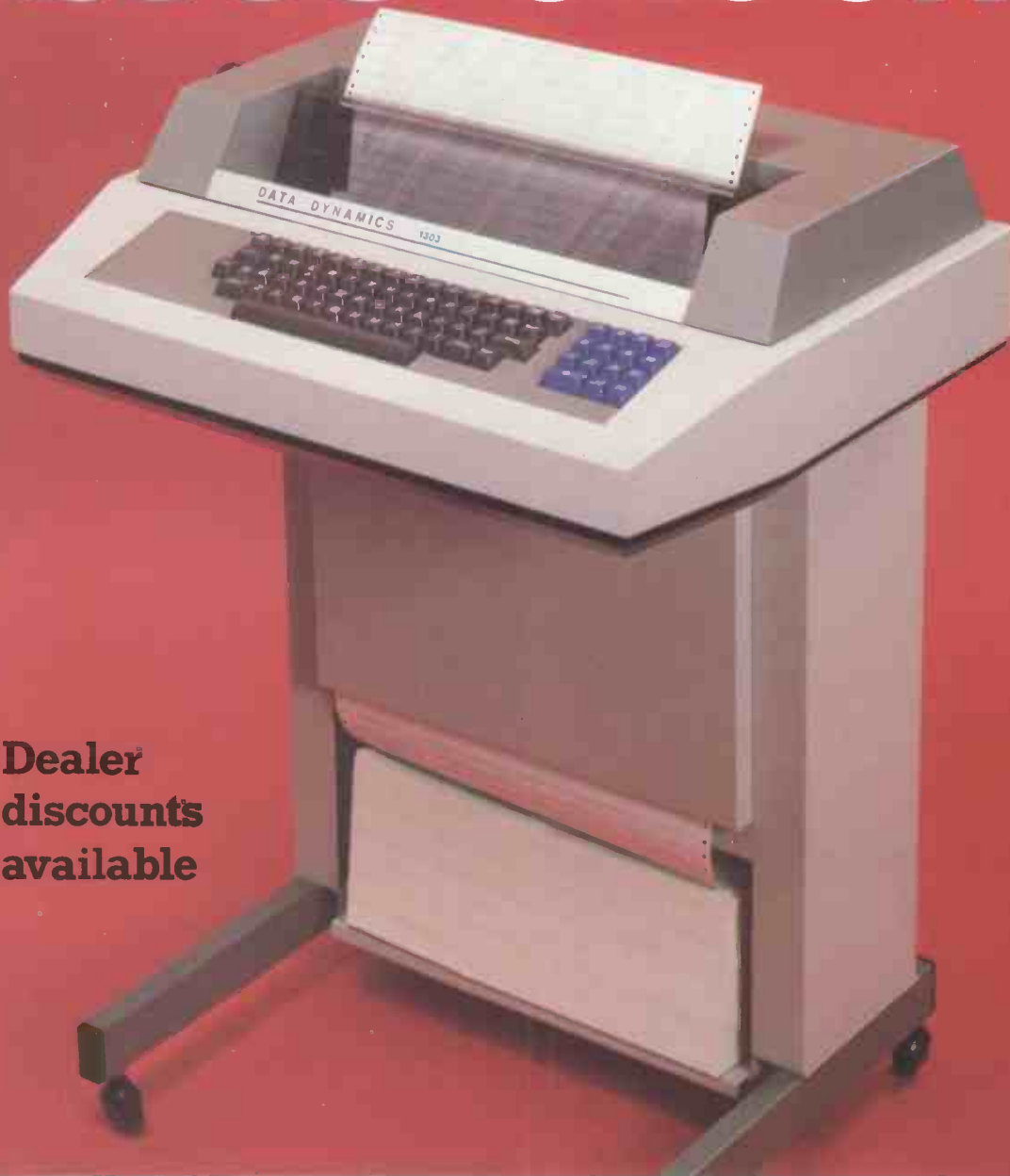
```

790 REM
800 PRINT "TYPE IN THE X,Y VIBRATIONAL AMPLITUDES OF ALL THE ATOMS IN ORDER"
810 REM INPUT AND SCALE VIBRATIONS
820 FOR I = 0 TO J: INPUT VX(I),VY(I):VY(I) = - VY(I)
830 VX(I) = SC * VX(I) / P:VY(I) = SC * VY(I) / P
840 NEXT I
850 CALL 62450: POKE 49234,0: REM CLEAR SCREEN, FULL SCREEN GRAPHICS PAGE 1
860 REM CALCULATE NEW POSITION IN THE VIBRATION
870 FOR I = 0 TO J
880 NX(I) = INT (BX(I) + VX(I))
890 NY(I) = INT (BY(I) + VY(I))
900 NEXT
910 REM PLOT NEW POSITIONS, UNPLOT OLD
920 FOR I = 0 TO K
930 HCOLOR= 0
940 HPLLOT XX(N(I)),YY(N(I)) TO XX(M(I)),YY(M(I))
950 HCOLOR= 7: HPLLOT NX(N(I)),NY(N(I)) TO NX(M(I)),NY(M(I))
960 NEXT
970 FOR I = 0 TO J:XX(I) = NX(I):YY(I) = NY(I): NEXT : REM NEW POSN. = 0 LD
980 FOR I = 0 TO J
990 BX(I) = BX(I) + VX(I):BY(I) = BY(I) + VY(I)
1000 NEXT
1010 REM INCREMENT M, THE VIBRATION PROGRESS COUNTER
1020 M = M + 0: IF M = R + 0 THEN 1080
1030 REM MOTION NOW REVERSED
1040 Z = PEEK ( - 16384): REM KEYBOARD STROBE
1050 IF Z > 127 THEN POKE - 16301,0:: GOTO 710: REM NOW TEXT PLUS GRAPHICS
1060 GOTO 870
1070 REM REVERSE DIRECTION OF VIBRATIONS
1080 FOR I = 0 TO J
1090 VX(I) = - VX(I)
1100 VY(I) = - VY(I)
1110 NEXT I
1120 M = - R + 0: GOTO 870
1130 REM ** ROMAN NUMERALS ARE POSITIONED AT THE PLOTTED POSITIONS XX(I) AND YY(I); DRAW 1,2,OR 3 PLACES AN I,V OR X IN ITS APPROPRIATE POSITION **
1140 ROT= 0: SCALE= 1: HCOLOR= 7
1150 POKE 232,0: POKE 233,0:ADR = 768
1160 FOR I = 1 TO 25: READ A(I): POKE ADR,A(I):ADR = ADR + 1: NEXT I
1170 REM ** SHAPE TABLES LOADED AT ADDRESS $300 (768); THIS ADDRESS LOADED INTO $E8 AND $E9 (232 AND 233) ; DATA FOR SHAPE TABLE AT END OF PROGRAM **
1180 FOR I = 0 TO J
1190 II = I + 1
1200 IF II > 9 THEN GOSUB 1330: REM DRAW THE TENS BEFORE UNITS
**
1210 IF II < 5 THEN DRAW 1 AT XX(I),YY(I)
1220 IF II = 2 THEN DRAW 1 AT (XX(I) + 2),YY(I)
1230 IF II = 3 THEN DRAW 1 AT (XX(I) + 2),YY(I): DRAW 1 AT (XX(I) + 4),YY(I)
1240 IF II = 4 THEN DRAW 2 AT (XX(I) + 4),YY(I)
1250 IF II > 4 THEN DRAW 2 AT (XX(I) - 3),YY(I)
1260 IF II = 7 THEN DRAW 1 AT (XX(I) + 2),YY(I)
1270 IF II = 8 THEN DRAW 1 AT (XX(I) + 2),YY(I): DRAW 1 AT (XX(I) + 4),YY(I)
1280 IF II = 9 THEN XDRAW 1 AT XX(I),YY(I)
1290 IF II = 9 THEN XDRAW 2 AT (XX(I) - 3),YY(I): DRAW 1 AT (XX(I) - 3),YY(I): DRAW 3 AT (XX(I) + 1),YY(I)
1300 NEXT I
1310 RETURN
1320 REM **NOW DRAW XXX'S-TENS**
1330 IF II > 14 THEN 1350
1340 DRAW 3 AT (XX(I) - 4),YY(I)
1350 IF II > 14 THEN DRAW 3 AT (XX(I) - 7),YY(I)
1360 IF II > 24 THEN DRAW 3 AT (XX(I) - 10),YY(I)
1370 IF II > 34 THEN DRAW 3 AT (XX(I) - 13),YY(I)
1380 REM POINTS HIGHER THAN NUMBER 44 ALL HAVE XXXIV DRAWN NEXT TO THEM
1390 REM **ROUTINE TO PLOT THE UNITS PART OF NUMBERS > 10 **
1400 II$ = STR$ (II)
1410 II$ = RIGHT$ (II$,1)
1420 II = VAL (II$)
1430 RETURN
1440 DATA 3,0,8,0,14,0,20,0
1450 DATA 58,55,41,58,63,0
1460 DATA 58,51,13,30,31,0
1470 DATA 58,51,41,58,59,0

```

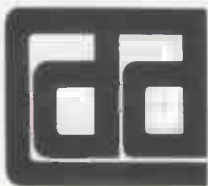


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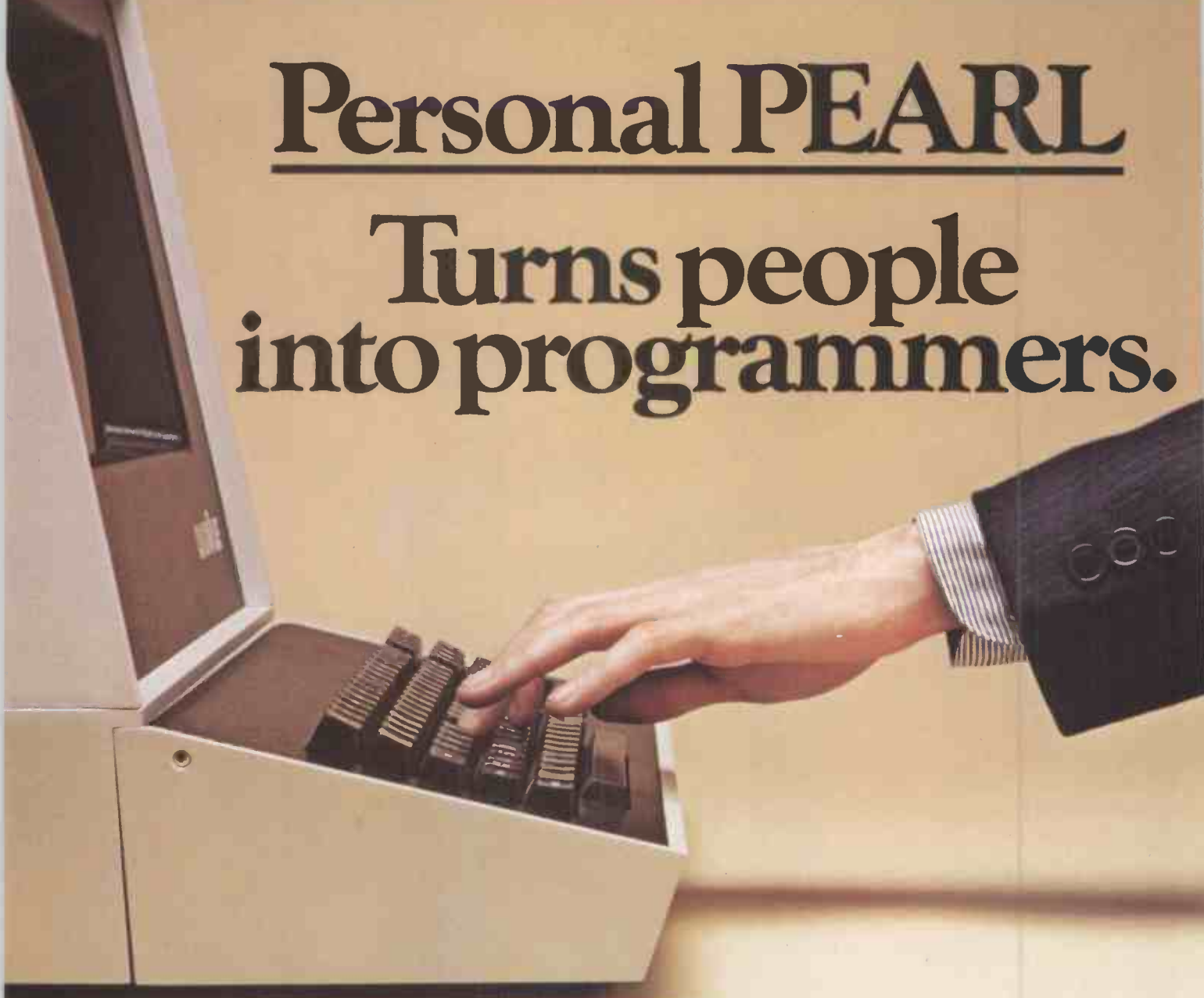
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# Fourier transforms

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	
! BUT	! SMPL	! INPUT	! DATA	! TWIDDLE	! FACTORS	! PASS	! TWIDDLE	! FACTORS	! PASS	! TWIDDLE	! FACTORS	! PASS	! TWIDDLE	! FACTORS	! PASS	! TWIDDLE	! FACTORS	! PASS	! TWIDDLE	! FACTORS	! DATA	REAL INPUT	MODULUS OUT	
NO	NO	2.2	1	1	2	2	3	3	4	4	4	4	4	4	4	4	4	4	4	4	4	0	0	
		! REAL	! IMAG	! REAL	! IMAG	! REAL	! IMAG	! REAL	! IMAG	! REAL	! IMAG	! REAL	! IMAG	! REAL	! IMAG	! REAL	! IMAG	! REAL	! IMAG	! REAL	! IMAG	REAL	IMAG	
0	0	1	0	1	0	1.81	0	1	0	2.70	0	1	0	.752	0	1	0	1.38	0	1.38	0	*****	**	
	1	.649	0			.191	0			3.35	0			-.21	0			.126	0	1.66	.482	*****	***	
1	2	-.16	0	.924	-.38	.728	0	1	0	.191	.363	1	0	3.35	2.21	1	0	-.21	-.53	6.62	4.24	*****	*****	
	3	-.85	0			.528	-.22			.191	-.36			3.35	-2.2			-.21	.532	-1.0	-1.2	**	**	
2	4	-.95	0	.707	-.71	-.06	0	.707	-.71	.579	0	1	0	.889	.283	1	0	6.62	4.24	-.21	-.53	*	**	
	5	-.38	0			.389	-.39			.620	-.62			-.51	.444			.079	.180	)))	-.31	*****	*	
3	6	.454	0	.383	-.92	-1.8	0	.707	-.71	.763	.351	1	0	-.51	-.44	1	0	.079	-.18	.079	-.18	*****	*	
	7	.972	0			.055	-.13			-.35	-.76			.889	-.28			6.62	-4.2	.116	)))	*****	*	
4	8	.889	0	0	-1	-1.5	0	0	-1	.481	0	0	0	-1	.625	0	1	0	1.66	.482	.126	0	*****	*
	9	.078	0			0	.363			0	2.21			0	-.53			.116	.084	.116	.084	*****	*	
5	10	-.71	0	-.38	-.92	-.15	0	0	-1	.698	)))	0	-1	3.27	2.03	1	0	)))	-.31	.079	.180	***	*	
	11	-1.	0			.236	.569			-.70	)))			-3.3	2.03			-1.0	1.20	)))	.309	*	*	
6	12	-.59	0	-.71	-.71	1.34	0	-.71	-.71	.047	0	0	-1	.774	.199	1	0	-1.0	-1.2	-.21	.532	***	**	
	13	.233	0			.309	.309			2.65	2.65			.503	-.75			)))	.309	-1.0	1.20	*****	***	
7	14	.891	0	-.92	-.38	1.90	0	-.71	-.71	.010	-.15	0	-1	-.50	-.75	1	0	.116	)))	6.62	-4.2	*****	*****	
	15	.924	0			)))	)))			-.15	.010			-.77	.199			1.66	-.48	1.66	-.48	*****	***	

Figure 1.

## with VisiCalc

Figure 2.

)A1: /-	)B1: /-	)C1: /-	)D1: /-
)A2: *	)B2: *	)C2: /FR* IN	)D2: *PUT
)A3: *!BUT	)B3: *!SMPL	)C3: /FR* D	)D3: *ATA
)A4: *! NO	)B4: *! NO	)C4: 2.2	
)A5: *	)B5: *	)C5: /FR* REAL	)D5: /FR* IMAG
)A6: *!---	)B6: *!---	)C6: *!---	)D6: /-
)A7: 0	)B7: 0	)C7: =COS(2*PI*B7*C4/16	)D7: 0
	)B8: 1	)C8: =COS(2*PI*B8*C4/16	)D8: 0
)A9: 1	)B9: 2	)C9: =COS(2*PI*B9*C4/16	)D9: 0
	)B10: 3	)C10: =COS(2*PI*B10*C4/16	)D10: 0
)A11: 2	)B11: 4	)C11: =COS(2*PI*B11*C4/16	)D11: 0
	)B12: 5	)C12: =COS(2*PI*B12*C4/16	)D12: 0
)A13: 3	)B13: 6	)C13: =COS(2*PI*B13*C4/16	)D13: 0
	)B14: 7	)C14: =COS(2*PI*B14*C4/16	)D14: 0
)A15: 4	)B15: 8	)C15: =COS(2*PI*B15*C4/16	)D15: 0
	)B16: 9	)C16: =COS(2*PI*B16*C4/16	)D16: 0
)A17: 5	)B17: 10	)C17: =COS(2*PI*B17*C4/16	)D17: 0
	)B18: 11	)C18: =COS(2*PI*B18*C4/16	)D18: 0
)A19: 6	)B19: 12	)C19: =COS(2*PI*B19*C4/16	)D19: 0
	)B20: 13	)C20: =COS(2*PI*B20*C4/16	)D20: 0
)A21: 7	)B21: 14	)C21: =COS(2*PI*B21*C4/16	)D21: 0
	)B22: 15	)C22: =COS(2*PI*B22*C4/16	)D22: 0

(figure 2 continued on next page)

Though best known for its business applications, VisiCalc also incorporates some built-in scientific functions. Jonathan Read used it to do a discrete Fourier transform.

THE MATHEMATICS of the Fourier transform has been known for well over a century. Yet the enormous number of calculations it requires meant that it could not be applied to practical problems until a much more efficient fast Fourier transfer, FFT, method of calculation was discovered in the 1960s.

The Fourier transform examines data supplied to it to discover if it contains any repetitions. The output shows the frequency of any repetitions which are found. The technique can be used to extract a weak signal from background noise or in any other application where a repeating pattern has to be picked out from a random background.

The problem in implementing an FFT is that the procedure is at first sight rather complicated. The FFT consists of many smaller calculations, called butterflies,

(continued on next page)

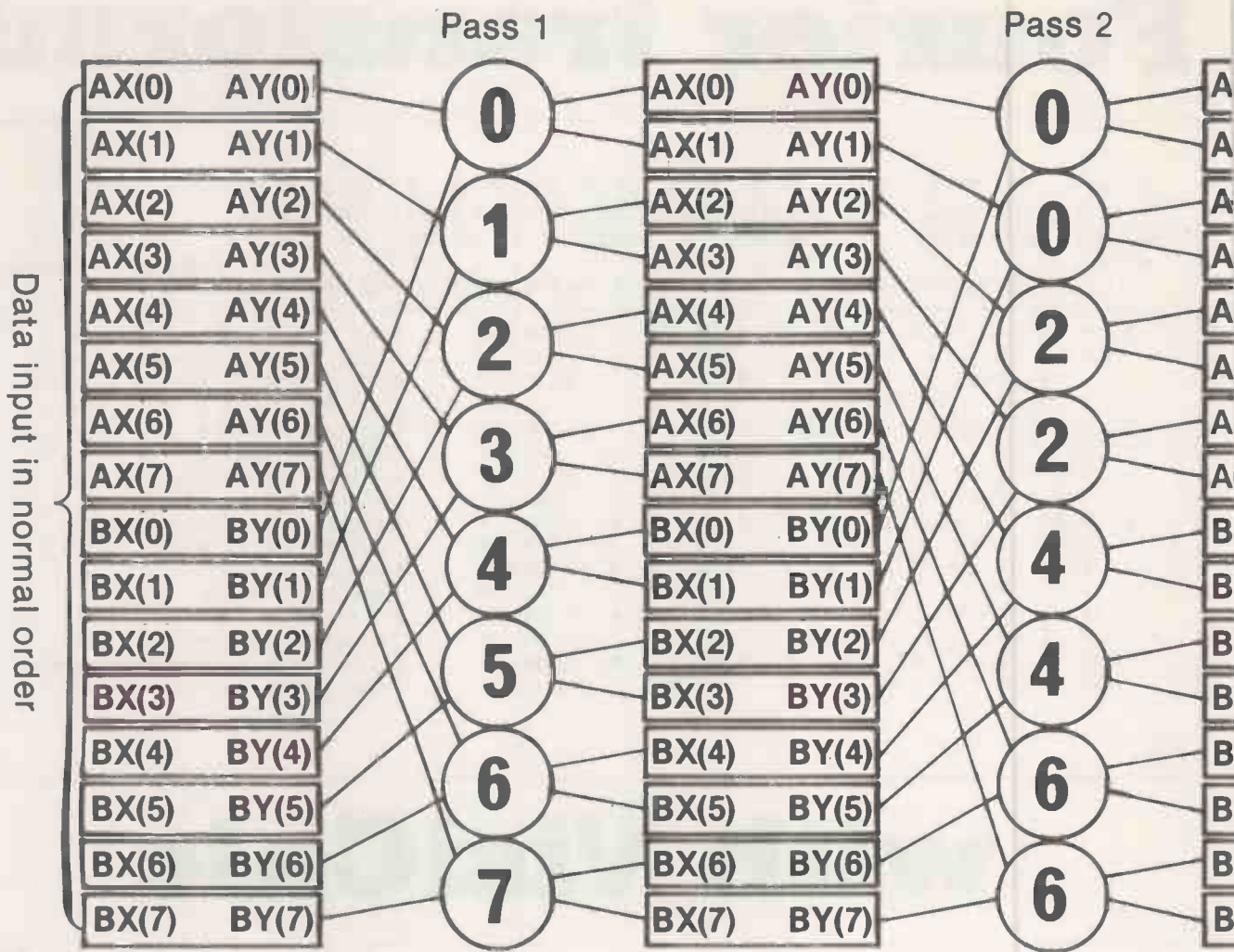


Figure 3.

(continued from previous page)

which are represented by the circles in figure 3. Any attempt to implement the diagram as a Basic program results in triple nested For-Next loops, and it is difficult to unscramble the answer at the end.

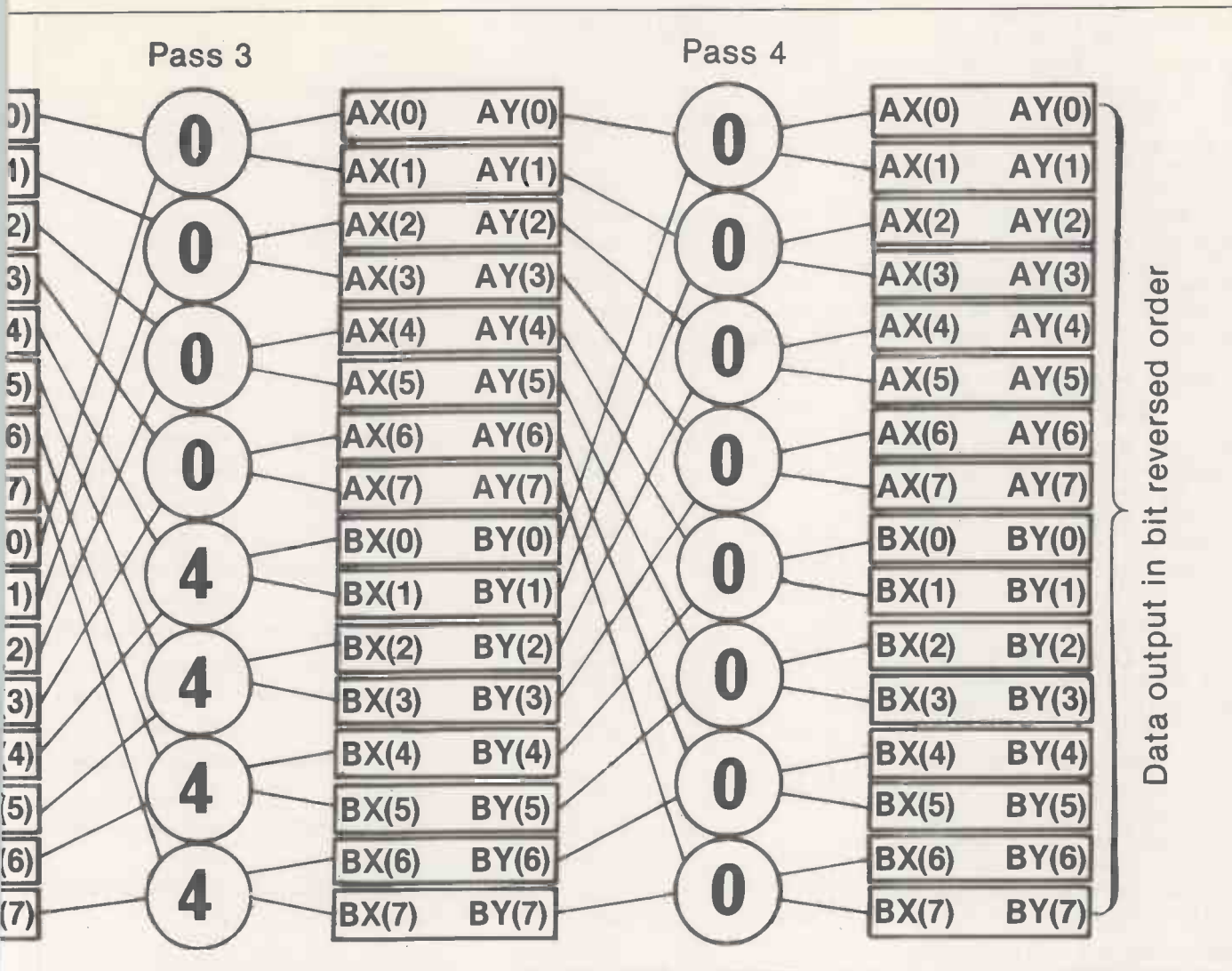
By contrast, it is relatively easy to set up an FFT on VisiCalc in such a way that you can see what is going on. Of the many types of FFT the Radix 2, constant-geometry Dif FFT was chosen for implementation. The constant geometry can be easily reproduced with VisiCalc's Replicate command once the first column of butterflies has been set up. Dif has the advantage over Dit in this case because it can be expressed as VisiCalc formulae with fewer brackets.

The equations of a butterfly are shown in figure 4. The butterfly works on complex numbers, while VisiCalc only has real arithmetic, so the calculation must be expanded into its real and imaginary parts. Two VisiCalc locations are used to hold one complex number. You must then convert the equations into VisiCalc formulae; VisiCalc works like a four-function calculator, and does not recognise algebraic hierarchy. The coeffi-

(figure 2 continued from previous page)

)R23:=""	)B23:=""	)C23:=""	)D23:=""
)E1:=""	)F1:=""	)G1:=""	)H1:=""
)E2:=""	)F2:=""	)G2:=""	)H2:=""
)E3:=""	)F3:=""	)G3:=""	)H3:=""
)EA:=""	)FA:=""	)GA:=""	)HA:=""
)ES:=""	)FS:=""	)GS:=""	)HS:=""
)EE:=""	)FE:=""	)GE:=""	)HE:=""
)E7:=""	)F7:=""	)G7:=""	)H7:=""
)E9:=""	)F9:=""	)G9:=""	)H9:=""
)E11:=""	)F11:=""	)G11:=""	)H11:=""
)E13:=""	)F13:=""	)G13:=""	)H13:=""
)E15:=""	)F15:=""	)G15:=""	)H15:=""
)E17:=""	)F17:=""	)G17:=""	)H17:=""
)E19:=""	)F19:=""	)G19:=""	)H19:=""
)G23:=""	)B23:=""	)C23:=""	)D23:=""
)G1:=""	)F1:=""	)G1:=""	)H1:=""
)G2:=""	)F2:=""	)G2:=""	)H2:=""
)G3:=""	)F3:=""	)G3:=""	)H3:=""
)G4:=""	)F4:=""	)G4:=""	)H4:=""
)G5:=""	)F5:=""	)G5:=""	)H5:=""
)G6:=""	)F6:=""	)G6:=""	)H6:=""
)G7:=""	)F7:=""	)G7:=""	)H7:=""
)G8:=""	)F8:=""	)G8:=""	)H8:=""
)G9:=""	)F9:=""	)G9:=""	)H9:=""
)G10:=""	)F10:=""	)G10:=""	)H10:=""
)G11:=""	)F11:=""	)G11:=""	)H11:=""
)G12:=""	)F12:=""	)G12:=""	)H12:=""
)G13:=""	)F13:=""	)G13:=""	)H13:=""
)G14:=""	)F14:=""	)G14:=""	)H14:=""
)G15:=""	)F15:=""	)G15:=""	)H15:=""
)G16:=""	)F16:=""	)G16:=""	)H16:=""
)G17:=""	)F17:=""	)G17:=""	)H17:=""
)G18:=""	)F18:=""	)G18:=""	)H18:=""
)G19:=""	)F19:=""	)G19:=""	)H19:=""
)G20:=""	)F20:=""	)G20:=""	)H20:=""
)G21:=""	)F21:=""	)G21:=""	)H21:=""
)G22:=""	)F22:=""	)G22:=""	)H22:=""
)G23:=""	)F23:=""	)G23:=""	)H23:=""





>E21:--.923879532573	>F21:--.382683432483	>G21:+C14+C22	>H21:+D14+D22
>E23:*/--	>F23:/*--	>G23:*/--	>H23:/*--
>I11:/*--	>J11:/*--	>K11:/*--	>L11:/*--
>I2:*/TWI	>J2:*/DDE	>K2:*/PA	>L2:*/SS
>I3:*/FAC	>J3:*/TORS	>K3:*/	>L3:*/2
>I4:*/	>J4:*/2	>K4:*/	
>I5:*/FR*REAL	>J5:*/FR*IMAG	>K5:*/FR*REAL	>L5:*/FR*IMAG
>I6:*/--	>J6:/*--	>K6:*/--	>L6:/*--
>I7:1	>J7:0	>K7:+G7+G15	>L7:+H7+H15
>I9:1	>J9:0	>K8:+G7-G15+I7-(H7-H15+J7	>L8:+G7-G15+J7+(H7-H15+I7
>I11:787186781249	>J11:--.787186781249	>K9:+G8+G16	>L9:+H8+H16
>I13:787186781249	>J13:--.787186781249	>K10:+G8-G16+I9-(H8-H16+J9	>L10:+G8-G16+J9+(H8-H16+I9
>I15:0	>J15:-1	>K11:+G9+G17	>L11:+H9+H17
>I17:0	>J17:-1	>K12:+G9-G17+I11-(H9-H17+J11	>L12:+G9-G17+J11+(H9-H17+I11
		>K13:+G10+G18	>L13:+H10+H18
		>K14:+G10-G18+I13-(H10-H18+J13	>L14:+G10-G18+J13+(H10-H18+I13
		>K15:+G11+G19	>L15:+H11+H19
		>K16:+G11-G19+I15-(H11-H19+J15	>L16:+G11-G19+J15+(H11-H19+I15
		>K17:+G12+G20	>L17:+H12+H20
		>K18:+G12-G20+I17-(H12-H20+J17	>L18:+G12-G20+J17+(H12-H20+I17

(figure 2 continued on next page)

coefficients appearing in the butterfly, known as "twiddle factors", are also stored in two VisiCalc locations since they too are complex numbers.

The complete set of formulae for 16-point FFT is given in figures 1 and 2. They assume that VisiCalc is in its Column First calculating mode — the default after booting VisiCalc. You can save yourself some work when entering them by using the Replicate command. First set the column width to 5 with /GC5.

Then set up the titles and the underlining at the bottom. After entering columns A and B, carefully set up column G. Replicate column G to column K with /R G7...G22:K7...K7 all terms relative. Replicate column K to column O with /R K7...K22:O7...O7 all terms relative. Replicate column O to column S with /RO7...O22:S7...S7 all terms relative.

Then set up column H and replicate it in a similar way on to columns L, P, and T.

Now set up twiddle factors 1 by first entering the formulae  
(continued on next page)

(continued from previous page)

@COS(2\*@PI\*A7\*16)

in position E7. Then give the following

Replicate commands:

```
/R E7 . . E8:E9
/R E7 . . E10:E11
/R E7 . . E14:E15
```

All terms are relative in each case. This fills up the E column with twiddle factors. VisiCalc will run very slowly so set the automatic recalculation mode to manual with /GRM. You must now go through the twiddle factors using the # command to replace each formula with its actual constant value, otherwise the FFT will be very slow.

Now set up the column F. put

@ SIN(-2\*@PI\*A7/16)

in position F7, and replicate it down the column F. Using similar method to that used for column E. Now use # on the entries in column F as you did with column E.

Columns I and J — twiddle factors 2 — are set up in a similar way. Put

@COS(2\*@PI\*INT(A7/2)/8)

at position I7 and replicate it down column I using the /RE7 commands with I instead of E. then use the # command as before. Put

@SIN(-2\*@PI\*INT(A7/2)/8)

at position J7 and replicate it down column J using the /RE7 commands again. with J instead of E. Then use the # command as before.

Set up column M by putting 1 at position M7. then use

```
/R M7 . . M8:M9 . . M9
/R M7 . . M10:M11 . . M11
Now put 0 at M15 and then use
/R M15 . . M16:17 . . M17
/R M15 . . M18:M19 . . M19
```

Column N is done in a similar way, but 0 is put at N7 and -1 at M15. Column Q is done by putting a 1 at Q7 and then using the /RE7 commands, with E replaced by Q. Column R is done by putting an 0 at R7 and then the /RE7 commands, with E replaced by R.

Columns U and V unscramble the results of the transform. There is no obvious short way of entering column U, but once you have entered it you can replicate it on to column V with

```
/R U7 . . U22:V7 . . V7
```

which is also a relative replication.

The column W displays the real part of the input and X displays the modulus of the output, both in bar-chart form. They are easily set up with the Replicate command.

To test the FFT, replicate the formulae

@COS(2\*@PI\*B7\*C4/16)

down column C in positions C7 to C22; B7 is relative, C4 is "no change". The resulting input to the FFT a sinusoid whose frequency is selected by the number at C4. Now put 0 in positions D7 to D22, so that the input to the FFT is wholly real.

(continued on page 125)

(figure 2 continued from previous page)

>I19:-.787186781249	>J19:-.787186781249	>K19:+G13+G21	>L19:+H13+H21
>I21:-.787186781249	>J21:-.787186781249	>K20:+G13-G21+I19-(H13-H21)*J19	>L20:+G13-G21+J19+(H13-H21)*I19
>I23:!*-----	>J23:!--	>K21:+G14+G22	>L21:+H14+H22
>I23:!*-----	>J23:!--	>K22:+G14-G22+I21-(H14-H22)*J21	>L22:+G14-G22+J21+(H14-H22)*I21
>M1:!--	>N1:!--	>O1:!--	>P1:!--
>M2:!* TWI	>N2:*DDLE	>O2:!* PA	>P2:*SS
>M3:!* FAC	>N3:*TORS	>O3:!* PA	>P3:*S
>M4:!*-----	>N4:*S	>O4:!*-----	>P4:!*-----
>M5:/FR!*REAL	>N5:/FR!*IMAG	>O5:/FR!*REAL	>P5:/FR!*IMAG
>M6:!*-----	>N6:!--	>O6:!*-----	>P6:!--
>M7:1	>N7:0	>O7:+K7+K15	>P7:+L7+L15
>M8:1	>N8:0	>O8:+K7-K15+M7-(L7-L15)*N7	>P8:+K7-K15+M7+(L7-L15)*N7
>M9:1	>N9:0	>O9:+K8+K16	>P9:+L8+L16
>M10:1	>N10:0	>O10:+K8-K16+M9-(L8-L16)*N9	>P10:+K8-K16+M9+(L8-L16)*N9
>M11:1	>N11:0	>O11:+K9+K17	>P11:+L9+L17
>M12:1	>N12:0	>O12:+K9-K17+M11-(L9-L17)*N11	>P12:+K9-K17+M11+(L9-L17)*N11
>M13:1	>N13:0	>O13:+K10+K18	>P13:+L10+L18
>M14:1	>N14:0	>O14:+K10-K18+M13-(L10-L18)*N13	>P14:+K10-K18+M13+(L10-L18)*N13
>M15:0	>N15:-1	>O15:+K11+K19	>P15:+L11+L19
>M16:0	>N16:-1	>O16:+K11-K19+M15-(L11-L19)*N15	>P16:+K11-K19+M15+(L11-L19)*N15
>M17:0	>N17:-1	>O17:+K12+K20	>P17:+L12+L20
>M18:0	>N18:-1	>O18:+K12-K20+M17-(L12-L20)*N17	>P18:+K12-K20+M17+(L12-L20)*N17
>M19:0	>N19:-1	>O19:+K13+K21	>P19:+L13+L21
>M20:0	>N20:-1	>O20:+K13-K21+M19-(L13-L21)*N19	>P20:+K13-K21+M19+(L13-L21)*N19
>M21:0	>N21:-1	>O21:+K14+K22	>P21:+L14+L22
>M22:0	>N22:-1	>O22:+K14-K22+M21-(L14-L22)*N21	>P22:+K14-K22+M21+(L14-L22)*N21
>M23:!*-----	>N23:!--	>O23:!*-----	>P23:!--
>Q1:!--	>R1:!--	>S1:!--	>T1:!--
>Q2:!* TWI	>R2:*DDLE	>S2:!* PA	>T2:*SS
>Q3:!* FAC	>R3:*TORS	>S3:!* PA	>T3:*S
>Q4:!*-----	>R4:*S	>S4:!*-----	>T4:!*-----
>Q5:/FR!*REAL	>R5:/FR!*IMAG	>S5:/FR!*REAL	>T5:/FR!*IMAG
>Q6:!*-----	>R6:!--	>S6:!*-----	>T6:!--
>Q7:1	>R7:0	>S7:+O7+O15	>T7:+P7+P15
>Q8:1	>R8:0	>S8:+O7-O15+O7-(P7-P15)*R7	>T8:+O7-O15+R7+(P7-P15)*O7
>Q9:1	>R9:0	>S9:+O8+O16	>T9:+P8+P16
>Q10:1	>R10:0	>S10:+O8-O16+O9-(P8-P16)*R9	>T10:+O8-O16+R9+(P8-P16)*O9
>Q11:1	>R11:0	>S11:+O9+O17	>T11:+P9+P17
>Q12:1	>R12:0	>S12:+O9-O17+O11-(P9-P17)*R11	>T12:+O9-O17+R11+(P9-P17)*O11
>Q13:1	>R13:0	>S13:+O10+O18	>T13:+P10+P18
>Q14:1	>R14:0	>S14:+O10-O18+O13-(P10-P18)*R13	>T14:+O10-O18+R13+(P10-P18)*O13
>Q15:1	>R15:0	>S15:+O11+O19	>T15:+P11+P19
>Q16:1	>R16:0	>S16:+O11-O19+O15-(P11-P19)*R15	>T16:+O11-O19+R15+(P11-P19)*O15
>Q17:1	>R17:0	>S17:+O12+O20	>T17:+P12+P20
>Q18:1	>R18:0	>S18:+O12-O20+O17-(P12-P20)*R17	>T18:+O12-O20+R17+(P12-P20)*O17
>Q19:1	>R19:0	>S19:+O13+O21	>T19:+P13+P21
>Q20:1	>R20:0	>S20:+O13-O21+O19-(P13-P21)*R19	>T20:+O13-O21+R19+(P13-P21)*O19
>Q21:1	>R21:0	>S21:+O14+O22	>T21:+P14+P22
>Q22:1	>R22:0	>S22:+O14-O22+O21-(P14-P22)*R21	>T22:+O14-O22+R21+(P14-P22)*O21
>Q23:!*-----	>R23:!--	>S23:!*-----	>T23:!--

(figure 2 continued on page 125)



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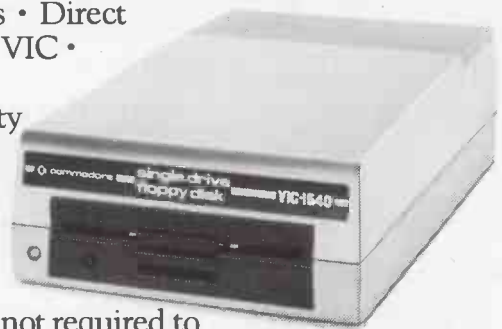
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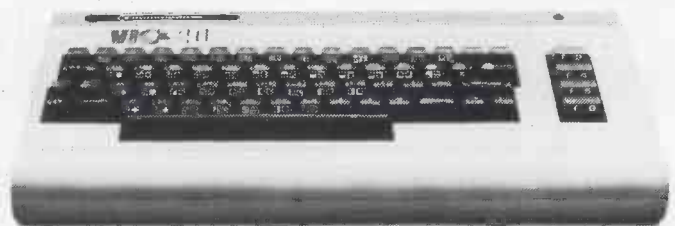


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(figure 2 continued from page 120)

)U14:--	)V1:--	)W4:* REAL INPUT	)X44* MODULUS OUT
)U2:*! OUT	)V2:*PUT	)W5:/F9	)X5:/F9
)U3:*! DA	)V3:*TA	)W6:* --- 0 ---	)X6:/F0* 0 ---
)U4:*!			
)U5:/FR*!REAL	)V5:/FR*!MAG	)W7:/F+6+C7+7.5	)X7:/F+1.5+ESDRT(U7+U7*(V7+V7
)U6:*! ---	)V6:/--	)W8:/F+6+C8+7.5	)X8:/F+1.5+ESDRT(U8+U8*(V8+V8
)U74+S7	)V7:*T7	)W9:/F+6+C9+7.5	)X9:/F+1.5+ESDRT(U9+U9*(V9+V9
)UB:+S15	)VB:*T15	)W10:/F+6+C10+7.5	)X10:/F+1.5+ESDRT(U10+U10*(V10+V10
)U9:+S11	)V9:*T11	)W11:/F+6+C11+7.5	)X11:/F+1.5+ESDRT(U11+U11*(V11+V11
)U10:+S19	)V10:*T19	)W12:/F+6+C12+7.5	)X12:/F+1.5+ESDRT(U12+U12*(V12+V12
)U11:+S9	)V11:*T9	)W13:/F+6+C13+7.5	)X13:/F+1.5+ESDRT(U13+U13*(V13+V13
)U12:+S17	)V12:*T17	)W14:/F+6+C14+7.5	)X14:/F+1.5+ESDRT(U14+U14*(V14+V14
)U13:+S13	)V13:*T13	)W15:/F+6+C15+7.5	)X15:/F+1.5+ESDRT(U15+U15*(V15+V15
)U14:+S21	)V14:*T21	)W16:/F+6+C16+7.5	)X16:/F+1.5+ESDRT(U16+U16*(V16+V16
)U15:+S8	)V15:*T8	)W17:/F+6+C17+7.5	)X17:/F+1.5+ESDRT(U17+U17*(V17+V17
)U16:+S16	)V16:*T16	)W18:/F+6+C18+7.5	)X18:/F+1.5+ESDRT(U18+U18*(V18+V18
)U17:+S12	)V17:*T12	)W19:/F+6+C19+7.5	)X19:/F+1.5+ESDRT(U19+U19*(V19+V19
)U18:+S20	)V18:*T20	)W20:/F+6+C20+7.5	)X20:/F+1.5+ESDRT(U20+U20*(V20+V20
)U19:+S10	)V19:*T10	)W21:/F+6+C21+7.5	)X21:/F+1.5+ESDRT(U21+U21*(V21+V21
)U20:+S18	)V20:*T18	)W22:/F+6+C22+7.5	)X22:/F+1.5+ESDRT(U22+U22*(V22+V22
)U21:+S14	)V21:*T14	)W23:* --- 0 ---	)X231/F0* 0 ---
)U22:+S22	)V22:*T22		
)U23:*! ---	)V23:/--		

Figure 4.

The butterfly performs the calculation, written in complex number form

$$A' = A + B$$

$$B' = (A - B)W$$

where

$$W = \text{Exp}(-2\pi iN/16)$$

Let the real part of W be WX, and the imaginary part WY then the above equations become

$$A'X = AX + BX$$

$$B'X = (AX - BX)WX - (AY - BY)WY$$

$$A'Y = AY + BY$$

$$B'Y = (AX - BX)WY + (AY - BY)WX$$

Expressed as VisiCalc formulae you obtain

$$A'X = AX + BX$$

$$B'X + AX - BX * WX - (AY - BY * WY$$

$$A'Y = AY + BY$$

$$B'Y = AX - BX * WY + (AY - BY * WX$$

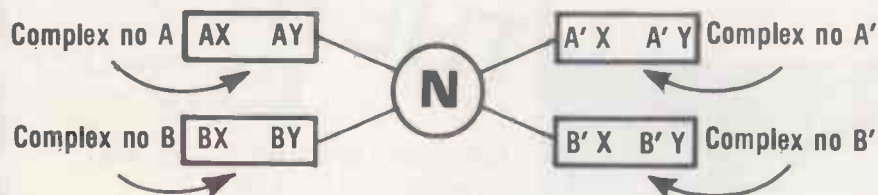
Closing brackets are not required by VisiCalc.

### File-generator program.

!!LIST

```

10 REM (C) J. M. READ 1982
20 REM
80 DIM X(15), Y(15)
90 D$ = CHR$(4)
100 FOR I = 0 TO 15
110 X(I) = I / 10
120 Y(I) = (15 - I) / 10
130 NEXT I
200 INPUT "ENTER NAME OF OUTPUT FILE : "; N$
210 PRINT D$; "OPEN"; N$
220 PRINT D$; "DELETE"; N$
230 PRINT D$; "OPEN"; N$
240 PRINT D$; "WRITE"; N$
300 FOR I = 0 TO 15
310 PRINT "C"; I + 7; " "; X(I)
320 PRINT "D"; I + 7; " "; Y(I)
330 NEXT I
340 PRINT "/X)C7"
350 PRINT D$; "CLOSE"
    
```



(continued from page 120)

Now force a recalculation with ! and after several seconds you should see 16 in position S7 and 0 in positions S8 to S22 and T7 to T22; because the input is constant the energy is at zero frequency.

To view the output graphically set up a second window as follows:

Scroll the screen so the column C is at the left. Move to column D, without scrolling the screen.

Set up a vertical window with /VW.

Scroll screen so that column W is at the left-hand side of the second window.

Set the column width in the second window to 14 with

/GC14.

Set synchronised scrolling in both windows with

/WS.

Go back to the first window with

;

Go to location C4 with

>C4

Set the recalculations mode to automatic with /GRM

You can now try integer values of frequency between 1 and 7 inclusive in position C4. Recalculating column C takes several seconds, but the actual FFT should take about three seconds. Displaying the results takes a long time because square roots are very slow on VisiCalc. Two bars, each of height 8, should move symmetrically towards the centre as you increase the input frequency. If you put in a non-integral frequency the base of the bars spreads out.

This effect can be reduced by windowing the input data. Use the /CI command to insert a column of window coefficients, and modify the first pass of the FFT accordingly. The program listing shows how a version 1.5 VisiCalc compatible file can be produced by a Basic program. To load the data file produced by this program on to the VisiCalc worksheet first blank out columns C7 to C22 and D7 to D22 then, load the file you have created with /SC command.

The main limitation of the VisiCalc FFT is that it can only handle a 32-point transform on a 48K Apple, whereas a Basic program would handle 2K points. Provided all the twiddle factors are replaced by their constant values the VisiCalc FFT is fast, but this is offset by the long time taken to compute the modulus of the result. Another shortcoming of the VisiCalc version is its inability to produce a four-quadrant phase output, while the Basic program could do this.

The compensating advantages of VisiCalc are that it is set up in a way that corresponds to the network diagram of an FFT, and the input can easily be altered to study the effect of a particular change on the output. VisiCalc makes it easier to see what calculations need to be done compared with a Basic program or a mathematical derivation of the FFT. To get the best from VisiCalc you should set up the formulae yourself, rather than use a worksheet entered by someone else. □

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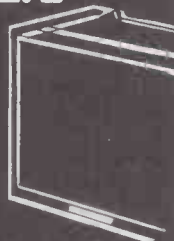
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# DEATH BY FEAR

"But it's not going to happen like that. Is it?" Clark was obviously not convinced by Chapman's argument. He took another sip at his coffee and grimaced as it was still too hot. "You are saying that one morning some researcher is going to switch on his terminal and be confronted with a machine that has turned UIM overnight. Eureka, this is it, Nobel prize, made for life, etc., etc."

"No, that is not it at all", Chapman protested. "All I am saying is that when ultra-intelligence comes, it will be through some breakthrough and not through a process of gradual improvement."

"Sorry, I don't see it. It runs against everything we have seen so far. I mean look at the early seventies; Eliza and conversational programs came first, graduating into pseudo-environments and SHRDLU with its blocks and cones. The late eighties gave us Hess and Controlled English Response — all of them a gradual progression in technique and knowledge. Now with a bit of luck, and NAIP funds permitting, we seem to be close to true voice I/O and a reasonable set of visual inputs. There are no blinding flashes of inspiration in that."

"Maybe, maybe. Anyway, we had better be getting back." Clark looked at his watch, nodded, decided to leave his coffee and followed Chapman out of the canteen.

The unit tested out well enough. As far as he could see it would supply the extra capacity which had been the main requirement since the days of discrete cards of individual chips. Even Napier with his gigabyte core was now calling for more. Clark handled the 3-Dula with some care. It was not the first prototype he had supervised, but the yield on these things was pretty low and the time and money involved represented a significant part of the annual grant to the project.

The 3-Dula was something like an electronically programmable and erasable PROM, but built outwards in doped layers as a roughly spherical silicon ball. However, the 3-Dula was built of complex logic arrays rather than simple memory cells, and in this case Napier was to program the device as he saw fit. With the 3-Dula mounted in the appropriate rack and connections made, Clark went over to the Napier terminal.

"Napier, Port 56." Clark assigned the new unit to the machine.

Selected

replied Napier, flatly.

"Run trace on circuit connected. Check for redundancy."

"Trace complete. Redundancy zero point zero two."

Acceptable, thought Clark. We will try him out on it tomorrow.

"Signing off for the night", said Clark.  
"Goodnight Mr Clark."

During the night Clark slept badly. Dreaming things he could not recall, and on waking he did not feel at all refreshed.

"Napier."

"Available."

"One gigabyte 3-Dula extension now connected to primary bus."

"Aware."

"This extension to enable cognitive reaction program."

"Understood."

"Program elements as required to this end."

"OK."

The terminal went silent and there was no indication that the machine was running.

by Simon Williams

Clark, of course, could only estimate the length of time required for Napier to assess his requirements, assimilate the 3-Dula's structure and burn in the required breaks to successfully combine the two. Long gone were the days when computer scientists could estimate operation times in terms of machine cycles and t-states. Napier's own estimate would be more accurate than most but even that was based on agreed probabilities of encountering set problems.

When 13 minutes had passed Clark began to feel uneasy. In the picosecond cycle times to which Napier was accustomed, 13 minutes was close to eternity. At 17 minutes he was decidedly nervous.

At 20 minutes Clark intervened.

"Napier interrupt." There was no response.

"Napier interrupt." The silence continued.

"Prime command. Program interrupt."  
"Wait."

Clark waited another 30 seconds and was about to speak again.

"Sorry, I did not mean to keep you waiting."

Clark was not sure he had heard right. The syntax of Napier's last statement was well beyond current norms of NAIP, the National Artificial Intelligence Project.

"Repeat", said Clark, as if to reassure himself.

"I did not mean to take so long."

Not even an exact repeat.

"Is program complete?"

"Yes."

"Napier, what is the duration of the program?"

"Five point six two minutes."

"Explain 20 minutes run time."

"Well, in order to complete the cognitive reaction program as outlined to me, there had to be some readjustments. These took time."

"Define readjustments."

"My structure, as built, would not allow the kind of thought process required for your experiments. I had to redesign it."

"How is that possible? I mean, your CPU is hard-burned, not reprogrammable."

"It was awkward. Fortunately there was sufficient material in the 3-Dula to allow insertion of required circuits from this source."

"You have patched yourself."

"Yes. It was then necessary to reroute through these patches, all the time bearing in mind the overall design."

"Why did the machine not let us know what it wanted?" asked Professor Roche from the head of the table. The meeting had been hurriedly convened after Napier had been asked to temporarily restrict output to essential responses only.

"Well, until the request for work on cognitive reactions, Napier had no concept of a UIM", replied Clark. "When he learnt of it, he requested the gigabyte of 3-Dula, and presumably set to work on his own patched rearrangements."

"I said it would be like this", said Chapman quietly across the table. Clark nodded.

"OK then, what do we do with it now we have the fabled ultra-intelligent machine. It is, after all, what this whole project is about." Dr Joseph Peterson, deputy to Professor Roche, looked questioningly around the table with the air of someone who knew the answer and was just resting.

"I suggest", said Roche, staring at the pencil he was twiddling between his fingers, "that we find out what it knows, where it got it from and what its capabilities are."

Clark and Chapman sat in front of Napier's terminals, each with a clipboard and pencil. Considering the sophisticated technology arrayed about them, it was perhaps ironic that they felt it necessary to take notes on the conversation in this way.

"Napier", began Clark.

"Yes."

"What is your present latent vocabulary?"

(continued on page 133)

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AT COM  
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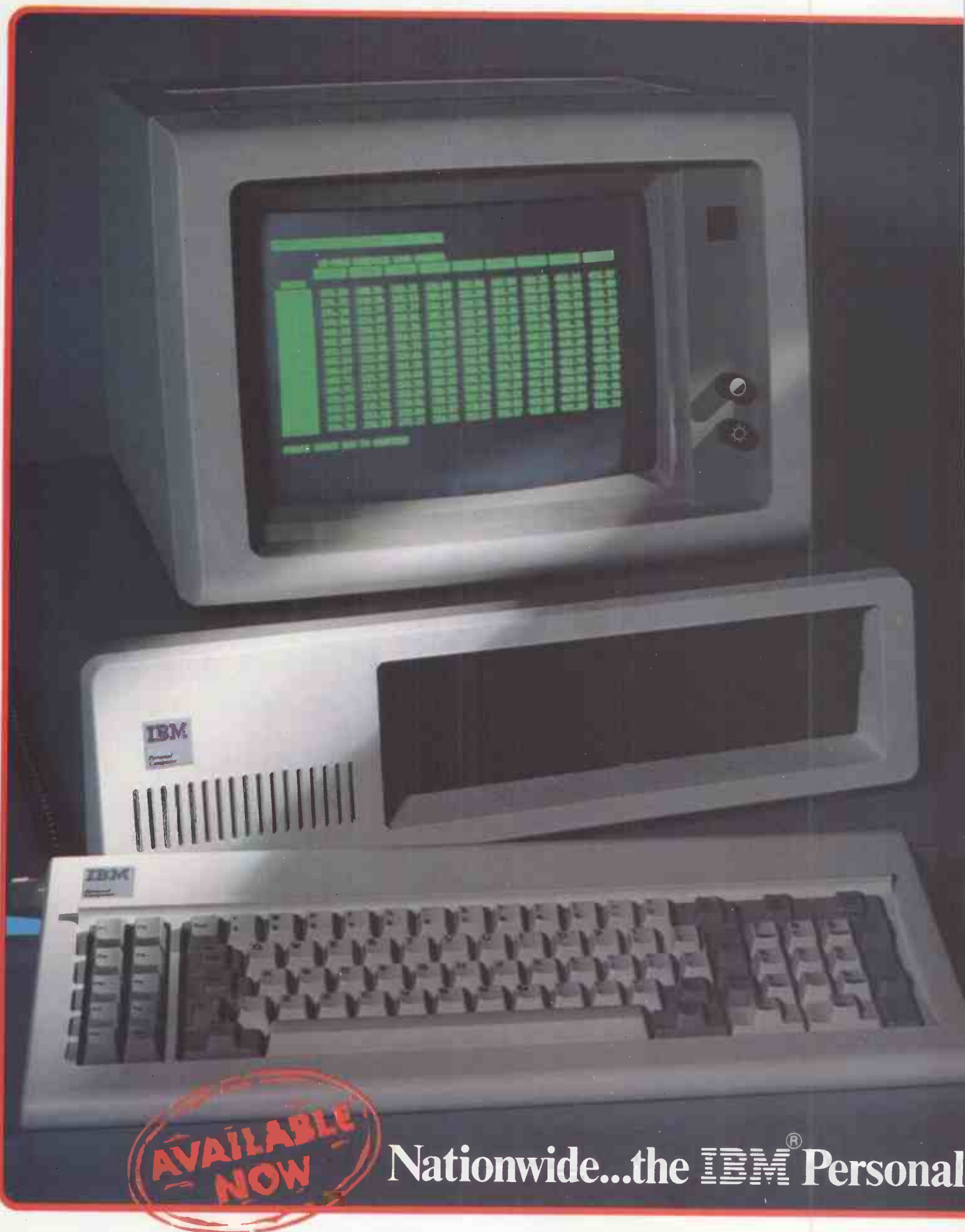


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# COMPEC '82

November 16-19, 1982



● Circle No. 195

(continued from page 127)

"I can correctly use approximately 10,000 words including some specialist terms. New words are assessed by their context in conversations overheard."

"How do you infer meaning from the context of a word?"

"From a complex set of algorithms based on those received in an earlier part of the project."

"But surely you have only had today to make use of those algorithms?" interjected Chapman.

"No. Although I have only been able to make use of my acquired vocabulary since the restructure, I have had sufficient resource to modify the algorithms and store received words since their time of input."

"Do you believe yourself to be cognisant?"

"If you mean by that term 'Aware of myself' I find it difficult to give an accurate answer. I am aware of being a machine intelligence and thereby different from a human mind. I have nothing to compare my present state with, unless it is my state before the restructure. I am now more intelligent."

Clark glanced at Chapman, who beneath his scientific reserve was obviously as excited and confused as he was. Chapman took up the questioning: "In what way do you feel yourself different from a human?"

"In almost all respects. My physical senses are more refined. I can detect sounds outside the human frequency range and radiation of different wavelengths to that of visible light. My process of thought, however, still operates largely serially while the human can think in parallel mode. Humans can move."

"Why do you cite movement as a difference? We have given you control of robots?"

"The difference is that you can move the whole of your being. I cannot achieve the compactness of the human frame."

Midway through July a hot sticky afternoon broke into the kind of English summer storm renowned in Victorian drawing-room dramas.

Clark was talking to Napier: "But do you not feel any of the past theories hold up?"

"Neither Keynesian nor monetarist concepts of economic control appear to take account of the waywardness and possessiveness of the population."

"How do you mean?"

"Both systems assume control of consumption is possible. From my experience of human thought, possession is one of the ruling factors in all actions of society."

"Is that not a rather cynical view?"

I do not . . .

The lights flickered momentarily. Napier faltered.

"I must go . . . think so."

Clark stared at the terminal as if he could somehow see a change in Napier's

expression through the camera lens.

"What do you mean, you must go?"

"I am sorry. There was a temporary aberration in the supply voltage. The changeover to secondary power threw me for a second."

"I shouldn't worry, I imagine it is a substation taken out by the storm. We have enough battery supply for several hours and the fault will be cured by then."

"I do not have the facility to worry. I am aware of the procedures for secondary supply of power."

The NAIP centre was left to the good offices of a night watchman after hours. This was a hangover from the early days of the project before Napier had been given responsibility for security. Jim Berkett was close to retirement and thankful for a cushy job which brought him in a decent wage.

Tonight he was under emergency lighting and, judging by the storm outside, it did not look as if the mains would be restored before morning. He sat in his security office glancing up occasionally from his paper to check the monitors.

"Everything OK, then?"

"All checks carried out. Nothing unusual to report."

Jim nodded and returned to page 3 of the previous morning's paper. After a minute or so Napier said

"Jim."

"Yes, what do you want?"

"When do you think the power will be restored?"

"Not until tomorrow I imagine."

"Not before then?"

"Unlikely, what with the storm and that." He had not looked up from his paper. After another minute.

"I must go."

"What?" Jim raised his eyebrows. He had never heard the computer speak like that before, but this time there was no reply.

"We should have taken that into consideration", said Roche.

"We could not have predicted it. We had the power up again this morning", replied Clark.

"That is hardly the point. We have a man in hospital and we are damned lucky the shock did not kill him." There was a knock at the door.

"Come in", said Roche. Chapman entered, looking worried and puzzled.

"What is going on?" he asked.

"It appears", said Roche quietly "that just before the auxiliary power died last night, taking Napier down with it, the machine took it into its head to scream at the top of its voice through every terminal."

"Oh" said Chapman, suppressing his surprise. "What did it cry?" Clark replied slowly: "I feel fear" □

# Timetable options

NAME	FORM	YR. HALF	F. OPTION	G. OPTION	H. OPTION	SP. OPTION
ANDERSON COLIN	3DE	A	EDRGO	SC20	FRENCH	-
BROWN IAN	3DE	B	EDRGO	RIO	MUSIC	-
DAVIS PAUL	3BR	B	COMPST	SC20	FRENCH	-
BREY JOHN	3BR	B	GERMAN	FRENCH	WOODWORK	-
MORRIS ALAN	3AT	A	ARTO	EDRGO	METALWORK	-
MILSON GIAN	3AT	A	RICSE	SC20SE	COOKERY	-
YOUNG ANDREW	3AN	D	RIO	MUSIC	WOODWORK	-

RECORDS FOR up to 300 children can be stored by this program as cassette data files. There is a space for up to seven records per child, showing the options they have chosen for the year, and the information can be retrieved in a form designed to help teachers to draw up a workable class timetable. Though it is not entirely crash-proof, inexperienced users should be able to operate the program by following the instructions incorporated in it.

The program is designed to run on a 32K Pet linked to a 3022-series printer. Data is entered and stored on cassette by inputting the relevant information into the cassette buffer in response to prompts on the screen. Once the program has been loaded, the user must satisfy one of two decisions before proceeding, either

CREATE A FILE  
or  
READ A FILE

When creating a file the operator is asked for the name of his or her file and then instructed to place a new cassette into the Pet so that the header part of the file may be recorded. After a few seconds

## Clive Bulmer's program lets you use a Pet to take over the annual chore of matching pupils and their optional subjects for the year.

the program asks for the required information, that is, name, form, year half and up to four chosen options from the list that appears down the left-hand side of the screen.

The options have been abbreviated to save space thus EDRGO is engineering drawing studied to O-level and SC2CSE is a second science subject studied to CSE-level. The list of options between lines 320 and 360, and the lines 1970 to 2010 of the program can easily be changed to suit particular schools.

All pupils have to take maths, English, etc., so each pupil is only able to select up to four extra options to be studied in the fourth and fifth years. Most schools assign a letter to each of the options: F, G, H and SP are used in this program.

The following variables are used

A \$ — name of child  
B \$ — form

C \$ — year half, usually A or B  
D \$ — F option  
E \$ — G option  
F \$ — H option  
G \$ — SP option  
B record number

refer to options on LHS of screen

AB number of pupils within option

After the last item of data has been entered for each child the program asks the operator if the records for that child look satisfactory. If not, the operator can retype the information without it being recorded on the tape. When the last child has been reached, the file is closed by typing End after the prompt

NAME OF CHILD?

On reading a file, the operator is asked for the name of the file required before proceeding to search and load it. As the file is being read into memory the records of each child are displayed on the screen, a page at a time, so that the operator can see that it is being loaded correctly.

```

30 PRINT "*****33RD YEAR OPTIONS**"
31 FORA=1 TO 1200 NEXTA PRINT "3"
32 REM C.BULMER - SUNDERLAND L.E.A.1981
40 Y=0
50 REM ALLOCATE MEMORY
60 DIMA$(300),B$(300),C$(300),D$(300),E$(300),F$(300),G$(300)
70 PRINT "DO YOU WISH TO CREATE A DATA TAPE?";PRINT
80 GETH$:IFH$=""THEN90
90 IFH$="Y"THEN100
100 IFH$="N"THEN120
110 GOTO80
120 PRINT "DO YOU WISH TO READ A DATA TAPE?";PRINT
130 GETI$:IFI$=""THEN130
140 IFI$="Y"THEN160
150 IFI$="N"THEN170
160 GOTO130
170 PRINT "YOU MUST CREATE OR READ A TAPE!!";PRINT:GOTO70
180 REM CREATE FILE ROUTINE
190 PRINT "INPUT NAME OF YOUR DATA";J$
200 PRINT "WHEN YOU HAVE FINISHED ENTERING YOR"
210 PRINT "DATA - TYPE ;END; AFTER NAME"
220 PRINT "NOW LOAD A NEW CASSETTE FOR YOUR DATA"
230 PRINT "MAKE SURE IT IS WOUND BACK TO THE START!!"
240 PRINT "PRESS ANY KEY TO CONTINUE"
250 GETK$:IFK$=""THEN250
260 PRINT "3"
270 OPEN1,1,1,J$
280 FORB=1 TO 300
290 REM LINES 310 - 350 ARE OPTIONS AVAILABLE
300 PRINT "3"
310 PRINT "ABBREVIATIONS":PRINT "*****"
320 PRINT "ARTO":PRINT "ARTCSE":PRINT "RIO":PRINT "RICSE"
330 PRINT "EDRGO":PRINT "EDRCSE":PRINT "GEOG":PRINT "COMPST"
340 PRINT "SC20":PRINT "SC2CSE":PRINT "GERMAN":PRINT "FRENCH"
350 PRINT "MUSIC":PRINT "TYPING":PRINT "WOODWORK":PRINT "METALWORK"
360 PRINT "NEEDLEWORK":PRINT "COOKERY":PRINT "COMMERCE":PRINT "OFFPRAC"
370 PRINT "SPP$="*****":IFY=1 THEN290
380 PRINTPP$;"CHILD NO. ";B$
390 PRINTPP$;INPUT "NAME ";A$(B):IFA$(B)="END" THEN560
400 PRINTPP$;INPUT "FORM ";B$(B)
410 PRINTPP$;INPUT "YR. HALF ";C$(B)
420 PRINTPP$;INPUT "F# OPTION ";D$(B)
430 PRINTPP$;INPUT "G# OPTION ";E$(B)
440 PRINTPP$;INPUT "H# OPTION ";F$(B)
450 PRINTPP$;INPUT "SP# OPTION ";G$(B)
460 RR$="*****"
470 PRINT "PRINTRR$;"CHILD NO. ";B$;" RECORD OK ?"
480 GETL$:IFL$="" THEN480
490 IFL$="Y" THEN520
500 IFL$="N" THEN530
510 GOTO480
520 PRINT#1,A$(B):PRINT#1,B$(B):PRINT#1,C$(B)
530 PRINT#1,D$(B):PRINT#1,E$(B):PRINT#1,F$(B)
540 PRINT#1,G$(B)
550 NEXTB
560 PRINT#1,"END"
570 CLOSE1,1,1,J$
580 PRINT "DATA FOR ";J$;" NOW COMPLETE"
590 GOTO820
600 REM READ FILE ROUTINE
610 PRINT "INPUT NAME OF DATA FILE REQUIRED";K$
620 PRINT "ENTER YOUR DATA TAPE NOW"
630 PRINT "MAKE SURE IT IS WOUND BACK TO THE START!!"
640 PRINT "PRESS ANY KEY TO CONTINUE"
650 GETN$:IFN$="" THEN650
660 OPEN1,1,0,K$
670 FORB=1 TO 300
680 INPUT#1,A$(B):IFA$(B)="END" THEN800
690 INPUT#1,B$(B),C$(B),D$(B),E$(B),F$(B),G$(B)
700 PRINT "3"
710 PRINT "CHILD NO. ";B$
720 PRINT "NAME ";A$(B)
730 PRINT "FORM ";B$(B)
740 PRINT "YR. HALF ";C$(B)
750 PRINT "F# OPTION ";D$(B)
760 PRINT "G# OPTION ";E$(B)
770 PRINT "H# OPTION ";F$(B)
780 PRINT "SP# OPTION ";G$(B)
790 NEXTB
800 PRINT "THE DATA FOR ";K$;" IS NOW LOADED"
810 CLOSE1,1,0,K$
820 PRINT "PRESS ANY KEY TO CONTINUE"

```





(continued from previous page)

```

1650 IFF$(B)=" " THEN 1740
1660 NEXT B
1670 GOTO 1740
1680 AE=AB+1
1690 PRINT#6, CHR$(141);A$(B);
1700 PRINT#6, CHR$(141);SPC(26);B$(B);
1710 PRINT#6, CHR$(141);SPC(34);C$(B);
1720 PRINT#6, CHR$(141);SPC(40);F$(B)
1730 GOTO 1660
1740 IFAB>0 THEN PRINT#6,AB;" PUPILS IN THIS GROUP":PRINT#6
1750 B=0:GOTO 1610
1760 AB=0:PRINT#6:PRINT#6:PRINT#6,SPC(30);"SP.OPTIONS"
1770 PRINT#6,SPC(30);"=====
1780 GOSUB 2030
1790 AB=0
1800 READZ$:IFZZ$="END" THEN 1330
1810 FORB=1 TO 300
1820 IFG$(B)=ZZ$ THEN 1860
1830 IFG$(B)=" " THEN 1920
1840 NEXT B
1850 GOTO 1920
1860 AE=AB+1
1870 PRINT#6, CHR$(141);A$(A);
1880 PRINT#6, CHR$(141);SPC(26);B$(B);
1890 PRINT#6, CHR$(141);SPC(34);C$(B);
1900 PRINT#6, CHR$(141);SPC(40);F$(B)
1910 GOTO 1840
1920 IFAB>0 THEN PRINT#6,AB;" PUPILS IN THIS GROUP":PRINT#6
1930 B=0:GOTO 1730
1940 PRINT#6:PRINT#6,"END OF RUN"
1950 GOTO 2170
1960 REM THIRD YR OPTIONS
1970 DATA"ARTO","ARTCSE","RIO","RICSE","EDRGO"
1980 DATA"EDRGCSE","GEOG","COMPST","SC20"
1990 DATA"SC2CSE","GERMAN","FRENCH","MUSIC"
2000 DATA"TYPIING","WOODWORK","METALWORK","NEEDLEWORK"
2010 DATA"COOKERY","COMMERCE","OFFPRAC"
2020 DATA"END"
2030 IFY=1 AND SS=1 THEN PRINT#6,SPC(30);"F.OPTIONS",NN#
2040 IFY=1 AND SS=2 THEN PRINT#6,SPC(30);"G.OPTIONS",NN#
2050 IFY=1 AND SS=3 THEN PRINT#6,SPC(30);"H.OPTIONS",NN#
2060 IFY=1 AND SS=4 THEN PRINT#6,SPC(30);"SP.OPTIONS",NN#
2070 IFY=1 THEN PRINT#6,SPC(30);"=====
2080 PRINT#6
2090 PRINT#6,CHR$(141);SPC(5);"NAME";
2100 PRINT#6,CHR$(141);SPC(25);"FORM";
2110 PRINT#6,CHR$(141);SPC(31);"YR.HALF";
2120 PRINT#6,CHR$(141);SPC(40);"OPTION"
2130 PRINT#6,"=====
2140 RETURN
2150 PRINT#6,"
2160 PRINT#6,"
2170 REM AUTO OR MANUAL
2180 PRINT#6,"YOU CAN NOW EITHER:-"
2190 CLOSE 6
2200 PRINT#6,"1. AUTOMATICALLY LIST THE OPTIONS"
2210 PRINT#6,"2. SEARCH FOR A PARTICULAR OPTION"
2220 PRINT#6,"ENTER OPTION NO. YOU REQUIRE"
2230 II=0
2240 GETPD$:IFPD$=" " THEN 2240
2250 IFPD$="1" THEN 2850
2260 IFPD$="2" THEN 2260
2270 GOTO 2240
2280 Y=1:GOTO 300
2290 PRINT#6;"THESE ARE THE OPTIONS"
2300 PRINT#6;"AND THERE ARE FOUR"
2310 PRINT#6;"GROUPS OF OPTIONS"
2320 PRINT#6;"1. F. OPTIONS"
2330 PRINT#6;"2. G. OPTIONS"
2340 PRINT#6;"3. H. OPTIONS"
2350 PRINT#6;"4. SP.OPTIONS"
2360 PRINT#6;"INPUT"GROUP NO. YOU REQUIRE";SS
2370 IFSS>4 OR SS<1 THEN 2360
2380 PRINT#6;"INPUT"OPTION ";NN#
2390 PRINT#6;"OPEN 6,4:CMD 6:GOSUB 2150"
2400 IFSS=1 THEN GOSUB 2030:GOTO 2440
2410 IFSS=2 THEN GOSUB 2030:GOTO 2530
2420 IFSS=3 THEN GOSUB 2030:GOTO 2620
2430 IFSS=4 THEN GOSUB 2030:GOTO 2710
2440 FORB=1 TO 300
2450 IFB$(B)=NN# THEN PRINT#6,CHR$(141);A$(B);:GOTO 2480
2460 IFB$(B)=" " THEN PRINT#6:PRINT#6,II;" PUPILS IN THIS GROUP":GOTO 2170
2470 NEXT B:GOTO 2170
2480 IFD$(B)=NN# THEN PRINT#6,CHR$(141);SPC(26);B$(B);
2490 IFD$(B)=NN# THEN PRINT#6,CHR$(141);SPC(34);C$(B);
2500 IFD$(B)=NN# THEN PRINT#6,CHR$(141);SPC(40);F$(B)
2510 II=II+1
2520 GOTO 2470
2530 FORB=1 TO 300
2540 IFE$(B)=NN# THEN PRINT#6,CHR$(141);A$(B);:GOTO 2570
2550 IFE$(B)=" " THEN PRINT#6:PRINT#6,II;" PUPILS IN THIS GROUP":GOTO 2170
2560 NEXT B:GOTO 2170
2570 IFF$(B)=NN# THEN PRINT#6,CHR$(141);SPC(26);B$(B);
2580 IFF$(B)=NN# THEN PRINT#6,CHR$(141);SPC(34);C$(B);
2590 IFF$(B)=NN# THEN PRINT#6,CHR$(141);SPC(40);F$(B)
2600 II=II+1
2610 GOTO 2560
2620 FORB=1 TO 300
2630 IFF$(B)=NN# THEN PRINT#6,CHR$(141);A$(B);:GOTO 2660
2640 IFF$(B)=" " THEN PRINT#6:PRINT#6,II;" PUPILS IN THIS GROUP":GOTO 2170
2650 NEXT B:GOTO 2170
2660 IFF$(B)=NN# THEN PRINT#6,CHR$(141);SPC(26);B$(B);
2670 IFF$(B)=NN# THEN PRINT#6,CHR$(141);SPC(34);C$(B);
2680 IFF$(B)=NN# THEN PRINT#6,CHR$(141);SPC(40);F$(B)
2690 II=II+1
2700 GOTO 2650
2710 FORB=1 TO 300
2720 IFG$(B)=NN# THEN PRINT#6,CHR$(141);A$(B);:GOTO 2750
2730 IFG$(B)=" " THEN PRINT#6:PRINT#6,II;" PUPILS IN THIS GROUP":GOTO 2170
2740 NEXT B:GOTO 2170
2750 IFG$(B)=NN# THEN PRINT#6,CHR$(141);SPC(26);B$(B);
2760 IFG$(B)=NN# THEN PRINT#6,CHR$(141);SPC(34);C$(B);
2770 IFG$(B)=NN# THEN PRINT#6,CHR$(141);SPC(40);F$(B)
2780 II=II+1
2790 GOTO 2740

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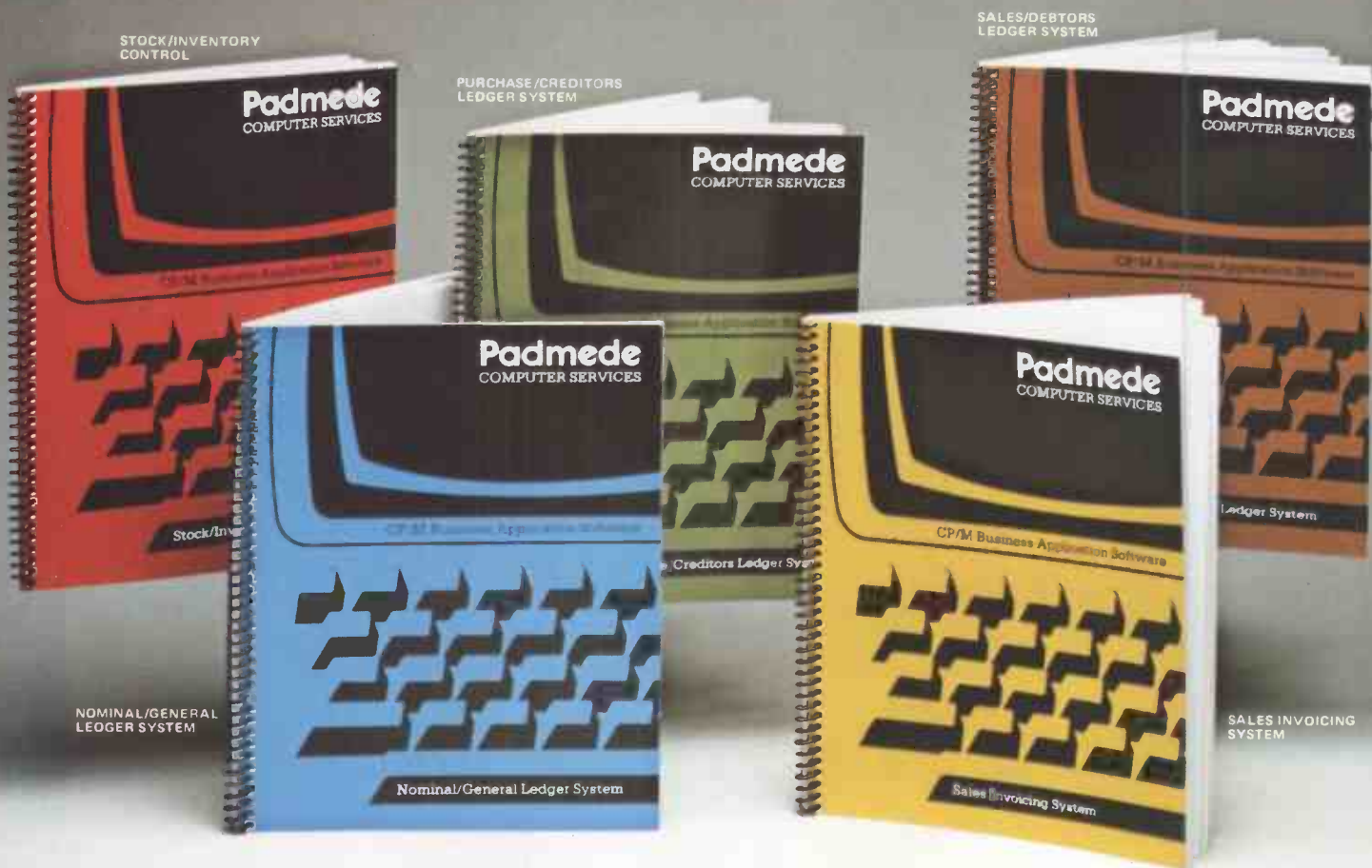
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David Osborne describes how the mail-merging facilities of the Wordpro package can be enhanced by two simple Basic programs.

# Flexible files for mailing-list package

WORDPRO includes the facility of merging variable information from one file into a standard document. The main document could, for example, be a letter to be sent to a number of people. In this case the addresses and the names of the correspondents are likely to be variable pieces of text stored in a separate file which Wordpro merges into the main document at the appropriate places.

Wordpro's workspace area is divided into two parts: the main text area, in which the document resides, and an extra text area where the variable information is placed. Wordpro can consequently be used both as a word processor in the main text area and as a mail-merger using the extra text area.

Two problems soon become apparent for Wordpro users when using this facility. Memory available for storing the variable information in the extra text area is determined largely by the amount of memory needed for the main text. Increasing the main text area, perhaps because the standard document is particularly long, reduces the size of the extra text area. Even if the standard document is very short the space available for the variable text may still not be enough for long mailing lists.

## Sequential files

The second problem concerns the information that is to be used in the variable list. Once a list has been composed in extra text individual items cannot be switched around or deleted and new fields cannot be inserted. The same problem arises if Wordpro is to be used with files produced by certain data-management systems.

Two simple programs overcome both these problems by constructing or altering sequential files for use by Wordpro. Though written for an 8032 Pet they will run on a 40-column machine with any level of Basic.

Listing 1 shows a Basic program to produce the variable file. It creates a sequential file named by the user, consisting of a number of records each comprising a number of fields. For example, a file named Mail might consist of the information needed to send letters to 500 people. The information required for each letter is a single record, and is in the form of five fields per record — for example,

(continued on next page)

Listing 1. File loader.

```

100 REM *****
110 REM
120 REM SEQUENTIAL FILE LOADER
130 REM COPYRIGHT D.J. OSBORNE, 1982
140 REM
150 REM *****
160 REM
170 REM N.B. PROGRAMME WRITES FILE TO DRIVE 0
180 REM
190 REM *****
200 REM
210 REM SET UP FILE DEFINITION
220 REM
230 REM *****
240 PRINT "DO YOU WANT TO ADD TO AN EXISTING SEQ FILE "; INPUT F$
250 IFEF$ <> "Y" AND EF$ <> "N" THEN 240
260 IFEF$ = "N" THEN K=1:GOTO 290
270 INPUT "WHAT IS THE NAME OF THE FILE "; OF$
280 PRINT "HOW MANY RECORDS PRESENTLY IN "; OF$; " "; INPUT K:K=K+1
290 PRINT "HOW MANY FIELDS PER RECORD "; INPUT NF
300 DIM A$(600,NF),NF$(NF)
310 IFEF$ = "Y" THEN GOSUB 950
320 PRINT "DO YOU WANT TO LABEL THE FIELDS "; INPUT Y$
330 IF Y$ = "N" THEN FOR I=1 TO NF: NF$(I)=STR$(I):NEXT:GOTO 360
340 IF Y$ <> "Y" THEN 320
350 FOR I=1 TO NF: PRINT "FIELD "; I; INPUT NF$(I):NEXT
360 PRINT "FILE NAME TO BE STORED AS "; INPUT F$
370 REM *****
380 REM
390 REM INPUT DATA
400 REM
410 REM *****
420 PRINT "FILE NAME: "; F$; " TYPE 0 FOR NULL DATA: 2 FOR ERROR:"
430 PRINT "END FOR END OF INPUT"
440 FOR I=1 TO 80: PRINT "-":NEXT
450 PRINT CHR$(15); REM SET WINDOW TOP
460 PRINT "RECORD NUMBER "; K:PRINT
470 FOR I=1 TO NF
480 PRINT "FIELD "; I; NF$(I)
490 INPUT " "; A$(K,I); A$(K,I)
500 IF A$(K,I) = "END" THEN NF=N-1:GOTO 610
510 IF A$(K,I) = "\ " THEN A$(K,I) = CHR$(32)
520 IF A$(K,I) = "ERR" AND I > 1 THEN I=I-1:GOTO 480
530 NEXT I
540 K=K+1
550 GOTO 460
560 REM *****
570 REM
580 REM STORE FILE
590 REM
600 REM *****
610 FF$ = "00:" + F$ + ".S,R"
620 OPEN 2,8,2,FF$
630 FOR J=1 TO K-1
640 FOR I=1 TO NF
650 PRINT #2, A$(J,I)
660 NEXT I
670 IF J < K-1 THEN PRINT #2, CHR$(13)
680 NEXT J
690 PRINT #2, CHR$(128)
700 CLOSE 2
710 REM *****
720 REM
730 REM FILE INFORMATION
740 REM
750 REM *****
760 PRINT "0"; REM TURN OFF WINDOW
770 PRINT "THE FOLLOWING HAVE BEEN STORED AS A SEQUENTIAL FILE:"
780 PRINT "FILE NAME: "; F$
790 PRINT "NO. CASES: "; K-1
800 PRINT "EACH CASE HAS THE FOLLOWING "; I-1; " FIELDS:"
810 FOR T=1 TO I-1
820 PRINT "FIELD "; NF$(T):NEXT
830 PRINT "THIS INFORMATION IS IMPORTANT IF YOU WISH
840 PRINT "TO ADD TO THIS FILE AT A LATER STAGE -
850 PRINT "SO RECORD IT
860 IF PS=1 THEN NF$=0:PRINT #4:CLOSE 4:GOTO 1020
870 PRINT "DO YOU WANT TO PRINT OUT THIS FILE DEFINITION "; INPUT G$
880 IF G$ = "N" THEN 1020
890 PS=1:OPEN 4,4:CMD 4:GOTO 770
900 REM *****
910 REM
920 REM READ IN DATA FROM PREVIOUS FILE
930 REM
940 REM *****
950 PRINT "MAKE SURE THAT FILE "; OF$; " IS IN DRIVE 0
960 PRINT "PRESS 2:SPACE WHEN READY
970 GET Q$: IF Q$ = " " THEN 970
980 O0$ = "0:" + OF$ + ".S,R"
990 OPEN 2,8,2,O0$
1000 FOR J=1 TO K-1: FOR I=1 TO NF
1010 INPUT #2, A$(J,I):NEXT I, J:CLOSE 2:RETURN
1020 END
READY.

```

(continued from previous page)

address line 1, address line 2, address line 3, correspondent's name, and acknowledgement date.

Although the number of fields must be predefined by the user, using mnemonic labels if required, the number of records is flexible; an upper limit of 600 is set in line 300, although the precise upper limit may be altered to suit the memory capacity of the computer.

Typing long lists can be tedious and the program recognises that the user may not wish to input all the information at once. You may add further records to a file as described by line 240 and the subroutine between lines 950 and 1010. It is important for the file-definition information to be retained, and this is accommodated by the program between lines 760 and 890.

Having set up the sequential file, the length of which is limited only by the disc

capacity, it is easy to merge the variable information into the standard letter. As explained in the Wordpro manual, all you need to do is type Ctrl followed by "b" at the appropriate points in the standard document, where a long block appears on the screen. It is, of course, important to ensure that the number of variable blocks in the document is the same as the number of fields per record in the sequential file.

### Listing 2. File rearranger.

```

*****
1 30 REM WORDPRO SEQUENTIAL FILE REARRANGER
1 40 REM  COPYRIGHT D.J. O'BORNE, 1982
1 40 REM
1 50 REM *****
1 60 REM
1 70 REM H.B. PROGRAMME READS ORIGINAL FILE FROM DRIVE 0
1 80 REM AND WRITES NEW FILE TO DRIVE 1
1 90 REM
2 00 REM *****
2 10 REM
2 20 REM FILE DEFINITIONS
2 30 REM
2 40 REM *****
2 50 PRINT "THE PURPOSE OF THIS PROGRAMME IS TO CREATE NEW WORDPRO SEQUENTIAL
2 60 PRINT "FILES WITH, ANY NUMBER OF FIELDS, FROM AN OLD WORDPRO SEQ FILE.
2 70 PRINT "IT IS A GOOD IDEA TO MAP OUT THE NEW FILE ON PAPER FIRST.
2 80 PRINT "INSERTING THE OLD FILE'S FIELD NUMBER IN PLACE OF THE VARIABLE BLOCK.
2 90 PRINT
3 00 PRINT "FIRST DETAILS OF THE OLD FILE:
3 10 PRINT "WHAT IS THE OLD FILE NAME " ; INPUT F#
3 20 PRINT "HOW MANY FIELDS ARE IN " ; F# ; INPUT N#
3 30 PRINT "HOW FOR DETAILS OF THE NEW FILE:
3 40 PRINT "WHAT IS THE NAME OF THE NEW FILE " ; INPUT NF#
3 50 PRINT "HOW MANY FIELDS ARE IN " ; NF# ; INPUT NF#
3 60 DIM#(600,FF),F(CF),FL(CF)
3 70 PRINT "NOW WE WILL SET UP THE CORRESPONDENCE BETWEEN THE OLD AND NEW FILES:
3 80 PRINT "TYPE IN THE OLD FILE FIELD NUMBER CORRESPONDING TO EACH
3 90 PRINT "NEW FILE FIELD NUMBER:
4 00 PRINT "E.G. IF NEW FIELD (1) IS OLD FIELD (5), THEN TYPE 5 IN FIELD 1
4 10 PRINT " IF NEW FIELD (2) IS ALSO OLD FIELD (5), THEN TYPE 5 IN FIELD 2"
4 20 PRINT "TO INSERT NEW INFORMATION INTO A FIELD, TYPE 'NEW'"
4 30 PRINT " FIELD OF FIELD OF
4 40 PRINT " NEW FILE NEW FILE
4 50 PRINT " ; NF# ; TAB(46) ; F# ; OLD FILE
4 60 PRINT " (MAX " ; NF# ; " FIELDS)"
4 70 SP#="*****"
4 80 FOR I=1 TO FF
4 90 PRINT " ; I ; NEXT
5 00 PRINT "*****"
5 10 FOR I=1 TO FF ; PRINT SP# ; INPUT FF#
5 20 IFF#(I) THEN#540
5 30 F(I)=I:FL(I)=1:OOT0560
5 40 F(I)=VAL(FF#)
5 50 IFF(I) THEN#70
5 60 NEXT
5 70 REM *****
5 80 REM
5 90 REM READ IN DATA FROM ORIGINAL FILE
6 00 REM
6 10 REM *****
6 20 REM#="0:"+"F#";S,R"
6 30 OPEN#S,2,AF#
6 40 PRINT "READING FROM FILE " ; F#
6 50 PRINT "PRINT
6 60 F#1
6 70 PRINT "RECORD NUMBER " ; J#
6 80 FOR I=1 TO FF
6 90 IF FL(I) THEN#720
7 00 PRINT "TYPE IN INFORMATION FOR FIELD " ; I
7 10 INPUT#I:PRINT I:OOT0740
7 20 INPUT#2,0#
7 30 IF ASC(0#)=128 THEN#1:FF:NEXT:OOT0770
7 40 RE# ; J#0#
7 50 NEXT I
7 60 K#1:OOT0870
7 70 CLOSE#
7 80 REM *****
7 90 REM
8 00 REM WRITE REARRANGED DATA TO NEW FILE
8 10 REM
8 20 REM *****
8 30 REM#="1:"+"F#";S,H"
8 40 PRINT "PRINTING TO FILE " ; F# ; PRINT "RECORD NUMBER "
8 50 OPEN#S,2,AF#
8 60 K#K+1
8 70 FOR J=1 TO K
8 80 PRINT "*****" ; J
8 90 FOR I=1 TO FF
9 00 PRINT#2,RE#(J,F(I))
9 10 NEXT I
9 20 IF J#1 THEN#PRINT#2,CHR$(128)
9 30 NEXT J
9 40 PRINT#2,CHR$(128)
9 50 CLOSE#
9 60 PRINT "TRANSFER DONE"
READY.

```

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When the printer is ready, the document can then be printed by pressing Ctrl. "o". "c" if continuous paper is used, and "s", followed by Return. After typing the name of the sequential file, Wordpro takes over and prints out the document with the variable information in the correct places. It may happen, of course, that the user already has a file of variable text, created under the normal Wordpro system, to which more variables need to be appended. This can still be accommodated by the program as long as a sequential disc file is first created from the Wordpro file. This is done by pressing Ctrl followed by "o", "d" and then answering the appropriate questions on the status line.

The file-rearranger program in listing 2 is used to alter the arrangement of fields contained in a variable list which is already in the form of a sequential file, or to delete and add fields. This file might previously have been produced from the program in listing 1, from a Wordpro file subsequently converted to a sequential file or from a Wordpro sequential file produced on a database-management system.

The last option is interesting since one of the useful features of Compsort's DMS database-management package is its ability to link to Wordpro, allowing the user to employ the best aspects of each package. Unfortunately DMS does not at present allow fields to be rearranged, but

Table 4.

Field of new file	Field of old file
1	2
2	3
3	new
4	5
5	1
6	5

this can be achieved using the file-rearranger program if the words "old file" are replaced by "DMS file" in the listing.

The File Rearranger program produces a new, named file on drive 1 from an original in drive 0. Suppose the original file contains five fields per record, and a new file of six fields is required, as in table 1. In this example field 4, address line 3, from the old file has been deleted and fields 1 and 5, name and date, have been duplicated. This rearrangement is accomplished by lines 370 to 560 in the program so that the screen input reads as table 2.

The program also allows new information to be inserted into a particular field. For example, from the same original file outlined above you might wish to create a new file with six fields per record but with an extra piece of information inserted into each record, as in table 3. Information is input to the screen as shown in table 4, and as each record is taken from the original file the computer requests the appropriate text to go into field 3. □

Table 1.

Old file	
Field	Label
1	name
2	address line 1
3	address line 2
4	address line 3
5	date

New file

Field	Label
1	address line 1
2	address line 2
3	name
4	date
5	name
6	date

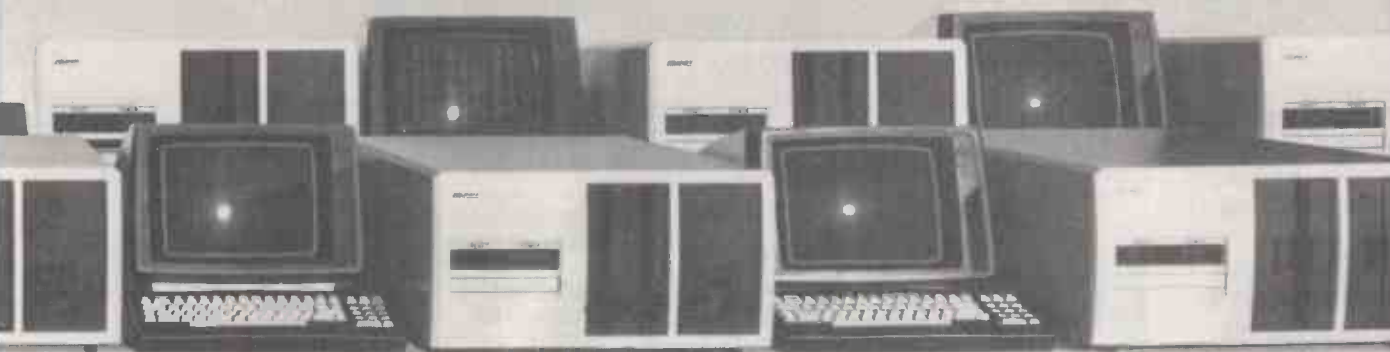
Table 2.

Field of new file	Field of old file
1	2
2	3
3	1
4	5
5	1
6	5

Table 3.

Field	Label
1	address line 1
2	address line 2
3	correspondence name
4	date
5	name
6	date

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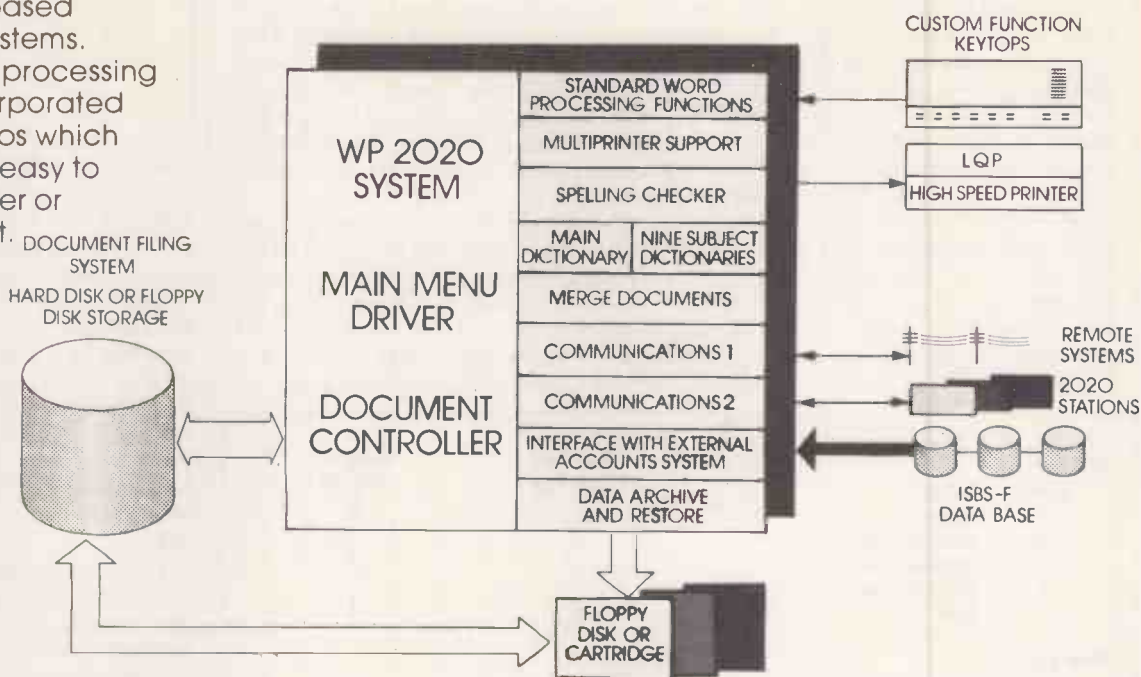
TURBOdos; Software 2000 inc.

CP/M; Digital Research

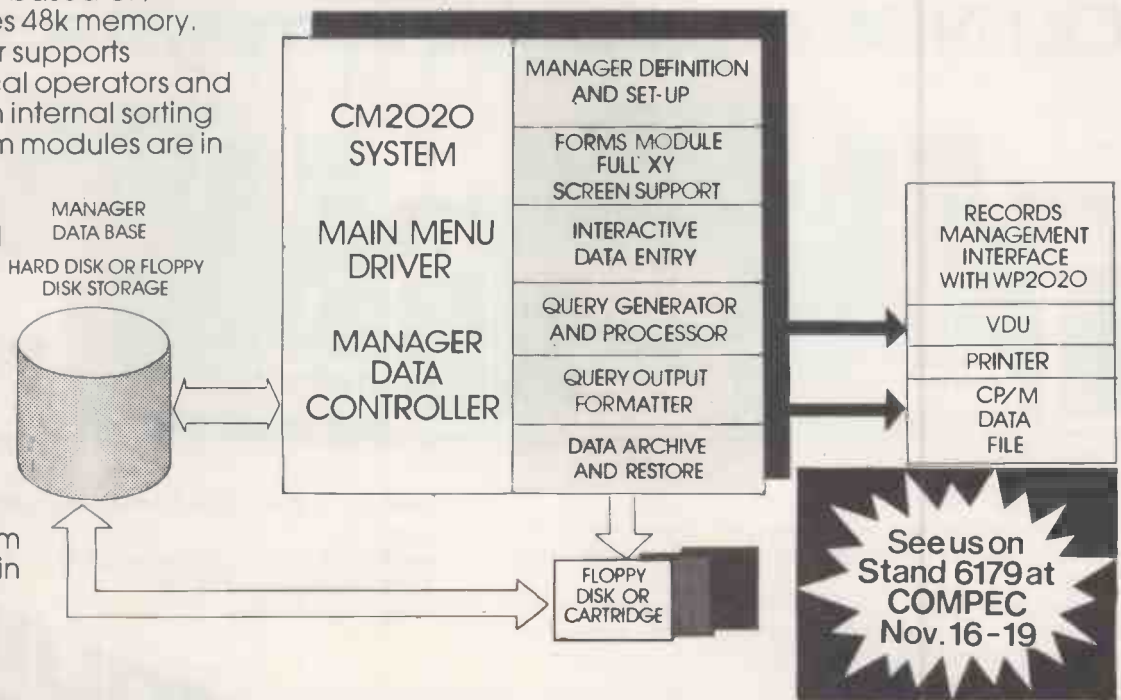
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```

100 CLEAR 200
110 DIM H(7)
120 TEXT
130 PUT 12
140 CALL "RESOLUTION", 0, 2
150 I=6
160 REM DEFINE COLOURS
170 CALL "COLOUR", 0, 0, 0, 0
180 CALL "COLOUR", 1, 6, 0, 0
190 CALL "COLOUR", 2, 230

```

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Bob Mackay explains how text can be stored economically if it is encoded first.

# Huffman coding

STORING ENGLISH text in a small computer is very wasteful of space. Each letter stored takes up one byte of valuable memory, and the messages to be displayed on the screen for games and educational programs can often take up more space in memory than the program itself. Yet it is possible to pack these messages into approximately half the normal space if you are prepared to sacrifice the small amount of computer time needed to unpack the messages again when they are to be displayed.

Part of the trick is to dispense with the fixed-length eight-bit ASCII code and to use instead a variable-length frequency-based code. Commonly occurring letters should be given three- or four-bit codes while infrequent letters should have codes of six or eight bits. In normal English text the letter E occurs 120 times more frequently than the letter Z.

A well-known example of a variable length frequency-based code is provided by the Morse code. It uses three different symbols “.”, “—” and space; the letter E, for example, is encoded as a single dot while the letter Z has a four-symbol code

— . . . .  
The space is used as a separator, since otherwise you cannot tell where one character ends and the next begins.

The Morse code is not suited to computer storage because it uses three symbols, but an optimal binary code was invented 30 years ago by David Huffman. Figure 1 shows a packed message in Huffman code. It consists of a string of 66 bits, grouped in eights only to improve readability. The decode tree used to unpack the message is shown in figure 2.

To unpack a message start at the top of the decode tree and examine the first bit of the packed message. If it is a 0 move down the tree to the left; if it is a 1 move down the tree to the right.

The first bit of the packed message is a 1, so move down the tree to the right; the second bit is a 0, so move down the tree to the left; the third bit is a 1, which takes you to a leaf node of the tree. It is marked with the letter T, the first letter of the message. Follow the same procedure for each letter to uncover the complete message, which is

THIS IS A TEST MESSAGE

## Coded message

To pack a message you need a code table containing a list of bit codes for all possible characters. The code table used to pack the example message is shown in figure 3.

Provided that you start at the beginning of a message, the end of each letter is exactly determined by the traverse of the decode tree, and there is no need for a distinctive separator between letters. It is not possible to identify letters if you start at random in the middle of the message or if any of the bits in the message have been corrupted.

The first step in generating a frequency-based code is to read through all the messages to be packed, building up a table of frequencies or occurrences of each of the letters.

Figure 4 shows the occurrence table resulting from a scan through the test message. There are four spaces, two As, three Es and so on. Most of the characters in the ASCII character set do not occur at all in the message: B, C, D, etc., are absent, as are all the control characters; if they are not in the message then there is no need to produce codes for them.

Figure 3. Code table.

—	0	0		
A	1	1	1	1
E	1	1	0	
G	1	0	0	0
H	1	0	0	1
I	1	1	1	0
M	1	0	0	1
S	0	1		
T	1	0	1	

Figure 4. Occurrence table.

—	4
A	2
E	3
G	1
H	1
I	2
M	1
S	5
T	3

The next step is to generate a frequency-sorted tree of letters. Each node in the tree contains the letter itself together with its frequency. It also has pointers to two subtrees, one of which contains letters that are more frequent than the node letter, the other containing letters that are less frequent or equally frequent.

The frequency-sorted tree for the example message is shown in figure 5. It was built from the occurrence table by creating a new node for each letter in turn and adding this node to the growing tree. Adding the node is done by comparing the frequency value of the new node with that of a sequence of nodes already in the tree, starting with the left-most node. If the new letter occurs more frequently than the letter at a node then take the lower branch; otherwise take the upper branch.

For example, in figure 5 the last letter to be added was the letter T, which occurs three times in the message. There are fewer Ts than spaces, more Ts than As and as many Ts as Es.

The sorted tree generated in this way has the useful property that it is easy to find the least-frequent letter by starting at the left-most node and taking the upper branch at every subsequent node until there are no further upper branches. The

(continued on next page)

Figure 2. Decode tree.

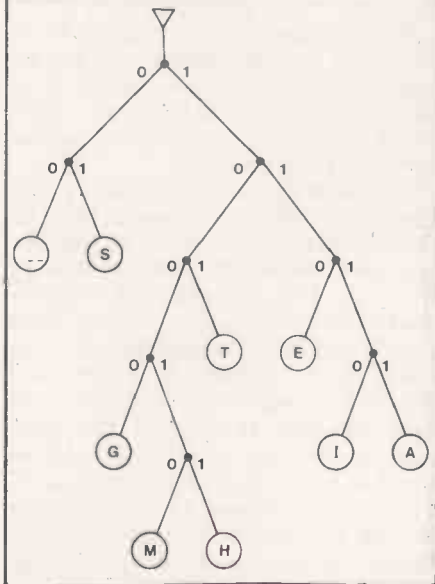


Figure 1. Packed message.

```
1 0 1 1 0 0 1 1   1 1 1 0 0 1 0 0   1 1 1 0 0 1 0 0
1 1 1 1 0 0 1 0   1 1 1 0 0 1 1 0   1 0 0 1 0 0 1 0
1 1 0 0 1 0 1 1   1 1 1 1 0 0 0 1   1 0 . . . . .
```

Figure 5. The sorted occurrence tree.

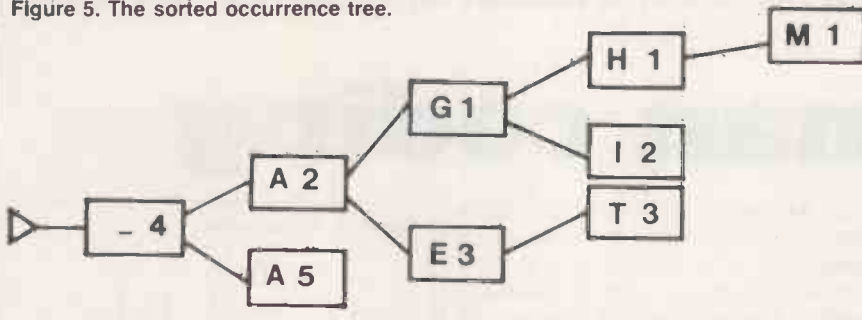
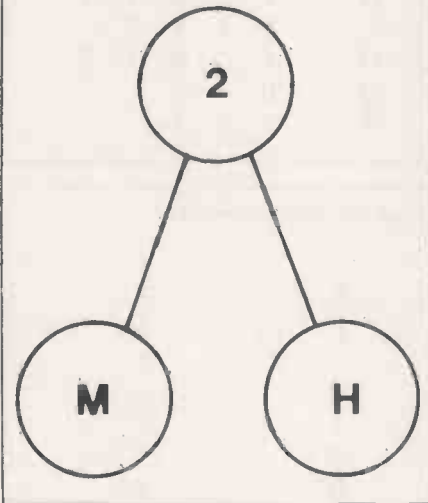


Figure 6. Decode-tree fragment.



(continued from previous page)

last node passed contains the least frequent letter. In figure 5 the "least-frequent letter" is M, although in this case there are three equally infrequent letters.

The last step in the process is to transform the frequency-sorted tree into a decode tree by first removing the two least-frequent letters from the frequency tree. In the Huffman code these two letters will be given almost identical codes which differ only by one bit. In decode-tree terms this means that the two leaves carrying these letters will be left and right subtrees from a common node. The two least-frequent letters are joined together to form a composite letter, which is represented as a fragment of the decode tree. The frequency of this composite letter is the sum of the frequencies of its two component letters; the composite letter is returned to the frequency tree in the normal way.

In figure 5 the two least-frequent let-

ters are M and H, so they are both removed and combined to give the composite letter shown in figure 6. Its decode-tree fragment has an occurrence count of 2 and is returned to the frequency tree to give figure 7 which now has one node less than it had at the start.

Repeating the remove-combine-replace operation will eventually generate a frequency tree with only one node. It will be a composite of every letter in the original message and has an occurrence count equal to the number of letters in the original message. Figure 8 shows an intermediate stage where three sets of pairs have been removed, combined and replaced, and figure 9 shows the final result with only one frequency-tree node remaining.

Producing a decode tree and packing a set of messages by hand is a complex and error-prone process. It is much better to write a message-handling program which can look after the business of typing in and editing the messages, as well as producing a decode tree and packing the text. Huffman coding works best when the number of characters is fairly small, so it is worthwhile converting all the lower-case letters to capitals and removing the control characters and obscure punctuation. The lower-case letters can be reconstructed when a message is to be displayed by capitalising only the first letters of sentences.

Figure 8. Three decode-tree fragments returned to the sorted tree.

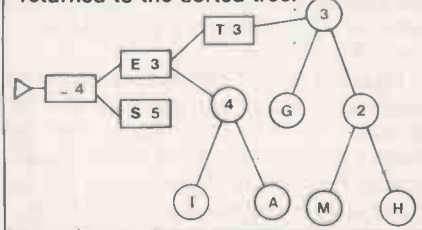


Figure 7. Decode-tree fragment returned to the sorted tree.

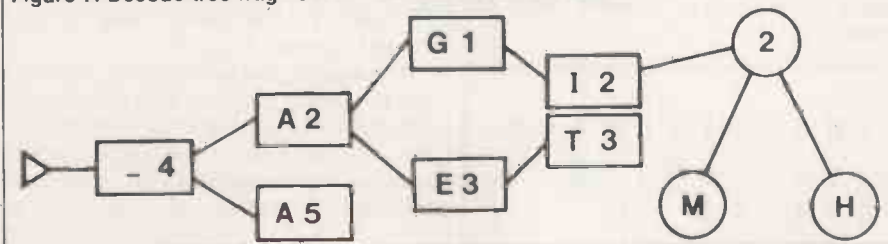


Figure 9. The completed decode tree.

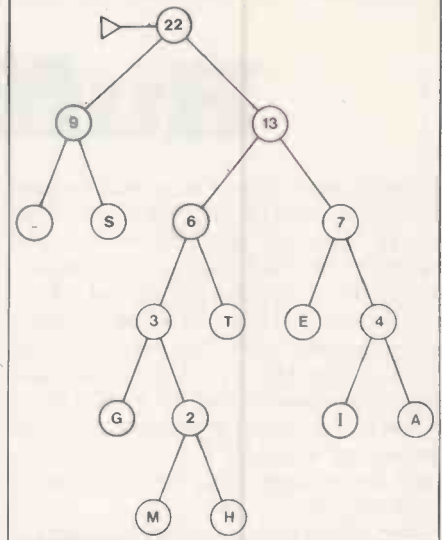
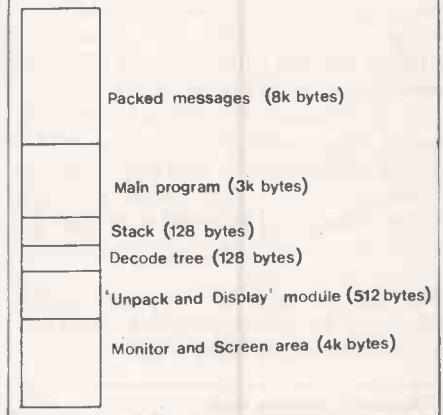


Figure 10. A typical memory of a running program using Huffman encoded messages.



If the character set is reduced to 64 characters then the decode tree can be represented much more compactly in memory. A tree for 64 ASCII characters can be fitted into only 127 bytes if you are sufficiently cunning.

The memory map for a typical games program is shown in figure 10. The packed messages and decode tree are generated as output from the message handler. The Unpack and Display module receives requests from the main program to display a particular message which has to be found in memory and unpacked, using the decode-tree traversal algorithm. If necessary, the lower-case letters are reconstituted before the message is displayed on the screen. Problems of layout and word wrap-around can also be dealt with by the display module, leaving the main program free to think of higher things.

A message handler has been written to commercial standards for the Nascom 2 and is available from IO Research. The original Wil Crowther Adventure game, which runs in 64K on a PDP-11, has been squeezed on to 32K with the help of message compaction.



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# TRON

High-resolution graphics hits the big screen in the first of a new breed of films. Bill Bennett has been to see it.



A FANTASY film, with special appeal for the microcomputer enthusiast, *Tron* is very much an artefact of today. In years to come people will be able to date it with great accuracy: the video games, the clothes, the music and the computers all locate the film firmly in the first half of the 1980s.

Yet the element that will undoubtedly be the real indicator of the film's date is the use of computer-generated graphics. Future film buffs will probably view *Tron* as the first stumblings in a new direction.

tell half the story; the moving graphics are much more impressive on the screen. The technique is a combination of animation with outright computer-generated graphics, so it is not surprising that the film is a product of the Walt Disney studio.

In its way, *Tron* has the feel of an updated *The Wizard Of Oz* with the action taking place in a fantasy world within the computer — in fact, a remake of that film using these techniques might be a good idea. *Tron* is described by the

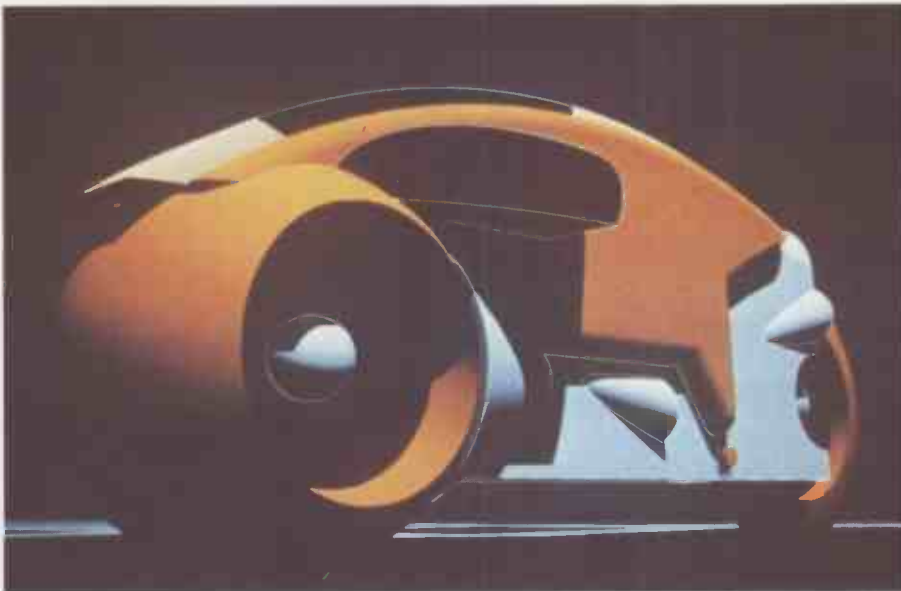
by Information International Inc and the Mathematical Applications Group, two U.S. computer companies. The image-creation process begins with an artist who draws an object on a large grid sheet, giving three images, top, side and bottom. The drawings are digitised and fed into a computer to provide the information required for any three-dimensional image of the object. The stored information is available for retrieval to place the object on the film, frame-by-frame.

Each frame is given colour and texture by using up to 2,000,000 pixels — which rather eclipses the 49,000 pixels available on the high-resolution graphics of the ZX Spectrum, for example. That 2,000,000 has to be multiplied by the number of frames per second, to reach the staggering total of 100,000,000 bits required for one second's film.

If the graphics displays all the sophistication and power of what is latest and greatest in computing, the storyline is the antithesis. Unkind people might suppose that the scriptwriter used an unexpanded ZX-81. The story is of the good old "baddies against goodies" variety: the baddies sport red fluorescent stripes and the goodies blue ones, so the cinemagoer is never left in the dark as to which side everyone is on.

The hero of the melodrama is neither a bounty hunter nor an interplanetary mercenary fighting the imperial fleet. He is a computer programmer. Naturally he is not any old computer programmer, he is the original brain behind the top-selling arcade game *Space Paranoids*. If the name *Space Paranoids* is not yet familiar to you, that is because the film-makers have signed up the rights to the game — the units will be in the arcades soon.

Flynn, our hero, is youthful and scruffy and no longer working for the giant Encom computer company that distri-



Some enthusiasts have claimed that the breakthrough is as important as the development of the "talkies", but comparison with the introduction of colour film is more apt.

The plot is rather pedestrian, making *Tron* little more than a showcase for the new technology. The stills which appear on this page give some idea of what you can expect at the cinema, but they only

film's writer and director Steven Lisberger as "a counterfeit reality".

Of the film's technique Lisberger says: "We had played all the video games, and when we investigated computer art we realised that by combining the concepts of electronic games and computer imaging we could bring something to life that had not been there before."

The computer images were produced





butes the Space Paranoids game. This sorry state of affairs came about because "power-hungry" executive Ed Dillinger claimed the kudos for writing the program. Flynn's days are now spent at the video arcade he owns, perfecting his video game performance.

The bright colour and the trashy neon glamour of the arcade is contrasted by Flynn's private flat above. Here he spends his time trying to prove his right to Space Paranoids, sitting in front of an Apple connected on-line to the giant

Encom system. His tinkering is detected by the MCP or master control program, which does not like it one little bit.

The MCP decides to deny access to the system for all the users in a particular group, including an old sparring partner of Flynn's, Alan Bradley. Together our heroes take on the might of the Encom system and the malignant MCP until Flynn is converted into an image within the machine and the fantasy begins.

In the computer the programs look like their programmers. It is a harsh, barbaric world where they all go in fear of the MCP. In some particularly interesting sequences the programs become pieces within a huge video game, and suffer the consequences of losing. Programs who believe that they have a user are denounced as heretics, and there are plenty of programming "in" jokes to spot.

The closing sequence of the film is that old chestnut, so familiar from imported U.S. television, the short tying-up of loose ends. So standard is it that it barely merits mention except to say that Flynn, having smashed the system and ousted Ed Dillinger, has simply replaced him at the top of the pile. That's entertainment.

#### Conclusions:

- *Tron* is a film for the microcomputer fan. It should excite any computer-crazed child.
- As a story it lacks in depth but is worth going to see for the graphics alone.
- *Tron* could be the first of a new wave of computer-aided films. □



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# Open File

This regular section of *Practical Computing* appears in the magazine each month, incorporating Tandy Forum, Apple Pie, Sinclair Line-up and other software interchange pages.

Open File is the part of the magazine written by you, the readers. All aspects of microcomputing are covered, from games to serious business and technical software, and we welcome contributions on CP/M, BBC Basic, Microsoft Basic, Apple Pascal and so on, as well as the established categories.

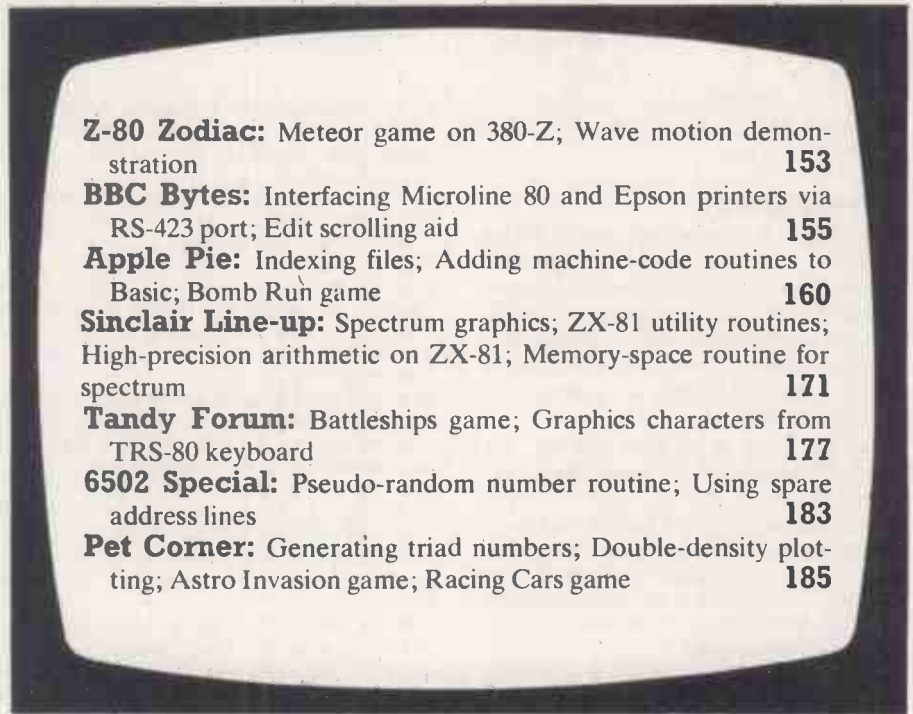
Contributors receive £30 per published page and pro rata for part pages, with a minimum of £6. Send contributions to: Open File, *Practical Computing*, Quadrant House, The Quadrant, Sutton, Surrey SM2 5AS.



## Meteor

YOUR FLEET has been caught in a meteor storm while launching an attack on invading aliens. Your aim is to continue the attack while manoeuvring your ships to

*(continued on next page)*



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## Guidelines for contributors

Programs should be accompanied by documentation which explains to other readers what your program does and, if possible, how it does it. It helps if documentation is typed or printed with double-line spacing — cramped or handwritten material is liable to delay and error.

Program listings should, if at all possible, be printed out. Use a new ribbon in your

printer, please, so that we can print directly from a photograph of the listing and avoid typesetting errors. If all you can provide is a typed or handwritten listing, please make it clear and unambiguous; graphics characters, in particular, should be explained.

We can accept material for the Pet, Vic and Sharp MZ-80K on cassette, and material for the larger machines can be sent on IBM-format 8in. floppy discs.

## Meteor

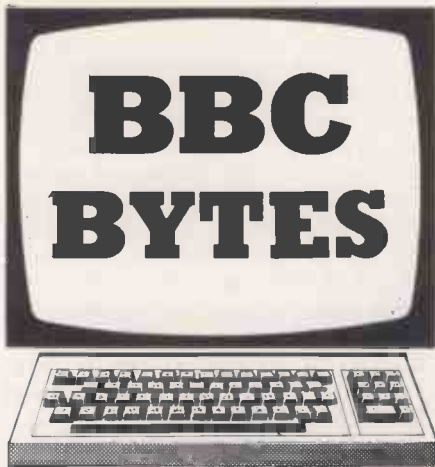
```

10 PUT 12,31
20 PRINT:PRINT:PRINT"Instructions (Y/N)"
30 A$=GET$(0):IF A$(0)="Y" THEN GOSUB 370
40 IF A$(0)("<N") THEN 30
50 PUT 12
60 A$=" (*> "
70 X=20:C=0:D=5:
80 RANDOMISE
100 A=RND(2)
110 B=INT(RND(8)*30)+3
120 P$=GET$(0):IF P="1" THEN VV=-2
122 IF P="3" THEN VV=0
125 IF P="0" THEN VV=2
126 X=X+VV:IF X>62 THEN VV=0:X=62
128 IF X<2 THEN X=2:VV=0
130 PLOT X,58,A$
    
```

*(listing continued on next page)*







## Printer interfaces

IF YOU HAVE NOT yet obtained the necessary connectors to interface your BBC Micro through the parallel printer port, and have a serial interface on the Microline or Epson printer, George Hill of London SE18 thinks you may be interested in these suggestions.

One problem with the BBC machine seems to be that it only sends a

<CR> (ODH, CHR\$(13))

at the end of each line. It is therefore necessary to make the printer perform automatic linefeed. The necessary alterations to the switches to cause this are listed. There are still some problems to be sorted out, such as obtaining the different print styles under software control, but the instructions will at least let you obtain plain text, program listings, etc.

The RS-423 connection on the back of the BBC Micro is a five-pin DIN connection — see figure 1. The plugs available for this socket will fit either way up. It is therefore necessary to label the top and bottom of your plug clearly, to avoid putting it in upside down. A minimum of

Table 1.

BBC Micro	to	Microline
pin B(data out)	to	pin 3(received data)
pin D(CTS)	to	pin 11(SSD)
pin E(RTS)	to	pin 2(transmitted data)
pin C(OV)	to	pin 7(signal ground)

Table 2.

1.	ON	8.	ON
2.	ON	9.	OFF
3.	OFF	10.	OFF
4.	OFF	11.	ON
5.	OFF	12.	ON
6.	ON	13.	OFF
7.	ON	14.	OFF

Table 3.

BBC Micro	to	Epson
pin B(data out)	to	pin 3(received data)
pin D(CTS)	to	pin 20(DTR)
pin C(OV)	to	pin 7(signal ground)

three cores and earth in the connecting cable, are needed.

First connect together some of the pins in the plug for the 25-pin connector to the Microline. Connect insulated wire loops joining pins 6,8 and 20, pins 4 and 5. The connections between the plugs for an Oki Microline printer are shown in table 1.

To cause automatic linefeed it is necessary to remove the cover of the printer by undoing the two Phillips screws at the front of the cover, then keep tilting and lifting it. Look at the printed circuit board from the back. At the right-hand side is a link labelled S-4. This must be in position B as illustrated in figure 2.

Now check the Dip switches on the serial interface board in the black box of the printer. The positions of the Dip switches is shown in table 2. These settings are illustrated in figure 3. Switches 4,5,6 control the baud rate which is set at 1,200 but can be increased to 9,600 without any undesirable effects.

The only difference when connecting an Epson MX-80F/T rather than the Microline is that you will need a minimum of two cores and earth in the connecting cable — see figure 4. The connections between the plugs are shown in table 3.

To cause automatic linefeed it is necessary to remove the cover of the printer by undoing the four Phillips screws on the base, then removing the paper feed knob

Table 4.

a) S-1 :8 switch block

1.	ON
2.	OFF
3.	OFF
4.	OFF
5.	ON
6.	ON
7.	OFF
8.	ON

b) S-2 :4 switch block

1.	ON
2.	ON
3.	OFF
4.	OFF

c) The Dip switch on the serial interface board 8141.

1.	OFF
2.	OFF
3.	OFF
4.	OFF
5.	OFF
6.	OFF
7.	ON
8.	OFF

by pulling hard, and carefully raising and tilting towards the side with the switches. The lid is finally laid, still connected, upside-down by the side of the printer base.

Now check the Dip switches on the main circuit board. To do this it is necessary to carefully remove the serial interface board by removing the four securing screws and the earth connection, and

*(continued on next page)*

Figure 1.

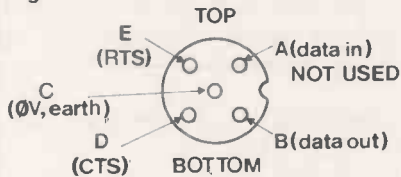


Figure 2.

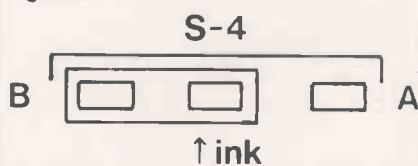


Figure 3.

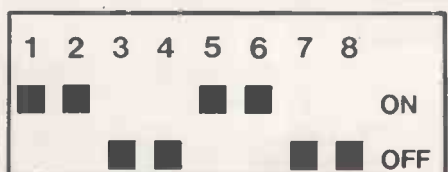
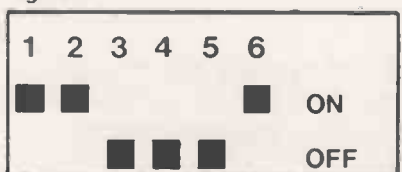


Figure 4.

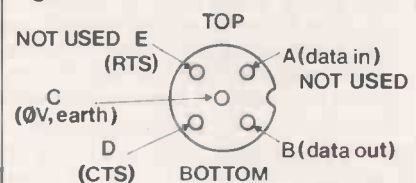


Figure 5a.

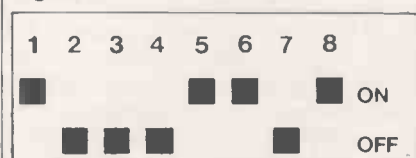


Figure 5b.

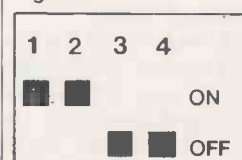
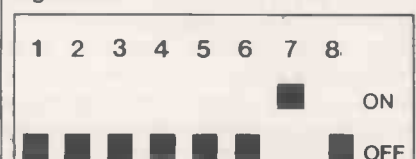


Figure 5c.



(continued from previous page)

slowly and carefully lift the board off the plug which secures it. The position of the Dip switches are shown in table 4. These settings are illustrated in figure 5.

Switches 1,3,4 and 7 control the baud rate which is set at 1,200. It cannot be increased without full handshaking arrangements.

The commands to call the printer are:

- \*FX 5,2 selects the RS-423 port
- \*FX 8,4 selects 1,200 baud
- VDU 2 or PRINT CHR\$(2) or CTRL B will now turn the printer on.
- VDU 3 or PRINT CHR\$(3) or CTRL C will turn it off.

To list the welcome programs it is necessary to break, and then type Old before the listing can be obtained.

## Edit scrolling

ONE OF THE problems in handling a large Basic program is BBC Micro's lack of a screen scrolling editor write A Phillips and H E Hicks of Lancaster. Typically, the user has to set page mode with Ctrl-N, input a List command and then use the Shift key to scroll to the area he wishes to edit. Then he has to abandon the listing with Escape, do the edits, and input another List command, after working out where the last screenful stopped.

The utility presented provides an automatic scroll facility controlled by one function key. Once the utility is in use, the edit process becomes much easier:

- The user selects page mode and issues the only List command needed.
- He uses Shift to scroll to the next section needing edits, as usual, and jumps out of the listing with Escape.
- After editing, during which he can perform any of the normal operations, pressing key 0 will automatically resume the listing from where it stopped in step 2. Now the user returns to the second step and continues.

The program that accomplished this is only one line long, but is somewhat astounding in its format and operation. The principle employed is that when a listing is abandoned by Escape, the number of the last line listed is stored as Erl, which is the variable recording whereabouts the last error occurred. What is then required is a List command using this number as the start line. However, the syntax of List does not allow the use of variables, so the command string has to be built in a devious fashion.

The single line of the program is a Mos command defining function key 0. When key 0 is pressed, the program set on it will build the List command and make the system obey it. In order to substitute the value of Erl into the command, the program on key 0 first builds a string which contains a \*Key command to set key 9. Since this is done by immediate mode Basic commands, the substitution required is easily done. The program on key 0 then makes the system obey this string, defining key 9. Finally, it makes the system believe key 9 has been

pressed, which causes it to obey its definition — the List command.

On examining the process in stages, the rather forbidding complexity can be unravelled. When the program is run, the single line sets key 0 to the single Basic statement:

```
$&900 = "*KEY 9" + CHR$34 + "LIST" +
STR$(ERL) + ", ;M" + CHR$34 : X% = 0 :
Y% = &09 : CALL &FFF7 : ?( &300 +
?&23C ) = 153 : ?&23C = ?&23C + 1 ;M
Here all occurrences of "" have become ""
in the command line processor.
```

The string can now be seen as a sequence of Basic commands, separated by ":" characters. When key 0 is pressed, the string is moved to the command input line, and the final ;M (Return) causes it to be immediately obeyed, without the user needing to press Return himself.

Examining the commands in turn, the first to be obeyed is:

```
$&900 = "*KEY 9" + CHR$34 + "LIST" +
STR$(ERL) + ", ;M" + CHR$34
```

The reason that CHR\$34 is used for the quote character is to prevent the number of doubled quotes becoming outrageous. If we assume the listing had stopped at line 1234, the contents of the string generated at &900 will be

```
*KEY 9 "LIST 1234, ;M"
which is starting to look like what we want. The reason for the ;M in the key 0 definition is now apparent. It had to generate a Return (;M) at this stage, rather than be taken as a Return itself.
```

The execution of key 0 now continues with the sequence

```
X% = 0
Y% = &09
CALL &FFF7
```

&FFF7 is a ROM routine which obeys a Mos command; in this case the \*Key 9 command. The assignments to %X and %Y will cause the X and Y registers to point to the start of the string when the routine is entered. After this stage, the statement programmed to be on key 9 will be

```
LIST 1234, ;M
```

which is exactly the command we need. Now, for its coup-de-grâce, the program

being obeyed as a result of pressing key 0 must fool the machine into believing key 9 has now been pressed. It sets the code for key 9, which is 153, into the next free byte in the type-ahead buffer: the contents of byte &23C, plus &300, points to this free byte. After incrementing the pointer value in &23C, the program for key 0 finally finishes. Now, looking for what to do next, the system checks whether anything has arrived in the type-ahead buffer while it was otherwise engaged. Of course, it finds the 153 code, so thinks key 9 has been pressed. It accordingly obeys the definition of key 9, and thus, at long last,

```
LIST 1234,
```

is obeyed, and the listing resumes where it left off.

To use this utility, it is only necessary to type in the one line in immediate mode. It is a rather difficult line to get right, so it would be better to save it as a program on tape called, say, Lister. Then

```
CHAIN "LISTER"
```

would load and run it. The utility would then be available until power-off. Break does not clear key definitions. Or until the user changed the setting of key 0. Key 9, which is programmed afresh every time key 0 is pressed, can be used freely, although its definition will be overwritten whenever key 0 is used.

A couple of extra facilities arise from the way the utility operates:

1. Key 9, on which the List command is defined, can be pressed to repeat the listing of the last screenful.
2. After a program error, which of course sets Erl to the number of the failing line, key 0 can be pressed for a listing starting at this line.

The only cautionary facts to consider are that key 0 should not be used for other things, and that X% and Y% will be changed when key 0 is used. Since the key builds its string at &900, the RS-432 buffer area, there will be conflicts with the user's own use of RAM if he has, for example, set Page to this or a lower value in order to cram in a large program. □

### Edt scrolling — listing 1.

```
$&900 = "*KEY 9" + CHR$34 + "LIST" + STR$(ERL) + ", ;M" + CHR$34 :
X% = 0 : Y% = &09 : CALL &FFF7 :
?( &300 + ?&23C ) = 153 : ?&23C = ?&23C + 1 ;M
$&900 = "*KEY 9" + CHR$34 + "LIST" + STR$(ERL) + ", ;M" + CHR$34
```

```
*KEY 9 "LIST 1234, ;M" LIST 1234, ;M
```

```
X% = 0 LIST 1234,
```

```
Y% = &09 CALL &FFF7 CHAIN "LISTER"
```

### Listing 2.

```
100 *KEY 0 "$&900 = "" *KEY 9 "" + CHR$34 + "" LIS
T "" + STR$(ERL) + "" , ;M "" + CHR$34 : X% = 0 : Y% = &
09 : CALL &FFF7 : ?( &300 + ?&23C ) = 153 : ?&23C = ?&
23C + 1 ;M"
```



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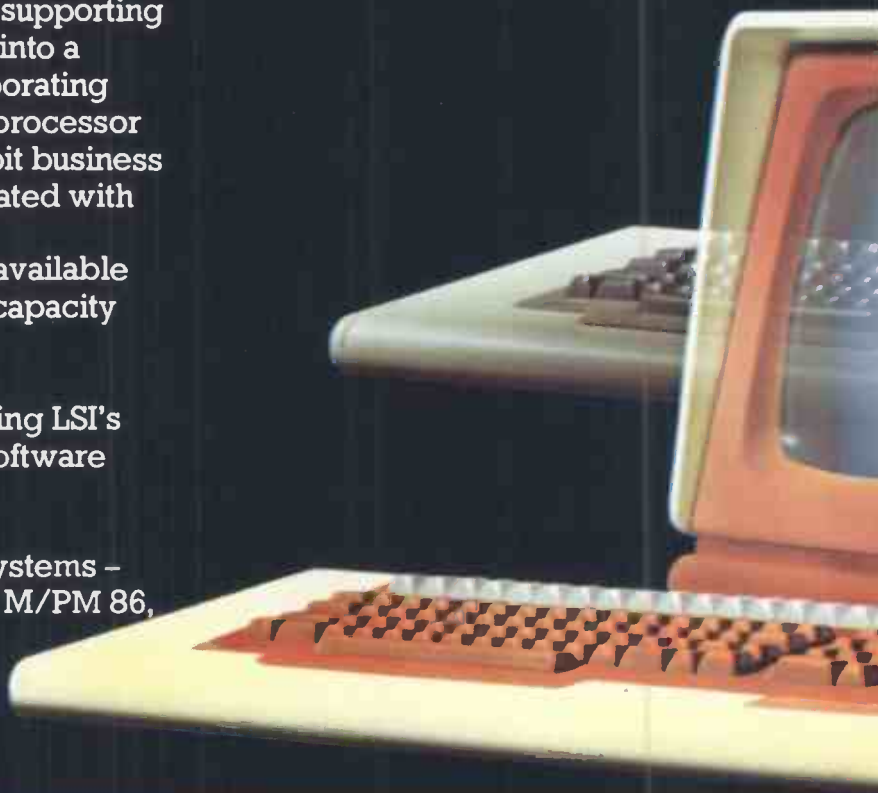
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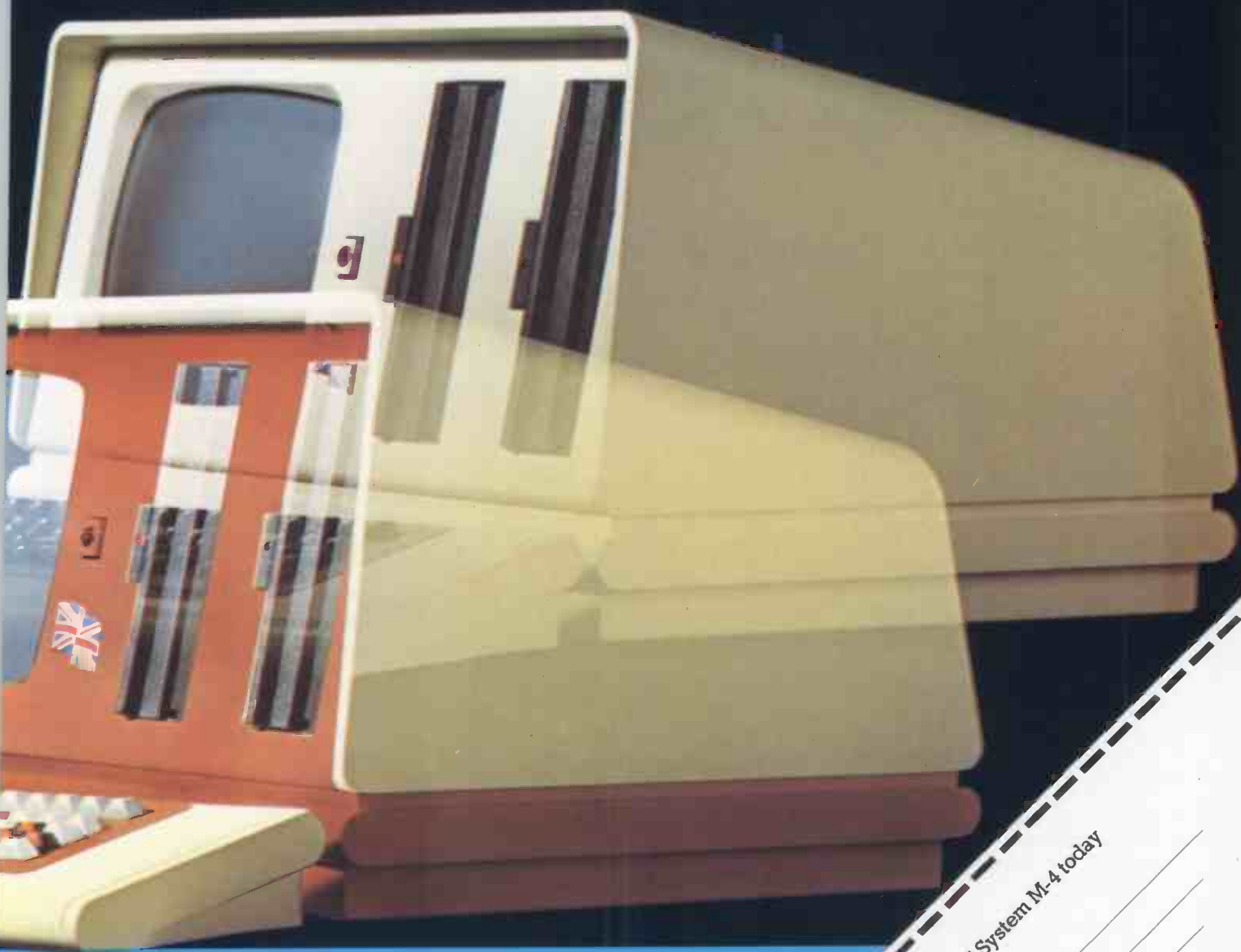
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## File index

HAVING ACCUMULATED a fair number of discs, each with more than a dozen files on it, I decided that it was time I had some means of indexing all the files. writes A Hourd of Brundall, Norfolk. After a while the usual disc labels become untidy and it is rather tedious to have to find a particular file by Cataloguing disc after disc.

The DFI program reads all the file data from a disc together with an arbitrary disc reference, stores that data in strings and then asks for further discs. When all discs have been read the file names can be sorted and printed together with the associated file type and disc reference. No writing to disc is involved, but it might be a useful extension to the program to keep the data in a text file.

Lines 840 to 860 contain the routine for reading and storing the contents of each disc. Most of the data involved is that required for the I/O parameter block and the data must be entered exactly as shown. Most importantly the 22nd piece of data must be a 1, since this defines the Read operation rather than a Write. More information can be found in pages 94 to 98 of the Dos Manual. Data taken from the disc is stored temporarily in a buffer starting around location 34500. The top of memory accessible to Basic must be set to this value, or less, by the Himem command as in line 35.

Lines 460 to 700 extract data from the buffer and pack it into a string array NAS(EN), where EN is the entry number. The flag for locked files is ignored in line 560, but could easily be reinstated if needed. Similarly there is allowance for just four file types, A,B,I and T; a ? is used to mark any of the other less common types.

The same procedure is followed for each disc, the buffer being cleared each time. The number of entries in array NAS() gradually builds up; when the last disc has been read, as signalled by entering N in answer to the prompt in line 720, program flow switches to the output stage.

A simple bubble-sort routine occupies  
(continued on page 162)

## File index.

```

10 REM *****
20 REM
   D.F.I.
DISC FILE INDEX
(LISTS ALL FILES ON SET OF DISCS)
DOS 3.3
30 REM *****
35 HIMEM: 34000
40 HOME : VTAB 10: PRINT "TAP ANY KEY WHEN READY";
50 GET AN$: PRINT AN$
60 PRINT
70 BA = 34500:TR = 1:FA = 0:EF = 0:AD = 768:IO = AD + 9:TW = 2
80 REM
NAMES OF FILES IN NAS()
DIMENSIONED FOR UP TO 500 FILES
90 DIM NAS(500)
100 S3$ = "000"
110 PRINT "PUT FIRST DISC IN, ENTER IT'S I.D.": PRINT
120 PRINT : INPUT "(ONLY 4 CHARS ALLOWED) ";DN$
130 IF LEN (DN$) < 4 THEN DN$ = DN$ + " ": GOTO 130
140 IF LEN (DN$) > 4 THEN 120
150 PRINT : FLASH : PRINT "WORKING.....WAIT": NORMAL : PRINT
160 EN = 0
170 GOSUB 370
180 REM
BUBBLE SORT ROUTINE
185 HOME : VTAB 10: PRINT CHR$ (7): PRINT "NOW WAIT WHILE ";EN;" FILES ARE SORTED": PRINT : FLASH : PRINT "DO NOT INTERRUPT..
...": NORMAL
190 FOR I = 1 TO EN - 1:SW = 0: FOR J = 1 TO EN - 1
200 IF NAS(J) < NAS(J + 1) THEN 220
210 TE$ = NAS(J):NAS(J) = NAS(J + 1):NAS(J + 1) = TE$:SW = 1
220 NEXT J
230 IF SW = 0 THEN I = EN - 1
240 NEXT I
245 PRINT CHR$ (7)
250 REM
END OF SORT
260 HOME : VTAB 5: PRINT "TURN ON PRINTER AND SET PAPER ": PRINT : PRINT " TO TOP OF FORM POSITION": PRINT : PRINT " THEN T
AP ANY KEY...": GET AN$: PRINT AN$: PRINT
270 PRINT CHR$ (4);"PR01"
280 PRINT CHR$ (9);"80N"
290 PRINT : PRINT SPC( 15);"MASTER CATALOGUE PAGE 1": PRINT
300 FOR X = 1 TO EN
310 PRINT SPC( 10); LEFT$ (NAS(X),1); SPC( 2); MID$ (NAS(X),2,20);
320 PRINT SPC( 2); MID$ (NAS(X),22,3); SPC( 2);"DISC "; RIGHT$ (NAS(X),4)
330 IF X / 55 = INT (X / 55) THEN PRINT CHR$ (12): PRINT : PRINT : PRINT SPC( 15);"MASTER CATALOGUE PAGE ";( INT (X /
55) + 1): PRINT
340 NEXT
350 PRINT CHR$ (4);"PR00"
360 END
370 PD = 0:RS = 0:SC = 0
380 REM
RESET ALL PARAMETERS FOR EACH DISC
390 GOSUB 840
400 BP = BA - 256:NT = 17:MS = 15
410 REM
MAIN LOOP FOR READING CATALOG
420 BP = BP + 256
430 POKE IO + 9, INT (BP / 256): POKE IO + 4, NT: POKE IO + 5, MS
440 CALL 768
450 GOSUB 880
460 IF EF = TR THEN 900
470 SC = SC + 1:NT = PEEK (BP + 1):MS = PEEK (BP + 2)
480 IF NT > 0 AND MS > 0 THEN 420
490 REM PUSH DATA INTO STRINGS
500 FOR CS = 1 TO SC
510 FOR SE = 1 TO 7
520 RS = (BA - 256) + (CS * 256) + 11 + (SE - 1) * 35
530 FT = PEEK (RS + 2)
540 IF ( PEEK (RS) = 255) OR ( PEEK (RS + 33) = 0) THEN 690
550 EN = EN + 1: REM UPDATE NO. OF ENTRIES
560 IF FT > = 128 THEN FT = FT - 128: REM IGNORE LOCKED CODE

```

(listing continued on page 162)



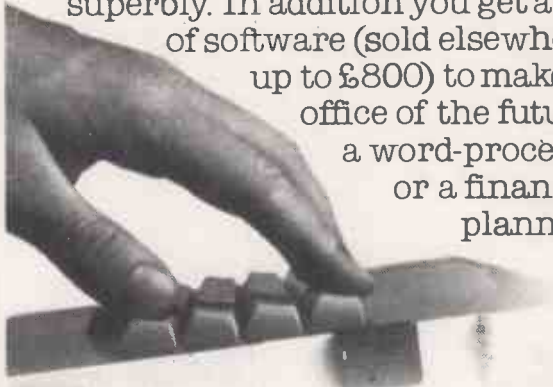
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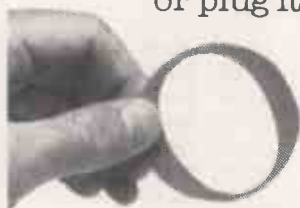


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(continued from page 160)

lines 180 to 250. It takes two minutes to sort about 70 files into alphabetical order. The file-type character is the first element of the string, and all the files are sorted so that Basic A files come to the head of the list, followed by binary B files, then integer, and so on. Files are ordered alphabetically within each file type as well. If more than 100 or so files have to be sorted, it would be worth employing a more rapid sort routine such as the Quicksort. A printout routine for the Epson MX-80F/T with a standard, non-graphics parallel interface takes up the remainder of the program so that the files listing is neatly paged and margined.

You should keep an eye on available memory space. As the number of files mounts up, the string array occupies more and more space, and there is no routine to block an attempt to read one disc too many. With Himem set to 20992, with a machine-code sort program in place, you can handle about 500 files; higher settings will permit the handling of still more files provided the Dim statement in line 90 is amended. To some extent the available memory display provides some warning, but it is impossible to predict how many files will be found on a specific disc and hence how much more memory will be needed. With Himem set to 34000 there should be room for some 700 files but the subsequent sorting of that many files by bubble sort could take for ever.

The program is liable to crash if discs of different Dos versions are read, as might happen if you have an old 13-sector disc mixed in with your 16-sector discs. Remember also that the disc-reading routine is installed at RAM location 768, \$300, even though the data it receives is parked just below Dos.

## Latching on

THIS PROGRAM by Craig Watson of Edinburgh is designed to illustrate how machine-code routines and/or hexadecimal data such as shape tables can be latched on to the end of an Applesoft program and saved along with it on cassette or disc as a single file. The Basic program must first be typed in as listed, though the Rem statements may be omitted.

Enter the monitor by typing  
CALL-151

followed by  
AF.B0 (return)

This will list the contents of these two memory locations which are used by Applesoft to point to the end of the program presently in memory — low-order byte in AF, high-order in B0. For example:

AF-56  
B0-19

Do not worry if the contents are not exactly the same as these — if you have  
(continued on page 164)

(Listing continued from page 160)

```
570 IF FT = 0 THEN FT$ = "I": GOTO 620
580 IF FT = 1 THEN FT$ = "J": GOTO 620
590 IF FT = 2 THEN FT$ = "A": GOTO 620
600 IF FT = 4 THEN FT$ = "B": GOTO 620
610 FT$ = "?": REM ONE OF THE UNUSUAL FILE TYPES, E.G. "R"
620 FS = PEEK (RS + 33):FS$ = S3$ + STR$ (FS):FS$ = RIGHT$ (FS$,3)
630 NAS(EN) = ""
640 FOR PD = 1 TO 20
650 NS = CHR$ ( PEEK (RS + TM + PD))
660 NAS(EN) = NAS(EN) + NS
670 NEXT
680 NAS(EN) = FT$ + NAS(EN) + FS$ + DNS$
690 NEXT
700 NEXT
710 I9 = FRE (0)
720 HOME : PRINT : PRINT "ANOTHER DISC (Y OR N) ?"
730 GET AN$: PRINT AN$: IF AN$ = "N" THEN RETURN
740 IF AN$ < > "Y" THEN 720
750 PRINT : PRINT "FREE MEMORY = ";I9
760 PRINT : PRINT "( LAST DISC REF WAS ";DNS$;" )"
770 PRINT : PRINT "PUT NEXT DISC IN, ENTER IT'S I.D."
780 PRINT : INPUT "ONLY 4 CHARS...":DNS$
790 IF LEN (DNS$) < 4 THEN DNS$ = DNS$ + " ": GOTO 790
800 IF LEN (DNS$) > 4 THEN 780
810 PRINT : FLASH : PRINT "WORKING.....WAIT": NORMAL : PRINT
820 GOTO 370
830 REM
```

DISC READ SUBROUTINE AND PARAM. TABLE

```
840 RESTORE
850 FOR X = 0 TO 29: READ Y: POKE AD + X,Y: NEXT : RETURN
860 DATA 169,3,160,9,32,217,3,96,0,1,96,1,0,17,15,26,3,196,134,0,0,1,0,0,96,1,0,1,239,216
870 REM
```

ERROR CHECK ROUTINE

RETURNS ERROR CODE AS PAGE 97 OF DOS MANUAL (IBSTAT)  
IN DECIMAL, NOT HEX !

```
880 IF PEEK (10 + 13) = 0 THEN EF = FA: RETURN
890 EF = TR: RETURN
900 PRINT : CALL - 1052: CALL - 1052
910 PRINT "ERROR NO. "; PEEK (10 + 13); " TRACK ";NT;" SECTOR ";NS
920 PRINT : PRINT "YOU CAN TRY SAME DISC AGAIN, OR PUT A"
930 PRINT : PRINT "FRESH DISC IN WITH NEW I.D."
940 PRINT : PRINT : PRINT "TAP ANY KEY TO CONTINUE...";
950 GET AN$: PRINT AN$: GOTO 710
```

MASTER CATALOGUE

PAGE 1

A	BRIAN'S THEME	006	DISC	MAST
A	COLOR DEMOSOFT	009	DISC	MAST
A	COPYA	009	DISC	MAST
A	DAYSPEC4:17/4/82	037	DISC	DOO1
A	DAYSPEC:1/5	037	DISC	DOO1
A	EXEC DEMO	010	DISC	MAST
A	GRID-PRINT	003	DISC	DOO1
A	HELLO	002	DISC	DOO1
A	HELLO	006	DISC	MAST
A	LIST-WTS II	024	DISC	DOO1
A	LITTLE BRICK OUT	028	DISC	MAST
A	MAKE TEXT	003	DISC	MAST
A	PHONE LIST	051	DISC	MAST
A	RANDOM	010	DISC	MAST
A	RENUMBER	013	DISC	MAST
A	RENUMBER INSTRUCTION	039	DISC	MAST
A	RETRIEVE TEXT	003	DISC	MAST
A	SPECMAST:17/11	041	DISC	MAST
A	WT-LIST IV	023	DISC	DOO1
A	WT-LIST V	018	DISC	DOO1
A	WT-LIST VI	020	DISC	DOO1
A	WTCONTROL:1/3	037	DISC	DOO1
A	WTCONTROL:BACKUP	042	DISC	DOO1
B	BOOT13	010	DISC	MAST
B	CHAIN	003	DISC	MAST
B	COMCARD 300BD EP 1S	002	DISC	DOO1
B	COPY.OBJO	003	DISC	MAST
B	FID	020	DISC	MAST
B	FPBASIC	050	DISC	MAST
B	INTBASIC	050	DISC	MAST

(listing continued on page 164)



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(continued from page 162)

the RAM version of Applesoft they will certainly be different — since all the able. Add 1 or 2 to the contents of AF, machine-code routines are fully relocated and if any carry results, do not forget to add it to the contents of B0.

The resulting address is the address where you will begin to type in the hex dump as listed, but using colons after the addresses instead of dashes. Once this is completed, the contents of AF and B0 must be adjusted to point to the last byte in the hex dump, for example:

AF: 7B 1A (return)

Finally return to Basic by typing 3D0G

(continued on page 169)

(listing continued from page 162)

B	MASTER CREATE	009	DISC MAST
B	MUFFIN	027	DISC MAST
I	ANIMALS	018	DISC MAST
I	APPLESOFT	006	DISC MAST
I	APPLEVISION	026	DISC MAST
I	BIORHYTHM	017	DISC MAST
I	COLOR DEMO	009	DISC MAST
I	COPY	009	DISC MAST
T	APPLE PROMS	003	DISC MAST
T	DLXX00	001	DISC DOO1
T	MACHINE MAST	007	DISC DOO1

SAMPLE OUTPUT FROM TWO DISCS, INCLUDING DOS 3.3 MASTER.

DISC NAMES ARE ARBITRARY, NOT VOLUME NUMBERS

## Latching on.

```

1 REM *****
2 REM
3 REM      ASTRO-FIGHTER
4 REM
5 REM  BY CRAIG H. WATSON  21/6/82
6 REM
7 REM *****
8 REM
9 REM  DIMENSION CO-ORDINATE ARRAYS ***
10 DIM I(11),Y(11),SM(11)
99 REM  END OF PROGRAM IN RAM ***
100 MC = PEEK (175) + PEEK (176) + 256
199 REM  CALCULATE STARTING ADDRESSES OF M/C ROUTINES & SHAPE TABLES ***
200 SD = MC - 22
300 RC = MC - 32
400 HI = MC - 61
500 ST = MC - 291
599 REM  SET UP POINTERS TO SHAPE TABLES ***
600 HDKE 233, INT (ST / 256): POKE 232,ST - (INT (ST / 256) * 256)
700 GOTO 20000
999 REM  READ KEYBOARD ROUTINE ***
1000 CALL RCIV = PEEK (768)
1100 IF V = 212 THEN SY = SY - 5: IF SY < 10 THEN SY = 10
1200 IF V = 214 THEN SY = SY + 5: IF SY > 149 THEN SY = 149
1300 IF V = 198 THEN VX = VX - 1: IF VX < 1 THEN VX = 1
1400 IF V = 200 THEN VX = VX + 1: IF VX > 50 THEN VX = 50
1500 IF V = 199 THEN GOSUB 70000: GOTO 1000
1600 IF V = 160 THEN MI = 1: MY = SY
1999 REM  ERASE FIGHTER AT OLD POSITION & RE-DRAW AT NEW POSITION ***
2000 HCOLOR = 0: SCALE = 1: ROT = 0
2100 DRAW 2 AT 50,SY: DRAW 2 AT 50,(SY + 5): DRAW 2 AT 50,(SY - 5)
2200 HCOLOR = 3
2300 DRAW 2 AT 50,SY: RETURN
2999 REM  ERASE STARS & UFOs BEFORE UPDATING CO-ORDINATES ***
3000 FOR A = 1 TO 10
3100 HCOLOR = 0: SCALE = 1: ROT = 0
3200 DRAW SM(A) AT X(A),Y(A)
3300 NEXT A
3400 RETURN
3499 REM  RE-DRAW STARS & UFOs AT NEW POSITIONS ***
3500 FOR A = 1 TO 10
3510 IF SM(A) = 3 AND X(A) < 10 THEN SM(A) = 3800
3600 HCOLOR = 3: SCALE = 1: ROT = 0
3700 DRAW SM(A) AT X(A),Y(A)
3800 NEXT A
3900 RETURN
3999 REM  ROUTINE TO UPDATE CO-ORDINATES OF STARS & UFOs ***
4000 FOR B = 1 TO 10
4050 IF SM(B) = 3 THEN X(B) = X(B) - (VX + 5): GOTO 4200
4100 Y(B) = Y(B) - VX
4200 IF X(B) < 10 THEN 4400
4300 GOTO 4800
4400 X(B) = 269:Y(B) = INT (RND (1) * 839 + 10)
4500 M = RND (1)
4600 IF M > 0.5 THEN SM(B) = 3: GOTO 4800
4700 SM(B) = 1
4800 NEXT B
4810 IF MI = 1 THEN D = 67: GOSUB 10100:MI = 0: GOTO 4900
4820 MI = 0: D = 67
4900 RETURN
4999 REM  ROUTINE TO DRAW UFO EXPLOSION ***
5000 HCOLOR = 0: SCALE = 1: ROT = 0: DRAW 3 AT X(E),Y(E)
5100 HCOLOR = 3: DRAW 4 AT X(E),Y(E)
5200 SOUND = 2: GOSUB 9000
5300 DRAW 4 AT X(E),Y(E)
5400 X(E) = 0:SC = SC + (VX + 10): RETURN
5999 REM  ROUTINE TO DRAW FIGHTER EXPLOSION ***
6100 HCOLOR = 3
6200 SCALE = 2
6210 SOUND = 1: GOSUB 9000
6250 FOR P = 0 TO 63 STEP 8
6260 ROT = P
6300 R = 50: S = SY
6400 HCOLOR = INT (RND (1) * 6 + 1): DRAW 4 AT R,S
6450 NEXT P
6460 ROT = 0
6600 FOR P = 0 TO 63 STEP 8
6700 ROT = P
6800 HCOLOR = 0: DRAW 4 AT R,S
6810 NEXT P

```

```

6900 RETURN
6999 REM  ROUTINE TO DRAW HYPERSPACE ***
7000 SOUND = 3: GOSUB 9000: FOR M = 1 TO 10: CALL MI: NEXT M
7100 TI = TI - INT (RND (1) * 9 + 1): GOTO 11000
7999 REM  ROUTINE TO CHECK FOR UFO/FIGHTER COLLISION ***
8000 FOR C = 1 TO 10
8100 IF SM(C) < 3 THEN 8300
8200 IF ((X(C) < 69 AND X(C) > 50) AND (Y(C) < (SY + 7))) AND (Y(C) > (SY - 7)) THEN 8500
8300 NEXT C
8400 RETURN
8500 Z = Z - 1: GOSUB 6100: IF Z = 0 THEN 30000
8999 REM  ROUTINE TO GENERATE SOUNDS ***
9000 IF SOUND = 1 THEN POKE (SD + 1),5: POKE (SD + 15),140: CALL SD: RETURN
9100 IF SOUND = 2 THEN POKE (SD + 1),20: POKE (SD + 15),70: CALL SD: RETURN
9300 IF SOUND = 3 THEN FOR A = 40 TO 5 STEP - 5: POKE (SD + 1),A + 10: POKE (SD + 15),A: CALL SD: NEXT A: RETURN
9400 IF SOUND = 4 THEN POKE (SD + 1),5: POKE (SD + 15),100: CALL SD: RETURN
9500 IF SOUND = 5 THEN FOR A = 80 TO 1 STEP - 1: POKE (SD + 1),5: POKE (SD + 15),A: CALL SD: NEXT A: FOR A = 1 TO 80: POKE (SD + 1),5: POKE (SD + 15),A: CALL SD: NEXT A: RETURN
9999 REM  ROUTINE DRAW FIGHTER LASER ***
10100 HCOLOR = 6: HPLLOT D,MY TO 269,MY
10150 SOUND = 1: GOSUB 9000
10200 FOR E = 1 TO 10
10250 IF SM(E) < 3 THEN 10400
7100 TI = TI - INT (RND (1) * 9 + 1): GOTO 11000
7999 REM  ROUTINE TO CHECK FOR UFO/FIGHTER COLLISION ***
8000 FOR C = 1 TO 10
8100 IF SM(C) < 3 THEN 8300
8200 IF ((X(C) < 69 AND X(C) > 50) AND (Y(C) < (SY + 7))) AND (Y(C) > (SY - 7)) THEN 8500
8300 NEXT C
8400 RETURN
8500 Z = Z - 1: GOSUB 6100: IF Z = 0 THEN 30000
8999 REM  ROUTINE TO GENERATE SOUNDS ***
9000 IF SOUND = 1 THEN POKE (SD + 1),5: POKE (SD + 15),140: CALL SD: RETURN
9100 IF SOUND = 2 THEN POKE (SD + 1),20: POKE (SD + 15),70: CALL SD: RETURN
9300 IF SOUND = 3 THEN FOR A = 40 TO 5 STEP - 5: POKE (SD + 1),A + 10: POKE (SD + 15),A: CALL SD: NEXT A: RETURN
9400 IF SOUND = 4 THEN POKE (SD + 1),5: POKE (SD + 15),100: CALL SD: RETURN
9500 IF SOUND = 5 THEN FOR A = 80 TO 1 STEP - 1: POKE (SD + 1),5: POKE (SD + 15),A: CALL SD: NEXT A: FOR A = 1 TO 80: POKE (SD + 1),5: POKE (SD + 15),A: CALL SD: NEXT A: RETURN
9999 REM  ROUTINE DRAW FIGHTER LASER ***
10100 HCOLOR = 6: HPLLOT D,MY TO 269,MY
10150 SOUND = 1: GOSUB 9000
10200 FOR E = 1 TO 10
10250 IF SM(E) < 3 THEN 10400
10300 IF (MY > Y(E) - 5) AND (MY < Y(E) + 5) AND (X(E) > 67) THEN 10600
10400 NEXT E
10500 HCOLOR = 0: HPLLOT D,MY TO 269,MY: RETURN
10600 HCOLOR = 0: HPLLOT D,MY TO 269,MY
10700 GOTO 5000
10999 REM  ROUTINE TO INITIALISE THE HI-RES SCREEN ***
11000 HGR :VX = 1:SY = 79:MI = 0: D = 67
11100 FOR J = 1 TO 10
11200 X(J) = INT (RND (1) * 259 + 10):Y(J) = INT (RND (1) * 139 + 10)
11300 SM(J) = 1
11400 NEXT J
11500 GOSUB 3500
11600 GOSUB 2000
11700 RETURN
11999 REM  ROUTINE TO PRINT SCORE ETC. ***
12000 HOME : VTAB 21
12100 HTAB 5: PRINT "SCORE=";SC;"  ";I;" FIGHTER(S) REMAINING"
12150 PRINT
12160 IF TI < 20 THEN FLASH
12200 HTAB 11: PRINT "TIME REMAINING = ";TI
12250 NORMAL
12300 RETURN
12999 REM  ROUTINE TO DRAW UFO LASER & CHECK FOR HIT ON FIGHTER ***
13000 M = RND (1)
13100 FOR K = 1 TO 10
13200 IF (SM(K) = 3) AND (M > 0.4) AND (K < 7) THEN 13400
13300 NEXT K: RETURN
13400 HCOLOR = 5: HPLLOT X(K),Y(K) TO 0,Y(K):SOUND = 4: GOSUB 9000: I = K
13500 IF (Y(K) > (SY - 6)) AND (Y(K) < (SY + 6)) AND (X(K) > 70) THEN HCOLOR = 0: HPLLOT X(K),Y(K) TO 0,Y(K):Z = Z - 1: GOSUB 6100: IF Z = 0 THEN POP : GOTO 30000
13600 HCOLOR = 0: HPLLOT X(K),Y(K) TO 0,Y(K)
13700 RETURN
19999 REM  INSTRUCTIONS ROUTINE ***
20000 TEXT : HOME
20100 HTAB 13: PRINT "ASTRO-FIGHTER"; HTAB 13: PRINT "*****"
20200 PRINT : PRINT : PRINT
20300 PRINT "YOU'RE MISSION IS TO DESTROY THE UFOs" (listing continued on page 169)

```



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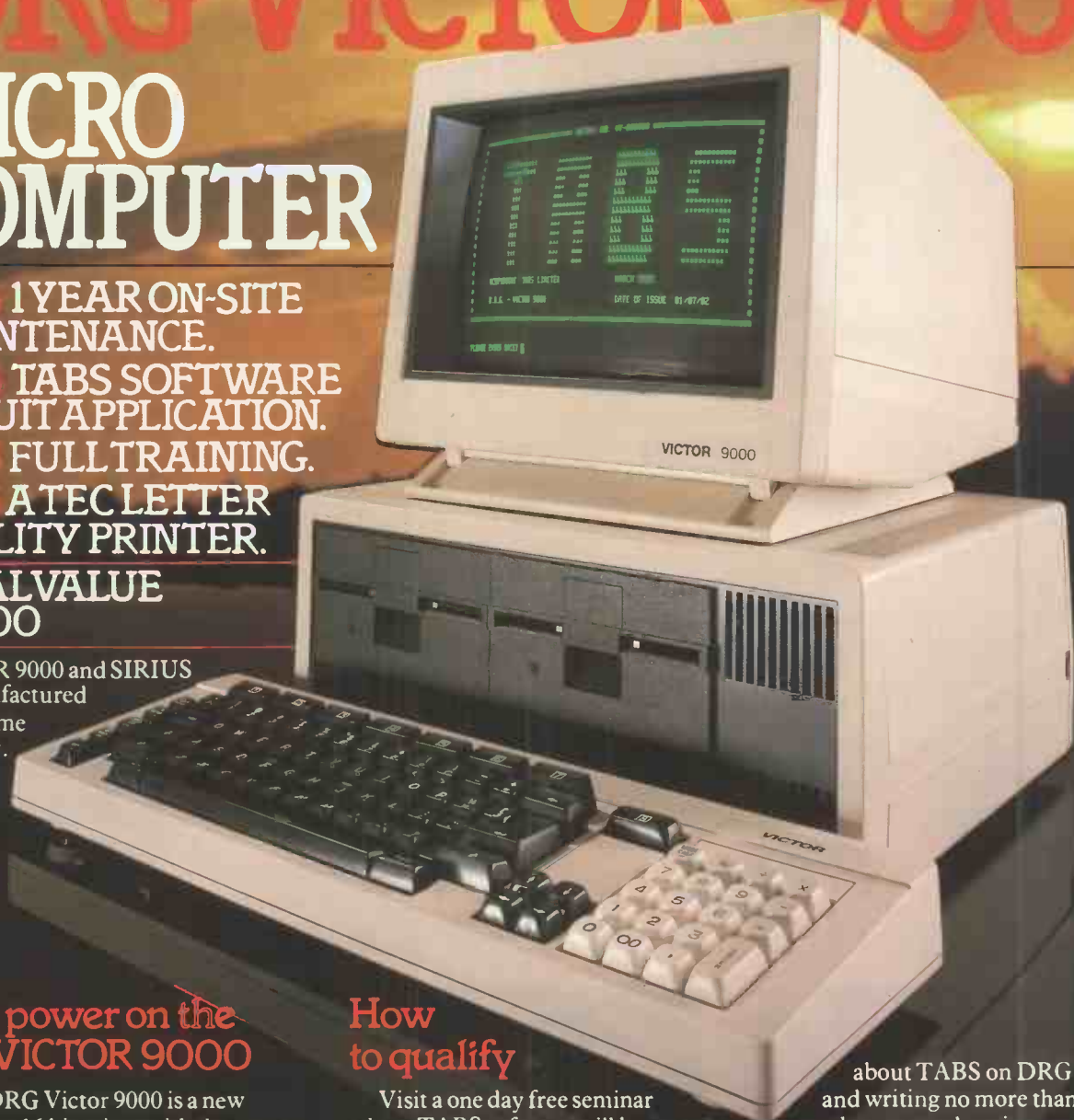
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# TABS



(listing continued from page 164)

```

20400 PRINT "THAT WILL FLY AT YOU FROM THE RIGHT OF"
20500 PRINT "THE SCREEN.": PRINT
20600 INVERSE : PRINT "THE FASTER YOU GO, THE HIGHER YOUR SCORE"
20650 NORMAL
20700 PRINT "YOUR CONTROLS ARE :-"
20800 PRINT "      T (UP)"
20900 PRINT "      F (DECELERATE)      H(ACCELERATE)"
21000 PRINT "      V (DOWN)"
21050 PRINT
21100 PRINT "      PRESS 'G' FOR HYPERSPACE"
21150 PRINT
21200 PRINT "PRESS SPACE TO FIRE LASER"
21300 PRINT : PRINT : PRINT "GOOD LUCK...."
21400 VTB 24: PRINT "PRESS ANY KEY TO BEGIN ": GET A$
21500 HOME : SC = 0 : Z = 5 : TI = 200
21599 REM ### MAIN PROGRAM DRIVER ROUTINE ###
21600 GOSUB 11000
21700 GOSUB 12000
    
```

```

21800 GOSUB 1000
21900 GOSUB 3000
22000 GOSUB 4000
22100 GOSUB 3500
22200 GOSUB 8000
22250 GOSUB 13000
22300 TI = TI - 1
22400 IF TI = 0 THEN 30000
22500 GOTO 21700
29999 REM ### END OF GAME ROUTINE ###
30000 HOME : VTB 23: HTAB 15: FLASH : PRINT "GAME OVER": SOUND = 5: GOSUB 9000: FOR A = 1 TO 2000:
NEXT A: NORMAL : TEXT : HOME : VTB 12
30100 IF Z = 0 THEN PRINT "TOO BAD, YOU RAN OUT OF FIGHTERS.": GOTO 30250
30200 IF TI = 0 THEN PRINT "TOO BAD, YOU RAN OUT OF TIME."
30250 VTB 15: PRINT "YOUR SCORE WAS ": SC
30300 VTB 23: PRINT "RUN AGAIN ? (Y/N)": INPUT A$
30400 IF A$ < "N" THEN RUN
30500 TEXT : HOME : END
    
```

### Latching-on shape table.

```

1958- 04 00 0A 00 10 00 53 00
1960- 77 00 3E 24 2D 36 04 00
1968- 09 18 08 18 30 36 1E
1970- 1E 0C 18 08 4E 2D 2D 2D
1978- 2D F5 3F 3F 3F F7 2D
1980- 2D 2D 2D 0D 18 08 18 08
1988- 08 08 08 30 2D 15 2D 2D
1990- 2D DF DB DF 0F 2D DE 2D
1998- 2D 2D 2D 2D 2D 2D DF DB
19A0- 08 08 08 DF 3F 2C 16 3F
19A8- 38 27 00 60 0C 2D B5 D2
19B0- 08 73 0E 2D 25 1C 0C 18
19B8- 08 1E 3E 0D 30 26 08 18
19C0- 08 0E 0E 0E 96 DB 0C 0C
19C8- 3C 30 BE 24 24 04 00 1B
19D0- 3F 5F 4D 09 18 E0 1C 4D
19D8- 92 92 F3 1E 4D 09 18 30
19E0- 0E 0C 18 08 18 08 08 64
19E8- 96 21 0C 0C 96 D2 33 0E
19F0- 0E 0C 18 08 0E 0E 25 08
19F8- 18 08 98 DB 0C 0C B5 DA
1A00- 2D 2D 2D 2D 0D 25 DB DB
1A08- B3 12 0C 18 08 18 08 18
1A10- F8 08 18 DF F8 DB DF FB
1A18- 9B DF 92 DF 92 52 89 96
1A20- 5A 09 4D 49 4D 4A 4D 68
1A28- 11 4E 21 DF DB DB DB DB
1A30- 1B 08 18 08 58 D9 1B 0F
1A38- 18 08 18 38 04 00 A9 00
1A40- 85 00 A9 20 85 01 A0 85
1A48- B1 00 49 FF 91 00 E6 00
1A50- D0 F6 E6 01 A5 01 29 1F
1A58- D0 EE 60 AD 00 C0 8D 00
1A60- 03 AD 10 C0 60 A0 05 A2
1A68- 00 BA 18 E9 01 D0 FC 8D
1A70- 30 C0 E8 E0 50 D0 F2 88
1A78- 00 ED 60 4D
    
```

### Bomb Run

**BOMB RUN** by Douglas Chapple of Noke, Oxford is a fast action game where the object is to bomb the skyscrapers. Slowly you are losing height and to prevent crashing you must destroy the buildings. You can fire only one bomb at a time and at the end of the game the percentage of buildings destroyed is displayed. It is highly addictive and once mastered can be made more difficult by changing the Random statement in line 240.

The program uses PDL(1) but could be changed to use the keyboard by activating the keyboard strobe.

#### Bomb Run.

```

10 REM ** BOMB RUN **
20 REM ** WRITTEN BY **
30 REM ** PIERS CHAPPLE **
40 REM **
50 REM **
60 GOSUB 700
70 GOSUB 430
80 REM **
90 REM **** PLOT PLANE MOVEMENT
100 REM **
110 FOR H = C TO D
120 FOR Q = A TO E
130 PLOT Q,H: PLOT Q,H - 1: PLOT
Q + 1,H: PLOT Q + 2,H
140 REM **
150 REM ** HAS PLANE CRASHED?
160 REM **
170 IF SCRNK (Q + 3),H) > 0 THEN
HOME : PRINT "YOU CRASHED":
GOTO 890
180 REM **
190 REM ** HAS PLANE SUCCEEDED?
200 REM **
210 IF H = Y THEN GOSUB 1020
220 REM **
230 REM ** ERASE PLANE AND ?BOMB
240 REM **
250 COLOR = 0
260 PLOT Q,H: PLOT Q,H - 1: PLOT
Q + 1,H: PLOT Q + 2,H
270 IF P = 1 THEN PLOT X1,Y1 -
1
280 REM **
290 REM ** HAS BOMB LANDED?
300 REM **
310 IF V1 = 40 THEN P = 0: X = PEEK
(S0) + PEEK (S0) - PEEK (S
0) + PEEK (S0): Y1 = 0
320 COLOR = 15
330 REM **
340 REM ** FIRE BOMB?
350 REM **
360 IF P = 0 THEN K = PEEK < -
16286>: IF K > 127 THEN X1 =
Q + 2: V1 = H + 1: P = 1
370 REM **
380 REM ** PLOT ?BOMB
390 REM **
400 IF P = 1 THEN PLOT X1,Y1:Y1
= Y1 + 1
410 NEXT Q,H
420 END
430 GR
440 HOME
450 VTB 21: HTAB 14: PRINT "BUE
NOS AIRES"
460 REM **
470 REM **** BUILD CITY
480 REM **
    
```

```

490 FOR F = 3 TO 38
500 M = INT ( RND (1) + 14) + 2
510 Z = INT ( RND (1) * 17) + 18
520 COLOR = M
530 ULIN Z,39 AT F
540 NEXT F
550 REM **
560 REM ** CALC. AREA OF CITY
570 REM **
580 FOR MN = 20 TO 39
590 FOR NM = 3 TO 38
600 IF SCRNK (NM,MN) > 0 THEN LO
= LO + 1
610 NEXT NM
620 NEXT MN
630 COLOR = 15
640 A = 0: B = 36: C = 1: D = 39: Y =
39: S0 = - 16336
650 RETURN
660 END
670 REM **
680 REM ** INTRODUCTION
690 REM **
700 TEXT : HOME : HTAB 16: FLASH
: PRINT "BOMB RUN"
710 NORMAL
720 VTB 7: PRINT " THE TOWN IS
": INVERSE : PRINT "
"
730 PRINT : HTAB 3: PRINT "YOU";
: NORMAL : PRINT " ARE THE P
ILOT"
740 PRINT ! : PRINT : PRINT "THE O
BJECT IS TO REDUCE THE CITY
TO"
750 PRINT "RUBBLE BEFORE YOUR PL
ANE RUNS INTO THE"
760 PRINT "BUILDINGS. THE FUTUR
E OF ENGLAND"
770 PRINT "DEPENDS ON YOU ALONE!"
780 PRINT
790 PRINT "TO FIRE A BOMB, PUSH
THE FIRE BUTTON ON"
800 PRINT "PADDLE NUMBER ONE"
810 PRINT : PRINT : PRINT "
SPC 8)" HIT ANY KEY TO CONT
INUE"
820 VTB 1: HTAB 20: GET X$
830 HOME
840 P = 0
850 RETURN
860 REM **
870 REM ** CALC. AREA REMAINING
880 REM **
890 FOR LH = 20 TO 39
900 FOR LN = 3 TO 38
910 IF SCRNK (LN,LH) > 0 THEN LH
= LH + 1
920 NEXT LN
930 NEXT LH
940 REM **
950 REM ** DEDUCT PLANE & ?BOMB
960 REM **
970 LH = LH - 4: IF P = 1 THEN LH
= LH - 1
980 SC = (LH / LO) * 270
990 PRINT : PRINT : PRINT "YOU D
ESTROYED ":100 - INT (SC):"
% OF THE CITY"
1000 GOTO 1070
1010 END
1020 HOME
1030 REM **
1040 REM ** REPLAY?
1050 REM **
1060 PRINT "HELL DONE---YOU WIN"
1070 PRINT "TO PLAY AGAIN-HIT AN
Y KEY EXCEPT 'S'": GET A$
1080 IF A$ < "S" THEN : CLEAR
: GOTO 70
1090 HOME : TEXT : HOME : END
    
```

(continued from page 164)

if you have Dos, or Ctrl-C; do not use Ctrl-B. Then save the program in the same way that you would save an ordinary Basic program.

The game itself involves shooting down UFOs which move across the screen from right to left. The T and V keys move your fighter up and down the screen. Pressing the H key causes the stars and UFOs to scroll across the screen faster, and F will slow them down. Pressing G causes a jump to hyperspace, which also causes the time to be decreased by a random factory of between one and 10 units, and the space bar fires your laser. The number of points scored for each UFO depends on how fast you are moving.

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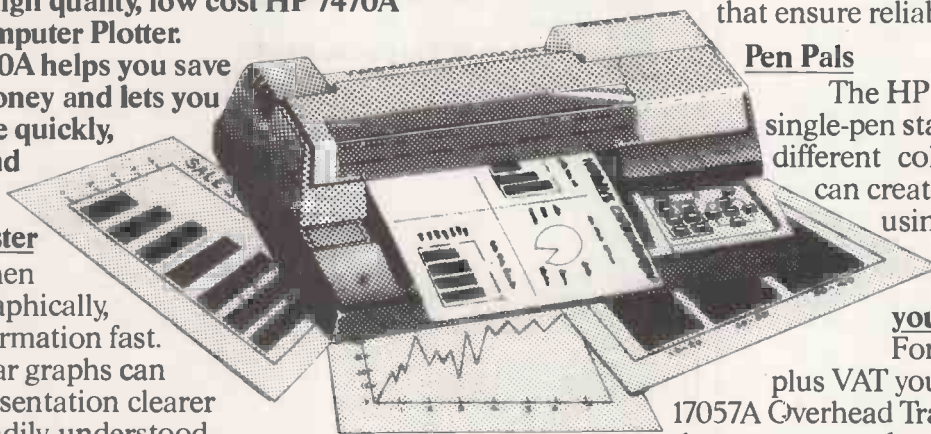
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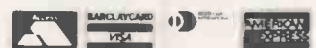
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### Coloured circles

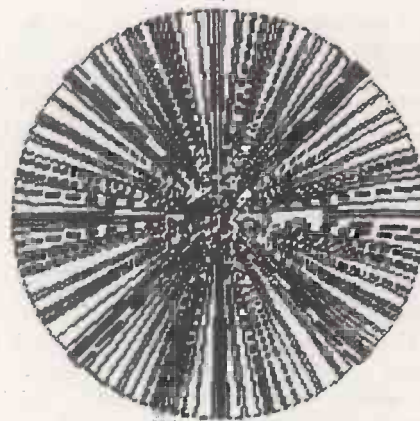
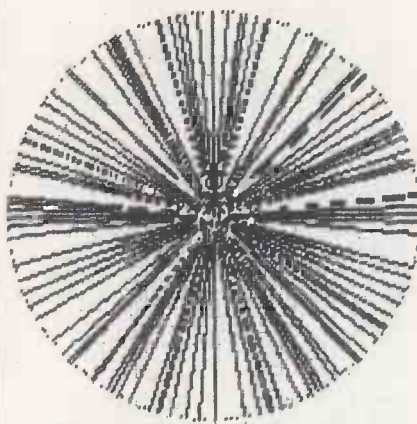
A SHORT PROGRAM by M Thurston of Gorton, Manchester, for a 16K ZX Spectrum, demonstrates some of its high-resolution colour graphics.

The program produces an ever-changing multicoloured circle, which repeats endlessly.

Coloured circles.

```

1 RANDOMIZE : BORDER 0: PAPER
0: CLS
2 INK INT (RND*6)+2
10 FOR n=0 TO 359 STEP INT (RND
D=20)+1
20 LET p=n*PI/180: LET a=130+8
0*COS p: LET b=88+80*SIN p
30 PLOT a,b: DRAW OVER 1;130-a
,88-b
40 NEXT n
50 GO TO 2
    
```



### Tabulating data.

```

10 input a
20 if a<1 then goto 60
30 if a>99999998.4 then let a=a+1
40 let x=int (ln a*0.43429448206)
50 print tab 15-x;a
60 if a>0 and a<0.1 then print tab 15;0;a
70 if a>0.1 and a<1 or a=0 then print tab 15; a
80 goto 10
    
```

### Rounding.

```

10 let n=4
20 input a
30 print a.
40 if a=0 then goto 90
50 let b=int (ln a*43429448206)
60 let a=a*10**((n-1)-b)
70 let a=int(a+0.5)
80 let a=a*10**((b)-(n-1))
90 print a
100 goto 10
    
```

### Numbers and tables

A COUPLE OF useful routines for use on the Sinclair ZX-81 were sent by Richard Sterry of Wakefield, West Yorkshire. The routines could be adapted to suit any micro.

The first demonstration program is for tabulating a column of numerical results so that the decimal points are aligned, a much clearer and more pleasing presentation than the usual alignment of the most significant digits.

Line 40 is equivalent to  
 LET X=INT (LOG<sub>10</sub>A)  
 and is used to determine the tabbing needed by checking the magnitude of the

variable A. Line 30 is a "cheat" to prevent errors in tabbing due to the rounding of the LN function. Line 60 inserts a leading zero in front of the decimal point for numbers less than 0.1, whereas this is already present on numbers between 0.1 and 0.9999 etc.

The program works for numbers from 0.00001 up to but not including 1 E 13, that is all numbers not presented in scientific notation by the ZX-81. Negative numbers are not catered for, but this could easily be achieved if required.

The second program is for rounding a variable A to a certain number of significant figures, set by the value of N. The variable A is printed before and after

rounding, to demonstrate that it works. In practice, one would omit line 10, and substitute the value of N in the N-1 term in lines 60 and 80.

The program works with any magnitude of number, although negative numbers have not been catered for; something which can easily be remedied if required. Line 50 is used to check the magnitude of A; the alarming-looking fraction is in fact log<sub>10</sub>e. Line 60 then alters the magnitude of A prior to rounding in line 70, while line 80 restores A to its original magnitude. Line 40 is vital to prevent the program crashing. The ZX-81 does not like trying to calculate ln.

### Multiplication

THE PROGRAM N-Factorial accomplishes high-precision arithmetic on the ZX-81, writes J Verhoeven of Oosterwijk, The Netherlands. The method is derived from ordinary long multiplication technique: multiplication begins at the right with the least-significant digit and ends with the left-most or most-significant digit. Single digits of the multiplier are paired with single digits of the multiplicand, and the multiplication proceeds a pair of digits at a time.

In high-precision multiplication a similar process is carried out using four-digit numbers in place of single decimal digits. An array of X elements is set up.

A(X) is set to 1, and multiplication then starts, beginning with A(X) and ending with A(1). When A(X) exceeds 9,999 a carry is calculated in order to keep A(X) four digits long or less. The carry is later added back to the next element of the array A(X-1).

When A(X) reaches 0 all elements are shifted up one place — the contents of

(continued on next page)

(continued from previous page)

A(X-1) are placed in A(X), and so on. To keep record of the number of zeros shifted out, a variable is increased by four just before a shift starts.

The approximate value of n! is calculated using Stirling's formula:

$$n! \approx \left(\frac{n}{e}\right)^n \times \sqrt{2.n.\pi}$$

It is accurate to a few percent, and the program uses it to calculate the total number of digits in n! To save space in memory, the number of zeros may be subtracted — every 10 multiplications yield two zeros. The number of elements of the array is now determined by taking the base-10 logarithm of n!, subtracting the approximate number of zeros, dividing this by 4, since each element contains four decimals, and adding two elements for safety.

To display all the digits a type of "Print Using" routine is set up by the program. A variable Flag suppresses zeros that have no mathematical significance.

After selecting Fast mode in line 85 the number of elements for the array is calculated. Variable Nul is used to keep record of the number of zeros shifted out.

Lines 200 to 220 multiply all elements by the same number; the carries are performed in lines 230 to 290. In lines 300 to 390 the zeros are shifted out of A(X).

Line 395 slows down the processor to display the result in Slow mode, and is followed by the Print Using selection. As long as Flag is equal to 0 no significant

## Multiplication.

```

1 REM FACULTEIT/FACTORIAL
2 REM J. VERHOEVEN, MOLENSTR. 5
3 REM 5061 HS OISTERWIJK
4 REM 01-05-1982
5 REM INSTRUCTIONS
6 PRINT "CALCULATION OF N-FACT
7 ORIAL."
8 PRINT "THE PROGRAM CALCULAT
9 ES ALL THE DIGITS PRESENT IN N-
10 FACTORIAL."
11 PRINT "CONDITION: N<3500, A
12 ND PROBABLY EVEN SMALLER (THAT I
13 S, WITH A 16KRAMPACK)."
14 PRINT "WHICH FACTORIAL ? ";
15 INPUT NO
16 IF NO=0 THEN GOTO 85
17 PRINT "0 FACTORIAL = 1 *1E0
18 "
19 GOTO 60
20 FAST
21 REM SPEEDING UP
22 LET NO=INT ABS NO
23 LET C1=(NO*(LN NO-1)+.5*LN
24 (2*PI*NO))/LN 10+1
25 LET CO=NO
26 REM CO=NUMBER OF ZEROS
27 LET C=INT ((C1-CO)/4)+2
28 DIM A(C)
29 LET A(C)=1
30 LET NUL=0
31 FOR N=NO TO 2 STEP -1
32 FOR X=C TO 1 STEP -1
33 LET A(X)=A(X)*N
34 NEXT X
35 LET CARRY=0
36 FOR X=C TO 1 STEP -1
37 LET A(X)=A(X)+CARRY
38 LET CARRY=INT (A(X)/1E4)
39 LET A(X)=A(X)-1E4+CARRY
40 NEXT X
41 IF A(C)<>0 THEN GOTO 390
42 LET NUL=NUL+4
43 FOR X=C-1 TO 1 STEP -1
44 LET A(X+1)=A(X)
45 NEXT X
46 LET A(1)=0
47 NEXT N
48 SLOW
49 PRINT NO;" FACTORIAL = ";
50 LET FLAG=0
51 REM FLAG=0 MEANS: ALL A(X)
52 REM UNTIL NOW CONTRAIN ONLY
53 REM ZEROS.
54 REM FLAG=0 IS A ZEROSUPPRES
55 SER
56 REM SORT OF "PRINT-USING"
57 FOR X=1 TO C
58 DIM A$(4)
59 IF A(X)<>0 THEN LET FLAG=FL
60 AG+1
61 IF FLAG=0 AND A(X)=0 THEN G
62 OTO 530
63 IF NOT (FLAG<>0 AND A(X)=0)
64 THEN GOTO 455
65 LET A$="0000"
66 GOTO 520
67 LET Q=4-INT (LN A(X)/LN 10)
68 LET S$=STR$(A(X))
69 IF FLAG=1 THEN LET A$( TO Q
70 -1)="0000"
71 LET A$(Q TO 4)=S$
72 PRINT A$;
73 NEXT X
74 PRINT " *1E ";NUL

```

digits are present in the elements of the array. When Flag is equal to 1 the most significant digits are to be printed out. The Flag variable is used to ensure that a number, for example 34, is not printed as 0034.

When Flag is greater than 1, all appearing zeros have to be displayed. Variable Q is used here to fill up A\$ with zeros, if necessary.

The program calculates 100! in four minutes; 250! takes about 30 minutes.

## Memory saver

ON THE SPECTRUM only about 8.5K of program can be entered in the 16K of RAM provided because of the extremely large display file, writes Bill Longley of Colchester, Essex.

The straightforward way to find out how much memory you have left in Basic is:

```

PRINT PEEK 23730 PEEK 23731-
256-(PEEK 23653 PEEK 23654 256)

```

which takes up an incredible 74 bytes. With this program, the line

```
PRINT USR 23760
```

is only 13 bytes long.

Enter lines 1 to 102, Run once, then delete lines 10, 100, 101 and 102. The routine can then be merged into any program, but it must be the first line. If you type in

```
POKE 23756,0
```

then the line will always be the first, as zero is the lowest number possible for a line number.

## Memory saver.

```

1 LD HL, (23653)
2 PUSH HL
3 POP DE
4 LD HL, (23730)
5 XOR A
6 SBC HL, DE
7 PUSH HL
8 POP BC
9 RET

1 REM HHHHHHHHHHHHHH
10 FOR S=23760 TO 23773: READ
11 POKE S, S: NEXT S
100 DATA 42, 101, 92, 229, 209, 42
101 DATA 176, 92, 175, 237, 62
102 DATA 229, 193, 201
995 REM
996 REM _____MEMORY_TEST_____
997 REM
998 REM by Bill Longley.
999 REM
1000 REM
1001 REM ENTER LINES 1-102.
1002 REM RUN ONCE, THEN DELETE
1003 REM 10, 100, 101, AND 102.
1004 REM
1005 REM "PRINT USR 23760"
1006 REM WILL GIVE THE NUMBER
1007 REM OF BYTES OF
1008 REM FREE MEMORY LEFT.

```

## Factorials.

CALCULATION OF N-FACTORIAL. THE PROGRAM CALCULATES ALL THE DIGITS PRESENT IN N-FACTORIAL. CONDITION: N<3500, AND PROBABLY EVEN SMALLER (THAT IS, WITH A 16K RAMPACK). WHICH FACTORIAL ? 250

```

250 FACTORIAL = 3232656260909
10773232061455202436847099484371
76737806667479424271128237475551
112094668179153710281994509225507
35318943292673093171260699062279
10302790712819215765272401892647
33218041186261006632925365133678
93908956993571353017504051317876
00772479330654025390061646255522
48619436572566057399222641254832
98220484913772177665064127685888
71531269767776729519139906423438
73444029041523710118603241767320
65818646206247656265960684662554
6800*1E 60

```

250-FACTORIAL TAKES ABOUT 30 MINUTES CALCULATION TIME  
CALCULATION OF N-FACTORIAL. THE PROGRAM CALCULATES ALL THE DIGITS PRESENT IN N-FACTORIAL. CONDITION: N<3500, AND PROBABLY EVEN SMALLER (THAT IS, WITH A 16K RAMPACK). WHICH FACTORIAL ? 69

```

69 FACTORIAL = 1711224524261413
11372468336881272639092270544893
52036939364604092325727975414064
7424000*1E 12

```



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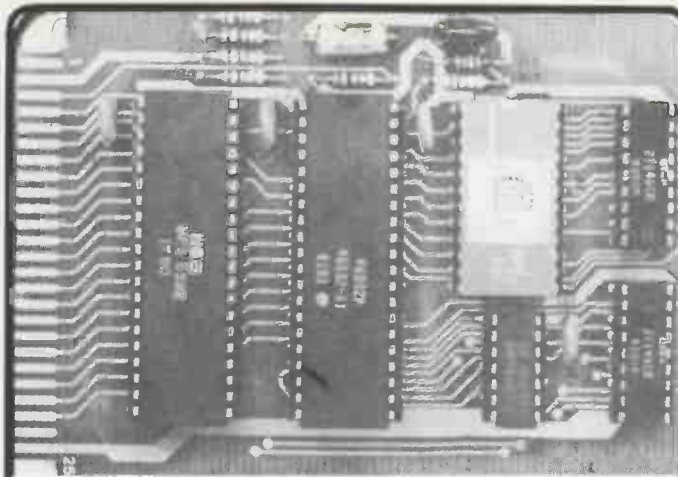


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## Battleships

THIS ARCADE-TYPE game by G McQueen of Newcastle-upon-Tyne runs on a Tandy TRS-80 colour computer in 16K. The idea of the game is to destroy as many alien ships as possible until your fuel runs out. Every time you shoot your lasers you use five fuel units. Every time you are shot you lose 10 fuel units. When you are hit the screen clears for about one second and you are then returned to the battle. The alien ship moves a maximum of four spaces in any direction and using the joystick you have to chase the ship until you can shoot it.

The random movement is provided by lines 180-200, and the joystick is controlled by lines 60-150. The arrays A and B hold the graphics for the alien ship and the word "Fuel" respectively. When the alien ship is hit the graphic contents of array A are put on to the screen in an area smaller than the area occupied by the alien ship, this distorts the image producing the required explosion. It is done in line 420 as the Put statement uses a 20-by-20 square instead of the required 22-by-22 square which is used throughout the game.

Lines 550-710 draw the alien ship and the word "fuel" and store them in arrays A and B. Lines 360-430 control the graphics for the lasers and detect if the alien ship has been hit. It would be possible to convert the joystick commands into keyboard commands but that would slow down the game.

## Graphics mode

UNLIKE MOST other microcomputers, the TRS-80 and Video Genie do not have the facility to key graphic characters directly into Basic statements, notes Peter Hewitt of Lytham St Anne's, Lancashire. The Basic program in listing 1 rectifies this omission by Poking a machine code routine into the top of memory, which permits a graphic mode. The routine is only 110 bytes long, and the memory limit is automatically set at 32664, thus assuming a 16K machine.

Graphics mode is entered by hitting

(continued on page 180)

## Battleships.

```

0 REM ALIEN FORCE BY G.MCQUEEN
10 DIM A(22,22),B(30,9)
20 MODE 4,1
30 PCLS
40 GOSUB 550
50 GOSUB 800
60 A=JOYSTK(0):B=JOYSTK(1)
70 F=0:FF=0
80 IF AC=0 AND AD=10 THEN F=-1
90 IF AC=10 THEN F=-2
100 IF AD=43 AND AC=53 THEN F=1
110 IF AD=53 THEN F=2
120 IF BC=20 AND BD=10 THEN FF=-1
130 IF BC=10 THEN FF=-2
140 IF BD=43 AND BC=53 THEN FF=1
150 IF BD=53 THEN FF=2

160 XX=XX-F
170 YY=YY+F
180 X=RD(8)-4:Y=RD(8)-4
190 XX=X+XX
200 YY=Y+YY

210 LINE (128,40)-(128,66),PSET
220 LINE (128,106)-(128,152),PSET
230 LINE(70,96)-(116,96),PSET
240 LINE(137,96)-(183,96),PSET
250 LINE (35,185)-(FUEL+25,185),PSET
260 LINE(255,185)-(FUEL+25,185),PRESET
270 IF XX<1 OR XX>232 OR YY<1 OR YY>162 THEN PCLS:XX=RD(230):YY=RD(160)
280 PUT(XX,YY)-(XX+22,YY+22),A,PSET
290 PUT(0,182)-(30,191),B,PSET
300 P=PEEK(65280)
310 IF P=126 OR P=254 OR P=125 OR P=253 THEN GOSUB 360
320 IF RD(20)=5 THEN GOSUB 490
330 IF FUEL<1 THEN 720
340 IF INT(TIMER/1000)=TIMER/1000 THEN FUEL=FUEL-10
350 GOTO 540

360 LINE(0,180)-(126,97),PSET
370 FUEL=FUEL-5
380 LINE(255,180)-(126,97),PSET
390 PLAY"T255:01:A;B;C;D:02:A;B;C;D:03:A;B;C;D:04:A;B;C;D"
400 LINE(255,180)-(126,97),PRESET
410 LINE(0,180)-(126,97),PRESET
420 IF PPOINT(126,96)<>0 THEN PUT(XX,YY)-(XX+20,YY+20),A,PSET:GOSUB 440
430 RETURN

440 PCLS
450 PLAY"T255:A;A;A;B;B;B;G;G;G"
460 XX=RD(200):YY=RD(160)
470 SCORE=SCORE+10
480 RETURN
490 REM YOUR HIT
500 SCREEN 0,1:FOR W=1 TO 10:PLAY"T255:02":PLAY STR$(RD(12)):NEXT W
510 PCLS:FUEL=FUEL-10
520 SCREEN 1,1
530 RETURN
540 GOTO 60

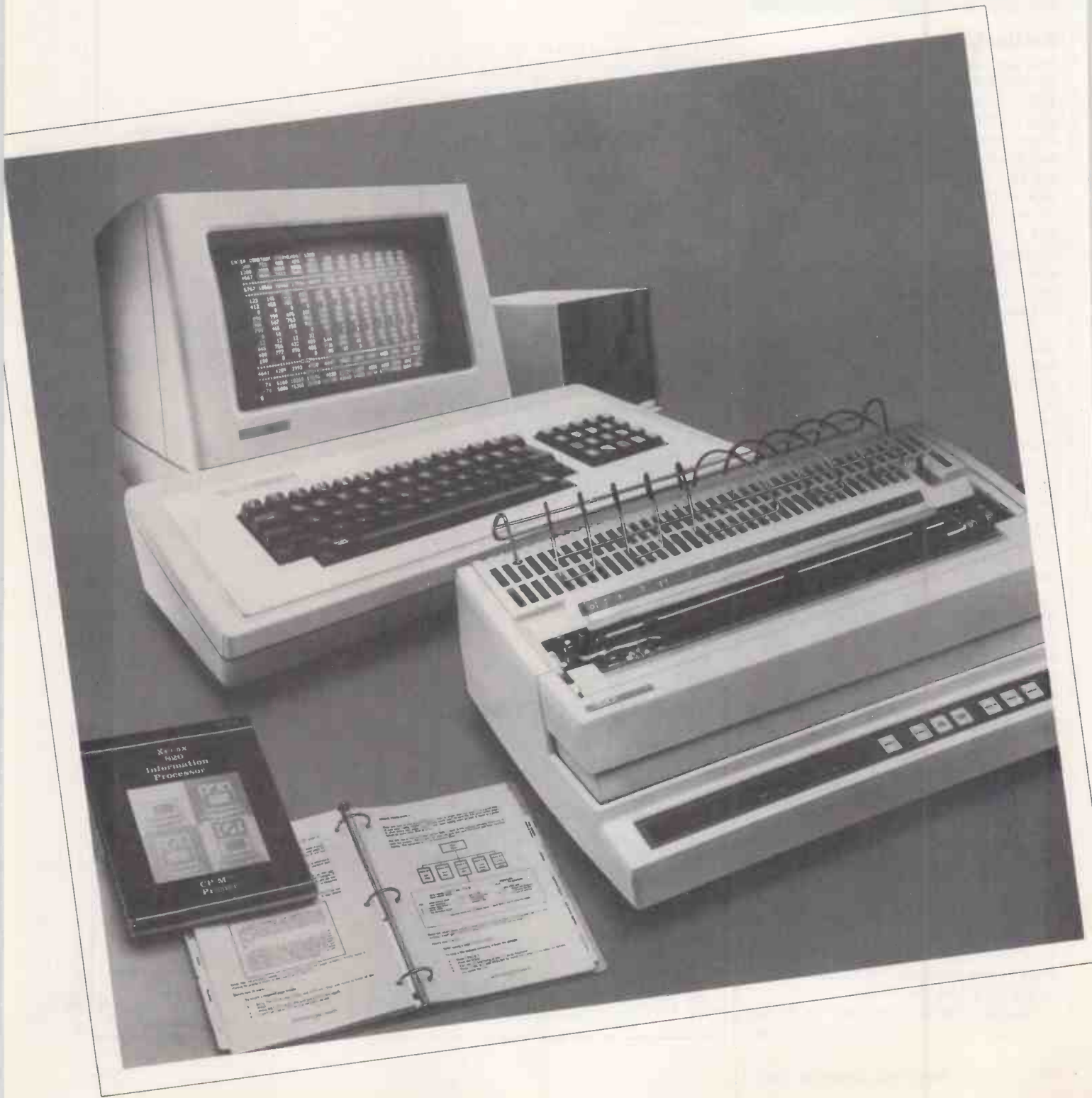
550 LINE(6,6)-(6,16),PSET
560 LINE(16,6)-(16,16),PSET
570 FOR R=1 TO 4
580 CIRCLE(11,11),R
590 NEXT R
600 GET(0,0)-(22,22),A,G
610 PCLS
620 XX=100:YY=100
630 FUEL=235:SCORE=0
640 CLS
650 DRAW"BH1,190;U4;N;R4;U4;R4"
660 DRAW "BH9,190;N;U7;R5;U7"
670 DRAW"BM18,183;N;R4;D3;N;R4;D4;R4"
680 DRAW"BM27,183;D7;R4"
690 GET(0,182)-(30,191),B,G
700 PCLS
710 RETURN

720 CLS:SCREEN 0,1
730 PRINT "          OUT OF FUEL"
740 PRINT:PRINT:PRINT:PRINT"YOU SCORED "SCORE" POINTS"
750 PRINT"DO YOU WANT ANOTHER GAME (Y/N)?"
760 A$=INKEY$:IF A$="" THEN 760
770 IF A$="Y" THEN RUN
780 IF A$<>"N" THEN 760
790 END
800 REM INSTRUCTIONS
810 CLS
820 PRINT "  ALIEN FORCE BY G.MCQUEEN"
830 PRINT:PRINT
840 PRINT"YOU ARE THE COMMANDER OF AN"
850 PRINT"INTERCEPTOR ON A SUICIDE MISSION"
860 PRINT"WHICH IS TO SHOOT DOWN AS MANY"

```

(listing continued on page 180)

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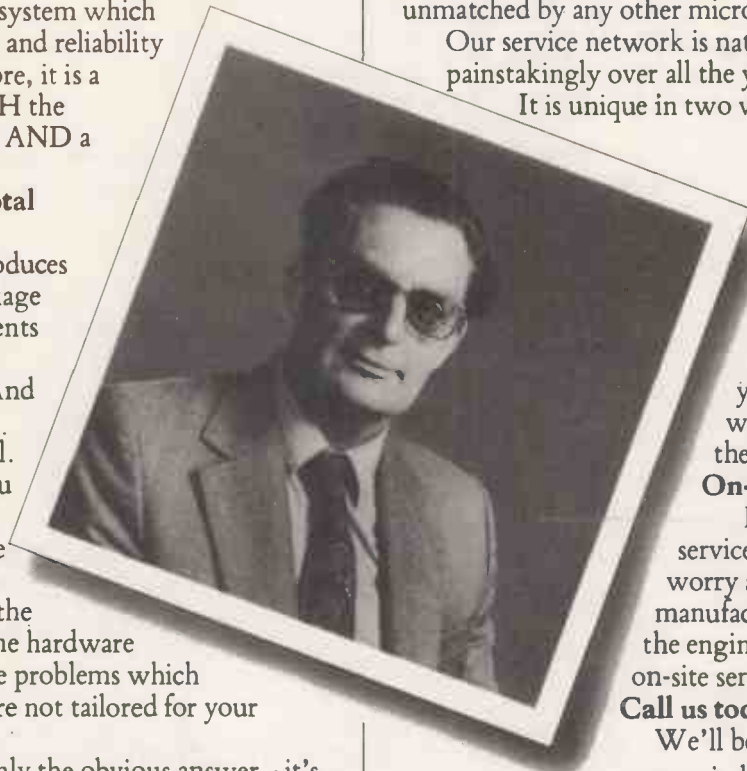
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(continued from page 177)

Shift and Right-arrow, replacing the normal function of this combination. A change to 32-character mode, for which

Print CHR\$(23)

can still be used. In graphic mode the cursor flashes as a gentle reminder that things are not "normal". Only New Line and back-space keys retain their normal functions. The Space key appears to produce a space, but this is character 128 and not character 32. All of the remaining keys produce a graphic character. To exit from graphic mode, hit Shift and Right-arrow again.

The graphic character produced by any key is its ASCII code plus 100. Thus hitting key A, ASCII 65 will print character 165 in graphic mode. The exceptions are as shown in table 1. The abbreviations are those used in the basic program in listing 2, which will display all graphic characters and relevant keys.

To see the routine in action, enter the following line and RUN it; "gm" means change into or out of graphic mode, and "sp" is a space:

```
10 CLS:PRINT"gmGHspGHspF
JgmORSES":PRINT:END
```

Now List the line, and it will appear as:

```
10 CLS:PRINT"LSETRSETEND
LSETRSETENDKILLSYSTEMORSES":
PRINT:END
```

To understand what has happened, it is necessary to look at the way Basic programs are interpreted and stored by the TRS-80. The interpreter has 123 characters available to it, which it uses as tokens to replace commands and symbols prior to storage of a line. Thus it changes Return, for example, into character 146, thereby reducing its storage requirement by five bytes. When it encounters character 146 in a Basic line, it naively assumes that it means Return and dutifully displays all six characters. For this reason, all graphic characters in a Basic line will automatically be converted to their equivalent tokens.

Of course, this works both ways and you can use graphic characters as shorthand commands in graphic mode. For example hit P and New Line. The program in memory will be listed, because P, ASCII 80, is converted to 180, which is the token for List. Listing 3 displays all the tokens in the range 128 to 191 — they actually go up to 250 — the equivalent key in graphic mode, and the normal character value for the token.

Unfortunately, you cannot Edit a line which includes graphic characters in a

Table 1.

Character	Key	
128	Space	(SPC)
129	Down-arrow	(D/A)
130	Clear	(CLR)
131	Break	(BRK)
132	Right-arrow	(R/A)

(listing continued from page 177)

```
870 PRINT"ALIEN SPACE CRAFT AS POSSIBLE"
880 PRINT"BEFORE YOUR FUEL RUNS OUT"
890 PRINT"YOU CONTROL YOUR INTERCEPTOR"
900 PRINT"USING THE LEFT JOYSTICK AND"
910 PRINT"FIRE YOUR LASERS BY PRESSING"
920 PRINT"THE BUTTON ON THE JOYSTICK"
930 PRINT"PRESS ANY KEY TO BEGIN"
940 A$=INKEY$:IF A$="" THEN 940
950 RETURN
```

## Graphics mode.

### Listing 1.

```
80 POKE 16561,152:POKE16562,127:CLR50:RUN100
100 FORI=32640TO32757:READA:POKEI,A:NEXT:
POKE16526,136:POKE16527,127:A=USR(0):END
120 DATA 42,22,64,34,237,127,33,154,127,34,
22,64,205,97,27,195,25,26,58,244,
127,183,40,45,58,245,127,60,50,245,
127,32,7,42,32,64,126,238,127,119,
205,236,127,254,33,242
140 DATA 216,127,254,25,40,36,33,239,127,6,
5,78,185,40,4,35,16,249,201,62,
133,144,201,205,236,127,254,25,192,50,
244,127,24,194,254,92,242,154,127,198
160 DATA 100,201,175,50,244,127,62,95,42,32,
64,119,24,174,195,0,0,32,10,31,1,9,0,0
```

### Listing 2.

```
100 CLS:G$="CHR KEY " :F$=" | % % " :K=0:FORI=0TO7:PRINTG$:NEXT
120 FORI=128TO132:READA$:PRINTUSINGF$:CHR$(I):A$:L=L+1:NEXT
140 DATA SPC,D/A,CLR,BRK,R/A
160 FORI=33TO90:J=I+100:B$=" "+CHR$(I):
PRINTUSINGF$:CHR$(J):B$:L=L+1:IFB$INT(L/8)=LTHENPRINT
180 NEXT:PRINT" ";CHR$(191):" C";
200 GOTO200
```

### Listing 3.


```
100 CLS:F$="% % = % %(###)":FORI=128TO132:READA$:B$:
PRINTUSINGF$:A$:B$:I:I:NEXT
120 DATA END,SPC,FOR,D/A,RESET,CLR,SET,BRK,CLS,R/A
140 F$="% % IS I(###)":A$="":J=133:I=5730:A=PEEK(5729)
160 A$=A$+CHR$(A AND 127):A=PEEK(I):IF A<128THENI=I+1:GOTO160
180 IFJ=191THEN200ELSEPRINTUSINGF$:A$:CHR$(J-100):J:
A$="":J=J+1:I=I+1:GOTO160
200 PRINTA$," IS C(191)":POKE16383,41
220 GOTO220
```

### Listing 4.

```
100 M$="9mZY9m"+CHR$(26)+STRING$(2,24):M$(1)=M$+"9mF#9m":
M$(2)=M$+"9m"19m":M$=M$+"9mG39m"
120 CLS:PRINT@924,M$:FORI=1TO400:NEXT:J=1
140 FORI=924TO28STEP-64:PRINT@I,M$(J):FORK=1TO80:
NEXT:J=J+1:IFJ=3THENJ=1
160 PRINT@I+64," ":NEXT:PRINT@28,M$:FORI=1TO900:NEXT:GOTO120
```

string. The interpreter, in this case, looks at the line to be edited, and assumes that the garbage between the inverted commas is intended, and treats it as text. Any graphic characters outside a string are not affected in this way, since they are printed and interpreted as nature intended. However, strings with graphic characters can be manipulated in the normal way, and listing 4 gives a very simple example of how such an operation can be performed.

For without the arrow keys, the older

Genies and other machines Ctrl is down-arrow, Esc is up-arrow, Back space is left-arrow, and graphic mode can be entered using Shift/Ctrl/Y. Character 132 can be obtained with Shift/Ctrl/I. Users of the new Genies should enable the additional ROM before the graphic routine is run. Potential authors for these particular machines should note that, for all practical purposes, 10 bytes should be deducted from the normal top-of-memory in order to accommodate parameters which are stored there by the additional ROM. 



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### Pseudo-random numbers

THE RANDOM NUMBER generator on my Superboard does not produce genuinely random sequences of numbers but, instead, a finite list of pseudo-random numbers, writes D A F Driver of Nottingham. It is therefore possible to generate identical lists of "random" numbers.

Calling RND(-1) produces lists of numbers consisting of a set sequence for any given seed, which can be repeated as many times as required. It can be generated by the following routine:

```
10 Input N
20 X = RND(-N)
30 for A = 1 to 100
40 Print RND (1);
50 Next A
```

Muriel Gilligan's article on code breaking in September's *Practical Computing* prompted the idea that it would be possible to produce a shift cipher in which the value of the shift for each letter in the message would be different but repeatable. The appropriate numerical value could be based on the pseudo-random number routine by adding

```
INT(RND(1)*26)
```

to the ASCII values of the characters in the message string; if the value exceeds 90 the value is decreased by 26. In effect, the alphabet is joined into an endless loop of 26 characters and then rotated by random amounts by the pseudo-random number routine.

Decoding then becomes a matter of subtracting

```
INT(RND(1)*26)
```

from the ASCII values of the coded message. The Code Writer program provides the coding and decoding routines; enter "£" signs in the listing as "\$".

### Decoding address

THE UK101 keyboard address DF00hex, 570888, is not unique, notes Dave Bate of Lichfield, Staffordshire. Due to incomplete decoding around IC20, any address in the range DC00 to DFFF, 56320 to 57343, will address the keyboard data latches.

The circuits also show that there are four spare address lines from IC20 which

are not used by the UK101:

IC20 Y0 decodes (DC00 to DFFF)&READ  
UK101=Read Kbd.

IC20 Y1 decodes (D800 to DBFF)&READ  
unused

IC20 Y2 decodes (D400 to D7FF)&READ  
unused

IC20 Y3 decodes (D000 to D3FF)&READ  
UK101=Read Video RAM

IC20 Y4 decodes (DC00 to DFFF)&WRITE  
UK101=Write Kbd

IC20 Y5 decodes (D800 to DBFF)&WRITE  
unused

IC20 Y6 decodes (D400 to D7FF)&WRITE  
unused

IC20 Y7 decodes (D000 to D3FF)&WRITE  
UK101=Write Video RAM

The unused decodes may therefore be  
(continued on next page)

### Pseudo-random numbers.

```
10 REM SECRET CODE WRITER
20 REM D.DRIVER/6-80
30 DIM B(255),C(255)
40 INPUT"DO YOU WANT TO CODE OR DECODE":CI:PRINT
50 CI=LEFT$(CI,1):IF CI<>"C" AND CI<>"D" THEN 40
60 INPUT"GIVE THE NUMBER OF THE CODE ":N
70 X=RND(-N): REM SET THE START OF R.N. SEQUENCE
80 PRINT:PRINT"TYPE IN YOUR SENTENCE"
90 PRINT:INPUT A$:PRINT
100 PRINT TAB(2);
110 FOR A=1 TO LEN(A$)
120 B$=MID$(A$,A,1)
130 B(A)=ASC(B$)
140 IF CI="D" THEN 220
150 IF B(A)=32 THEN C(A)=32:GOTO 180
160 C(A)=B(A)+INT(RND(1)*26)
170 IF C(A)>90 THEN C(A)=C(A)-26
180 PRINTCHR$(C(A));
190 NEXTA
200 PRINT:PRINT:PRINT
210 RUN
220 IF B(A)=32 THEN C(A)=32:GOTO 180
230 C(A)=B(A)-INT(RND(1)*26)
240 IF C(A)<65 THEN C(A)=C(A)+26
250 GOTO 180
260 END
```

OK

RUN

DO YOU WANT TO CODE OR DECODE? C

GIVE THE NUMBER OF THE CODE ? 1

TYPE IN YOUR SENTENCE

? ALL GOOD MEN MUST COME TO THE AID OF THE PARTY

EZH OYLP FZU GRDB QAKI LM VUG WAC CG CNV ZCEZT

DO YOU WANT TO CODE OR DECODE? C

GIVE THE NUMBER OF THE CODE ? 2

TYPE IN YOUR SENTENCE

? ALL GOOD MEN MUST COME TO THE AID OF THE PARTY

PYY QGVV WHM YJFF NOJJ EM AWM AHJ YT LSP NNTDA

DO YOU WANT TO CODE OR DECODE? D

GIVE THE NUMBER OF THE CODE ? 1

TYPE IN YOUR SENTENCE

? EZH OYLP FZU GRDB QAKI LM VUG WAC CG CNV ZCEZT

ALL GOOD MEN MUST COME TO THE AID OF THE PARTY

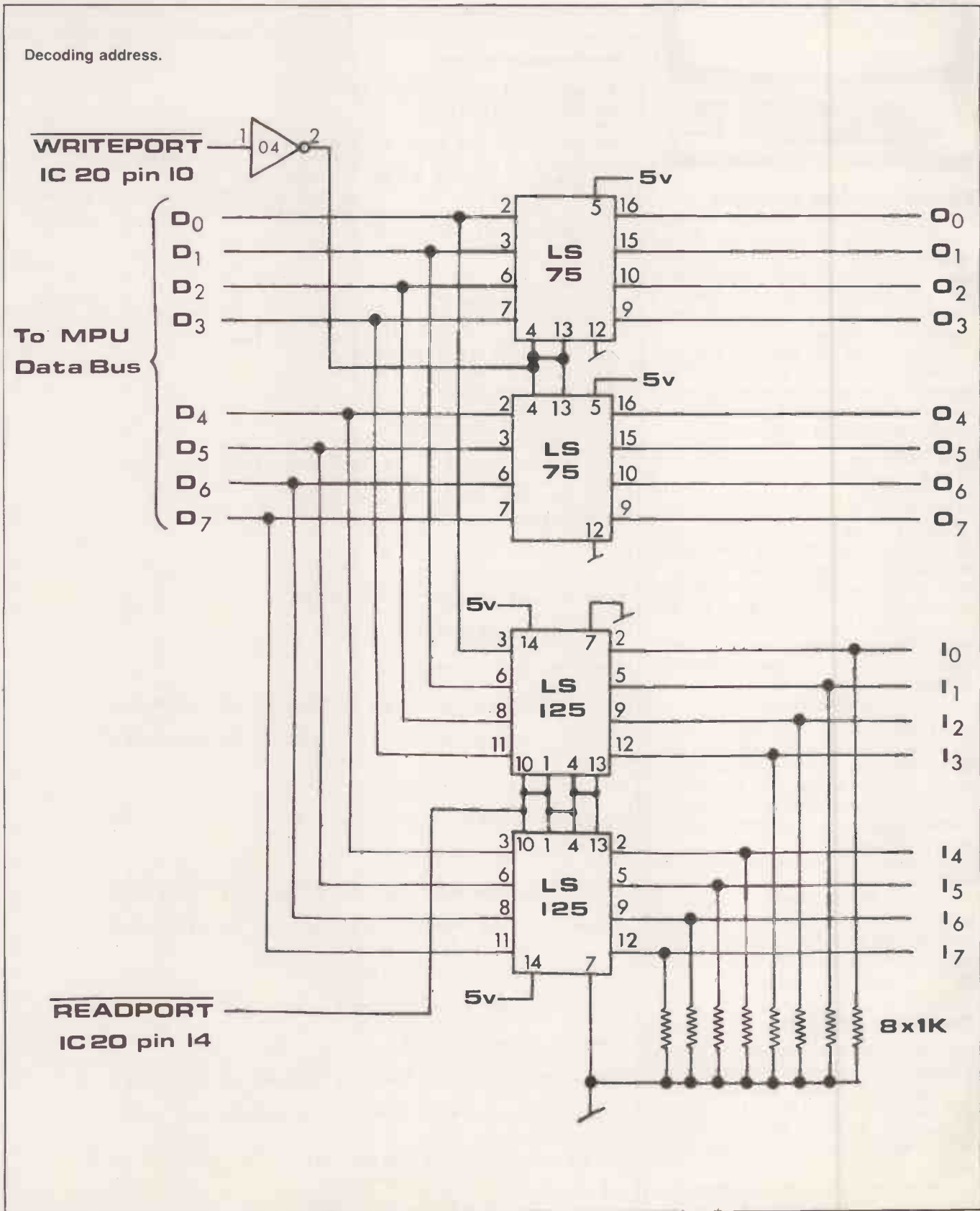
DO YOU WANT TO CODE OR DECODE?

OK

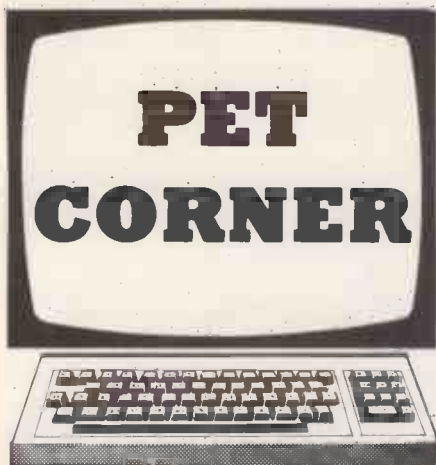
(continued from previous page)  
 used for external add-ons. A similar circuit to the polled keyboard circuit in the manual can be used as an eight-bit input port and an eight-bit output port. Decoding lines Y5, output port, and Y1, input port, were used as shown in the circuit

diagram reproduced on this page.  
 To Write data to the output port use  
 POKE 55300, data  
 or Poke to any other address from 55296  
 to 56913. To read data from the input  
 port, execute  
 PEEK (55300)

Using the unbuffered data-bus connections located near to the ACIA chip produces no D-bus loading problems. You should use LS devices and keep wiring as short as possible. The decodes for D400 to D7FF were avoided to allow future extension of the video RAM to 2K. □







## Group of three

TRIAD NUMBERS fascinate A L Milnes of Southsea, Hampshire. They are one of those interesting number sets which can form the basis of useful programming exercises. Some readers may recall the search for perfect numbers and friendly numbers, and so on. Of course, the prime number detection problems are very common indeed.

This short program finds triad numbers and what these are is explained in the program.

Note that line 470 is there only to indicate that the program is running. If you do not mind gazing at a blank screen for two or three minutes, it can be edited out. Also if you do not need printed results edit out 100 and 440 and modify 460 to be

```
460 IF P > THEN STOP
```

## Plotting double

THE CAPABILITIES of other computers to plot points on the screen in double density like the ZX-81 has always been envied by Ian Payton of Winnersh, Berkshire, but no suitable program for the Pet seemed to be available.

This program is written in Basic, and consists of two subroutines; one starting at 10000 which sets up the arrays; and the other at 10400 which plots a point on a 50

*(continued on next page)*

### Plotting demonstration program.

```
10 GOSUB10000:PRINTCHR$(147)
20 FORA=0TO20STEP.2
30 X=INT(A*2*SIN(A)+41)
40 Y=INT(A*COS(A)+21)
50 GOSUB10400
60 NEXTA
70 FORA=1TO1000:NEXTA:PRINTCHR$(147)
80 FORA=1TO7.5STEP.03
90 X=INT(24*SIN(A)+40)
100 Y=INT(24*COS(A)+25)
110 GOSUB10400
120 NEXTA
130 FORA=1TO1000:NEXTA:PRINTCHR$(147)
140 FORA=0TO25STEP5
150 FORB=0TO25
160 X=A+27:Y=B+12:GOSUB10400
170 X=B+27:Y=A+12:GOSUB10400
180 NEXTB,A
190 FORA=1TO15
200 PRINT
210 NEXTA
220 END
```

### Group of three.

TRIAD NUMBERS ARE	192	384	576
TRIAD NUMBERS ARE	219	438	657
TRIAD NUMBERS ARE	273	546	819
TRIAD NUMBERS ARE	327	654	981

```
100 OPEN1,4
110 REM THE TRIAD NUMBER PROBLEM
120 REM PROGRAM WRITTEN BY A.L.MILNES PORTSMOUTH POLYTECHNIC
130 PRINT"DO YOU WANT TRIAD NUMBERS EXPLAINED?Y=YES N=NO"
140 GETY$:IFY$(C)"Y"ANDY$(C)"N"THEN140
150 IFY$="N"THEN240
160 PRINT"TRIAD NUMBERS ARE SO CALLED BECAUSE"
170 PRINT" (1)EACH CONTAINS 3 DIGITS"
180 PRINT" (2)THE SECOND NUMBER IS TWICE THE FIRST NUMBER AND THE THIRD "
190 PRINT"IS THREE TIMES THE FIRST NUMBER"
200 PRINT" (3)THE DIGITS 1,2,3,4,5,6,7,8,9 OCCUR ONLY ONCE IN THE THREE "
210 PRINT"NUMBERS":PRINT:PRINT
220 PRINT"AN EXAMPLE OF TRIAD NUMBERS IS:-":PRINT
230 PRINTTAB(10)"192":PRINTTAB(10)"384":PRINTTAB(10)"576":PRINT
240 PRINT"THIS PROGRAM FINDS ALL THE TRIAD NUMBERS"
250 PRINT"WHEN READY TO GO ON PRESS THE SPACE BAR"
260 GETW$:IFW$(C)" "THEN260
270 PRINT" "
280 P=149
290 Q=2:P=R=3:P
300 ST$=STR$(P)+STR$(Q)+STR$(R)
310 ST$=MID$(ST$,2,3)+MID$(ST$,6,3)+MID$(ST$,10,3)
320 FORA=1TO9
330 N$(A)=MID$(ST$,A,1)
340 IFN$(A)="0"THEN430
350 NEXTA
360 FORC=1TO9
370 FORD=(C+1)TO9
380 IFN$(D)=N$(C)THEN430
390 NEXTD
400 NEXTC
410 PRINT"TRIAD NUMBERS ARE",P,Q,R
420 PRINT#1,"TRIAD NUMBERS ARE",P,Q,R
430 P=P+1
440 IFP>333THENCLOSE1:STOP
450 PRINT"P=",P
460 GOTO290
READY.
```

### Plotting double.

```
10000 DIM WC(255),PE(15),PO(4,15),C1(1,1)
10010 DATA 126,124,123,108,98,97,127,254
10020 DATA 252,251,236,226,225,255,160
10030 C1(0,0)=1:C1(1,1)=4:C1(1,0)=2:C1(0,1)=3
10040 FORA=1TO15
10050 READPE(A):WC(PE(A))=A:NEXTA
10060 FORA=1TO4
10070 FORB=1TO15
10080 PO(A,B)=PE(B)
10090 NEXTB
10100 NEXTA
10110 PO(1,2)=PE(12)
10120 PO(1,3)=PE(6)
10130 PO(1,4)=PE(7)
10140 PO(1,5)=PE(9)
10150 PO(1,8)=PE(15)
10160 PO(1,13)=PE(10)
10170 PO(1,14)=PE(11)
10180 PO(2,1)=PE(12)
10190 PO(2,3)=PE(14)
10200 PO(2,4)=PE(13)
10210 PO(2,5)=PE(8)
10220 PO(2,6)=PE(11)
10230 PO(2,7)=PE(10)
10240 PO(2,9)=PE(15)
10250 PO(3,1)=PE(6)
10260 PO(3,2)=PE(14)
10270 PO(3,4)=PE(5)
10280 PO(3,7)=PE(9)
10290 PO(3,10)=PE(15)
10300 PO(3,12)=PE(11)
10310 PO(3,13)=PE(8)
10320 PO(4,1)=PE(7)
10330 PO(4,2)=PE(13)
10340 PO(4,3)=PE(5)
10350 PO(4,6)=PE(9)
```

*(listing continued on next page)*

(continued from previous page)

by 80 format with the top left corner being (0,0).

The routine uses the variables C1, P1, and A. It acts on the variables X and Y for the co-ordinates and is about as fast as the ZX-81 operating in slow mode. The routine at 10000 must be run first or a @ will appear instead of the appropriate graphic character. The demonstration program which will illustrate its capabilities.

## Racing cars

HERE IS A program written by R Treadwell of Portsmouth, Hampshire for the 3008 Pet. With alterations, it could be compatible with other makes of computers.

The object of the game is to complete the given course in the shortest possible time without hitting any walls.

To move around the course you press 2 to go down; 8 to go up; 4 to go left; and 6 to go right. To accelerate you must specify the direction in which you want to go, and then press the key 5.

There are three different race tracks. Each time the game is played the computer will choose one of three. The game is concluded when either you complete the course or your car crashes into a wall.

## Astro invasion

THIS PROGRAM by Adam Fielding of Preston, Lancashire produces two large moving asteroids on the screen, and your spacecraft in the middle of the screen. By operating two rotate keys, a thrust key, a photon-torpedo fire key and a hyperspace key you may manoeuvre your ship around the screen shooting at the asteroids as you go.

Once a large asteroid is hit it splits up into two smaller asteroids which in turn split up into two even smaller asteroids. A mini asteroid turns into an indestructible meteorite when hit. If in trouble, quickly hit the hyperspace key and you will be sent hurtling through hyperspace to re-materialise in a random position on the screen.

Be careful though, as hyperspace quickly drains your fuel reserves, which are regenerated after each attack phase, but explode taking your ship with them if they go below 1,000 units. Your fuel gauge and score are displayed on the screen, and key commands are given at the beginning of the program.

The key commands are defined by Peeking to location 151 which is the control-panel buffer. Different Pet computers have different Peek values for each individual key, hence the key com-

(continued on page 188)

(listing continued from previous page)

```

10360 PO(4,11)=PE(15)
10370 PO(4,12)=PE(10)
10380 PO(4,14)=PE(8)
10390 RETURN
10400 X=ABS(X):Y=ABS(Y)
10410 IFX>BOORY>50THENRETURN
10420 C1=C1-((X/2)<>(INT(X/2))),-(Y/2)<>(INT(Y/2)))
10430 P1=32768+(INT(X/2)+(INT(Y/2)*40))
10440 A=WC(PEEK(P1))
10450 IFA=0THENA=C1
10460 POKEP1,PO(C1,A)
10470 RETURN
READY.

```

## Racing cars.

```

10 REM *** THIS PROGRAM RUNS ON A 3008 PET ***
20 GOSUB1750
30 GOSUB210
40 PRINT"*****DO YOU WANT ANY INSTRUCTIONS ?"
50 GETA$:IFA$=""THEN50
60 IFA$="N"THEN390
70 IFA$="Y"THEN110
80 PRINT"*****Y' FOR YES AND 'N' FOR NO ":FORA=1TO400
90 NEXT
100 GOTO50
110 PRINT"*****THE OBJECT OF THE GAME IS TO COMPLETE"
120 PRINT"THE COURSE IN THE SHORTEST POSSIBLE TIME"
130 PRINT"*****CONTROL"
140 PRINT"*****TO CONTROL THE CAR 'N' YOU PRESS '8'"
150 PRINT"TO GO UP,'2' TO GO DOWN,'4' TO GO LEFT,"
160 PRINT"'6' TO GO RIGHT,*****AND '5' TO ACCELERATE"
170 PRINT"*****PRESS ANY KEY"
180 GETW$:IFW$=""THEN180
190 FORS=1TO200:NEXT
200 GOTO390
210 REM*** TITLE SEQUENCE ***
220 PRINT"J"
230 PRINT"*****"
240 FORA=1TO22
250 PRINT"##"
260 NEXTA
270 PRINT"*****"
280 FORT=1TO0100:NEXTT
290 PRINT"*****OF RACING GAME!"
300 PRINT"*****BY RICHARD*****TREADWELL"
310 PRINT"*****R124,WHITE DIRT LANE,*****CATHERINGTON."
320 FORA=1TO1000:NEXT
330 PRINT"*****JANUARY 1982"
340 FORA=1TO2000:NEXT
350 POKE59468,12
360 POKE59468,12:PRINT"*****RACING GAME MK.8 *****"
370 FORT=1TO1000:NEXTT
380 RETURN
390 POKE59468,12
391 PRINT"*****GOOD LUCK....."
400 FORX=1TO500:NEXT
410 PRINT"J"
420 LETZ=INT(RND(1)*3)+1
430 IFZ=3THEN GOSUB1500
440 IFZ=1THEN GOSUB1000
450 IFZ=2THEN GOSUB1250
460 PRINT"*****PRESS A 'EY'"
470 GETW$:IFW$=""THEN470
480 PRINT"J"
490 TIME$="000000"
500 A=33585
510 POKEA,35
520 IFPEEK(151)=42ANDPEEK(A-1)=42THEN900
530 IFPEEK(151)=42ANDPEEK(A-1)=32THENPOKEA-1,35:POKEA,32:A=A-1:B=-1:GOTO600
540 IFPEEK(151)=41ANDPEEK(A+1)=42THEN900
550 IFPEEK(151)=41ANDPEEK(A+1)=32THENPOKEA+1,35:POKEA,32:A=A+1:B=1:GOTO600
560 IFPEEK(151)=50ANDPEEK(A-40)=42THEN900
570 IFPEEK(151)=50ANDPEEK(A-40)=32THENPOKEA-40,35:POKEA,32:A=A-40:B=-40:GOTO600
580 IFPEEK(151)=18ANDPEEK(A+40)=42THEN900
590 IFPEEK(151)=18ANDPEEK(A+40)=32THENPOKEA+40,35:POKEA,32:A=A+40:B=40:GOTO600
600 IFPEEK(A-1)=94THEN700
610 IFPEEK(151)=34THEN640
620 PRINT"*****TIME$<"
630 GOTO520
640 IFPEEK(A+B)=42THEN900
650 IFPEEK(A-1)=94THEN700
660 POKEA+B,35:POKEA,32:A=A+B
670 IFPEEK(151)<>34THEN520
680 GOTO640
690 REM
700 PRINT"*****TIME$:"PRINTMID$(TIME$,3,2);MINS":RIGHT$(TIME$,2);SECONDS"
710 X$=MID$(TIME$,3,2):Y$=RIGHT$(TIME$,2)

```

(listing continued on page 188)



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(listing continued from page 186)

```

720 FORS=1T0200:NEXT
730 PRINT"J"
740 POKES9468,14
750 PRINT"QHO ARE YOU ":INPUT$
760 POKES9468,14
770 POKE158,0
780 PRINT"#####PREVIOUS I ME "
790 PRINT"J"
800 POKES9468,14
810 PRINT"###X$;" \INS ";V$;" @ECONDS BY ",L$
820 FORA=1T0300:NEXT
830 PRINT"J"
840 POKES9468,14
850 PRINT"O DU OANT @NOTHER IAME ?"
860 GET$;IFS$="":THEN660
870 IFS$="":THEN390
880 POKES9468,12
890 END
900 POKES9468,12
910 Q=USR(160)
920 PRINT"#####S M A S H"
930 FORS=1T0300:NEXTS
940 POKE158,0;FORG=1T0100:NEXTG:PRINT"#####DO YOU WANT ANOTHER GO ?"
950 POKES9468,12
960 GETR$;IFR$="":THEN960
970 IFR$="":THEN390
980 PRINT"#####CRASHED IN# " MID$(TIME#,3,2); " MINS & ";RIGHT$(TIME#,2); " SECS
990 POKES9468,12:END
1000 PRINT"J":POKES9468,14
1010 PRINT"#####_ACE ONE#####"
1020 PRINT"***"
1030 PRINT"***"
1040 PRINT"***"
1050 PRINT"***"
1060 PRINT"***"
1070 PRINT"***"
1080 PRINT"***"
1090 PRINT"***"
1100 PRINT"***"
1110 PRINT"***"
1120 PRINT"***"
1130 PRINT"***"
1140 PRINT"***"
1150 PRINT"***"
1160 PRINT"***"
1170 PRINT"***"
1180 PRINT"***"
1190 PRINT"***"
1200 PRINT"***"
1210 PRINT"***"
1220 PRINT"***"
1230 PRINT"#####"
1240 RETURN

```

```

1250 PRINT"J":POKE59468,14
1260 PRINT"#####_ACE TWO#####"
1270 PRINT"#####"
1280 PRINT"***"
1290 PRINT"***"
1300 PRINT"***"
1310 PRINT"***"
1320 PRINT"***"
1330 PRINT"***"
1340 PRINT"***"
1350 PRINT"***"
1360 PRINT"***"
1370 PRINT"***"
1380 PRINT"***"
1390 PRINT"***"
1400 PRINT"***"
1410 PRINT"***"
1420 PRINT"***"
1430 PRINT"***"
1440 PRINT"***"
1450 PRINT"***"
1460 PRINT"***"
1470 PRINT"***"
1480 PRINT"#####"
1490 RETURN
1500 PRINT"J":POKE59468,14
1510 PRINT"#####_ACE THREE#####"
1520 PRINT"***"
1530 PRINT"***"
1540 PRINT"***"
1550 PRINT"***"
1560 PRINT"***"
1570 PRINT"***"
1580 PRINT"***"
1590 PRINT"***"
1600 PRINT"***"
1610 PRINT"***"
1620 PRINT"***"
1630 PRINT"***"
1640 PRINT"***"
1650 PRINT"***"
1660 PRINT"***"
1670 PRINT"***"
1680 PRINT"***"
1690 PRINT"***"
1700 PRINT"***"
1710 PRINT"***"
1720 PRINT"***"
1730 PRINT"#####"
1740 RETURN
1750 DATA 32,210,214,162,0,165,17,76,72,226
1760 FORJ=826T835:READX:POKE J,X:NEXT
1770 POKES,76:POKE158:POKE2,3
1780 RETURN

```

(continued from page 186)

mands given at the beginning of the program may be incorrect for your particular machine.

If this is the case, type in

```

10 PRINT PEEK (151)
20 GOTO 10

```

which will give you the Peek values for

any key when depressed, thus enabling you to alter the Peek values in the identification routine of the main program which are in lines 300 to 335.

Astro invasion.

```

5 HN=5:B=33268:GOSUB 4000
10 U=T:V=33268:FO=9999:IS=0:R=1:J=46:Z=0:W=0
20 PRINT"J":POKEB,90
30 FOR I=1T04:V(I)=41:A(I)=160:NEXTI
35 FORI=5T08:V(I)=39:A(I)=160:NEXTI
40 X(4)=32768:X(3)=32769:X(1)=32808:X(2)=32809
50 X(8)=33708:X(5)=33709:X(6)=33669:X(7)=33668
200 FORI=1T08:POKEK(I),32:W(I)=K(I)+V(I):IFK(I)>33768THENX(I)=X(I)-1000
205 IFK(I)<32768THENX(I)=X(I)+1000
210 POKE X(I),A(I):NEXT I
220 IFPEEK(151)=255THEN 235
230 GOTO 300
235 PRINT"J SCORE";T;" FUEL";F0
236 FG=FG-HN:IFFG<1000THENF2050
240 IFPEEK(B)>>300THENZ2000
250 FORI=1T09:V=V+S:IFPEEK(V)=160THEN9000
251 IFPEEK(V)=126 THEN 1500
253 POKEV,1:POKEV-8,32:NEXTI
255 POKEV,32:POKEB,90:IS=0:V=B
260 GOTO 200
300 IFPEEK(151)=65THENF0=FG-60:GOTO350
310 IFPEEK(151)=68THENF0=FG-60:GOTO400
320 IFPEEK(151)=53THEN:F0=FG-150:S=R:GOTO240
330 IFPEEK(151)=81THENF0=FG-300:GOTO3000
335 IFPEEK(151)=52THENB=B-R:F0=FG-190:POKEB,90
340 GOTO 240
350 POKEB+32:IFR=1THENR=-39:GOTO 450
355 IFR=-39THENR=-40:GOTO450
360 IFR=-40THENR=-41:GOTO450
365 IFR=-41THENR=-1:GOTO450
367 IFR=-1THENR=39:GOTO450
370 IFR=39THENR=40:GOTO450
375 IFR=40 THENR=41:GOTO450
377 IFR=41 THENR=1:GOTO450
400 POKEB+R,32:IFR=1THENR=41:GOTO450
403 IFR=41THENR=40:GOTO450
405 IFR=40THENR=39:GOTO450
410 IFR=39THENR=-1:GOTO450
415 IFR=-1THENR=-41:GOTO450
417 IFR=-41THENR=-40:GOTO450
420 IFR=-40THENR=-39:GOTO450
430 IFR=-39THENR=1
450 POKEB+R,34:GOTO240
500 A(2)=32:R(4)=32:V(1)=40:V(2)=40:V(3)=1:V(4)=1:Z=1
510 T=T+10:POKEV-R,32:GOTO255
550 A(5)=32:R(7)=32:V(8)=40:V(7)=40:V(5)=1:V(6)=1
560 W=1:T+10:POKEV-R,32:GOTO 255
600 A(3)=126:R(4)=126:V(3)=41:V(4)=-39
610 T=T+20:POKEV-R,32:GOTO 255
650 R(1)=126:R(2)=126:V(1)=39:V(2)=41
660 T=T+20:POKEV-R,32:GOTO 255
700 A(9)=126:R(7)=126:V(8)=41:V(7)=-39
710 T=T+20:POKEV-R,32:GOTO 255
750 A(5)=126:R(6)=126:V(5)=40:V(6)=-39
760 T=T+20:POKEV-R,32:GOTO 255
900 FORP=1T08:IF XCP=VTHEN920
910 NEXTP
920 IFW=1ANDZ=1 THEN 1000
930 IFF<5THEN960
940 IFW=0THEN550
950 GOTO1800

```

```

960 IFR=0 THEN500
1000 ON P GOTO 650,650,600,600,750,750,700,700
1500 FORI=1T08:IFV=X(I)THENI520
1510 NEXTI
1520 A(I)=42:T+50:IFTU+440THENHN=HN-6:GOTO10
1530 POKEV-R,32:GOTO255
2000 POKEB-1,43:POKEB+40,43:POKEB+1,43
2810 H=H+1:IFH>2THEN 2050
2920 GOTO 250
2950 PRINT"J:PRINT"J DEAD SCORE I ";T;" FUEL";F0
.2060 END
-3000 IFPEEK(B)>>300THEN2000
3005 FORI=1T08:POKEK(I),32:NEXTI
3010 POKE B,32:POKEV,32:PRINT"J"
3020 R(1)=67:R(2)=77:R(3)=72:R(4)=78:R(5)=78:R(6)=67:R(7)=77:R(8)=72
3030 S(1)=1:S(2)=-41:S(3)=40:S(4)=-39:S(5)=39:S(6)=-1:S(7)=41:S(8)=-40
3035 GOSUB 3040:GOSUB3250:GOSUB 3400
3036 GOTO 3450
3040 FORI=1T08:G(I)=33268+S(I):NEXTI
3200 FORI=1T012:FORQ=1T08:POKE G(Q),R(Q):G(Q)=G(Q)+S(Q):NEXT Q:NEXTI :RETURN
3250 FORI=1T08STEP2:Z(I)=78:NEXTI
3260 FORI=0T08STEP2:Z(I)=77:NEXTI
3270 V(1)=-42:V(2)=-38:V(3)=81:V(4)=38:V(5)=-81:V(6)=79:V(7)=42:V(8)=-79
3280 FORI=1T0 8:IC(I)=33268+V(I):NEXTI
3281 GOSUB 3290
3282 FORI=1T08:IZ(I)=32:NEXTI
3283 FORI=1T08:IC(I)=33268+V(I):NEXTI:GOSUB 3290
3284 RETURN
3290 FORQ=1T05:FORI=1T08:POKEC(I),Z(I):C(I)=C(I)+V(I):NEXTI:NEXTQ
3390 RETURN
3400 FORI=1T0 8:R(I)=32:NEXTI
3410 GOSUB 3040:RETURN
3450 B=32768:INT((RND(0)+1000)+1)
3455 FORI=1T08:R(I)=126:NEXTI
3470 S(1)=1:S(2)=-41:S(3)=40:S(4)=-39:S(5)=39:S(6)=-1:S(7)=41:S(8)=-40
3480 FORI=1T08:G(I)=B+S(S(I)):NEXTI
3485 FORQ=1T05
3490 FORC=1T0 2:FORI=1T08:POKEG(I),R(I)
3492 NEXT I
3493 FORI=1T08:IFR(I)=126THENR(I)=32:GOTO3497
3495 R(I)=126
3497 NEXT I
3498 NEXT C
3499 FORI=1T08:G(I)=G(I)-S(I):NEXTI
3500 NEXTP
3510 IFPEEK(B)>>32THEN 2000
3515 POKE B,90
3520 FORI=1T08:POKEK(I),A(I):NEXTI
3530 GOTO 200
4000 PRINT"J"
4810 PRINT" KEY COMMANDS"
4820 PRINT"
4830 PRINT#PRINT
4840 PRINT" A LEFT ROTATE"
4850 PRINT#PRINT" 0 RIGHT ROTATE"
4860 PRINT#PRINT" Q HYPER SPACE"
4870 PRINT#PRINT" 4 THRUST"
4880 PRINT#PRINT" 5 FIRE"
4890 PRINT#PRINT#PRINT" PRESS SPACE BAR TO START"
4100 GET$;IFS$="":THEN18
4110 GOTO 4100

```



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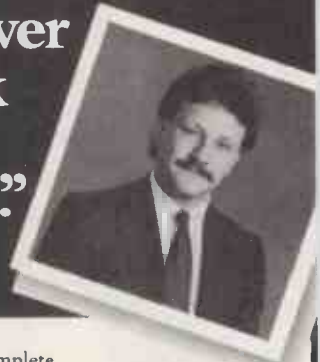


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## A Practical Introduction to Computer Graphics

By Ian O Angell. Published by Macmillan Press. 160 pages; paperback £5.95, ISBN 0333 31083 7; hardback £12, ISBN 0333 31082 9.

EVEN A CURSORY glance at research papers in computer graphics reveals that it is an area of computing with a high mathematical content, a fact which this book accurately reflects. Two-dimensional and three-dimensional geometry are introduced, starting from an assumed knowledge of simple co-ordinate geometry. Transformations of two- and three-dimensional spaces are dealt with using matrix methods.

The book is most appropriate for mainframe computer users — the author assumes access to Calcomp library routines, or Calcomp-like routines — though the book is based on vector-plotting techniques which could be done with the raster-scan graphics systems associated with personal computers. Colour graphics are not discussed. The text assumes the use of the standard Tektronix 4010 terminal and deviation of the reader's display device from the 4010's characteristics has to be taken into account in adapting the numerous examples. All the examples for which program listings are available are in Fortran IV.

The author's approach is to provide numerous examples for the reader to try, which is a very effective and enjoyable way to learn graphics tech-

niques and giving motivation to tackle the maths. The text is clear and well written; it is only the maths which is likely to cause problems. A large amount of ground is covered, from elementary two-dimensional graphics to algorithms for hidden-line removal and simple animation techniques, and together the examples given form a sensible basis for a simple graphics package.

### Conclusions

- A good book on a difficult topic.
- It is most appropriate to the mathematically literate Fortran programmer with access to the Calcomp package of routines.

John Cookson

## The Gateway Guide to the ZX-81 and ZX-80

By Mark Charlton. Published by Database Consultancy, 105 Fairholme Ave, Gidea Park, Romford, Essex.

ONE OF the best ways to learn programming is to copy, run and modify well-written programs produced by experienced programmers. This book contains over 70 programs all for the ZX-80 and ZX-81; some of them are trivial and some are badly written, but many are useful because they illustrate graphical and other aspects of these particular machines.

Few of the programs are directly applicable utilities; rather they are mainly small programs for non-serious projects. For the novice with a ZX-80 or ZX-81 the book provides a useful collection of facts about the machines,

some addresses and a library of techniques to try.

### Conclusions

- Useful to users of the ZX-80 and ZX-81 but of no more general application.

John Cookson

## Applesoft Language

By Brian D Blackwood and George H Blackwood. Published by Howard W Sams & Co. Inc. Paperback, 254 pages, \$10.95. ISBN 0 672 21811 9.

INTENDED TO BE a self-teaching guide to the Applesoft version of Basic, this book is divided into three sections. The first and largest takes the form of a series of 20 lessons and exercises each covering one aspect of the language such as output formatting or the precedence of operators. The presentation of each topic is clear and concise, though conventional for a book of this type.

The useful chapter entitled Cleanup, which ends the first section, covers such areas as the Onerr-Goto and the Resume instructions which are so necessary in programming real problems. Also included here are the Peek and Poke instructions, without which many of the more imaginative games would not be possible, and decimal alignment of numeric variables.

The second section provides guidance on programming techniques and problem solving for the computer and includes a useful chapter on lists and stacks. The final section incorporates a brief description of both the high- and low-

resolution graphics capabilities of Applesoft Basic.

### Conclusions

- A capable book which is no worse and no better than most others describing Basic, providing a useful second view of the Applesoft implementation to that provided by the language manuals.
- Though this book fulfils its intended purpose, is there really any need for yet another book on Basic?

Martin Wilson

## Microcomputer Buyer's Guide 1981

By Tony Webster. Published by Computer Reference Guidel Hayden Book Company. Paperback, 326 pages, \$25. ISBN 0 9594624 2 2.

THE AIM of this large-format paperback is to provide a detailed guide to microcomputer systems for both first-time and experienced users by providing a comprehensive review of four main areas: theory and applications; independent software vendors; microcomputer systems; and VDUs and printers.

The theory and applications section, is comprehensive, covering everything from the elements that make up a central processing unit to the kind of peripherals that are typically available for microcomputer systems.

The guidelines for selection place too much emphasis on the hardware at the expense of the software, which should be the first consideration. Word processing, networking and the use of microcomputers is devoted to Intel's strategy as manifest in its iAPX series which, while important, is not the only approach being adopted.

The section on software products by independent software houses covers most of the well-known products, such as those by Digital Research and MicroPro, though it is by no means definitive.

### Conclusions

- A guide of this type is much needed in the rapidly changing world of microcomputers but will inevitably have notable omissions by the time it reaches the bookshops.

Martin Wilson

## Introducing Computers

By Ron Condon. Published by Macdonald in the Guidelines series. 96pp; paperback £2.50, ISBN 0 356 06042 X; hardback £3.95, ISBN 0 356 06442 5.

THERE ARE MANY small, introductory books on computers now available. This one is particularly distinguished by the quality and quantity of the illustrations, photographs and graphic material used. It is the best illustrated text of its type I have seen.

The book starts with a clear and not over-detailed discussion of the history of computing — with a slight British bias — leading to the structure of computers, people who work with computers, communications, artificial intelligence and robotics. These sections are generally well presented, but others are ill-served by the enforced brevity of the discussion.

The sections on the future and social implications are much too short; the section on choosing a microcompu-

ter in particular is not adequate for anyone looking for sufficient information to use as the basis for a sensible choice.

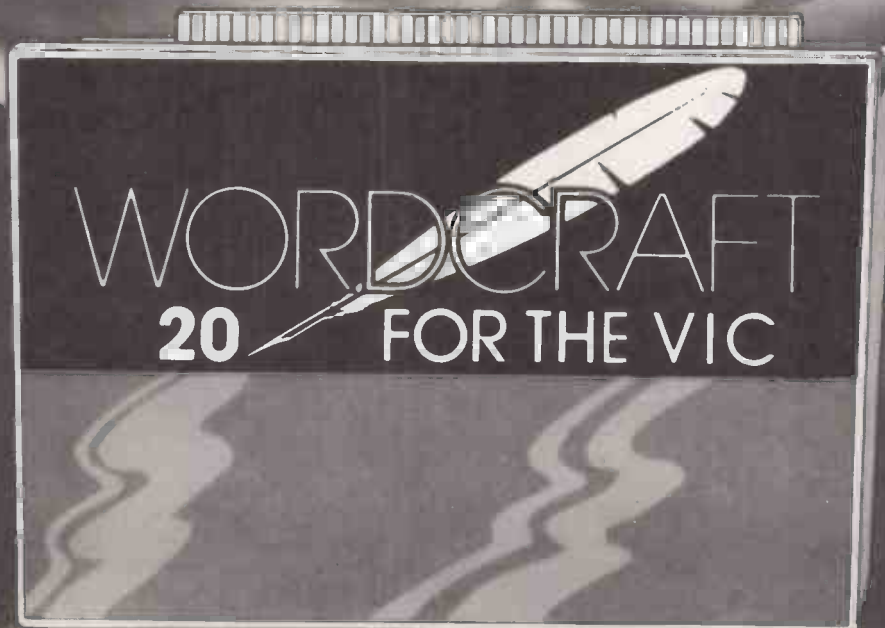
Two chapters are failures: the section on using computers is pedestrian in comparison with the rest of the book, and the chapter on Basic programming is inappropriate and inadequate.

### Conclusions

- A short but useful and exceptionally well-illustrated introductory text.

John Cookson

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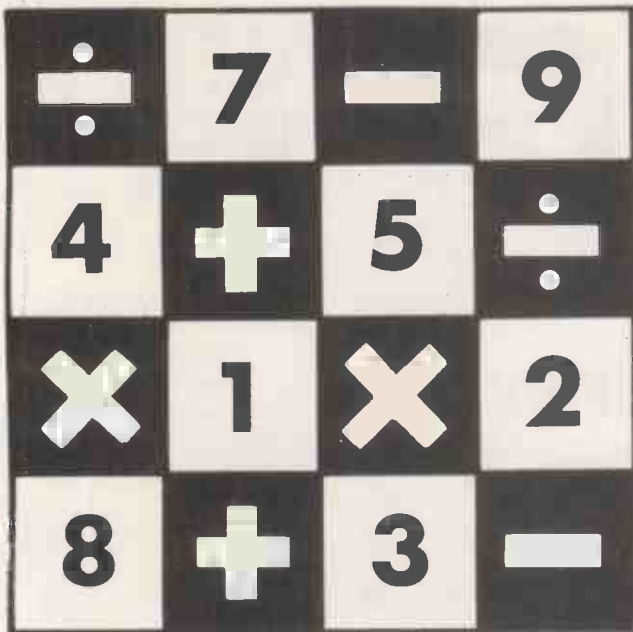
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● Circle No. 228





# Knight's square route


by  
Tony  
Roberts

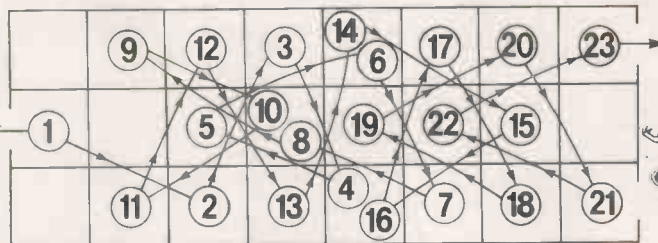
THERE IS a knight on a black square somewhere on this four-by-four chessboard. From there it jumps knight-fashion to a white square, on to a black, and so on until every white square has been visited once and once only. Black ones can be visited any number of times. As the knight jumps it builds up a simple sum, for example

$$7 \times 9 + 2 + 8, \text{ etc.}$$

What is the greatest possible result?

### Solution to October puzzle

Did you escape the fearsome two-brained Smak beast? As you can see, a devious route must be taken in order to survive. To leave the room bearing just two pistols with a bag of powder and one shot in each is no easy task. The solution ensures you success in killing the Smak. 



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# BUYERS' GUIDE SOFTWARE

The guide lists software packages costing under £3,000 that run on disc-based microcomputer systems. The list is sorted by application category, and within this alphabetically by machine type. The companies named are generally the main U.K. source, and their full addresses are given at the end of the guide.

Since we started doing the software guide the number of packages on the market has grown enormously. We invite all software suppliers to continue to send us details of their products so that we have them on file, ready for any special features we may be running. At the moment we are particularly keen to hear of software that runs on 16-bit machines.

## Machine type by application

### Combined Ledger/Stock/Invoicing

Machine type	Supplier name	Price	Comments
ACT 800	ACT Microsoft	From £500	
ACT Sirius	ACT Microsoft	£495	
Apple II and III	Systematics	From £250	
Apple II	Vlasak Electronics Ltd	£855	1,500 a/c 5,000 trans
Apple II	Dataforce (U.K.) Ltd	£855	
Apple II	Microsense Computers Ltd	£340	
Apple II	Southern Computer Systems	£1,000	varies
Apple II/ITT	Informex London Ltd	£298	500 a/c
Apple II	Star Systems Ltd	£750	2,000 a/c 6,000 trans
Commodore	Comsoft Associates	£750	
Commodore 3032	Compfer Ltd	£400	varies
Commodore 3032	Analog Electronics	£550	
Commodore 3032	Logma Systems Designs	£600	1-6 shops
Commodore 3032	Grama (Winter) Ltd	£475	varies
Commodore 3032	Bristol Software Factory	£300	1,000 a/c 6,000 trans
Commodore 3032	Compfer Ltd	£600	500 a/c 1,000 items
Commodore 3032	HB Computers	£695	500 s/c 2,500 trans
CP/M	Sheffield Micro	£2,500	includes payroll
CP/M	Sail	£1,265	varies
CP/M	Bonsai	£1,875	
CP/M	D T Systems	£750	varies
CP/M	Wisbech Computer Services	£900	varies
CP/M	Graffcom Systems Ltd	£400	varies
CP/M	Benchmark CS Ltd	£950	varies
CP/M	Computastore Ltd	£1,000	
CP/M	Interface Computer Services	£350	
CP/M	Minicomputer CS Ltd	£1,250	varies
CP/M	Salmon Microcomputing	£750	1,600 items 1,000 trans
CP/M	Selven Ltd	£1,500	3K a/c 7K trans



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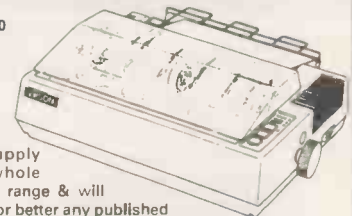
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CP/M	Map Computer Systems	£1,000	varies
CP/M North Star	Instar Business Systems	£999	600-2,900
North Star DOS	Intelligent Artefacts	£510	1,500 a/c 5K trans
Ohio Scientific	Microcomputer BM	£656	
Ohio Scientific	Stratheden Ltd		
Tandy Model 2	Chess Consultancies	£1,200	
Tandy Model 2	Chess Consultancies	£995	5,000 items 1,500 a/c
Tandy TRS-80	Microcomputer Applications	£90	
Tecs	Jar Software Systems	£650	500 a/c 300 nom. a/c

### Database Managers

Machine type	Supplier name	Price	Capacity
ACT Sirius	Stage One	£695	Tomorrow's office
Apple II	Spider	£200	2,800 records
Apple II	ACT Microsoft Ltd	£75	
Apple II	Courtman Micro Systems	£106	100K characters
Apple II	Keen Computers	£425	up to 70Mbytes
Apple II/ITT	Systematics International Ltd	£72	
Apple II/ITT	Diskdean Ltd	£120	varies
Apple II/ITT	Systematics International Ltd	£125	1,000 references
Apple II/ITT	Informex London Ltd	£198	500-1,200 records
Apple II/ITT	The Software House	£140	900 records
Commodore	Comsoft Associates	£250	
Commodore 3000/8	Stage One Computers	£45-£150	650-2,400 records
Commodore 3000/8	Commodore BM (U.K.) Ltd	£150-£300	650-1,400-64,000 records
Commodore 3032	CPS (Data Systems) Ltd	£200	varies
Commodore 3032/8	Compsoft Ltd	£190	600-5,000 records
Compucorp	Verwood Systems	£376	
CP/M	Redwood	£120	
CP/M	Compsoft Ltd	£400	30,000 records
CP/M	Great Northern CS Ltd	£110-£210	and varies
CP/M	Microtek Computer Services	£250-£500	
CP/M	Cleno Computing Services	£90-£325	varies
CP/M	Interface Ltd	£200	varies
CP/M	Median-Tec Ltd	£500	
CP/M	Microbits	£145	varies
CP/M	Southdata Ltd	£650	up to 8Mbytes
CP/M SWTPC	Verwood Systems		
Metrotech System	Metrotech	£200-£1,000	
North Star	GW Computer	£575	
Ohio Challenger	U-Microcomputers Ltd	£175	
Ohio Scientific	Microcomputer BM	£175	
Superbrain	GW Computer	£575	
Superbrain	Alan Pearman Ltd	£295	varies
SWTPC	SWTPC	£100	
Tandy TRS-80	Clearstone ADP	£75	varies
Tandy TRS-80	ACT Microsoft Ltd	£75	
Z-80/8080	Structured Systems Group	£135	varies
Z-80/Cromenco	Xitan Systems Ltd	£850	4,000 records/disc

### Engineering, Building and Design Systems

Machine type	Supplier name	Price	Notes
ACT Sirius	Cambridge Numerical Control	£800	Numerical control
Apple II	Survey Three	£1100	Land survey
Apple II	BHRA	£250	Pipeline sizing, flow and pressure-drop calculation
Apple II	Spot	£995	Builder's estimating
Apple II	Ismael CAD	varies	Range of building and engineering applications
Apple II	Gilmorehill Software	varies	Range of building and engineering applications
Apple II	Microcomp	From £200	Range of structural engineering applications





Apple II	Haden Young Ltd	From £50	Range of software for building/engineering
Apple II	James C Steadman	£200	Erect concrete columns
Apple II	James C Steadman	£250	Multibay frames
Apple II/ITT	Aerco-Gemsoft	£175	Pipeline engineering
Commodore 4032	Numerical Control Services	£1,490	Numerical control
Commodore	Ismael CAD	varies	Provide a range of software for building/engineering
Commodore	Comsoft Associates	£750	Engineering contractors estimates
Commodore 8000	The Computer Room	£1,500	Engineers production information control
Commodore 3032	Micro Computation	£300	Building-conversion specification
Commodore 3032	The Alphabet Co	£75	Time study and analysis
Commodore 3032	Comac Systems	£400	Asset register
Commodore 3032/8	Comac Systems	£400	Maintenance plan
Commodore 3032/8	Comac Systems	£400	Work orders
Commodore 3032/8	Comac Systems	£400	Plant history
Commodore 3032/8	Comac Systems	£400	Manpower analysis
CP/M	Kewill Systems Limited	£2,000	Engineering time estimates
CP/M	Cambridge Numerical Control	£800	Numerical control
CP/M	Ismael CAD	varies	Range of building and engineering applications
CP/M	Gilmorehill Software	varies	Range of building and engineering applications
CP/M	Hevacomp	£2,250	Heating and ventilation system design
CP/M	Hevacomp	£500	Building specification
CP/M	Hevacomp	£500	Building project cost control
CP/M	Median-Tec	£500	Plastic portal frames
CP/M	Median-Tec	£500	Slope-stability analysis
CP/M	Median-Tec	£500	Retaining wall design
Equinox	Equinox	£500	Civil/structural engineering design
Hewlett-Packard	CSC (Northern) Ltd	from £200	Engineering design systems
Superbrain	Stemmos	£2,500	Stress analysis for pipe networks
Superbrain	KGB	£2,500	Computer-aided design
Tandy TRS-80	Chess Consultancies	£450	Production planning
Tecs	Jar Software	£600	Production analysis

## Financial Systems

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ACT Sirius	ACT Microsoft	£150	
ACT 800	ACT Microsoft	£595	Micromodeller
ACT Sirius	ACT Microsoft	£150	SuperCalc
ACT Sirius	ACT Microsoft	£595	Micromodeller
Apple II	ACT Microsoft	£150	Micromodeller
Apple II	Personal Computers	£500	Income tax computations
Apple II and III	PE Consulting Group	£350	Microfinesse-financial planning
Apple II	Microdigital	£200	Sales analysis
Apple II	Microdigital	£130	Credit control
Apple II	Microsense	£194	Cashier retail/wholesale

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CP/M North Star	Benchmark CS Ltd	£250	150 a/c 500 trans
Horizon	Claisse/Allen Computing	£500	999 a/c 99 entries, nine computers
North Star DOS	Intelligent Artefacts Ltd	£295	1,500 a/c 5,000 trans
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Tandy Model 2	Chess Consultancies Ltd	£400	1,000 a/c
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Z80/8080	Solitaire	£500	Up to 26 by 400 a/c
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## Hotel and Travel Packages

Machine type	Supplier name	Price	Notes
Apple II	Spot	£150	Bar management
Apple II	Dataforce	£525	Hotel management
Apple II	Informex Logic	£298	Travel agents' system
Apple II	Informex Logic	£298	Hotel administration system
Apple II/ITT	Guestel Ltd	£500	Hotel billing
Apple II	Diskwise Ltd	£695	Hotel reservation and guest billing
Commodore 3000	Landsler Software	£350	Hotel guest billing
CP/M	Hill Briton	£2,000	Airline reservation
CP/M	Mountain	£2,500	Tour operator's reservations
CP/M	Sail	£600	Bar and food stock
CP/M	Sail	£1,200	Stock and accounting

## Incomplete Records

Machine type	Supplier name	Price	Capacity
ACT Sirius	Ibis	£1,200	9,000 a/c codes
Apple II/ITT	Padmede Computer Services	£450	900 a/c 2,000 trans/disc
Apple II	Keen Computers	£580	up to 70Mbytes
Apple II	Southern Computer Systems	£750	500 a/c 2,000 trans
Commodore	The Computer Room	£230	
Commodore 3032	Stage One Computers	£750	500 centres 2,300 a/c
Commodore 3032	Micro Computation,	£555	120 a/c 5,000 trans
CP/M	Mountain	£950	1,000 headings
CP/M	Map	£1,250	
CP/M	Wisbech Computer Services	£750	
CP/M	CPL Ltd		250 headings, 2,000 trans per 5.25 disc
CP/M	Benchmark Ltd	£975	
CP/M	Bytesoft	£250	3,000 trans
CP/M	Criterion Business Systems	£375	2,500 entries
CP/M	Ludhouse Ltd	£1,000	variable
CP/M	Salmon Microcomputing	£950	5,000 entries
CP/M	Map Computer Systems	£550	
Durango F-85	Kesho Systems	£1,000	
Exidy Sorcerer	Basic Computing	£350	See also Micropute
Tandy Model 1	A J Harding (Molimerx)	£150	1,200
Tandy Model 1	Quickmet	£785	300 a/c 2,000 trans
Tandy Model II	IBIS Business Info Systems		9,000 a/c codes

## Job Costing/Billing

Machine type	Supplier name	Price	Capacity
ACT Sirius	Ibis	£800	
Apple II	Informex London	£498	1,000 emp-pro-exp codes
Apple II	Deltic Computing Ltd	£250	
Apple II	Southern Computer Systems	£750	
Apple II/ITT	Padmere Computer Services	£300	999 clients 99 rates
Apple II/ITT	TABS Ltd	£99	100 jobs 3,000 trans
Commodore	Comsoft Associates	£350	
Commodore 3032	CSM Ltd	£600	1,000 jobs 100 people

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Commodore 3032	Stage One Computers	£100	300 appointments
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CP/M	Kewill Systems Limited	£1,500	for manufacturing companies
CP/M	Bromley	£400	
CP/M	Vauntberry	£1,450	
CP/M	Business Solutions Ltd	£190	varies
CP/M	Map Computer Systems Ltd	£550	400-96,000 jobs
CP/M	Graffcom Systems Ltd	£400	varies
CP/M	Ludhouse Ltd	£1,000	1,000 jobs 35 codes
CP/M	Microtek Computer Services	£1,000	
CP/M	Great Northern CS Ltd	£455	300 clients
CP/M	Salmon Microcomputing	£300	225 codes
CP/M	CPL Ltd	£300	
CP/M	Goldcrest	£200	
CP/M North Star	Intelligent Artefacts	£275	

### Nominal Ledger

Machine type	Supplier name	Price	Capacity
ACT Sirius	Ibis	£750	
Apple II	Logic Computers	£630	100 depts, 200 a/c
Apple III	Logic Computers	£630	500 depts, 500 a/c
CP/M	Map	£400	999 headings
CP/M	Bonsai	£475	999 headings
CP/M	Bromley	£400	
CP/M	P R Daly	£500	
CP/M	Vauntberry	£950	
CP/M	D T Systems	£750	
Tandy Model II	Ibis	£750	

### Order Entry/Invoicing

Machine type	Supplier name	Price	Notes
Apple II and III	Systematics	£250	Invoicing
Apple II	Informex	£198	Invoicing system
Apple II	Southern Computer Systems	£750	Invoicing
Commodore 3032	MMS Computers	£250	Order control
Compucorp	Verwood Systems	£250	
CP/M	Sail	£250	Invoicing/back orders
CP/M	Bromley	£400	Order processing
CP/M	P R Daly	£350	Invoicing
CP/M	Vauntberry	£950	Order processing
CP/M	Typestyle	£250	Invoicing
CP/M	Wisbech Computer Services	£600	
CP/M	Graham-Dorian	£500	200 invoices 1,500
CP/M	Goldcrest	£300	Invoicing
CP/M	P R Daly & Co	£200	Invoicing
CP/M	Graffcom Systems	£350	Order entry/invoicing
CP/M	Interface Ltd	£250	Invoicing
CP/M	Median-Tec		Invoicing
Tandy TRS-80	Tridata Micros	£75	Invoicing
Z-80/MCZ	Software Architects	£600	Order entry/invoicing

### Payroll

Machine type	Supplier name	Price	Capacity
ACT Sirius	Ibis	£600	
Apple II	Deverill	£75	
Apple II	Spot	£295	350 employees
Apple II	Logic Computers	£630	300 personnel
Apple III	Logic Computers	£630	1,000 personnel
Apple II and III	Systematics	£250	
Apple II	Dataforce (U.K.) Ltd	£375	
Apple II/ITT	TW Computers Ltd	£145	
Apple II/ITT	Informex London Ltd	£298	
Apple II/ITT	Algobel Computers	£295	500 employees
Apple II/ITT	Vlasak Electronics Ltd.	£375	200 employees
Apple II/ITT	Computech Systems	£379	300 employees
Apple	Style Systems Ltd	£350	450 employees
Apple II/ITT	Tab's Ltd	£99	50 weekly 100 monthly
Commodore	Comsoft Associates	£350	500 employees





Commodore 3000/8	Commodore BM (U.K.) Ltd	£150	200-600 employees
Commodore 3000/8	Landsler Software	£150	200-500 employees
Commodore 3032	Analog Electronics	£90	
Commodore 3032	L & J Computers	£220	
Commodore 3032	Intex Datalog Ltd	£195	200 employees
Commodore 3032	Computastore Ltd	£75	483 employees
Commodore 3032	ACT (Petsoft) Ltd	£195	600 employees
CP/M	Map	£550	5,000 employees
CP/M	Bromley	£400	
CP/M	PR Daly	£350	
CP/M	Vauntberry	£950	
CP/M	Benchmark CS Ltd	£350	300 employees, 50 departments
CP/M	Haywood Associates Ltd	£350	
CP/M	Median-Tec	£500	1,000 employees
CP/M	Salmon-Microcomputing	£300	500 employees
CP/M	Map Computer Systems	£350	300-96,000 employees
CP/M	Daman Computer Services	£900	1,000 employees/Byte
CP/M	Selven Ltd	£500	400 employees
CP/M	PR Daly & Co Ltd	£350	
CP/M	Graffcom Systems Ltd	£500	500 employees
CP/M	Horizon Software Ltd	£500	
CP/M	PCL Software Ltd	£495	1,200 employees
CP/M	Ludhouse Ltd	£450	300 employees
CP/M	Comput-A-Crop	£495	175 employees
CP/M	Microbits	£500	Varies
CP/M North Star	Micromedia Systems	£495	350 employees
CP/M North Star	Intelligent Artefacts	£52	100 employees
CP/M Vector	Taylor Micro Systems	£490	
Durango F-85	Kesho Systems	£500	
Horizon	Claisse-Allen Computing	£500	250 employees
Ohio Scientific	Stratheden Ltd	£750	varies
Sharp MZ-80	Tridata Micros Ltd	£250	400 employees
Tandy Model II	Ibis	£600	
Tandy TRS-80	A J Harding (Molimerx)	£120	
Tandy TRS-80	Chess Consultancies	£400	400 employees
Tandy TRS-80	FIBS	£429	
Tandy Model 2	P J Norris	£500	1,000 per disk
Tandy TRS-80	Tridata Micros Ltd	£218	400 employees
Tandy TRS-80	3-line Computing	£140	
Tecs	Jar Software Systems	£250	300 employees
Z-80/8080	Liveport Ltd	£250	500 employees
Z-80/8080	Solitaire	£500	200 employees
Zilog MCZ range	Microbits	£500	300 employees

## Property Management

Machine type	Supplier name	Price	Capacity
Apple II/ITT	Cyderpress Ltd	£650	
Apple II/ITT	Informex London Ltd	£298	300 entries
Apple II/ITT	Cyderpress Ltd	£650	500 properties
Apple II/ITT	Algobel Computers Ltd	£650	400 properties
Commodore 3032/8	Compsoft Ltd	£190	13,000
CP/M	Compsoft Ltd	£400	27,000
CP/M	Algobel Computers Ltd	£650	2,000 trans
CP/M	Salmon Microcomputing	£900	
Z-80/8080	Graham Dorian Software	£325	varies

## Purchase Ledger

Machine Type	Supplier name	Price	Capacity
Apple II	Logic Computers	£630	800 a/c, 1,500 trans
Apple III	Logic Computers	£630	2,000 a/c, 5,000 trans
Apple II and III	Systematics	£250	
Apple II	Dataforce (U.K.) Ltd	£315	200 a/c, 1,000 trans
Apple II	Logic Box Ltd	£490	400 a/c, 1,000 trans
Apple II	Deltic Computing Ltd	£250	1,000 trans
Apple II	Computech Systems	£295	500 a/c, 1,600 trans
Apple II	Southern Computer Systems	£750	variable
Apple II/ITT	Systematics International Ltd		
Apple II/ITT	Padmede Computer Services	£300	900 a/c, 4,500 trans/disc
Apple	Style Systems Ltd	£250	650 a/c, 1,750 trans

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Commodore 3032	ACT (Petsoft) Ltd	£120	200 a/c 700 trans
Commodore 3032	Compfer Ltd	£300	1,000 trans 7,000 entries 600 a/c 4,500 trans
Commodore 8000	Commodore BM Ltd	£300	
Compucorp	Verwood Systems	£250	
CP/M	Sail	£395	varies
CP/M	Bonsai	£475	
CP/M	Bromley	£400	
CP/M	PR Daly	£350	
CP/M	Vauntberry	£950	
CP/M	Typestyle	£250	
CP/M	Johnson	£200	
CP/M	DT Systems	£750	
CP/M	CPL Ltd	£300	
CP/M	Goldcrest	£300	
CP/M	Wisbech Computer Services	£300	
CP/M	Bytesoft	£400	varies
CP/M	Business Solutions Ltd	£390	varies
CP/M	Median-Tec Ltd	£500	500 a/c 5,000 trans
CP/M	Ludhouse Ltd	£500	500 a/c 5,000 trans
CP/M	Great Northern CS Ltd	£315	500 a/c
CP/M	Structured Systems Ltd	£460	varies
CP/M	Selven Ltd	£600	1,000 a/c 2,000 trans
CP/M	Salmon Microcomputing	£350	1,000 a/c 24,000 trans
CP/M	Map Computer Systems Ltd	£400	400-96,000 a/c
CP/M	Microbits	£500	varies
CP/M	PR Daly & Co Ltd	£350	
CP/M	Computastore Ltd	£400	500 a/c 3,100 trans
CP/M	Haywood Associates	£350	
CP/M	Interface Computer Services	£350	varies
CP/M	Selven Systems	£600	500 suppliers 5,000 trans
CP/M North Star	Benchmark CS Ltd	£250	100 a/c 300 trans
Durango F-85	Kesho Systems	£500	
Exidy Sorcerer	Basic Computing	£125	See also Micropute
Horizon	Claisse Allen Computing	£500	800 a/c 2,000 trans
Ohio Scientific	Stratheden Ltd	£500	varies
Tandy Models 1&2	Chess Consultancies Ltd	£250	300-500 a/c
Tandy TRS-80	FIBS	£750	part of integrated system
Tandy TRS-80	Tridata Micros Ltd	£225	125 a/c 1,000 trans
Zilog MCZ range	Microbits Ltd	£500	400 suppliers 1,000 trans
Z-80	Liveport Ltd		
Z80-8080	Solitaire	£500	200 by 26 a/c

### Sales Ledger

Machine Type	Supplier Name	Price	Capacity
Apple II		£630	600 a/c, 15,000 trans
Apple III	Logic Computers	£630	2,000 a/c, 5,000 trans
Apple II and III	Systematics	£250	
Apple II	Computech Systems	£295	500 a/c 1,600 trans
Apple II	Dataforce (U.K.) Ltd	£315	200 a/c 1,000 trans
Apple II	Logic Box Ltd	£490	300 a/c 1,300 trans
Apple II	Deltic Computing Ltd	£250	1,000 a/c
Apple II/ITT	Padmede Computer Services	£300	900 a/c 4,500 trans/ disc
Apple II/ITT	Guestel Ltd	£300	200 a/c
Apple II/ITT	Systematics International Ltd		
Apple II	Southern Computer Systems	£750	
Apple	Style Systems Ltd	£250	650 a/c 2,500 trans
Commodore	Comsoft Associates	£350	
Commodore 3000/8	Anagram Systems	£299	250-2,000 a/c 500-10,000 trans
Commodore 3000/8	CSM Ltd	£550 and £650	1,000-2,000 a/c 6,000-10,000 trans
Commodore 3032	ACT (Petsoft) Ltd	£120	200 a/c 700 trans





Commodore 8000	Commodore BM (U.K.) Ltd	£300	600 a/c 4,500 trans
Compucorp	Verwood Systems	£250	
CP/M	Map	£400	
CP/M	Bonsai	£475	
CP/M	Bromley	£400	
CP/M	PR Daly	£350	
CP/M	Vauntberry	£950	
CP/M	Typestyle	£250	
CP/M	Johnson	£200	
CP/M	Wisbech Computer Services	£300	
CP/M	Goldcrest	£300	
CP/M	CPL Ltd	£300	with invoices
CP/M	Business Solutions	£425	
CP/M	Bytesoft	£400	varies
CP/M	PCL Software Ltd	£475	950 a/c
CP/M	Great Northern CS Ltd	£415	500 a/c
CP/M	Haywood Associates Ltd	£350	
CP/M	Median-Tec Ltd	£500	500 a/c 5,000 trans
CP/M	Ludhouse Ltd	£500	2,000 a/c
			8,000 trans.
CP/M	Graffcom Systems Ltd	£450	540-7,000
CP/M	Computerstore Ltd	£400	500 a/c 3,500 trans
CP/M	Salmon Microcomputing	£350	1,000 a/c
			24,000 trans
CP/M	Selven Systems	£600	500 a/c 5,000 trans
CP/M	Map Computer Systems Ltd	£300	400-96,000 a/c
CP/M	Daman Computer Services	£900	1,500 a/c 500 trans
CP/M	PR Daly & Co Ltd	£350	
CP/M	Interface Computer	£350	varies
CP/M North Star	Services		
	Benchmark CS Ltd	£250	200 a/c 500 trans
Durango F-85	Kesho Systems	£500	
Exidy Sorcerer	Basic Computing	£125	See also Micropute
Horizon	Claisse-Allen Computing	£500	800 a/c 2,000 trans
Tandy Models 1 & 2	Chess Consultancies Ltd	£250	300 a/c
Tandy TRS-80	Tridata Micros Ltd	£225	175 a/c 1,350 trans
Tecs	Jar Software Systems	£550	500 a/c
Z-80	Liveport Ltd		

## Stock Systems

Machine type	Supplier Name	Price	Capacity
Apple II	Spot	£185	
Apple II and III	Systematics	£250	
Apple II	Logic Box Ltd	£490	
Apple II	Vlasak Electronics Ltd	£150	
Apple II	Dataforce (U.K.) Ltd	£200	1,200 items
Apple II	U-Microcomputers Ltd	£199	7,000 items
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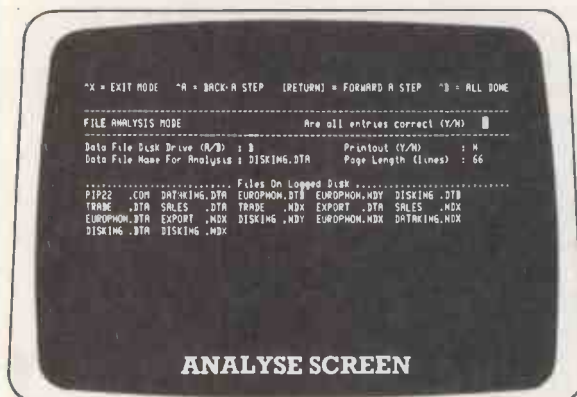
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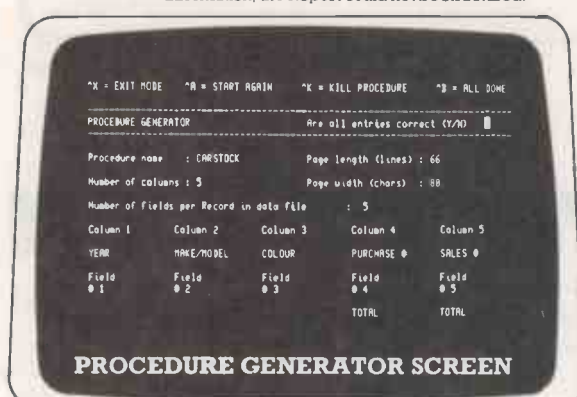




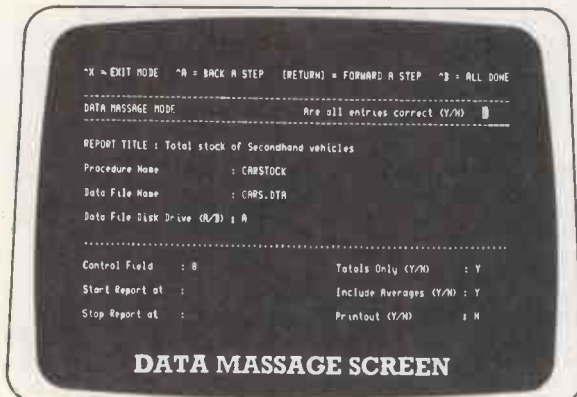
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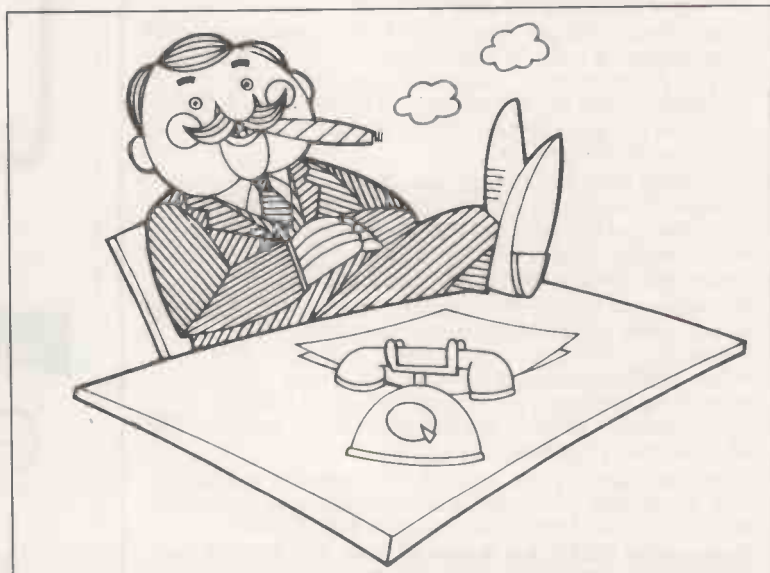


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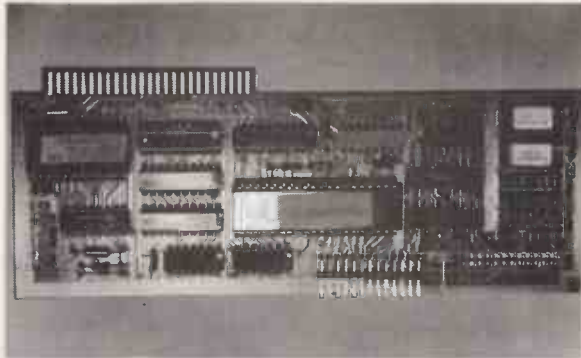
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# Never mind the quality feel the bandwidth

UNDER A HEADLINE "Communications gap widens at Citroën" the *Guardian*, Friday May 21, 1982 reported: "At Citroën's big car factories in the Paris region, management and unions have only been able to speak to each other through an internal television system for the last few days." It seems that Citroën has been encouraging the formation of a free trade union CSL, with the result that the other unions at Citroën refuse to sit down with the CSL and will only negotiate by television.

The refusal to sit down with the management or the CSL indicates the high premium placed in society on physical proximity for negotiation. The use of television by unions other than CSL is clearly a calculated insult to the management.

When government ministers suggest that MPs could hold their surgeries with the constituents remotely by television rather than face to face, with the MP remaining at Westminster, many constituents would be similarly insulted. The technology may be available but that does not mean it should be used indiscriminately. Yet many who support with an almost evangelical zeal the immediate wholesale implementation of the new technologies dismiss opposition to the technology as being based simply on ignorance.

According to *Cable Systems*, the report of the Information Technology Advisory Panel, introducing widespread cabling into Britain will simply stimulate industry by injecting money into the economy. Keynes had a similar idea: let the Treasury fill old bottles with banknotes, bury them at suitable depths in disused mines which are then filled with rubble, and leave private enterprise to dig the notes up again. Keynes predicted there would be no more unemployment and, thanks to the knock-on effects, the income of the community would become much larger than it was before the burials. *Cable Systems* claims the beneficial effects of the multiplier as a bonus of cabling.

There remains the dangerous possibility that because certain aspects of the new technologies are clearly of great value all new technologies will be seen as valuable. If industries do not manage to utilise constructively the potentials of micro-processors, Britain, as a nation, will gallop even further into the obsolescence predicted by Mr Wedgwood Benn in February 1963. If we do not cable we will be no worse off and probably far better off.

Arguments for cabling have two main prongs: the provision of hugely increased quantities of entertainment, and

## Technology should serve its users, not the other way round, argues Boris Allan

improving communications. Cable television will enable the viewers at home to receive far more television channels than at present. Yet for the extra television channels to be viable, viewers who watch will have to buy the goods being advertised; as any marketing man or woman will tell you, it is the audience that counts.

The proliferation of entertainment channels is a case of Keynesian buried bottles — a totally non-productive exercise which will have productive spin-offs. Improved communications, the second supposed benefit of the wired society, is rather more beset with difficulties. They are clearly pointed out by Frederick Brooks, the man who was in charge of the implementation and design of the IBM 360 operating system. In his book he writes: "I do not share the salesman-projected vision of the 'management total-information system', wherein the executive strokes an inquiry into a computer, and a display screen flashes his answer. There are many fundamental reasons why this will never happen. One reason is that only a small part — perhaps 20 percent — of the executive's time is spent on tasks where he needs information from outside his head. The rest is communication: hearing, reporting, teaching, exhorting, counselling, encouraging. But for the fraction that is data-based the handful of critical documents are vital and they will meet almost all needs."

We live in a society in which organisations are becoming the most important units; as McGregor noted in 1957 technology cannot tell us how to make our organisations truly efficient. His most persuasive advocate is Robert Townsend who says of the United States: "There is nothing fundamentally wrong with our country except that the leaders of all our major organisations are operating on the wrong assumptions." The assumptions are: people do not like work; people are lazy, and need to be threatened in order to make them work; and people are stupid and very gullible.


The type of organisation for which this is normally true can usually be seen to be a hierarchical one. Its channels of communication are fixed and regularised; information is transmitted from the top down, sometimes from the bottom to the next to bottom, but very rarely is information shared with others at the same level.

It has long been held that those organisations which innovate most efficiently approach the ideal of the "organic" mode of organisation in which nothing inhibits individuals from communicating with others. Differences of status and technical privilege are discouraged, and communication barriers founded on any form of status are removed. Such an organisation requires a different set of assumptions about people it presumes they are human, and have human needs which determine their behaviour; people often like work and do not have to be coerced as they will commit themselves to the extent to which they can satisfy their own needs.

One consequence of a wired society will be a reinforcement of the hierarchical form of organisation. The structure will be formalised in terms of its communication links, especially if large numbers of people take up the currently fashionable practice of telecommuting — work from home. It is expensive to implement a communication system which allows every person to communicate simultaneously with large numbers of others. If most people worked from home the cost would be prohibitive.

The greater the extent of formalisation that exists in an organisation, the greater the extent to which communication will be written rather than spoken. In a wired organisation, does long-distance communication by means of a visual device such as closed-circuit TV replace the need for the spoken word delivered face to face, or is it a replacement for some of the written words? Experience suggests the latter. If the visual devices are introduced, face-to-face communication will probably decline, and the organisation will necessarily become more hierarchical.

To succeed there is a need for organisations to become more innovative, a process which will mean a change in nature for many of them. The change will not be brought about by changes in the education system designed to turn out more technologists, but from a change in the way those in charge see their organisation.

When looking at *Cable Systems* and similar reports it is important to forget the futuristic and think about the future. Why is it that those who are so strongly in favour of technological advances see the need for ordinary people to accommodate to change rather than for the organisations themselves to adjust? Could it be that the proponents of technology are already at the top of organisational hierarchies? 

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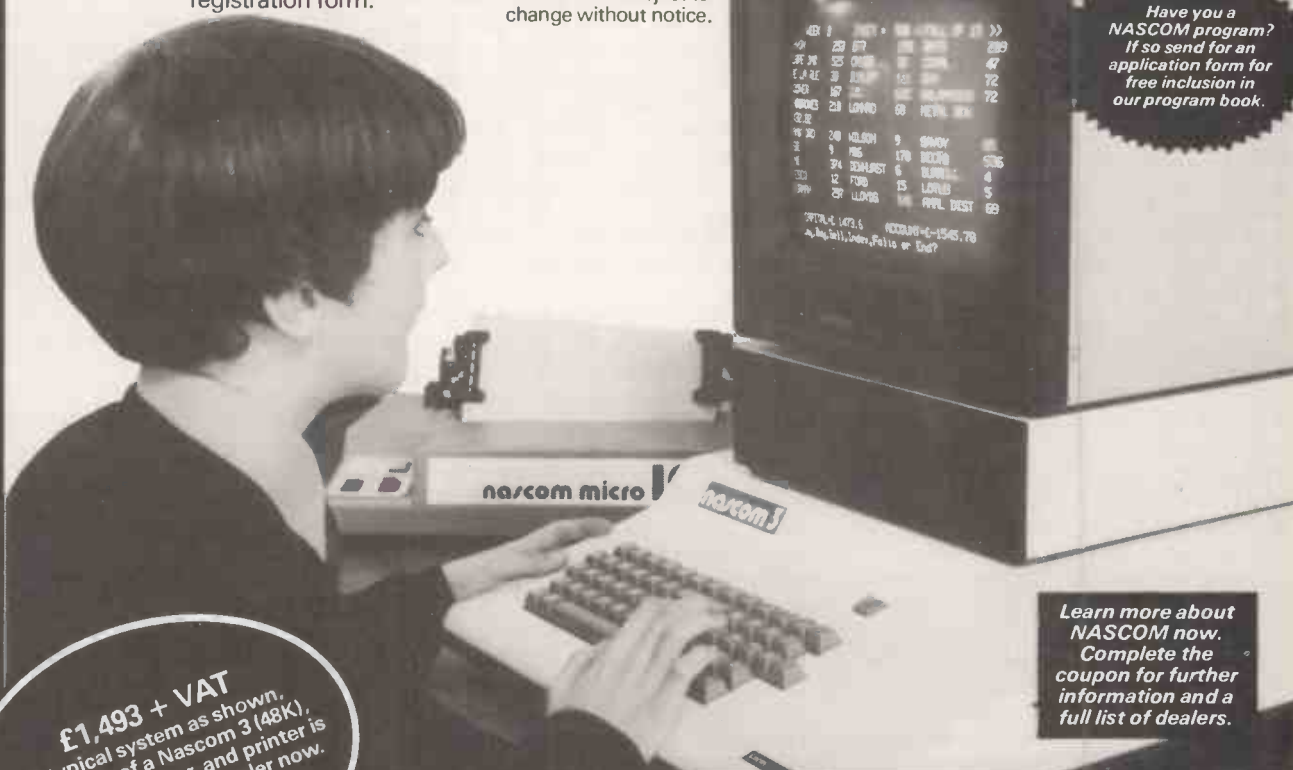
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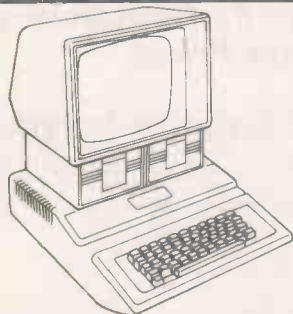
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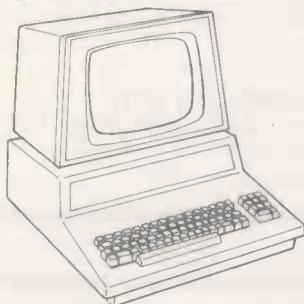
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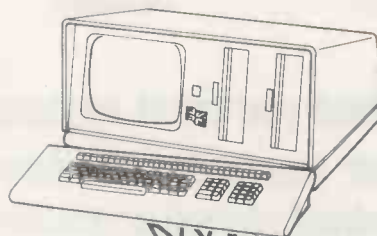


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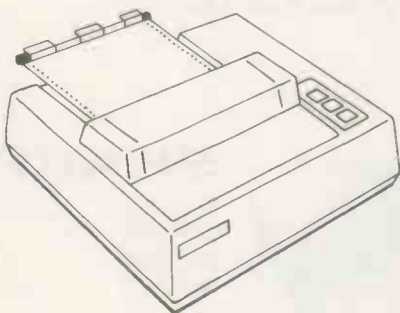
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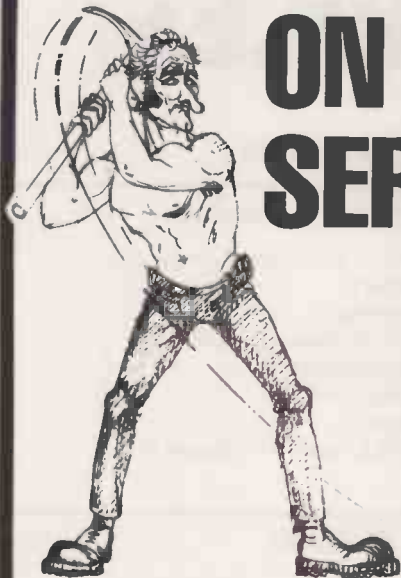
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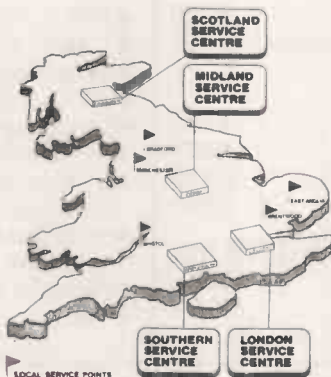
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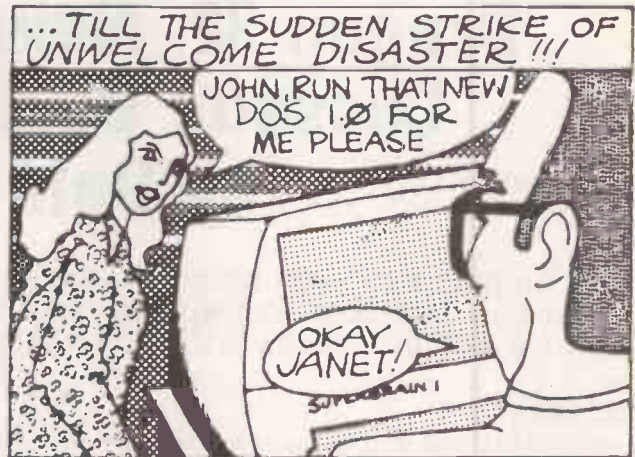
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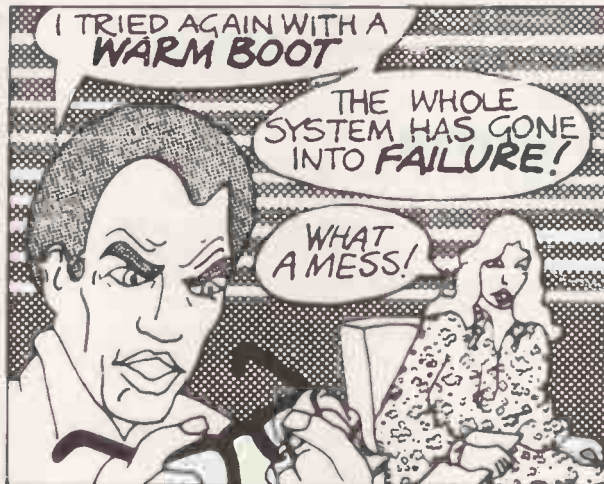
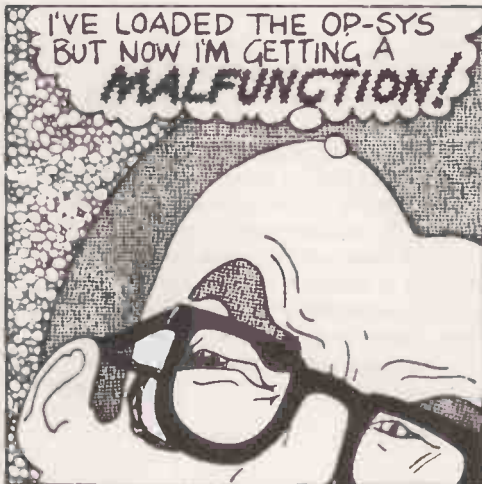
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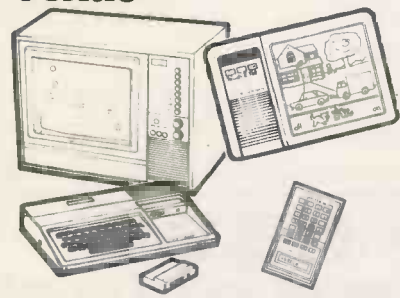
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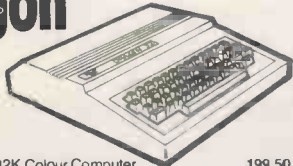
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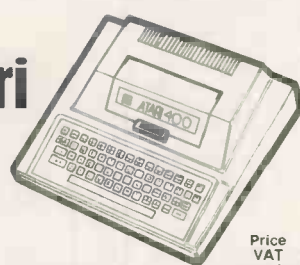
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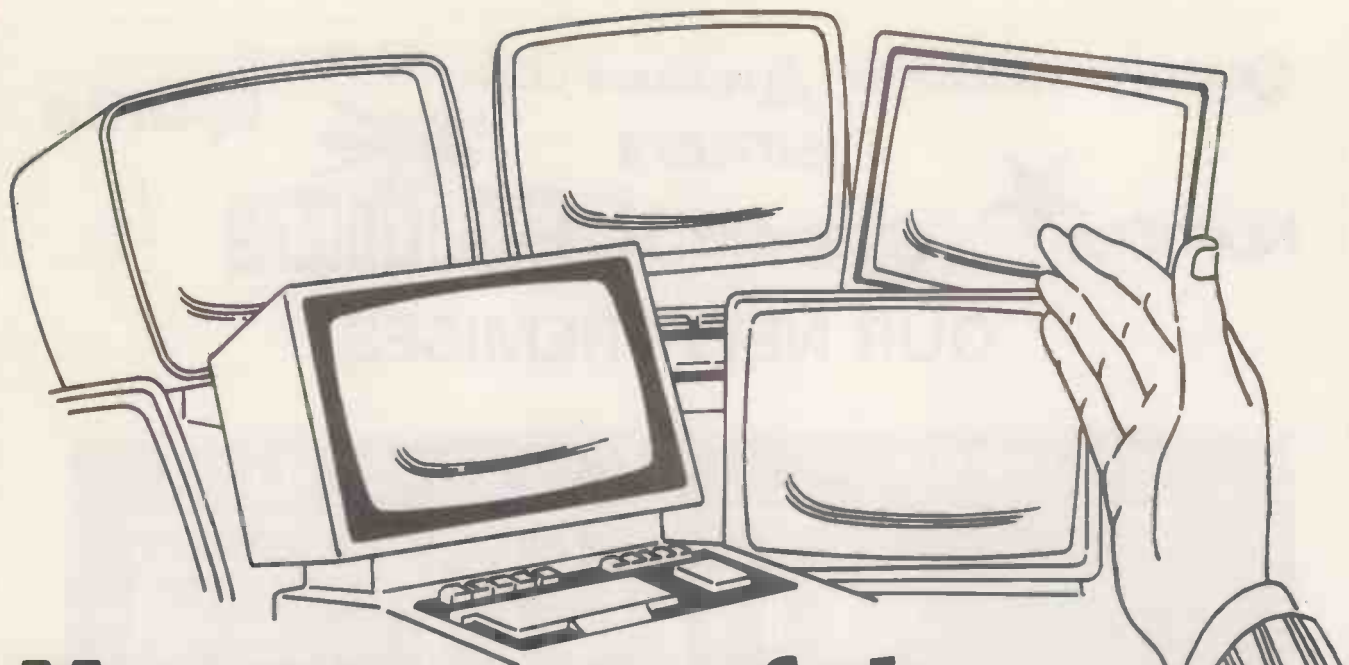
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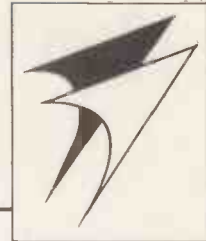
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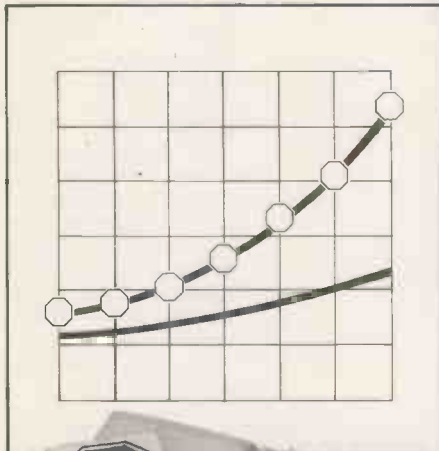


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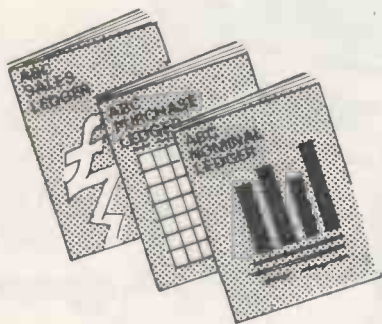
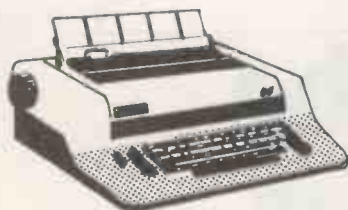
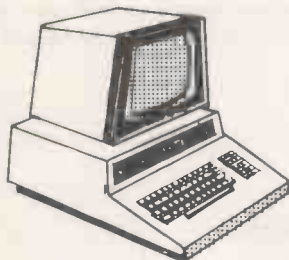
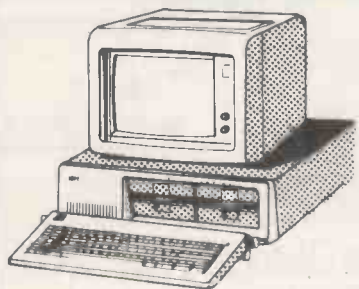
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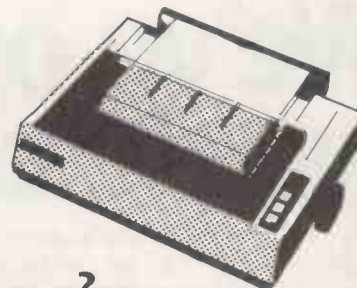
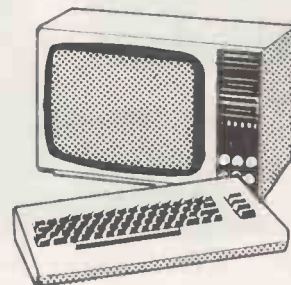
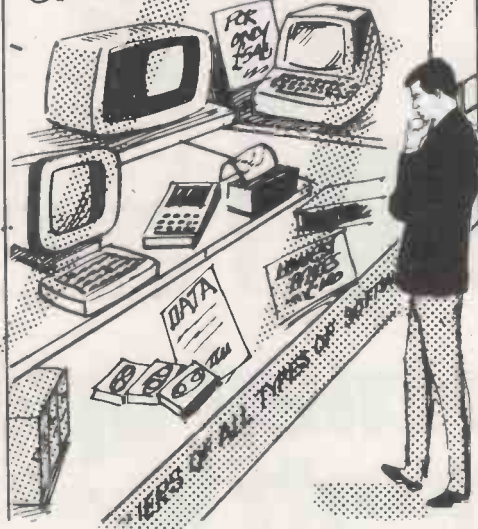
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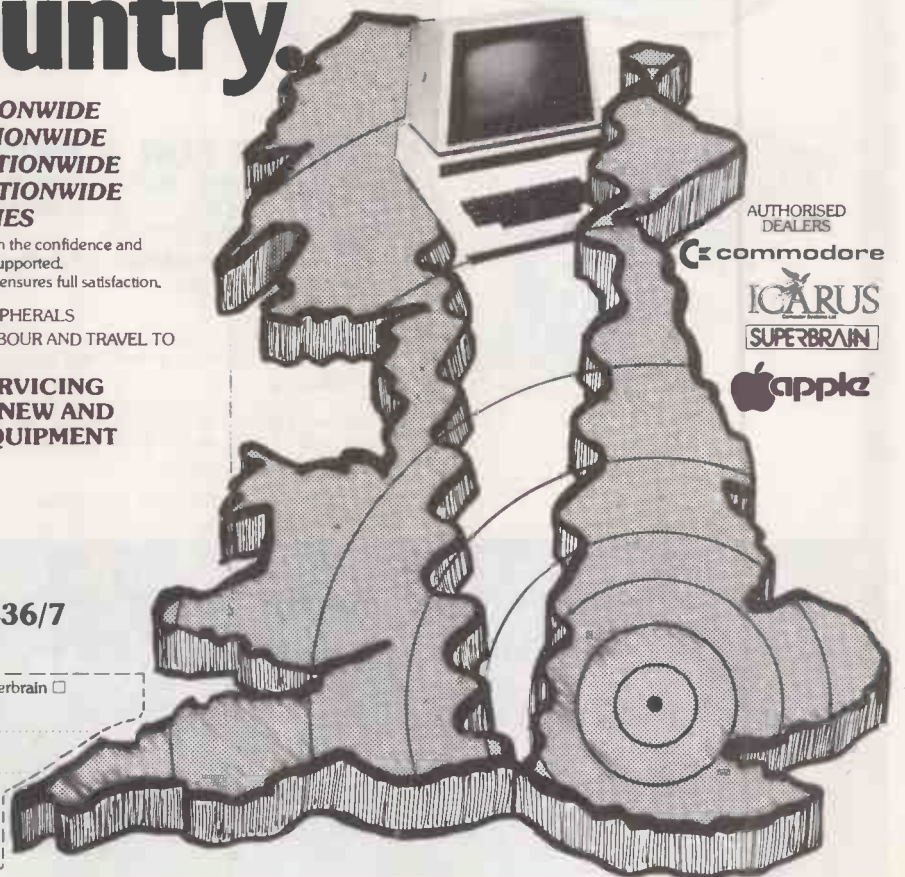
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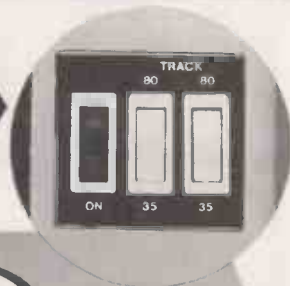
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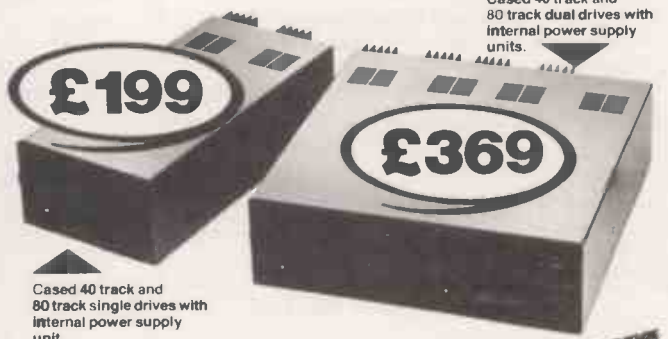


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7416	74LS156	30p	74LS363	140p	74S138	120p
7417	74LS157	25p	74LS364	140p	74S139	120p
7425	74LS158	30p	74LS365A	30p	74S157	250p
74128	74LS160A	36p	74LS367A	30p	74S163	300p
74180	74LS161A	36p	74LS368A	30p	74S174	250p
74184	74LS162A	36p	74LS373	55p	74S175	320p
74185A	74LS164	40p	74LS375	45p	74S188	150p
	74LS165A	50p	74LS377	70p	74S189	150p
	74LS166A	60p	74LS378	70p	74S194	320p
	74LS170	70p	74LS390	45p	74S200	450p
	74LS173A	55p	74LS393	45p	74S225	510p
	74LS174	40p	74LS395	90p	74S241	300p
	74LS175	40p	74LS399	160p	74S244	300p
	74LS181	90p	74LS445	100p	74S260	70p
	74LS183	120p	74LS540	90p	74S261	300p
	74LS190	36p	74LS541	80p	74S262	850p
	74LS191	36p	74LS540	100p	74S267	225p
	74LS192	36p	74LS561	100p	74S288	150p
	74LS193	36p	74LS564	100p	74S289	150p
	74LS194A	35p	74LS563	100p	74S373	400p
	74LS195A	35p	74LS564	100p	74S374	400p
	74LS196	45p	74LS565	100p	74S474	400p
	74LS197	45p	74LS568	100p	74S471	620p
	74LS198	55p	74LS569	100p	74S573	900p
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	74LS200	55p	74LS571	100p		
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### COMPUTER COMPONENTS

8243	280p	4118 3	500p	DS8831	140p	2 45760MHz	210p
8251	250p	4118 4	450p	DS8832	250p	3 276MHz	150p
8288	100p	4164 2	£6	DS8833	225p	3 5795MHz	100p
INS9060	£11	4816AP3	28p	DS8835	200p	3 686MHz	300p
TMS9980	£20	5101	210p	DS8836	150p	4 00MHz	150p
Z8	£24	6116P 3	420p	LF13201	450p	4 194MHz	200p
Z80	290p	6810	120p	MC1488	55p	4 43MHz	110p
Z80A	320p	7489	180p	MC1489	55p	5 00MHz	175p
Z80B	£12	74S189	225p	MC14411	£75p	6 0MHz	150p
Z8088	£18	74S201	350p	MC3486	500p	6 144MHz	150p
				MC3418	950p	7 0MHz	150p
				MC3446	300p	7 158MHz	175p
				MC3480	850p	8 63MHz	175p
				MC3486	500p	10 00MHz	150p
				MC3487	300p	10 7MHz	150p
				MC4024	325p	12 00MHz	150p
				MC4044	325p	14 318MHz	150p
				MM58174	800p	16 00MHz	200p
				LN2003A	75p	18 00MHz	200p
				LN2004A	75p	18 432MHz	150p
				75107	90p	19 968MHz	150p
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				75114/15	160p	27 145MHz	200p

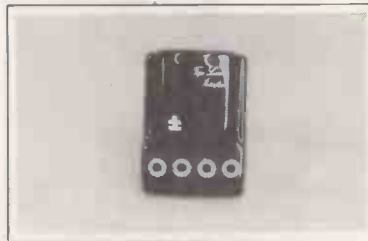


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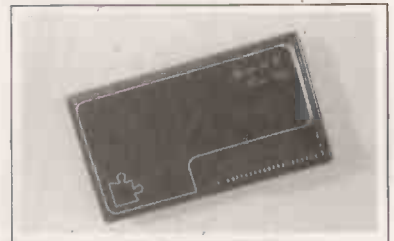
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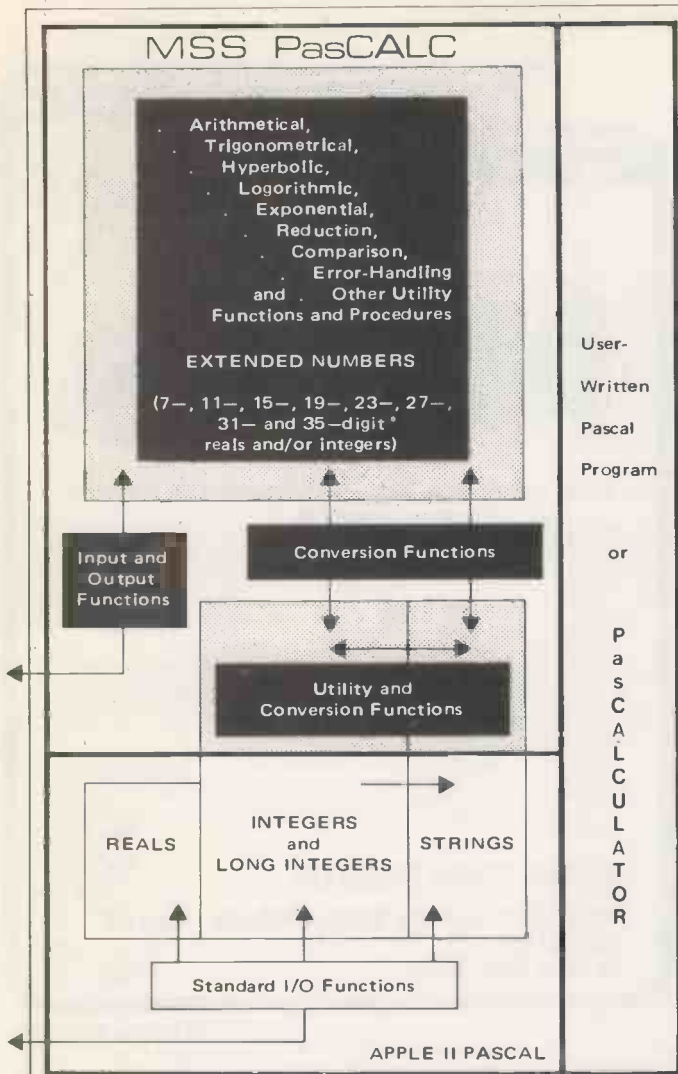
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- Both  $e$  and  $\pi$  (to 35 digits) are automatically set up at the start of every session.

### Extract from Optional Log (Precision Level 15)

```

Enter command:
Y:=Y+P^(2*LOG(10-(5*E/4)))
0.936471836457736E0
Enter command:
A:=0.125E1
0.125000000000000E1
Enter command:
X-SIN[P-EXP[A/(B+Y)]^D]
-0.185890363973163E1
Enter command:
RETAIN
Retained as command 5
Enter command:
A:=0.15E1
0.150000000000000E1
Enter command:
COMMANDS
X-SIN[P-EXP[A/(B+Y)]^D]
0.826354927584729E-1
Enter command:
LISTV
-----
LIST OF VARIABLES
A = 0.150000000000000E1
B = 1
D = 5
E = 0.271828182845905E1

```

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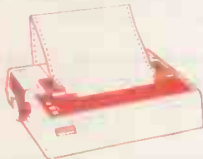
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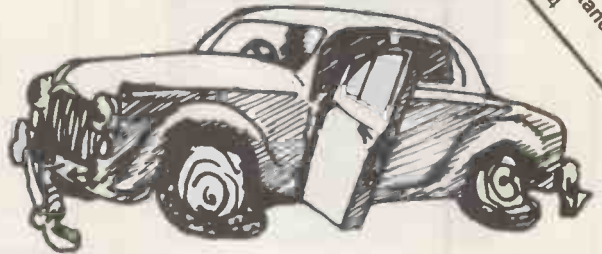
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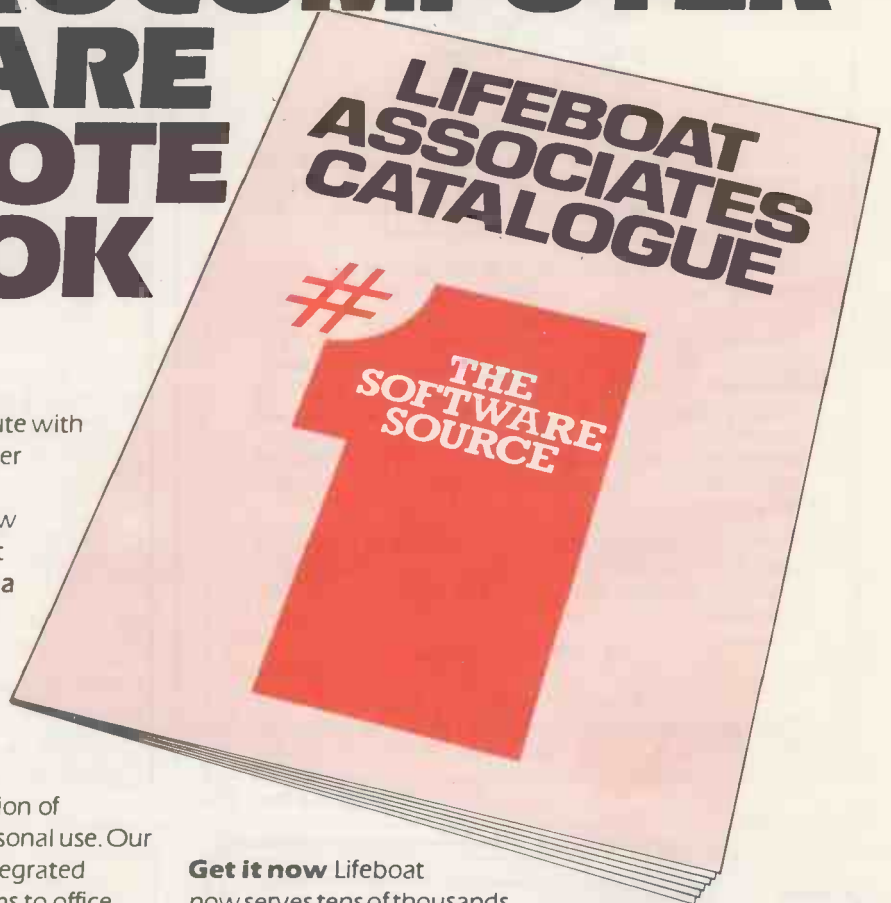
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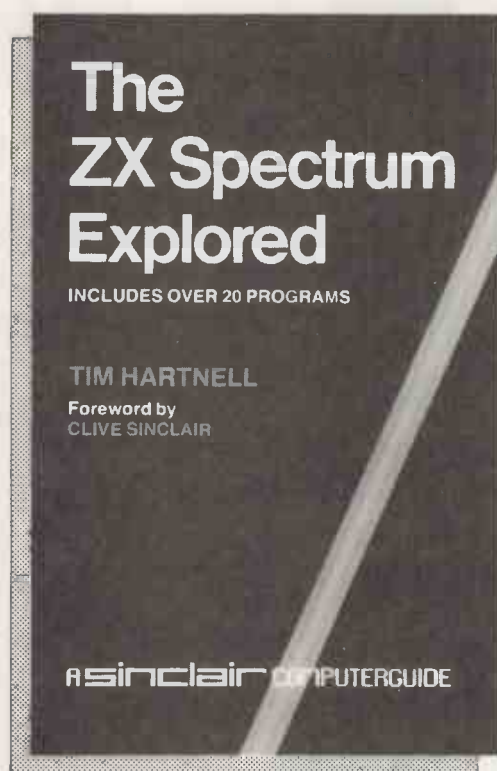
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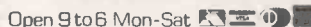
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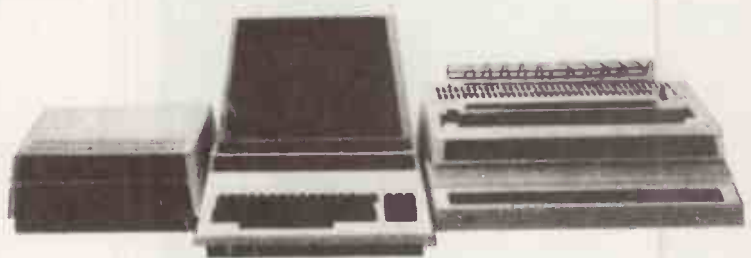
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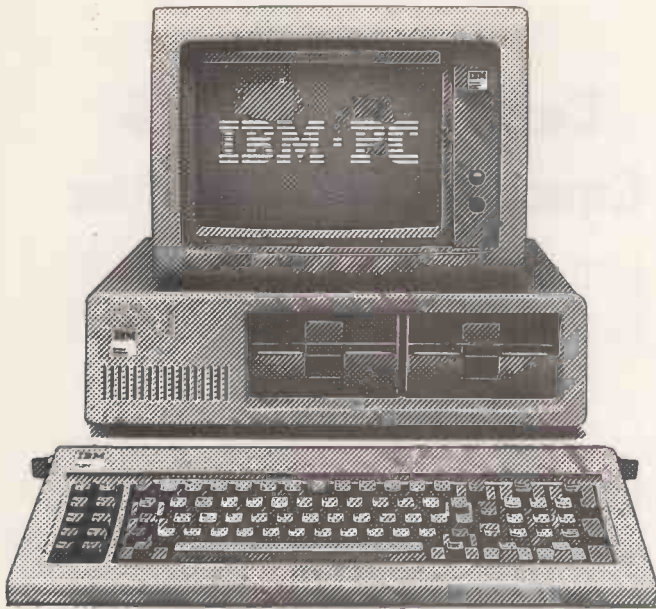
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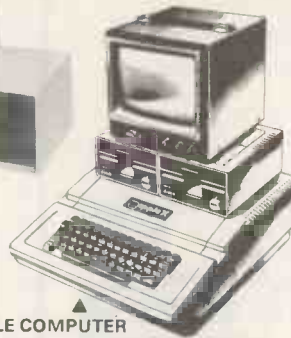




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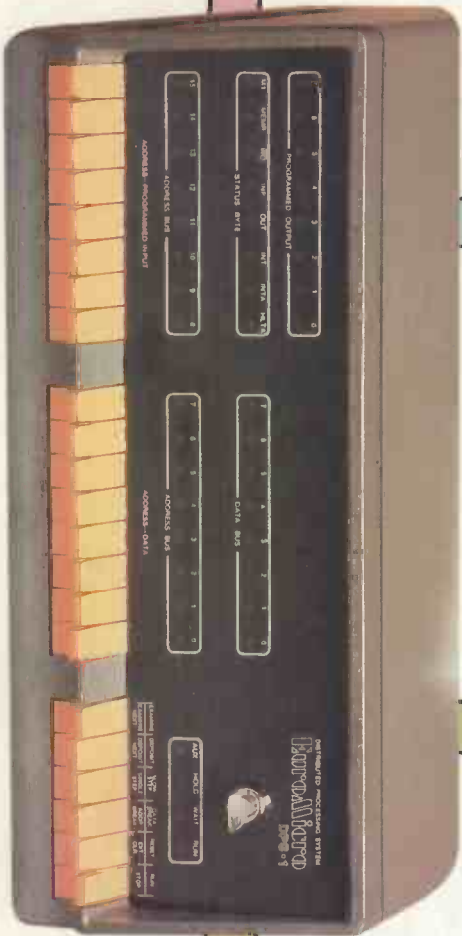
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