

# Practical Computing

March 1982

Volume 5 Issue 3

**Adventure —  
the greatest game  
Giant mazes**

**Reviews:  
16-bit Sirius  
Sales Ledger**

**Satellite tracking**

**Programmers'  
aptitude test**

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# Practical Computing

Adventure — the greatest game  
Giant mazes

Reviews  
16-bit Sirius  
Sales Ledger

Satellite tracking

Apple software

Best software

Adventure; the greatest game — page 89

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Every effort is made to check articles and listings but PC cannot guarantee that programs will run and can accept no responsibility for any errors.

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◀ 101 for inside cover



# PRINTERS

## SEIKOSHA GP-80

**The Smallest 80 Column Dot Matrix Printer.**

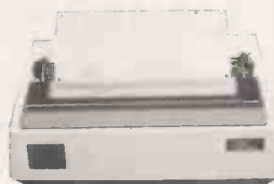


Unique printer principle. 80 col lines. 30 cps. 12 cpl. Plain Paper. Tractor drive. Weight 2.5 kg. Footprint 12.6 sq. ins. Bit addressable graphics. Parallel interface standard. RS 232 Apple Pet TRS 80 options

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## OKI MICROLINE 80 & 82A

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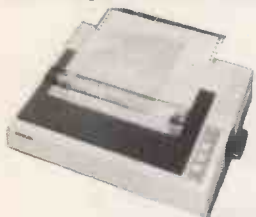


80-120 cps. Uni direction ML 82A bi-direction). Parallel interface. Serial interface option. (ML 82A standard). Pin and friction feed. Tractor option. Condensed and expanded characters. 80, 40, 66 and 132 cpl.

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ML 82A £437

## EPSON MX SERIES

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MX-80 F/T £399

MX-82 £447

MX-80 II £399 MX 80 F/T-II £447 MX-100 £569

## OKI MICROLINE 83A

**Medium Speed 15" Printer.**



120 cps. Bi-direction. Pin and friction feed. Tractor option. 132 cpl at 10 cpi. 4 character sizes. Graphic characters. Parallel and serial interface. Fast serial interface option.

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## ANADEX DP-9000 RANGE

**Fast, Versatile Printers.**



Seven models. Up to 15 inch paper width. Lower case descenders. 160-220 cps bi-directional printing. RS232 current loop & parallel interface. X on X off. Optional 2K buffer. Multiple print densities. Fast print of high-density bit image graphics.

DP-8000 £541

DP-9000L £747

DP-9001 £888

DP-9500 £935

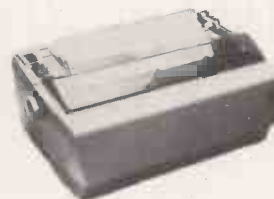
DP-9000 £841

DP-9500L £841

DP-9501 £982

## TEC STARWRITER

**Best-Buy Daisy Wheel Printer.**



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Serial Interface £1067

## LEAR SIEGLER 310

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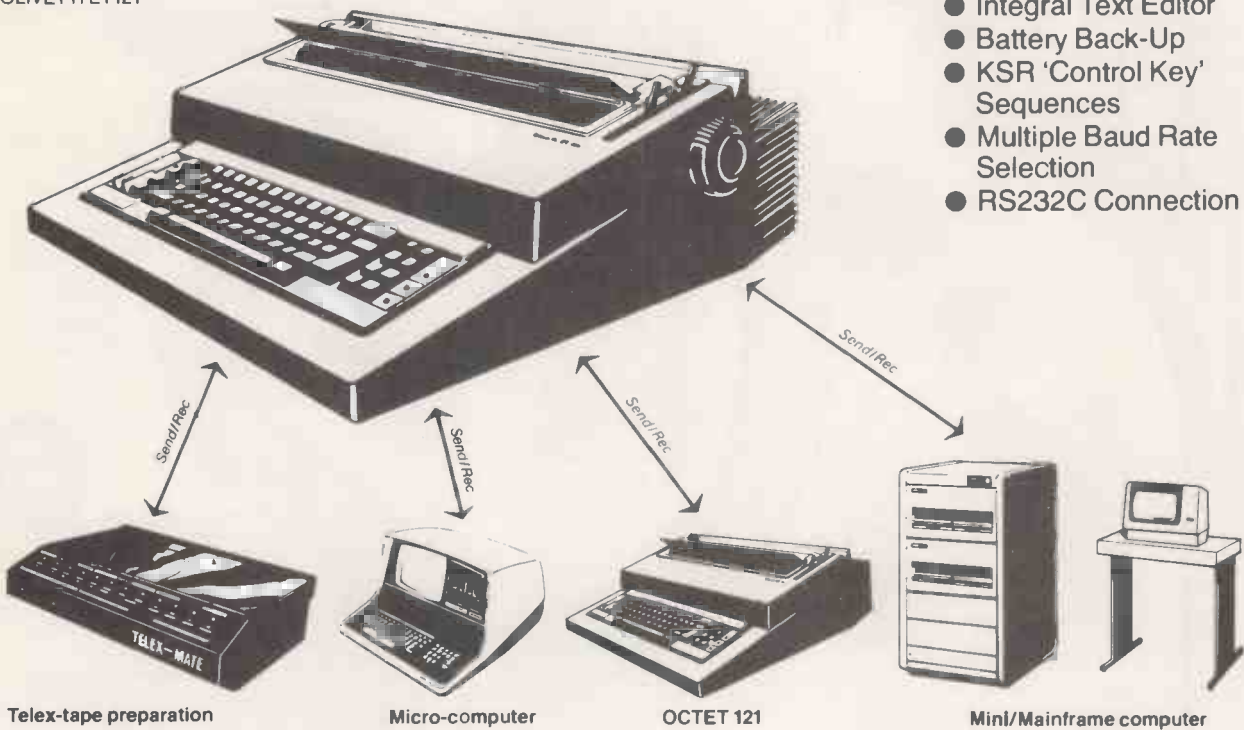
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- RS232C Connection



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OCTET 121 communication is achieved by simple cable connection or through an acoustic modem. Ideal for remote offices who would like to use the main office telex facilities. Prepare text at the remote office and transmit to main office to cut tape for forward transmission.

The OCTET 121 is a true KSR with all standard control sequences for operating system use. Ideal for the user who requires 'letter quality' print at all times. Use as a standard typewriter or telex prep. when not in KSR mode.



**OCTET 121** has many uses and can be installed very easily in your office.  
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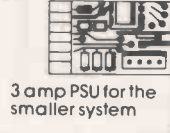


# Gemini MultiBoard

# THE

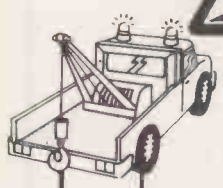
**STOP & PICK UP ANY MULTIBOARDS ON YOUR WAY**

**GM 807**



**GM 810**

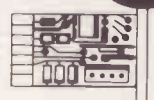
5 amp PSU with an 8-slot Motherboard



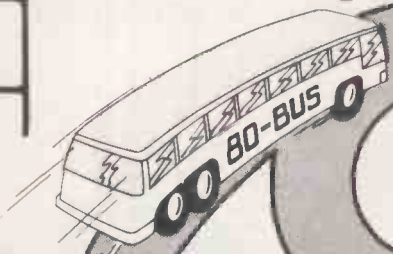
**CHEAPSKATE ROUTE**

**ESOTERIC ROUTE**

**GM 811 CPU**

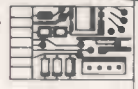


Utilising the powerful 4MHz Z80A Microprocessor the GM811 CPU card can be used as either a stand alone controller or as the heart of a complex microcomputer system. Four 'Bytewise' sockets allow great flexibility in the type and size of memory devices chosen. Input and output facilities include both programmable serial and parallel interfaces - RS232, 1200 baud CUTS cassette interface, Z80A PIO, and an eight bit input port. In an expanded system the unique on-board RPIM monitor allows the creation of cassette or Eprom based programs or files which are upwards compatible with a disk based CP/M system.



**nascom OWNERS START HERE**

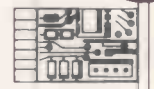
**GM 813 CPU/RAM**



Similar to the popular GM811 CPU card, the new GM813 CPU/RAM card has 64K of dynamic RAM replacing the 'bytewise' sockets. An extended addressing mode facilitates future memory expansion up to 2 megabytes! The RPIM 2 monitor retains full RP/M - CP/M compatibility.

With a 59 key full QWERTY layout, this ASCII encoded keyboard includes cursor control keys, caps, lock, two key rollover and auto-repeat.

**GM 821 KEYBOARD**



## 80 BUS STATION

### ROUTE

The Gemini MultiBoard concept is the logical route to virtually any microcomputer system you care to name. Whether you require a business system, an educational system, a process control system or any other system, there is a combination of MultiBoards to fulfil that function.

This concept ensures maximum flexibility and minimal obsolescence. Maintenance and expansion is greatly enhanced by the modular board design. MultiBoard is based on the 80-BUS structure, which is finding increasing acceptance among other British manufacturers; thus broadening the product base.

### FARES

#### Hardware (BUILT & TESTED)

|         |                           |        |
|---------|---------------------------|--------|
| GM802   | 64K RAM card              | £140   |
| GM803   | EPROM/ROM card            | £65    |
| GM807   | 3A PSU                    | £40    |
| GM808K  | EPROM programmer          | £29.50 |
| GM809   | FDC card                  | £125   |
| GM810K  | 5A PSU/8 slot motherboard | £69.50 |
| GM811   | Z80 CPU card              | £125   |
| GM812   | Z80 IVC card              | £140   |
| (* Kit) |                           |        |

#### Software

|       |                                      |     |
|-------|--------------------------------------|-----|
| GM512 | CP/M 2.2 for MultiBoard              | £90 |
| GM517 | Gem-Zap edit/iasm tape               | £45 |
| GM518 | Gem-Zap edit/iasm disk               | £45 |
| GM519 | Gem Pen editor/ text formatter tape  | £45 |
| GM520 | Gem Pen editor/ text formatter EPROM | £45 |
| GM521 | Gem Pen editor/ text formatter disk  | £45 |

|         |  |        |
|---------|--|--------|
| GM813   | Z80 CPU/64K RAM card                   | £225   |
| EV814   | IEEE 488 card                          | £140   |
| GM815-1 | Single drive disk unit with PSU (350K) | £325   |
| GM815-2 | Double drive disk unit with PSU (700K) | £550   |
| GM816   | Multi I/O board                        | £140   |
| AM819   | Speech board                           | £85    |
| AM820   | Light Pen                              | £35    |
| GM821   | ASCII keyboard                         | £57.50 |

|       |                                     |      |
|-------|-------------------------------------|------|
| GM524 | Gem Dis disassembler/ debugger tape | £30  |
| GM525 | Gem Dis disassembler/ debugger disk | £30  |
| GM526 | Comal-80 tape                       | £100 |
| GM527 | Comal-80 disk                       | £100 |
| GM528 | APL disk                            | £200 |



# LOGICAL ROUTE

**GM 812**  
-IVC



The GM812 Intelligent Video Controller card features an on board Z80A processor to provide independence of the host processor and the ability to redefine the functions and parameters of the display.

Normally used in an 80 x 25 mode the card contains a programmable character generator allowing three additional modes of operation - inverse characters, 160 x 75 block graphics, or user defined characters.

A keyboard socket allows buffered character input, and a light pen socket is provided for specialist applications. Being I/O mapped the card does not occupy any system memory space.

**GM 809**  
FDC

**GM 815**  
DRIVE UNIT



**GM 809 FDC**

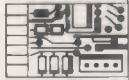
The GM809 floppy disk controller card can support up to four disk drives in either single or double density modes. The card uses the Western Digital 1797 controller and has variable write precompensation and phase locked loop data recovery circuitry.

**GM 815 Drive unit**

The GM815 floppy disk housing contains one or two 5 1/4" double density, double sided Perfec FD 250 drives. This gives a storage capacity of 350K per drive. Power for the drives is provided by an integral supply unit.

The GM802 RAM board provides a full 64K of dynamic memory. The 80 BUS RAMDIS signal is fully supported so that any EPROM in the system is given priority over the RAM, preventing any possibility of bus contention. Page Mode is also supported by the card which, with the appropriate software, allows up to four memory boards to be used in a system.

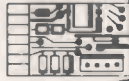
**GM 802**  
RAM



RPIM software is available on tape and includes Editor/Assembler; Text Editor/Formatter; Disassembler/Debugger; Pascal and Comal-80. These packages can also be run under CP/M.

The GM803 Eprom Board will accept up to 16 2708 or 2716 Eprom devices. This allows the addition of up to 32K of firmware to the system. The board supports the Page Mode system and consequently need not occupy any memory space when not in use.

**GM 803**  
EPROM BOARD



**PROTO-TYPING BOARDS**

80 BUS compatible prototyping boards are available from both Vero and Winchester Technology. These allow the user to easily add a card of their own design to the system.

**QM 816**  
I/O BOARD



The Quantum Micro I/O board provides a unique solution for interfacing to "the real world". The board contains 3 PIO's,

a CTC and a real time clock with battery back up. "Daughter" boards may also be added and these include A-D, D-A, opto-coupling and serial interface boards.

**GM 808**  
EPROM PROGRAMMER



The GM808 EProm programmer connects to the PIO on the CPU card and allows the user to program 2708 or 2716 type Eproms.

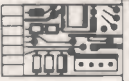
The EVC IEEE 488 Controller card has been designed to fully implement all IEEE 488 interface functions. This card gives the user a very versatile method of controlling any equipment fitted with a standard IEEE 488 or GPIB interface at minimal cost.

**ONE WAY**

A number of manufacturers are busy working on additional 80-BUS boards which will progressively increase the potential of your MultiBoard system.

**MEN AT WORK**

**AM 819**  
SPEECH BOARD



The Arfon Microelectronics speech board utilises the National Semiconductor Digitaltalker chip set. This gives a vocabulary of over 140 words and sub sounds. Output is from an on-board speaker.

**AM 820**  
LIGHT PEN



This low cost light pen can be used with the GM812 IVC for many applications, including answer selection, editing, menu selection and movement of displayed data blocks.

**EV 814**  
IEEE 488

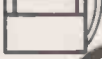


**AUTO-EXCHANGE**  
All your RP/M software automatically transferred to CP/M

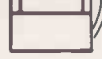


**FILL-UP WITH SOFTWARE**

**RP/M**



**CP/M 2-2**



A CP/M 2.2 package is available with the GM 809 card and Perfec drives. On-screen editing auto single/double density selection and parallel or serial printers are supported. Running under CP/M is a wide range of utilities, application software and languages.

**GEMINI MULTIBOARDS - BUY THEM AT YOUR LOCAL MICROVALUE DEALER**

All the products on these two pages are available while stocks last from the MicroValue dealers listed on right. (Mail order enquiries should telephone for delivery dates and post and packing costs.) Access and Barclaycard welcome.



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Nottingham.  
Tel: (0602) 45053/45215

**TARGET ELECTRONICS**  
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Tel: (0272) 421196.

**BITS & PC'S**  
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W. Yorks.  
Tel: (0937) 63774.

**HENRY'S RADIO**  
404 Edgware Road, London W2.  
Tel: (01) 402 6822.

Tlx: 262284 (quote ref: 1400).

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## BYROM SOFTWARE

|  |     |     |
|--|-----|-----|
| BSTAM—Utility to link one micro-computer to another also using BSTAM | £95 | £6  |
| BSTMS—Utility to link a micro to a mini or mainframe                 | £95 | £11 |

## CP/M USER LIBRARY

|                                  |     |  |
|----------------------------------|-----|--|
| 51 Volumes—Price per volume      | £5  |  |
| 8" disc (one volume per disc)    | £10 |  |
| 5" disc (one volume per 2 discs) | £2  |  |
| Index                            |     |  |

## CREATIVE COMPUTING

|                           |     |  |
|---------------------------|-----|--|
| BASIC Games Volume 1      | £14 |  |
| BASIC Games Volume 2      | £14 |  |
| More BASIC Games Volume 1 | £14 |  |
| More BASIC Games Volume 2 | £14 |  |

## DIGITAL RESEARCH

|               |      |     |
|---------------|------|-----|
| CBASIC v 2.08 | £65  | £15 |
| MPM 1.1       | £195 | £20 |
| MPM 2.0       | £250 | £30 |
| CP/M86        | £160 | £27 |
| CP/M 2.2      | £95  | £20 |
| CP/NET        | £120 | £14 |
| SID           | £50  | £14 |
| ZSID          | £55  | £14 |
| MAC           | £60  | £14 |
| TEX           | £50  | £14 |
| DESPOOL       | £33  | £6  |
| PL/1          | £300 | £27 |
| BT-80         | £140 | £20 |

## INFORMATION UNLIMITED

|                                      |     |  |
|--------------------------------------|-----|--|
| WHATSIT (Database Management System) | £80 |  |
|--------------------------------------|-----|--|

## KLH SYSTEMS

|                              |     |    |
|------------------------------|-----|----|
| Spooler for CPM systems v3.0 | £70 | £6 |
|------------------------------|-----|----|

## MPI LTD.

|                    |       |     |
|--------------------|-------|-----|
| FORTH              | £72   | £20 |
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| SALES LEDGER       | £200  | £15 |
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| NOMINAL LEDGER     | £200  | £15 |
| INCOMPLETE RECORDS | £1200 | £20 |

## MICROFOCUS

|                       |      |     |
|-----------------------|------|-----|
| CIS COBOL version 4.4 | £400 | £25 |
| FORMS 2 v11           | £100 | £10 |

## MICROLOGY

|  |     |    |
|--|-----|----|
| FTNUMB (FORTRAN-80 RENUMBER & REFORMATTER) | £50 | £5 |
|--|-----|----|

## MICROPRO INC.

|                                    |      |     |
|------------------------------------|------|-----|
| WORD-MASTER 1.7A                   | £75  | £22 |
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| SPELLSTAR 1.0 (requires Wordstar)  | £125 | £10 |
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| WORDSTAR CUSTOMIZATION NOTES       | £50  |     |
| SUPER-SORT 1.6: Version 1          | £125 | £22 |
| Version 2                          | £110 | £22 |
| DATASTAR 1.101                     | £175 | £25 |
| CALCSTAR                           | £150 | £25 |

## BASF DISCS

The following formats are available from stock: 8" SSSD  
5 1/4" Soft Sected, 5 1/4" 10 Sectors, 5 1/4" 16 Sectors

| Quantity  | Price Per Disc Ex VAT |
|-----------|-----------------------|
| 1 - 50    | £2.40                 |
| 51 - 100  | £2.00                 |
| 101 - 200 | £1.80                 |
| 201 - 500 | £1.70                 |
| 501 -     | £1.50                 |

Minimum order quantity 10 discs. Orders must be in multiples of 10. Postage, Package & Insurance 86p per 10 Discs up to 50 Discs thereafter 17p per 10. Other formats on request.

## SOFTWARE FOR CP/M COMPUTERS INCLUDING

|                    |                     |                   |                         |
|--------------------|---------------------|-------------------|-------------------------|
| CROMEMCO Z2D       | COMART COMMUNICATOR | RESEARCH MACHINES | OTHER FORMATS AVAILABLE |
| EXCIDY SORCERER    | COMART EDUCATOR     | GEMINI            |                         |
| SUPERBRAIN         | RAIR BLACK BOX      | TRANSAM TUSCAN    |                         |
| VECTOR MZ          | SD SYSTEMS          | XEROX 820         |                         |
| NORTH STAR HORIZON | NASCOM              | +8" IBM FORMAT    |                         |

## MICROSOFT INC.

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|--------------------|------|--|
| BASIC-80 5.21      | £185 |  |
| BASIC Compiler 5.3 | £205 |  |
| FORTRAN-80 3.43    | £260 |  |
| COBOL-80 4.01      | £380 |  |
| M/SORT 1.01        | £75  |  |
| EDIT-80 2.02       | £65  |  |
| MACRO-80 3.43      | £105 |  |
| MULISP 2.10        | £105 |  |
| MUMATH 2.10        | £130 |  |

## MICROTECH EXPORTS

|             |     |     |
|-------------|-----|-----|
| REFORMATTER | £98 | £17 |
| CPM ↔ IBM   | £98 | £17 |
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## MT MICROSYSTEMS

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|-----------------------------------|------|-----|
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| PASCAL MT+ 5.25 with SPP          | £265 | £50 |
| Library Sources                   | £110 |     |
| Speed Programming Pkge. (Softbus) | £125 | £25 |

## OSBORNE & ASSOCIATES

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|--|-----|-----|
| ACCOUNTS PAYABLE & ACCOUNTS RECEIVABLE | £50 | £15 |
| GENERAL LEDGER                         | £50 | £15 |

## PHOENIX SOFTWARE ASSOCIATES (For Z80 only)

|                                     |      |     |
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| PEDIT—Line editor with Macros       | £72  | £15 |
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| PDEVELOP Package with all the above | £193 | £33 |
| PLINK—2 Overlay Link Loader         | £185 | £15 |

## STRUCTURED SYSTEMS (All converted to UK Standard)

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|--|------|-----|
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# NEW PRODUCTS

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| INFOSTAR    | TBA |     |
| QUICKSCREEN | £87 | £12 |

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|            |      |     |
|------------|------|-----|
| SELECTOR V | £275 | £25 |
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## ORDER INFORMATION

When ordering CP/M software please specify the format you require otherwise software will be despatched on an 8" single density disc.

All software items are subject to VAT. Manuals, when purchased separately, are not subject to VAT.

Please add £3.45 for postage, packing and insurance on each item purchased. For overseas please add £6.50 per item.

Most software in this advertisement is available from stock and a 72 hour return service is thereby offered on most prepaid orders.

These details and prices are all current as of January 1982. Our prices reflect an exchange rate of U.S. \$2.00 to £1.00. Should the exchange rate vary by more than 5 cents, a surcharge may be added or a discount given.

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# 4

# GOOD REASONS TO RING 01-591 6511

## 1 QUICKSCREEN



The purpose of QUICKSCREEN is to provide a simple, carefree way for people to create screen forms on the computer. The uses for these forms can be as varied as the reasons people buy computers. With the computer revolution that has occurred since 1975, computers are finding their way onto the desks of managers, professionals, teachers, and students. M.P.I. Ltd. welcomes this development. We hope that QUICKSCREEN will find a home on all those desks and help everyone to get more out of their computer.

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For each phrase, word, or title, you must identify the exact line and column where it appears. Then you must type each of these locations into the computer. Once you see the results on your VDU, you may not like the appearance, so you would want to rearrange things. This means you will have to recalculate all the line and column locations and type them in again.

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**For Use With BASIC-80, CBASIC, DBASE-II, or FMS-80**

## 2 CIS COBOL WITH FORMS-2

The CIS COBOL product family brings you the most successful business programming tool ever devised, COBOL, in a form optimized for today's most cost effective hardware, the microcomputer. Standard COBOL as defined by ANSI X3.23-1974.

The reliability and performance of CIS COBOL are strongly emphasized by its continued qualification for U.S. government contracts.

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CIS COBOL is powerful but simple to use. Its screenhandling, dynamic module loading and fast ISAM let you take full benefit from micro computer facilities.

The FORMS-2 utility is a COBOL source code generator to help you build interactive applications with ease. Using the unique demonstration "How to create a COBOL program in 20 minutes," you can quickly try out new application ideas.

And if you are developing software for resale, the variety of systems running CIS COBOL offers you a very large available market.

## 3 SELECTOR V

is a totally self-contained system providing complete data, procedural, query, and report definition functions. It allows records to be managed on a one-for-one basis as well as in 'batch' mode where several files can communicate with each other in a variety of ways. It uses the capabilities of an addressable terminal making the entry and editing of data and definitions, smoothly efficient. The facets that make SELECTOR V more functional than any other system of its kind include:

### MULTIPLE 'KEY FIELDS'

Of the up to 80 data fields each record can contain, any or all may be assigned to be 'keys' so that records can be recalled, individually or consecutively, by the contents of those fields.

### BATCH, MULTIPLE FILE PROCESSING

SELECTOR V can process records from several different files at the same time. It can freely move information from one file to another. It can do it on a conditional basis, can arithmetically process one field against another or a constant value, it can convert MANAGER to MGR, delete redundant records, multiple the QUANTITY in a Transaction file against the STOCK PRICE of inventory records, add the results to a Receivables file, and update a Journal file, all as the result of a simple procedure definition that can be executed whenever needed.

### DATA DEFINITIONS

Records can be structured just as you require. Files can be re-defined and converted as necessity dictates.

### SELECTION UTILITIES

SELECTOR V allows records to be selected, in any order according to the most definitive, compoundable criteria either for reporting purposes, or to create uniquely defined new data bases. It can conditionally transform records into new formats and perform arithmetic procedures in the process.

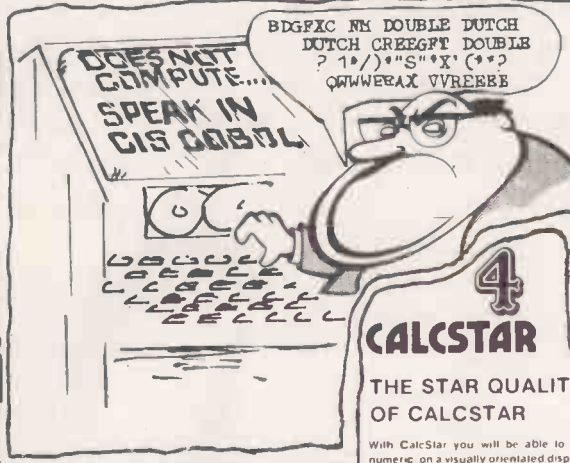
### REPORTS

With two report generators at your disposal, your data can be made absolutely productive. Both allow inputs from several different files, with conditional and arithmetical processing. The first is oriented to reporting to you about your data. We take care of the formatting. You just specify what information you want. You can designate up to 80 actual and derived fields to be reported upon.

The second report generator produces output in any form that you want. Anything from gummed labels, to dated, automatically sequentially numbered invoices, complete with text paragraphs, can be produced on printed continuous forms of plain paper.

### APPLICATIONS DEVELOPMENT SYSTEM

SELECTOR V is primarily geared towards managing dedicated integrated applications. With its multi-file, conditional arithmetical processing abilities, it will handle a variety of complex tasks with ease. No language coding is required. Procedures are defined as named definitions and can be executed as needed.



## 4 CALCSTAR

### THE STAR QUALITY FEATURES OF CALCSTAR

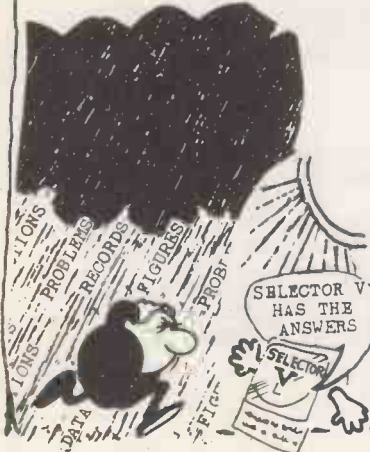
With CalcStar you will be able to manipulate data, either text or numeric, on a visually oriented display. The numeric data may either be constant or be dependant on other data. CalcStar has facilities for editing, formatting, storing, calculating and printing all data. This is a true electronic worksheet, with 127 columns and 255 rows. Uses include:

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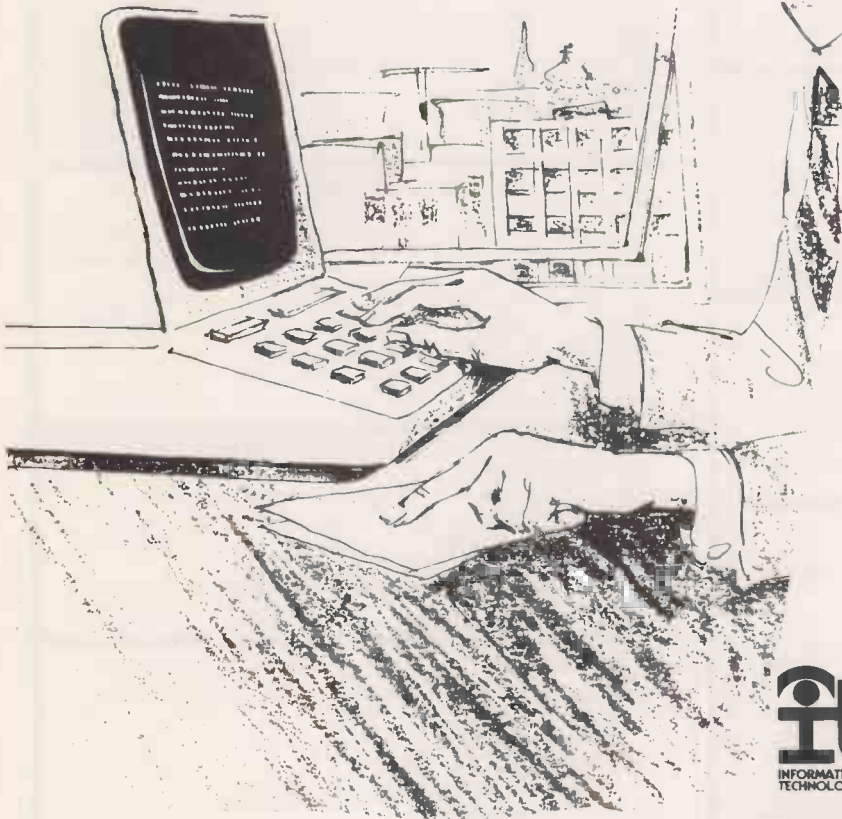


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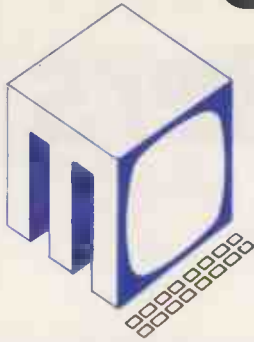
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# CP/M SOFTWARE



from

## METROTECH

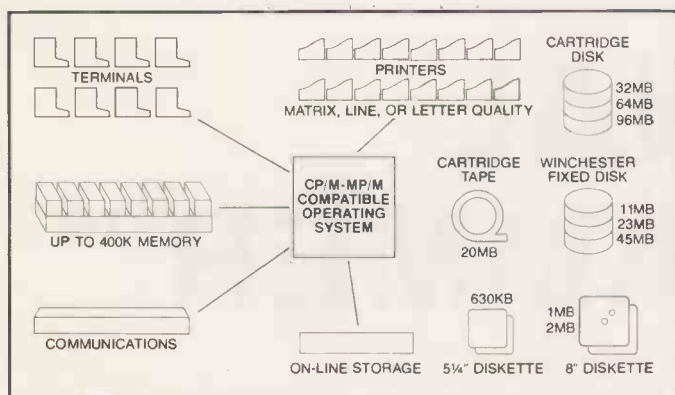
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|---|---|
| <p><b>* NEW *<br/>CALCSTAR</b></p> <p>CalcStar is MicroPro's new electronic Spread sheet and financial modelling Program — a sophisticated, yet easy to use calculating and planning tool. CalcStar also links with WordStar, so you can easily include your final calculations within your report.</p> <p><b>CALCSTAR</b> £140/£20</p>   | <p><b>* NEW *<br/>BCPL</b></p> <p>BCPL CINTCODE is full and extended implementation of the popular Systems programming language BCPL. CINTCODE gives a dramatic reduction in the space required for programs, requiring about a third the storage of fully compiled Z80 code.</p> <p><b>BCPL</b> £250/£35</p>   |
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Disc Size & Format .....

But the real beauty of the CompuStar is its "shared logic" design concept. Each user station contains its own distinct microprocessor and RAM. The result is lightning fast program execution. Even when all 16 users are on-line. Even when all are performing different tasks! A special multiplexor circuit in the CompuStar ties all external users together to "share" the system's disk resources so that no single user ever need wait on another. An incredibly exciting concept!



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**\*\*\* THE NEW DBMS (DATABASE) \*\*\***

DBMS2 is a record relational as well as a file relational database management tool that is capable of being at different times, many different things. The one core program can be set up to perform tasks normally associated with the following list.

- |                       |                   |                 |
|-----------------------|-------------------|-----------------|
| Accounting            | Budgeting         | Cashflow        |
| Stock control         | Address mailing   | Letter writing  |
| Simulations           | Time recording    | Filing          |
| Calc-type predictions | Hospital indexing | Profit analysis |
| Bureaux services      | General analysis  | Mathematics     |
| Answer what-if's      | Employees records | Tabulate values |
| Print reports         | Sort files        | Edit records    |

Within hours perform all the above in French or German.

The list is as endless as that which meets the requirements of your own imagination.

Within the appropriate frames of reference you could ask questions like the following:

Find someone whose name begins with W, who is either in London or Birmingham, and available for work at a salary of less than 10,000.00; and is under 40 years of age, not married, of credit worthiness grade 1, with a car, prepared to travel, and who likes horses, does not mind the hours he works, is congenial and has good references. When you find such persons produce a printed list of them showing their names, telephone numbers, and what their salaries are as well as their salary if increased by 10% and show their availability for work. At the end of the list enumerate the total of such persons.

Find all stock items that are codes micro-computers that are either in warehouse 1 or warehouse 2, where the quantity on hand is more than 50 units, the cost is less than 1000.00, the selling price higher than 2000.00; that are not in cartons, bought from supplier 52, allocated more than 20, rated for tax at .15% and weigh less than 50 lbs. When you find such categories then print a report showing the description, cost price, quantity on hand, lead time for refills, what the selling price should be if raised by 12.3% as well as the profit in either percent or round figures of that projected selling price.

Find all patients who suffered from cold, that are either girls or women younger than 23 years old, and who live in London at a socio-economic grade higher than 3; do not smoke; have more than 3 children, are currently at work and where treatment failed to effect a cure in under 6 days. When you find such persons then print a list showing their age, marital status, income, and frequency of illness in the past 2 years.

Currently you can ask 5 types of questions 20 times for a single selection criterion, and then you can compute 10 mathematical relationships between the questions for the individual as well as for the total number of matches. In all some 60 bits of information relating to one record or a group or records on simply one permutation of the selection criterion, with a cross referencing facility as well.

Every word in the system, as well as the file architectures, print masks, and field attributes, is capable of alteration by you without programming expertise (but with some thought).

ALL IN ONE PROGRAM FROM G.W. COMPUTERS. THE DBMS2 II.

**G.W. COMPUTERS LTD, 01-636 8210 01-631 4818**

**\*\*\* ALL YOU NEED FROM A COMPUTER SYSTEM \*\*\***

**DATABASE MANAGEMENT + WORD-PROCESSING + MODELLING + DIY INTERPRETER + SERVICE**

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| 10 - DBMS2 (DATABASE)           | 575.00   | 10 - DBMS2 (DATABASE)          | 575.00   |
| 11 - MAGIC WAND                 | 190.00   | 11 - MAGIC WAND                | 190.00   |
| 12 - MBASIC-80                  | 150.00   | 12 - MBASIC-80                 | 150.00   |
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| 18 - INSTANT BASIC              | 9.00     | 18 - INSTANT BASIC             | 9.00     |
| (NOT INC VAT)                   | 4225.50  | (NOT INC VAT)                  | 6220.50  |
| OUR PRICE                       | 2995.00  | OUR PRICE                      | 4950.00  |

(NOTE: ITEMS 1 AND 2 ARE MORE FLEXIBLE)

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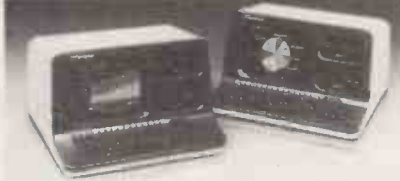
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The North Star ADVANTAGE™ is an interactive integrated graphics computer supplying the single user with a balanced set of Business-Data, Word, or Scientific-Data processing capabilities along with both character and graphics output. ADVANTAGE is fully supported by North Star's wide range of System and Application Software.

The ADVANTAGE contains a 4 MHz Z80A® CPU with 64Kb of 200 nsec Dynamic RAM (with parity) for program storage, a separate 20Kb 200 nsec RAM to drive the bit-mapped display, a 2Kb bootstrap PROM and an auxiliary Intel 8035 microprocessor to control the keyboard and floppy disks. The display can be operated as a 1920 (24 lines by 80 characters) character display or as a bit-mapped display (240 x 640 pixels), where each pixel is controlled by one bit in the 20Kb display RAM. The two integrated 5¼ inch floppy disks are double-sided, double-density providing storage of 360Kb per drive for a total of 720Kb. The n-key rollover Selectric style keyboard contains 49 standard typewriter keys, 9 symbol or control keys, a 14 key numeric/cursor control pad and 15 user programmable function keys.

## G.W. COMPUTERS LTD, 01-636 8210 01-631 4818

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(BUSINESS EFFICIENCY)

WIDELY USED IN U.K./FRANCE/U.S.A. AND ENGLISH SPEAKING COUNTRIES FOR ITS OVERALL FLEXIBILITY AS A COMPLETE BUSINESS PACKAGE INCLUDES INVENTORY, DATABASE MANAGEMENT, INVOICING, MAILING ADDRESSES, STATEMENTS, SALES/PURCHASE LEDGER WITH OR WITHOUT AUTO STOCK UPDATE AND DOUBLE ENTRY JOURNALS INCLUDING NOMINAL LEDGER; PLUS A/C RECEIVABLE AND PAYABLE MAKING AUTO BANK ENTRIES.

|                         |                                |                            |
|-------------------------|--------------------------------|----------------------------|
| 01 = ADDRESS SECTION    | 10 = ORDER FILES               | 19 = NOMINAL ANALYSIS      |
| 02 = STOCK CONTROL      | 11 = 30/60/90 DAY AGE ANALYSIS | 20 = AGED DEBTOR ANALYSIS  |
| 03 = A/C RECEIVABLES    | 12 = ARITHMETIC SECTION        | 21 = DISK DIRECTORIES      |
| 04 = SALES LEDGER       | 13 = PRINT CUSTOMER STATEMENTS | 22 = FILE MANAGEMENT       |
| 05 = A/C PAYABLES       | 14 = PRINT SUPPLIER STATEMENTS | 23 = SORTS                 |
| 06 = PURCHASE LEDGERS   | 15 = PRINT AGENT STATEMENTS    | 24 = DISK SWAP/EXIT SYSTEM |
| 07 = BANK UPDATE        | 16 = PRINT TAX STATEMENTS      | WHICH OPTION . . .         |
| 08 = USER DATABASE AREA | 17 = RUN SEPARATE PROGRAMS     | (LEVEL 8.00@875.00)        |
| 09 = INVOICE CREATION   | 18 = CHANGE VOCABULARY         |                            |

+++++ SUPER — BUS ++++++ A NEW HIGHER LEVEL OF THE ABOVE PACKAGE . . . HAS BEEN REDUCED IN SIZE BY 50 PER CENT TO A SINGLE 15K BASIC PROGRAM, MAKING ALL FILE RETRIEVALS A MATTER OF NANoseconds. WORKS UNDER M/PM AND COMPUSTAR FOR COMMON DATA RETRIEVAL LEVEL 10.00..... \*\*\*\* 1475.00 \*\*\*\*

DBMS (DATABASE) HAS 01=; 02=; 04=; 06=; 07=; 08=; 17=; 18=; 21=; 24=. PRICE 475.00

DATABASE FEATURES ARE: . . . FOR ANY SIZE RECORD UP TO TWENTY FOUR FIELDS FILE ARCHITECTURES CAN BE DESIGNED WITH COMPLETE FREEDOM OVER THE LINGUISTIC CONVENTIONS ASSIGNED TO EACH FIELD. THE FILE THEN CAN STORE 32000 RECORDS WHICH CAN BE SEARCHED BY THE RANDOM ACCESS NUMBER (RETRIEVED IN LESS THAN ONE SECOND) OR 'KEY' RANDOM ACCESS ON SPECIFIED FIELD OR SEQUENTIALLY COMPARING FOR LEFT FIELD PARTS, FIELD-INKEYS, OR PARTS OF RECORD, AND THEN CHANGED, PRINTED, DELETED, SKIPPED.

GRAMA (WINTER) LTD/G.W. COMPUTERS LTD. ARE THE PRODUCERS OF THIS PACKAGE WHICH IS UNEQUALLED FOR ITS LEVEL OF TOTAL INTEGRATION, LINGUISTIC FLEXIBILITY AND MAXIMISED DISK/MEMORY CONSERVATION. AUTHOR TONY WINTER (M.D.; B.A.LIT; B.A.HON.PHIL; AND LECTURER)

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|--------------------|------------|-----------------|-----------|---------------|---------|
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| 64K + 700 K DISK   | 2495.00    | 64K MDL 15 PRNT | 1595.00   | OKI MICRO-83  | 795.00  |
| 64K + 1.5 M DISK   | 2995.00    | 64K MDL 20 VPU  | 2495.00   | OKI MICRO-83A | 850.00  |
| 64K + 6.3 M DISK   | 4595.00    | 64K MDL 30 VPU  | 2795.00   | EPSON MX80FT  | 475.00  |
| N*STAR & GRAPHICS  | 2395.00    | 64K MDL 40 VPU  | 2995.00   | EPSON MX100   | 575.00  |
| 5.7 MEG CORVUS DSK | 2250.00    | 10 MEG INTERTEC | 3250.00   | TEXAS 810     | 1395.00 |
| 10 MEG CORVUS DSK  | 3250.00    | BUS VER 8.00    | 875.00    | NEC 5510      | 1695.00 |
| 20 MEG CORVUS DSK  | 4250.00    | BUS MANUAL      | 25.00     | NEC 5525      | 1895.00 |
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|                 |                |                   |  |                  |        |
|-----------------|----------------|-------------------|--|------------------|--------|
| <b>SYSTEM 3</b> | <b>2950.00</b> | 64K+1.5 MEG       |  | BUS VER 8.00     | 155.00 |
| CRT AND TWIN 5" |                | IN COMPUSTAR UNIT |  | MAGIC CALC (CPM) | 975.00 |
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|                 |                |                   |  | MAGIC WAND       | 190.00 |
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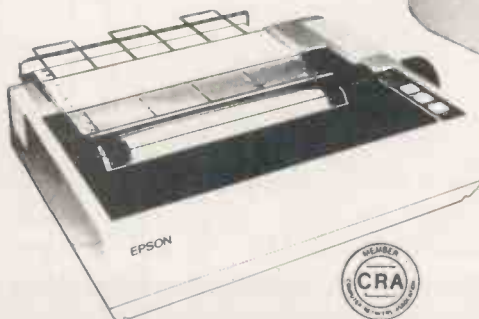
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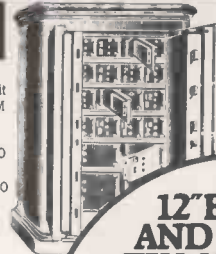
If you are looking for a VDU to complement your system, NSC can supply any one from a variety of manufacturers at prices ranging from £400 - £2,500.  
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Most manufacturers now recommend Dyan floppy disks with their computers. We stock Dyan at the following prices: S/Sided S/Density suitable for Apple etc. £25.00 per 10 (plus 50p p&p).  
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PC 3/82

# SYSTEM 4000 EPROM EMULATOR/PROGRAMMERS

EX-STOCK



## P4000 PRODUCTION EPROM PROGRAMMER

This unit provides 'simple, reliable' programming of up to 8 EPROMs. It has been designed for ease of operator use — a single 'program' key starts the blank check — program — verify sequence. Independent blank check and verify controls are provided along with mode, pass/fail indicators for each copy socket and a sounder to signal a correct key command and the end of a programming run. Any of the 2704/2708/2716 (3 rail) and 2508 / 2758 / 2516 / 2716 / 2532 / 2732 EPROMs may be selected without hardware or personality card changes.

2 year warranty. Price **£545 + VAT:**  
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This compact, lightweight Video Monitor gives a clean crisp picture on its 10" screen. Suitable for use with the EP4000, SOFTY and other systems. 12 month warranty. Price **£88 + VAT, carriage paid.**

## MODEL 14 EPROM ERASERS



### MODEL UV140 EPROM ERASER

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# The programme guide

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## ISBS-W

A totally integrated suite of software designed for microcomputers which use Hard disks or Winchester disks. The user can choose from any combination of modules and add others at a later stage if required.

### 1.0 Business Controller

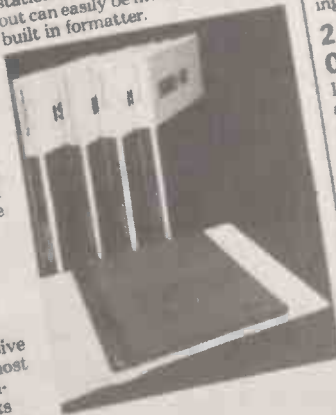
The business control module acts as a task manager and supervisor for all users and mainfile updates. Operators will feel at ease with the menu prompting when selecting tasks such as order processing, invoicing, accounting modules and word processing. The controller is used to set the system parameters, typically the number of disk units and sizes, number of printers, password and authorization codes. You can develop your own application modules for those special jobs and have them incorporated in the business control menu.

### 2.0 Accounting

The system offers a comprehensive range of facilities to meet the most demanding accounting applications. The modules cover tasks such as sales and purchase ledger, payroll and nominal ledger. Management reports including the P/L and Balance sheet can be produced from the data captured by the system. Audit trails are produced for all transactions entered, with batch totals where applicable. In addition to the main accounting reports, pre-printed output includes statements, cheques and remittances, and also payslips and bank giro.

### 3.0 Stock & Order Processing

Stock levels can be checked quickly using the on-line enquiry module, and the operator can also allocate stock if required. Order processing allows orders to be entered and maintained until all items and quantities have been shipped. Invoices and order acknowledgements can be produced on line if required with automatic release of stock and drawdown from the orders file. Pre-printed invoice stationery can be used and the layout can easily be modified using the built in formatter.



### 4.0 Word Processing

To complete the suite, the word processing module offers one of the most sophisticated systems found on today's microcomputers. It includes all the standard features that you would expect to find in a WP system, such as tabs, justification, margins, global search and replace, proportional spacing etc. In addition there is a merge document option to produce those personalised mailshots and labels, and also a built in spelling checker with a 10,000 word (expandable) dictionary.

## ISBS-F

ISBS-F is a comprehensive system designed for first time users of floppy disk systems. It can be fully integrated or each module can be used individually, adding others at a later date, which makes it an ideal choice for the first time user.

### 1.0 Stock Control

The programme allows fast interrogation of any stock line and produces 11 comprehensive reports to achieve optimum stockholding. Amongst the many features, including stock updates, release and goods inwards, the system has the option to define stock groups allowing for parts explosion.

### 2.0 Order Entry & Invoicing

Invoices can be produced quickly and easily, either by referring to an order already entered, or by entering data at the invoice stage. If necessary, part orders can be sent, as the system can keep track of each order until it is completed. Release of stock and posting of invoices to the Company Sales System is carried out automatically.

### 3.0 Company Sales System

Customers can be set up as open item or balance forward accounts, and statements can be produced easily at anytime. An online enquiry and comprehensive credit control reports allow you to monitor customer credit limits and help maintain a healthy cash flow. The system can handle part payments and unallocated cash, and produces a full audit trail of payments received.

### 4.0 Company Purchases System

Target payment dates can be assigned to each supplier invoice, to plan cash flow and to help speed payment procedure. There are reports to show ageing of invoices and the system also has the facility to print cheques on preprinted stationery or payment advices on Company letterheads.

### 5.0 General Accounting System

The main feature on this programme is the flexibility of the cost code system, which allows you to design final Company reports such as the Profit and Loss Account and Balance sheet. Comprehensive budget reports can be produced, showing any variances between budget and expenditure for your own chosen accounting period.

### 6.0 Payroll

Employees can be paid by cheque, cash or bank giro transfer, on a weekly, monthly or hourly basis, depending on the Company requirements. The system is fully maintained and incorporates all new legislation. Some of the facilities include overtime, holiday pay, coin analysis reports, and production of P11/P60 forms at year end.

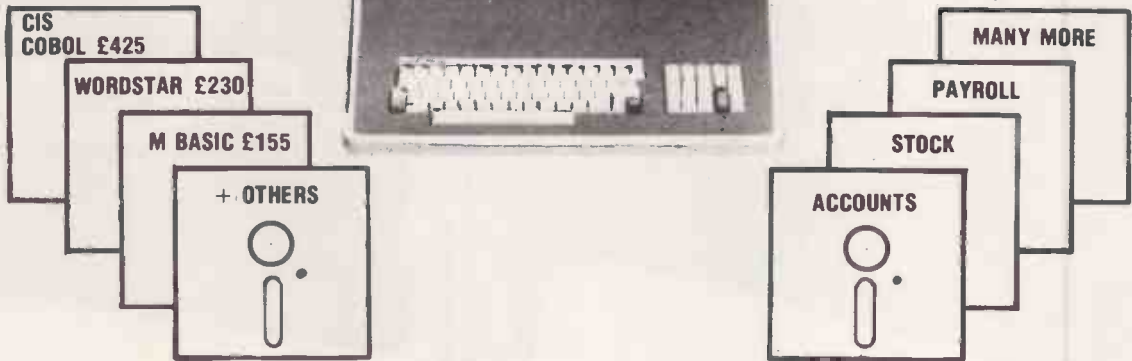
### 7.0 Names and Addresses

Names and addresses of customers and suppliers together with any others you may wish to keep a record of, can be stored centrally in this system. Names are retrieved by the programmes for completion of invoices, statements etc., by use of an id code unique to each name. A report generator allows you to design and store your own reports.

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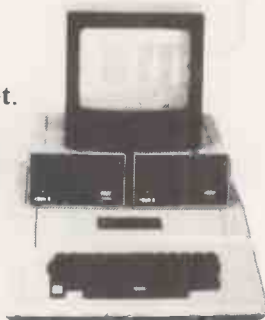
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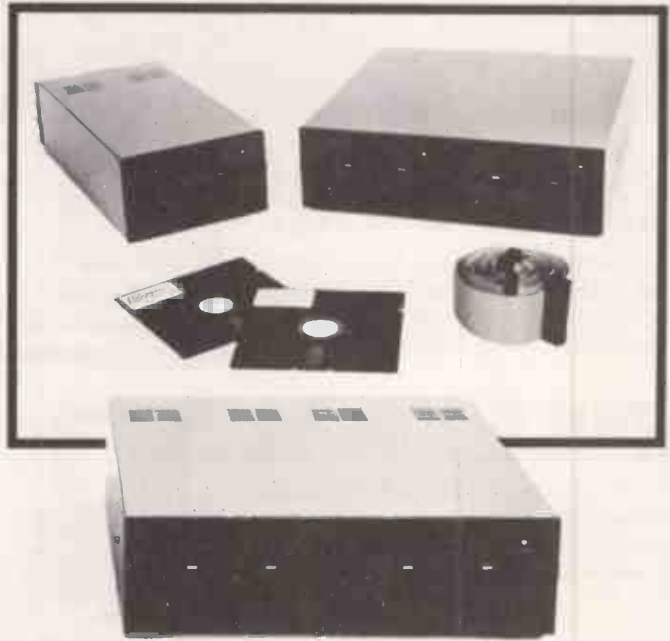
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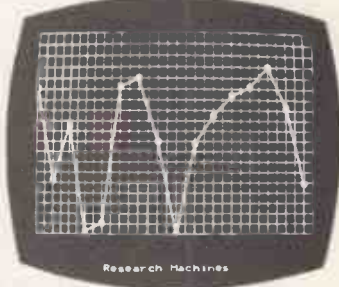
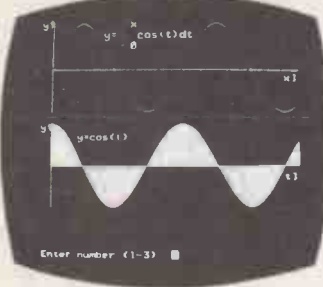
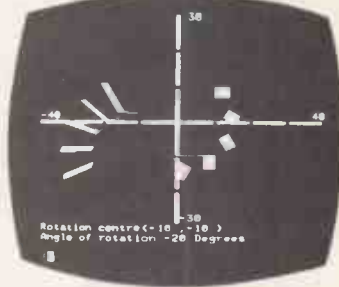
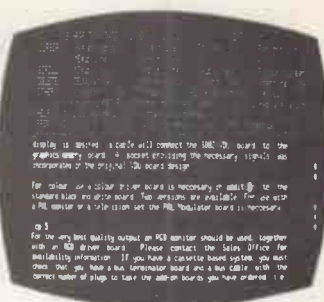
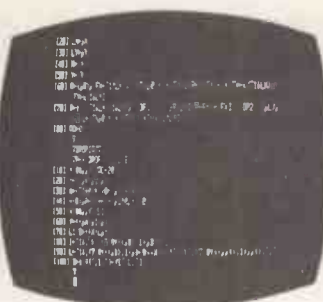
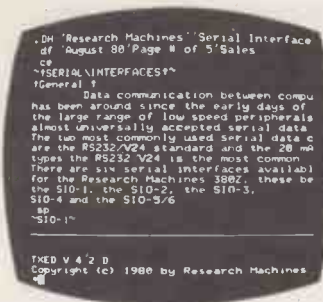
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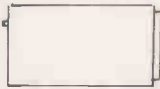
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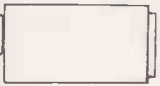
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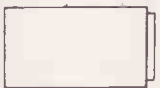
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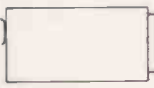


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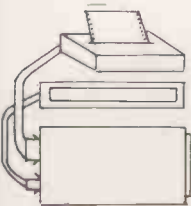


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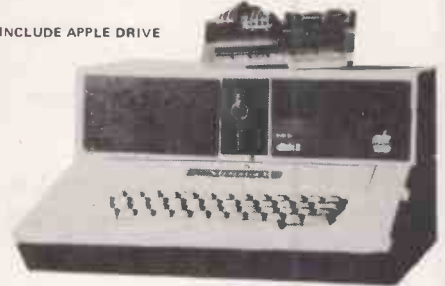
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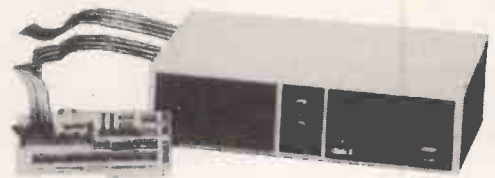
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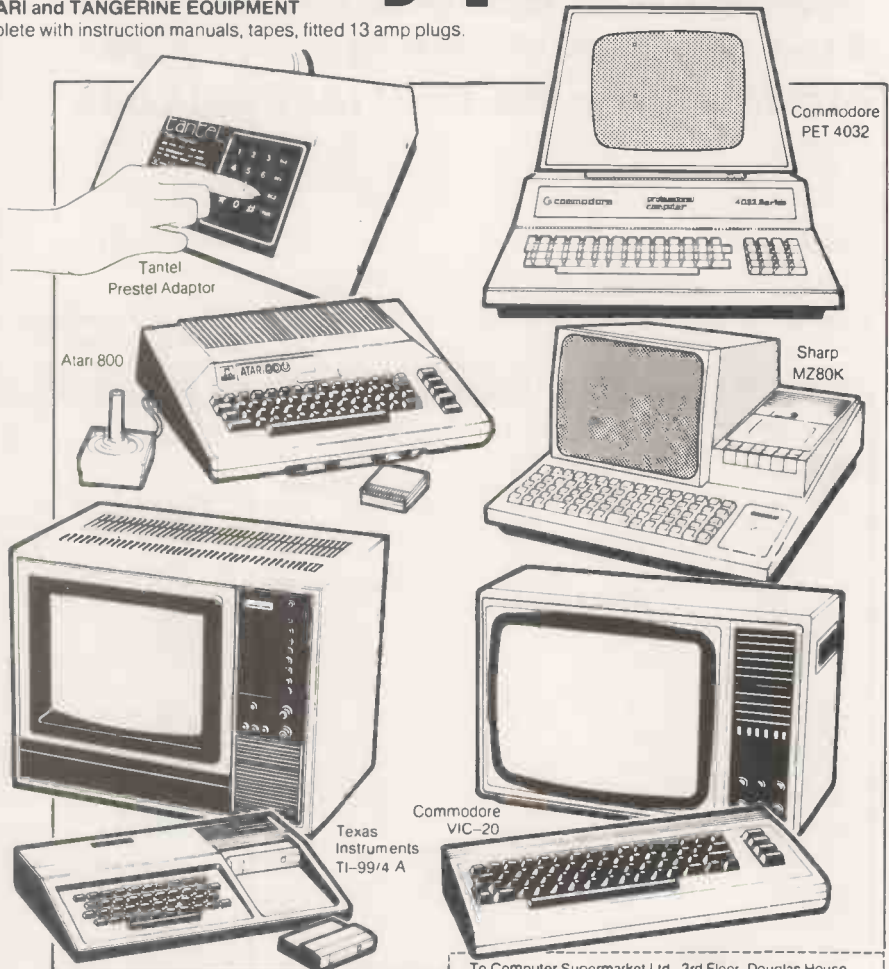
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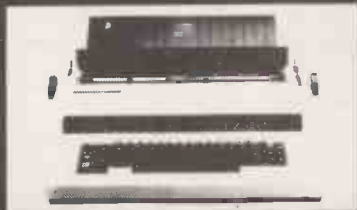
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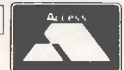
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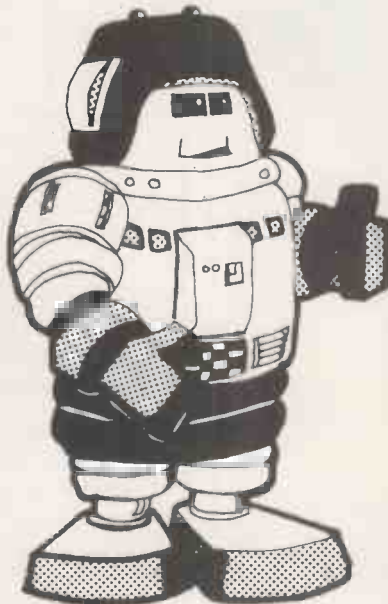
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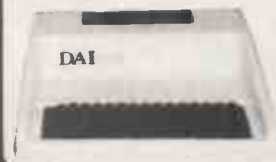
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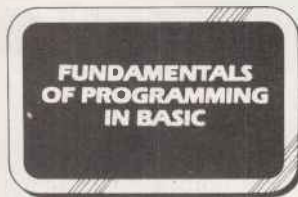
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# The end of history

THERE is a very touching play currently running in London. It is written about a most unpromising subject: the passions of the bibliophile. *84 Charing Cross Road* is contrived from the genuine correspondence of a lady living in New York during the Second World War, and a firm of antiquarian booksellers at the address mentioned.

She finds it easier to order the books she wants — many of them 100 years old or more — from London, than to struggle through New York's inferior shops. As the correspondence continues she becomes friends by post with the staff of the shop. When at last she comes to London to see them they are all dead or gone. The play ends with the bookshop being closed. Its shelves are empty: it is all very sad.

No doubt the audience just felt unhappy that she had failed to meet the people she had come to know so well by post. For us it ought to be doubly sad because it is clear that the bookshops of the world are in a like condition, and that we are the murderers.

Why should you care? Books are heavy, expensive, slow, immediately out-of-date. These criticisms apply to other paper publishing as well — technically this magazine is a fairly ridiculous object. It takes us months to produce each issue. It has to be copied on to 30 tons of paper and physically carried round the world. After a week, a month, a year, almost every copy has been thrown away. Print and paper cost us about half our income.

The people that are really keen on electronic publishing are, ironically enough, the conventional publishers of today — it will save them so much money. It is infuriating to have to produce books and magazines by typing them on to paper, encoding them into electronic pulses to set them in type, then printing on paper and taking issues by lorry and train to the reader. The reader almost certainly has a telephone wire through which the same information could speedily be delivered, and a TV screen on which to display it.

There are plenty of obviously bad things about paper publishing. What are the good things? Firstly, it is very simple and very permanent. If we had been brought up on electronic data processing and knew no other way, the invention of paper would occasion the wildest enthusiasm. "What! You just boil up a tree for your non-volatile memory? What is the refresh time — a thousand years? Oh, wow! And your writing technology — a burnt stick? "This product has to be a panic!"

Many of its other advantages are shared by electronics. It permits knowledge and ideas to flow forward in time and sideways in space. Before paper a man could only, if he was lucky, pass on what he knew to a few dozen students during his lifetime. They in turn had to repeat what they knew to their students — and the seed fell so often on sterile ground that ideas could barely hold their own against the contrary forces of death, boredom, savagery, drunkenness, whoring and war.

Once printing had got going, the mechanical process of making identical sheets and spreading them around the place guaranteed permanence to ideas and exposed large numbers of people to them. Consequently, if the ideas behind steam engines were in the air, one could be confident that somewhere, someone had read the relevant texts and would set about building one.

Of course, book-lists, libraries, bibliographies and all the paraphernalia of scholarship help the whole process along, but the fundamental virtue of paper is that, given quite ordinary care, it is almost indestructible. We know what books Caxton printed and how much he charged for them because his catalogue survives. He printed enough of them to blow about the world like dried leaves, and some blew into crannies

where they survived long enough to be recognised as treasures

Although many strong-minded regimes down the ages have tried to rewrite history by calling in and burning those books they disapproved of, experience shows that once a book has been printed and distributed it is virtually indestructible. In fact books that have completely disappeared are so rare as to rank as curiosities.

Perhaps one copy in every 1,000 that we print of this magazine will survive 100 years; one copy in 10,000 might last 1,000 years. If, then, it is interesting enough it can be translated into whatever language the English speak, re-edited, republished and sent off on another voyage through time and space. By the simple act of printing this sentence, the idea it contains is added indelibly to the store of human knowledge.

What happens when all this is done electronically? True, the transmission and display of information is potentially much faster and much cheaper than its paper equivalent. People can have just the information they want and they can ignore what they do not want. They can be helped to find what they want by the machine, so they can make use of a much bigger pool of data than would otherwise have been at their disposal.

On the down side, however cheap computer storage becomes it is very unlikely to have the permanence that multiple copies of books have, if only because the data will only exist in one or two sites. It is as if only one, two, half a dozen copies were printed of any book. Their chance of surviving the carelessness or malice of posterity becomes small and they will disappear as so many thousands of handwritten Greek and Roman books have disappeared.

Future generations might be very interested — for reasons we cannot guess at now — to see *Practical Computing's* first Prestel pages, just as we would be interested in a printing magazine published by Caxton. They cannot have them though — we cannot see them now — because they have all gone. The BBC recently wiped the early episodes of *Doctor Who* — not for any ideological reasons, but just to reclaim a few thousand metres of video tape.

Scripts of the plays and concerts that amused our parents are still to be found and give some idea of the real thing. But how much of the entertainment, the news reports or the documentaries of the last 20 years on TV will survive 100 years — or has survived even to today? Future generations will be presented with an invisible world. History will say what we did, but very little about what we thought we were doing while we did it.

Happily there is still a voluminous printed record, though it is already under fierce attack. In 20 years' time the electronic record may be all there is.

The invention of the telephone has robbed us of enormous quantities of evidence. Think of the Victorians' letters that detail every moment of their lives — there were 10 posts a day in Byron's London. In 20 years' time even the skimpy letters and newspapers of today will be electronic. For the purposes of the historian, they will be no more information than a mirage.

No doubt the book and the magazine will survive, because time will show them to have advantages over electronic media, however they evolve. But at what cost? This summer you may see stalls at country bring-and-buys where books are sold for 10p each, and have difficulty in resisting the temptation to buy them all. If you can see that soon the cheapest book will cost £20 and that vast amounts of the world's literature will never see print again, even an unreadable book at that price is a bargain, and anything which is any good becomes a gift from the gods.

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## THE BUTEL PRICE GUIDE

### Sharp MZ-80K Personal Computer

|             |  |         |
|-------------|--|---------|
| MZ-80K      | Computer 20K. 25cm CRT. Tape cassette. ASCII keyboard. | £305.00 |
| MZ-80K      | Computer 48K.  | £347.00 |
| MZ-U/G      | 28K upgrade.   | £80.00  |
| MZ-80 I/O   | Interface unit.  | £82.00  |
| MZ-80FD     | Dual disk drive.                                       | £693.00 |
| MZ-80FDK    | Additional dual disk drive.                            | £616.00 |
| MZ-80       | RS232 interface.                                       | £110.00 |
| MZ-80P3     | Matrix printer.  | £395.00 |
| CP/M        | Operating system.                                      | £196.00 |
| MZ-80 I/O-1 | Universal interface card.                              | £50.00  |
| MZ-80BM     | BASIC manual.  | £7.00   |
| MZ-80T10B   | BASIC tape.  | £9.00   |
| MZ-80T20C   | Machine language tape and manual.                      | £19.00  |
| MZ-80TU     | Assembler tape and manual (System Program).            | £38.00  |
| MZ-80T40E   | PASCAL interpreter manual and application tape.        | £50.00  |



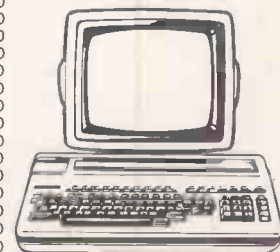
### Sharp MZ-80B Personal Computer

|             |  |         |
|-------------|--|---------|
| MZ-80B      | Computer 64K. 23cm CRT. Tape cassette. ASCII keyboard. | £966.00 |
| MZ-80FD     | Twin floppy disk unit.                                 | £590.00 |
| MZ-80FDK    | Additional twin floppy disk unit.                      | £590.00 |
| MZ-80P5     | Matrix printer, 80cps. 80col.                          | £415.00 |
| MZ-80F1     | Floppy disk interface card.                            | £100.00 |
| MZ-80MDB    | Master diskette and manual.                            | £31.00  |
| MZ-80F15    | Cable for MZ-80FD.                                     | £9.00   |
| MZ-F05      | Cable for MZ-80FDK.                                    | £7.00   |
| MZ-BCJ      | Floppy disk cable joiner.                              | £15.00  |
| MZ-80EU     | Expansion unit.  | £50.00  |
| MZ-80GMK    | Graphic RAM-II option.                                 | £120.00 |
| MZ-80 I/O-2 | Universal interface card.                              | £45.00  |
| MZ-80T10C   | MZ-80K to MZ-80B converter tape.                       | £7.00   |
| CP/M.       | Operating system.                                      | £65.00  |



### Sharp PC3201 Business Computer

|           |  |          |
|-----------|--|----------|
| PC-3201   | Computer 64K. ASCII keyboard.                | £1500.00 |
| CE-320C   | 80x25-character display terminal.            | £250.00  |
| CE-332P   | 80cps. 80/132col matrix printer.             | £450.00  |
| RP-1600/5 | 60cps. 132col daisywheel High-Q printer.     | £1495.00 |
| CE-331 M  | Twin floppy diskette unit.                   | £670.00  |
| CE-341 M  | Floppy diskette interface.                   | £125.00  |
| CE-350L   | Additional diskette drive cable.             | £30.00   |
| CE-332A   | 48K RAM upgrade.                             | £150.00  |
| CE-340R   | RS232 interface card.                        | £150.00  |
| CE-340G   | General purpose I/O parallel interface card. | £145.00  |
| CE-350R   | Printer ribbon for 332P.                     | £8.00    |
|           | 10x5 1/4in diskettes.                        | £30.00   |
| CE-330G   | Direct program generator.                    | £120.00  |
|           | Sales Ledger program and manual.             | £300.00  |
|           | Purchase Ledger program and manual.          | £300.00  |
|           | Nominal Ledger program and manual.           | £450.00  |
|           | Invoicing System program and manual.         | £300.00  |
|           | Stock Control program and manual.            | £300.00  |



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**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.**

## Business software

THE SERIES OF ARTICLES on business software by Charles Somerville were the most worthwhile that I have found in the popular computing magazines.

I now have a Superbrain, having started with a secondhand Pet to learn something of the art. My basic concept was to understand enough to obtain a management package for my consultancy practice. I did not want to use a computer for technical programs as I did not want my responsibility to rest upon somebody else's knowledge. In order to learn I found myself writing technical programs which are being "proved" for use.

The requirements of business-management packages do not seem to be met by those normally available and I have been advised to write the program myself. Charles Somerville's articles provide useful help — and there must be many other people in a similar situation.

**R. E. Chittock,**  
Tadworth,  
Surrey.

## NEC PC-8001B

I WOULD LIKE to draw your attention to a number of inaccuracies in the review of the NEC PC-8001 — *Practical Computing*, December 1981.

There are two types of expansion unit which are available in the U.K. One is the "rather large box" which contains a seven-slot mother-board which will accept various interface cards including hard disc, etc. The other contains various interfaces but cannot be configured by the user. This by its nature has a much lower profile.

The "noisy fan" referred to in the disc unit is, in fact, the drive motor whirring. None of the NEC units requires cooling as there is sufficient ventilation to dissipate any heat produced.

Perhaps the remark about the limiting effect of only being allowed 15 files per drive implies that the reviewers did not read the manuals. If they had, they would realise that you can open up to 15 file buffers within the system. This allows any program to access information on up to 15 data files concurrently, and that would be a very large and complex program. The number of program and data files that can be stored on a disc is limited only to the capacity of the diskette itself. Therefore there is no limitation in comparison with the Pet.

I was very pleased to hear that the Hitachi monitor performed so well, but

the system as supplied for review included an NEC high-resolution colour monitor. What happened to it? Unfortunately our graphic resolution is only 160 by 100 points and not as stated.

The fact that we have CP/M available was omitted from your article and that of course implies a very large software base. We will provide technical support to any software house that wishes to implement its packages on the PC-8001.

**Andy Bush,**  
NEC Telecommunications Europe,  
London NW1.

## Software market

I WAS FASCINATED by the article in the November 1981 issue on modelling the software market. I think this is the first time anybody has attempted such an exercise in print.

I would, however, quarrel with the conclusion. If we are to believe the figures quoted nobody is going to make any money until 1990, which is manifestly absurd. I have been through the assumptions very carefully to see where they might be going wrong.

While I realise that you are talking about CP/M-type disc-based machines your figures for the current market base seem a trifle low. Our own estimate, based only on feel and observation of the market place, is that the base is over 300,000 machines worldwide, and that the rate of sale of such machines is about 15,000 per month. I concur with your estimate of saturation point at 11 million machines. Overall, perhaps you should clip the top eight years out of your schedule.

**John Phipps,**  
Phipps Associates,  
Epsom,  
Surrey.

## Speech synthesis

I WAS DISAPPOINTED in the article on speech synthesis in the November issue. For example, no mention has been made of the Computalker system which was a milestone in computer speech, introduced in 1977 with a complete machine-language driver for 8080 and S-100. Neither did the writer mention the Votrax Type-n-Talk, which costs only £275 and speaks for plain English text.

"Speakeasy" is the single most popular speech synthesiser in the U.K., suitable for absolutely any computer, and ought to have been described. Software exists for

direct phonetic spelling, and the whole product costs only £69. Microspeed, though, costs an order of magnitude more.

**David Sands,**  
Royston,  
Hertfordshire.

## The view from ICL

HOW NICE it is to be welcomed. The interesting editorial in the December 1981 issue of *Practical Computing* pointed out that the micro business adds up to about 5 percent of IBM's turnover. ICL's turnover is a little larger than that, but no matter — it is of the same order of magnitude as that of the micro business as a whole and very much smaller than that of our principal competitor.

To survive at all in such circumstances requires exemplary management by ordinary standards. To prosper needs superlative direction and that is just what we do now have. So perhaps we are wrong to feel included in your welcome, because we are not really big boys — indeed a great deal of our present reorientation revolves around the frank acceptance of that very fact.

We see ourselves as part of a worldwide industry which is functioning more and more like the chemical industry or the petroleum industry — buying raw materials and intermediate products wherever they are available and combining them and processing them and supporting them to meet the needs of our customers. If our customers need a particular piece of hardware or software to complete a system, and we cannot best meet it from our own resources, then we must perforce scan the world for it and ensure an adequate supply of the right item. That is how our scene is moving — though we still have some way to go before we have caught up with the older high-technology industries in this regard.

This change of point of view has two immediate consequences for ICL. On the one hand, we must not seek to rely on in-house production of components such as chips if, for volume or other reasons, these cannot be produced at world market prices. We must therefore seek alternative stable sources of supply for such basic raw material of our business. Similar considerations apply to firmware and software.

The other consequence lies at the extreme end of the long chain of productive processes stretching from raw silicon to the finished customer application

(continued on page 45)



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(continued from page 43)

system. The essence of successful applications development lies in achieving the right balance between "off the peg" applications and bespoke tailoring to meet particular needs.

On the one hand, there has to be a solid base of system hardware, software and applications development tools orientated towards networked systems, and that is what we can best supply. On the other hand, there is the great variety of situations encountered in each particular business. In Britain, this variety is immense and world wide it is overwhelming. Our experience with our System 10 products has conclusively demonstrated that it is the software houses who hold the key to efficient bespoke tailoring.

If we are to sell our products in the volumes required to achieve competitive prices, we have to develop entirely fresh market outlets and this also is an area in which the system houses are of crucial importance. Marketing strategy and customer applications both demand a quite different approach from that which was previously traditional in ICL.

At ICL, we believe that there will be a big part for the micro community to play in all this — especially those micro system houses with solid, in-depth knowledge of particular applications. Without this knowledge, the resulting products can fail to meet the customers' needs in quite elementary ways.

For example, a very competent but exasperated small business user has told us of a well-known micro product which only allowed four-line addresses for suppliers and of a payroll package which included the state pension scheme but not private pension schemes. Such solecisms are not tolerated by serious users.

Much of the effort of getting a worthwhile business application going involves the detailed study and appraisal of the way the business works, the way its data is structured, validated and accessed. Indeed, it is our experience that once the problems of data structure and data management have been adequately tackled, then — and only then — the programming reduces to a relatively straightforward task.

Applications development tools involving novel approaches such as non-procedural languages, artificial intelligence thinking and integrated data dictionaries and data bases are going to be essential to achieve the kind of simplicity of application which will be essential for the networked office systems of the future.

To achieve all this, all the different parts of the computer community must work together as never before and we for our part are ready, willing, experienced and determined to play our part.

Conway Berners-Lee,  
ICL Corporate Communications,  
London.

## Reading into a Pet

I POSSESS a number of data tapes on which I have recorded temperature readings using a multi channel recorder. I want to read them out on my 32K Basic 4.0 Pet.

The information is recorded as a series of eight-bit words with a "1" as start bit.

The "1" is recorded as "┘" and a "0" as "┘". However, as you cannot record two consecutive ones that way, what is done is this:



where the first bit is the start bit and the rest represents a reading of 99 hex or 153 decimal.

It is recorded at about 200 bits per inch with a three-bit gap and the start bit and eight data bits. A tape speed of 1.875 inches per second gives about 375 bits per second.

Does any reader have any ideas on how I can read these tapes? It would save me having to type about 17,000 readings.

Peter Dolphin,  
Petersfield,  
Hampshire.

## Family tree on ZX-81

I WAS very interested in Bob Merry's article "Climbing the Family Tree" that appeared in the November issue of *Practical Computing*. I am an owner of a Sinclair ZX-81 and also a genealogist, but very new to computer programming. Has anyone been able to produce a similar program for the ZX-81?

A N Little,  
Farnborough,  
Hampshire.

## Solicitors' letters

CONTRARY TO the assertion made by the editor of *The Solicitor's Practice* — Feedback, November 1981 — word processors are eminently suitable for production of letters from a solicitors' office. A simple microcomputer with a daisywheel printer costing less than £2,500 has the following advantages:

- The solicitor need not take so much care with the dictation on tape, e.g. you tell the operator to go back higher up the page and alter one word to another, or insert a new line or paragraph — something which would make an ordinary typist resign on the spot.
- Even the smallest floppy disc will hold an average day's work with the result that every letter to be sent out may be saved magnetically, at least for the day. Alterations may be made at the end of the day in a minute or two.
- Formal parts of each day's letters such as the date, the solicitor's reference and any other messages which may have to go on every letter — such as an additional partner's name or a change of address since the last printing of note headings — may be printed automatically on each letter.
- The typist does not need to retype long names and addresses for the envelope. They may be printed from the text of the letter.

- The names and addresses of regular correspondents may be saved on a disc and added automatically to appropriate letters.

The same machine can cope with drafts and engrossments, as well as probate affidavits and forms — despite the remarks of the learned editor of *The Solicitor's Practice*. With the assistance of VisiCalc it will deal with every aspect of the accounts, bills and time costing of any solicitor who is already familiar with the single-entry type of book-keeping.

For the litigation solicitor, the microcomputer can easily be programmed by anyone with even such lowly qualification as myself — School Certificate maths, failed — to cope with taxed bills.

Vincent Hale,  
Sheffield,  
South Yorkshire.

## Your experiences, please

I AM CARRYING OUT research into applications of microcomputers to small businesses, especially the problems of the first-time user. I would be interested in making contact with any small businesses who have used micros, as well as consultants and anyone else doing research in this field.

Frank Blewitt,  
Department of Accounting and  
Administrative Studies,  
Polytechnic of North London,  
London N7 8DB.

## Extra Qume characters

THE ASCII CODE only allows for direct code access to 94 printable characters, and most keyboards used in microprocessor systems allow you to directly access, at the most, 92 characters — far fewer than this on some systems. All systems, however, can transmit all of the 94 printable characters.

To print the two extra characters on Qume 96-character printwheels, however, it is necessary to transmit a two-character string to get each character to print. To print the character in printwheel position 002, the system needs to transmit ESC/; the character in position 004 is accessed by transmitting ESC SP.

R D Taylor,  
Qume (U.K.) Limited,  
Reading,  
Berkshire.

## Teledak update

UNFORTUNATELY the information given on the Teledak 2000 in "Adapt to Choice", October 1981 issue, was out of date. Zycor has recently moved from London and the new address is: Gateway House, 302/308 High Street, Slough SL1 1NB. Telephone: Slough (0753) 79127.

The current price of the Teledak 2000 is £225.

B A Price,  
Zycor Ltd,  
Slough,  
Buckinghamshire. ☐

# Twin-processor Torch may be leading light

THE TORCH COMMUNICATOR is a new British computer that combines both the Z-80 and 6502 microprocessors in the same machine. The twin-processor machine has 96K of user memory together with powerful communications and network facilities. The basic machine is capable of handling Telex, Prestel and teletext, connecting directly to a dial-up telephone line. A built-in Modem services a direct 120cps telephone communicator.

Messages can be received without interrupting the current operating mode. The user is informed that a message is being received by the screen; it is then stored until it is either called up and converted into hard copy or is sent to another station on the Econet network. It takes a mere 10 seconds to send a full screen of information to any destination in the world.


On-line backing storage of 1Mbyte is provided by the twin 5.25in. double-density mini-floppy disc unit. There is also a hard-disc option providing a maximum of 10Mbyte of on-line storage. The 80-column VDU is capable of providing high-resolution colour graphics, together with a teletext mode.

The graphics capability is greatly enhanced by the twin processor. One processor can operate all the disc-handling

## Pascal learnt by video

A VIDEO SERIES called Programming in Pascal consists of 16 half-hour programmes which teach this structured language to users with no previous experience.

At £1,250 plus VAT the tapes are no snip, but educational establishments will be able to purchase the series at a discount. The pace is slow at first but picks up momentum once the basic concepts have been tackled.

For more details contact the publishers, John Wiley and Sons, Baffins Lane, Chichester, West Sussex. 




functions while the other is sorting data.

The popular CP/M operating system opens up a vast library of tried and tested software to the user, including the ubiquitous VisiCalc and various standard accounting packages. All of them are, of course, fully integrated.

A word-processing system which is fully integrated with the communications software allows letters to be typed, edited and speeded to their destination without the users ever leaving their seats. Languages include the popular Microsoft Basic, the currently fashionable BBC Basic, Pascal, Fortran, Cobol, Algol 68, Lisp, Forth and C.

The Communicator is a joint


manufacturing venture between two British companies: Acorn Computer, the manufacturer of the powerful Atom and the BBC Micro-computer, has collaborated with the Climar Group. Acorn provides the hardware expertise gained during development of the Atom, the BBC Micro and the successful Econet. Experience in business software is Climar's contribution.

The machine is entering a highly-competitive part of the market and, as a Torch spokesman pointed out, the machine is only half the price of the IBM equivalent. The Torch Communicator retails at £2,500 and will be manufactured in the U.K. 

## The Welsh connection


IF YOU NEED to run a program that calculates the revenue of this year's leek harvest, or if you want to run a stock-control program for your daffodil plantation, why not program in Basicm? If your programs Rhed rather than Run, and Llwy instead of Load, then you are probably a Welsh programmer and will find Basicm a boon — it is a version of Applesoft Basic in the Welsh language.

All Applesoft and DOS commands, the error messages and the relevant single-letter suffixes are all in Welsh. So, a syntax error becomes *gwall iaith*, and should you see *gorchymyn anyniongyrchol*, then all that is wrong is that it is not a direct command.

The language system has been written for a minimum configuration Apple with one disc drive and the language card — not the Welsh one — is available from Cardiff Micro-Computers, 46 Charles Street, Cardiff, South Glamorgan. Telephone: 0222 373072. 

## Form a model balance sheet

MULTI-PLAN is a new software package designed for financial modelling. Income statements, balance sheet and cash flow can be produced for given inputs of production units.

Multi-Plan is available from Keating Computer, 42 Knoll-Back Avenue, Brampton, Barnsley, South Yorkshire. 

## Building a network of Pets with multi-headed Hydra


THE LEGENDARY HYDRA was a many-headed beast; its electronic namesake has the same characteristic, the heads being Commodore Pet microcomputers. Networking systems are all the rage these days: inter-micro communication is only one of many facilities provided by such a network. Up to 255 items can be connected to Hydra, enabling users to share disc drives, printer devices, etc with obvious financial savings.

Hydra itself comprises a



small board which plugs into the Pet memory expansion port, together with some software in ROM. Installation is simple and it is available for


the 3000, 4000 and 8000 Pets. The total length of the network can be up to one kilometre; four-way screen wire must be provided by the user.

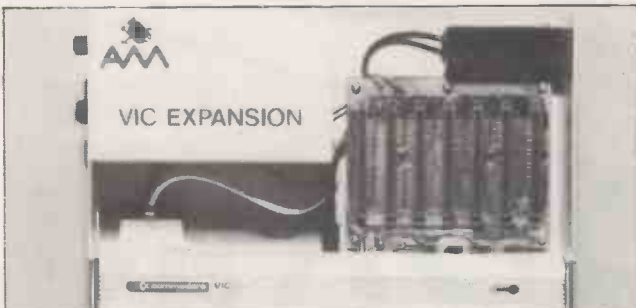
Seven extra commands are provided in Basic, and facilities to restrict access to nominated drives are included. Hydra costs £125 plus VAT for each Pet in the system, and comes with a comprehensive manual. For details contact Wordcraft Systems, 9 Little-over Lane, Derby. 


## More fluent flowcharting

FLOWCHARTING is an important stage in the development of software intended for serious use.

Rather than sit for hours with pencils, pencil sharpeners rubbers and reams of paper drawing flowcharts, programmers at Data Communication Ltd produced the idea of the flowchart planner.

The workboard and a complete set of symbols sells for £21.97 plus £1.75 postage and packing from Flowchart Systems. 01-942 2830. 



This Vic-20 microcomputer is fitted with the Arfon Vic Expansion unit, a device which greatly extends the possibilities of the computer. The unit contains a power supply which can cope with the extra power requirements of the expansion, contained in the safe enclosure at the top left-hand corner of the picture. To the right is a seven-slot expansion motherboard, behind which is a holder for the modulator. The existing port for joystick, paddle or light pen remains free, as do the cassette and disc-drive ports. The motherboard accepts memory, program ROMS or functional units. For further information contact Arfon Microelectronics. Telephone: Caernarfon (0286) 5005. 

# Chemists' Pet prints message on a bottle

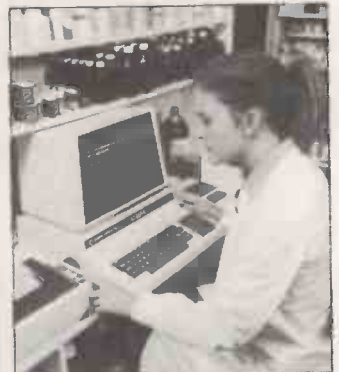
PRESCRIPTION LABELLING is a task that readily lends itself to computerisation. It is a boring, tedious job but the consequences of not doing it correctly could be disastrous. Pals — the Prescription Automatic Labelling System — is an applications package that performs the job on the Commodore Pet microcomputer.

A prescription is normally


dispensed and labelled manually, which is inefficient and expensive in manpower. A further problem is that quality tends to deteriorate as pressure increases during peak dispensing periods. The label is the last link between the patient and the doctor, so clarity is essential. Research indicates that printed instructions are more likely to be followed correctly and completely. Pals provides labels with similar quality to type-written labels at a higher speed.

The system runs on the Commodore Pet computer, together with a tape drive and the Epson printer. The end-user price for the system is £1,495, which includes installation and some training, plus 12 months' maintenance on a same-day-service basis with an initial supply of pre-printed labels and plain printer stationery.

The system comes with a number of standard products and dosage instructions, all of which can be reprogrammed using the computer. Any standard item can be overwritten to produce a non-standard




label. A typical label takes four seconds to print, rising to seven seconds when combinations of standard drugs and doses are mixed. The patient's name is entered only once, regardless of the number of items dispensed. There is an inbuilt tutorial routine to familiarise the user.

Pals is available from Taylor-Wilson Systems, Oakfield House, Station Road, Solihull, West Midlands. Telephone: (05645) 6192. 

## Tandy display improved

TRS-80 MODEL 1 owners can improve their video displays with the AV-1 board from RHA (Minisystems). A total of 96 ASCII characters are added to provide the scripsit-compatible lower case. The board enables characters to be displayed white on black or black on white. The graphic character set is retained to give a total of 256 characters. The whole screen can be inverted under separate control.

All the functions are totally software-compatible with the existing TRS-80 software, and the board does not affect the operation of the cassette unit. It contains seven chips and is supplied, assembled and tested.

The unit fits inside the keyboard case. Some tracks must be cut and some soldering done; there is a fitting service which costs an extra £10. The kit costs £23 plus VAT; for other prices and further details contact RHA (Minisystems), 83 Gidley Way, Horspath, Oxford OX9 1TQ. 

# Attractive properties for estate agents

ALPHA ESTATES is a new business system specially for estate agents which takes into account all aspects of this volatile market. The software runs on the Adler Alpatronic microcomputer and was developed by John Elmer, an Alpatronics systems house, in collaboration with regional estate agencies.

Operators need no prior knowledge of computing to use the system, as clear instructions in plain English guide the user. Alpha Estates will perform the creation and amendment of property records, the creation and amendment of applicant records, matching of proper-


ties to applicants, and selection of applicants for the mailing of new property details. It provides full details and summary reports for office use.

There are customised coding facilities to meet agents' requirements, automatic production of mailing labels, on-the-spot printing of properties suiting applicants' needs. Full instructions are included, together with sample files and documentation and sub-agents property print for easy updating.

Searches can operate across four criteria — type of house, price, number of bedrooms, etc. — and can then be broken down by further criteria. A

search takes about four seconds. Other search factors increase the efficiency of the office, for example by providing a list of all houses not sold after a given period. Advertising effectiveness can be analysed to help the company to maximise results.

As well as the estate agent's system, word-processing and accounting software can also be purchased; a property management system will follow shortly.

The package costs £525 and is available from Triumph Adler U.K., Alpatronics Division, 27 Goswell Road, London EC1M 7AJ. Telephone: 01-250 1717. 

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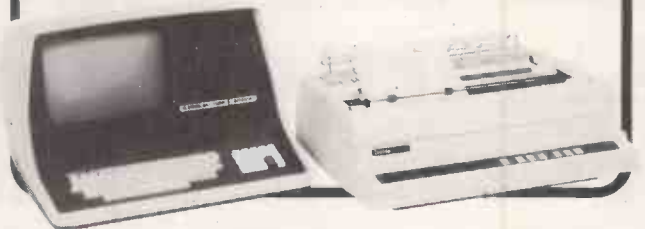
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Massive storage capability is available with the 8in. Winchester Micropolis 7MB - 35B Hard Disk from £3500 including a controller to connect directly to your Superbrain. 12 month warranty included in price.



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**Integrated Accounting System - Stock Control @ £350. Order Entry and Invoicing @ £350. Sales Ledger @ £450. Purchase Ledger @ £450. General/Nominal @ £400. Name & Address @ £250. Complete Package so far @ £1650 plus Payroll @ £500.**

**Financial Modelling - T/Maker @ £155 and Micromodeller @ £645**

**Data Base Management - DMS @ £400 Word Processing - Wordstar @ £250 and Mailmerge @ £75.**

Also available - Form Creation, Debugging etc. Alternatively we will design and implement software packages to suit your specific needs

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The Iona is a stylish eight-bit microcomputer which combines keyboard, main circuit board and power supply in a metal, semi-portable desk-top case. Memory can be expanded all the way up to 960K. Accessories include both a colour and a monochrome monitor, 5.25in. mini-floppies and a matrix colour printer. A full range of CP/M systems software is provided, and a dealer network is being set up. For details contact IOTEC, 4 Playhouse Yard, Blackfriars Lane, London EC4V 5EX. Telephone: 01-236 7968. □

## How to keep the 380-Z at a distance

USING THE RK-100T or RK-100R, a school can adapt the Research Machines 380-Z microcomputer to operate from a number of remote terminals. This facility allows terminals to be set as and where they are needed while the computer itself is kept at the most convenient location. Terminals can be sited in science labs, classrooms or the administration offices — in fact anywhere up to 500 metres from the main processor.

Though the ability to do this is not new, the remarkable feature of this implementation is that the links are made without recourse to expensive 15-core cable. These units from

Robots Unlimited use only two-core cable. Video or TV signals are transmitted by the normal video-cable network. The system will therefore be of particular use to those educational establishments already using a video link.

Contact Robots Unlimited for further information at 1 Denbigh Road, Luton, Bedfordshire. Telephone: Luton (0582) 507838. □

## Free Apple II brochures

APPLE COMPUTER (U.K.) has published a series of glossy colour brochures for the popular Apple II microcomputer. The five separate booklets, available free on request, have been written to enable enquirers to obtain initial information about Apples.

The booklets in the range are: Apple at a Glance, Apple in Business, Apple in Industry and Science, Apple in Education, and Apple has the Answers. Write to Apple Computer (U.K.), Finway Road, Hemel Hempstead, Hertfordshire. □

TWIN Z-80A PROCESSORS AND triple quad-density floppy drives make the new Quantum 2000 no ordinary microcomputer. However, this British-built machine would appear to be remarkable value at only £2,250 plus VAT. Internally the computer lives on a series of 8in.-by-8in. boards, making for easy servicing. Four empty slots leave room for expansion.

The basic system uses the two processors and the British-originated 80-bus standard to provide an unusually fast machine. Its advantages will be most strongly felt in the multi-user system. The triple quad-density mini-floppies offer a total of 2.1Mbyte of on-line storage in addition to the 64K user RAM available in the micro itself.

## Group boosts micros in primary schools

MICROCOMPUTERS and Primary Education is a non-profitmaking association of practising teachers which provides members with specialised help. The organisation aims to co-ordinate and initiate ventures into microcomputing by teachers of younger children. All affiliated schools receive the information pack, which is paid for by the central government and produced by the MEP project.

Members have access to a library of educational software, and are offered preferential insurance terms. Regular newsletters inform participating schools on various aspects of the microcomputer world. Mape, as the organisation is known, also provides primary teachers with a united voice and has been consulted by central government representatives on important issues.

In the light of the Government's decision to provide backing for microcomputers in primary schools, Mape is prepared for a massive response to an appeal for members among the 250,000 primary-school teachers. Membership

of Mape costs £7.50 per school. For further information contact the secretary, Barry Holmes, St Helen's County Primary School, Bluntingsham, Cambridgeshire; a stamped, addressed envelope will be appreciated.

Primary-school teachers will also be interested to hear of the second conference of teachers involved in microcomputing which will be held at Exeter University at Easter. For further details and bookings, contact Roy Garland, College of Education, St Lukes, University of Exeter, Exeter, Devon. □

## Accounting to taste

AIRS stands for Accountants' Incomplete Records System, a modular package which may be expanded to meet particular requirements. Basic modules allow the user to prepare a cash and bank analysis with reconciliation.

The package costs £975 and can be purchased from MSS, 54 Chapel Road, Worthing, West Sussex. Telephone: Worthing (0903) 34755/6. □

## Speed-and-power theory of British Quantum



A 12in. green screen monitor is an integral part of the system and displays 80 by 25 characters mapped to the user RAM. A programmable character generator produces 128 graphics characters including pixel combinations. The built-in ASCII keyboard has a 128-

character buffer and 16 special-function keys, as well as a numeric keypad.

For more details contact the manufacturer, Quantum Micros, 60/62 Balcony Unit, Merrion Centre, Leeds, West Yorkshire. Telephone: Leeds (0532) 45877. □


# Advanced Anadex makes its impact

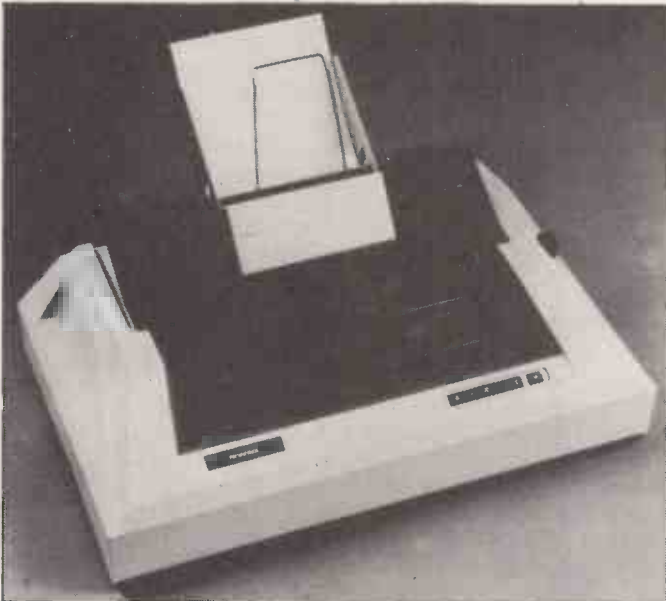
MANUFACTURERS are understandably enthusiastic about their products, but the WP-6000 printer may well live up to claims that it is the most

advanced impact matrix printer. The 18-wire print head and the high-speed, bi-directional, logic-seeking servo system enable the

machine to print correspondence-quality text at over 150 cps. In the rough-draft or data-processing modes, the speed can rise to over 500 cps.

Multiple resident character fonts and optional downloading of other fonts from a host computer are provided along with proportional-spacing and text-justification features. The scientific font will be welcomed by the scientific and engineering communities; Greek letters are available in both upper and lower case.

Contact Anadex, Weaver House, Station Road, Hook, Basingstoke, Hampshire. Telephone: Hook (025672) 3401. 




## Low-cost Camp cuts surveyors' paperwork

QUANTITY SURVEYORS, consulting engineers and contractors will find Camp an attractive software package. The Contract Account and Measurement Program provides a low-cost facility for producing bills of quantity under all conditions of use.

Tender documents, interim valuations and forecasting are integral parts of the program. Price fluctuations can be carried out for Baxter, BEAMA, NEDO Series 2 building

works, and NEDO Series 2 specialist engineering works.


The software runs on the Hewlett Packard-85 machine, with twin disc drive and printer. By using the HP-85 with integral cartridge, interim evaluations can be undertaken at site offices. For further details contact Civil and Structural Computing, Ash Court, 2 Ash Grove, Great Horton Road, Bradford BD7 1BN. Telephone: Bradford (0274) 391706. 



## Variety of formats on bi-directional Facit

THE FACIT 4526 bi-directional printer costs £1,050. It offers 132 characters per line and a print speed of 150 characters per second. The 9-by-9 dot matrix, with true descenders, can produce a variety of character sets in addition to ASCII.


A wide range of formats and printing modes is available,


including hex trace. The printer uses minimum-distance sensing logic to ensure economy and speed of printing. The 4525, an 80-column version, is available at £938. For details contact Hi-Tek Distribution, Trafalgar Way, Bar Hill, Cambridge. Telephone: (0954) 81996. 


## Naming successor to The Last One

IT SEEMS that The Last One was poorly named; it was in fact only one in a string of program generators. The latest to come to our attention is an ingenious piece of software called the Program Writer/

Reporter. It writes complete, running and debugged Basic programs that are fully documented and easily modified by the user.

The originators claim that users with no previous experience will be able to write their own programs within the hour, and that experienced programmers will be able to save up to 90 percent of their time. There are four versions of the program available: Apple II, Apple III, Apple CP/M and standard CP/M. Prices range from £220 to £260. The program, distributed by a nationwide network of dealers, is also available from Apple Computer and Taunton Electronics. Telephone: Taunton (0823) 433142 — 24-hour answering service. 

The special flake-proof oxide coating of the Inmac Plus flexible disc gives software a lifetime's protection. Each disc is individually numbered and will be replaced if a fault occurs. Both standard and mini-floppy discs are available. The 5.25in. discs cost £4.10, and the 8in. discs £5.95. Inmac can supply any U.K. destination within two days, Europe takes a little longer. Contact Inmac on 09285 67551. 

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The MZ80B opens up a new world of graphic display potential, more flexible data storage and retrieval, and ease of operation.

Here is the computer from the future. Available today.

## Stunning Graphic Display.

Seeing is believing. The large-screen, high-focus, green-face display incorporated in the MZ80B gives you high-resolution graphics of 320 x 200 dots.

An additional graphic RAM can be added which allows another 320 x 200 dot resolution pattern to be displayed.

This dual high-resolution graphic ability is especially useful for simulating and displaying a dynamic picture. It can display 40 characters x 25 lines or 80 characters x 25 lines via software switching.

In addition there are facilities for full, on-screen editing, reverse video, partial scrolling and a full range of graphic symbols.

## Character and Graphic Printer.

This fast, quiet printer will reproduce your graphic displays and, of course, print-out upper and lower case letters and symbols. A tractor/friction feed version is also available.

## Data Storage/retrieval.

The MZ80B has a remarkable memory. 64K of RAM. And that constitutes all the memory area, giving flexible storage of any computer language and its software. The cassette deck is electromagnetically-controlled, with a data transfer speed of 1800 bits/sec combined with a unique

programme search facility to make data storage and retrieval super-fast.



A typewriter-style keyboard incorporates characters and symbols plus a numeric key-pad and ten user-definable keys for fast and simple operation.

BASIC is, of course, provided with Z-80 Assembler Packages, PASCAL and a BASIC compiler.

## Floppy Disk Drive.

A twin Floppy Disk Drive unit can be added which will give you 560 bytes of storage on double-sided, double-density disks.



## Comprehensive Documentation.

Each MZ80B comes complete with a full set of documentation including an owners' manual giving full circuit diagrams, a monitor reference manual and programming manuals.

## Interfaces

RS-232C and IEEE Interfaces are available from January 1982 allowing the MZ80B to communicate with scientific instruments and other peripherals.

## CP/M\*2.2

CP/M\* is also available making a wide range of packages immediately available including wordprocessing, financial modelling, data base management to mention but a few. CP/M\* also increases the disk capacity to 680K.

(CP/M\* is a Trade Mark of Digital Research Ltd).

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\* and a Z80A processor!

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# Micros for business and the consumer

MICRO-C is the microcomputer division of the Curry's High Street electrical retailer. Better known as a purveyor of more conventional electrical goods, Curry's now markets a selection of 12 systems ranging from relatively small games machines to large, all-singing, all-dancing business systems. In addition there is a comprehensive support network for both hardware and software, and there lies the strength of Curry's brave foray into microcomputing.

**The national retailing chains are keeping a canny eye on the potentially lucrative microcomputer market. Bill Bennett visited one which has already taken the plunge, and reports on how it is faring.**



Birmingham was the first and, together with Leeds, is the most successful Micro-C branch. It is to be found tucked away near the back of Curry's huge city-centre showroom beyond the rows of televisions, refrigerators and washing machines. This shop-within-a-shop is reminiscent of those esoteric little departments in Harrods or Selfridges, an oasis for the enthused.

Micro-C subscribes to a philosophy which is becoming increasingly popular with microcomputer dealers — dealers, that is, as opposed to retailers. A Micro-C branch is not merely a shop where customers walk in with bulging wallets and leave with a box full of silicon chips. For the staff at one of these branches the real work begins once the system has been bought.

## Sizeable staff

The Birmingham branch has a sizeable staff led by Mike Griffin, who has been with Micro-C since its inception two years ago. He knows more about the sharp end of the business than most. Together with Carol Weaver, the branch software expert, and Tony Gwalchmai the salesman, they furnished me with the answers to my questions.

How does Micro-C operate? It all starts before the customer becomes involved, with experienced staff conducting rigorous tests on all equipment before it is put on the Micro-C list. Only equipment on this list is supported, but inclusion means the hardware and software is of a high standard. As soon as a prospective user has made a decision to purchase a micro,

Micro-C staff can provide advice and demonstrations.

Once the relevant hardware and software has been selected, a Micro-C representative visits the prospective user's site. Tony Gwalchmai considers that this is one of the more important jobs after the feasibility study, because once the equipment has been ordered, the user must find somewhere suitable to put it. "It is surprising, but many customers believe that all they need is a single power point and that's it". He then went on to reveal that customers are taken aback when they discover that a Pet computer, a disc unit and a printer each require a power socket; in the case of the Apple II an extra point is required for the monitor.

The next stage of the process takes place when the truck carrying the equipment arrives at the branch. Once unloaded, the relevant machine is connected up and checked. Only when the system has been proved does the scene shift back to the customer's office as the system is reassembled by the Micro-C representative.

The supervised installation of a system is essential. Some might scoff, but to the inexperienced all those connecting wires are just so much spaghetti. At this stage the sales team can take a breather, or make another sale, because the support people take over. Carol Weaver is responsible for ensuring that the users can operate the software packages that they have bought. A customer buying a new system together with some software is given two days training free of charge.

Weaver often finds that the people who

will be operating the microcomputer have no idea about what it can or cannot do, and are absolutely clueless when it comes to making the beast work. The two days' training cannot be taken all at once. Not all the information is assimilated anyway, but small doses help to make it more digestible so sessions usually last half a day or less.

The economics of the training scheme are quite simple. A complete computer system costs around £2,000 and Curry's offers few discounts. The training is loosely structured, starting with a short session on how the hardware works and progressing to disc handling and practice sessions with dummy data. Weaver never lets users go live with their own data until she feels they are safe.

## The longer term

Over the longer term, Curry's makes available post-sales support and Carol Weaver will follow up any phone calls requiring help. Customers can also buy further training if they wish, though this option has yet to be taken up. Buyers of one of the smallish software package, such as VisiCalc, are entitled to about half a day of supplementary training as well as the initial two days.

Micro-C recognises that it cannot expect to supply all its customers' needs. Tony Gwalchmai reasons that there is a wide enough range of software on the Micro-C lists for most users, but there will always be some esoteric applications for which they will look elsewhere. Using software which has been bought from other sources does not affect the 12-month guarantee on the hardware parts and labour, nor does the addition of approved peripherals. Service within 24 hours can be assured for an extra charge.

Prudent buyers take up the option of a service contract at the time they buy the initial system. There are three levels of service; ordinary, 24-hour, and preventive maintenance. Ordinary service costs about 10 percent of the equipment cost — a little extra for printers and other service levels.

The question remains, how successful is the Micro-C approach? There are no precedents on which to form a judgement, though the staff at Birmingham are all sure that they are on the right lines, and within two years Micro-C has expanded from one branch to nine.

At the present each of the two Birmingham field salesmen sells, on average, one complete business system a week. This number is sure to increase as past customers return for more machines and the branch's reputation becomes known. □

# ACT SIRIUS

The Sirius is new 16-bit micro from Chuck Peddle, designer of the Pet. Will it take the top off the eight-bit market? Bill Bennett takes its top off to see.



THE ACT SIRIUS is the latest episode in the short but action-packed history of micros. The designer of the system, American Chuck Peddle, has already reserved his place in microcomputing history — he is the originator of the world-famous 6502 microprocessor and the one-time best-selling micro in the U.K., the Commodore Pet.

There are many critics of the Pet, but for all its faults that venerable old warhorse of a micro has kept millions of satisfied customers happy for years and continues to do so. The key to the Pet's success was that for one initial outlay a would-be computer user could buy a complete, self-contained system.

## Air of confidence

In those days it was most unusual to find a microcomputer which you could plug in, switch on and start computing immediately. Originally, Pets were supplied with the keyboard, processor, screen and cassette drive all in one case at one price — a neat package with no extras to buy or trailing wires.

The Sirius — or the ACT Sirius to give the machine its full U.K. title — bears no resemblance to the Pet. The smart good looks of the Sirius — so important in desk-top computing where the executive image must be maintained at all times — places the Sirius far from the ugly utility of the Pet. Ergonomic to a fault, the Sirius has an air of lofty confidence about it — even when the power is off.

There is, however, one common thread

between the ancient and modern; they are both complete in themselves. The system specification of the Sirius reads like next year's fashions in desk-top computing. Everything that the man who has everything could ever need — in one package.

Obviously this machine has been developed for the business user. The keyboard has all the conventional keys and more. To be pedantic, it "features an IBM Selectric-style nucleus with an additional range of special-function keys". The screen has the highest-resolution imaginable on a machine of this size, and the memory is an ample 128K of user RAM — which can be extended internally to 0.5MB and externally to 1MB.

The system supplied for review was one of the first to enter the U.K. By the time ACT starts installing the machines in volume, the manuals will have been written. For the purposes of the review I was furnished with a set of photocopied notes. Even these notes seemed comprehensive, there was little missing, and some manufacturers supply far worse documentation with production-model machines.

When the machine arrived, I was treated to a short display of its powers. I was highly impressed, despite the fact that the micro insists on saying "I am the Sirius 1, the number one choice in personal computers", every time it is switched on.

I realise that when a machine is being demonstrated by somebody whose very livelihood depends on it, it is difficult to make objective judgements. I decided to

commit to memory all the impressive things I had been shown and see if I could re-create them later. The high-resolution graphics were probably the greatest revelation. Not only is the resolution extremely good for a small machine, but the pictures can be called quickly — the product of its 16-bit processor and mammoth memory.

One other interesting point I discovered during this short demonstration was that the whole system is software-driven. By that, I mean that apart from the boot-up routines which are in PROM, all else is down-loaded from disc — even the character fonts. This gives the Sirius a flexibility that other microcomputers simply do not possess. Various character fonts can be loaded at will and the definition of the function keys can be changed; in fact there is total flexibility.

## Operating system choice

Although the Sirius can work under the new IBM personal operating system, the review machine had a version of Digital Research CP/M called CP/M-86. In fact in the immediate future, ACT expects CP/M-86 to be the more popular choice, because of its similarity to CP/M rather than to the IBM operating system.

However all the indications are that the IBM system is set to take the personal computing world by storm. My own feelings are that it hinges on two matters: one, whether the IBM Personal Computer actually makes its mark and two, whether the applications, software written under

the system is of a sufficiently high quality.

On the surface, CP/M-86 is very much the same as CP/M on any other machine. It differs because it was written for the Intel 8086 processor. The Sirius micro-computer does not use the 8086; it uses the Intel 8088 chip. This may seem unusual until you discover that the 8088 has exactly the same instruction set as its sister, the 8086. The difference between the two is that although they are both 16-bit processors internally, the 8088 is designed so it can interface to the eight-bit microcomputer world.

## CP/M commands retained

To the user, CP/M-86 is the same as CP/M on eight-bit machines, it still uses the same commands. There is still the same A > prompt to tell which disc you are using. Dir works in the same way, if you type a file it appears in the same way and it even spots errors in the same way. Of course, all the bad aspects of CP/M have also been retained. If you were considering buying a Sirius, CP/M might be a problem for you if you have never met it before.

As an in-depth look at CP/M-86 will only really be of use to the professional programmer, I shall cover it only briefly here. If you want to know more, I suggest you read *CP/M Programmers' Guide* and *CP/M System Guide* which are both written by Digital Research.

Sirius CP/M-86 is a control program, for a disc-based personal microcomputer. It provides the necessary tools for the writing, storing, editing and documentation of programs. In addition, it provides an assembler and a debugging aid. In this much it is the same as CP/M. The difference lies in the assembly facilities which are for the 8086 assembly code, as are the dynamic test and debug program and not for Z-80 as conventional CP/M. The list of recognisable file types under CP/M-86 are:

A86 8086 assembly-language source code.

### Technical Specification

Processor: the Intel 8088 16-bit chip.  
 Memory: 126K standard, expandable to 1MB.  
 Disc capacity: 1.2MB to 10MB. Twin mini-floppies standard.  
 Operating systems: CP/M-86, MDOS.  
 Keyboard: 97 keys, Selectric nucleus, separate numeric pad.  
 Screen: 11in. display in swivel mounting. Colour display optional.  
 Sound: Codex speech generation and storage.  
 Languages: Microsoft Basic, compiled Basic, Cobol, Pascal, Fortran.  
 Price: £2,395.

BAK Back-up file created by Ed — the text editor.

BAS Basic source code.

CMD Executable command file.

COB Cobal Source code.

DAT Data file.

FOR Fortran source code.

H86 Intel-format hexadecimal file.

INT Intermediate compiled code.

LST Listing of compilation or assembly.

OVR Overlay module.

PRN Listing of compilation or assembly.

REL Relocatable object-code module.

SUB Command file executed by Submit command.

SYM Symbol table of assembly.

XRF Cross-reference of absolute assembly.

\$\$\$ Temporary, system-generated file.

CP/M-86 is included on the Sirius system disc. It automatically boots itself when the disc is inserted in the left-hand drive and when the drive door has been closed. On the review system there was no prompt for this until a disc was inserted. All that the screen showed was an identification message. On production models of the system there is a visual prompt which appears on the screen to tell the user to insert the systems disc.

Also included on the Sirius system disc are some general software packages. ASM86.CMD which is the 8086 assembler; DDT86.CMD the dynamic debugging tool; DCopy a program which copies the source disc to the destination

disc, destroying everything on that destination disc; ED.CMD the text editor, which is used to create and edit text files.

ED.CMD however is not the best of text editors — if you have a good deal of text editing to do, buy a word processor. Format.CMD is a program which formats — that is, prepares — a new disc for use on the system. GENCMD.CMD creates executable command files from Intel hexadecimal-format object-code files.

Pip.CMD is the peripheral interchange program, which is used in the main for copying files from disc to disc.

Finally, Stat.CMD is a program to display the disc files statistics. It marks files or drives as read-only and assigns physical devices to logical devices.

Also included on the system disc is Basic 86. To all intents and purposes it is the same as normal Microsoft Basic. There is also a program called Pippin which, like Pip, is a file-transfer program. However, the purpose of Pippin is to transfer files between computers, or more specifically between a large "master" computer and the Sirius.

## Programmable codes

One of the most interesting aspects of the Sirius is the provision for a myriad of escape codes. These can be used either directly from the keyboard or within a Basic program. For example, the escape code to clear the screen is escape E. This can be entered by pressing the escape key, followed by E and then return.

On the screen is the normal CP/M-86 prompt, then up-arrow, square bracket, a pair of symbols used to display escape, then E. When return is hit, the screen goes blank and, the prompt followed by the cursor reappear at the top of the screen.

Accessing escape codes from Basic 86 is simple — remembering that the code for escape is 27. A short program to clear the screen would be:

```
10 PRINT CHR$( 27); "E";
```

That clears the screen and leaves the cursor in the top left-hand corner of the screen. There are many of these escape codes which make the cursor do almost anything you could possibly want.

Apart from the previous examples such as moving the cursor up and down various numbers of lines, making it flash, and clearing the screen — both partially and completely — escape codes can be used to insert text, reverse the video, transmit pages, change the intensity, underline and clear the foreground.

A pair of particularly useful routines are escape V and escape W. The first enables wrap-around of text at the end of a line. The second disregards any text which falls after the end of a line. They provide a facility which will be welcomed by word-processing users.

Another useful code — but offering a facility most other machines have anyway

(continued on next page)



(continued from previous page)

— is escape Y followed by a pair of numbers. This code moves the cursor by direct addressing — that is, escape Y 1,C moves the cursor to line number 1, column number C — remember that these numbers are in hexadecimal.

The Sirius keyboard is larger than most, encased in a shallow, grey case about 8in. by 18in. It is a masterpiece of ergonomics and is very easy to use conventionally, say, when using the Word-Star package supplied with the review machine.

There are, however, a large number of keys which can be confusing especially as some of the keyboard functions do not always work. This is because all such functions are loaded from the system disc.

A further complication in the keyboard are the keys whose functions change, and the multiple-key commands. No doubt those codes which are used often are learnt quickly.

One rather strange quirk of the review machine was that when in Basic 86, the dollar sign which is used to denote a string variable could not be summoned by shift followed by 6, which is where it is marked. After a short panic I discovered that the pound symbol — that is, shift followed by 4 — appears on the screen during Basic 86 as the dollar or string symbol.

This quirk is no doubt due to the ASCII character set used by the Basic being that used in the U.S. It is a problem that can be easily ironed out because of Sirius' easily changeable software.

### An ergonomic dream

The best aspect of Sirius' separate keyboard is its construction; each key is moulded and located exactly how and where it feels it ought to be. For someone who uses a keyboard professionally, it will really be a revelation. The keyboard on the early Pet bore no resemblance to a typewriter keyboard, but later personal computers such as the Tandy, Apple and 8032 Pet all had keyboards which were approximations to typewriters. Much as I abhor word processing, using a word-processing package with an ergonomic keyboard like this must be merely a chore — as opposed to the usual nightmare.

There are, however, not only the typewriter-like central core of keys, but another four groups. To the left of the main typewriter part of the keyboard is a cluster of five keys, called the special-function key group.

The top key of the group — marked ESC — is used to initiate the escape codes. The second enables the intensity control, the third is used to switch the reverse-video mode, the fourth enables underlining and the last activates the auto-repeat mode.

Slightly to the right of the typewriter keys is a group of 10 keys called the editing key group. These keys provide such functions as returning the cursor to

the home position, clearing the screen, the generation of special codes for the applications software, the lowering and raising of the loudspeaker volume, and controlling the brightness and contrast of the visual display.

Above the central typewriter group is a set of seven general-function keys, primarily for use from within applications programs, but which can be used in other modes. For example, when in CP/M-86 the first key will act like Dir-carriage return, and display the file directory. Key number three acts as Control-C, the break command.

On the far right is the numeric keypad, an arrangement found on almost all microcomputers which claim to be primarily for business use. The idea of such a pad is that pure numerical data can be input much faster. These keys can be used



in any mode to display the number written on them, as can those operator signs included on this pad. It should, however, be noted that entering, say,  $6 + 8 \times 4$  will not calculate anything; it just displays the symbols. The key marked Calc is intended for use from the applications software and Enter performs a carriage return.

The typewriter part of the keyboard is standard, nevertheless there are some anomalies. First, there are two keys that provide special functions: the Alt key, which enables the alternative function of another key, and the Cont key which provides the control-S CP/M facility. The other keys provide those characters printed on them.

As mentioned, the Sirius is entirely under software control. Unlike other machines, the character set or fount is read from disc on booting. In other machines the fount would be read from ROM. This means that the fount need not always be the same. This is very important, because in the past, manufacturers have done one of two things; either they programmed a ROM with the fount at source — usually in the U.S. — a process that meant U.K. users could print the dollar but not the pound sign. Or they would have available at slightly higher cost a fount prepared for a particular market.

If a microcomputer was used, for example, by an engineering company for word

processing, it would be difficult to produce scientific equations without changing the ROM. There are ways round this, but they are not really satisfactory. The Sirius circumvents this problem. The review model was supplied with a large number of founts, including German, and scientific characters, with the integration symbol, various Greek letters, and so on.

It is even possible to use the Edot program — supplied with the machine to create customised founts. Each fount can contain up to 256 different characters which can be reversed. It would appear that a similar process is used when drawing graphics.

### High-resolution graphics

The screen display is the last word in high resolution graphics, though slightly smaller than a conventional 80-column display. This is because, although the system employs the same size tube, only the middle part has been used so eliminating the effect of the curved corners of the screen. This stops words of text from bending. The green mesh which covers the screen has been applied in such a way that it strengthens the "squareness" of the display.

The high-resolution graphics characters are on a grid of 25 lines by 80 columns. Each character is in a 9-by-12 dot matrix, within a 10-by-16 cell. When in the graphics mode, each dot within each square is addressable and there is a total resolution of 800 by 400 pixels.

To show off just how high the resolution on the screen is, a demonstration disc of pictures was provided. They were instantly recognisable as the pictures used to demonstrate the Apple II high resolution. The difference was that the Sirius showed four pictures to a screen. One neat feature about the screen is that it swivels and tilts to the user's preferred viewing position.

Although the review machine was supplied without a printer, there is a full range available. I would suggest, however, that to make full use of the Sirius' graphic capabilities a high-resolution printer is required. ACT suggests a graphics printer. Dimensional details of the machine are: height 18in., width 18in., depth 20in., weight 49lb. and operating temperature — environmental — 0 to 49°C.

### Conclusions

- At a cost of around £2,400 for the 128K model, the Sirius 1 will present the more established personal computers with a serious rival.
- The generous allowance of memory, together with the soon to be announced high-density floppy discs will provide most users with all they need.
- CP/M-86 and the IBM operating system give users access to a very wide range of good applications software.
- A very impressive machine. □



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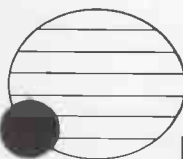
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# RICOH RP-1600



**We tested this recent daisywheel printer from Japan alongside Appropriate Technology's new Flowriter, based on the Ricoh mechanism. Chris Bidmead reports.**

THE FASTEST daisywheel printers on the market today are Japanese, and the very latest models are claiming a speed of 80 characters per second. We thought Ricoh's specification of 60 cps impressive, but judging from the machines we have reviewed to date we were aware that the figures are probably derived from optimised runs on the manufacturer's test bench. They might not reflect actual speed in use.

Our usual tests proved this to be the case. The Ricoh RP-1600 is fast, and may well print at 60 cps in short single-line bursts with no carriage-returns. Sadly, few office documents fit that restriction.

## Angularity avoided

The Ricoh's cream-coloured static-proof metal case is well styled, somehow managing to avoid the angularity of the Qume and latest Diablo. The machine is noticeably smaller than some of its rivals: its height without attachments is 20cm, and the front-to-back depth is about 40cm. The power pack is internal, so these dimensions represent the true size of the working machine.

The version under review — which is compatible with Sprint 3 — comes with no front panel, although other versions offer an option of a top-of-form switch and printer-state LED indicators. You reach the innards by lifting the spring-counter-balanced front cover, unclipping the platen in the fashion set by the old IBM golf-ball typewriter, and releasing two small captive bolts inside the cover to the left and right of the chassis. The top

half of the case can then be lifted straight off, with no snagging mechanisms to be manipulated round and no trailing wires attached.

The printer chassis is a solid aluminium casting, nestling into the foam damping that lines the case and keeps the noise down to a claimed 59dB. The main motor, a high-torque device Ricoh makes in-house, is situated centrally under the platen, driving the print head via steel pulley wires in the conventional fashion. Any stretching of this wire in use is compensated by a powerful spring, and there is an arrangement to take up the slack with a screw thread when wear becomes excessive. The designer seems to have planned on a long life for these pulley wires, which are lubricated in manufacture and sealed in a plastic coating.

With the RP-1600 Ricoh has introduced yet another standard of daisywheel, though there is good sense behind this apparent contrariness. The Ricoh wheel is some 20 percent smaller in diameter than the familiar Diablo/Qume counterpart, keeping down the rotational inertia and thus helping to pep up the speed.

The number of petals is reduced to 64 while Diablo/Qume standard is 96. Each Ricoh petal carries two characters, so some of the characters have to be accessed by a shift mechanism like a typewriter's. The component that carries the burden of this extra task is called the "dog-bone," an electromagnetically

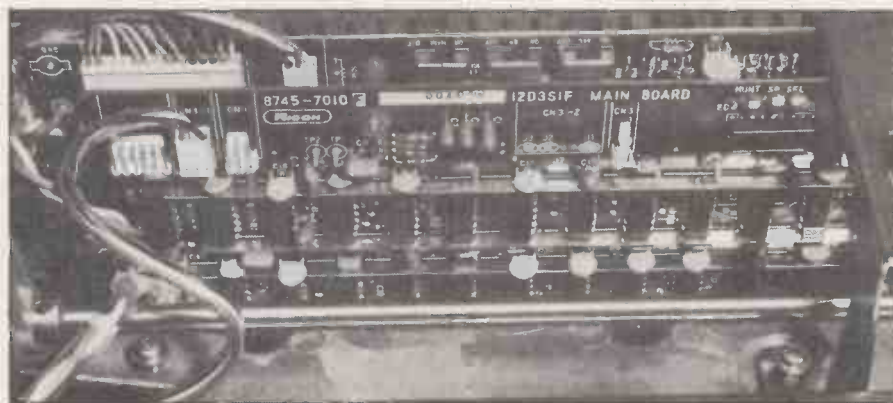
piece to be mass-produced more or less like a gramophone record. But the compromise requires the plastic to be both flexible and light for the petals, and impact-resistant for the character face. We have found that the founts on these single plastic wheels tend to flatten noticeably in use, particularly on a poorly-adjusted machine. Diablo does offer the alternative of a well-engineered metallised wheel, but at the hand-tailored cost of about £35.

## Hand-tailoring

The Ricoh approach splits the difference. Tailoring very like that of the metal wheels has gone into the Ricoh daisywheels: a separate plastic is used for the body of the wheel and the flexible arms, which are embedded in a vibration-damping rubber-like base. By skipping the metallising stage, the end-user price of these wheels is kept below £12.

All the electronics of the basic machine are housed on a heat-dissipation panel screwed into the rear of the case. To reach the boards once the case is open you have to remove a heavy, perforated, metal, static shield. Again, the solidity and finish of this component are impressive.

The Sprint-3 interface is piggy-backed on to the main processor board. Although accessible, this pair do not exactly invite removal, being held on to the lower part of the case with two bolts concealed under a pair of plastic protection caps which also serve as feet when the machine is stood on



The main processor board of the Qume-compatible Ricoh printer.

operated articulation in the axle that drives the wheel. It seems a vulnerable piece of additional mechanics to have introduced at a time when the whole thrust of development is towards reducing the number of moving parts. But this is a theoretical objection only — during a long test period the "dog-bone" gave us no trouble.

There was some significant extra engineering in the daisywheel itself. The Diablo equivalent has the advantage of cheapness, being moulded as a single

end. We shirked the task of unclipping all the necessary connectors to get these boards out, but a peek at the components in place — the main processor is the 8085, the speeded-up version of the 8080 — seems to confirm the manufacturer's claims that the electronics are "state-of-the-art".

While the electronics were uncovered we took the opportunity to run the self-test program, which puts the print mechanism through its paces while little

*(continued on next page)*

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winking LEDs on the processor board monitor its progress. We were reassured by the manufacturer's claim that had anything gone down, these on-board diagnostics should be enough to isolate the trouble without additional test gear.

Nothing did go wrong during the course of a long trial. The claimed mean time between failures of over 2,000 hours is now becoming standard on the present generation of daisywheel machines, thanks to the reduction in the number of moving parts. The RP-1600 certainly seems extremely robust, and runs quietly and coolly even during day-long continuous use.

## Variety of guises

Nexos is the exclusive OEM franchise agent for the RP-1600 in the U.K., Ireland, and most of Europe. A new daisywheel printer typically comes to the market-place with the bare bones of its mechanism dressed up in a variety of guises. Nexos/Ricoh marketing is no exception, and in addition to the Sprint-3 look-alike we tested, Nexos also offers a Hi-Type II Diablo version, and a Centronics C-3 interface.

An RS-232 version was in preparation at the time of writing, but a firm by the name of Appropriate Technology, otherwise known as ApTec, is ahead of Nexos here. Dr Ali Baghdadi, the brains behind this small British company, was able to lend us an RS-232/Diablo-compatible

version of his new Flowriter, a development of the RP-1600 basic mechanism that features a substantial character buffer for fast, smooth throughput at speeds up to 9,600baud. This data-transfer rate is not, of course, matched by the print head: the idea of putting memory into the printer is to release the central processor in the computer from the need to stay hooked to the time-consuming needs of the "real-world" device.

There are two additional advantages to the RS-232/Diablo-compatible interface of the Flowriter we had on loan. The data line is simple to install, as you can attach it to the computer with four wires — or three, if you do not overflow the buffer. As most commercial word-processing software is provided in versions that send Diablo codes, the printer should require no special software adaptation.

ApTec, now manufacturing and marketing the project in association with Small Systems Engineering, has achieved this by adding a special interface board inside the machine. Printers normally employ some sort of buffer between the data line and the print head so that a jerky supply of characters can be translated into a smoother load for the moving parts.

Usually these buffers are of the order of 125 to 256 bytes. But Baghdadi has taken advantage of the space available on his interface board inside the Flowriter to put in a 2K buffer, with a de-luxe 8K option.

The 8K buffer in the review version can deal with about five pages of A4 double-

spaced text, and it proved very useful when printing out files of this size or larger to be able to leave the printer to get on with its work. To make the most of the facility, either continuous stationery or a sheet-feeder is essential.

If you are more used to working with single sheets it will take time to overcome the feeling of being out of control of the printer. The latest revision of the firmware implements the Diablo ESC CR P as an instruction to abort the buffer immediately, which returns a measure of control to the user's keyboard.

## Retaining control

We suggested to ApTec that it would be an advantage to be able to switch out the buffer altogether. There are times when it is useful to retain control of the printer from the computer keyboard — to print a list from the screen on to an odd scrap of paper, for example. We gather that future versions will incorporate a buffer-defeat option into the software.

The flexibility of the RS-232 interface is gained at the expense of some speed: TTL logic inside the computer is being translated into a bit stream padded with start and stop bits, and then translated back again at the other end. But with proper handshaking — the Flowriter offers hardware handshaking or a choice of ETX/ACK or DC1/DC3 — the Ricoh mechanism can be driven at a speed almost rivalling that of the Qume-compatible version. The Flowriter is also available with either a Centronics or an IEEE interface.

## Conclusions

- The Qume-compatible parallel-interface version is almost twice as fast as the Flowriter in graphics mode. But the Flowriter is only marginally slower during normal printing.

- The RS-232/Diablo version of the Flowriter we tested is simpler to connect to a variety of different computers, and the buffer makes for easier use in applications like batch mailing.

- The only disadvantage of either machine is the very slightly more ragged text the mechanism produces. This is really only appreciable to the eye when columns of vertical characters need to be critically aligned, as in the production of tables for camera-copy.

- Both machines reviewed were based on the Ricoh RP-1600 print mechanism, a fast and solidly-engineered device. The Diablo mechanism still produces the best-formed print we have seen, but for most normal office purposes this Japanese product, in both Flowriter and Qume-compatible versions, seemed to us to come out well ahead.

- Ricoh/Nexos Qume Sprint-3 version
 

|                          |            |
|--------------------------|------------|
|                          | £1,500     |
| Flowriter with 2K buffer | £1,660     |
| Flowriter with 8K buffer | £1,720     |
| keyboard                 | £250 extra |

| TEST                       | TIME TAKEN | COMMENTS  |
|----------------------------|------------|---|
| <b>Standard text test</b>  |            |   |
| Qume-type (Q)              | 1m. 23s.   | Not much difference between Q and F — around 47 cps.  |
| Flowriter (F)              | 1m. 25s.   |   |
| <b>Formatted text test</b> |            |   |
| Qume-type (Q)              | 42s.       | Nearly 15 percent faster than the Diablo 630. RS-232 is only a small overhead.                          |
| Flowriter (F)              | 48s.       |   |
| <b>Tabbing test</b>        |            |   |
| Qume-type (Q)              | 30s.       | An excellent speed, but for both Q and F alignment was poor in comparison to the Diablo and Spinwriter. |
| Flowriter (F)              | 36s.       |   |
| <b>Graphics test</b>       |            |   |
| Qume-type (Q)              | 3m. 30s.   | Very fast for Q: the parallel interface pays off.   |
| Flowriter (F)              | 6m. 00s.   |   |

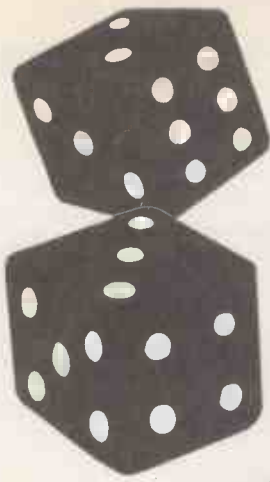
These tests are fully described in the Diablo 630 review, published in the March 1981 *Practical Computing*.

**Formatted text test** Both machines save time by ignoring spaces, and only move to a column when instructed to print a character. The vertical equivalent, platen-movement optimisation, is implemented on the Qume-compatible version only.

**Tabbing test** On both machines the high speed of the print-head pays its price in this test. After its travel across the tab the print-head is still oscillating as it prints the vertical-bar character. Unlike the later Diablo machines, which incorporate an escape-

code instruction to increase the "settling time" — the time between the print head arriving at its destination and printing a character — there is no comparable instruction to improve the Ricoh mechanism's rather poor character alignment after tabbing.

**Graphics test** The parallel interface of the Qume type is more complicated to implement but pays dividends here. The Flowriter's speed is respectable for RS-232, but USART computations and the large count of start and stop bits that have to be introduced into the line at the transmitting end and removed at the terminal inevitably create an overhead in speed.



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**SOFTKEY** £99.00  
16asic or pascal version available! A 15 key programmable keypad.

Patch for WORDSTAR and SOFTKEY to permit use of programmable pad using WORDSTAR. £29.95

**SUP-TERMINAL** £195.00

**WIZARD 80** £195.00  
A new 80 column board with both switchplate and softswitch.

**VIOEX VIDEOTERM** £185.00

**40/80 Column switchplate** £12.95

**Video softswitch** £21.95

**Character Eprams: French, German, Katakana, Spanish, Inverse, Math and** £17.95

**Greek symbols, Super and subscript, Line draw graph** £22.95

**Videoterm Utilities disk** £89.00

**NEW! - VIDEX KEYBOARD ENHANCER II**  
The very latest from Vindex - uses 6504 microprocessor to provide typewriter like keyboard, adds ability to store macro instructions, remembering words and phrases. Can remember what you typed whilst your Apple was busy talking to disk or doing other things. Can auto-repeat any key held down. Replaces the existing keyboard encoder for easy installation.

**PASCAL TUTOR** £79.00  
If you want to learn Pascal this is the package to use - complete with two disks.

**APPLE MUSIC THEORY** £29.95

Apple Inc's own program designed to teach the fundamentals of music. £29.95

**APPLE HOW TO** £29.95  
Lessons in integer programming.

**APPLE SHELL GAMES** £14.95  
An interesting shell in which to place your children to learn in the best way.

**TYPING TUTOR** £12.95

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Algebra 1 - Compumath: Fractions - Compumath: Decimals - Each £20.95

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Computer £12.95

Perception £10.95

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Edupac. 1 £22.95

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5 disks by Pedagog Aids.

**MOUNTAIN MUSIC SYSTEM** £239.00  
A 16 voice digital synthesizer for Apple, now much reduced price.

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Program Line Editor - Higher Text II - Applesoft Command Editor - Macro Screen Editor - Graphic Dump Programs for 445/460/560 Tiger, Anadex 9501, Spinwriter, in both PASCAL and BASIC Each £20.95

Apple Doc - Program Line Editor in ROM - Applesoft Extended Editor (AXE) Each £24.95

**DAKIN 5 Programming Aids 3.3 (12 utilities in one pack)** £49.95

**APPLE DOS TOOL KIT** £36.95  
Animation, programming and assembling all in one pack from Apple Inc.

**PASCAL PROGRAMMER** £79.00  
The pascal programmer's dream - all the utilities you wanted to use but never had time to write.

**DOS SOURCE 3.3** £24.95  
A disassembled listing of DOS on 4 sides of 2 disks - Limited Edition.

**SENSIBLE SOFTWARE UTILITIES** £12.95  
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Saturn Navigator (needs animat. pack) £20.95

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PASCAL Graphics Editor (Sirius) £149.95

**VERSAWRITER** £149.95  
Superb graphics tablet from Versa Computing - you don't have to go to the expense of an Apple Graphics Tablet for graphics capability.

**VERSA EXPANSION SOFTWARE** £20.95  
Auxiliary pack for the VERSAWRITER includes the ability to draw in fine detail using magnification mode.

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**MACHINE COVERS** - only the best material used

Apple only £5.95

Single Disk £2.95

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Apple, 2 disks and 12in monitor £9.95

12in monitor cover £7.95

9in monitor cover £5.45

**BASF DISKS (for 10)** £18.50

**DYSAN DISKS (for 10)** £25.00

Kassette disk boxes 5.25 in £2.45

**Z80 SOFTCARD** £195.00  
A Z-80 microprocessor for Apple comes with CP/M operating system and Microsoft Basic 5.

**COBOL 80** £299.00

**FORTRAN 80** £109.95

**BASIC COMPILER** £199.00

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**MYCHESS** £20.95  
A chess game for Apple with a Z80 Softcard installed - beats Sargon II.

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Software that allows you to emulate the terminal of your choice whilst using Apple with a Z-80 Softcard.

**THE MILL** - A 6809 plug in board for Apple £249.95  
Can run at full speed whilst the 6502 runs at 20%. Comes with either a Pascal speed up kit to increase the speed of execution of Apple's U65D Pascal or a 6809 assembler. Also available a debugging utility. Coming Soon - OS9 Operating System.

## 64 RAM CARDS

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## APPLE OS9 - STELLATION TWO'S MILL 6809

Now available with OS9 and BASIC D9. £399.00  
BASIC D9 allows simultaneous running of separate programs. It has to be seen to be believed. IOS9 is modelled along the lines of UNIX.

Single board £124.00

**EPSON MX 80 T** £349.00  
9 x 9 matrix printer with friction and tractor feed

**EPSON MX-80 T** £349.00  
Tractor feed only.

**INTERFACE AND CABLE** £65.00  
For the above (non-graphic).

**GRAPPLER** from Orange Micro £99.00  
An interface for the Epson MX 80 and 100 that obeys Apple protocols and has a graphics dump program in ROM producing 2 sizes of picture and 360 degrees rotation with positive or negative image.

**AIO Parallel I Serial Interface from SSM** £119.95

**MOUNTAIN CPS - Multi function Card** £135.00  
A bi-directional serial interface - parallel port and clock/calendar card - all on one board. Can be made to use phantom slots.

**RAMCARD** £99.95  
A 16K Expansion card for your Apple. It will provide additional memory for Visicalc load integer from a System Master and is fully compatible with Apple's Pascal System. The only board with Neon Read/Write indicators. The only card with data bus lines for faster data retrieval.

**RAMEX 16** £89.95  
UK entrant to the expansion card market - does not need to be ribboned to the memory area.

**THE MANAGER** £19.95  
A utility that moves DOS onto a 16K expansion card - freeing motherboard Ram space for larger programs.

**TG PRODUCTS**

**JOYSTICK** - Self-centering, adjustable pots £34.95

**PADDLES** - Top quality controllers £20.95

**VERSA EXPANDER PORT** £12.95  
An expansion cable ZIP socket for the Apple game I/O socket-allows zero insertion force of peripherals requiring connection to game socket.

★ SPECIAL OFFER ★

**EXPEDITER II** only £49.00  
An Applesoft Compiler from On-Line Systems.

**TASC - THE APPLESOFT COMPILER** £99.00  
A two pass compiler from Microsoft - the Applesoft authors. Comes with extensive documentation and copyable disk. Compiles to disk so can complete any length of programme. From 2 to 20 times improvement in speed.

**NEC GREEN SCREEN MONITOR** £139.00

**ABT NUMERICAL KEYPAO** £74.95

**APPLE HOW TO** £29.95  
Requires Int Basic or 16K Expansion Card - teaches calculating and programming.

**APPLE MUSIC THEORY** £29.95

**ELEMENTRY MY DEAR APPLE** £19.95  
Tuition for children.

**ECHO II SPEECH SYNTHESIZER** £139.95  
Based on TMS 5200 chip from TI - type in speech direct from keyboard.

**EXPANSION CHASSIS** £399.00  
Long awaited - here at last - More slots for your Apple.

## GAMES

Apple Galaxian - Galaxy Wars - Head-On - Galactic Revolution - Galactic Trader - Galactic Empire - Mystery House - Bridge Partner - Checker King - Gammon Gambler - Roulette - Craps - Apple 21 - Puckman - Global War - Space Warrior - Apple Typhoon - Sneakers - Galactic Attack - Olympic Decathlon - Cribbage - Star Dance - Asteroid Field - Anti Ballistic Missile All at £12.95

Microsoft Adventure - ABM - Dog Fight - Phantoms Five - Orbitron - Pulsar - Microchess 2 - Odyssey - LA Land Monopoly - Morloc's Tower - Rescue at Rigel - Space Eggs - Trilogy of Games - The Prisoner - Raster Blaster - Autobahn - Space Raiders - Tawala's Last Redoubt - Gamma Goblins - Apple Parank - Red Alert - Firebird - Genetic Onif - Mad Venture - Space Quarks - Castle Wolfenstein - Appledods - Pegasus II - Softporn Adventure - Cross-Fire - Jaw Breaker - Zork II - Crush-Crumble and Champ - Dragon's Eye - Dark Forest - Star Thief - Bug Attack - Outpost - Borg - Sneakers - Hi Res Soccer All at £14.95

Cyborg - DO-Tops - David's Midnight Magic - Akalabeth - Pool 1.5 - Beer Run - Epoch - Hadron - Russki - Duck - Ulysses - Wizard and the Princess All at £19.95

Computer Conflict - Computer Quarterback - Cartels and Cutthroats - Space Album - Bill Budge 3D Graphics Tutor - Cyber Strike - 3 Mile Island - Adventure 789 - Temples of Apshar - Hellfire Warrior - Zork - Computer Baseball - President Elect - The Battle of Shloh - Tigers in the Snow - Warp Factor - Computer Conflict - Gorgon - Flight Simulator - Ultima - Trick Shot - Robot War - The Best of Muse - Cops and Robbers - Southern Command All at £20.95

Computer Air Combat - Computer Ambush - Computer Bismark - Operation Apocalypse - Torpedo Fire - Dragon Fire - Napoleon's Campaigns All at £29.95

## Authorised Apple Sales and Service

LONDON RETAIL 98 Moyer Road, London SW16 6SH  
Tel: 01-677 2052/7341

MAIL ORDER AND DISTRIBUTION, Waingate Lodge,  
Waingate Close Rosendale Lanc BB4 7SD.  
Tel: Rosendale 07061 227011

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Postage and packing FREE

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# sinclair ZX81 PERSONAL COMPUTER



# Sinclair ZX81 Personal Computer the heart of a system that grows with you.

1980 saw a genuine breakthrough – the Sinclair ZX80, world's first complete personal computer for under £100. Not surprisingly, over 50,000 were sold.

In March 1981, the Sinclair lead increased dramatically. For just £69.95 the Sinclair ZX81 offers even more advanced facilities at an even lower price. Initially, even we were surprised by the demand – over 50,000 in the first 3 months!

Today, the Sinclair ZX81 is the heart of a computer system. You can add 16-times more memory with the ZX RAM pack. The ZX Printer offers an unbeatable combination of performance and price. And the ZX Software library is growing every day.

## Lower price: higher capability

With the ZX81, it's still very simple to teach yourself computing, but the ZX81 packs even greater working capability than the ZX80.

It uses the same micro-processor, but incorporates a new, more powerful 8K BASIC ROM – the 'trained intelligence' of the computer. This chip works in decimals, handles logs and trig, allows you to plot graphs, and builds up animated displays.

And the ZX81 incorporates other operation refinements – the facility to load and save named programs on cassette, for example, and to drive the new ZX Printer.



New BASIC manual

Every ZX81 comes with a comprehensive, specially-written manual – a complete course in BASIC programming, from first principles to complex programs.

## Kit: £49.<sup>95</sup>

### Higher specification, lower price – how's it done?

Quite simply, by design. The ZX80 reduced the chips in a working computer from 40 or so, to 21. The ZX81 reduces the 21 to 4!

The secret lies in a totally new master chip. Designed by Sinclair and custom-built in Britain, this unique chip replaces 18 chips from the ZX80!

### New, improved specification

- Z80A micro-processor – new faster version of the famous Z80 chip, widely recognised as the best ever made.
- Unique 'one-touch' key word entry: the ZX81 eliminates a great deal of tiresome typing. Key words (RUN, LIST, PRINT, etc.) have their own single-key entry.
- Unique syntax-check and report codes identify programming errors immediately.
- Full range of mathematical and scientific functions accurate to eight decimal places.
- Graph-drawing and animated-display facilities.
- Multi-dimensional string and numerical arrays.
- Up to 26 FOR/NEXT loops.
- Randomise function – useful for games as well as serious applications.
- Cassette LOAD and SAVE with named programs.
- 1K-byte RAM expandable to 16K bytes with Sinclair RAM pack.
- Able to drive the new Sinclair printer.
- Advanced 4-chip design: micro-processor, ROM, RAM, plus master chip – unique, custom-built chip replacing 18 ZX80 chips.



## Built: £69.<sup>95</sup>

### Kit or built – it's up to you!

You'll be surprised how easy the ZX81 kit is to build: just four chips to assemble (plus, of course the other discrete components) – a few hours' work with a fine-tipped soldering iron. And you may already have a suitable mains adaptor – 600 mA at 9 V DC nominal unregulated (supplied with built version).

Kit and built versions come complete with all leads to connect to your TV (colour or black and white) and cassette recorder.



ter-



**Available now-  
the ZX Printer  
for only £49.<sup>95</sup>**

Designed exclusively for use with the ZX81 (and ZX80 with 8K BASIC ROM), the printer offers full alphanumeric and highly sophisticated graphics.

A special feature is COPY, which prints out exactly what is on the whole TV screen without the need for further instructions.

At last you can have a hard copy of your program listings – particularly useful when writing or editing programs.

And of course you can print out your results for permanent records or sending to a friend.

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 computer – using a stackable connector so you can plug in a RAM pack as well. A roll of paper (65 ft long x 4 in wide) is supplied, along with full instructions.

**16K-byte RAM  
pack for massive  
add-on memory.**

Designed as a complete module to fit your Sinclair ZX80 or ZX81, the RAM pack simply plugs into the existing expansion port at the rear of the computer to multiply your data/program storage by 16!

Use it for long and complex programs or as a personal database. Yet it costs as little as half the price of competitive additional memory.

With the RAM pack, you can also run some of the more sophisticated ZX Software – the Business & Household management systems for example.

**How to order your ZX81**

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, Access, Barclaycard or Trustcard.

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

To: Sinclair Research, FREEPOST, Camberley, Surrey, GU15 3BR.

| Qty | Item  | Code | Item price<br>£ | Order<br>Total<br>£ |
|-----|---|------|-----------------|---------------------|
|     | Sinclair ZX81 Personal Computer kit(s). Price includes ZX81 BASIC manual, excludes mains adaptor.       | 12   | <b>49.95</b>    |                     |
|     | Ready-assembled Sinclair ZX81 Personal Computer(s). Price includes ZX81 BASIC manual and mains adaptor. | 11   | <b>69.95</b>    |                     |
|     | Mains Adaptor(s) (600 mA at 9 V DC nominal unregulated).  | 10   | <b>8.95</b>     |                     |
|     | 16K-BYTE RAM pack.  | 18   | <b>49.95</b>    |                     |
|     | Sinclair ZX Printer.  | 27   | <b>49.95</b>    |                     |
|     | 8K BASIC ROM to fit ZX80.   | 17   | <b>19.95</b>    |                     |
|     | Post and Packing.   |      |                 | <b>2.95</b>         |

Please tick if you require a VAT receipt

TOTAL £

\*I enclose a cheque/postal order payable to Sinclair Research Ltd, for £

\*Please charge to my Access/Barclaycard/Trustcard account no.

\*Please delete/complete as applicable.

Please print.

Name: Mr/Mrs/Miss

Address:

FREEPOST – no stamp needed.

PRC 03

**sinclair  
ZX81**

6 Kings Parade, Cambridge, Cambs., CB2 1SN.  
Tel: (0276) 66104 & 21282.

# How the ZX81 compares with other personal computers

| SYSTEM IDENTIFICATION |  | ZX81 | ZX80 | ACORN<br>ATOM | APPLE II<br>PLUS | PET<br>2001 | TRS 80<br>LEVEL I | TRS 80<br>LEVEL II |
|-----------------------|--|------|------|---------------|------------------|-------------|-------------------|--------------------|
| ROM                   |  | 8K   | 4K   | 8K            | 8K               | 14K         | 4K                | 12K                |
| GUIDE PRICE           | Basic unit – inc. VAT                                      | £70  | £100 | £175          | £630             | £435        | £290              | £375               |
|                       | Unit plus 16K RAM (*12K RAM)                               | £120 | £150 | £285*         | £630             | £530        | £360              | £375               |
| COMMANDS              | LIST, LOAD, NEW, RUN, SAVE                                 | ●    | ●    | ●             | ●                | ●           | ●                 | ●                  |
| STATEMENTS            | PRINT, INPUT, LET, GOTO,<br>GOSUB/RETURN, FOR/NEXT IF/THEN | ●    | ●    | ●             | ●                | ●           | ●                 | ●                  |
|                       | STEP   | ●    |      | ●             | ●                | ●           | ●                 | ●                  |
|                       | TAB  | ●    |      |               | ●                | ●           | ●                 | ●                  |
| ARITHMETIC            | ABS, RND   | ●    | ●    | ●             | ●                | ●           | ●                 | ●                  |
| FUNCTIONS             | INT  | ●    |      |               | ●                | ●           | ●                 | ●                  |
|                       | ATN, COS, EXP, LOG, SGN, SIN, SQR, TAN                     | ●    |      |               | ●                | ●           |                   | ●                  |
|                       | ARCSIN, ARCOS  | ●    |      |               |                  |             |                   |                    |
| STRING<br>FUNCTIONS   | CHR\$  | ●    | ●    |               | ●                | ●           |                   | ●                  |
|                       | LEN  | ●    |      | ●             | ●                | ●           |                   | ●                  |
| NUMBERS               | ASC(CODE), STR\$, VAL, INKEY\$                             | ●    |      |               |                  | ●           |                   | ●                  |
|                       | FLOATING PT ±10 <sup>±38</sup>                             | ●    |      |               | ●                | ●           | ●                 | ●                  |
| NUMERIC<br>VARIABLES  | INTEGERS   |      | ●    | ●             | ●                | ●           |                   | ●                  |
|                       | A-Z  |      |      | ●             |                  |             | ●                 |                    |
|                       | AA-ZØ  |      |      |               | ●                | ●           |                   | ●                  |
| STRING<br>VARIABLES   | An-Zn, n=any alphanumeric string                           | ●    | ●    |               |                  |             |                   |                    |
|                       | A\$ & B\$  |      |      |               |                  |             | ●                 |                    |
|                       | A\$ to Z\$   | ●    | ●    | ●             |                  |             |                   | ●                  |
| NUMERIC<br>ARRAYS     | An\$ to Zn\$ n=any alphanumeric character                  |      |      |               | ●                | ●           |                   | ●                  |
|                       | SINGLE DIMENSIONAL   |      | ●    | ●             |                  |             | ●                 |                    |
| DISPLAY               | MULTI DIMENSIONAL  | ●    |      |               | ●                | ●           |                   | ●                  |
|                       | ROWS   | 24   | 24   | 16            | 24               | 25          | 16                | 16                 |
|                       | COLUMNS  | 32   | 32   | 32            | 40               | 40          | 64                | 64                 |
|                       | LOW RES GRAPHICS (<7000 pixels)                            | ●    | ●    | ●             | ●                | ●           | ●                 | ●                  |
| SPECIAL<br>FEATURES   | HI RES GRAPHICS (>40000 pixels)                            |      |      | ●             | ●                |             |                   |                    |
|                       | USR (CALL, LINK)   | ●    | ●    | ●             | ●                | ●           |                   | ●                  |
|                       | PEEK, POKE (OR EQUIV)                                      | ●    | ●    | ●             | ●                | ●           |                   | ●                  |

## Sinclair software on cassette.

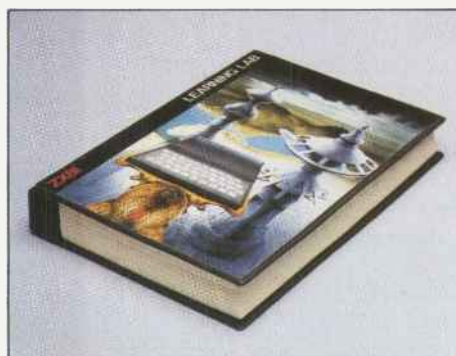


The unprecedented popularity of the ZX Series of Sinclair Personal Computers has generated a large volume of programs written by users.

Sinclair has undertaken to publish the most elegant of these on pre-recorded cassettes. Each program is carefully vetted for interest and quality, and then grouped with others to form single-subject cassettes.

Software currently available includes games, junior education, and business/household management systems. You'll receive a Sinclair ZX Software catalogue with your ZX81 – or see our separate advertisement in this magazine.

## The ultimate course in ZX81 BASIC programming.



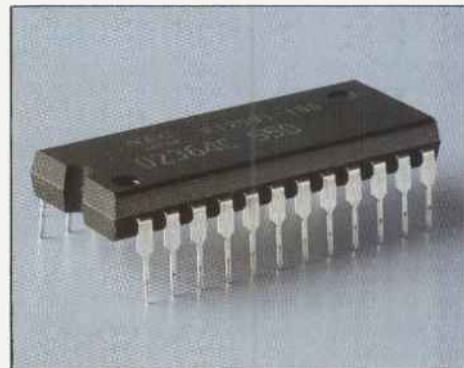
Some people prefer to learn their programming from books. For them, the ZX81 BASIC manual is ideal.

But many have expressed a preference to learn *on* the machine, *through* the machine. Hence the new cassette-based ZX81 Learning Lab.

The package comprises a 160-page manual and 8 cassettes. 20 programs, each demonstrating a particular aspect of ZX81 programming, are spread over 6 of the cassettes. The other two are blank practice cassettes.

Full details with your Sinclair ZX81.

## If you own a Sinclair ZX80...



The new 8K BASIC ROM used in the Sinclair ZX81 is available to ZX80 owners as a drop-in replacement chip. (Complete with new keyboard template and operating manual.)

With the exception of animated graphics, all the advanced features of the ZX81 are now available on your ZX80 – including the ability to drive the Sinclair ZX Printer.

# sinclair ZX81

6 Kings Parade, Cambridge, Cambs., CB2 1SN.  
Tel: (0276) 66104 & 21282.

# GEMINI VIDEO CARD

**Nick Laurie examines a high-powered, intelligent board for the Nascom micro.**

ONE OF the leading lights in the Gemini Microcomputers series of 80-Bus Multi-boards, the Intelligent Video Card, uses a dedicated Z-80A CPU to control a keyboard, VDU and light-pen as well as providing more than 50 features. Gemini's 80-Bus resembles, and is generally totally compatible with, Nascom's Nasbus.

A number of manufacturers are producing 8in.-by-8in. cards suitable for this bus, but there can be little doubt that Gemini's Multiboard range is among the most comprehensive and compatible. After all, with John Marshall, Paul Greenhough and various others who worked on the original Nascom, the experience behind the Multiboard designs is second to none.

## Exotic applications

The IVC provides a sophisticated interface which, although provided with very comprehensive software for its on-board Z-80A, can be reprogrammed by the user to offer even more facilities. Plenty of spare RAM is available to hold user programs while the Byte-wide socketing allows ROM and RAM to be interchanged for even more exotic applications.

As standard, it has a 128-character keyboard buffer which is interfaced to a socket suitable for most seven-bit ASCII keyboards. We tested it with a Nascom 2 keyboard and was pleased to find that it worked instantly and without problems. Connection is via a 16-pin IDS plug.

The video interface is, naturally, the most comprehensive part of the board; it provides a peak-to-peak 2V composite video signal capable of driving even the most overworked monitors. When used with a good-quality monitor, there is nothing one could fault in the quality of the final image.

Although the board defaults to 26 lines of 80 characters or 26 lines of 48 link-selectable characters, it can be programmed to give any number of row and column combinations, character heights, interlace and skew factors, cursor types and screen widths. The various combinations are easily selected by loading the required hexadecimal values to the cathode ray tube controller (CRT) registers.

A number of the more common formats are selectable using escape sequences typed directly through the keyboard. The more technically-minded may be wondering how a crystal-controlled clock can provide all the possible timing

● Circle No. 153

### General:

Bell  
Backspace, linefeed, carriage return  
Cursor up, down, left, right, on, off, define  
Cursor co-ordinates — position cursor or return values

### Character set

Define character  
Define character set  
Construct block graphic set  
Invert character set  
Duplicate and modify character set

### Screen formatting:

Select format — 80 or 48 wide or user-defined  
Define format  
Blank, unblank screen  
Invert, normal video  
Default to one of two character sets  
Memory lock on, off — for fixed headings

### Screen editing:

Insert, delete line  
Insert, delete character in line  
Insert, delete character in screen  
Clear to end of line, end of screen  
Return contents of current line  
Clear screen

### Block graphics:

Set, reset, test a point

### Keyboard:

Get keyboard status  
Get keyboard character  
Get keyboard line

### Miscellaneous:

High-speed write to display  
Load a user program  
Execute a user program  
Return light-pen co-ordinates  
Return version number

The standard operations available from the intelligent video card.

combinations required. The answer is simple: there are two clocks, one crystal and the other a variable oscillator. There is no modulator on-board so this card will not drive a domestic TV set.

A five-pin socket allows connection of a range of light pens — Gemini will be producing one of its own very soon — and the software to read them is already present in the monitor. The outputs are +12V, +5V and ground, while the inputs are for a cleaned-up phototransistor output and a switch.

## Simple interface

By keeping this interface as simple as possible, Gemini has made it possible for all but the most ham-fisted to construct a suitable pen without having to go out and buy yet more expensive peripherals.

There are two character generators. A PROM carries 128 of the usual alphanumeric and graphic characters, while a RAM chip can be automatically loaded — again among the escape codes — with the character set for minor modifications or with the inverse of the standard set.

Provision is made for creating, storing and down-loading characters of your own design. The Byte-wide socketing allows you to replace the ROM with RAM or vice versa for even greater versatility.

Data is transferred between the IVC and the host computer via three I/O ports addressed through the 80-Bus. The first transfers data, the second carries the various handshake signals, and the third is used by the host system to reset the IVC. A 256-byte PROM is provided to assign the ports — 0 to 7, B1, B2 and B3 by default. The documentation explains how to recode this for use with other port addresses.

This PROM also provides the decoding required to maintain compatibility with Nascom systems. The whole board usually

functions satisfactorily when plugged into a Nascom 2, though there is one exception. Nascom monitors such as Nas-Sys are suited to the memory-mapped screen system and rely heavily on screen-line mapping for user input.

Using the IVC — which is, in effect, a separate input/output terminal — means turning your back on most existing Nascom software unless you are willing to rewrite some of your input routines. However, if you have already taken the plunge and turned to CP/M, you will already have the answers to this problem and will find that the IVC card is one very good answer to overcoming the VDU limitations of the Nascom.

The table shows a summary of the standard functions available with the IVC. However, as with any complex product this table can do little more than sketch an outline of this outstanding device. The full documentation runs to nearly 40 A4 pages — and even then it barely touches on the possibilities.

The documentation is thorough though not particularly well presented. Written by engineers for engineers, it is definitely not for the faint-hearted.

## Conclusions

● At £161 including VAT, the IVC represents good value for money, providing, as it does, the equivalent of a complete VDU terminal on a single 8in.-by-8in. board.

● It is hardware-compatible with Nascom systems, but some rearrangement of the Nas-Sys input routines is required if the current Nascom software library is to be maintained.

● A short length of Veroboard for a bus, a Gemini CPU card and RAM card, together with this IVC, provide one of the least expensive ways for users to build themselves a very sophisticated computer system. □



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With a wealth of software already imprinted on its mini-Winchester, the Kontron parades major attractions for the business user. Mike Hughes conducts the inspection.

KONTRON ELEKTRONIK of Munich, West Germany, manufactures a range of computers carrying the prefix PSI-80. Variations within the range depend on whether or not disc drives are supported and, if so, which types. The PSI-80D/W5 is based on a Z-80A microprocessor operating at 4MHz. It has 64K of dynamic RAM, up to 16K of PROM or EPROM — it takes the 2716 type — and 16K of video-display memory, the equivalent of eight screen pages. Memory blocks are selected into or out of the system architecture via I/O channels.

### Hardware layout

Standard peripheral devices on the D/W5 are a parallel-interface keyboard, which is separate from the main console, and a medium-persistence, green-phosphor 9in. display built into the console. A 5Mbyte mini-Winchester hard disc is built in, as is a single, soft-sectored floppy-disc station, configured to take single-sided double-density discs — 77 tracks, 16 sectors per track and 256 bytes per sector to provide 308K of storage.

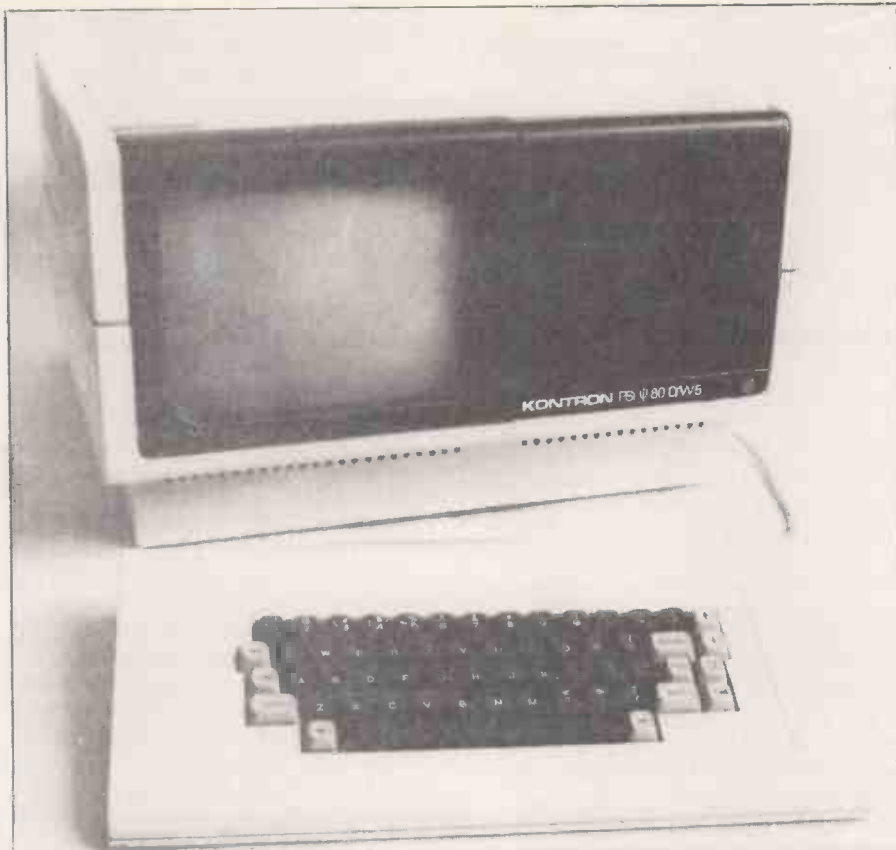
In addition to the keyboard socket on the rear of the console there are terminations for serial and parallel interfaces driven from the internal S/O and P/O chips. One such termination is pin-configured to support a Centronics-type printer.

Serial baud rates can be software-selected via the internal CTC chip; by altering the position of an internal jumper, the rate can be driven by an external clock for synchronous applications. The video signal to the internal display is paralleled out to an auxiliary socket to allow an external video monitor to be used if required.

The front panel of the console carries the display, the mini-Winchester, the floppy drive, an on/off switch and a Master Reset panic button. Apart from these two fundamental controls all other functions are reached through the 58-position QWERTY keyboard. There is no numeric key pad.

An internal loudspeaker generates a half-second bleep which is software-triggered via a monostable from one bit of the status port. The frequency of the bleep can be selected by software through the internal CTC channel.

The master computer board inside the console contains the CPU, main memory, I/O devices and clocks. It is set neatly within the base of the unit. Removing the base cover gives easy access to the slide-on jumpers which can be used to alter the hardware configuration. Though this should be a simple operation, the board



## Hard disc and software in Kontron's price

lacks silk-screened component designations and there is no drawing of the board layout in the hardware manual.

### Ample software

Connections are taken from the main board through ribbon-cable links to the main section of the console where the video-display module is to be found together with the tube, which appears to be of Japanese origin. The power supply, which is well protected from fingers, the mini-Winchester and a Micropolis 5.25in. disc drive are housed in the same unit. All this is neatly laid out, leaving ample room for a multi-slot motherboard frame which carries an ECB busbar designed to take single- or double-width Eurocards. The busbar is buffered to take up to seven standard or 30 LS TTL loads. The positioning of the ECB expansion frame should make it quite easy to extend the busbar externally via an extra ribbon cable.

Kontron's own organisation, based at St Albans, Hertfordshire, markets the machine in the U.K. The system supplied for review was priced at £6,663, including

a wealth of software already imprinted on the mini-Winchester. Kontron tells us that buyers receive over 330K of system and utility software which includes the KOS operating system, Kontron's own 17K Basic and a 10K editor. Together with the operating system's command files, these three account for about 190K of the software; the balance comprises graphics and I/O drivers, together with a handful of sample "fun" programs written in Basic.

Other utilities are available free of charge if the user wishes to drive alternative peripherals such as digitising tablets, light pens, digital plotters or any other peripheral-interface ECB extension cards which Kontron supplies. We were supplied with a number of CP/M programs which Kontron normally sells as extras. These include MBasic, Pascal, Fortran, Cobol, Assembler and WordStar, which the system quite happily supported, justifying Kontron's claim that KOS is upwards-compatible to CP/M version 1.4.

Although the price buys much more

*(continued on next page)*

(continued from previous page)

software than most manufacturers supply, as well as over 5Mbyte of hard disc, it must be remembered that it did not include a printer. The system thus appears rather costly compared with competing small office systems, though it does have a number of built-in overheads. While they may not be required immediately, these features allow ample provision for future expansion.

## Operating system

Kontron has written KOS to implement CP/M so as to retain access to the wide variety of software written in that system. At the same time the manufacturer claims to have incorporated state-of-the-art improvements to allow multi-tasking and the support of a wider range of mass-storage media through I/O channels. Up to 10 different varieties can be interfaced, including single- and double-density floppies, Winchesters, and bubble memories. Each medium can have a capacity up to 64Mbyte and file size can range from zero to eight megabytes. KOS also provides secrecy through the optional use of hidden passwords and invisible or secret files.

Like CP/M, KOS has a number of internal commands, though they are more numerous and very different in style and format. The more complex utilities are run as external commands from .COM files; there are 23 such commands which carry out similar functions to CP/M utilities but, again, are of different format.

Internal commands require single-letter keywords followed, if necessary, by specific parameters defining addresses, the names of I/O drivers, the disc-drive number, etc.

- A — allocates memory to prohibit use by user or system programs.
- C — reverses the function of the Shift key.
- D — frees memory which has previously been allocated.
- I — lists a short form index of files or file types on a specified memory medium.
- M — displays the number of the current master medium — disc drive — or assigns a new drive number.
- N — initialises a named I/O driver.
- P — selects one of the eight pages of the video display.
- R — allows a string of command macros to be stored in memory and subsequently executed in the sequence specified simply by typing "R".
- S — saves a specified number of 128byte blocks to a specified medium number.
- X — executes a .COM program after it has been initially loaded; it is useful for repeating an operation without having to re-enter the file name.

The documentation is aimed squarely at the knowledgeable user and will not be of much help to the non-technical. Even if you accept that this approach is justified, the documentation has a number of shortcomings. Although presented in English it has obviously suffered somewhat in translation from the German original

which makes for difficult reading at times. The meaning is unclear in places.

The Technical Manual describes the intrinsic KOS internal and external commands as well as the drivers which are supplied as utility software. Several of these are used to control the use of high-resolution graphics on the internal display. The manual goes on to describe the Kontron Debugging Module, KDM, which is a near equivalent to CP/M DDT, and then goes into considerable detail on the inner workings of KOS. This is heavy going even for the most determined of readers. The final section deals with the software-to-hardware interface and gives details of the memory architecture, designation of I/O ports and pinning of the external sockets.

This section gives no details of circuitry or board layouts, and there is no components list. There are four unmarked sockets on the rear of the console unit, and a thorough search of the manual failed to reveal any information as to which is which. The only socket referred to is that for the keyboard which, fortunately, is identified in the section dealing with the initial setting up.

The User's Manual deals very briefly with initial setting-up, and is aimed at the user with floppy discs. There are no obvious instructions on a system using a mini-Winchester. It then describes how to use the text editor and goes on to describe the instruction set of Kontron's own PSI/Basic in a section which is well peppered with short examples of the keywords used in their correct syntax.

Most information the technical user might need is contained somewhere within the manuals, but they are not clearly laid out and omit a considerable amount of important hardware information. The User's Manual will be of very little help to the inexperienced user. Unless the software backroom boys generate some automatic loading and running programs, available off the shelf, this will seriously limit the machine's appeal.

## Conclusions

● The hardware is neat and tidy, and seems well designed. Flexible expansion is possible by adding Eurocards.

● More than 5Mbyte of storage is available on the integral mini-Winchester unit — an impressive capacity for a desk-top machine.

● The software of the KOS disc-operating system is reliable, but only an experienced specialist will be able to make the most of its refinements.

● KOS is upwards-compatible to CP/M to provide a wide range of software for the more down-to-earth user.

● At £6,663 the Kontron is rather expensive compared with other small office systems, though for some users the built-in capacity for expansion may offset the extra cost.

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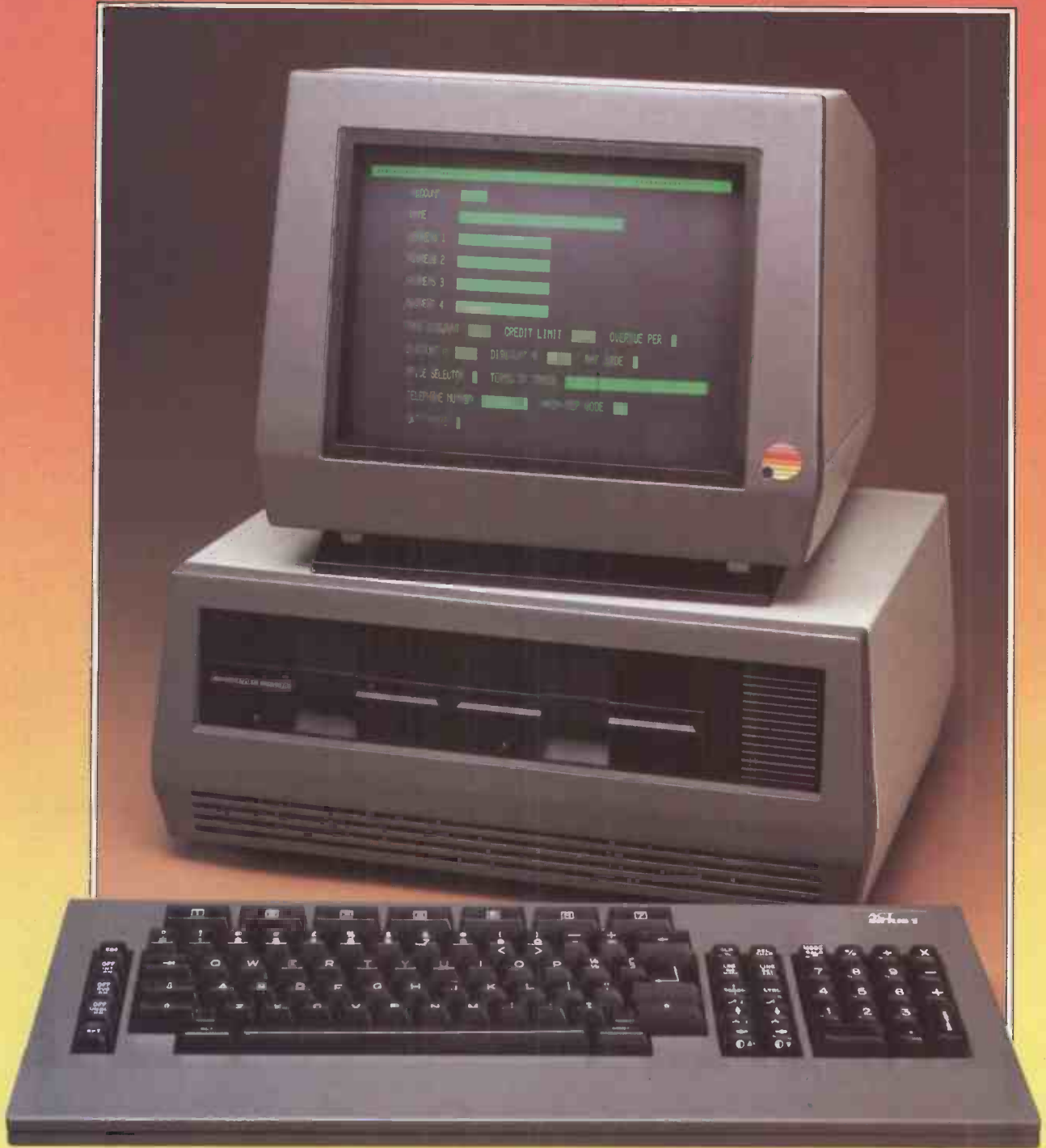
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# SHAPE MANAGER

THERE ARE two ways of presenting graphics during a program. You can either arrange for the user to watch the picture drawn line by line as the program runs, or you can fill the screen with a picture from memory all in one go. In the Apple "Lemonade" demonstration program, for example, 12 lines have been slowly drawn on the screen before anyone watching realises that the developing picture is of the inside of a living room. Rapid drawing is perhaps most useful when animation is required.

The only remaining problem is establishing the pictures, or some representation of them, in memory in the first place. Until we can all afford light-pen or graphic-tablet accessories, utility programs which enable pictures to be stored and reproduced easily will be particularly valuable. The Sinta Shape Manager is such a utility designed to ease the burden of creating shape tables for the Apple II of ITT 2020 computers.

The Basic for these machines has five special commands which enable shapes to be manipulated: Draw, XDraw, Rot, Scale and ShLoad. Before these com-

Figure 1. In order to draw the shape (a) by conventional means, you have to convert it to a set of vectors (b) which are then plotted.



mands can be used, a shape must be defined by a shape definition. Then you can ShLoad and Draw it, rotate the shape and scale it up or down as necessary.

The Sinta Shape Manager provides help in the shape-creation stage. In order to draw a shape in the conventional manner it must first be converted into a series of plotting vectors — see figure 1. The

by Michael Thorne

vectors must then be converted to hexadecimal code and the results stored in memory.

With the Sinta product you only need to draw the high-resolution shape on the screen by moving a dot around with the games paddles. The path traced out by the dot forms the shape which the system automatically codes into memory.

You can change your mind and alter the design at any stage, calling into play any one of more than 30 functions to help you. Facilities include the computer generation of the rest of a picture after you have drawn part of it. For example, to draw the picture of two men and a flag, you move the dot around to produce the basic shapes, then ask the system to duplicate the first, and glue together the result with the flag shape at the appropriate point. For 10 pin men you simply duplicate the original nine times.

Very complicated shapes can first be traced using an acetate sheet and pen provided. The tracing is placed over the computer's display screen so that the traced image can be followed with a screen dot, thereby transferring the shape to memory.

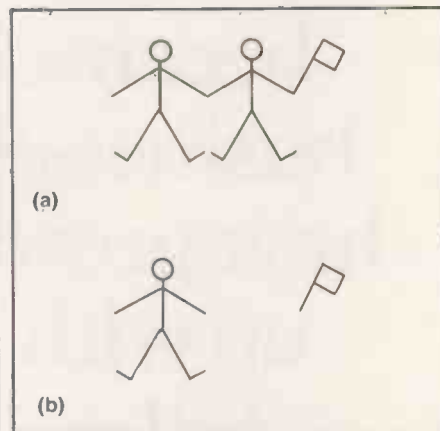


Figure 2. The finished picture (a) can be constructed automatically from its two elements (b).

The software is robust, and contrives to have all the commands documented on the screen at the press of a CTRL-C or two. Sound from the speaker is used to assist you in a novel and enterprising way. Built-in utilities generate standard shapes such as regular polygons and ellipses.

If you can afford a graphics tablet, the Sinta Shape Manager will not be of interest. If not, the system can save hours of programming effort and enable you to enhance the graphics aspect of your programs considerably.

## Conclusions

- This is an impressive first package from Sinta, available for about £60, which provides easily-accessible graphics for your programs.
- Commands are documented on the screen by simple keystrokes.
- The manual is easy to follow and lively. □

STRUCTURED LANGUAGES have their enthusiastic advocates as well as equally firm detractors. Aplus, from Sensible Software, is a pre-compiler which allows you to write programs in a structured Basic. It is supplied on a disc or tape which, in addition to the pre-compiler

by Kieron Leach

itself, contains a set-up program, a demonstration program in structured Basic and a game called Surround, also written in structured Basic.

To start the system up you simply put the disc in drive 1 and type PR#6. Alternatively you can run the program called Hello Aplus which is on the disc. This set-

◀ ● Circle No. 157

# APLUS BASIC

up program will ask you if you have Renumber, the DOS 3.2 version, and a program called AOPT on the disc. These are not supplied on the disc so you must either transfer them on to the Aplus disc or put structured Basic on a disc containing them.

Once you have answered the questions, the program tells you it is starting the system up. It will eventually end by telling you which commands you may use. The only two you can always use are:

- &L — indented listings
- &C — convert structured Basic to Applesoft Basic

Others may be available, depending on

whether you have Renumber or AOPT.

Having established a system with structured Basic, what can you do? The new functions it provides are listed in table 1, and with them you can dispense with the Goto statement. Unfortunately the manual merely lists the new functions and briefly explains how to use them, but gives no good examples of a structured Basic program showing how they fit together. The sample program on the disc is no help either.

The pre-compiler provides 11 extra error messages:

(continued on page 79)

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The MT110 is also available in the range offering 100 cps print speed and 7x7 character matrix.



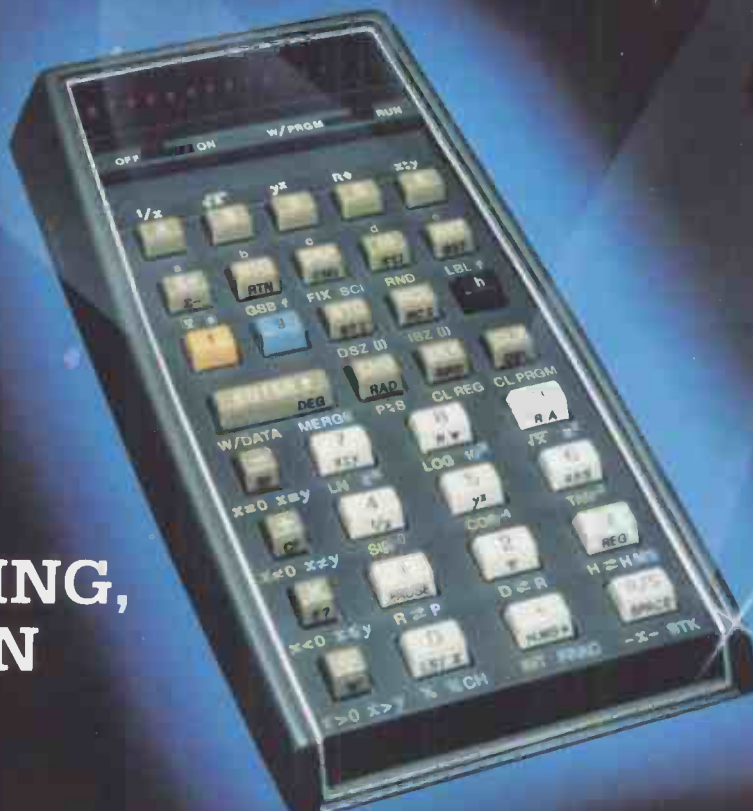
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Automatic retention of variable values for chain calculation.

Free use of "ask variables" to allow "what if" and repeat types of calculations.

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User numbers assigned, so multiple user files may reside on disk.

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Rapid calculation or stepped calculation for viewing intermediate results.

Automatic repeat calculation.

Comprehensive user reference manual with sample applications.

# Sales Ledger answers the stock questions

REVIEWING the Anagram Stock System back in September 1980, we said that "The system is a superb piece of programming on a par with VisiCalc". Anagram Systems has come a long way since then, having converted its packages from the 40-column Pet to the new 80-column machines, including some extra features at the same time. The few criticisms we made have been noted and acted upon, and now the system is available integrated with the Sales Ledger and Invoice Printing on 8050 disc format.

The 8050 gives far greater capacity than the original 2040, 3040 or 4040 units and thereby provides the software authors with a much bigger market-place for stock and ledger systems. Since Commodore announced the Mator Shark hard-disc unit, and the Corvus hard disc became available for Pet, the capacity problems normally associated with stock systems on micros have virtually evaporated — with up to 40,000 stock lines on one Mator, for instance. The larger directory capability of the 8050 unit has allowed Anagram to integrate its Sales Ledger program with the Stock System, and produce a very comprehensive and detailed program suite, with sufficient capacity to interest many businesses. In addition, Anagram has produced a manufacturer's version of the Stock System, with assemblies, costings and shortfalls; a Purchase Ledger with nominals and a Sales Ledger with nominals. All the Anagram packages have been adopted by Commodore and constitute the core of Commodore's business software range.

## High-quality manuals

The standard of software documentation improves almost daily now, with more suppliers realising that good manuals mean good sales, and repeat business. Commodore has recently employed a full-time technical writer: her influence can be seen in the revamped Anagram manuals, which are easy to read, well-indexed and accurate.

All the Anagram programs are written entirely in 6502 machine code, which makes them very fast and extremely efficient, a fact that is especially noticeable when swapping between screen displays. The screen information is updated so quickly that it is virtually impossible to see the change take place.

Movement between the various screens is effected by pressing so-called Program Function Keys, a term borrowed from IBM, whose keyboards include keys marked PF1, PF2 and so on. On the Pet, the PF keys are emulated by pressing shift

Taking advantage of the greater screen and memory capacity of the 8050 Pet, Sales Ledger from Anagram contains a complete stock-control system in one comprehensive suite. Peter Wood evaluates its features.

| Stock item | Description               | In stock |
|------------|---------------------------|----------|
| C-E        | CBM to IEEE Cable         | 19       |
| CBM4022    | 80 col.dot matrix printer | 4        |
| CBM8024    | 132 col. printer          | 2        |
| CBM8032    | CBM 8032 32K Micro.       | 8        |
| CBM8050    | CBM 1Meg. Disc Drive      | 15       |
| E-E        | IEEE to IEEE Cable        | 7        |
| PUR        | Purchase Ledger Package   | 0        |
| SAL        | Sales Ledger Package      | 0        |
| SCS        | Stock Control Package     | 0        |

and a number key, so that PF0 is a shifted zero for instance. This may seem unnecessarily complex, but when there can be over 100 different screens in a program, it is a sensible way of allowing the user to move around the system quickly, without going through innumerable menus.

Each screen display has an associated "help" screen, which may be displayed by pressing PF0. It allows inexperienced operators to find their way around quickly and without continually referring to the manual, while leaving the main screens uncluttered by spurious information. Once the concept of PF keys has been grasped — which take the average user about five minutes — the system is remarkably easy to use and very friendly. A file-create program has to be run when the system is first installed, in order to define the number of diskettes to be used or, in the case of the hard disc, the number of blocks to be allocated for the file. Once the file creation has been run, the user may begin entering data into the system.

The program is loaded, as are the majority of Pet programs, by pressing Shift and Run, with the program disc in drive and the data disc in drive 1. The system displays a copyright notice for a few seconds, while the main program is loaded, and then requests the date. If the system is being run for the first time ever, the period start date — first of the month — must also be entered.

Once the system has been told the year,

you will never have to enter it again, as a full Gregorian calendar checks all date entries for validity. Pressing PF3 takes you to the Master Menu, which has five options:

- Sales Ledger menu,
- Stock Control menu,
- Produce an Invoice,
- General processing,
- File maintenance.

The screen invites you to "select the option required with the cursor and press shifted Return". Moving the cursor from line to line on the menu can be accomplished by pressing any unshifted key except Stop, which allows you to close down the system if required.

The first option to select when setting up the system initially is general processing. Through it you may enter the current VAT rates — four are permitted, with VAT Exempt as the fifth — the printing defaults and your firm's details. The printing defaults include standard messages for the various reports, such as terms of sale, settlement discount and settlement days; the next automatic invoice number, if automatic numbering is required; the number of invoice copies to be printed; whether letterhead stationery is to be used, in which case the firm's details are not printed by the system; and type of printer and size of paper.

The firm's details are name; four lines of address, including post code; telephone number; and VAT registration number. This flexibility means that you

may opt to use plain paper, letterhead or pre-printed stationery designed for use with the system. Once this information has been entered, it is used as the default for all future printing, but it may be amended at any time.

Selecting the sales-ledger option produces another menu of five options:

- Ledger Processing,
- Customer Processing,
- Suspense Account,
- Sales Area Processing,
- Report Printing.

Customer Processing allows examination, addition, alteration or deletion of customer details.

Unlike most other systems, this pro-

| Order | Allocated | Price   |
|-------|-----------|---------|
| 0     | 0         | 25.00   |
| 0     | 0         | 425.00  |
| 10    | 0         | 1200.00 |
| 25    | 0         | 895.00  |
| 10    | 1         | 895.00  |
| 0     | 0         | 25.00   |
| 0     | 0         | 399.00  |
| 0     | 1         | 299.00  |
| 0     | 1         | 400.00  |

gram stores and retrieves accounts by customer name rather than account code, which eliminates the problem of remembering account numbers and makes the process far simpler. Once stored, the account may, if required, be accessed by only the first few letters of the name, making for much faster operation. If the partial name is unique, then the account is displayed immediately; if more than one account matches the input, then all the possibilities are shown and the operator may select the correct one with the cursor.

## Fail-safe feature

Another aspect of the program which makes for faster and easier operation is the way the system ignores upper and lower case when looking up a record, while retaining the correct case when printing. For instance the account "Practical Computing" would be printed exactly as entered, but may be looked up by simply typing "prac", for example. You cannot delete an account unless the balance is zero — a valuable safety feature which prevents costly mistakes.

If the operator is unsure of the name of an account, then an index of all the accounts may be displayed, and the correct one selected with the cursor. Accounts are automatically placed in alphabetical order as they are entered, which avoids time-consuming sorting and ensures that individual accounts are easy to find, even in a long list.

The ledger-processing option requests

the account name, which is entered again as either the full name or a partial name. A menu of options is then displayed, along with the account name and the current balance. The program caters for the addition, alteration or cancellation of invoices, credit notes and payments as well as "unallocated credit", where a single credit note is to be issued against a number of unspecified invoices. This credit may then be allocated to the appropriate invoices at a later date.

The system is entirely "open item", which means that any unpaid invoices are held on file indefinitely. Partial payments of invoices and partial credits are also catered for. The account detail may be examined on the screen at any time, with all outstanding invoices, credits and payments appearing in date order. There is not enough space on a floppy diskette to store the full details of every invoice, so only the goods total, carriage, VAT and discounts are retained. The user is expected to keep a copy of the physical invoice.

The suspense account is provided for those awkward occasions when a cheque is received without remittance advice, and the account for which it is intended cannot be identified immediately. Posting the amount of the cheque, together with an appropriate note, into the suspense account, records the arrival of the payment in the system. As soon as the customer has been identified, the posting can be transferred from suspense to the correct account. There is a facility to clear down all the items in suspense, but a printout of all the postings occurs before this can take place.

The Sales Area Processing option provides for the examination, addition, alteration or deletion of sales areas, which may be used for the analysis of sales by area, salesman and so on. These areas are identified by a code of up to three characters, and carry a fuller description for reporting. For example, you may set up "SY" as a sales area, with "Surrey" as the description, for use as a report heading. Each customer can be assigned to a sales area, so that the analysis takes place automatically.

Selecting Report Printing produces one of the largest menus in the system, with eight different reports provided, each of which has further selection criteria that may be applied. The reports are:

Sales List — equivalent to a sales day book.

You may produce the report for month-to-date or as a daily list for a particular day; for all sales areas or for a specified area; and for all customers or a group of customers selected alphabetically.

Cash List — equivalent to cash received.

Selections as for the sales list option.

Credit Note List — equivalent to the other side of the sales day book. Selections as for the sales-list option.

Current Balances shows the up-to-date account balances, and may be produced for all customers or only those with non-zero

balances, for all sales areas or a specified area, and for all customers on file or a group.

Aged Debt Analysis — the traditional aged debtors' list, but shown for four months and over, three to four months, two to three months, one to two months and under 30 days. May be produced by area and by group if required.

Customer Statements may be selected for the following categories: only customers with an outstanding balance; customers with an outstanding balance and all accounts settled this month; customers with an outstanding balance which includes an invoice dated earlier than a date you specify; the same customers but including all accounts settled this month. You may specify also a sales area and a group of accounts for selection. Suspense Account prints details of all suspense postings in date order.

Customer Names and Addresses prints this information by sales area and by group. It may be printed with full detail on to plain paper, or as address labels on gummed label stationery.

The stock control menu consists of nine different options:

- Stock Enquiry,
- Stock Item Processing,
- Order Processing,
- Allocation Processing,
- Movement Processing,
- Stocktaking,
- Price Changes,
- Supplier Processing,
- Report Printing.

Stock Enquiry allows you to examine a "stock card", either by entry of the stock-item reference or via an index of references, similar in operation to the sales ledger. A stock-item reference may be up to 10 characters in length, and may be any mixture of letters or numbers. As with the sales ledger, upper case may be used for legibility when adding a new stock item, but lower case is sufficient for recall of the information.

The first page of the stock card shows the stock-item reference and its description; a free-stock figure, which is physical stock plus quantity on order less quantity allocated; in-stock, on-order and allocated figures; the date of the last activity on this item; its bin number or location; "supersedes" and "superseded-by" information; the quantity description, e.g., dozen, kgs, gross; reorder level, reorder quantity, minimum stock level, maximum stock level, lead time, cost price, selling price and VAT rate.

Pressing PF2 displays the name and address of the main supplier of the item, followed by as many pages as are required to show the sub-suppliers, with separate lead times and cost prices. The main cost price may be used as an average cost price, automatically calculated from the quantity received from each supplier at either the price specified in the supplier record, or a price entered manually when the goods are received.

Pressing PF4 displays details of all outstanding orders for the item, with date of order, order reference, quantity ordered, date due, supplier code, quantity received

(continued on next page)

(continued from previous page)

to date, lead time and total order value. Each receipt or partial receipt of order may also be displayed. The original stock card may be redisplayed by pressing PF8.

PF5 will show all the in and out movements for the month for the item, and PF6 will show all outstanding allocations. Allocation details displayed are: date required, allocation reference, quantity required, cost centre, quantity sent and total allocation. PF7 causes the entire stock card to be printed out.

The facility to flit about throughout the system provided by the PF keys makes the program very quick and easy to use, especially where a large amount of data is being held.

## Stock-control options

Stock Item Processing is used to examine, add, alter or delete stock cards. The user is prevented from deleting any item that remains active.

Order Processing is split into two main sections; single item or bulk order. In both cases the options are to raise, alter or cancel an order, but the bulk-order facility allows easy batch-entry of information, plus optional printing of the order to be sent to the supplier, complete with the supplier's name and address. When raising a bulk order, the operator has only to enter the stock-item reference for the program to display the description and standard cost price automatically.

Once the date due has been entered for the first item on the order, the system will default to that date for every following item, although the user may overtype both the date and cost price if necessary. The total cost of each line of the invoice is calculated and displayed at each stage, apparently instantaneously, providing yet another visual check.

Allocation Processing acts as the complement of order processing, and provides for single or bulk allocations.

Movement Processing is used for receipt of orders, issues of allocations, and miscellaneous in and out movements. There is an option to process either a single item or a bulk order or allocation. In-movements may be used to update the standard cost price if required, and automatic averaging may be used. Stock may be issued at standard selling price or at a manually-entered figure. Each out-movement may be analysed to a cost centre if required.

The Stocktaking option is used for manual adjustment of stock figures after completing a stocktake, and generates an appropriate in- or out-movement with a reference of "stocktake" on the stock record.

The Price Changes option is used to either increase or decrease the cost and/or retail prices by a percentage specified by the operator. The changes may be selectively applied to only those items relating to a specific supplier, and further

to only a range of items selected by item reference.

Supplier Processing simply provides the ability to examine, add, alter or delete a supplier record. A supplier record consists of a code of up to three characters, name, four lines of address, telephone number and contact name.

The stock-control Report Printing menu is thoroughly comprehensive, with 11 different reports, each of which may be selectively produced for a range of items, as well as by other criteria:

**Stock Cards** — full page per item, showing the semi-permanent information about the item, together with suppliers, order history, in- or out-movements and allocation history. It may be selected for only those items which have had activity in the current month.

**Stock Level Highlights** shows all items that are under reorder level and/or minimum-stock level or over maximum-stock level.

**Stocktaking List** shows item reference, description, bin location, quantity description and quantity in stock, used to physically check stock items.

**Outstanding Orders** shows items on order and total value of orders, either for all suppliers or for a specific supplier.

**Outstanding Allocations** operates as for outstanding orders, but not by supplier.

**Stock Valuation** gives total cost and retail value for each stock line, plus a total stock value.

**Stock Movement Analysis** gives total cost of all in-movements and total selling value of all out-movements for each item, and computes the difference as a gross profit figure item by item.

**Cost Centre Analysis** shows all movements for a specific cost centre.

**Inactive Stock** prints all items that have had no activity since a specific date entered by the user.

**Price List** simply prints a price list.

**List of Suppliers** prints full details of all suppliers on plain paper.

The heart of the integration of this system is the produce-an-invoice option on the master menu. This section first requests a customer account name, or partial name, exactly as in the sales ledger section. Once the account has been found, the name and the account balance is displayed together with the following information: invoice number, which is normally generated automatically; the invoice date and tax point; which both default to the current date; the settlement discount and days; terms of payment; and the customer's address. The operator may overtype any of the default information.

The user then enters the following: order reference; the amounts charged for carriage and VAT on carriage; a trade-discount percentage figure, if required; the delivery note number; and up to three lines of notes to appear on the invoice. Once this detail is complete, PF2 is pressed to go on to entering the invoice lines.

Up to 20 lines may be printed in each page of the invoice, and as many pages as necessary may be produced. Each line requires only the entry of the stock-item reference to cause the display of the des-

cription, quantity description, default unit price and VAT rate for that item. The quantity is then entered, together with a line discount, if required, and the price if an alteration is necessary. The line total is automatically calculated and displayed.

Once the invoice page is complete, the system will print the invoice, post the totals to the appropriate ledger, and adjust the stock levels as necessary. It will also suggest that you check the stock level of any items which are under the preset levels.

The final option from the main menu is the file maintenance section which consists of a four-option menu:

- **File Usage** displays the amount of the space used, and the amount remaining at any time.
- **Start of Month Processing** is used to clear off all completed invoices, orders and allocations, to make room for the next month. This section also sets the system date to the first of the next month.
- **Condense Customers** is used to clear off completed invoices for a specific customer or range of customers when disc space is at a premium.
- **Condense Stock Items** does for the stock items what the previous option does for customers.

During a fairly long and detailed evaluation, we were unable to crash this program in any way, by entering the wrong data, or selling items that we did not have, or turning the printer off, or any of the other "standard" ways of breaking a piece of software. It is a credit to the authors that they have managed to write a program that is both secure and convenient to use.

The Anagram Sales Ledger with Stock Control is available from most Commodore dealers or direct from Anagram Systems, 60A Queen Street, Horsham, West Sussex. Telephone, (0403) 50854.

## Conclusions

- **The Anagram Sales Ledger and Stock Control System** is a very comprehensive and detailed program, which should provide most medium-sized companies with all they need for stock and ledger work.
- **The standard of software is very high:** it is easy to use and apparently unbreakable.
- **The speed of operation is satisfactory,** since machine code has been used.
- **The accounting facilities seem more than adequate for most companies.**
- **The stock facilities are comprehensive** and those we tested are generally suited to a marketing company. We understand a version exists for manufacturers.
- **The use of PF keys may be slightly confusing at first,** but they greatly speed up the operation of the system, and provide far greater flexibility than other methods we have seen.
- **The package is well documented,** and the help screens within the program provide an excellent back-up to the manual.
- **At £799 the program represents good value for money.**

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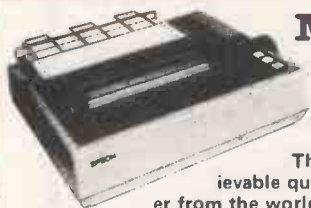
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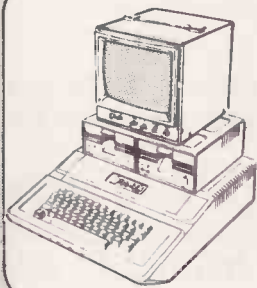
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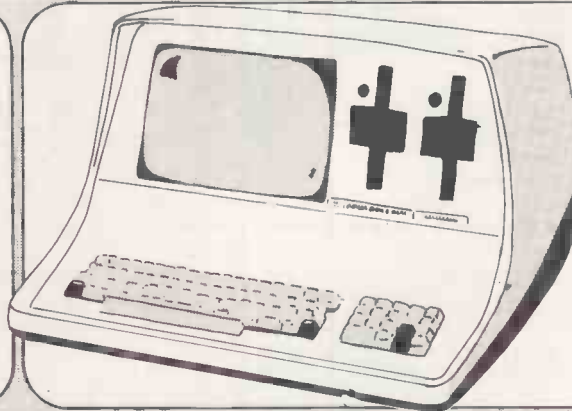
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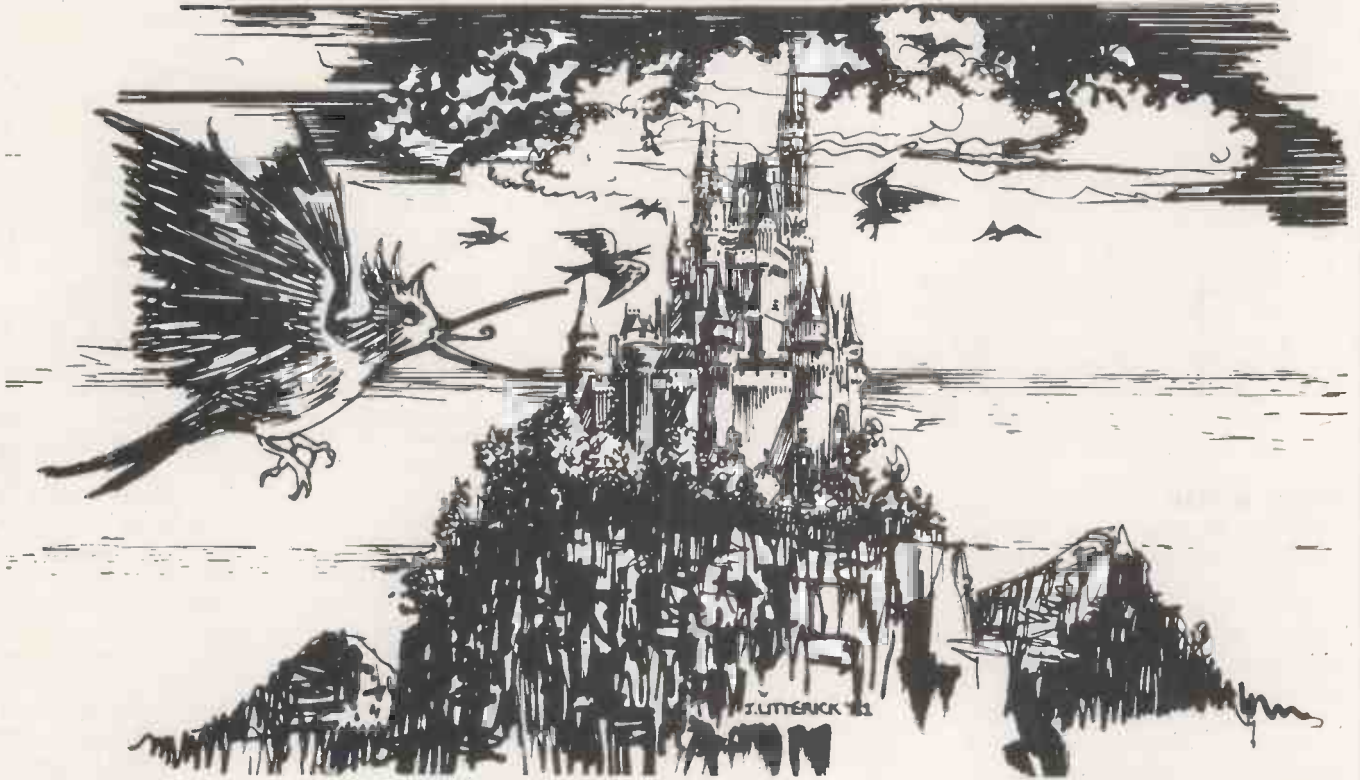
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● Circle No. 162



Adventure, the classic microcomputing game, has spawned hordes of look-alike programs and seems destined to dominate the game-playing scene for some time. Dennis Ellis reviews its origins and looks ahead to the exotic versions of the future.



OF THE COUNTLESS computer games to have arisen in the last few years, the one called Adventure towers head and shoulders above all the rest. It is equalled in its popularity only by the immensely successful Space Invaders games. Adventure was written by Crowther and Woods of Stanford Research Institute, based on the game of Dungeons and Dragons by Gygax and Arneson.

### Dungeon master

Dungeons and Dragons was the first role-playing game in which players assume alter-egos and use them to wander through strange, exotic lands or caves, encounter hideous monsters and strive to accumulate wealth while building up the personality of their particular character. Their origins can be traced back even further to the appeal of the sword-and-sorcery novels, by such authors as Michael Moorcock, that gained such popularity in the early 1970s.

These games usually have a dungeon master who does not actually participate. He or she has a detailed map of the dungeon, and charts the progress of the players and other unsavoury inhabitants of the dungeon. At the start the players do not know the layout of the dungeon. They tell the dungeon master which passage they want to enter next, and the dungeon master describes their new location plus any objects around. If a confrontation with a creature takes place, the dungeon master throws dice to simulate the random element in any conflict, and after

## Kings of the castle walls

weighing up such factors as what weapons are being carried, how strong the contestants are — based on earlier skirmishes and blows suffered — the result is announced. As you can see, there are few limitations to the game, and some games have lasted for many weeks.

Will Crowther's computer program for Adventure was written in Fortran and undertook the role of the dungeon master for the players. You typed in your request and the program described your new location and its contents. Adventure was released to an unsuspecting world in 1976. It was added to the Decus library — the free software-exchange mechanism for the Digital Equipment Computer Users' Society — and installed mostly on Dec's PDP-11 systems. Within a short time its popularity was outstripping every other program on this library, which contained several thousand very worthy works.

In 1978, Dungeon was added to the Decus library. It amplified the concept even further, with more locations, descriptions, inhabitants and intriguing puzzles to solve. Dungeon was written by four members of the Programming Tech-

nology Division of the MIT Laboratory for Computer Science, Tim Anderson, Marc Blank, Bruce Daniels and Dave Lebling. Again, it proved a winner.

With so little information available about such popular public property, it is not surprising that modern myths are emerging around these programs. One of them relates how players telephoned the authors at 3 a.m. to ask how to get back across the Troll's bridge.

It has been said that Dungeon was written in only four days — from Friday evening working solidly through to Monday morning, though it must take longer just to type in the text. So much interest was generated by Adventure that the wary Dungeon authors embedded a strong warning in the program to the effect that any personal callers would be rudely ejected from their premises.

Adventure and Dungeon both needed extensive disc back-up to store the database containing the descriptive text and the links between interconnecting passageways. Though this clearly made it unsuitable for the normal home computer, the floodgates opened and all man-

*(continued on next page)*

(continued from previous page)

ner of Adventure games poured on to the micro market. Even a watered-down version of Dungeon, called Zork, is now available to home users.

Most Adventures cannot have people walking about willy-nilly so they usually restrict themselves to some constraining environment such as caves, dungeons, pyramids, mansion houses or even a spaceship. There are now a large number of Adventure games using every computer trick and gimmick available and the list is growing every day.

Classification of these games is a difficult task as there are hundreds of databases and almost as many ways of implementing them. Some games use high-resolution graphics, while others have real-time action. Some use a mixture of both. There are two clearly distinct

### Solid world

types of Adventure games: those that are mappable, and those that are not.

It is the essence of an Adventure game to be able to feel that you are in a believable and solid world. If you pass over a large chasm on your way, you have every right to expect it to be in the same place when you come back. It is possible, if not essential, to construct a map as you explore. You can achieve great satisfaction from breaking through to new ground and filling in another blank area on the map.

Some smaller games do not have the necessary memory capacity and rely on other means. They sometimes have levels to their domain: the program only holds one level at a time and creates a new one from random every time you pass up, or down, to a new plane. The levels differ only in the strength of their inhabitants and the value of the treasures found, which usually means multiplying a base value by whatever level you are on. "Aha", says the author, "but the Evil Magician has cast such a spell on the cavern that the walls slide about and the exits move whenever you pass to another plane". Which just goes to show that if you document a flaw, it can become a feature.

Another major difference between games is something called the end-game. This is present in Adventure, Dungeon and most mappable variants. Once you have explored the passages and solved all the puzzles, the game changes gear and you are permitted to pass into some previously inaccessible inner sanctum when the ultimate challenge is thrown at you.

Sometimes these end games are mini-Adventures in themselves and can be excruciatingly difficult to solve. Such a grand-slam finale beckons the player to strive for an attainable goal. Other games, usually non-mappable ones, offer only an ever-increasing score as a reward. Admittedly, they never end, but they lack any soul-satisfying climax.

| Name                         | Machine               | Supplier           | Approximate Price |
|------------------------------|-----------------------|--------------------|-------------------|
| Adventure                    | Apple                 | PDS                | £14.95            |
| Adventure                    | ZX-80/81              | Artic computing    | £7                |
| Adventure                    | Atari                 | Maplin Electronics | £10               |
| Adventure                    | UK 101                | M Ward             | £8                |
| Adventureland                | TRS-80                | Instant Software   | £12.50            |
| Akalabeth                    | Apple                 | Gatepost           | £21.50            |
| Alien Adventure              | Apple, Pet, TRS-80    | Compukit           | £3                |
| Alien Labyrinth              | Nascom 1 and 2        | Program Power      | £6.95             |
| Beneath the Pyramids         | Apple, Pet, TRS-80    | Crystal Software   | £15               |
| Catacombs                    | Pet                   | Supersoft          | £10               |
| Creature Venture             | TRS-80                | SBD Software       | £14.95            |
| Crowley Manor                | TRS-80                | Micro Applications | £13.50            |
| Cursed Chambers              | Sharp                 | J W Wolstonecraft  | £5                |
| Datestones of Ryn            | Apple                 | The Software House | £11               |
| Death Dreadnought            | TRS-80                | Algray             | £9.95             |
| Deathmaze                    | TRS-80 level II, 16K  | Essential Software | £10               |
| Demon Dungeon                | Acorn Atom            | Program Power      | £6.95             |
| Dog Star Adventure           | TRS-80                | The Software House | £6                |
| Dragonquest                  | TRS-80                | Algray             | £9.95             |
| Dragons Fire                 | Apple                 | Pete and Pam Comps | £29.95            |
| Dungeon of Death             | Pet 8K                | CT Software        | £7.50             |
| Escape (3-D)                 | TRS-80                | Kansas City Supp   | £7.50             |
| Fantasyland 2041             | Apple, Pet, TRS-80    | Crystal Software   | £30               |
| Fracas                       | Apple                 | Gatepost           | £13               |
| Galactic Empire              | TRS-80                | Calisto Computer   | £16.50            |
| Galactic Quest               | Apple, Pet, TRS-80    | Crystal Software   | £15               |
| Galactic Saga                | TRS-80                | Calisto Computer   | £12.50            |
| Galactic Trilogy             | TRS-80                | Calisto Computer   | £33               |
| Ghost Town                   | TRS-80                | Calisto Computer   | £12.50            |
| Hellfire Warrior             | Apple                 | Pete and Pam Comps | £20.95            |
| House of 30 Gables           | TRS-80                | Calisto Computer   | £12.50            |
| House of Usher               | Apple, Pet, TRS-80    | Crystal Software   | £15               |
| Imperial Walker              | Apple, Pet, TRS-80    | Crystal Software   | £15               |
| Jason and the Argonauts      | Pet                   | Commodore          | £5                |
| Keys of Kraal                | Nascom 1 and 2        | Program Power      | £8.95             |
| Kid Venture                  | TRS-80                | Calisto Computer   | £12.50            |
| Ky Temple of the Dragon King | Apple, Pet, TRS-80    | Compukit           | £3                |
| Labyrinth (3-D)              | TRS-80, level II, 16K | Essential Software | £10               |
| Little Crystal               | Apple, Pet, TRS-80    | Crystal Software   | £20               |
| Local Call for Death         | TRS-80                | Calisto Computer   | £16.50            |
| Lord of the Rings            | TRS-80, Video Genie   | Kansa City         | £9.50             |
| Lost Dutchman's Gold         | TRS-80                | Algray             | £9.95             |
| Mad Hatter's Adventures      | Apple                 | The Software House | £28               |
| Microsoft Adventure          | Apple                 | Pete and Pam Comps | £15.95            |
| Mission Impossible           | TRS-80                | Calisto Computer   | £12.50            |
| Morlocs Tower                | Apple                 | Pete and Pam Comps | £15.95            |
| Mystery Fun House            | TRS-80                | Calisto Computer   | £12.50            |
| Mystery House                | Apple                 | Spider Software    | £13.95            |
| New York Subway              | Apple, Pet, TRS-80    | Compukit           | £3                |
| Odyssey                      | Apple                 | Pete and Pam Comps | £15.95            |
| Oldorf's Revenge             | Apple                 | Spiders Software   | £11.95            |
| Pirate's Adventure           | TRS-80                | Calisto Computer   | £12.50            |

It comes as a surprise to learn that Adventure is not restricted to computers, and there have been several efforts to tailor the concept for other media. The original board game of Dungeons and Dragons came first, and is still very popular.

There was even a book, published some years ago, with which you could construct your own Adventure-style plot. On reaching a certain point in the text, where our hero Mr Bloggins was poised before a door behind which he suspected a trap, the narration ended on the following note:

If you think Mr Bloggins should enter the room, turn to page 118. If not, continue reading from page 95.

The story then continued, depending on your choice of plot. The whole book was fragmented in this way, and its limitations are obvious.

There have been stories in the computer trade papers based on people's alter-ego adventures experienced in a game and expanded into a true sword-and-sorcery piece. Attempts at constructing unstructured plots in literature hark back even as far as the old parlour game of Consequences. This idea spawned

| Name                        | Machine            | Supplier           | Approximate Price |
|-----------------------------|--------------------|--------------------|-------------------|
| Pyramid of Doom             | TRS-80             | Calisto Computer   | £12.50            |
| Rescue at Rigel             | Apple              | Pete and Pam Comps | £15.95            |
| Sands of Mars               | Apple, Pet, TRS-80 | Crystal Software   | £20               |
| Savage Island               | TRS-80             | Calisto Computer   | £16.50            |
| Six Micro Stories           | TRS-80             | Calisto Computer   | £12.50            |
| Slag                        | TRS-80             | Calisto Computer   | £12.50            |
| Sleuth                      | TRS-80             | The Software House | £9                |
| Sorcerer's Castle           | Pet                | Commodore          | £5                |
| Spider Mountain Adventure   | TRS-80             | Algray             | £9.95             |
| Strange Odyssey             | TRS-80             | Calisto Computer   | £12.50            |
| Tarturian                   | TRS-80             | SBD Software       | £14.95            |
| Tawala's Last Redoubt       | TRS-80             | SBD Software       | £14.95            |
| Temple of Apschai           | Apple              | Pete and Pam Comps | £20.95            |
| The Count                   | TRS-80             | Calisto Computer   | £12.50            |
| The Galactic Empire I       | TRS-80             | SBD Software       | £12.95            |
| The Galactic Revolution III | TRS-80             | SBD Software       | £12.95            |
| The Galactic Trader II      | TRS-80             | SBD Software       | £12.95            |
| The Hitch-Hiker's Guide     | Pet                | Supersoft          | £16               |
| The Prisoner                | Apple              | Pete and Pam Comps | £15.95            |
| The Wizard and the Princess | TRS-80             | SBD Software       | £17.95            |
| Troll's Tunnel              | Apple, Pet, TRS-80 | Compukit           | £3                |
| Two Heads of the Coin       | TRS-80             | Calisto Computer   | £16.50            |
| Underground Quest           | ZX-80/81           | David Blagden      | £4                |
| Vampire Castle              | Apple, Pet, TRS-80 | Compukit           | £3                |
| Voodoo Castle               | TRS-80             | Calisto Computer   | £12.50            |
| Waterloo II                 | Apple, Pet, TRS-80 | Crystal Software   | £25               |
| Wizardry                    | Apple              | Pete and Pam Comps | £29.95            |
| Wizards Mountain            | TRS-80             | The Software House | £9                |
| World War III               | Apple, Pet, TRS-80 | Crystal Software   | £15               |
| Zombie Forest               | Apple, Pet, TRS-80 | Compukit           | £3                |
| Zork                        | TRS-80             | The Software House | £22               |

Algray, Algray House, 33 Bradbury Street, Barnsley, West Yorkshire. (0226) 83199.

Artic Computing, 396 James Reckitt Avenue, Hull HU8 0JA.

David Blagden, ZX-80/81 User's Club, PO Box 159, Kingston-upon-Thames, Surrey KT2 5UQ.

Calisto Computer's, 119 John Bright Street, Birmingham B1 1BE. 021-632 6458.

Compukit, 290 Station Road, Stechford, Birmingham B33 8QR.

Crystal Computer, 12130 Steffs Ct., San Martin, California 95046, USA. (408) 683 0696.

Essential Software, 47 Brunswick Centre, London WC1N 1AF. 01-837 3154.

Gatepost, Gate Microsystems, The Nethergate Centre, 35 Yeaman Shore, Dundee.

Pete and Pam Computers, 98 Moysers Road, London SW16 6SH. 01-677 2052/7341.

PDS, Professional Data Systems, Carne House, Markland Hill, Chorley New Road, Bolton, Greater Manchester. (0204) 493816.

Program Power, 5 Wembley Road, Leeds, West Yorkshire LS7 2LK. (0532) 683186.

SBD Software, 15 Jocelyn Road, Richmond TW9 2TJ. 01-948 0461.

Spider Software, 98 Avondale Road, South Croydon, Surrey. 01-661 2365.

Supersoft, 10-14 Canning Road, Wealdstone, Harrow, Middlesex. 01-861 1166.

The Software House, 146 Oxford Street, London W1. 01-637 2108.

J. W. Wolstonecraft, Sagar Fold, Bleasdale, Preston. (Chipping) 327 09956.

**These Adventure-style games were available in November 1981. At least one known supplier is given for each game, though it may be available elsewhere — it can pay you to shop around as prices vary considerably.**

some extremely funny computer games that inserted words into a pre-defined story at random.

Television has taken a stab at similar ideas. In the mid-1960s there was a children's serial that used to end each week with the invitation for people to write in with the script for the next episode. In 1979 the BBC brought out a programme called *The Adventure Game*, a thinly-disguised attempt to grab the popularity of the computer game. The show had three celebrities, held captive in an alien cave system, who used various obstacles to retrieve a special crystal needed for

their spaceship. The show was said to be unscripted and the dungeon master was a friendly alien who appeared offering help whenever they got stuck. They even sat at a computer terminal and played a variation of Adventure at the start of each show.

### Solving teasers

More recently, the BBC has screened *Now, Get Out Of That*, in which a group of strangers are dropped into the countryside pretending to be enemy saboteurs. They have to solve the usual mental and physical teasers before finally reaching

the end-game of stealing a solar-powered battery from a castle.

Perhaps the most successful of this type of show was ITV's *Masterspy*, screened in 1978. It was really a game or quiz show, with three contestants pretending to be secret agents training for a mission. The first half of each show was a series of clever mental tests to score "agent ratings". The two higher scorers went on into the second half to participate in a strange play in which they were free to say and do anything, while the other parts were taken by actors.

A tremendous amount of imagination and effort went into each episode and the actors always managed to steer the contestants without spoiling the illusion. The dungeon master was William Franklyn and it was he who helped to make it all believable. Sadly, the show ended after the second series but it still remains one of TV's best attempts at creating a fictitious world for contestants.

More sophisticated programming languages and innovations in the hardware will allow future authors of Adventure games much greater scope. As memory becomes cheaper and on-line disc storage readily available to more users, Adventure games will undergo a dramatic increase in size.

### Restrictions lifted

Once the storage space restrictions are lifted, many more "rooms" and their various connecting passages will be available for the games. Fast-access discs can hold enormous databases for Adventure programs and will lead to even more mind-stretching puzzles to solve. Perhaps there might be a version of Adventure implemented through the viewdata terminals tapping the mammoth databases there.

There will be a move towards graphical representation of scenes in the games. There are already Adventure games that use graphics to a limited extent. Future games will not just have "plan view" graphics but true isometric images and colour.

The recent television series *Cosmos* contained several computer-generated scenes of simulated fly-bys of planets as viewed from a passing spaceship. These images are realistic enough to equal modern photography, and their smooth movements rival conventional animation. Such software could be used to create vivid scenes on a screen in which objects can be manipulated and various creatures can move around a fictitious landscape in real time.

In due course, we will have true three-dimensional images using red/green overlays or holographics. A three-dimensional Space Invaders computer game using holography techniques has already been aired at a computer-games exhibition in the United States.

(continued on page 93)

# COMMAND-O ON TRIAL!

If you own a PET or CBM computer with disks then you ought to have a COMMAND-O chip. It's got all the facilities of that other chip (can't think of the name), plus BLEEP, EXECUTE, INITIALIZE, PRINT USING, AUTO-REPEAT — and you can scroll a program listing up and down the screen! There are lots more functions, but perhaps the best way to learn about COMMAND-O is to use one. If you order a COMMAND-O chip from SUPERSOFT before 31st March you'll qualify for our special money back offer. Just return it in good condition within 10 days and we'll refund your money in full! COMMAND-O is for Basic 4 users only and costs £59.95 plus VAT. It fits in the UD3 or UD12 socket and comes with a comprehensive, but readable manual.

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There is already an arcade game that creates a simple landscape. It shows a view as seen from the forward slit of a tank turret. As you manipulate the joystick, you can turn the turret and your view pans across a chequered horizontal plane filled with symmetrical geometric polyhedra and other tanks. These shapes obey the laws of perspective, giving the impression that your tank is moving forward across the plane.

### Wire-shape effect

One major drawback is that all the edges of the figures are visible at once, giving a wire-shape effect rather than a true solid feel. Nevertheless, games like this are a big step forward in creating a world within the computer. Perhaps we may even see some form of Adventure game appearing in arcades in the future.

Although these advances are the logical step in computer graphics for Adventure games, the most startling development comes from an improbable source, the American Central Intelligence Agency. The CIA is concerned that its agents may be unfamiliar with the layout of the streets of a town when they are acting as bodyguard or are on other duties. The CIA has developed a method of familiarising its agents with the streets in towns where they will be operating, based on a special form of video disc. A car travelling along all the streets of the town films the view from the driver's seat. The film is transferred on to a special

video disc — which is simply a device for the random access of visual information. With the aid of a micro and a monitor, trainees can then "drive" through the town without ever going there. At each junction, the driver decides which way to go, and the relevant section of film is selected off the disc with no loss of continuity.

Does the future hold Adventure video discs? Perhaps finely-detailed models and animation will be used for scenes, or we may find ourselves roaming down passages that tower over us on the scale of a Cecil B De Mille film set.

Adventure games of the future will also be able to use voice input and output in conjunction with the graphical images. You will be able to hear characters speak, and sound-effects will come into their own as in no other game. Hear the crackling of fires, the clank of swords, the screaming cries of things not of this world!

### New horizons

On the software side, we might see a special Adventure programming language which will make it easier for non-specialists to write new Adventures and thereby open new horizons to famous conventional authors. Imagine an Adventure program written by Isaac Asimov or Harold Robbins, or perhaps moving full circle with a game written by Michael Moorcock.

A further software development for future games would be the introduction of a time-sharing aspect. There are, as yet,

no Adventure games that can support simultaneous access where one player can enter a room and meet another player who is also exploring the passages. Such a game could already be written using the resource-sharing minis and the capabilities of networking micros together, and several people using separate terminals could participate in the same game. They could enter the passageways together, split up to explore, and meet back at some prominent landmark to share their treasures. To each player, the other players would just be other objects in the Adventure universe.

### A fantasy universe

You might be able to talk to one another, leave each other messages chalked on the walls of a cavern, or even fight and kill each other. Could gang warfare break out in Adventureland? You are not restricted by distance either. With modern telecommunications and satellites, you could be accompanied into the caves by someone sitting at a terminal in Australia.

Most current Adventures take place in a fantasy universe, but this need not be so. Why not a game where you can wander down faithful renderings of the streets of London? This would be handy for London cabbies "on the knowledge" or tourists finding their way round. You could even enter the Underground and catch a train. You could set a game in Medieval England populated with famous kings and queens and containing realistic descriptions of contemporary scenes. □

# Repeatable functions for limitless mazes

MANY EXCELLENT games are marred by a limited capacity for storing mazes and the computing time required to set up the data at the start of each run. When the details of the game parameters are stored byte by byte in memory, mazes and other game boards are restricted to a few hundred positions or cells on all but the largest systems.

There are ways, however, to overcome this problem so that even a humble 4K machine can guide the game player round labyrinths which are large enough to tax the most enthusiastic game players.

### Learning the trick

The trick is, in effect, to store the details of the maze in a mathematical function. Suitable functions are already used in some methods of generating random numbers. To generate a maze, they must be repeatable random numbers: given a set of parameters such as position co-ordinates the function must always provide the same number, but that number must appear to vary randomly as the parameters change.

**Graham Relf leads you down dark, winding corridors, through deep mines shaken by earthquakes in this maze game. This Basic program means you can generate as large a maze as you need — on even the smallest micro.**

Consider the following simple algorithm for generating random numbers:

```
N = 0.5
FOR I = 1 TO 1000
  N = FRAC (( π + N) * )
  PRINT N
```

NEXT I  
It prints 1,000 random numbers between zero and one.

On the first line of the algorithm N is set with a seed value. In the For loop it is changed to successive random values — for purists, pseudo-random values. The function FRAC returns the fractional part of its argument. It is not a standard Basic function but it can be reproduced by

$$X - \text{INT}(X)$$

where INT(X) is usually available as a standard function which returns the integer part of its argument. FIX(X) is an alternative.

It is the process of discarding the most significant digits of N which makes the algorithm appear to be random. A similar principle can be applied to any function. For example, the third and fourth digits of cos(X) for various X gives two-digit results which appear to be fairly random, provided that the values of X are not too close together.

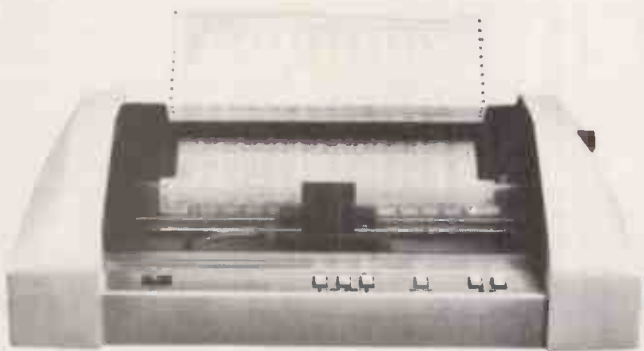
One important feature is that while the results are random for different X, the same number is always returned by the function for any particular X. The Basic statements in listing 1 extract the third and fourth digits of cos(X).

Mazes are two- or three-dimensional structures which can be defined by random functions of two or three co-ordinates. The function indicates whether any

(continued on page 95)

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STRATHCLYDE Robox Ltd Tel: 041 221 5402 WALES: SOUTH GLAMORGAN Datatype Terminals Ltd Tel: 063 33 65307

(continued from page 93)

given location is open corridor or solid wall. If the location is defined by co-ordinates X, Y and Z — for unit measurements east, north and downwards — then a possible function would be computed by the Basic subroutine:

```
9000 U = 100 * SQR (X *
X + Y * Y * Z)
9010 W = U - INT (U)
9020 RETURN
```

Note that negative Z should be avoided before calling this subroutine. If  $W > T$ , where T is a constant "threshold" value set at the beginning of the program, a wall is present; otherwise the given co-ordinates X, Y, Z define a corridor location.

### On the threshold

The maze represented by this function is clearly enormous. The co-ordinates are restricted only by the number of significant figures held for each variable in the particular computer. It requires no initial setting up and no data storage except for the threshold value, T. This threshold may be useful in Adventure games: by varying it only slightly some cells change from wall to corridor and vice versa, while most remain unaltered. In this way "earthquakes" can be simulated.

Once the function has been calculated for a given location the value returned, W, can provide further information about that location. By examining particular digits or groups of digits, and determining whether they lie within predetermined ranges, events or objects can be identified for the given location from preset tables which apply throughout the maze.

The probability of particular events or objects can be programmed into such tests. Suppose W has been calculated for the explorer's current location. Programming the Basic equivalent of  $V = \text{digits } 4, 5 \text{ and } 6 \text{ of } W$  if  $V \geq 20$  and  $V < 60$  then there is a monster here; the type also depends on V

gives a probability of  $(60-20)/1000 = 0.04$  of finding a monster at any location in the corridors — assuming that the random function is sufficiently random.

### Table of objects

Such methods can be used to determine numerous attributes for any location, each with different probabilities of occurring. Notice that these attributes are not affected at all by the earthquakes previously described. The snag with this technique is that objects cannot be

### Listing 2.

```
10 PRINT 'MAMMOTH MAZE IN 2.5 K-BYTES BY G.T.RELF'
20 REM SET STARTING POSITION (EAST, WEST, DOWN):
30 X=103 : Y=97 : Z=1
40 REM SET THRESHOLD:
50 T=0.3
60 REM RANDDHISE FOR EARTHQUAKES:
70 RANDOM
80 REM INSERT ANY OTHER INITIALISING STATEMENTS HERE.
90 REM MAIN LOOP:
100 REM COMPUTE PROPERTIES OF CURRENT LOCATION:
110 GOSUB 250
120 REM GET COMMAND & BRANCH ACCORDINGLY:
130 INPUT 'COMMAND'; CM$
140 CM%=LEFT$(CM$,1)
150 IF CM$='N' THEN 490
160 IF CM$='E' THEN 530
170 IF CM$='W' THEN 570
180 IF CM$='S' THEN 610
190 IF CM$='U' THEN 650
200 IF CM$='D' THEN 690
210 PRINT 'IMPOSSIBLE!'
220 GOTO 110
230 REM END OF MAIN LOOP.
240 REM COMPUTE ATTRIBUTES OF CURRENT LOCATION:
250 V1=INT(W*1000)
260 IF V1>35 AND V1<39 AND Z>1
THEN PRINT 'HERE IS A CROCK OF GOLD!'
270 REM (YOU WON'T FIND CROCKS OF GOLD
JUST LYING ON THE GROUND!)
280 REM INSERT OTHER ATTRIBUTE TESTS HERE:
290 REM CHECK FOR EARTHQUAKES:
300 IF RND(1000)=9
THEN PRINT 'RUMBLE, RUMBLE...': T=T+0.2*RND(0)-0.1
310 REM INSERT OTHER LOCATION-INDEPENDENT TESTS HERE.
320 REM IDENTIFY CORRIDORS FROM CURRENT LOCATION (CHANGES W):
330 IF Z=1 THEN 440
340 PRINT 'CORRIDORS : ' : NC=0
350 X=X+1 : GOSUB 720 : IF W<T THEN PRINT 'E ' : NC=NC+1
360 X=X-2 : GOSUB 720 : X=X+1 :
IF W<T THEN PRINT 'W ' : NC=NC+1
370 Y=Y+1 : GOSUB 720 : IF W<T THEN PRINT 'N ' : NC=NC+1
380 Y=Y-2 : GOSUB 720 : Y=Y+1 :
IF W<T THEN PRINT 'S ' : NC=NC+1
390 Z=Z+1 : GOSUB 720 : IF W<T THEN PRINT 'D ' : NC=NC+1
400 Z=Z-2 : GOSUB 720 : Z=Z+1 :
IF W<T OR Z=2 THEN PRINT 'U ' : NC=NC+1
410 IF NC=0 THEN PRINT 'NONE - THE EARTHQUAKE HAS TRAPPED YOU!'
420 PRINT
430 RETURN
440 PRINT 'GROUND LEVEL.'
450 Z=Z+1 : GOSUB 720 : Z=Z-1
460 IF W<T THEN PRINT 'SHAFT DESCENDS FROM HERE.'
470 RETURN
480 REM MOVE NORTH:
490 Y=Y+1 : IF Z=1 THEN 110
500 GOSUB 720 : IF W<T THEN 110
510 Y=Y-1 : GOTO 210
520 REM MOVE EAST:
530 X=X+1 : IF Z=1 THEN 110
540 GOSUB 720 : IF W<T THEN 110
550 X=X-1 : GOTO 210
560 REM MOVE WEST:
570 X=X-1 : IF Z=1 THEN 110
580 GOSUB 720 : IF W<T THEN 110
590 X=X+1 : GOTO 210
600 REM MOVE SOUTH:
610 Y=Y-1 : IF Z=1 THEN 110
620 GOSUB 720 : IF W<T THEN 110
630 Y=Y+1 : GOTO 210
640 REM MOVE UP:
650 IF Z=1 THEN 210
655 Z=Z-1 : IF Z=1 THEN 110
660 GOSUB 720 : IF W<T THEN 110
670 Z=Z+1 : GOTO 210
680 REM MOVE DOWN:
690 Z=Z+1 : GOSUB 720 : IF W<T THEN 110
700 Z=Z-1 : GOTO 210
710 REM RANDOM FUNCTION:
720 U=100*SQR(X*X+Y*Y*Z)
730 W=U-INT(U)
740 RETURN
```

moved, but are frozen into the random-number function. One way to avoid this problem is to keep a table of objects which the explorer has moved or altered. Such a table will be relatively small and can be organised so that the program can quickly determine whether there are any entries in it for the current location, e.g., by hash-coding the co-ordinates. This is a small price to pay for the other benefits.

Listing 2 shows a development program which experiments with these techniques. It is written in a general Basic, avoiding graphics, so that it will run on most machines, though it was developed in Tandy level-II Basic.

The program accepts six direction commands: east, north, west, south, up and down, each of which may be abbreviated to the initial letter. After each move, the initial letters of the directions of all open corridors leaving the new location are displayed. Invalid commands or attempts to move into the wall are greeted with the response "Impossible!"

When  $Z=1$  you have reached ground level, and further upward movement is prevented. The program starts at ground

level, where you may wander freely until you find a mineshaft going down. There are some very deep mines, but it is possible to get back out of them. Here lies the joy of this technique: by using various functions of the type described you can invent your own structures and explore them without knowing in advance what you will find.

The particular function used in this program is only an example and probably a rather poor one at that because it takes a significant time to compute. A "torch" command, finding the length of a straight corridor, can take several seconds to give an answer. You may well be able to develop faster functions with the desired properties, particularly if you are willing to experiment with assembly code. By using several such functions, very complicated game structures can be created, even in the smallest machines.

### Listing 1.

```
10 INPUT X
20 C = COS (X)
30 C = C * 100
```

```
40 C = ABS (C)
50 C = C - INT (C)
60 C = C * 100
70 C = INT (C)
80 PRINT C
```

Puts the third and fourth digits immediately to right of decimal point  
Ignore sign for next step of work.  
Chops off integer part.  
Puts the digits to left of decimal point.  
Chops off the fractional part.

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# Heart of the labyrinth

Find your way to the centre of the maze with this intriguing machine-portable game presented by P J Goss.

THIS PROGRAM creates a labyrinth through which the player has to move to find the centre. Four different sizes can be created with cells ranging from five by five to 11 by 11. The labyrinth is scrolled up the screen, leaving the player to move around in the dark. Occasionally the player is told how far away the centre is.

The program makes extensive use of arrays. The labyrinth is first created with all the cell walls intact and with no paths. This is done when array A is initiated. Arrays B and C are zeroed ready for use later on.

A path is then randomly created from the centre. A wall is removed from either the north, south, east or west side of a cell and from the adjoining cell until a continuous path is found to an outside wall.



```

10REM LABYRINTH P. J. GOSS 2-9-81
20DIM A[24,24],B[121],C[121]
30PRINT "***** LABYRINTH *****"
40PRINT
50PRINT "FOUR SIZES OF LABYRINTH ARE AVAILABLE"
60PRINT "AFTER SELECTING THE REQUIRED SIZE A"
70PRINT "LABYRINTH WILL BE DISPLAYED AND THEN"
80PRINT "DISAPPEAR FROM THE SCREEN."
90PRINT "TO MOVE AROUND THE LABYRINTH YOU ARE"
100PRINT "ASKED TO TYPE DIRECTIONS IN THE FORM"
110PRINT "OF N,S,E OR W."
120PRINT "TO FINISH TYPE F"
130PRINT
140PRINT "SIZE";
150INPUT L
160IF L<1OR L>4GOTO 130
170LET M=7+(INT(L)*4)
180GOTO 200
190REM*****INITIATE ALL ARRAYS*****
200FOR I=2TO M+1STEP 2
210FOR J=2TO M+1STEP 2
220LET A[I,J]=0
230LET A[I-1,J-1]=1
240LET A[I,J-1]=2
250LET A[I-1,J]=3
260NEXT J
270NEXT I
280LET A[(M+1)/2,(M+1)/2]=4
290GOTO 300
300FOR I=1TO 121
310LET B[I]=C[I]=0
320NEXT I
330REM*****SELECT RANDOM PATH FROM CENTRE*****
340LET D=1
350LET S=T=(M+1)/2
360LET B[1]=C[1]=S

```

(continued on next page)

Tests are made to stop the path turning back on itself, and to ensure that it is created with a pre-defined minimum length. The relevant values to signify the absence of a wall are stored in array A. The cell co-ordinates for the path to the centre are stored in arrays B and C.

The remainder of the labyrinth is created from the player's starting point. Tests are made in a clockwise sequence on the adjoining cells for a possible path. When one is found it continues until a dead end is reached. Further paths are then taken off the main route in the same way; when no further paths can be taken off the main route they are then taken off the secondary paths until the labyrinth is complete.

A subroutine is used to display the contents of the array A in a graphical form. The player's starting position is marked with a "?" and the centre with an "X". The screen is cleared by 23 line-feeds and the player is asked to move. If the display disappears too quickly a delay can be inserted before line 1340.

After each move the program decides if you have walked into a wall or tried to walk out of the labyrinth. A variable P keeps track of how far away the player is from the centre, and is displayed every six, five, four or three moves, depending on the size of the labyrinth. A continuous update of steps to the centre can be produced by making line 1780 an unconditional jump,

```
1780 GOTO 1800
```

When P=0 the game is over and the labyrinth is displayed again, but this time showing the path to the centre and the final position of the player. The same will happen if you give up before reaching the centre by typing F.

(continued from previous page)

```

0037 370LET Z=0
0038 380GOTO INT(RND<1>)*4)+10F 400,500,600,700,370
0039 390REM*****NORTHERN PATH SELECT*****
0040 400IF T=2:GOTO 460
0041 410IF A[S,T-2]=4OR Z=1:GOTO 380
0042 420LET Z=1
0043 430LET A[S,T-1]=0
0044 440LET T=T-2
0045 450GOTO 750
0046 460IF D<N-(INT(M/2)):GOTO 380
0047 470LET A[S,T-1]=0
0048 480GOTO 830
0049 490REM*****EASTERN PATH SELECT*****
0050 500IF S+2=M+1:GOTO 560
0051 510IF A[S+2,T]=4OR Z=2:GOTO 380
0052 520LET Z=2
0053 530LET A[S+1,T]=5
0054 540LET S=S+2
0055 550GOTO 750
0056 560IF D<N-(INT(M/2)):GOTO 380
0057 570LET A[S+1,T]=5
0058 580GOTO 830
0059 590REM*****SOUTHERN PATH SELECT*****
0060 600IF T+2=N+1:GOTO 660
0061 610IF A[S,T+2]=4OR Z=3:GOTO 380
0062 620LET Z=3
0063 630LET A[S,T+1]=0
0064 640LET T=T+2
0065 650GOTO 750
0066 660IF D<N-(INT(M/2)):GOTO 380
0067 670LET A[S,T+1]=0
0068 680GOTO 830
0069 690REM*****WESTERN PATH SELECT*****
0070 700IF S-2=0:GOTO 800
0071 710IF A[S-2,T]=4OR Z=4:GOTO 380
0072 720LET Z=4
0073 730LET A[S-1,T]=5
0074 740LET S=S-2
0075 750LET D=D+1
0076 760LET A[S,T]=4
0077 770LET B[D]=S
0078 780LET C[D]=T
0079 790GOTO 380
0080 800IF D<N-(INT(M/2)):GOTO 380
0081 810LET A[S-1,T]=5
0082 820REM*****CREATE REMAINDER OF LABYRINTH*****
0083 830LET E=F=G=0
0084 840FOR K=D+1 TO ((M-1)/2)^2
0085 850REM*****TEST FOR NORTH WALL BREAK*****
0086 860IF C[E]-2=0:GOTO 940
0087 870IF A[B[E],C[E]-2]=4:GOTO 940
0088 880LET A[B[E],C[E]-1]=0
0089 890LET A[B[E],C[E]-2]=4
0090 900LET B[K]=B[E]
0091 910LET C[K]=C[E]-2
0092 920GOTO 1160
0093 930REM*****TEST FOR SOUTH WALL BREAK*****
0094 940IF B[E]+2=M+1:GOTO 1020
0095 950IF A[B[E]+2,C[E]]=4:GOTO 1020
0096 960LET A[B[E]+1,C[E]]=5
0097 970LET A[B[E]+2,C[E]]=4
0098 980LET B[K]=B[E]+2
0099 990LET C[K]=C[E]
0100 1000GOTO 1160
0101 1010REM*****TEST FOR EAST WALL BREAK*****
0102 1020IF C[E]+2=M+1:GOTO 1100
0103 1030IF A[B[E],C[E]+2]=4:GOTO 1100
0104 1040LET A[B[E],C[E]+1]=0
0105 1050LET A[B[E],C[E]+2]=4
0106 1060LET B[K]=B[E]
0107 1070LET C[K]=C[E]+2
0108 1080GOTO 1160
0109 1090REM*****TEST FOR WEST WALL BREAK*****
0110 1100IF B[E]-2=0:GOTO 1190
0111 1110IF A[B[E]-2,C[E]]=4:GOTO 1190
0112 1120LET A[B[E]-1,C[E]]=5
0113 1130LET A[B[E]-2,C[E]]=4
0114 1140LET B[K]=B[E]-2
0115 1150LET C[K]=C[E]
0116 1160LET E=K
0117 1170GOTO 1270
0118 1180REM*****TEST FOR PATHS OFF MAIN
ROUTE*****
0119 1190IF F=2:GOTO 1240
0120 1200LET F=F-1
0121 1210LET E=F
0122 1220GOTO 860
0123 1230REM*****TEST FOR PATHS OFF PREVIOUS
PATHS*****
0124 1240LET G=G+1
0125 1250LET E=G
0126 1260GOTO 860
0127 1270NEXT K
0128 1280REM*****DISPLAY LABYRINTH*****
0129 1290LET A[B[D],C[D]]=7
0130 1300LET A[(M+1)/2,(M+1)/2]=6
0131 1310PRINT
0132 1320PRINT
0133 1330GOSUB 2040
0134 1340REM*****CLEAR SCREEN*****
0135 1350FOR I=1 TO 23
0136 1360PRINT
0137 1370NEXT I
0138 1380REM*****MOVE PLAYER TEST FOR COLLISION
AND EXIT
0139 1390LET S=B[D]
0140 1400LET T=C[D]
0141 1410LET P=D-1
0142 1420LET N=D
0143 1430LET W=R=V=0
0144 1440PRINT
0145 1450PRINT "N,S,E OR W"
0146 1460INPUT A$
0147 1470IF A$="N":GOTO 1530
0148 1480IF A$="S":GOTO 1570
0149 1490IF A$="E":GOTO 1610
0150 1500IF A$="W":GOTO 1650
0151 1510IF A$="F":GOTO 1960
0152 1520GOTO 1440
0153 1530IF A[S,T-1]=2:GOTO 1850
0154 1540IF T=2:GOTO 1890
0155 1550LET T=T-2
0156 1560GOTO 1690
0157 1570IF A[S,T+1]=2:GOTO 1850
0158 1580IF T+2=N+1:GOTO 1890
0159 1590LET T=T+2
0160 1600GOTO 1690
0161 1610IF A[S+1,T]=3:GOTO 1850
0162 1620IF S+2=M+1:GOTO 1890
0163 1630LET S=S+2
0164 1640GOTO 1690
0165 1650IF A[S-1,T]=3:GOTO 1850
0166 1660IF S-2=0:GOTO 1890
0167 1670LET S=S-2
0168 1680REM*****CALCULATE STEPS TO CENTRE*****
0169 1690FOR I=1 TO ((M-1)/2)^2
0170 1700IF S=B[I] AND T=C[I]:GOTO 1720
0171 1710GOTO 1750
0172 1720IF I<NLET P=P-1
0173 1730IF I>NLET P=P+1
0174 1740LET N=I
0175 1750NEXT I
0176 1760LET R=R+1
0177 1770IF P=0:GOTO 1930
0178 1780IF R=7:LGOTO 1800
0179 1790GOTO 1440
0180 1800LET V=V+R
0181 1810LET R=0
0182 1820PRINT
0183 1830PRINT "NUMBER OF STEPS TO CENTRE ARE "P
0184 1840GOTO 1440
0185 1850PRINT
0186 1860PRINT "OUCH! - YOU WALKED INTO A WALL"
0187 1870LET W=W+1
0188 1880GOTO 1440
0189 1890PRINT
0190 1900PRINT "YOU HAVE JUST TRIED TO WALK OUT"
0191 1910PRINT "OF THE LABYRINTH"
0192 1920GOTO 1440
0193 1930PRINT
0194 1940PRINT "YOU HAVE FOUND THE CENTRE IN "V+R+W
0195 1950PRINT "NUMBER OF BRUISES "W
0196 1960FOR I=2 TO D
0197 1970LET A[B[I],C[I]]=8
0198 1980NEXT I
0199 1990LET A[(M+1)/2,(M+1)/2]=6
0200 2000LET A[S,T]=7
0201 2010GOSUB 2040
0202 2020GOTO 2190
0203 2030REM*****LABYRINTH DISPLAY ROUTINE*****
0204 2040FOR J=1 TO M
0205 2050FOR I=1 TO M
0206 2060IF A[I,J]=0:PRINT " ";
0207 2070IF A[I,J]=1:PRINT "+";
0208 2080IF A[I,J]=2:PRINT "---";
0209 2090IF A[I,J]=3:PRINT "|";
0210 2100IF A[I,J]=4:PRINT " ";
0211 2110IF A[I,J]=5:PRINT " ";
0212 2120IF A[I,J]=6:PRINT "X";
0213 2130IF A[I,J]=7:PRINT "?";
0214 2140IF A[I,J]=8:PRINT "*";
0215 2150NEXT I
0216 2160PRINT " "
0217 2170NEXT J
0218 2180RETURN
0219 2190END

```

# British Genius



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# TROJAN HORSE

Atkin picked up the instruction leaflet and, not for the first time, turned to a single paragraph printed in red. "This circuitry is copyright", it stated. "Any attempt to probe, study, or otherwise examine, will cause the toy to harmlessly destruct".

He picked up the doll itself, lying face down on the bed where Tina had left it. Its large, round, blue eyes stared owlishly at him, meeting his troubled gaze with dumb insolence. Maybe the thing could see as well as hear. Yes, there was definitely something disturbing about the Candy doll, and if Tina had not been so attached to it he would have tried taking it apart, despite that admonitory red paragraph.

It had seemed such a good idea at first. For three years he had struggle to bring up Tina alone after his wife had left him — three years with a precocious, demanding, possessive little daughter, and an equally demanding job as project co-ordinator at System Alpha, heart of the Ministry of Defence computer network. Then the advertising material had arrived through the post. A glossy brochure introduced Candy, the cybernetic aid to the natural development of the young.

"The fabulous Candy doll"! it said. "Candy walks! Candy talks! Candy will enthral your daughter and keep her amused for hours.

"This unique creation stands two feet six inches tall, and is powered by an atomic battery. She has real hair which can be styled, plus four different fashion outfits. Candy is the ideal playmate for the intelligent child.

"Let our doll educate, instruct and entertain. Answer the following questions about your child's IQ and environment, and send the reply with the order form. The Candy doll's vocabulary will be individually matched to your child's needs.

"Stocks are limited, so order without delay". The address was a box number at a central London office.

The price was astoundingly low. Atkin had been unable to resist the offer, and a few days later had almost fallen over a large package on the front doorstep. In it was the doll, with its steely eyes and over-large head.

Tina had loved it. She spent hours imparting all manner of childish confidences to the toy, while it replied in its precise, pedantic little speaking voice. Atkin was able, after many a trying day, to relax in peace.

But that had been several weeks ago. Now there was too much silence, too much retreating into the nursery. Tina, the hitherto extrovert six-year-old, had

become subdued and sullen. The doll had never responded to Atkin's questions, apart from a peremptory "Give me back to Tina", so he had no idea what his child and the automaton had been discussing.

Atkin's worries were solely centred on his efficiency as a single parent. Having established that Tina was not misbehaving at school, and having been accused of over-reacting, he forced himself into

by Marise Morland

silence. To have done anything else would have been to admit to his inadequacies.

He was determined to cope, despite increasing pressures at work brought about by the mounting international tension. Naturally, he had tried to listen at Tina's door, but Candy's sensitive instrumentation had detected him at once. The doll's cry of "Hello Daddy!" had made him feel faintly ridiculous. The last thing he wanted was to look foolish in the eyes of his own child.

Atkin replaced the doll on the coverlet and quietly left the room. From now on, Tina and Candy would have privacy.

Years of preparation had elapsed before the Candy promotions had been sent out. Atkin and many other defence personnel had been under surveillance for a long time, ever since nuclear submarines had been discarded in favour of a less expensive land-based programme.

Atkin had always been high on the list of priority targets, but the departure of his wife had placed him at its head, for it

rendered him vulnerable in a way which ideally suited Candy's creators.

Spies could be relied on to co-operate in small matters such as the updating of pass-codes, but the main objective — it had long been decided — could only be implemented by someone who was totally ignorant of the consequences.

Candy's programming was as complete as possible on delivery, but the doll still received certain updates at irregular intervals, in the form of coded FM transmissions. Daily, it received Tina's undivided attention.

"Again, Candy! I want to hear Mummy again!"

"You heard her yourself, when you were three", Candy said placidly. "You heard why she was leaving Daddy. You were hiding on the stairs".

"Play her again", Tina repeated.

"You were very little when Mummy went away", said Candy in the same even tone. "Too little to understand why. Do you understand now?"

"Play her"! Tina was close to tears.

Finally, Candy obliged. Jean Atkin had rejected her daughter as well as her husband, but any such suggestion had been edited out. What the child heard, issuing tinnily through the doll's speech circuits, was: "I'm going away. Any other man would have seen the danger signs long ago, but not you. Too single-mindedly loyal to System Alpha. For five years I've had to put up with your unscheduled overtime, conferences, system malfunctions and Christ knows what else. Only I haven't been putting up with it, not for the past six months".



Here, Jean had described her lover, but that had prudently been deleted as well. "If you want me to stay", her voice continued, "you will have to change your job. If you are not prepared to make that sacrifice then there is nothing more to be said".

Atkin had remained silent. His injured pride would not allow him to plead. "That's it, then", said Jean after a moment. "I'm going. Oh, don't look so hurt, darling — you've still got your damned computer. You don't really need me!"

The recording ended. Tina stared expressionlessly at the floor.

"Do you understand why Mummy went?" repeated Candy.

"Course I do", Tina said crossly. "Don't keep on. It was Daddy's job".

"Would she come home if it were not for the job?" asked Candy. "I think she would, don't you?"

"Yes. But Daddy won't give it up. Not ever".

Many miles away, the split-second decision was made. This was the right moment to initiate phase two of the operation.

"Daddy will not resign as long as the computer's working", said Candy after a long pause. "But if it stopped, he would have to stop too! Think how pleased Mummy would be".

"She'd come back to us, said Tina with utter conviction. "But Daddy says the computer never stops".

"I could stop it", said Candy quietly. "I know how. But you will have to take me there".

Tina looked apprehensive. "I don't know the way".

"I'll show you".

"I'm not allowed out on my own", said Tina, twisting her hands together nervously.

"Don't be a baby", said Candy sharply. "You will not be on your own — you'll have me".

Tina stood in front of a large security door which looked uncompromisingly shut. "Hold me up to the voice identification grid", said Candy. "You should just be able to reach it. And remember what I told you on the way here — no talking when I'm talking, or you will spoil everything".

"Yes, Candy", said Tina dutifully. She hefted the doll by its ankles. In a perfect resonant imitation of Atkin's voice, Candy recited: "If music be the food of love, play on". The door rolled back.

"Candy, how did you do that?" Tina squealed.

"Quiet"! snapped Candy. "Do you want to get us caught? Run to the end of this passage, and hurry!"

Tina obeyed, scurrying fearfully along. High up in the walls, far above her head,

were transparent panels, from behind which came the sound of movement and chatter. Candy had not told her what to do if she met anyone, and she dared not ask now. The passage remained clear and they reached the security doors leading to the computer room, and once more Tina raised the doll as high as she could.

"Ill met by moonlight", pronounced Candy in Atkin's voice. The doors parted briefly, closing again as soon as Tina had stepped through. Inside, disc and tape drives whirred busily, but no people were in evidence. Beyond the rows of storage units was the unattended executive console.

Tina hesitated, warily hostile, before this array of hardware. "I don't like..." she began in a whisper.

"At the other end of the room there is a little TV", said Candy brightly. "Go over to it, and sit me on the chair".

Reassured, the child crossed to the executive console and perched Candy on the swivel chair which faced the VDU. Then she waited, fidgeting.

"Tina", said the doll after another long silence. "I'm not high enough to watch

## There was something profoundly disturbing about the Candy doll.

the screen. Find something to put on the chair seat, and sit me on top".

Candy had never before mentioned an ability to see, but Tina was too preoccupied to notice anything out of the ordinary. Tiptoeing back into the computer section, she found some surplus disc packs and returned with a pair of them.

"Good girl", said Candy after being repositioned. "I'm going to talk to the computer now, so stay absolutely quiet till I have finished. Do not go near the main doors. Is that clear"?

"Yes Candy". Tina took a couple of paces backwards and stood waiting.

"Shall I compare thee to a summer's day", Candy began, using Atkin's voice. "Request account utility".

The screen began to list options.

"Create new account holder", Candy continued.

"Priority levels one through six. Request voice print".

Bored by this incomprehensible conversation, Tina turned her attention to the rather pretty display of lights on the diagnostic panel.

"The quality of mercy is not strained". Candy's own voice had returned, quoting words from the screen. The new LD was

duly listed and acknowledged. Tina moved away and began to pick at a loose piece of wall tiling.

"The quality of mercy is not strained", Candy said again. "General network broadcast. Abort all current tasks. Erase existing account voice prints. Initiate network-test mode. Terminate interactive session."

The screen blanked. Candy then proceeded to give the Shakesperian identities of several key personnel, with voices to match. Each time the VDU responded with the simple statement "account nullified."

Suddenly there was a sharp crack. Little fragments like hailstones spattered briefly against the console as Tina whirled round. Her shriek was followed by a flood of incredulous tears. Her doll had gone.

Seconds later, the sobbing child ran from the computer room. She was met by a throng of people who had been trying to get in. Atkin was among them.

"What on earth..." he began, seizing his daughter and shaking her. "Tina! Tina, what are you doing here?"

"We were stopping the computer for Mummy", said Tina when she had calmed down enough to speak. "Candy talked in your voice and a lot of different voices. I put the things on the chair so she could talk to the television, and then she... she..." Her face crumpled once again.

"There is no possible error", said the general. "Norad confirms that ICBMs have been launched against the United Kingdom".

"Then why don't the fools retaliate"?

"It looks like someone has taken out their defence network, sir. Have you your permission to launch a counter-strike"?

The President, unlike his predecessor, was not a warlike man. He paused only a moment before replying.

"No, Commander you have not".

"But sir," he protested. "The terms of the NATO alliance clearly state..."

"I am aware of the terms", snapped the President. "But unless the hostiles are aimed at our own shores, we do not use counter-force. That, gentlemen, is final".

The radar screens were dotted with traces, each heading for a selected target. Technicians worked frantically, trying to countermand Candy's instructions, though, like Atkin, they knew perfectly well there would not be enough time to start a launch.

One blue, glass eyeball, the single recognisable part of the wrecked doll, stared accusingly from the floor. Atkin stood next to his lost, lonely little daughter, who clutched earnestly at his arm.

"I'm sorry, Daddy", she whispered. "Can I make it better, Daddy? Can I"?

Overwhelmed by a chilling sense of failure, Atkin gazed blankly at the screen as the traces moved steadily onward. □

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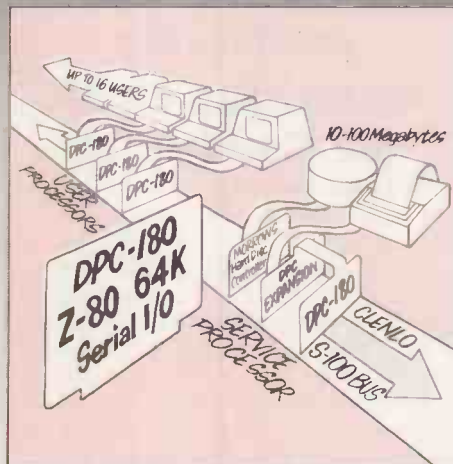
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# An Atom in exile

ST HELENA is one of the most remote places on Earth. A tiny volcanic island about half the size of the Isle of Wight, it lies just over 2,000 km south of the equator in the South Atlantic. The west coast of Africa is 1,700km away.

As one of the last few Crown colonies in Britain's possession, St Helena is administered by a rearguard of colonials. Its 5,000 inhabitants, despite their provenance from Africa, Asia and South America, share only seven family names and look to England as the centre of their world. Many households sport a picture of the Queen in their living rooms. The first video recorder arrived on the island complete with a recording of the wedding of the Prince and Princess of Wales, and it was almost done to death as the inhabitants clamoured to see the events which had taken place several weeks previously in London.

It was against this background that a recent expedition by a fieldwork group from University College, London introduced the microcomputer. The machine in question was an Acorn Atom with which the deputy leader of the expedition, Tony Nicholson, proposed to undertake statistical analysis of the results of human geography researches into the people of St Helena.

## Use and abuse

So small and rugged is the island that there is no airstrip. Transport from the U.K. is strictly by boat, with stops at Tenerife and Ascension Island. The



The ship's faltering power supply was a severe test for the micro.

14,000 km trip on the RMS *St Helena* — the last Royal Mail ship in existence — follows an old spice-trade route and takes three weeks. Once the micro was embarked at Avonmouth, there could be no looking back.

It is a credit to the construction quality and general reliability of the Atom that it performed almost flawlessly throughout the long period of use and abuse of the field trip. The computer was loaded and

unloaded from a lighter at St Helena, where the ship moors offshore since there is no proper harbour. It was demonstrated by team members to the ship's crew and passengers, and to the Public Works Department of the island's administration. Perhaps the most severe test of all came when it was hammered by classes of schoolchildren who had never before played, or even seen, Space Invaders. It was even used at sea, on deck, hooked up to the occasional deck power supply which is driven by the ship's generators at a nominal 60Hz.

## Mainframe to micro

One of Nicholson's prime objectives was to see how a standard micro would behave in field conditions. Computing is nothing new to geographical and geological studies, and Nicholson had used Leicester University's Cyber CDC as an undergraduate. More recently he worked with University College's GEC minis — which recently replaced an IBM 360 mainframe — and London University's Prime. Despite this mainframe-oriented background he sees the future of computing in geography departments lying with linked micros. Few departments will have sufficient funds, he believes, to replace equipment of this size.

Casting around for a suitable micro for geographical work, he had used both Pet and Sharp machines. He was looking, he says, for a robust, popular and cheap personal computer with good graphics. Acorn Computer became one of many sponsors who contributed, directly or indirectly, to setting up the expedition with its travel arrangements, supplies, equipment and insurance.

The Atom was finally delivered in kit

form, one month before the ship was due to sail. In that period Nicholson assembled and tested the computer and wrote the necessary software in Basic, modelling its features on the statistical package implemented on the Prime mini.

The package offers the following facilities:

- Product-moment correlation coefficient and test statistic.
- Simple linear regression and test statistic.
- Analysis of variance (parametric).
- Student's t-test.
- Histogram — asterisks only, as the graphics space is used to store data.
- Mean and standard deviation; subsequently combined under the heading "descriptive statistics".
- Log 10 transformation, with the results of the transformation stored in a user-specified column.
- Autocorrelation.
- List one variable.
- Amend data.
- Save data set on tape.
- Input data set from keyboard or tape.

This formidable list of subroutines has been crammed into rather less than 6K, leaving the other partition, normally used as the graphics area, free for data.

## Widespread interest

Data is stored as a series of columns, each representing a different variable. The main constraints are that variables should consist of equal numbers of cases and the data set should not exceed 1,000 items. After a data set has been entered, a prompt is printed to which the user replies with a four-line command to choose the operations required. The bulk of the program is loaded from 2900 hex and consists of a series of subroutines taking approximately 5K. A simple control program, loaded into the graphics area at 8200 hex, dimensions array space and then transfers control to the main program. The data set is thus loaded into the graphics area, optimising available memory space. Nicholson hopes to take advantage of the graphics feature — which he had specifically looked for — in a future map-plotting program.

The principal use of the computer to the expedition was in analysing the answers to 1,000 questionnaires on emigration which had been sent to St Helenites before the expedition set sail. Part of Tony Nicholson's purpose was to promote and popularize the microcomputer, and he succeeded in arousing interest in a number of quarters, including the Secondary Selective School and among island officials.

# Satellite tracker scans the skies

SINCE THE first Oscar satellite was launched in 1961 there has been an ever-increasing interest in the specialised techniques of space communications. The reception of cloud-cover pictures from the American NOAA and Soviet Meteor weather satellites has also proved to be an interesting challenge to many, amateurs and professionals alike. The first British amateur satellite Uosat, launched last year, heralds a new era in amateur satellites. Uosat carries a number of experiments which are designed to allow ground stations to investigate a variety of physical phenomena ranging from microwave propagation to solar particles.

For full use to be made of some of the ionospheric propagation experiments, ground stations must have orbital predictions of the highest possible accuracy.

The most important information required to track a satellite on a particular pass is a series of parameters known as "look angles". These are simply aerial aiming angles which specify the direction of the satellite as viewed by the observer. Look-angles have three elements:

Azimuth, AZ — the bearing, measured in degrees clockwise from north, to the point on the Earth's surface vertically below the satellite known as the sub-satellite point.

Elevation, EL — the vertical angle between the horizon and the satellite measured in the direction of the azimuthal bearing.

The time for which a particular set of AZ-EL data is valid.

The combination of ground-station location, satellite and time results in a unique look angle. Generating a set of look angles calls for extensive calculation using spherical trigonometry, and to sim-

A program from David O'Neill with which you can pinpoint the position of any Earth satellite.

plify this procedure most stations adopt a graphical approach to tracking. This usually involves preparing a chart of true bearings from the station to various points on the Earth's surface, which is a tedious process in itself. Subsidiary charts of elevation and track must then be constructed for each satellite; when used with the true-bearing chart, they yield the look angles for a particular orbit.

Such charts are more than adequate for aerial-aiming. A chart error of 5° might seem large, but it is quite insignificant when used to aim an aerial with a beam width of perhaps 50°.

British Aerospace's transmission-test satellite was launched in May 1978.

Many stations do not attempt to track the satellite at all but use a simple, fixed, low-gain aerial such as a turnstile. Though this is adequate for overhead passes, it is less satisfactory on low-angle passes when the satellite is always close to maximum range. Higher transmission frequencies also favour the use of high-gain steerable aeri-als. For SHF propagation experiments using the Uosat microwave beacons on 2.401GHz and 10.470GHz steerable aeri-als are essential.

The main features of the program are:

- Generation of reference-orbit data,
- Generation of azimuth and elevation angles.
- Latitude and longitude of the sub-satellite track.
- Slant range of the satellite.
- Accurate rise and set times.
- Time of closest approach.
- Ease of updating changing orbital parameters.
- All times displayed in GMT; hours, minutes and seconds.

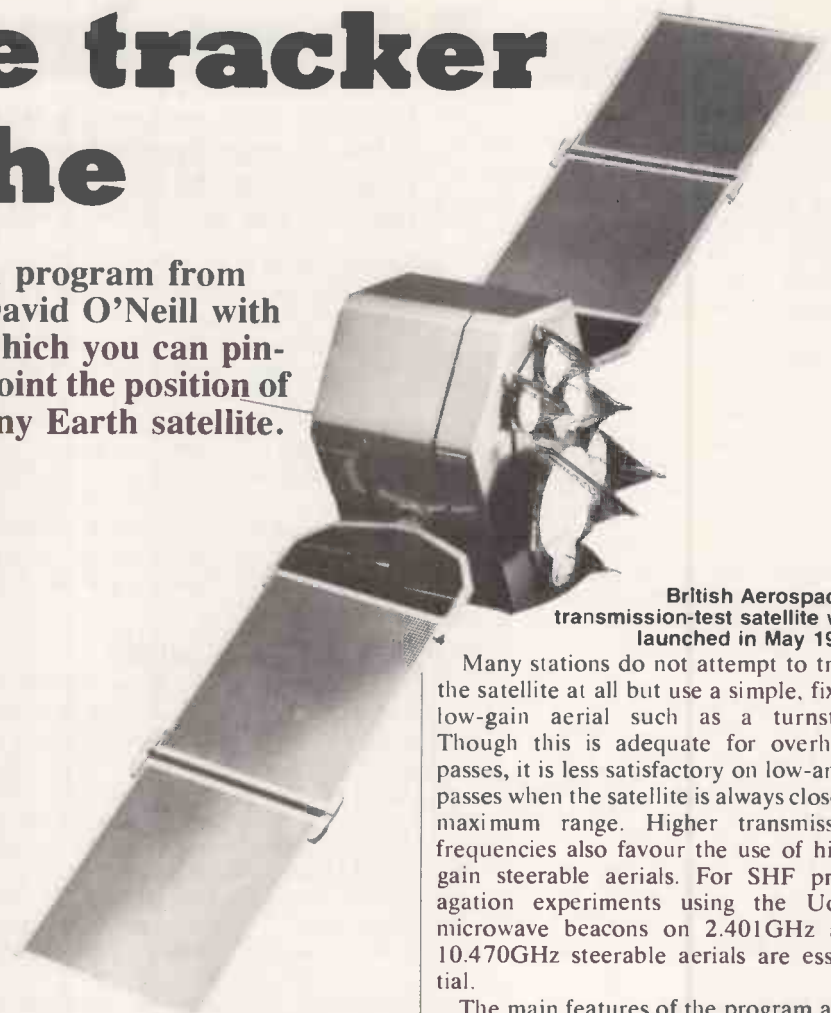
With the addition of the necessary hardware, the program can be adapted to automatically track the aerial as the satellite makes a pass.

The program displays time with a resolution of one second, though the accuracy of all calculated values is ultimately dependent on the accuracy of the orbital parameters used in the program. These parameters should be updated as frequently as possible.

All the equations used in the program assume a circular orbit and a spherical earth; satellites with markedly elliptical orbits will produce erroneous data.

When the EQX time (equatorial crossing time) and longitude are input, the program calculates the EQX time and longitude for the next 10 orbits, or more if requested.

After the EQX time and longitude for the orbit of interest, the program requests a start time. This is the period of time



```

45 REM ***** SATELLITE TRACKING *****
50 REM ***** D O'NEILL - GMS FRD *****
55 CLEAR 500
75 V$ = "*****.      %      %      ###.##"
80 U$ = "%      %      ##.#      ##.##      #####"
85 L1=0.062471 : L2=0.960972
100 CLS : PRINT"WHICH SATELLITE DO YOU REQUIRE?" : PRINT : PRINT
105 PRINT"          1. TIROS-N" : PRINT
110 PRINT"          2. UOSAT" : PRINT : PRINT
115 INPUT"ENTER CODE":N : ON N GOTO 150,155
120 CLS : PRINT"WHICH OPTION?" : PRINT : PRINT
125 PRINT"          1. REFERENCE ORBITS" : PRINT
130 PRINT"          2. AZ-EL CALCULATIONS" : PRINT : PRINT
135 INPUT"ENTER CODE":N : ON N GOTO 1200,400
150 P=102.1241 : PH=1 : PM=42 : PS=7.45 : PL=25.53 : I1=1.726352 :
RH=7235 : R=0.881799 : GOTO 120
155 P=98.0 : PH=1 : PM=38 : PS=0 : PL=24.5 : I1=1.701696 : RH=8901
R=0.9232 : GOTO 120
400 CLS : INPUT"WHAT IS THE EQX TIME - HHMMSS":XG$
405 XH$=LEFT$(XG$,2) : XH=VAL(XH$)
410 XM$=MID$(XG$,3,2) : XM=VAL(XM$)

```

(Listing continued on next page)



L1 Station longitude  
 L2 Station latitude  
 L3 Sub-satellite longitude  
 L4 Sub-satellite latitude  
 L5 EQX longitude (degrees west)  
 C Quadrant angle  
 EL Satellite elevation  
 I1 Orbit inclination  
 D Great-circle angle  
 P Period in minutes  
 PH Period (hours)  
 PM Period (minutes)  
 PS Period (seconds)  
 PL Longitude increment per orbit  
 T Time after EQX (minutes)  
 AZ Azimuth  
 RH Earth radius + satellite altitude  
 R Earth radius ÷ RH  
 RA Slant range

Table 1. Program variable list.

between EQX and the first calculation. The next request is for the time interval between calculations.

By way of a demonstration, try the following values for Tiros-N.

|                |        |
|----------------|--------|
| EQX time       | 144630 |
| EQX longitude  | 345    |
| Start time     | 0600   |
| Time increment | 0200   |

Six sets of data should be printed out, starting at 14 52 30 and ending at 15 02 30.

The sub-satellite track is not normally required but is available and may be printed out with the AZ-EL data by including L3 and L4 in the relevant Print lines. The direct, line-of-sight distance between the ground station and the satellite, known as the "start range", is printed out in kilometres.

The rise time of the satellite is the time at which it appears on the horizon, i.e., when its elevation is zero. Ionospheric refraction may render the radio beacon audible while the satellite is still below the horizon, and the acquisition-of-signal (AOS) time or the radio-rise timing differ from the true rise time. The beacon may be heard for some time after the satellite has set thus giving a loss-of-signal (LOS) time or radio-set time. To realise the full value of Uosat's propagation experiments the true rise and set times of the satellite must be established as accurately as possible.

To calculate the rise time, the AZ-EL routine is used to obtain a time when the satellite elevation is close to zero but negative. It is then used as the start time for the following run, and the time increment is reduced. By repeating this process a few times, a close approximation to the rise time can be obtained. A subroutine can be incorporated into the program to perform the iterative process of arriving at the rise or set time.

The satellite is closest to the observer when its elevation is at its maximum. The time of closest approach can be found by applying the iterative process.

Orbital parameters are held in lines 150 and 155. The period is held in

(Listing continued from previous page)

```

415 XS=RIGHT$(XG$,2) : XS=VAL(XS$)
420 PRINT : INPUT"WHAT IS THE EQX LONGITUDE - DEGREES WEST";L5
425 PRINT : INPUT"HOW LONG AFTER EQX IS THE START TIME - MMSS";ST$
430 SM=LEFT$(ST$,2) : SM=VAL(SM$)
435 SS=RIGHT$(ST$,2) : SS=VAL(SS$)
440 PRINT : INPUT"WHAT IS THE TIME INCREMENT - MMSS";DT$
445 DM=LEFT$(DT$,2) : DM=VAL(DM$)
450 DS=RIGHT$(DT$,2) : DS=VAL(DS$)
455 XG=XH$+" "+XM$+" "+XS$ : CLS
460 PRINT"CALCULATIONS START "SM$ MINS "SS$" SECS AFTER EQX
    AT "XG$" / "L5 : PRINT : PRINT
465 S=0 : M=0 : H=0 : T=SM+SS/60
470 S=X+SS
475 IF S>=60 THEN S=S-60 : M=M+1 : GOTO475
480 M=XM+SM+M
485 IF M>=60 THEN M=M-60 : H=H+1 : GOTO 485
490 H=XH+SH+H : IF H>=24 THEN H=H-24
495 GOSUB 1300 : GOSUB 1400
500 PRINT" GMT          AZIMUTH          ELEVATION  RANGE" : PRINT
505 PRINT USING U$;G$,AZ*57.29578,EL*57.29578,RA
510 FOR I=1 TO 6
515 S=S+DS : IF S>=60 THEN S=S-60 : M=M+1
520 M=M+DM : IF M>=60 THEN M=M-60 : H=H+1
525 IF H>=24 THEN H=H-24
530 T=T+DM+DS/60 : GOSUB 1300 : GOSUB 1400
535 PRINT USING U$;G$,AZ*57.29578,EL*57.29578,RA : NEXT I
540 PRINT : INPUT"OPTIONS - 1.SAME ORBIT 2.NEW ORBIT 3.NEITHER";N
    CLS
545 ON N GOTO 425,400,100
1199 REM ***** REFERENCE ORBIT ROUTINE *****
1200 SC=0 : S=0 : M=0 : H=0
1205 CLS : INPUT"WHAT IS THE ORBIT NUMBER";N : PRINT : PRINT
1210 INPUT"WHAT IS THE EQX GMT - HHMMSS";XG$
1215 XH=LEFT$(XG$,2) : H=VAL(XH$)
1220 XM=MID$(XG$,3,2) : M=VAL(XM$)
1225 XS=RIGHT$(XG$,2) : S=VAL(XS$) : GOSUB 1400
1230 PRINT : PRINT : INPUT"WHAT IS THE EQX LONGITUDE - DEG WEST";L5
1235 CLS : PRINT"ORBIT NO.          EQX GMT          EQX LONG"
1240 PRINT : PRINT USING V$;N,G$,L5
1245 FOR I=1 TO 10
1250 N=N+1 : L5=L5+PL : IF L5>=360 THEN L5=L5-360
1255 B=S+PS+SC : S=INT(B) : SC=B-S : IF S>=60 THEN S=S-60 : M=M+1
1260 M=M+PM : IF M>=60 THEN M=M-60 : H=H+1
1265 H=H+PH : IF H>=24 THEN H=H-24
1270 GOSUB 1400 : PRINT USING V$;N,G$,L5 : NEXT I
1275 PRINT : PRINT : INPUT"OPTIONS - 1. NEXT 10 ORBITS 2. NEW REF
ORBIT 3.NEITHER";Z : ON Z GOTO1235,1200,55
1299 REM ***** AZ - EL ROUTINE *****
1300 SI=SIN(6.283185*T/P)*SIN(I1)
1305 L4=ATN(SI/SQR(-SI*SI+1))
1310 CO=COS(6.283185*T/P)/COS(L4)
1315 L3=1.570796-ATN(CO/SQR(-CO*CO+1))+T*0.004363+(L5*0.0174533)
1320 IF L3>=6.283185 THEN L3=L3-6.283185
1325 IF L3>=0 AND L3<=3.141593 THEN L=L3 : GOTO 1335
1330 L=L3-6.283185
1335 L=L1-L
1340 IF L>3.141593 THEN L=L-6.283185
1345 IF L<=-3.141593 THEN L=L+6.283185
1350 X=ATN(COS(L)/TAN(L4))
1355 C=ATN((SIN(X)*TAN(L))/COS(L2+X))
1360 IF L>0 AND C>0 THEN AZ=C
1365 IF L>0 AND C<0 THEN AZ=C+3.141593
1370 IF L<0 AND C>0 THEN AZ=C+3.141593
1375 IF L<0 AND C<0 THEN AZ=C+6.283185
1380 CO=(SIN(L2)*SIN(L4))+COS(L2)*COS(L4)*COS(L)
1385 I=1.570796-ATN(CO/SQR(-CO*CO+1))
1390 EL=ATN(COS(D)-R)/SIN(D)
1395 RA=RH*SIN(D)/SIN(1.570796+EL) : RETURN
1399 REM ***** GMT ROUTINE *****
1400 IF SC10 THEN S$="0"+RIGHT$(STR$(S),1) ELSE S$=RIGHT$(STR$(S),2)
1405 IF MC10 THEN M$="0"+RIGHT$(STR$(M),1) ELSE M$=RIGHT$(STR$(M),2)
1410 IF HC10 THEN H$="0"+RIGHT$(STR$(H),1) ELSE H$=RIGHT$(STR$(H),2)
1415 G$=H$+" "+M$+" "+S$ : RETURN
    
```

minutes and also in hours, minutes and seconds as PH, PM, PS. PL is the longitude increment, i.e., the angle by which the Earth rotates between two consecutive equatorial crossings. The inclination of the orbit plane is held in I1.

The values given in line 150 are typical of a Tiros-N spacecraft, and those in line 155 are the expected values for Uosat.

A subroutine enables all times to be

displayed in the standard form of HH, MM, SS to permit direct readout of the GMT times for which the calculations are valid. The station longitude, L1 and latitude, L2, are set in line 85. Longitudes east of Greenwich are negative.

Lines 75,80 are the image lines for Print Using statements. For machines without this facility the Print statements must be formatted accordingly. □

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For the next generation of buyers, the packaging and charisma of the product will be more important than its technical niceties. Martin Hayman argues that manufacturers who ignore this trend do so at their peril.

IMAGE-MAKING is an under-rehearsed phenomenon in microcomputing. At present this is perhaps a welcome situation, for when one product so closely resembles another — who is to tell the difference between two floppy discs? — the essence of the product is in the features it offers to the user. Amateur computer users generally have a high level of awareness of what they are buying and using, and would feel slighted if anyone were to suggest otherwise. The kind of hype which surrounds the record and audio-cassette industry, you might think, is not for us.

Nevertheless, it will come. As entry-level systems get steadily cheaper, more of the uninitiated will be buying machines which they, at least, will call a "computer". No matter that it might only be capable of running Asteroids, and that the principal input is from a pair of joysticks rather than a keyboard. One of the future selling features of the games computers — which are becoming available in steadily increasing numbers in High Street electrical stores — will be upward compatibility with all sorts of other peripherals including, obviously, a keyboard.

Increasingly, the first sale will be made on availability, support, advertising, packaging, TV slots — perhaps, even, favourable reviews secured from journals like this one. In short, image-making and hype will be to the fore.

There are products which will not require any external boost to their image particularly if there is already sufficient recommendation in the name itself, but these are unlikely to be the High Street entry-level systems which will attract the future mass market for home-computing products. The BBC Micro will be one such, thanks to the august nature and intrinsic respectability of its sponsor. Another, of course, will be IBM's Personal Computer.

### Charismatic element

Others will have to offer more before they even start to compete, and will have to shape up their selling techniques accordingly. In some cases an element of personal charisma may help to sell a product which is otherwise only the equal of its competitors.

One example is the Osborne briefcase micro. Doubtless it will soon be joined by other, smaller, faster, more powerful portable micros. But it is likely to remain pre-eminent, not only because it was the first such computer on the scene, but also

# Pulling in the public

for the name of its creator, West Coast micro guru Adam Osborne.

Not for nothing do the crack salesmen — even in software — simply ask for the market, the price, the discount structure and the availability, and tell their masters: "Forget the features, just let me get on with the job of selling it". Does IBM send its Hursley research personnel into the field to argue the merits of their systems to the potential customers? It does not.

To return nearer to our field, in which a herd of disconsolate telesoftware sheep are grazing. What about the manufacture of Modems, vital to any process of data communication? There can be no doubt that the Datel 600 Modem, which is supplied to many customers of British Telecom in scores of different configurations, is a solid and robust device. We even have one here at *Practical Computing*. It took



ModTech brings showbiz to telesoftware, using French farce and roller-skaters.

about two months to agree the specification with British Telecom and to get it installed — a process which also involved getting BT approval for the Research Machines 380-Z, but that's another story.

In the meantime the swashbuckling proprietor of Modular Technology, John McNulty, had arranged for us to have one of his smaller, simpler and lighter Modems. It worked, which is more than can be said of the communications software attached to the Research Machines.

McNulty's ModTech operation is an example of the high-profile — some might even say charismatic — approach to selling what is to the customer, little more than a small box. It may be significant that the ModTech Modem is finished in poppy red while the Datel is a staid ironside grey. Yes, of course everyone knows that BT now sells Mickey Mouse telephones, but look at all the cheap and mouthwatering appliances advertised in the mail-order catalogues.

ModTech's stand at recent Compec exhibitions, for example, has always been noted for its racy presentation. In 1980 there was a bevy of attractive young ladies

scooting around on roller skates and last year it featured the concept "Linking the Unlinkable". The stand was divided into two parts, with space-age decor on one wing and an antique Louis l'Hotel scene on the other. On the modern side there was a micro which was communicating with an obsolete teleprinter installed on the French farce side.

The ostensible message was that you can drive anything from anything else with a ModTech Modem. More to the point, it featured some very presentable young women who attracted heavy traffic to the ModTech stand from among the predominantly charcoal-suited gentlemen who attended Compec. Only the Nashua Data Products stand, where they were giving away free vinyl footballs in exchange for your business card, attracted a comparable surge of clients. These, mark you, are business professionals. How much more will the newcomer be swayed by presentation and all the razzmatazz of packaging, presentation and good, old-fashioned hype?

### The greyer products

The manufacturers of the greyer micro products would do well to take note of Atari's plans to establish a users' network in Britain. Along with its parent company, Ingersoll, Atari is owned by Warner Brothers — an organisation best known for its interests in film, cable TV and the record industry. An Atari users' club, communicating via the usual U.S. 300/300baud standard, is already in operation in the States and Atari's U.K. outfit has expressed interest in implementing a Prestel-standard communications network. There is even a consultant working on the enhancement.

A Prestel interface for the Atari 400/800 would be a boost for Prestel telesoftware. Regular computer users might not think much of these brightly-packaged machines and their garish games cartridges, but the capability to load new games, or update with new versions of existing games from the telephone line — via Prestel and through the Gateway to Atari's own games database — could prove a strong sales point. Some of the existing features of Atari's network service in the U.S. — which includes news of hardware developments and catalogues of Ingersoll's extensive range of electronic products, plus the possibility of ordering by direct credit-card debit — cannot fail to add to the attractions. In the end, it may be promotion rather than technical features which wins the struggle for the teenager's pocket money. M

Assess your talent as a programmer with Michael Smith's Patsy, the Programmer Aptitude Testing System. It makes its choice according to analytical abilities.

# Patsy's gift for spotting programming skill

THE MOST DIFFICULT problem in selecting people for training as programmers is ensuring that the trainees will have the necessary blend of abilities to benefit fully from the training course, and to make sure that they will develop, with experience on the job, into competent programmers. This requires an identification of the prerequisite skills, and a test or series of tests which will have the necessary predictive power to indicate which candidates will justify spending money and time to train.

There is considerable evidence that a programmer needs only three fundamental skills. This may startle some readers and infuriate others, but more than 20 years as a programmer in charge of the training and employment of programmers has convinced me of the truth of this assertion. I suggest that the basic skills are as follows:

- Literacy. The ability to read and write reasonably simple English.
- Numeracy. For most applications, certainly in the commercial field, the equivalent of O-level mathematics is quite adequate.
- Logical/analytical ability. The ability to break a problem down into its constituent parts or requirements, and then to build up a solution on a logical basis.

When testing for these abilities, it soon becomes apparent that the situation is not quite so simple. There are perfectly satisfactory methods of testing in the first two areas using "paper and pencil" types of test which have been in use for many years, but you come to the crunch when you start to think about the third requirement — perhaps the most crucial of all the three.

There are "pencil and paper" tests which claim to measure logical ability, for example the type sometimes called Progressive Matrices, or "fill in the next two numbers in the series". I have used a number of tests of this type, and though solving them requires an element of logical ability I feel they suffer from a number of drawbacks.

The most serious shortcoming is that the recommended procedure is usually to sit the candidate down at a table, give him the test paper and instructions, start the clock and leave him to it. At the end of the stipulated period his paper is removed and marked and you are, perhaps, convinced that you have tested something. However, many people have become very familiar with this type of test, and there is evidence that familiarity increases speed

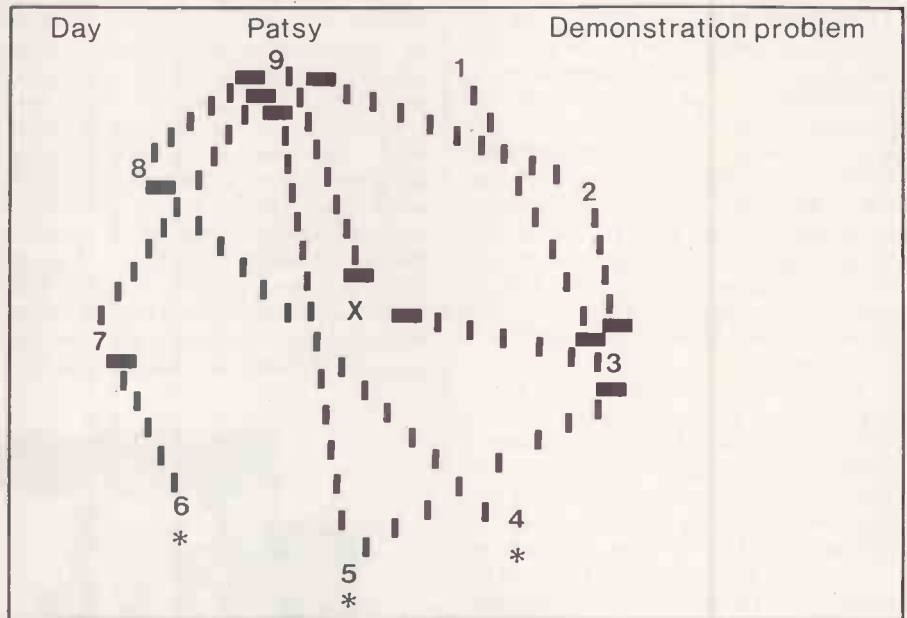


Figure 1. The display for the demonstration problem.

in completing these tests. A more serious criticism is that they provide no idea just how the candidate hit on the solutions even of those problems which were completed correctly. In other words, there is no test of the most vital factor — the analytical ability of the candidate. To test for it, the examiner needs to be able somehow to observe the mental processes brought to bear on the problem, or at

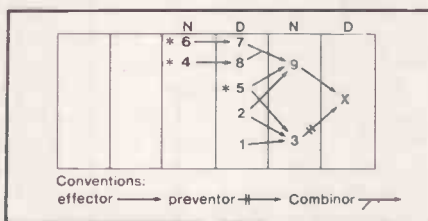


Figure 2. Notation used for solution.

least the nature of the steps which the candidate takes to solve it.

Patsy — Programmer Aptitude Testing System — presents the candidate with a set of 10 problems. It includes a demonstration problem which the examiner works through in the course of his explanation, and four grades of increasingly complex problems. There are alternative problems at each level of complexity, which can help to eliminate collusion between successive candidates.

When the program is run, a menu of the 10 problems is displayed first. After a selection from the menu is made, the screen displays the numbers 1 to 9

arranged in a circle, with a letter X in the centre of the circle and a number of lines running across the circle from one number to another and to the central X. In the top left corner of the screen, the word "Day" appears. After an interval of some three seconds this alternates with the word "Night" in the same position. This alternation of day and night continues throughout the solution of each problem — see figure 1. The number of the problem being worked on is also displayed.

When a number key is pressed on the keyboard, a lighted graphics block or "light" appears on the screen next to the corresponding number, and remains on until the end of the time period during which it was switched on. At the start of the next period, the "light" goes out, and if a line on the screen connects that number to some other, or the centre, then the light for the latter number may be turned on, depending on a relationship which the line represents.

Solving the problem is very much a matter of discovering the relationships that exist within the problem. The principal rules of the problem are typed on a card which is available to the candidate throughout the testing session.

The program is written for a TRS-80 in level II Basic and fits into 16K. The rather crude representation of an arrow — rule 5 — is necessary because of the low-resolution graphics on the TRS-80. On a

machine with higher resolution graphics, you can undoubtedly provide a more elegant display.

Converting the program to other micros should be straightforward, except for the routine which detects single or coincident key depressions, lines 3010 to 3050. On the TRS-80, RAM location 14352 contains a power of two from  $2^1$  to  $2^7$  whenever a number key from 1 to 7 is pressed, or the addition of the corresponding powers if a combination of keys is pressed. Similarly, location 14368 contains  $2^n$  when an 8 is pressed and  $2^1$  for a 9.

The routine in question sorts out what has been pressed and turns the lights on accordingly. Your micro no doubt does things differently, and if you cannot see how to produce a routine which does the same thing, you probably have the Inkey\$ function which you can make use of instead. You may have to introduce into the rules a prohibition on simultaneous key depressions.

If you want to change the problem setups which I give — although they are good ones — lines 10000, 10100, 10200, etc., give the start of each set-up. Array T determines whether lights are day or night workers in any one problem — 1 for day, 2 for night. Lines 10n20 to 10n50 give the logical relations for day workers, and lines 10n60 to 10n80 give those for night workers, using Boolean operators And and Not; n in the line number is the problem number as per the menu. The Data lines 20 to 350 are used to set screen points for the relationship lines and are those appropriate for the TRS-80 screen format of 128 by 48 points. These lines are, unfortunately, tedious to key in and will in any case need to be changed for different screen formats.

The procedure is, if anything, more important than the program. It is vital to have uniformity of testing conditions and procedure, and at the start of testing the candidate should always be provided with

**Table 1. An outline of the grading scheme used.**

| Grade | Recommendation | Problem levels solved |   |   |   |           |  | Remarks |
|-------|----------------|-----------------------|---|---|---|-----------|--|---------|
|       |                | 1                     | 2 | 3 | 4 | 4 with MO |  |         |
| A     | HR             | *                     | * | * | * | *         | } 16 minutes<br>} 20 operations<br>on MO |         |
| A-    | HR/R           | *                     | * | * | * | *         |  |         |
| B+    | R              | *                     | * | * | * | *         |  |         |
| B     | MR/R           | *                     | * | * | * | X         |  |         |
| B-    | MR/NR          | *                     | * | * | * |           |  |         |
| C+    | MR/NR          | *                     | * | * | X |           |  |         |
| C     | NR             | *                     | * | * |   |           |  |         |
| C-    | NR             | *                     | * | * |   |           |  |         |
| D+    | NR             | *                     | * | X |   |           |  |         |
| D     | NR             | *                     | * |   |   |           |  |         |
| D-    | NR             | *                     | X |   |   |           |  |         |
| E+    | NR             | *                     |   |   |   |           |  |         |
| E     | NR             | X                     |   |   |   |           |  |         |

**Key:** HR: Highly recommended  
R: Recommended  
MR: Marginally recommended  
NR: Not recommended  
\*: Problem solved at this level  
X: Partial solution due to excessive time or less than total understanding  
MO: Minimum operations

paper for notes, pencil and eraser. Any candidates who have never sat in front of a micro keyboard before should be allowed to spend a little time familiarising themselves with the keys, although only keys 1 to 9 will be used.

The examiner then runs the program and selects the demonstration problem, 0 on the menu. The examiner should work through this, first showing how an effector relation from light 9 turns on the centre block while a preventor from light 3 stops this from happening. All the other relations in this problem are simple effectors and can be demonstrated as such, except for a combinator from lights 7 and 8 which turns on light 9. Thus all the possible types of relation between the various lights can be demonstrated. A solution involving only keys 4, 5 and 6 should then be shown.

The answer to the demonstration problem is to press 4 and 6 during the night period. Any questions which arise should be answered by the examiner, who should ensure at this stage that the candidate has a good understanding of what is involved.

When all is clear, press Enter to return to the menu. On the TRS-80, Clear can be used at any time to turn off all lights on the display. Problem 1A should then be selected and the candidate told to start. There is no specific time limit for each problem, but I have found the following limits for each level:

- level 1: 10 minutes
- level 2: 15 minutes
- level 3: 17 minutes
- level 4: 20 minutes

A candidate who is clearly nowhere near a solution after these times should be told to abandon the problem. The relations involved in that problem are then explained and the solution demonstrated. An alternative problem at the same level is then presented. A candidate's session finishes if the second problem is not solved. After a candidate has solved a

problem at one level, the test should be taken to the next level.

When the candidate has successfully solved a problem at level 2, a system of notation is introduced to him, equivalent to a form of flow-charting. It is explained that its use is optional, but that it may help to solve succeeding problems.

An example of the notation is shown in figure 2, which represents the demonstration problem. The vertical lines represent time periods, and a sensible use of the notation would be first to put an X in the

*(continued on page 111)*

### Summary of Principal Rules

The problem is solved when you manage to turn on the centre light three times in succession using only keys 4, 5 and 6. These are marked with an asterisk on the screen to remind you of their importance. The "best" solution will be one derived from full understanding of the logical relations involved. You may be asked to explain your solution.

1. Time is derived into two periods called "day" and "night".
2. Every light is active in only one or other of the time periods.
3. The number keys do nothing except turn on their respective lights. Hold the key down. If the light does not come on after a fraction of a second, wait until the time changes and press the key again.
4. There are three kinds of relation between lights:
  - Effector — this turns on the light the line points to.
  - Combinor — this works only in combination with another light.
  - Preventor — this prevents a light from being turned on.
5. Each line indicates the existence of one relation. The small block permanently shown at one end of the line can be thought of as an arrow-head showing the direction of the line. If there is no line between two lights, neither one affects the other.
6. The relation takes effect in and only in the following time interval. After a light has gone out, it has no effect until turned on again. All relationships exist between lights; it makes no difference whether the light was turned on by pressing a key or as a result of a relation between lights.
7. Within a time interval the order of key depressions makes no difference. Keys may be pressed one at a time or simultaneously.
8. You may press any number keys or any combination at any time. You may combine asterisked keys and non-asterisked, you may press an asterisked key and follow up with a non-asterisked key or vice versa.
9. You may "back up" or start again at any time. That is, if you have tried an unsuccessful asterisk key combination, you may switch to non-asterisk key operations to get more information.
10. You may study the problem diagram on the screen as long as you wish. You may take notes. You may refer to this sheet. You may ask questions to clarify the rules.
11. Every problem is solvable. There are no "tricks" or "secrets" or ambiguous rules.

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|--|--|-----|-----|-----|-----|--|---------------------------|--|------|-----|------|------|-----|
| Mr/s O. referred by  |  |     |     |     |     | Mr/s S. referred by  |                           |  |      |     |      |      |     |
| was examined by M. Smith on 23/12/80 from 1.55 to 3.05   |  |     |     |     |     | was examined by J. Buchanan on 22/7/81 from 2.00 to 3.45   |                           |  |      |     |      |      |     |
| Instructions used: Standard X Other Minimum operations on problem 4B   |  |     |     |     |     | Instructions used: Standard X Other  |                           |  |      |     |      |      |     |
| Sequence of problems   |  | 1A  | 2A  | 3A  | 4A  | 4B   | Sequence of problems      |  | 1A   | 1B  | 2A   | 3A   | 3B  |
| Solved (S) Not solved (N)  |  | S   | S   | S   | S   | S  | Solved (S) Not solved (N) |  | N    | S   | S    | N    | S   |
| Minutes worked   |  | 4.0 | 7.9 | 6.4 | 7.0 | 6.3  | Minutes worked            |  | 10.5 | 6.1 | 15.4 | 21.4 | 7.7 |
| Total operations   |  | 13  | 34  | 21  | 22  | 10   | Total operations          |  | 44   | 10  | 46   | 91   | 35  |
| Quality Rating for Total Performance: A  |  |     |     |     |     | Quality Rating for Total Performance: C—   |                           |  |      |     |      |      |     |
| Analytical Characteristics Exhibited: Very little Some Much X  |  |     |     |     |     | Analytical Characteristics Exhibited: Very little Some X Much  |                           |  |      |     |      |      |     |
| X Consistently Analytical on problems 4A and 4B  |  |     |     |     |     | X Consistently analytical  |                           |  |      |     |      |      |     |
| X Primarily Analytical on problems 1A, 2A and 3A   |  |     |     |     |     | X Primarily analytical (but very redundant) on problem 3A  |                           |  |      |     |      |      |     |
| Sparadically Analytical  |  |     |     |     |     | X Sparadically analytical on problem 3B  |                           |  |      |     |      |      |     |
| Adopts analytical methods when other approaches fail   |  |     |     |     |     | Adopts analytical methods when other approaches fail   |                           |  |      |     |      |      |     |
| Initially analytical but abandons the method   |  |     |     |     |     | Initially analytical but abandons the method   |                           |  |      |     |      |      |     |
| Little evidence of analytical ability  |  |     |     |     |     | X Little evidence of analytical ability on problems 1A, 1B and 2A  |                           |  |      |     |      |      |     |
| Comments on performance: Ms O. demonstrates a concise, analytical attack over all problems. Her understanding of problem logic was accurate and thorough except for one relation on 2A and one on 3A. Her descriptions became more analytic and better organised with each succeeding problem. |  |     |     |     |     | Comments on performance: Mr S. attempted to solve the first three problems with the exclusive use of asterisk keys. His solutions to 1B and 2A appear to have been arrived at by chance. His descriptions of these problems were entirely in terms of the display phenomena with little reference to the exact nature of the relationships. He then used highly redundant analysis on 3A, but did not solve the problem because he failed to investigate one key relationship. |                           |  |      |     |      |      |     |
| Recommendation: Ms O. is highly recommended for computer programmer training.  |  |     |     |     |     | Recommendation: Mr S. is not recommended for computer programmer training.   |                           |  |      |     |      |      |     |

Figure 3. Two typical performance reports, one for a pass candidate and one for a fail.

(continued from page 109)

right-hand division, representing the target centre block, then entering in the division to the left of those numbers which have lines leading to the centre, and so on. As the relations in the problem are investigated and identified, they can be coded on the diagram, using the conventions shown. The examiner should observe whether the notation, once introduced, is used effectively in subsequent problems.

If problem 4A is successfully solved, the candidate should finally be set problem 4B. The candidate is instructed to make the maximum use of logic in order to minimise the number of operations, an operation being all activity — pressing one key or several — which takes place within one time period.

Different grades are allocated to what appears to be identical performance in the various levels of problem since performance on a particular problem is assessed on its logical and analytical content. A problem may be solved, but with

varying evidence of these qualities. The following terminology is used:

**Analytical.** Refers primarily to method, the breakdown of actions into their component parts.

**Logical.** Refers primarily to the correctness of the description of the solution.

For example, given  $6 - 8 - 9$ , the following might be found:

Logical and analytical: 9 is lit by 8 which is lit by 6

Analytical but not logical: 9 is lit by 8 which is lit by 2

Logical but not analytical: 6 eventually causes 9 to light

Figure 3 shows two typical performance reports produced from a testing session, one for a pass candidate and one for a fail. The examiner's assessment is very much a result of observing the candidate during the test itself. Judgements can then be made on the candidate's approach to problems involving increasingly complex logical relationships, and the level of analytical ability brought to the solution. This is the exceptionally

powerful aspect of this testing method, which I have not found to be equalled by any of the others I have used over the years.

The testing procedure is greatly enhanced by the use of a system containing a line printer. Routines could be added to the program which will

- Print a time marker on a separate line for each time period,
- Record all key depressions taking place within one time period,
- Print a marker every time the display is clear, i.e., all lights go out.

It should be quite simple to implement, and will then provide a permanent printed record of exactly what the candidate did at any given moment while progressing towards a solution. Such a record frees the examiner from the need to observe the candidate's actions, comments, etc.

If your system has a real-time clock, it could be used to terminate each problem, and it should not be difficult to devise a form of automatic scoring.

```

1 REM ** PROGRAMMER APTITUDE TESTING SYSTEM **
2 REM ** COPYRIGHT (C) 1981 BY MICHAEL SMITH **
10 REM ** THE DATA LINES FOLLOWING CONTAIN THE SETTING
    POINTS FOR THE RELATIONSHIP LINES FOR ALL THE
    PROBLEMS. THESE ARE THOSE APPROPRIATE FOR A
    SCREEN LAYOUT OF 128 X 48 POINTS. **
20 DATA 84,10,87,12,90,14,93,16,96,18,99,20,102,22,104,24,105,24,106,24,100,16,95,15,85,13,80,12,75,11,70,10,65,9,60,8,54,7,55,7,56,7,109,18,109,20,109,22,108,24,1
09,24,110,24,106,26,102,26,98,26,94,26,90,26,86,26,82,26,78,26,74,26,68,26,69,26
30 DATA 70,26,94,38,87,36,80,34,73,32,66,30,59,28,52,26,45,24,38,22,31,20,23,18,24,18,25,18,75,40,81,38,87,36,93,34,99,32,104,30,105,30,106,30,67,40,65,37,63,34,61
,31,57,25,55,22,53,19,51,16,49,13,46,10,47,10,48,10,35,38,32,36,29,34,26,32
40 DATA 22,30,23,30,24,30,25,26,28,23,34,17,37,14,40,11,43,9,42,9,43,9,22,13,25,12,28,11,31,10,34,9,37,8,39,7,40,7,41,7,50,9,52,11,54,13,56,15,58,17,60,19,62,21,6
2,22,63,22,64,22,79,9,76,11,73,13,70,15,67,17,64,19,61,21,60,23,61,23,62,23
50 DATA 103,15,99,16,95,17,91,18,87,19,83,20,79,21,75,22,71,23,66,24,67,24,68,24,104,26,100,26,96,26,92,26,88,26,84,26,80,26,76,26,72,26,66,26,67,26,68,26,89,38,86
,37,83,36,79,35,76,34,73,33,70,32,67,31,64,30,61,29,58,28,55,27,52,26,49,25
60 DATA 46,24,43,23,40,22,37,21,34,20,31,19,28,18,24,17,25,17,26,17,94,38,91,36,88,34,85,32,82,30,79,28,74,25,73,24,68,21,62,17,59,15,56,13,53,11,49,9,50,9,51,9,69
,40,73,38,77,36,81,34,89,30,93,28,99,24,102,22,105,20,107,18,108,18,109,18
70 DATA 68,42,73,40,78,38,93,32,98,30,102,28,103,28,104,28,37,39,40,38,43,37,46,36,49,35,52,34,55,33,58,32,61,31,67,29,70,28,73,27,79,25,82,24,85,23,88,22,91,21,94
,20,97,19,100,18,101,17,102,17,103,17,20,30,25,28,30,26,35,24,45,20,50,18,55,16
80 DATA 64,13,69,11,73,9,74,9,75,9,20,19,20,21,20,23,19,25,20,25,21,25,41,9,39,11,37,13,35,15,33,17,29,21,27,23,25,22,27,23,27,24,27,71,8,64,9,57,10,50,11,43,12
,36,13,29,14,24,15,25,15,26,15,102,14,99,13,96,12,93,11,90,10,86,9,87,9,88,9
90 DATA 105,26,101,26,97,26,93,26,89,26,85,26,81,26,77,26,73,26,67,26,68,26,69,26,67,37,99,35,101,33,103,31,105,30,106,30,107,30,68,40,71,38,74,36,77,34,80,32,83,3
0,86,28,92,24,95,22,98,20,100,18,101,18,102,18,64,39,63,37,62,35,61,33,60,31,59,29
100 DATA 58,27,57,25,56,23,55,21,54,19,53,17,52,15,51,13,48,9,49,9,50,9,38,39,44,38,50,37,56,36,68,34,74,33,86,31,92,30,98,29,102,28,103,28,104,28,33,38,31,36,29,3
4,27,32,25,30,22,28,23,28,24,28,21,25,25,25,29,25,33,25,37,25,41,25,45,25,49,25
110 DATA 53,25,59,25,60,25,61,25,26,17,34,18,41,19,48,20,62,22,65,23,66,23,67,23,50,6,54,6,58,6,62,6,66,6,70,6,74,6,75,6,76,6,76,9,74,11,72,13,70,15,68,17,66,19,64
,21,61,23,62,23,63,23,97,15,92,14,87,13,69,10,64,9,59,8,53,7,54,7,55,7
120 DATA 102,29,96,28,90,27,84,26,78,25,72,24,66,23,67,23,68,23,95,37,94,35,93,33,92,31,91,29,89,25,88,23,87,21,86,19,85,17,84,15,83,13,82,11,82,10,83,10,84,10,90,
39,87,38,84,37,81,36,78,35,75,34,72,33,65,31,62,30,59,29,56,28,53,27
    
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(continued on page 113)

# ITT 2020

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**SYSTEM SPECIFICATIONS:** ITT 2020 Microcomputer: Standard ASCII Keyboard displaying 24 lines x 40 Characters in upper case: optional lower case display available. 6502 CPU, 48K Bytes RAM and 12K fast floating point Palsoft Basic in ROM. Both high resolution (360 x 192) and low resolution colour graphics, ports for up to seven peripherals and paddle ports as standard. Manufactured in Britain under licence from Apple – largely compatible with Apple hardware and software (contact Lion for advice – this is NOT an Apple). ITT Disk Drive. 116K Capacity, random or sequential file access, 35 Track soft sectored disks – Apple DOS 3.2 (contact Lion for advice on other operating systems). Field Maintenance contracts for all equipment are available.

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● Circle No. 171



(continued from page 111)

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130 DATA 50,26,47,25,44,24,41,23,38,22,35,21,32,20,29,19,24,18,25,18,26,18,38,38,41,37,44,36,47,35,50,34,53,33,56,32,59,31,65,29,68,28,71,27,74,26,81,24,84,23,90,2
0,93,19,96,18,97,18,98,18,65,39,66,37,67,35,68,33,69,31,70,29,73,22,74,20
140 DATA 75,18,76,16,77,14,78,12,78,10,79,10,80,10,30,38,28,36,26,34,24,32,20,30,21,30,22,30,20,25,23,23,26,21,32,17,35,15,38,13,41,11,43,9,44,9,45,9,28,16,36,18,4
0,19,44,20,48,21,52,22,56,23,58,24,59,24,60,24,52,9,55,10,58,11,61,12
150 DATA 64,13,67,14,73,16,78,18,81,19,84,20,90,22,93,23,96,24,99,25,102,26,103,26,104,26,87,9,90,10,93,11,96,12,99,13,102,14,103,14,104,14,101,16,97,17,93,18,89,1
9,85,20,81,21,77,22,73,23,67,24,68,24,69,24,107,26,107,24,107,22,107,20,106,18,107,18
160 DATA 108,18,95,38,97,36,99,34,101,32,103,30,102,29,103,29,104,29,88,40,83,39,78,38,73,37,68,36,63,35,58,34,53,33,48,32,43,31,38,30,33,29,26,28,27,28,28,28,64,4
0,60,38,56,36,52,34,44,30,40,28,36,26,32,24,28,22,24,20,19,18,20,18,21,18,36,40
170 DATA 39,38,42,36,45,34,51,30,54,28,57,23,58,24,59,24,60,24,60,24,31,20,34,18,37,16,40,14,43,12,45,10,46,10,47,10,29,14,36,13,51,11,57,10,64,9,71,8,75,7,7
6,7,77,7,49,9,53,13,55,15,57,17,59,19,61,21,62,23,63,23,64,23
180 DATA 79,9,77,11,75,13,73,15,71,17,69,19,67,21,65,23,66,23,67,23,108,18,108,20,108,22,108,24,107,26,108,26,109,26,104,28,102,26,100,24,98,22,96,20,94,18,92,16,9
0,14,88,12,85,10,86,10,87,10,96,36,97,33,98,30,99,27,101,21,101,18,102,18
190 DATA 103,18,64,41,64,39,64,37,64,35,64,33,64,31,64,29,63,27,64,27,65,27,33,38,32,36,31,34,30,32,29,30,28,28,27,26,26,24,25,22,24,20,22,18,23,18,24,18,34,36,35,
34,36,32,37,30,38,28,39,26,40,24,41,22,42,20,43,18,44,16,45,14,46,12,46,10,47,10
200 DATA 48,10,22,29,33,27,45,25,52,24,57,23,58,23,59,23,24,15,31,14,38,13,54,11,62,10,70,9,75,8,76,8,77,8,44,9,41,11,34,16,31,18,28,20,22,24,18,26,19,26,20,26,76,
6,74,8,72,10,70,12,68,14,66,16,64,18,62,20,59,22,60,22,61,22
210 DATA 98,16,93,17,88,18,83,19,78,20,73,21,68,22,65,23,66,23,67,23,102,26,100,24,98,22,95,20,91,15,90,13,88,11,85,9,86,9,87,9,90,41,86,40,82,39,78,38,74,37,70,36
,66,35,61,34,56,33,51,32,46,31,41,30,36,29,29,28,30,28,31,28,96,38,92,37,88,36
220 DATA 84,35,80,34,76,33,72,32,68,31,64,30,59,28,55,27,53,26,47,25,43,24,39,23,35,22,31,21,27,20,23,19,18,18,19,18,20,18,64,39,65,37,67,33,69,29,70,27,71,25,72,2
3,74,19,75,17,76,15,77,13,78,11,78,9,79,9,80,9,66,38,68,37,72,35,74,34,78,32
230 DATA 80,31,82,30,84,29,86,28,88,27,90,26,92,25,94,24,96,23,100,21,102,20,104,19,106,18,107,18,108,18,31,37,33,35,34,33,35,31,37,27,38,25,40,21,41,19,42,17,43,1
5,44,13,45,11,45,9,46,9,47,9,34,37,36,36,38,35,40,34,42,33,44,32,48,30,50,29
240 DATA 53,28,57,26,58,25,59,25,60,25,25,27,28,27,31,27,34,27,40,27,43,27,46,27,49,27,52,27,58,27,61,27,64,27,67,27,73,27,76,27,79,27,82,27,85,27,91,27,94,27,97,2
7,98,27,99,27,26,14,29,13,32,12,35,11,38,10,41,9,42,9,43,9
250 DATA 54,7,60,8,66,9,84,12,96,14,97,14,98,14,78,9,76,11,74,13,72,15,70,17,67,20,65,22,63,23,64,23,65,23,102,15,96,16,89,17,82,18,75,19,61,21,54,22,47,23,40,24,3
3,25,24,26,25,26,26,103,26,98,26,93,26,88,26,83,26,78,26,74,26,70,26,66,26,67,26,68,26
260 DATA 92,38,91,35,90,32,89,29,87,23,86,20,85,17,84,14,83,11,81,9,82,9,83,9,99,36,103,34,107,32,110,30,111,30,112,30,60,40,57,39,54,38,51,37,48,36,45,35,42,34,39
,33,36,32,33,31,30,30,27,29,23,28,24,28,25,28,63,41,63,39,63,37,63,35,63,33,63,31
270 DATA 63,29,62,27,63,27,64,27,39,39,42,38,45,37,51,35,54,34,57,33,60,32,66,30,69,29,72,28,75,27,81,25,84,24,90,22,93,21,96,20,99,19,101,18,102,18,103,18,33,38,3
4,36,35,34,37,30,38,28,39,26,41,22,42,20,43,18,44,16,45,14,46,12,47,10,46,9,47,9
280 DATA 48,9,19,26,22,25,25,24,28,23,21,22,34,21,37,20,40,19,46,17,49,16,52,15,55,14,58,13,61,12,64,11,67,10,70,9,73,8,74,7,75,7,76,7,25,14,32,15,39,16,53,18,60,1
9,74,21,80,22,93,24,99,25,100,25,101,25,101,25,40,7,37,8,34,9,31,10,28,11,25,12,26,12,27,12
290 DATA 75,10,74,12,72,15,70,18,68,21,65,22,66,22,67,22,74,8,68,9,62,10,56,11,50,12,44,13,38,14,32,15,25,16,26,16,27,16,98,16,94,17,90,18,86,19,82,20,78,21,74,22,
70,23,66,24,67,24,68,24,105,25,101,25,97,25,93,25,89,25,85,25,81,25,77,25,73,25
300 DATA 70,25,71,25,72,25,95,37,94,35,93,33,92,31,91,29,90,27,88,23,87,21,85,17,84,15,83,13,82,11,80,9,81,9,82,9,68,41,72,40,75,39,78,38,81,37,84,36,87,35,90,34,9
6,32,99,31,102,30,103,29,104,29,105,29,60,41,53,39,46,37,39,35,32,33,25,31,19,30
310 DATA 20,30,21,30,33,36,31,30,30,27,29,24,28,21,25,18,26,18,27,18,22,25,25,23,31,19,34,17,41,12,44,10,45,9,46,9,47,9,24,15,28,15,36,15,40,15,44,15,48,15,52,15,5
6,15,60,15,64,15,68,15,76,15,80,15,88,15,92,15,94,15,95,15,96,15
320 DATA 51,6,55,6,59,6,63,6,67,6,71,6,72,6,73,6,56,7,62,8,88,12,94,13,99,14,100,14,101,14,79,10,77,12,75,14,73,16,71,18,69,20,67,22,65,23,66,23,67,23,102,13,99,12
,96,11,93,10,90,9,87,8,88,8,89,8,106,25,106,23,106,21,106,19,105,18,106,18,107,18
330 DATA 102,25,98,25,94,25,90,25,86,25,82,25,78,25,75,25,71,25,67,25,68,25,69,25,90,37,84,35,78,33,71,31,64,29,57,27,50,25,43,23,36,21,29,19,25,18,26,18,27,18,88,
35,84,32,48,9,79,28,76,26,72,23,70,22,65,18,62,16,60,14,58,12,54,10,51,8,50,7,51,7,52,7
340 DATA 66,41,69,39,72,37,75,35,81,31,84,29,87,27,93,23,96,21,99,19,100,17,101,17,102,17,24,29,28,29,32,29,36,29,40,29,44,29,48,29,52,29,56,29,60,29,68,29,72,29,7
6,29,88,29,92,29,96,29,100,29,102,29,103,29,104,29,22,27,26,25,30,23,41,19,46,17
350 DATA 51,15,56,13,61,11,67,9,70,7,71,7,72,7,73,40,42,39,48,38,54,37,60,36,66,35,72,34,90,31,95,30,96,30,97,30,26,16,31,17,36,18,46,20,51,21,56,22,59,23,60,23,61
,23,41,7,39,9,37,11,35,13,33,15,27,21,25,23,22,25,23,25,24,25
1000 DEFINA=B,D-Z
1010 BS=STRINGS(2,143):CS=STRINGS(2,128)
1020 A(0)=543:A(1)=167:A(2)=372:A(3)=629:A(4)=878:A(5)=927:A(6)=848:A(7)=585:A(8)=330:A(9)=151 ' PRINT POSITIONS
1030 REM ** MENU OF PROBLEMS **
1040 CLS:PRINTCHR$(23):PRINT"TO SELECT PRESS
DEMO PROBLEM 0
PROBLEM 1A 1
PROBLEM 1B 2
PROBLEM 1C 3
PROBLEM 2A 4
PROBLEM 2B 5
PROBLEM 3A 6
PROBLEM 3B 7
PROBLEM 4A 8
PROBLEM 4B 9"
1050 PRINT"
PLEASE SELECT OPTION":
1060 IS="" :IS=INKEYS:IFIS="" THEN 1060 ELSE:ASC(IS)-48
1070 IF<CORP> THEN 1060 ELSE:GOSUB 6010 :ONP+IGOSUB 10000, 10100, 10200, 10300, 10400, 10500, 10600, 10700, 10800, 10900 ' SET UP PROBLEM
2000 REM ** MAIN DAY AND NIGHT TIMING LOOP **
2010 TI=1:PRINT@0,"DAY ";:GOSUB 4010 :ONP+IGOSUB 10060, 10160, 10260, 10360, 10460, 10560, 10660, 10760, 10860, 10960 :GOSUB 5010 :FORI=1TO7:GOSUB 301C
:NEXT
2020 TI=2:PRINT@0,"NIGHT";:GOSUB 4010 :ONP+IGOSUB 10020, 10120, 10220, 10320, 10420, 10520, 10620, 10720, 10820, 10920 :GOSUB 5010 :FORI=1TO7:GOSUB 301C
:NEXT:GOTO 2010
3000 REM ** KEYBOARD DECODING ROUTINE **
3010 IFPEEK(14400)=1 THEN 1040 ELSEIFPEEK(14400)=2 THEN:GOSUB 4010 :FORI=1TO9:BI(1)=0:NEXT ' LOCATION 14400 CONTAINS 1 WHEN ENTER IS PRESSED
ED, 2 WHEN CLEAR IS PRESSED.
ENTER TAKES YOU BACK TO THE MENU,
3020 B=PEEK(14352)+PEEK(14368)*256 'CLEAR TURNS OUT ALL LIGHTS ON THE DISPLAY.
[ THIS LINE CODES NUMERIC KEYS (SEE TEXT)
3030 FORI=0TO9:C=B/2:B=INT(C):IPC=B>GANDT(I)=TITHENB(I)=1:PRINT@A(I),BS;
3040 NEXT
3050 RETURN
4000 REM ** CLEAR THE DISPLAY **
4010 FORI=1TO9:PRINT@A(I),CS;:NEXT:PRINT@A(0),"X ";:RETURN
5000 REM ** SCAN RELATIONSHIP RESULTS **
5010 FORK=1TO9:IFC(K)=0 THENB(K)=0ELSEB(K)=1
5020 C(K)=0:NEXT:RETURN
6000 REM ** DRAW THE BOARD **
6010 CLS:PRINT@28,"P A T S Y";:PRINT@92,STRINGS(9,131);:PRINT@149,"9";:PRINT@170,"1";:PRINT@328,"8";:PRINT@375,"2";:PRINT@543,"X";:PRINT@583,"7";:PRINT@632,"3";:P
INT@846,"6";:PRINT@910,"*";:PRINT@881,"4";:PRINT@945,"*";:PRINT@925,"5";:PRINT@989,"*";:RETURN
7000 REM ** DRAW THE LINES **
7010 RETURN
10000 REM ** SET UP PROBLEM 0 (DEMO) **
10010 T(1)=1:T(2)=1:T(3)=2:T(4)=2:T(5)=1:T(6)=2:T(7)=1:T(8)=1:T(9)=2:RESTORE:FORI=1TO106:READX,Y:SET(X,Y):NEXT:PRINT@45,"DEMO PROBLEM";:RETURN
10015 REM ** ESTABLISH RELATIONSHIPS **
10020 IFB(1)PRINT@A(3),BS;:C(3)=1
10030 IFB(2)PRINT@A(9),BS;:PRINT@A(3),BS;:C(3)=1:C(9)=1
10040 IFB(5)PRINT@A(3),BS;:PRINT@A(9),BS;:C(3)=1:C(9)=1
10050 IFB(7)ANDB(8)PRINT@A(9),BS;:C(9)=1:RETURNELSE:RETURN
10060 IFNOTB(3)ANDB(9)PRINT@A(0),BS;
10070 IFB(4)PRINT@A(8),BS;:C(8)=1
10080 IFB(6)PRINT@A(7),BS;:C(7)=1:RETURNELSE:RETURN
10100 REM ** SET UP PROBLEM 1 (1A) **
10110 T(1)=2:T(2)=2:T(3)=2:T(4)=1:T(5)=1:T(6)=1:T(7)=1:T(8)=2:T(9)=2:POKE16639,196:POKE16640,70:FORI=1TO146:READX,Y:SET(X,Y):NEXT:PRINT@45,"PROBLEM 1A";:RETURN
LOCATIONS 16639 & 16640 CONTAIN A POINTER TO LAST DATA ITEM READTHIS LINE RESETS IT !
10120 IFB(4)PRINT@A(8),BS;:PRINT@A(9),BS;:C(8)=1:C(9)=1
10130 IFB(5)PRINT@A(2),BS;:PRINT@A(3),BS;:C(2)=1:C(3)=1
10140 IFB(6)PRINT@A(2),BS;:C(2)=1
10150 IFB(7)PRINT@A(1),BS;:C(1)=1:RETURNELSE:RETURN
10160 IFB(1)ANDB(2)ANDNOTB(3)PRINT@A(0),BS;
10170 IFB(8)ANDB(9)PRINT@A(7),BS;:C(7)=1:RETURNELSE:RETURN
10200 REM ** SET UP PROBLEM 2 (1B) **
10210 T(1)=1:T(2)=2:T(3)=2:T(4)=1:T(5)=1:T(6)=1:T(7)=2:T(8)=2:T(9)=2:POKE16639,79:POKE16640,74:FORI=1TO116:READX,Y:SET(X,Y):NEXT:PRINT@45,"PROBLEM 1B";:RETURN
10220 IFB(1)PRINT@A(8),BS;:C(8)=1
10230 IFB(4)PRINT@A(3),BS;:C(3)=1
10240 IFB(5)PRINT@A(2),BS;:PRINT@A(9),BS;:C(2)=1:C(9)=1
10250 IFB(6)PRINT@A(3),BS;:PRINT@A(7),BS;:C(3)=1:C(7)=1:RETURNELSE:RETURN
10260 IFB(2)ANDB(9)PRINT@A(1),BS;:C(1)=1
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10270 IFB(3)AND(8)ANDNOT(7)PRINT@A(0),BS::RETURN;SERETURN
10300 REM ** SET UP PROBLEM 3 (1C) **
10310 T(1)=2:T(2)=2:T(3)=2:T(4)=1:T(5)=1:T(6)=1:T(7)=2:T(8)=2:T(9)=1:POKE16639,22:POKE16640,77:FORI=1TO145:READX,Y:SET(X,Y):NEXT:PRINT@45,"PROBLEM 1C":RETURN
10320 IFB(4)PRINT@A(1),BS::PRINT@A(8),BS::C(1)=1:C(8)=1
10330 IFB(5)PRINT@A(1),BS::C(1)=1
10340 IFB(6)PRINT@A(2),BS::PRINT@A(7),BS::C(2)=1:C(7)=1
10350 IFB(9)PRINT@A(3),BS::C(3)=1:RETURN;SERETURN
10360 IFB(1)AND(3)ANDNOT(8)PRINT@A(0),BS:
10370 IFB(2)AND(7)PRINT@A(9),BS::C(9)=1:RETURN;SERETURN
10400 REM ** SET UP PROBLEM 4 (2A) **
10410 T(1)=1:T(2)=2:T(3)=1:T(4)=2:T(5)=1:T(6)=2:T(7)=1:T(8)=2:T(9)=2:POKE16639,142:POKE16640,80:FORI=1TO100:READX,Y:SET(X,Y):NEXT:PRINT@45,"PROBLEM 2A":RETURN
10420 IFNOT(1)AND(3)PRINT@A(2),BS::C(2)=1
10430 IFB(5)PRINT@A(8),BS::C(8)=1
10440 IFB(7)PRINT@A(9),BS::C(9)=1:RETURN;SERETURN
10460 IFNOT(2)AND(6)AND(9)PRINT@A(0),BS:
10470 IFB(4)PRINT@A(3),BS::PRINT@A(7),BS::C(3)=1:C(7)=1
10480 IFB(8)PRINT@A(1),BS::C(1)=1:RETURN;SERETURN
10500 REM ** SET UP PROBLEM 5 (2B) **
10510 T(1)=2:T(2)=2:T(3)=1:T(4)=1:T(5)=2:T(6)=2:T(7)=2:T(8)=1:T(9)=1:POKE16639,251:POKE16640,82:FORI=1TO101:READX,Y:SET(X,Y):NEXT:PRINT@45,"PROBLEM 2B":RETURN
10520 IFB(4)PRINT@A(2),BS::C(2)=1
10530 IFB(9)PRINT@A(7),BS::C(7)=1
10540 IFB(8)ANDNOT(3)PRINT@A(1),BS::C(1)=1:RETURN;SERETURN
10560 IFB(5)AND(7)ANDNOT(1)PRINT@A(0),BS:
10570 IFB(2)PRINT@A(3),BS::C(3)=1
10580 IFB(6)PRINT@A(8),BS::PRINT@A(9),BS::C(8)=1:C(9)=1:RETURN;SERETURN
10600 REM ** SET UP PROBLEM 6 (3A) **
10610 T(1)=2:T(2)=2:T(3)=1:T(4)=1:T(5)=1:T(6)=2:T(7)=2:T(8)=2:T(9)=1:POKE16639,115:POKE16640,85:FORI=1TO170:READX,Y:SET(X,Y):NEXT:PRINT@45,"PROBLEM 3A":RETURN
10620 IFB(3)AND(5)PRINT@A(1),BS::C(1)=1
10630 IFB(4)PRINT@A(7),BS::PRINT@A(8),BS::C(7)=1:C(8)=1
10640 IFB(5)ANDNOT(9)PRINT@A(2),BS::C(2)=1:RETURN;SERETURN
10660 IFB(1)AND(6)ANDNOT(2)PRINT@A(0),BS:
10670 IFB(6)AND(8)PRINT@A(9),BS::C(9)=1
10680 IFB(7)PRINT@A(3),BS::C(3)=1:RETURN;SERETURN
10700 REM ** SET UP PROBLEM 7 (3B) **
10710 T(1)=2:T(2)=2:T(3)=2:T(4)=1:T(5)=2:T(6)=1:T(7)=1:T(8)=1:T(9)=2:POKE16639,132:POKE16640,89:FORI=1TO153:READX,Y:SET(X,Y):NEXT:PRINT@45,"PROBLEM 3B":RETURN
10720 IFB(4)AND(8)PRINT@A(3),BS::C(3)=1
10730 IFB(4)ANDNOT(7)PRINT@A(1),BS::C(1)=1
10740 IFB(6)PRINT@A(2),BS::PRINT@A(9),BS::C(2)=1:C(9)=1:RETURN;SERETURN
10760 IFB(3)AND(5)ANDNOT(1)PRINT@A(0),BS:
10770 IFB(2)AND(5)PRINT@A(7),BS::C(7)=1
10780 IFB(9)PRINT@A(8),BS::C(8)=1:RETURN;SERETURN
10800 REM ** SET UP PROBLEM 8 (4A) **
10810 T(1)=2:T(2)=1:T(3)=2:T(4)=1:T(5)=1:T(6)=2:T(7)=2:T(8)=1:T(9)=1:POKE16639,41:POKE16640,93:FORI=1TO130:READX,Y:SET(X,Y):NEXT:PRINT@45,"PROBLEM 4A":RETURN
10820 IFB(4)AND(9)PRINT@A(1),BS::C(1)=1
10830 IFB(5)PRINT@A(3),BS::PRINT@A(7),BS::C(3)=1:C(7)=1
10840 IFB(9)ANDNOT(8)PRINT@A(2),BS::C(2)=1:RETURN;SERETURN
10860 IFB(1)AND(3)ANDNOT(2)PRINT@A(0),BS:
10870 IFB(1)AND(6)PRINT@A(8),BS::C(8)=1
10880 IFB(7)PRINT@A(9),BS::C(9)=1:RETURN;SERETURN
10900 REM ** SET UP PROBLEM 9 (3B) **
10910 T(1)=2:T(2)=1:T(3)=2:T(4)=1:T(5)=2:T(6)=1:T(7)=1:T(8)=2:T(9)=2:POKE16639,67:POKE16640,96:FORI=1TO141:READX,Y:SET(X,Y):NEXT:PRINT@45,"PROBLEM 4B":RETURN
10920 IFNOT(2)AND(7)PRINT@A(1),BS::C(1)=1
10930 IFB(4)PRINT@A(8),BS::PRINT@A(9),BS::C(8)=1:C(9)=1
10940 IFB(6)AND(7)PRINT@A(3),BS::C(3)=1:RETURN;SERETURN
10960 IFNOT(1)AND(3)AND(8)PRINT@A(0),BS:
10970 IFB(3)AND(5)PRINT@A(2),BS::C(2)=1
10980 IFB(9)PRINT@A(7),BS::C(7)=1:RETURN;SERETURN
    
```



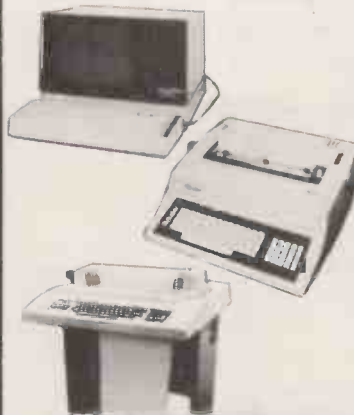
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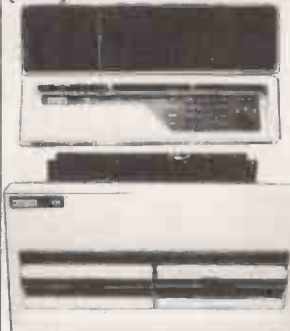
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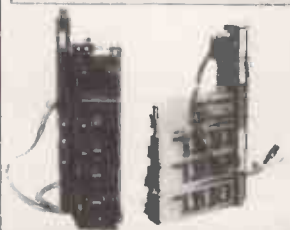
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# Systems art draws patterns to order

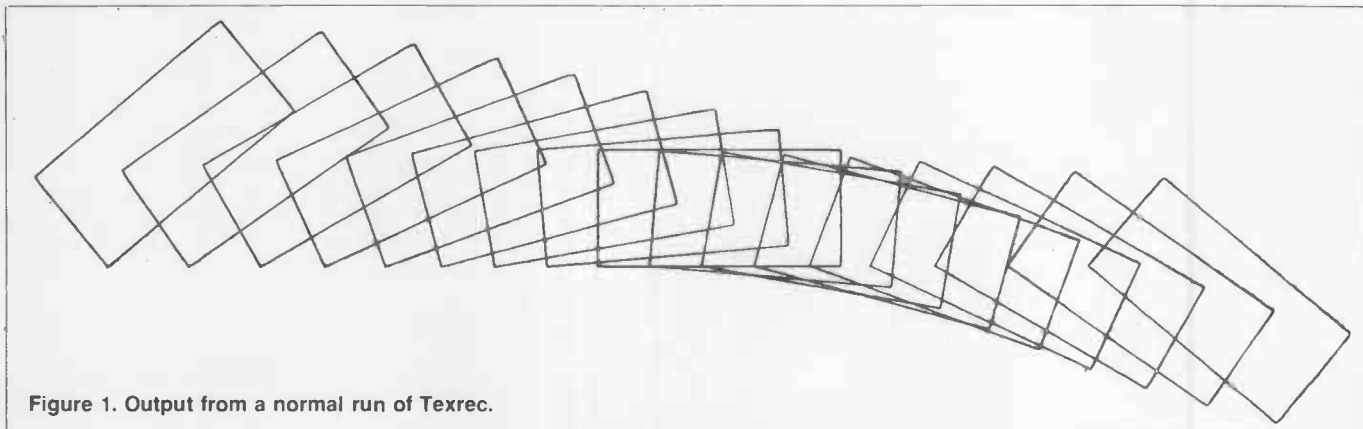


Figure 1. Output from a normal run of Texrec.

THE ROYAL COLLEGE OF ART has departments dealing with textiles and tapestry, as well as an advanced textile-research unit. Students from these areas are amongst the keenest users of our computing facilities. They do not just concern themselves with ordinary fabrics: fibreglass, feathers, leaves, paper and metal mesh have all been incorporated into more usual woven or knitted materials.

Sally Freshwater makes quite beautiful "tapestries" from paper. She took a sheet of plain paper and drew a horizontal pencil line across it, about half-way up. Then, from a point along the bottom edge of the paper, she fanned out lines at regular angles to meet the higher line, at points along its whole length.

She stuck small rectangles of translucent paper along the higher line with their corners each touching the line and one side lying parallel to the constructed "fan" line. The effect of these overlapping rectangles was much more interesting than it sounds, but it took her hours to try out one design.

We wrote the Texrec program to simulate the process on a screen or plotter. Each plot takes about two minutes to draw out on the Calcomp 81 plotter.

The listing of Texrec is written in Basic for the Research Machines 380-Z, with high-resolution graphics. It should run on any machine capable of drawing lines, such as the DAI, Atom, Apple, BBC Micro, etc.

It provides an example of one particular use of computer graphics: the repetition of some action — in this case, drawing the rectangle — with one or more controlling factors or parameters changing slightly each time. Here the parameters are position and angle.

The results can often be "counter-intuitive" — they turn out to be more interesting than you imagined just from thinking

part of the process. On screen, you should try adapting the program to produce a different shape, not merely a rectangle. If you know how, you might try ellipses or polygons, or introduce a random wobble.

If you don't yet know how to produce ellipses, polygons and so on, read these pages in the coming months. Watch out for "instant", curved, three-dimensional graphics. □

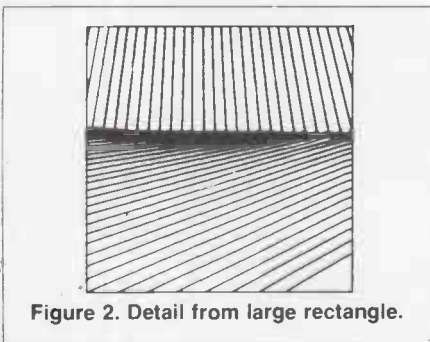


Figure 2. Detail from large rectangle.

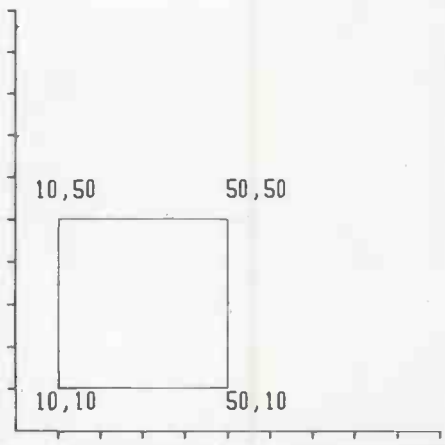
about the process. A whole branch of art — called systems art — concerns itself with such phenomena. With some notable exceptions, it tends to lead to a rather sterile and perhaps ultimately boring result, but it can be very useful as a design aid, and is always fun the first few times you try it.

The results of two runs are shown here. Figure 1 is a normal run, and should be self-explanatory. Figure 2 used a massive rectangle, and windowed in on just

## BEGINNING GRA Back to

WE SHOWED last month, in the simplest way possible, how a computer can store or display an image by using a symbolic representation. Now we will show how this technique can offer powerful ways of handling changes to images.

A small square seems to be a simple-enough shape from a computer-graphics point of view. How is it stored in the computer? Typically, a point that is to be at one end of a straight line is represented by a pair of numbers giving the position of the point in a flat space. Two numbers are



### Texrec.

```
100 CLEAR100
110 CALL"RESOLUTION",0,2
120 REM sets up hi-res graphics on 380Z
130 INPUT"COLOUR <1-3>";CS
140 INPUT"HEIGHT OF LINE ABOVE POINT";H
150 REM e.g. 100
160 INPUT"LENGTH & BREADTH OF RECTANGLE";L,B
170 REM e.g. 50,50 or 90,-100 etc.
180 INPUT"RANGE OF ANGLES (e.g.45,-45)";AL,AR
190 INPUT"STEP (e.g. 1 or 5 or 10 etc.)";S
200 INPUT"OK <Y/N>";ZS:IF ZS<>"Y"THEN130
210 PUT12:REM - CLEAR SCREEN
220 FOR A=AL TO AR STEP -S
230 F=3.142/180
```

```
240 X(1)=130-H*TAN(A*F)
250 Y(1)=H
260 X(2)=X(1)+(L*COS(A*F))
270 Y(2)=Y(1)+(L*SIN(A*F))
280 X(4)=X(1)+(B*COS(90+A)*F)
290 Y(4)=Y(1)+(B*SIN(90+A)*F)
300 X(3)=X(4)+(X(2)-X(1))
310 Y(3)=Y(4)+(Y(2)-Y(1))
320 FOR I=1 TO 4:X(I)=INT(X(I)):Y(I)=INT(Y(I))
330 REM CONNECT UP
340 CALL"PLOT",X(1),Y(1),CS
350 FOR I=2 TO 4
360 CALL"LINE",X(I),Y(I)
370 NEXT I
380 CALL"LINE",X(1),Y(1)
390 NEXT A
400 INPUT"MORE <Y/N>";ZMS:IF ZMS="Y"THEN130ELSE END
```

## ANALOGY BOX

A bug is an error you do not want. We hereby christen the "pug" — the creative mistake, which actually helps you. Do you have any good pugs?

Digitisers — devices for entering drawings, etc. into the computer — are at last coming cheaper, and that is a start. You can already by touch-sensitive displays in a variety of technologies, which allow you to use your finger to draw or point directly on to the TV screen.

The finest versions are pressure-sensitive as well as touch-sensitive. You can use them to "squidge" a shape, distorting

# So what's new?

COMPUTER USERS could be forgiven for believing that we are cursed for ever with the present kinds of graphic input and output device, that they are somehow natural or inevitable. Must we really limit ourselves to addressing 50-year-old television technology via keyboards deriving, for heaven's sake, from 19th-century typewriters? We seem to have conned ourselves into believing that it is pleasant to sit for hours, with our face a few inches away from a TV screen, and that it is satisfying to type in endless numbers to produce an image.

Some new devices are beginning to appear that will radically alter our attitudes to communicating with computer hardware. So far they are only available in limited quantities, but they will soon be cheap and common enough to influence much of what we do.

or compressing it, for instance. Or you might turn your finger into a blue paintbrush, an italic nib or a flashing cursor. We have used one from the United States, but are also considering other, cheaper ways of controlling everything from the finger tip. Strain-gauges, ultrasonics and stress-sensitive conducting foam are possibilities which have come to mind. Some people in America have even used short-range radar to produce gesture-sensitive displays.

Flat display screens will soon emerge in general use as TV screens and will do away with the flickery, probably dangerous, cathode-ray tube. Little thicker than a newspaper they, above all, are making people wake up to the emerging information environment. They will be built into desk-tops, cars, telephones and, of course, personal computers. □

## Competition

YOUR TASK for this month arises from the graphics manipulations described on this page. One way to approach similar problems is in reverse, by asking: What has to be done to these co-ordinates to produce such-and-such a transformation?

Submit a Basic program which enables a simple shape, such as a rectangle, to be rotated in two dimensions, by any angle, about any point on the screen. The £5 prize will go to the author of the shortest working routine; high marks will be awarded for tricks and "fudges" which make the routine simpler or quicker. Keep your program as general as possible so that it can be used, with the minimum of adaption, on any machine.

Send your entry to "Art", *Practical Computing*, Room L306, Quadrant House, Sutton, Surrey SM2 5AS.

One final note — do not worry too much about the mathematics and trigonometry you use. You can try referring to an old school maths textbook, or confound your old maths teacher and use first principles. □

# PHICS front and upside down

The shapes on your monitor screen are defined by a few numbers held in memory. Brian Reffin Smith explains how to apply some simple arithmetic so that you can alter those shapes at will.

required because you are dealing with a two-dimensional shape. The fact that there will be lines connecting pairs of these points need not be stored — a standard program dealing with the points will manage that.

The co-ordinates of the corners are expressed in terms of the grid of the basic picture elements called "pixels", which are available to you. The stored pairs:

10,10 10,50 50,50 50,10 10,10

define a square. Notice that there are five sets of co-ordinates, not just four. The computer has to be told to join up the fourth point to the starting point, and so you must name it again.

In a sort of pseudo-Basic, this might be expressed:

```
FOR I=1 TO 4
connect X(I), Y(I) to X(I+1), Y(I+1)
NEXT I
```

if the points are stored in arrays X(1 to 5) and Y(1 to 5).

On many computers, you would have to plot the first point, then just give the next point and the instruction to join it to the previous point, with a line or draw command.

Plotting a square is simple enough; things become interesting when you start to perform any one, or more, of the many possible "transformations" on that square, merely by operating on the numbers.

Multiplying them all by two gives a bigger square defined by points at:

20,20 20,100 100,100 100,20 20,20

Divide the numbers by, say, 10 and the square shrinks dramatically. Adding six to each number makes the shape move up and to the right. Halve all the X values, and it appears thin; halve the Ys, and it becomes flattened and squat.

Though we are describing the changes in terms of shape, it is only the numbers that are being defined and operated on. You have to assume some program for translating them into a visual form, at the time or maybe later, when you have finished manipulating the symbolically-represented shape.

Try these operations now, using a piece of paper or a computer. What happens?

```
X=X*Y/20
Y=-Y
Y=Y*SIN(X)
```

Here, X and Y mean "all the X values" or "all the Y values".

If you have not done so, try writing a program that lets you perform experiments on shapes like the one we have described. It must allow you to draw out some shape represented by pairs of numbers, and then allow you to alter all the numbers systematically and redraw the new shape. Use a For-Next loop, in Basic, to do the same thing to each X and/or Y.

You should now be able to see how a line drawing of a car body can rotate in those TV commercials. To work in three dimensions you just have to operate on the points with simple sines and cosines to give rotations — admittedly, there are a large number of points. The three-dimensional symbolic representation is then mapped on to a flat screen by altering each X and Y co-ordinate depending on how "deep" it is in the screen. A simple perspective algorithm does that job. □

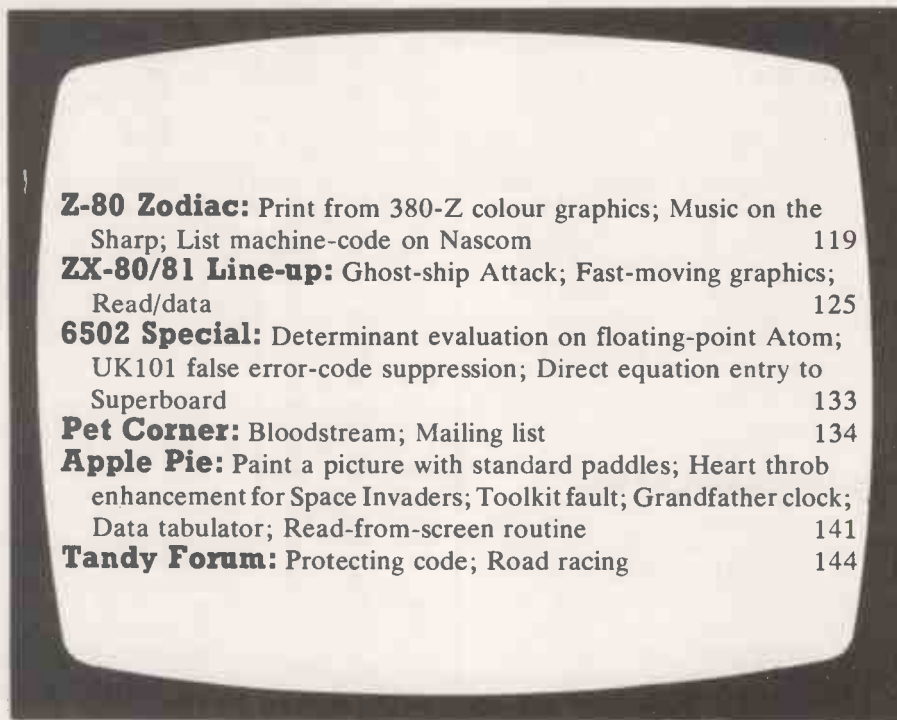


# Open File

This new section of *Practical Computing* will be appearing in the magazine each month, incorporating Tandy Forum, ZX-80/81 Line-up and the 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.

Each month the best contribution will be awarded £20; others receive £6. Send contributions to: Open File, *Practical Computing*, Quadrant House, The Quadrant, Sutton, Surrey SM2 5AS.



|   |     |
|---|-----|
| <b>Z-80 Zodiac:</b> Print from 380-Z colour graphics; Music on the Sharp; List machine-code on Nascom   | 119 |
| <b>ZX-80/81 Line-up:</b> Ghost-ship Attack; Fast-moving graphics; Read/data   | 125 |
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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.



### Colour copier

THIS PROGRAM for the Research Machines 380-Z copies colour pictures on to a normal printer, writes A Pennell of Cliftonville, Kent.

The program requires Basic V 5.0 H, and a printer of at least 80 columns that can handle the "chunky" graphics; I use a Microline 80. It copies medium resolution — 160 by 95 — colour pictures, but obviously only distinguishing between colour 0 — black — and any other colour. It could be modified by changing the X and Y For loops for high resolution, but only if a 160-column printer is used.

Line 10 sets up the printer, and should be modified to suit. Line 20 fools the 380-Z into thinking it is a very wide printer, to prevent spurious Newline characters upsetting the output. This should not be changed. The X and Y loops step through the screen, starting at top left — 0,94 — in sections of 2-by-3 pixels. These sections are then converted to the ASCII chunky character codes, by adding the base colour, 128, to powers of two if that pixel is on

|    |    |
|----|----|
| 1  | 2  |
| 4  | 8  |
| 16 | 32 |

e.g.



$$= 1+2+8+16+128 = \text{CHR}\$(155)$$

The function

CALL "RDOUT",X,Y,VARADR(P)

calls a machine-code subroutine resident in the interpreter which loads P with the colour at the point X,Y.

(continued on next page)

```

10 PRINTER 4,4 : LPRINT CHR$(30)
20 LWIDTH 255
30 FOR V=94 TO -2 STEP -3
40 FOR X=0 TO 160 STEP 2
50 S=5:C=128:P=0
60 FOR B=2 TO 0 STEP -1
70 FOR A=0 TO 1
80 S=S*2
90 CALL "RDOUT",X+A,V+B,VARADR(P)
100 IF P=0 THEN C=C+S
110 NEXT A
120 NEXT B
130 LPRINT CHR$(C);
140 NEXT X
150 LPRINT
160 NEXT V
170 LPRINT
    
```

(continued from previous page)

## Sharp music

MUSIC is a small Basic program from C J Davison of Newton Abbott, Devon, that simulates a simple organ. It also allows the user to add his own notes or other effects. The program is written in XTAL Basic but can be converted to Sharp Basic by changing Call in lines 70, 80 and 90 to USR( ). The program should run on any machine since it only occupies 1.2K.

The machine-code routine scans the keyboard to see if any key is depressed. If it is, it returns the ASCII value which is Peeked into I. To return to Basic just Shift/Break out.

## Machine-code transfer

A PROGRAM to copy Zeap listings into Naspens comes from C R Bruce of Farnham, Surrey. It adds the Zeap file to the end of the Naspens text but does not upset any pointers. This allows you to include assembler programs in letters or explanatory notes, for example:

```
; BLOCK SEARCH
LD HL,START OF BLOCK
LD BC,LENGTH OF SEARCH
LD A,ITEM TO BE SEARCHED FOR
CPIR
```

This powerful Z-80 command compares the A register with the byte pointed to by HL. If the result is not zero and BC

```
10 REM MUSIC KEYBOARD
20 DIM A(255), B(255), C(255)
30 REM SET UP M/C ROUTINE
40 FOR Z=24553 TO 24560: READ A: POKE Z,A: NEXT
50 FOR Z=1 TO 36: READ A(Z), B(A(Z)), C(A(Z)):NEXT Z: GOSUB 200
60 REM MAIN PROGRAM
70 CALL 24553: I=PEEK(24560)
80 IF I=0 THEN CALL 71: GOTO 70
90 POKE 4514,B(I): POKE 4513,C(I): CALL 68: GOTO 70
100 REM DATA ASC11, 4514,4513
110 DATA 205,27,0,50,240,95,201,0,71,18,208
120 DATA 81,17,196,87,15,212,69,14,238
125 DATA 82,13,78,84,11,218,89,11,48,85,9,248
130 DATA 73,8,226,79,7,234,80,7,119,61
135 DATA 6,167,229,5,237,244,5,152,236,4,252
140 DATA 218,4,113,115,3,245,90,29,220
145 DATA 88,26,156,67,23,180,86,22,96,66,19,240
150 DATA 49,16,196,51,14,24,52,12,142,54
155 DATA 10,144,55,9,104,56,8,98,48,7,12
160 DATA 45,6,71,221,5,72,203,4,180,209
165 DATA 4,49,65,28,48,83,25,28,70,21,32
200 REM PRINT KEY POSITIONS
210 PRINT "(CLS) TOP ROW.....SHARPS"
220 PRINT "(cursor down * 3) SECOND ROW...A-A-AB"
230 PRINT "(cursor down * 3) THIRD ROW...SHARPS"
240 PRINT "(cursor down * 3) LAST ROW.....C-G"
250 PRINT "(cursor down * 3) ***SHARPS ABOVE NOTES ***"
260 PRINT "(cursor down * 3) ***RELEASE KEY TO STOP***"
270 RETURN
280 END
```

is not zero then HL is incremented, BC is decremented and the comparison is made again until the byte is found or BC becomes zero.

The program is written in assembler. The object code is included for those without an assembler — the last column is a check-sum and must not be entered. **■**

## Zeap files transfer.

```
ORG £C80 ; THIS IS WHERE IT'S AT
LD HL,(£101A) ; NASPEN EOT PNTR
LD BC,0 ; TRANSFERED CHAR COUNTER
EXX ; SWOP NASPEN & ZEAP PNTRS
LD HL,(£F00) ; START OF ZEAP TEXT
LD DE,4H ; OFFSET
ADD HL,DE ; ADD THE OFFSET
XOR A ; CLEAR A
THERE LD A,(HL) ; GET 1st ZEAP CHAR
CP 0 ; IS IT ZERO
JR Z,CRLF ; IT IS !
INC HL ; IT ISN'T! SO...
EXX ; GET NASPEN POINTER
LD (HL),A ; PUT IN CHAR
INC BC ; COUNT THIS
INC HL ; POINT AT NEXT NASPEN SPACE
EXX ; GET BACK TO ZEAP
JR THERE ; DO IT AGAIN
CRLF INC HL ; CR LF SUBROUTINE
LD A,(HL) ; GET NEXT ZEAP CHAR
CP £FF ; ZEAP ENDS WITH FFH
JR Z,ENDIT ; IT IS ! GO TO END
INC HL ; IT ISN'T, BYPASS NEXT CHAR
INC HL ; GET NEXT CHAR
LD A,(HL) ; LOOK FOR FLAG
CP 20H ; IS IT A SPACE
CALL Z,SPACE ; YES. MAKE A NOTE
EXX ; GET BACK TO NASPEN
LD (HL),£0D ; PUT IN CRLF
INC BC ; COUNT THIS ONE
INC HL ; MOVE ON
LD (HL),£0D ; DOUBLE LINED IF YOU WANT
INC BC ; COUNT THIS ONE
INC HL ; MOVE ON
LD A,(NOTE+1) ; GET THE NOTE
CP 1 ; WAS IT MARKED
JR NZ,HERE ; YES,IF SPACE, HAVE ANOTHER
; IF NOT, MUST BE FLAG SO MISS SPACE
LD (HL),£20 ; PUT IN A SPACE
INC BC ; COUNT THIS
INC HL ; GET READY FOR NEXT TIME
HERE EXX ; GET BACK TO ZEAP
LD A,0 ; FOR NOTEBOOK
LD (NOTE+1),A ; CLEAR NOTE
JR THERE ; START ALL OVER AGAIN
ENDIT EXX ; THIS WHERE TO GET OUT
LD (HL),£20 ; PUT IN A SPACE
INC HL ; MOVE ALONG
LD (HL),£FF ; NASPEN ENDS WITH FFH TOO
LD HL,(101AH) ; START OF NASPEN TEXT PNTR
ADD HL,BC ; ADD CHAR CNT TO START PNTR
INC HL ; ONE FOR THE POT
LD (£101A),HL ; LOAD THIS TO NASPEN PNTR
JF £B806 ; JUMP TO NASPEN WARM START
SPACE LD A,1 ; FOR NOTEBOOK
LD (NOTE+1),A ; I HAVE SEEN A SPACE
NOTE RET ; R(h)ETORICALLY GO ELSEWHERE
; DELETE 35,36,37, FOR SINGLE SPACING.
This is printed from NASPEN.
```

## Object-code listing.

```
T C80 CDC FF
0C80 2A 1A 10 01 00 00 D9 2A E4
0C88 00 0F 11 04 00 19 AF 7E FE
0C90 FE 00 28 08 23 D9 77 03 40
0C98 23 D9 18 F3 23 7E FE FF 49
0CA0 28 24 23 23 7E FE 20 CC A6
0CA8 D7 0C D9 36 0D 03 23 36 0F
0CB0 0D 03 23 3A DD 0C FE 01 11
0CB8 20 04 36 20 03 23 D9 3E 7B
0CC0 00 32 DD 0C 18 C9 D9 36 D7
0CC8 20 23 36 FF 2A 1A 10 09 A9
0CD0 23 22 1A 10 C3 06 B8 3E 0A
0CD8 01 32 DD 0C C9 00 FF 00 C8
```



# Make the most of your Sinclair ZX Computer...

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The unprecedented popularity of the ZX Series of Sinclair Personal Computers has generated a large volume of programs written by users.

Sinclair has undertaken to publish the most elegant of these on pre-recorded cassettes. Each program is carefully vetted for interest and quality, and then grouped with other programs to form a single-subject cassette.

Each cassette costs £3.95 (including VAT and p&p) and comes complete with full instructions.

Although primarily designed for the Sinclair ZX81, many of the cassettes are suitable for running on a Sinclair ZX80 – if fitted with a replacement 8K BASIC ROM.

Some of the more elaborate programs can be run only on a Sinclair ZX Personal Computer augmented by a 16K-byte add-on RAM pack.

This RAM pack and the replacement ROM are described below. And the description of each cassette makes it clear what hardware is required.

### 8K BASIC ROM

The 8K BASIC ROM used in the ZX81 is available to ZX80 owners as a drop-in replacement chip. With the exception of animated graphics, all the advanced features of the ZX81 are now available on a ZX80 – including the ability to run much of the Sinclair ZX Software.

The ROM chip comes with a new keyboard template, which can be overlaid on the existing keyboard in minutes, and a new operating manual.

### 16K-BYTE RAM pack

The 16K-byte RAM pack provides 16-times more memory in one complete module. Compatible with the ZX81 and the ZX80, it can be used for program storage or as a database.

The RAM pack simply plugs into the existing expansion port on the rear of a Sinclair ZX Personal Computer.



### Cassette 1 - Games

For ZX81 (and ZX80 with 8K BASIC ROM)

**ORBIT** – your space craft's mission is to pick up a very valuable cargo that's in orbit around a star.

**SNIPER** – you're surrounded by 40 of the enemy. How quickly can you spot and shoot them when they appear?

**METEORS** – your starship is cruising through space when you meet a meteor storm. How long can you dodge the deadly danger?

**LIFE** – J.H. Conway's 'Game of Life' has achieved tremendous popularity in the computing world. Study the life, death and evolution patterns of cells.

**WOLFPACK** – your naval destroyer is on a submarine hunt. The depth charges are armed, but must be fired with precision.

**GOLF** – what's your handicap? It's a tricky course but you control the strength of your shots.

### Cassette 2 - Junior Education: 7-11-year-olds

For ZX81 with 16K RAM pack

**CRASH** – simple addition – with the added attraction of a car crash if you get it wrong.

**MULTIPLY** – long multiplication with five levels of difficulty. If the answer's wrong – the solution is explained.

**TRAIN** – multiplication tests against the computer. The winner's train reaches the station first.

**FRACTIONS** – fractions explained at three levels of difficulty. A ten-question test completes the program.

**ADDSUB** – addition and subtraction with three levels of difficulty. Again, wrong answers are followed by an explanation.

**DIVISION** – with five levels of difficulty. Mistakes are explained graphically, and a running score is displayed.

**SPELLING** – up to 500 words over five levels of difficulty. You can even change the words yourself.

### Cassette 3 - Business and Household

For ZX81 (and ZX80 with 8K BASIC ROM) with 16K RAM pack

**TELEPHONE** – set up your own computerised telephone directory and address book. Changes, additions and deletions of up to 50 entries are easy.

**NOTE PAD** – a powerful, easy-to-run system for storing and

retrieving everyday information. Use it as a diary, a catalogue, a reminder system, or a directory.

**BANK ACCOUNT** – a sophisticated financial recording system with comprehensive documentation. Use it at home to keep track of 'where the money goes,' and at work for expenses, departmental budgets, etc.

### Cassette 4 - Games

For ZX81 (and ZX80 with 8K BASIC ROM) and 16K RAM pack

**LUNAR LANDING** – bring the lunar module down from orbit to a soft landing. You control attitude and orbital direction – but watch the fuel gauge! The screen displays your flight status – digitally and graphically.

**TWENTYONE** – a dice version of Blackjack.

**COMBAT** – you're on a suicide space mission. You have only 12 missiles but the aliens have unlimited strength. Can you take 12 of them with you?

**SUBSTRIKE** – on patrol, your frigate detects a pack of 10 enemy subs. Can you depth-charge them before they torpedo you?

**CODEBREAKER** – the computer thinks of a 4-digit number which you have to guess in up to 10 tries. The logical approach is best!

**MAYDAY** – in answer to a distress call, you've narrowed down the search area to 343 cubic kilometers of deep space. Can you find the astronaut before his life-support system fails in 10 hours time?

### Cassette 5 - Junior Education: 9-11-year-olds

For ZX81 (and ZX80 with 8K BASIC ROM)

**MATHS** – tests arithmetic with three levels of difficulty, and gives your score out of 10.

**BALANCE** – tests understanding of levers/fulcrum theory with a series of graphic examples.

**VOLUMES** – 'yes' or 'no' answers from the computer to a series of cube volume calculations.

**AVERAGES** – what's the average height of your class? The average shoe size of your family? The average pocket money of your friends? The computer plots a bar chart, and distinguishes MEAN from MEDIAN.

**BASES** – convert from decimal (base 10) to other bases of your choice in the range 2 to 9.

**TEMP** – Volumes, temperatures – and their combinations.

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|     | 17   | *8K BASIC ROM for ZX80              | £19.95     |       |
|     | 18   | *16K RAM pack for ZX81 and ZX80     | £49.95     |       |
|     |      | *Post and packing (if applicable)   | £2.95      |       |
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## Dangerous addiction

THIS GAME is addictive, warns David Lawrence of Southampton; do not introduce your friends to it late in the evening, or you will still be sitting there in the early hours while they have "just one more try". Strikeout, the game in question, is an essentially simple game where you aim a projectile at a target on the screen, giving speed and trajectory for the shot which then follows a ballistic trajectory.

So what makes it addictive? The answer is that the whole trajectory is not printed out, only points along it. The interval between those points is randomly chosen for each new target position and remains constant until that target has been hit. To hit the target you not only have to make the trajectory pass through target position, but also make one of the plotted points coincide with it too.

The game begins by the setting of the target — an inverse space — on the right-hand side of the screen. The number of the shot and requests for speed and angle



then appears in the top left-hand corner.

Typical speeds range between 700 and 1,100 and angles are entered in degrees. The lower the speed, the smaller is the gap between plotted points, since the random element is the time interval at which the trajectory is plotted. At the end of

each shot, whether it is a hit or a miss, the shot remains displayed on the screen until Newline is entered. The screen then clears and resets. If you have missed, the target resets in the same position.

The game strains the memory of a 1K ZX-81, not so much by the program itself but because of the demand for screen memory. On rare occasions, such as a high lob from one side of the screen to the other, you may run out of memory.

If you do not mind the small extra effort, you can replace the few remaining literals with variables whose value is entered in direct mode, remembering not to use Run. Note also that S=P=P and T=P=P are both three bytes shorter than S=1 and T=0.

When you are familiar with the game you can increase the difficulty. This can be done either by reducing the value by which RND is divided in line 220, thus increasing the randomness of the intervals, or by replacing the 0.5 in the same line by a larger value, thus increasing the average interval between plotted points.

### DAVID A LAWRENCE

```
100 LET M=28
200 LET P=INT (RND*20)
210 LET S=P=P
220 LET T=RND/5+.5
230 LET T2=T
250 CLS
260 LET T=P<>P
270 PRINT AT P,M;"(graphic H)"
280 PRINT AT T,T;">";S;"SPEED?";
300 INPUT V
310 PRINT V;"ANGLE?";
340 INPUT A
350 PRINT A
360 LET A=A*.0174
370 LET X=INT (V/M*T*SIN
A-(4.9*T*T)
```

```
375 LET Y=INT (T*V/M*COS A)
380 IF Y>63 OR X>43 OR X<0 THEN
GOTO 470
390 PLOT Y,X
400 LET T=T+T2
410 IF INT (Y/2)=M AND 21-INT
(X/2)=P THEN GOTO 430
420 GOTO 370
430 UNPLOT Y,X
440 PRINT "HIT"
450 INPUT A$
460 GOTO S
470 LET T=T2
480 INPUT A$
490 LET S=S+1
500 GOTO 250
```

## Format subroutine

THE FORMAT SUBROUTINE by Mark Franklin of Erith, Kent, runs on the ZX-81, and ZX-80 with 8K ROM. Num is the number to be formatted. N\$ is the number on return from the subroutine, i.e., the number that is printed out. AF is the number of places after the decimal point, if there is one. PL in the number of places before the decimal point.

If AF = 0 the decimal point is completely suppressed. The maximum value of AF is eight, that is the number of zeros in the string in line 9050; the maximum for PL is 10, which must be the same as the number of spaces in line 9090.

## Taxing demands

A PRACTICAL PROGRAM for the employees to check their pay, tax and National Insurance records comes from Sean Sweeney of Wootton, Bedfordshire.

◀ 179 for p124

### ZX81 Format Routine.

Mark Franklin.

```
9000 LET N$ = STR$ NUM
9010 FOR Z = 1 TO LEN N$
9020 IF N$(Z)="." THEN GOTO 9050
9030 NEXT Z
9040 LET N$=N$+"."
9050 LET N$=N$+"00000000"
9060 IF AF<=0 THEN LET Z=Z-1
9070 LET N$(Z+1 TO )=N$(Z+1 TO AF+Z)
9080 IF AF<=0 THEN LET Z=Z+1
9090 LET N$="(10 SPACES )"
9100 RETURN
```

The tax and NI deductions are standard rate only — 30 percent and 7.75 percent respectively. They are calculated to agree with the manual tables and will probably differ from most computerised payrolls. When the program is run it will request:

Weekly or monthly paid? — enter "W" or "M".  
Tax code? — this must be numeric only for standard codes, suffix H, L, P, T or V.  
Previous total taxable pay TD? — this is the total gross pay for the current tax year up to

(continued on next page)

(continued from previous page)

and including the previous pay period.  
 Total tax deducted TD? — this is the total net tax deducted/refunded for the current tax year, up to and including the previous pay period. Enter minus amount for refund.  
 Tax month/week number? — this pay period number, per tax year.  
 Basic pay? — normal pay for the period.  
 Additional pay, holiday pay, etc? — extra taxable pay period paid this period, i.e. commission, overtime, bonus, holiday pay, etc.  
 Tax-free pay or EXP/S — any non-taxable reimbursements, etc.

Deductions? — any other deductions after tax and NI.  
 Number of weeks holiday pay? — if holiday pay has been included in additional pay then enter number of weeks holiday period pay paid, i.e. 1, 2 or 3.

The following variables are used:

M\$ for "monthly" or "weekly" calculation input.  
 TC tax code.  
 TG previous total gross taxable pay to date.  
 TT previous total tax deducted to date.  
 M month or week number.  
 B basic pay.  
 AP additional pay.

TF tax free pay.  
 OD other deductions.  
 Z free pay calculation — addition to tax code.  
 W free pay calculation — 12 or 52 for months or weeks.  
 P used in free pay calculation.  
 FP free pay.  
 T taxable.  
 TD tax due.  
 X tax this week.  
 G gross taxable pay this week.  
 C used in NI calculation.  
 D used in NI calculation.  
 E employee's NI this week.  
 H number of weeks' holiday pay.

SEAN D SWEENEY

```

1  REM "TAX CALCULATOR"
10 CLEAR
20 PRINT "WEEKLY OR MONTHLY PAID?"
30 PRINT
40 PRINT "ENTER", "" "M" FOR MONTHLY"
50 PRINT "" "W" FOR WEEKLY"
60 INPUT M$
70 IF M$="M" THEN LET Z=9
80 IF M$="M" THEN LET W=12
90 IF M$="W" THEN LET Z=11.4
100 IF M$="W" THEN LET W=52
110 CLS
120 SCROLL
130 PRINT "TAX CODE?"
140 INPUT TC
150 SCROLL
160 PRINT "ENTER PREV. TOTAL TAXABLE PAY TO"
170 INPUT TG
180 SCROLL
190 PRINT "ENTER TOTAL TAX DEDUCTED TO"
200 INPUT TT
210 SCROLL
220 PRINT "TAX MONTH/WEEK NUMBER?"
230 INPUT M
240 SCROLL
250 PRINT "THIS WEEKS/MONTHS BASIC PAY?"
260 INPUT B
270 SCROLL
280 PRINT "ADDITIONAL PAY,HOL.PAY ETC.?"
290 INPUT AP
300 CLS
310 IF M$="W" THEN GOSUB 1000
320 SCROLL
330 PRINT "ENTER ANY FREE PAY OR EXP/S"
340 INPUT TF
350 SCROLL
360 PRINT "ENTER ANY DEDUCTIONS"
370 INPUT OD
380 CLS
390 REM * FREE PAY CALC. *
400 LET P=INT ((TC*10+Z)/W*100)/10
405 IF M$="W" THEN GOTO 440
410 LET FP=(INT P/10+.05)*M
420 IF INT ((P-INT P)*100) > 50 THEN LET
FP=(INT P/10 + .10) *M
430 GOTO 460
440 LET FP=INT P/10*M
450 IF INT ((P-INT P) *100 ) >= 50 THEN LET
FP=(INT P/10+.05) * M
460 REM * TAXABLE *
470 LET TG=INT ((TG+B+AP)*100 +.5)/100
480 LET T=INT (TG-FP)
490 IF FP>TG THEN GOTO 930
500 REM * TAX DUE *
510 LET TD=T*.30
520 REM * TAX THIS WEEK *
530 LET X=INT ((TD-TT)*100+.5)/100
540 LET G=INT ((B+AP)*100+.5)/100
550 IF X>G THEN GOTO 970
560 IF M$="W" THEN GOTO 660
570 REM * MONTHLY N/I *
580 LET C=INT G
590 IF NOT INT (INT G/2)*2=INT G THEN LET
C=INT G+1
600 LET D=C*.0775
610 LET E=INT (D*100+.49)/100
620 IF G<117 THEN LET E=0

```

```

630 IF G=117 THEN LET E=9.07
640 IF G>=866.67 THEN LET E=67.17
650 GOTO 740
660 REM * WEEKLY N/I *
670 LET C=INT G+.25
680 IF INT ((G-INT G) *100)>=50 THEN LET C=INT
G+.75
690 LET D=C*.0775
700 LET E=INT (D*100+.49)/100
710 IF G<27 THEN LET E=0
720 IF G=27 THEN LET E=2.09
730 IF G>=200 THEN LET E=15.5
740 PRINT "PAYE AND N/I", "PERIOD";M
750 PRINT "CODE ";TC
760 PRINT "BASIC PAY";B
770 PRINT "ADDITIONAL PAY";AP
780 PRINT "GROSS PAY";G
790 PRINT
800 PRINT "TAXABLE PAY";T
810 PRINT
820 PRINT "TAX";X
830 PRINT "N/I";E
840 PRINT
850 PRINT "TAX FREE PAY";TF
860 PRINT "OTHER DEDS.";OD
870 PRINT
880 PRINT "NET PAY";INT
((G-X-E+TF-OD)*100+.5)/100
890 PRINT
900 PRINT "TOTAL GROSS YTD";TG
910 PRINT "TOTAL TAX YTD";INT
((TT+X)*100+.5)/100
920 GOTO 2000
930 REM * TAX REFUND *
940 LET X=0
950 IF TT>0 THEN LET X=-TT
960 GOTO 540
970 PRINT "TAX IS GREATER THAN PAY"
980 GOTO 2000
1000 PRINT "NUMBER OF WEEKS HOLIDAY PAY", "PAID
THIS WEEK?"
1010 INPUT H
1020 LET M=M+H
1030 CLS
1040 RETURN
2000 PRINT
2010 PRINT "ANOTHER RUN?"
2020 PRINT "ENTER", "" "Y" FOR YES"
2030 PRINT "" "N" FOR NO"
2040 INPUT A$
2050 CLS
2060 IF A$="Y" THEN GOTO 10
2070 STOP
PAYE AND N/I          PERIOD 4
                      CODE 213
BASIC PAY             555.55
ADDITIONAL PAY        0
GROSS PAY             555.55
TAXABLE PAY           1441
TAX                   -47.7
N/I                   43.09
TAX FREE PAY          100
OTHER DEDS.           25
NET PAY               635.16
TOTAL GROSS YTD       2154.55
TOTAL TAX YTD         432.3
ANOTHER RUN?
ENTER                 "Y" FOR YES
                      "N" FOR NO

```

## Fast-moving graphics

TWO PROGRAMS for the 1K ZX-81 come from I J Moore of Nottingham. Although they are not written in machine-code, they both have fast-moving graphics.

In Missile Dodger you are captain of a cargo ship which is under fire from alien raiders. You have to dodge the many missiles fired at you by using cursor controls 5 and 8 to move to the left and right respectively. You may be hit five times

before being totally obliterated.

If you have the 16K RAM pack, then the program can be made more difficult by changing line 120 to:

```
120 IF PEEK (P S) 23 THEN LET L=L-1
changing line 130 to:
```

```
130 PRINT AT 0,W;"(3 SHIFT A)
```

and adding:

```
115 FOR S=W TO W+2
```

```
125 NEXT S
```

or by adding:

```
85 PRINT AT 16,X 2;" "
```

In Grand Prix you are a racing driver.

As the track looms in front of you, you must steer your way through the cones without hitting any of them. Added danger is provided by jamcars which appear at random.

Once again, cursor controls 5 and 8 move you to the left and right respectively. The program can be made more difficult by removing lines 120 and 130 and shortening the width of the track in line 100.

### IAN MOORE

#### MISSILE DODGER

```
10 LET L=5
20 LET W=14
30 LET G=0
40 LET P=1+PEEK (16396)+PEEK (16397)*256
50 LET X=INT (RND*25)
60 LET G=G+1
70 PRINT AT 18,X+4;"*"
80 PRINT AT 20,X;"*"
90 SCROLL
100 SCROLL
110 PRINT AT 0,31;" "
120 IF PEEK (P+W)=23 OR PEEK (P+W+1)=23 THEN LET
L=L-1
130 PRINT AT 0,W;"(2 SHIFT A)"
140 IF INKEY$="5" AND W>6 THEN LET W=W-1
150 IF INKEY$="8" AND W<26 THEN LET W=W+1
160 IF L<1 THEN GOTO 180
170 GOTO 50
180 PRINT G;" EONS"
```

### GRAND PRIX

```
10 LET X=11
20 LET A=16
30 LET T=3
40 LET K=0
50 LET P=1+PEEK (16396)+PEEK (16397)*256
60 LET W=INT (RND*20-10)
70 LET F=SGN (W)
80 IF X+F<2 OR X+F>23 THEN GOTO 60
90 LET X=X+F
100 PRINT AT 21,X;"(1 SHIFT 5)(5 SPACES)(1 SHIFT 5)"
110 IF W=5 THEN PRINT AT 21,X+3;"H"
120 SCROLL
130 SCROLL
140 SCROLL
150 PRINT AT 0,31;" "
160 IF PEEK (P+A)=5 OR PEEK (P+A)=45 THEN LET T=T-1
170 PRINT AT 0,A;CHR$ (156+T)
180 IF INKEY$="5" THEN LET A=A-1
190 IF INKEY$="8" THEN LET A=A+1
200 LET K=K+1
210 IF T<1 THEN GOTO 230
220 GOTO 60
230 PRINT K;" LAPS"
```

## Drawing the line

THE SKETCH-PAD program allows you to draw pictures on the screen and erase any mistakes, writes Antony Lugger of Ivy-bridge, Devon. When the program is run and any key depressed, a black dot appears in the centre of the screen. A line can be drawn from this dot in any direction by depressing the appropriate key. To erase a line, the shift key should be pressed with the key for the appropriate direction.

To change the starting position the values of X and Y in lines 10 and 20 should be changed.

```
10 LET X=32
20 LET Y=22
22 PLOT X,Y
25 LET A$=INKEY$
31 IF A$="Q" OR A$="W" OR A$="E" THEN LET Y=Y+1
32 IF A$="Q" OR A$="A" OR A$="Z" THEN LET X=X-1
33 IF A$="Z" OR A$="X" OR A$="C" THEN LET Y=Y-1
34 IF A$="E" OR A$="D" OR A$="C" THEN LET X=X+1
35 IF A$=""" OR A$=" " OR "OR A$=" STEP " THEN LET Y=Y+1
36 IF A$=":" OR A$=";" OR A$="?" THEN LET Y=Y-1
37 IF A$=""" OR A$=" STOP " OR A$=":" THEN LET X=X-1
38 IF A$="STEP " OR A$=" SLOW " OR A$="?" THEN LET X=X+1
40 IF CODE A$ 37 OR CODE A$ 64 THEN PLOT X,Y
42 IF LEN A$=0 THEN GOTO 25
45 IF CODE A$<38 OR CODE A$>63 THEN UNPLOT X,Y
50 GOTO 25
```

left-hand side of the display or it, or one of the ghost ships, destroys you.

Lines 40 to 80 randomly position the ghosts.

Lines 90 to 160 print the display.

Line 170 compensates for memory movement.

Lines 190 and 200 position the defender and alien command ship.

Lines 220 to 330 position player's decoys, and will display a white square if a ghost is found.

Lines 350 to 400 move the defender's ship and deletes the old position.

Line 410 checks for a win.

Lines 420 to 485 set new positions for the ghost fleet and command ship, and prints a white square if a decoy is encountered.

Lines 500 to 530 identify the winner.

Lines 540 to 560 print positions of ghosts.

Lines 600 and 610 form a subroutine which finds the start of display.

## Ghost-ship attack

MY GAME Ghost Ship Attack, will just squeeze into a 1K ZX-80, writes Noel Swanton of Wellington, New Zealand. Apart from the command ship, all the attackers remain invisible until the game ends. The object of the game is to destroy the command ship before it reaches the

```
10 DIM A(7)
20 LET M=0
30 LET P=79
40 LET A(7)=102
50 FOR J=0 TO 6
60 LET A(J)=J*26+RND(14)+12
70 IF A(J)=102 THEN LET J=J-1
80 NEXT J
90 FOR K=0 TO 6
100 PRINT CHR$(151);
110 FOR J=0 TO 23
120 PRINT CHR$(128);
130 NEXT J
140 PRINT
150 NEXT K
160 PRINT "D"
170 LET K=4
180 GOSUB 600
190 POKE P+C,23
200 POKE A(7)+C,20
210 IF M>6 THEN GOTO 340
220 LET N=151
230 INPUT X
240 GOSUB 600
250 LET Y=M*26+X
260 FOR J=0 TO 6
```

(continued on next page)

(continued from previous page)

```

270 IF A(J)=Y THEN LET N=0
280 NEXT J
290 POKE Y+C,N
300 POKE M*26 + C,128
310 LET M=M+1
320 LET K=1
330 GOTO 210
340 POKE C +182 , 23
350 INPUT X
360 POKE P+C,128
370 IF X=5 THEN LET P=P-3
380 IF X=6 THEN LET P=P+25
390 IF X=7 THEN LET P=P-27
400 LET P=P+1
410 IF P=A(7) THEN GOTO 500
420 POKE A(7)+C,128
430 LET Y=1
440 LET N=RND(2)
450 FOR J=0 TO 7
460 LET A(J)=A(J)-N
470 IF A(J)= P OR A(7)<79 THEN GOTO 520
480 IF PEEK(A(J)+C)=151 THEN POKE A(J)+C,0
485 NEXT J
490 GOTO 180
500 PRINT "YOU";
510 REM
520 PRINT "ALIENS";
530 PRINT" WIN"
540 FOR J=0 TO 7
550 POKE A(J)+C,0
560 NEXT J
570 STOP
600 LET C=PEEK(16396)+PEEK (16397)*256+K
610 RETURN

```

## ZX-81 Read/Data

THIS routine by C Rouse of Gosport, Hampshire, will give the ZX-81 a version of Read/Data, and can be useful whenever information has to be printed on the screen.

The Basic is entered first and the decimal codes Poked into the first-line Rem from 16514 to 16536 using a standard machine-code loading program. Items to be printed are included in the program in Rem statements. Each item must be less than 64 characters long and must be enclosed in inverted commas.

More than one item may be included in each Rem as long as each one has its own inverted commas, e.g.,

```
100 REM "DATA""READ"
```

There is no space between the middle inverted commas.

The data Rems can be put anywhere in the program area and can be separated by both normal Rem statements and program lines. With the Basic entered as shown

```
XX GOSUB RESTORE
```

will set the pointer to the first item to be printed and the Step to 1.

```
XX GOSUB READ
```

will then print the items out, one at a time, moving the pointer to the next item.

In order to print the item in the middle of a sentence use the following format:

```
100 PRINT "THE NEXT"
110 GOSUB READ
120 PRINT "WILL ARRIVE SOON"
```

If no Rem data statements exist, or if

the program tries to call more than are available, an Error Code R/.. will result. If the item to print is longer than the 64 characters an error code Q/.. will be the result. This will happen if the inverted commas are omitted from the end of the data.

The length of the last item printed is in 16519. Any value less than the total number of items can be Poked into Step at 16520. For example every other item can be printed by

```
XX POKE 16520, 2
```

Random items can be printed by

```
XX GOSUB RESTORE
XX LET A = INT (RND * N) + 1
XX POKE 16520, A
XX GOSUB READ
```

where N < total number of items. Gosub Restore will reset the Step to 1.

|   |                    |       |                                    |
|---|--------------------|-------|------------------------------------|
| 1 | REM 123 FULL STOPS | 16514 | 24,100,130,64,0,1,1,33,130,64      |
| 2 | LET RESTORE=5      | 16524 | 34,132,64,62,0,50,134,64,60,50     |
| 3 | LET READ=7         | 16534 | 136,64,201,58,134,54,254,11,32,9   |
| 4 | GOTO 9             | 16544 | 42,132,64,35,34,132,64,24,30,237   |
| 5 | RAND USR 16521     | 16554 | 75,4,64,120,254,0,32,2,207,26      |
| 6 | RETURN             | 16564 | 62,234,42,132,64,237,177,34,132,64 |
| 7 | RAND USR 16514     | 16574 | 62,11,190,32,234,35,34,132,64,17   |
| 8 | RETURN             | 16584 | 0,0,6,64,62,11,190,40,6,19         |
| 9 | REM PROGRAM AREA   | 16594 | 35,16,249,207,25,123,50,135,64,237 |
|   |                    | 16604 | 91,132,64,35,34,132,64,126,50,134  |
|   |                    | 16614 | 64,201,58,136,64,71,197,205,153,64 |
|   |                    | 16624 | 193,16,249,58,135,64,79,6,0,205    |
|   |                    | 16634 | 107,11,201                         |

## Table trouble

IF YOU KNOW anyone who is having trouble with their multiplication tables at school, Dean Asher of Harlow, Essex has a program for the 1K ZX-81 which may be of help.

Line 60 determines the number of lines; you can replace the number 20 with any other number you choose.

```

10 INPUT N
20 PRINT N;"X TABLE"
30 LET C=0
40 LET C=C+1
50 PRINT C;"X";N;"=";C*N
60 IF C<20 THEN GOTO 40

```

## Automatic run

THE ROUTINE from J F Brown of Edenbridge, Kent, allows a ZX-81 program to run automatically after loading. This is particularly useful and convenient when a program question contains a large quantity of data in string variables or numeric arrays. The Run command erases all the variables, but the autorun preserves the data by using Goto statements instead. It is particularly useful for business software as no Basic commands have to be entered.

After typing in the program, run and load the data. Then save the program and variables on cassette, type New and try reloading the program. It will run automatically and the data will be preserved.

J. F. Brown.

```

10 DIM A(10)
20 FOR X=1 TO 10
30 INPUT A(X)
40 NEXT X
50 CLS
60 PRINT"DATA PROGRAM"
70 FOR X=1 TO 10
80 PRINT A(X)
90 NEXT X
100 REM SAVING ROUTINE
110 INPUT A#
120 CLS
130 SAVE A#
140 GOTO 60

```

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## Determinant evaluator

THIS ROUTINE to evaluate any N-by-N determinant up to order 15 was written for the Acorn Atom with floating point by S Draper of Lincoln. Its recursive nature makes it considerably shorter than most other determinant-evaluation routines, and does not suffer from division-by-zero errors since there are no divisions within the routine.

The determinant to be evaluated should be in the top left of the 15-by-15 array. For example, with a second-order determinant row one would go into the first two elements of row one of the array, and row two into the first two elements of row two of the array. Since the Atom only supports one-dimensional arrays, the second row of the array starts at the 15th element of the array, and the element X,Y would be found at element  $15*Y+X-16$  of the array. Note that in Atom Basic the % operator means floating point not integer.

## Error-code remedy

THE UK101 has very awkward error messages caused by bit 7 of the second character being set writes Douglas Fyffe of Welling, Kent. A cure could be to reset bit 7 of all printed characters, but this would affect the CHR\$ function.

This Basic program corrects the error messages with no other effect. Running it will enter machine code into page 2 of memory.

To reactivate it type

```
POKE538,40:POKE539,2
```

as one line.

## Determinant evaluator.

```
10DIMPP15,FF15,SS15
20FDIM%DD224,%EE15,%LL15
35REM**SUBROUTINE d EVALUATES AN N BY N DETERMINANT IN THE**
97REM**ARRAY %DD, AND RETURNS THE RESULT IN %D**
100d=N
110aPP(N)=1;SS(N)=1;%EE(N)=0
120IFN>1 N=N-1;GOTOb
130FORI=1 TO D;FF(I)=0;NEXT
140FORI=D TO 2 STEP-1;C=0;L=0
150D C=C+1
160CL=L+1;IF FF(L)=1 GOTOc
170UNTIL C=PP(I);FF(L)=1;NEXT
180FORI=1 TO D;IF FF(I)=0 J=I
190NEXT;%D=%DD(15*D-16+J);N=2;RETURN
195REM**RECURSIVE SUBROUTINE CALL OF SUBROUTINE a**
200bGOSUBa
210FORI=1 TO D;FF(I)=0;NEXT;FORI=D TO N STEP-1;C=0;L=0
220D C=C+1
230eL=L+1;IF FF(L)=1 GOTOe
240UNTIL C=PP(I);FF(L)=1;NEXT
250%EE(N)=%EE(N)+SS(N)*%D+%DD(15*(D-N)+L-1)
260PP(N)=PP(N)+1;SS(N)=-SS(N);IFPP(N)>N;%D=%EE(N);N=N+1;RETURN
270N=N-1;GOTOb
```

The program assumes the mono 2 monitor. For others, change the 538,9 numbers to those of the print vector of your monitor. AD to AE are used to save X and Y and are not normally free.

Though 61 to 64 are often quoted as free memory, they are actually used by Basic: 64 blanks printing when bit 7 is set, for instance.

D8 to FF are unused by Basic, so are free for use.

The RND function can be seeded by a negative argument.

## Equation entry

WHEN WRITING a graph plotter or similar program for the Superboard II, it becomes necessary to input an equation for plotting, writes Robert Schifreen of Edgware, Middlesex. This is usually done by asking the user to break in and add a

line of the form

```
10 DEF FNA(X)=(4*X)+7
```

and restart the program from line 10. However, the following segment of Basic will accept an equation as a string and Poke it directly into a statement. To use it, the start of the program must be at line 10 and must be exactly as follows:

```
10 DEF FNA(T)=+++++++(50 OF THESE)+++1-1
```

The T shows that the equation is in terms of T, and this subscript is asked for by the program. Then type in the equation. The equation is Poked to replace the corresponding number of + signs; the remaining + signs simply add and subtract 1 from the total, making no difference at all.

It is not possible to add 0, as this interferes with the end-of-line null used by Basic. The + signs are needed because pointers need to be set if a line length is altered, otherwise memory will be corrupted. The comparisons are needed because some characters are represented differently in a string and in an equation.

The program will not recognise any standard Basic functions: there are too many of them, and they will be tokenised by Basic. If you are going to use any functions frequently, find out their token by Peeking, and add an appropriate line to the program.

If typing programs that Poke memory, ensure that they are saved before running.

## Error-message remedy.

```
1 REM ROUTINE TO LOAD MC INTO RAM TO CORRECT
2 REM UK101 ERROR MESSAGES.
3 REM DOES NOT AFFECT CHR PRINT
4 REM
5 DATA132,174,134,173,166,168,4,1,192,162
6 DATA208,2,41,127,164,174,166,173,76
7 DATA0
8 REM MC CONVERTED TO DECIMAL FOR BASIC
9 X=512+40;REM START OF MC.
10 READA;IFA=0THEN40
20 POKEA,A;X=X+1;GOTO20
30 A=PEEK(538);POKEA,A;X=X+1
40 A=PEEK(539);POKEA,A
50 REM SETS UP PRINT POINTER
60 END
80 REM DONT CHANGE 40,50 AS THEY WILL NOT THEN
90 REM WORK DUE TO BASIC NOT SAVING POKE PTR.
99 REM AND PEEK OVERWRITING IT.
```

## Equation entry.

```
10 DEF FNA(T)=++++++1-1
100 PRINT"ENTER EQUATION..."
110 PRINT"X=";
120 INPUT EQ$
130 INPUT"IN TERMS OF ";Z$
140 POKE 778,ASC(Z$)
145 IF LEN(EQ$)>50 THEN PRINT"TOO LONG":STOP
150 FORC=1 TO LEN(EQ$)
160 A$=MID$(EQ$,C,1)
170 CC=ASC(A$)
175 R=788+C
180 IF CC>47 AND CC<58 THEN POKE R,CC
190 IF CC>64 AND CC<91 THEN POKE R,CC
200 IF CC=46 THEN POKE R,CC
210 IF CC=42 OR CC=43 OR CC=45 OR CC=47 THEN 300
220 IF CC=40 OR CC=41 THEN POKE R,CC
230 GOTO 400
300 IF CC=43 THEN POKE R,163
310 IF CC=45 THEN POKE R,164
320 IF CC=47 THEN POKE R,166
330 IF CC=42 THEN POKE R,165
400 NEXT C
```

## Bloodstream

YOU ARE a doctor in the year 2112. Your patient is dying of cancer and there is no drug that can help him. He has only one chance, but you will have to risk your own life if you want to save him.

This is the scene set by Greg Hopkins of Reigate, Surrey, in Bloodstream, a fast-action graphics game written for use on a new-ROM Pet. The Basic section of the program prints instructions and comments and sets up the screen, while the machine code actually plays the game.

The miniaturised player and ship are injected into the patient's bloodstream, where they must try to destroy the cancer cells, while evading collision with cancer and antibody cells. The game ends either

when all the cancer cells have been obliterated or when the ship has been hit three times.

If at first you find the program too difficult to beat, you can give yourself more shields by changing the threes in lines 280 and 510 to sixes, and the 300 in line 430 to 150. If you master the game you can increase the number of enemies by lengthening the For loop in line 130 and changing the sixes in lines 380, 430 and 480 accordingly.

To save memory space, the data statements are over-written by the machine-code program. You must, therefore, type in the program exactly as it is shown in the listing, including all Rems, and you must save it before you run it.



```

100 REM *** FANTASTIC VOYAGE ***
110 REM A PROGRAM BY GREG HOPKINS
120 DATA 77,66,78,67,43,67,78,66,77:GOTO580
130 FORX=1TO3:POKE32768+INT(RND(0)*240+25),35
140 POKE32768+INT(RND(0)*240+25),43
150 POKE33528+INT(RND(0)*240),35
160 POKE33528+INT(RND(0)*240),43:NEXT
170 POKE4397,172:SYS4112
180 P8=PEEK(178):P7=PEEK(177)
190 SYS4794:IFPEEK(185)=0THEN320
200 P=P8*256+P7:POKE177,P7:POKE178,P8
210 POKE59467,16:POKE59466,16
220 FORX=0TO8:READA:POKEP+X+INT(X/3)*37,A:NEXT
230 FORX=0TO255:POKE59464,X:NEXT
240 POKE59464,150
250 FORX=0TO8:POKEP+X+INT(X/3)*37,32:NEXT:RESTORE
260 POKE59467,0
270 D=D+1:PRINT"YOU JUST LOST SHIELD:"D
280 FORX=1TO800:NEXT:IFD=3THEN310
290 PRINT" "
300 POKE4397,172:SYS4120:GOTO180
310 SYS4794
320 C=PEEK(185):G=PEEK(186)
330 IFC=0THEN430
340 FORX=1TO10:GETA$:NEXT
350 PRINT"YOUR MISSION HAS FAILED !"
360 PRINT"BECAUSE OF YOUR INCOMPETENCE THE PATIENT
370 PRINT"WILL DIE OF CANCER."
380 PRINT"YOUR SCORE ONLY"6-C"POINTS"
390 PRINT"IF IT'S ANY CONSOLATION, YOU DIED JUST"
400 PRINT"IN TIME TO AVOID BEING DEMOTED TO "
410 PRINT"LAVATORY ATTENDANT."
420 END
430 S=1000-300*D-15*(6-G)
440 PRINT"CONGRATULATIONS !!!"
450 PRINT"YOU CURED THE CANCER AND THE PATIENT MAY";
460 PRINT"RECOVER."
470 PRINT"YOU LOST"D"SHIELDS."
480 PRINT"AND YOU KILLED"6-G"ANTIBODIES BY MISTAKE."
490 PRINT"SO YOUR SCORE"S"POINTS"
500 FORX=1TO10:GETA$:NEXT
510 IFC<>3THEN550
520 PRINT"YOU DIDN'T DIE IN VAIN, BUT IN THE MOST"
530 PRINT"NOBLE WAY POSSIBLE - IN SAVING ANOTHER
540 PRINT"MAN'S LIFE.":END
550 INPUT"WILL YOU HELP TO SAVE ANOTHER LIFE":A$
560 ILEFT$(A$,1)="Y"THENRUN
570 PRINT"GOODBYE...":END
580 PRINT" FANTASTIC VOYAGE"
590 PRINT"
600 PRINT"YOUR PATIENT IS DYING OF CANCER."
610 PRINT"YOUR TASK IS, HAVING BEEN SHRUNK TO"
620 PRINT"INFINITESIMAL SIZE, TO COMBAT ON A"
630 PRINT"MONO-CELLULAR BASIS THE ANTIGEN CELLS
640 PRINT"REPRESENTED BY THE #S ON YOUR SCREEN.
650 PRINT"ALL THESE CELLS MUST BE DESTROYED IF
660 PRINT"THE PATIENT IS TO SURVIVE."
670 PRINT" YOUR TASK IS MADE MORE DIFFICULT BY
680 PRINT"THE PRESENCE OF ANTIBODIES IN THE"
690 PRINT"BLOODSTREAM. NOT ONLY DO YOU HAVE TO"
700 PRINT"AVOID DESTROYING THEM (IF YOU DO IT "
710 PRINT"WILL MAKE THE PATIENT MORE SUSCEPTIBLE"
720 PRINT"TO INFECTION) BUT ALSO IF THEY HIT YOU"
730 PRINT"THEY CAN DESTROY YOUR SHIP. YOUR SHIP"
740 PRINT"HAS BEEN PROVIDED WITH THREE SHIELDS"
750 PRINT"TO PREVENT THIS EVENTUALITY BUT AFTER"
760 PRINT"THEY'RE GONE THE PATIENTS BLOOD-PRESSURE"
770 PRINT"WILL CRUSH YOUR SHIP (AND YOU IN IT).
780 PRINT"ANTIBODIES LOOK LIKE THIS - '+'."
790 PRINT"P.S. CANCER-COLLISIONS KILL YOU TOO!
800 IFPEEK(4112)<>169THEN1020
810 PRINT" PRESS A KEY"
820 GETA$:IFA$=""THEN820
825 GOTO940
830 PRINT" SHIP'S CONTROLS"
840 PRINT"TURN LEFT - 'I' KEY"
850 PRINT"TURN RIGHT - '#' KEY"
860 PRINT"FIRE - 'HOME' KEY
870 PRINT"MOVE - 'LEFT/RIGHT' KEY
880 PRINT"DO YOU WANT CONTINUAL MOTION"
900 INPUT"(PRESS MOVE KEY TO STOP)":M$
910 POKE4153,208
920 ILEFT$(M$,1)="Y"THENPOKE4153,16
930 PRINT" " :GOTO130
940 PRINTSPC(14)"REMEMBER:"
950 PRINTSPC(7)"YOUR SHIP = *
960 PRINTSPC(7)"A CANCER CELL = #
970 PRINTSPC(7)"AN ANTIBODY = +
980 PRINT"TURN ON YOUR SOUND BOX IF YOU HAVE ONE."
990 PRINT"PRESS A KEY"
1000 GETA$:IFA$=""THEN1000
1010 GOTO830
1020 FORJ=1TO9:READK:NEXT
1030 FORJ=4112TO4959:READK:POKEJ,K:NEXT
1040 RESTORE:GOTO810
1050 REM*** DATA STATEMENTS ***
1060 REM*** FOR MACHINE CODE PROGRAM ***
1070 DATA169,129,133,178,169
1080 DATA203,133,177,160,41,169,81,145,177,200
1090 DATA169,42,145,177,162,3,234,234,234,234
1100 DATA234,169,0,141,16,232,173,18,232,141
1110 DATA89,19,73,255,41,128,208,117,173,94
1120 DATA19,77,89,19,45,94,19,141,95,19
1130 DATA173,89,19,41,1,208,34,173,89,19
1140 DATA41,2,208,59,32,240,248,173,95,19
1150 DATA41,64,240,3,76,64,17,173,89,19
1160 DATA141,94,19,76,16,17,170,170,170,170
1170 DATA170,188,80,19,169,32,145,177,232,224
1180 DATA8,208,2,162,0,188,80,19,169,42
1190 DATA145,177,76,76,16,170,170,170,170,170
1200 DATA170,170,170,188,80,19,169,32,145,177
1210 DATA202,224,255,208,2,162,7,188,80,19
1220 DATA169,42,145,177,76,88,16,170,170,170
1230 DATA170,170,170,170,170,160,41,169,32,145
1240 DATA177,188,80,19,140,88,19,145,177,169
1250 DATA4,141,90,19,141,91,19,32,208,16
1260 DATA76,59,16,170,170,170,170,24,216,165
1270 DATA177,109,88,19,133,177,165,178,105,0
1280 DATA133,178,24,216,165,177,233,40,133,177
1290 DATA165,178,233,0,133,178,201,132,208,4
1300 DATA169,128,133,178,201,127,208,4,169,131
1310 DATA133,178,169,81,160,41,145,177,169,42
1320 DATA188,80,19,145,177,96,170,170,170,170
1330 DATA170,142,92,19,140,93,19,162,0,160
1340 DATA0,200,192,2,208,251,202,224,2,208
1350 DATA244,234,234,234,169,0,168,32,0,18
1360 DATA96,93,19,174,92,19,76,42,16,170
1370 DATA170,170,170,170,170,170,170,170,169
1380 DATA0,141,100,19,24,188,80,19,152,101
1390 DATA177,133,177,165,178,105,0,133,178,56
1400 DATA165,177,233,41,133,177,165,178,233,0
1410 DATA133,178,177,177,201,32,240,5,169,11
1420 DATA141,100,19,76,192,17,173,100,19,201
1430 DATA12,240,10,169,90,145,177,76,69,17

```

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1440 DATA234,234,234,75,164,17,56,165,177,253
1450 DATA80,19,133,177,165,178,233,0,133,178
1460 DATA4,165,177,105,41,133,177,165,178,105
1470 DATA0,133,178,177,177,201,90,208,7,169
1480 DATA32,145,177,76,131,17,169,0,141,75
1490 DATA232,76,98,16,170,170,170,170,170,170
1500 DATA170,170,170,170,170,170,170,238,100,19
1510 DATA165,178,201,127,208,5,169,12,141,100
1520 DATA19,169,16,141,75,232,169,32,141,74
1530 DATA232,169,104,141,72,232,142,92,19,140
1540 DATA93,19,162,0,160,0,200,192,37,208
1550 DATA251,232,224,37,208,244,174,92,19,172
1560 DATA93,19,76,111,17,170,170,170,170,170
1570 DATA170,169,128,133,186,169,0,133,185,141
1580 DATA99,19,177,185,201,35,240,63,201,43
1590 DATA240,62,230,185,208,242,230,186,165,186
1600 DATA201,132,208,234,169,128,133,186,169,0
1610 DATA133,185,177,185,201,36,208,4,169,35
1620 DATA145,185,201,44,208,4,169,43,145,185
1630 DATA230,185,208,234,230,186,165,186,201,132
1640 DATA208,226,173,99,19,208,3,76,172,18
1650 DATA96,238,99,19,141,98,19,32,0,19
1660 DATA24,165,185,109,96,19,133,179,165,186
1670 DATA105,0,133,180,56,165,179,233,41,133
1680 DATA179,165,180,233,0,133,180,201,132,208
1690 DATA4,169,128,133,180,201,128,16,4,169
1700 DATA131,133,180,169,32,145,185,238,98,19
1710 DATA177,179,201,81,240,31,201,42,240,27
1720 DATA201,32,208,8,173,98,19,145,179,76
1730 DATA11,18,206,98,19,76,103,18,234,234
1740 DATA234,234,234,169,254,133,185,169,96,141
1750 DATA45,17,96,170,170,170,170,169,128,133
1760 DATA170,169,0,133,177,168,133,185,133,186
1770 DATA177,177,201,35,208,2,230,185,201,36
1780 DATA240,27,234,234,201,43,208,2,230,186
1790 DATA201,44,208,2,230,186,230,177,208,226
1800 DATA230,178,165,178,201,132,208,218,96,169
1810 DATA35,145,177,76,205,18,170,170,170,170
1820 DATA170,170,170,170,170,170,170,169,41,141
1830 DATA96,19,234,234,234,169,40,141,97,19
1840 DATA32,32,19,169,1,141,97,19,234,234
1850 DATA234,32,32,19,96,234,234,234,234,32
1860 DATA127,223,165,138,201,255,16,11,24,173
1870 DATA96,19,109,97,19,141,96,19,96,201
1880 DATA255,16,1,96,56,173,96,19,237,97
1890 DATA19,141,96,19,96,170,170,170,170,170
1900 DATA170,170,170,170,170,170,170,0,1,2
1910 DATA42,82,81,80,40,82,127,4,4,4
1920 DATA82,127,0
READY.

```

## Mailing list

MAILING LIST is intended as part of a suite which handles business data. It will also be very useful for clubs and societies for membership records, suggests MJ Valentine of Rotherham, South Yorkshire.

The program is designed to handle 10 lines of data up to 24 bytes long, to be ordered by record number. Any character pattern on any line may be searched for, and various print formats are available as required. Lines 1 to 9 are intended for record data, while line 10 is intended for access, e.g.:

Smith a 1/10/81 aug

Where data could be subscription renewal dates, or coding that a particular function job had been done on that record, e.g., by another program.

The program is written in Commodore Basic 4.0 and requires a disc-DOS 2.1 or 2.5. The printer output is to device 4, so any suitable printer, such as the Commodore 3022, could be used.

The program uses Commodore's relative-file system. Record# positions the DOS record pointer prior to Print# or Input#. The variables DS and DS\$ contain the disc-status data.

The following are used:

- Backup-shifted B — creates a back-up copy of drive 0 in drive 1.
- End clears the screen and displays both disc directories prior to ending the program run.
- Drive targets either the program or the disc drive. Drive 0 is set on start-up. The disc identity is read and the first record from the file is displayed.
- File Name is used to access a file when several files exist on the same disc. Normally only one relative file is on the disc and may occupy all available blocks.
- Amend allows retyping of any line of the record displayed. Keys 1 to 9 will display the appropriate line, while 0, a or Return will access line 10. Once the line has been typed, the record is updated. To clear a record use Scratch, and New to enter a complete record. An entry must have at least one character to ensure a disc crash does not result. A single space is not allowed, neither are ", ", " etc. which are treated by

the Basic input statement as field terminators.

Record causes the specified record to be displayed onto the screen, providing it exists, otherwise the DOS error channel is displayed.

< & > keys cause the next record down — or next record up to be displayed and are used for thumbing through each record.

New allows retyping of all 10 lines in a similar manner to Amend. The record is updated on completion of line 10.

The Scratch command — shifted S — forces a Record Vacant flag. All lines contain a # after a Scratch, the # allows a search to be made for a Vacant record via Hunt. To expand or create a relative file, providing the file name and drive have been previously set up, the highest record is requested via the record command. A record-not-present error will result. If this record is scratched then this record is written to disc. The DOS will then allocate space to all the intermediate records, filling then with graphics CHR\$ 255. If this character is deleted in a record read, then the Scratch function is automatically forced.

The Hunt command will first request the start and finish record for examination; low to high will be examined sequentially. The matching line will then be requested. Lines from 169 may be specified, but any other key will default to line 10.

At the same time as the record is read during a sweep, the matching line is retained in the CBM memory. It will remain so until another access line is specified or the drive is changed. This feature allows rapid examination for a match in memory, saving on disc-access time. If the record access line is not in memory the record is accessed and memory updated. The pattern-matching rules are similar to those of the Commodore DOS:

- ? matches any character
  - \* matches all subsequent characters
- For example the command ?m?th\* will find  
SMITH

SMITHERONE  
SMYTH

but not  
scmitt and \* will find all records.

To find the 15th character, X on the access line try

```

????????????????X*
← 14*? →

```

If a match is found it is displayed on the screen. A print option appears, allowing one copy of the appropriate format to be printed. If a print is not required then the search proceeds by default.

To create a memory image of all access lines will take about four minutes on a 4040 disc. This function is caused by using an unlikely match such as \$\* as the pattern match.

The Card and Mail Print function is intended to print either a record-card label — e.g., as a stick-on label for a customer's personal file — or a mailing label, providing the appropriate stationery is loaded into the printer. The Printout option applies only to the record displayed where only one printout is produced.

The Scan option behaves like Hunt, with a printout resulting from a match. An advice of print will be placed on the specified position in line 10. This is intended to show a particular operation has been performed, e.g., a catalogue has been sent. The advice character and position may be specified prior to printout.

Selection of position 25 will abort this function. As to which character is used for what function depends on the user. It could be for use by another program.

The print function is as Card and Mail print, but the user may specify to print or ignore lines 3 to 9. If the line is ignored then a blank line is printed so as to maintain registration on any labels, etc. This function is intended for listing where sensitive areas of data are required to be omitted. Of course, any intending user

(continued on next page)



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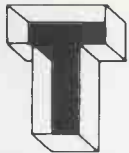
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| PRINT ELEMENT                       | DAISY-<br>WHEEL | DAISY-<br>WHEEL  | THIMBLE         | DOUBLE<br>DAISY-<br>WHEEL      | <b>DOUBLE<br/>DAISY-<br/>WHEEL</b> |
| AUTO<br>BIDIRECTIONAL               | Yes             | No               | No              | No                             | <b>Yes</b>                         |
| AUTO LOGIC<br>SEEKING               | Yes             | No               | Yes             | No                             | <b>Yes</b>                         |
| PROPORTIONAL<br>PRINT<br>CAPABILITY | Yes             | Yes              | Yes             | No                             | <b>Yes</b>                         |
| EXTENDED<br>CHARACTER SET           | No              | No               | Yes             | Yes                            | <b>Yes</b>                         |
| LETTER QUALITY<br>PRINT             | Yes             | Yes              | Yes             | Yes                            | <b>Yes</b>                         |
| CUSTOM INTER-<br>FACE OPTION        | No              | No               | No              | No                             | <b>Yes</b>                         |
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### Paint a picture.

```

1 HOME : GOSUB 1000
5 POKE - 16304,0: HOME
6 HGR
7 HCOLOR= Z
10 GOSUB 60
20 HPILOT X,Y
30 GOSUB 60
40 HPILOT TO X,Y
50 GOTO 30
60 X = PDL (1) / .914
65 IF PEEK ( - 16286) > 127 THEN 90
66 IF PEEK ( - 16287) > 127 THEN 90
70 LET Y = PDL (0) / 1.6
80 RETURN
90 POKE - 16301,0
91 POKE 35,21
92 POKE 34,21
94 POKE 33,39
95 HOME
100 INVERSE : PRINT "SAVE LOAD COLOR RUBOUT DELETE NEW EXIT";: GET A$
101 IF A$ = "S" THEN 500
102 IF A$ = "L" THEN 600
103 IF A$ = "E" THEN NORMAL : HOME : TEXT : NEW
104 IF A$ = "R" THEN HOME : LET Z = 4: GOTO 7
105 IF A$ = "N" THEN GOTO 5
106 IF A$ = "D" THEN 700
130 PRINT " SHADE CHANGE OF 1 2 3 5 6 ";: GET Z
140 HOME : POKE - 16304,0: GOTO 7
500 REM SAVE HI-RES PIC
520 INPUT " NAME FOR PICTURE ";A$
530 PRINT CHR$ (4);"BSAVE "A$", LB192, A$192"
540 GOTO 140
600 REM LOAD HI-RES PIC
620 INPUT " NAME OF PICTURE ";A$
630 HGR
640 PRINT CHR$ (4);"BLOAD "A$", A$192"
650 GOTO 91
700 REM DELETE HI-RES PIC
710 INPUT " NAME OF PICTURE ";A$
720 PRINT CHR$ (4)"DELETE "A$
730 GOTO 91
1000 FOR S = 1 TO 4: PRINT : NEXT : PRINT TAB( 10): FLASH : PRINT "ELEC
TRONIC SCRIBBLE PAD": NORMAL
1005 PRINT : PRINT
1010 PRINT : PRINT : PRINT "THIS PROGRAM WILL ALLOW YOU TO CREATE A PICT
URE USING THE HIGH RESOLUTION GRAPH—ICS."
1020 PRINT "IF THE CONTROLLER BUTTON IS PRESSED THE SCREEN WILL GO BLANK
.";
1025 PRINT "TO DISPLAY THE MAIN MENU PRESS THE BUTTON AGAIN."
1030 FOR R = 1 TO 5000
1035 IF PEEK ( - 16287) > 127 THEN IF PEEK ( - 16286) > 127 THEN GOTO
10000
1040 IF PEEK ( - 16286) > 127 THEN 5
1050 IF PEEK ( - 16287) > 127 THEN 5
1060 NEXT
10000 TEXT
10010 PRINT TAB( 10): FLASH : PRINT "PADDLES NOT PLUGGED IN": NORMAL
10015 FOR S = 1 TO 10
10020 FOR A = 1 TO 100:X = PEEK ( - 16336): NEXT
10030 NEXT
10040 HOME : POKE 35,0: POKE 34,0: POKE 32,0: POKE 33,0

```

Up to seven pictures can be saved on a standard 5in. disc, together with the program. Each complete screen of high-resolution graphics requires 8K memory, or 34 tracks.

## Heart throb

THIS MEMORY-DUMP routine can be used to modify the Space Invaders program so that it will produce the famous menacing heartbeat, writes D T Jones of Woodside Park, London.

Enter the hexadecimal as listed,

```

6100- A9 00 8D 6A 61 8D 6C 61
6108- A9 50 8D 6B 61 20 3D 4E
6110- 20 58 FC 4C 00 5F EE 6A
6118- 61 AD 6A 61 C9 10 D0 1F
6120- A9 00 8D 6A 61 CE 6B 61
6128- AD 6B 61 C9 19 D0 05 A9
6130- 50 8D 6B 61 AD 6B 61 8D
6138- 5A 61 4A 4A 8D 4D 61 BC
6140- 20 19 60 20 4A FF EE 6C
6148- 61 AD 6C 61 C9 14 B0 06
6150- AD 30 C0 4C 62 61 AD 6C
6158- 61 C9 50 90 05 A9 00 8D
6160- 6C 61 20 3F FF A5 19 C9
6168- F0 60 00 50 00 A9 14 8D
6170- 4D 61 A9 50 8D 5A 61 A9
6178- 00 8D 6A 61 8D 6C 61 A9
6180- 50 8D 6B 61 4C 00 5F 00
12F2- 20 43 61 EA
1A31- 20 16 61
5F2A- 4C 6D 61

```

and save it on tape by typing:

800.61FFW

With that done, the invaders will make the familiar increasing throb. To run the new version, type 6100G.

To put the program on disc, type.

7FD: 4C 00 61

BSAVE INVADERS, A\$7FD,L\$5A03

To run, type

BRUN INVADERS

## Toolkit fault

BELIEVE IT or not I have discovered a fault in some Apple software, writes Shaun Hope of Milton Malsor, Northamptonshire. The disc in question is the DOS Toolkit — Apple part number A2D-0029 — and the problem appeared on the Applesoft Programmers Aid, APA, program.

At first I could not believe my eyes but finally decided that something must be wrong. I got in touch with Apple U.K., who confirmed the problem but have been unable to find a solution.

The fault arises with the &XREF command referred to on page 10 of the Toolkit manual. It is supposed to give a complete cross-reference of all variables used in a program but it does not always work. To see the problem run Loadapa, then type New and enter the following example program:

```

10 DATA 10
20 READ A
30 PRINT A
40 END

```

Typing &X should give

A 20,30

(continued on next page)

(continued from previous page)

but it does not.

Now delete line 10. Typing &X now does give:

```
A 20,30
```

so it appears the cross-reference command does not like data statements — a rather fundamental omission. Apple promised to let me know when the problem had been sorted out, but that was back in July.

Apart from this slight bug the disc provides an excellent suite of programs and it is surprising that Apple has not gone out of its way to promote it. Apart from the Toolkit — which gives such commands as auto line number, renumber, append and compress — there is the comprehensive assembler/editor and a high-resolution character generator complete with countless sets of foreign scripts.

## Grandfather clock

I HAVE ALWAYS wanted a grandfather clock, writes R D Walker of Sutton Coldfield, West Midlands. The trouble is that I also wanted an Apple computer, and the micro won.

Whilst delving into the more interesting parts of the Apple it soon became clear that the combination of graphics and sound could satisfy my other desire, and give me the opportunity to get to know my new acquisition.

The program is rather novel in that it produces a circular clock face, displaying the hour and minute hands which will move in the normal way. The inclusion of a conventional second hand looked a little confusing, so the seconds are shown by a dot which steps around the clock face at one-second intervals. The clock strikes the hours in the same way as a grandfather clock.

A gesture to modern times is the inclusion of a digital display at the bottom of the clock face, which changes at the same time as the hands.

During the chiming sequence, no other activity is possible. The seconds dot must therefore be advanced afterwards by an amount determined by the time taken to chime the hours.

The clock does not depend on any internal timer, but uses the inherent delay caused of the For loop. Timing can be adjusted merely by modifying the value of TT in line 16. The accuracy of the seconds advancement each hour can be adjusted by altering the time taken for the chimes in line 5080.

The tone generator is set up in lines 1 to 7 and this machine-code program is called by the data in lines 5090 to 5120. Each of the numbers there causes a different note to be produced. It would be quite easy to extend the program to chime the quarter hours as well by selectively taking each of these lines as required.

Lines 10 to 13 set the co-ordinates of

## Grandfather clock.

```
1 REM INITIALISE TONES
2 FOR A = 768 TO 786: READ X: POKE A, X: NEXT A
3 DATA 162,255,164,0
4 DATA 136,234,234,234,234,208,248
5 DATA 173,48,192
6 DATA 202,208,240
7 DATA 96
10 HGR : HCOLOR= 7
11 A = 139: REM HALF WAY ACROSS SCREEN
12 B = 79: REM HALF WAY DOWN SCREEN
13 R = 75: REM RADIUS OF CIRCLE
14 PI = 3.1415
15 SC = - 1: REM SECONDS START AT -1
16 TT = 460: REM *** THIS IS THE TIME ADJUSTMENT (HIGHER TO SLOW
DOWN, LOWER TO SPEED UP ) ***
17 ML = 70:HL = 50: REM MINUTE AND HOUR HAND LENGTH
19 REM PLOT CLOCK FACE
20 FOR X = 0 TO 2 * PI STEP PI / 30
25 SC = SC + 1
26 IF SC = 5 THEN SC = 0:RX = 5
30 H PLOT A + (R * SIN (X)),B - (R * COS (X)) TO A + ((R - RX) *
SIN (X)),B - ((R - RX) * COS (X))
35 RX = 0
40 NEXT X
50 HOME : VTAB 23: PRINT "ENTER THE TIME AS HHMM": INPUT TM$
60 H = VAL ( LEFT$ ( TM$,2)):M = VAL ( RIGHT$ ( TM$,2))
70 IF H < 0 OR H > 12 OR M < 0 OR M > 60 THEN PRINT "ERROR": FOR
X = 1 TO 500: NEXT X: VTAB 24: PRINT : GOTO 50
80 HOME
90 GOSUB 1000: GOTO 400
99 REM DISPLAY THE SECONDS 'DOT'
100 SC = 0
105 FOR X = SC TO 2 * PI STEP PI / 30
110 HCOLOR= 7: GOSUB 2000
120 FOR ZZ = 1 TO TT: NEXT ZZ
130 HCOLOR= 0: GOSUB 2000
140 NEXT X
199 REM CLEAR THE LAST HANDS SETTING
200 HCOLOR= 0: GOSUB 1000
210 HCOLOR= 7
219 REM CALCULATE THE NEW SETTING AND PLOT
220 M = M + 1: IF M = 60 THEN M = 0:H = H + 1: IF H = 13 THEN H =
1
230 GOSUB 1000
349 REM ADD LEADING ZERO TO MINUTES
350 S$ = "": IF M < 10 THEN S$ = "0"
400 VTAB 24: HTAB 16: PRINT " : : ";
410 VTAB 24: HTAB 16: PRINT H; " : : ";S$;M;
440 IF M = 0 THEN GOSUB 5000: GOTO 105
450 GOTO 100
999 REM CALCULATE AND PLOT HANDS SETTING
1000 TM = M / 30 * PI:TH = ((H / 6) + (M / 360)) * PI
1010 H PLOT A + (ML * SIN (TM)),B - (ML * COS (TM)) TO A +
(HL * SIN (TH)),B - (HL * COS (TH))
1020 RETURN
1999 REM SECONDS DOT DISPLAY AND TICK
2000 H PLOT A + ((R - 2) * SIN (X)),B - ((R - 2) * COS (X))
2010 TK = PEEK ( - 16336)
2050 RETURN
5000 REM CHIMES SUBROUTINE
5080 FOR MM = 1 TO 4: FOR N = 1 TO 4: READ P: POKE 0,P: CALL 768:
NEXT N: FOR X = 1 TO 500: NEXT X,MM
5090 DATA 150,120,135,200
5100 DATA 150,135,120,150
5110 DATA 120,150,135,200
5120 DATA 200,135,120,150
5130 FOR MM = 1 TO H: POKE 0,150: CALL 768: FOR X = 1 TO 480: NEXT
X,MM
5139 REM ADD SECONDS TO ALLOW FOR TIME TAKEN FOR CHIMES
5140 SC = PI / 3 + (H * PI / 30)
5150 RETURN
```

the circle and line 14 is the value of PI. Line 16 sets the clock accuracy and line 17 gives the hand lengths.

Lines 50 to 90 request the time to be set up; if the response is not in the form HHMM you will be asked to re-enter the time.

The seconds dot is moved around the clockface by lines 99 to 140. The colour is

changed to erase the previous dot from the screen.

Every 60 seconds, the hands position is changed. Lines 199 to 230 take care of this and reverse the colour to erase the previous setting. Lines 349 to 450 put a leading zero to the digital display when needed. Line 5140 corrects the time after the chimes and hours have sounded.

## Tabulating data — driver program.

```

10 FOR I = 0 TO 5 STEP 1.25
20 ZI = 2:ZS = 7:ZZ = I: GOSUB 40400
30 ZZ = I * I: GOSUB 40400
40 ZB = 0:ZS = 4:ZZ = I * 10: GOSUB 40400
50 ZD = 4:ZS = 9:ZZ = COS (I) - SIN (I): GOSUB 40400
60 PRINT
70 NEXT I
80 END

```

## Main subroutine.

```

40400 ZA = VAL ("1E" + STR$ (ZI)):ZB = INT (ZZ * ZA + .5)
40410 ZI = 0:ZK = 0:
40420 IF ZD = 0 THEN ZK = 0: GOTO 40470
40430 IF ZB = 0 THEN ZK = ZD + 1: GOTO 40470
40440 ZC$ = STR$ (ZB)
40450 ZT = ZI: IF LEN (ZC$) < ZD THEN ZT = LEN (ZC$)
40460 FOR KZ = 1 TO ZT: IF MID$ (ZC$, LEN (ZC$) + 1 - KZ, 1) = "0" THEN Z
    K = ZK + 1: NEXT KZ: IF ZK = ZT THEN ZK = ZT + 1
40470 ZI = ZB / ZA:ZC$ = STR$ (ZI)
40480 PRINT SPC (ZS - LEN (ZC$) - ZK);ZI;
40490 IF ZK = 0 THEN 40520
40500 IF ZK > ZT THEN PRINT ".": FOR ZM = 1 TO ZK - 1: PRINT "0";: NEXT
    ZM: GOTO 40520
40510 FOR ZM = 1 TO ZK: PRINT "0";: NEXT ZM
40520 RETURN

```

## Example programs and output.

```

100 REM MENU SELECTABLE PRINTER
110 PRINT"1. PRINT TITLE.":PRINT
120 PRINT"2. PRINT DATE.":PRINT
130 PRINT"3. PRINT COST.":PRINT
140 PRINT"4. RETURN TO MAIN MENU":PRINT
150 VTAB20:HTAB5:INPUT"SELECT <1 - 4> ":M$:PRINT
160 M=VAL(M$):IF(M<1) OR (M>4) THEN 150
170 IF RIGHT$(M$,1)="P" THEN PR#1:PR$="P":GOTO 190
180 PR$="NP"
190 ON M GOTO -----

```

| IRUN | 0.00  | 0.00 | 0 | 1.0000 |
|------|-------|------|---|--------|
| 1.25 | 1.56  | 13   | - | .6337  |
| 2.50 | 6.25  | 25   | - | 1.3996 |
| 3.75 | 14.06 | 38   | - | 2.490  |
| 5.00 | 25.00 | 50   | - | 1.2426 |

## Data tabulator

THE PROBLEM of tabulating data is tackled in this subroutine from S M Fraser of Glasgow. Instead of the Print-Using format it uses variables to specify

- number of decimal places, ZD = 2,
- field width, ZS = 10,
- number to be tabulated, ZZ = 1.

Although it does not give scientific notation, it is useful for the majority of applications and is economical in its memory requirements.

Another useful facility, is a printer-on command letter when selecting from a menu. By taking the input from the Menu Select to be a string variable, the choice can be made as, e.g., 2 or 2P. If the number alone is selected then the infor-

mation is written to the screen but if 2P is selected then the information is printed to the printer as well as being displayed on the screen.

The printer should be turned off at some appropriate point by  
IF PR\$ = "P" THEN PR#0

## Reading from screen

A USEFUL FEATURE in any data-entry program is the ability to edit any characters displayed on the screen, and to do this some way of reading from the screen is necessary. The routine devised by Phil Reeve of Birmingham could provide the basis for such a function.

By supplying the row R — 0 to 23 — and the column C — 0 to 39 — of the

screen position required, the character Y\$ can be read from the screen.

The heart of the routine is the function defined at line 100 and used at line 110, which calculates the position in memory of the required row. Lines 130 to 190 are an optional routine which converts the character read into the range ASCII 32 to 95, i.e., the range of character values normally input from the keyboard. This routine is essential if inverse or flashing characters are to be read.

The majority of the remaining lines are for demonstration purposes only and all except 120 and 200 may be omitted. The routine reads any character from the text page 1 display regardless of video mode and window settings. M

## Read-from-screen routine.

```

10 REM *****
20 REM * ROUTINE TO READ CHAR *
30 REM * FROM THE SCREEN *
40 REM *
50 REM * PHIL REEVE, *
60 REM * OCTOBER, 1981 *
70 REM *****
80 REM R = ROW (0 TO 23)
90 REM C = COLUMN (0 TO 39)
100 DEF FN AC(X) = 1024 + INT (X / 8) * 40 + (X / 8 - INT (X / 8)) * 1024
103 GOSUB 2000: REM ** TEMP GOSUB **
105 GOSUB 1000: REM ** TEMP GOSUB **
110 X = FN AC(R) + C
120 Y = PEEK (X)
130 REM ** OPTIONAL ROUTINE TO CONVERT CHAR TO ASCII RANGE 32-95 **
140 IF Y < 32 THEN Y = Y + 64: GOTO 200: REM -INVERSE
150 IF Y < 64 THEN 200: REM -INVERSE
160 IF Y < 96 THEN 200: REM -FLASHING
170 IF Y < 128 THEN Y = Y - 64: GOTO 200: REM -FLASHING
180 Y = Y - 128: REM -NORMAL
190 REM ** END OF OPTIONAL ROUTINE **
200 Y$ = CHR$ (Y)
210 GOSUB 3000: REM ** TEMP GOSUB **
220 GOTO 105: REM ** TEMP GOTO **
999 END
1000 REM *** TEMP GOSUB FOR DEMO ONLY ***
1010 VTAB 22: CALL - 958
1020 INPUT "ROW,COLUMN ?":R,C
1030 VTAB 22: HTAB 30: PRINT "=>";
1999 RETURN
2000 REM *** TEMP GOSUB FOR DEMO ONLY ***
2005 HOME
2007 FLASH: REM (OR INVERSE OR NORMAL)
2010 FOR I = 1 TO 15
2020 FOR J = 32 TO 95
2030 PRINT CHR$ (J);
2040 NEXT J,I
2050 NORMAL
2999 RETURN
3000 REM *** TEMP GOSUB FOR DEMO ONLY ***
3010 PRINT CHR$ (Y)
3020 INPUT "HIT RETURN TO CONTINUE":A$
3999 RETURN

```

## Protecting code

A YEAR AGO I acquired a Tandy hardware modification to my TRS-80 to enable lower-case video, writes Tom Corrigan of Houghton-le-Spring, Tyne and Wear. The result is excellent, but the driver software tends to get in the way of other routines. There are a number of methods of protecting a machine-code subroutine — the standard one reserves memory size on power-up. The problems arise when two or more routines occupy the same area of memory.

I have overcome this for my own lower-case by having a modified ROM A installed, but for those who do not have this modification, I offer the following routine which finds space for itself in high RAM and reserves its own memory size.

The length of the operating routine is measured by the label Progl and this value is subtracted from the four vectors dependent upon memory size reserved. The memory size reserved is increased by an amount equal to the length of the program, approximately 100 bytes. All addresses within the program are adjusted relative to the modified memory size, and the operating routine is relocated immediately above it and hence, immediately beneath any resident high-



RAM machine-code routine.

The TRS-80 keyboard produces lower-case characters with the shift key and upper-case without. To invert this and simulate a typewriter, alphabetic characters are trapped and exclusively Ored with 20H, in line 1360. As written, line 1360 has the instruction Ret, but on initiation the facility is switched off and when shift zero is typed, line 1230 changes C9H (RET) to EEH (XOR nn) by exclusive Or with 27H. At the same time, the video-driver address is

exchanged with that stored at the location which, prior to relocation, is labelled Vidstr.

The character generator has a £ sign which can be displayed with the ASCII value 60H and obtained from the keyboard by shift @. This cannot, however, be used where it would be most desired: in the Print Using field specifier. The initialising part of the program asks if an exchange is required and, if so, substitutes 20H (JR NZ) for 18H (JR) at line number 1490. If a dollar sign appears in the video stream, it is replaced with a £ sign. This has no other effect, although a £ sign follows all string variables, instead of the usual dollar sign in Basic program listings.

The program will run under level II or DOS; the exit address being selected by the routine in lines 850 to 890. However, if an expansion interface is connected, but no disc drive, then line 880 should be modified to read

```
JP 1A19H
```

Once the routine is initialised, the lower case and keyboard inversion may be switched in and out alternately, by typing shift zero. Those who have no editor/assembler can insert the object code directly into memory, using a monitor such as T-Bug.

|      |       |                                     |                                     |      |       |   |                                |
|------|-------|-------------------------------------|-------------------------------------|------|-------|---|--------------------------------|
| 0100 |       |                                     |                                     | 0650 | LD    | A,20H   | : INSERT                       |
| 0110 | ORG   | 6000H                               |                                     | 0660 | LD    | (POFFON),A                                      | : JR NZ.                       |
| 0120 |       |                                     |                                     | 0670 |       |   |                                |
| 0130 |       |                                     |                                     | 0680 | NOPND | LD  | HL,KEYBD                       |
| 0140 | ;     | MODIFY MEMORY SIZE                  |                                     | 0690 |       | LD  | BC,PROGL                       |
| 0150 |       |                                     |                                     | 0700 |       | LD  | DE,(4049H)                     |
| 0160 | START | LD                                  | DE,PROGL ; PROGRAM LENGTH           | 0710 | LDIR  |   | ; MEM SIZE                     |
| 0170 |       | LD                                  | HL,(40D6H) ; MEM SIZE               | 0720 |       |   |                                |
| 0180 |       | OR                                  | A                                   | 0730 | CALL  | 1C9H  | : CLS                          |
| 0190 |       | SBC                                 | HL,DE                               | 0740 |       |   |                                |
| 0200 |       | LD                                  | (40D6H),HL ; MEM SIZE ADJUSTED      | 0750 |       |   |                                |
| 0210 |       | LD                                  | (40B1H),HL ; BASIC TOP LIMIT        | 0760 |       | LD  | HL,(4016H) ; INITIATE          |
| 0220 |       | INC                                 | HL                                  | 0770 |       | LD  | (KEYBD+1),HL ; KEYBOARD        |
| 0230 |       | INC                                 | HL                                  | 0780 | KVEC  | LD  | HL,KEYBD ; DIVERSION           |
| 0240 |       | LD                                  | (4049H),HL ; HIMEM FOR DOS          | 0790 |       | LD  | (4016H),HL                     |
| 0250 |       | LD                                  | DE,34H                              | 0800 |       |   |                                |
| 0260 |       | OR                                  | A                                   | 0810 |       |   |                                |
| 0270 |       | SBC                                 | HL,DE                               | 0820 | ;     | ALL SET   |                                |
| 0280 |       | LD                                  | (40A0H),HL ; STRING SPACE           | 0830 | ;     | NOW RETURN                                      |                                |
| 0290 |       | LD                                  | (40E8H),HL ; BASIC STACK POINTER    | 0840 |       |   |                                |
| 0300 |       | LD                                  | SP,HL ; LOCATE STACK                | 0850 |       | LD  | A,(37ECH) ; CHECK FOR          |
| 0310 |       |                                     |                                     | 0860 |       | INC   | A ; DISKS                      |
| 0320 |       |                                     |                                     | 0870 |       | CP  | 2                              |
| 0330 | ;     | POSITION PROGRAM ABOVE NEW MEM SIZE |                                     | 0880 |       | JP  | C,1A19H ; LEVEL II BASIC       |
| 0340 |       |                                     |                                     | 0890 |       | JP  | 402DH ; OTHERWISE DOS          |
| 0350 |       | LD                                  | HL,(4049H) ; RETRIEVE START ADDRESS | 0900 |       |   |                                |
| 0360 |       | LD                                  | (KVEC+1),HL ; KEYBOARD DIVERSION    | 0910 |       |   |                                |
| 0370 |       | INC                                 | HL                                  | 0920 | ;     | MESSAGE BUFFER                                  |                                |
| 0380 |       | LD                                  | (KVEC-2),HL ; FOR KEYBOARD ROM CALL | 0930 |       |   |                                |
| 0390 |       | LD                                  | DE,3AH                              | 0940 | MESS  | DEFB  | 'DO YOU WANT "'                |
| 0400 |       | ADD                                 | HL,DE                               | 0950 |       | DEFB  | 24H ; DOLLAR SIGN              |
| 0410 |       | LD                                  | (SVEC1+1),HL ; FOR SHIFT 0 TO       | 0960 |       | DEFB  | " " CHANGED TO "'              |
| 0420 |       | LD                                  | (SVEC2+1),HL ; TOGGLE KEYBOARD      | 0970 |       | DEFB  | 60H ; POUND SIGN               |
| 0430 |       | INC                                 | HL                                  | 0980 |       | DEFB  | " " ? "                        |
| 0440 |       | INC                                 | HL                                  | 0990 |       | DEFB  | 5FH                            |
| 0450 |       | INC                                 | HL                                  | 1000 | MESSL | END   | \$_MESS ; MESSAGE LENGTH       |
| 0460 |       | LD                                  | (VIDSTR),HL ; FOR VIDEO DRIVER      | 1010 |       |   |                                |
| 0470 |       | LD                                  | DE,24H                              | 1020 |       |   |                                |
| 0480 |       | ADD                                 | HL,DE                               | 1030 | ;     | THE FOLLOWING PART OF THE PROGRAM IS RE-LOCATED |                                |
| 0490 |       | LD                                  | (VVEC2+1),HL ; FOR SHIFT 0 TO       | 1040 |       |   |                                |
| 0500 |       | LD                                  | (VVEC3+2),HL ; TOGGLE LOWER CASE    | 1050 | KEYBD | CALL  | 3E3H ; SCAN WHOLE OF KEYBOARD  |
| 0510 |       |                                     |                                     | 1060 |       | PUSH  | AF                             |
| 0520 |       | CALL                                | 1C9H ; CLS                          | 1070 |       | LD  | A,(38B0H) ; SHIFT KEY PRESSED? |
| 0530 |       | LD                                  | HL,MESS ; PRINT MESSAGE             | 1080 |       | OR  | A                              |
| 0540 |       | LD                                  | DE,3D00H ; REQUESTING POUNDS        | 1090 |       | JR  | Z,NOTOG                        |
| 0550 |       | LD                                  | BC,MESSL ; FOR DOLLARS              | 1100 |       | LD  | A,(3810H)                      |
| 0560 |       | LDIR                                |                                     | 1110 |       | AND   | 1                              |
| 0570 |       |                                     |                                     | 1120 |       | JR  | Z,NOTOG ; ZERO KEY PRESSED?    |
| 0580 | LOOP1 | LD                                  | A,(3802H) ; SCAN KEY ROW            | 1130 | LOOP2 | LD  | A,(38B0H) ; SHIFT KEY          |
| 0590 |       | AND                                 | 40H ; "N" ?                         | 1140 |       | OR  | A ; RELEASED?                  |
| 0600 |       | JR                                  | NZ,NOPND                            | 1150 |       | JR  | NZ,LOOP2                       |
| 0610 |       | LD                                  | A,(3808H) ; SCAN KEY ROW            | 1160 |       |   |                                |
| 0620 |       | AND                                 | 2 ; "Y" ?                           | 1170 | VVEC2 | LD  | HL,(VIDSTR) ; TOGGLE           |
| 0630 |       | JR                                  | Z,LOOP1                             |      |       |   |                                |
| 0640 |       |                                     |                                     |      |       |   |                                |

(continued on page 147)

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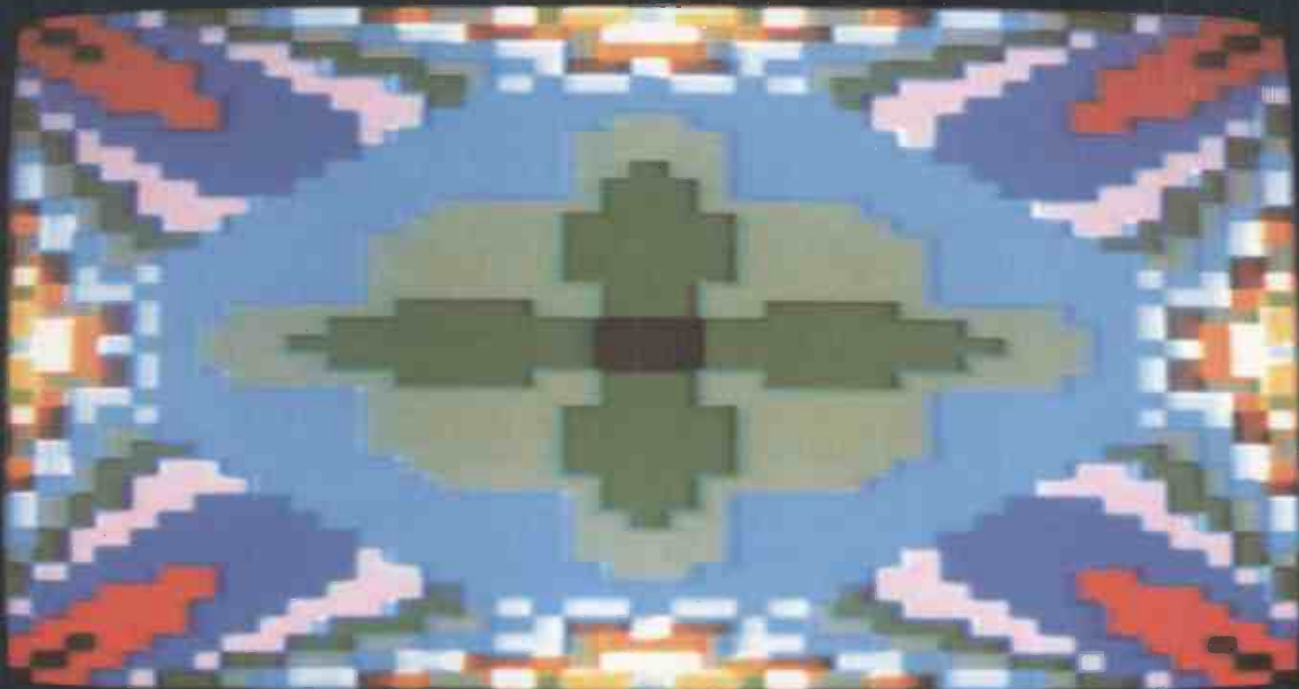
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146 The people who are really into Apples.



(continued from page 144)

|  |  |
|--|--|
| 1180 LD DE, (401EH) ; LOWER            | 1500 LD A, 60H ; POUND SIGN.                         |
| 1190 LD (401EH), HL ; CASE             | 1510 NODDL CP 20H                                    |
| 1200 VVEC3 LD (VIDSTR), DE ; VIDEO     | 1520 JP C, 0506H ; CONTROL CODE                      |
| 1210                                   | 1530 CP 80H  |
| 1220 SVEC1 LD A, (SWAP) ; TOGGLE       | 1540 JP NC, 04A6H ; GRAPHIC CHARACTER                |
| 1230 XOR 27H ; KEYBOARD                | 1550 JP 047DH  |
| 1240 SVEC2 LD (SWAP), A ; INVERSION    | 1560   |
| 1250                                   | 1570   |
| 1260 NOTOG POP AF                      | 1580 VIDSTR DEFS 4 ; VIDEO DRIVER ADDRESS STORE      |
| 1270 CP 41H ; FILTER                   | 1590   |
| 1280 RET C                             | 1600 PROGL EQU \$-KEYBD ; PROGRAM LENGTH GAUGE.      |
| 1290 CP 7BH ; OUT                      | 1610   |
| 1300 RET NC                            | 1620 END START                                       |
| 1310 CP 5BH ; ALPHABETIC               |  |
| 1320 JR C, SWAP                        |  |
| 1330 CP 61H ; CHARACTERS               | 6000 11 66 00 2A D6 40 B7 ED 52 22 D6 40 22 B1 40 23 |
| 1340 RET C                             | 6010 23 22 49 40 11 34 00 B7 ED 52 22 A0 40 22 E8 40 |
| 1350                                   | 6020 F9 2A 49 40 22 7C 60 23 22 79 60 11 3A 00 19 22 |
| 1360 SWAP RET ; CHANGED TO             | 6030 D5 60 22 DA 60 23 23 22 11 61 11 24 00 19 22    |
| 1370 DEFB 20H ; XOR 20H                | 6040 C7 60 22 D2 60 CD C9 01 21 8D 60 11 00 3D 01 22 |
| 1380 RET ; BY SHIFT ZERO               | 6050 00 ED B0 3A 02 38 E6 40 20 0C 3A 08 38 E6 02 28 |
| 1390                                   | 6060 F2 3E 20 32 00 61 21 AF 60 01 66 00 ED 5B 49 40 |
| 1400 VIDEO LD L, (IX+03H) ; POINTER TO | 6070 ED B0 CD C9 01 2A 16 40 22 B0 60 21 AF 60 22 16 |
| 1410 LD H, (IX+04H) ; CURSOR LOCATION. | 6080 40 3A EC 37 3C FE 02 DA 19 1A C3 2D 40 44 4F 20 |
| 1420 JP C, 049AH ; LINE FEED           | 6090 59 4F 55 20 57 41 4E 54 20 22 24 22 20 43 48 41 |
| 1430 LD A, (IX+05H) ; CURSOR FLAG      | 60A0 4E 47 45 44 20 54 4F 20 22 60 22 20 3F 20 5F CD |
| 1440 OR A ; TEST FOR CURSOR ON.        | 60B0 E3 03 F5 3A B0 3B B7 28 23 3A 10 38 E6 01 2B 1C |
| 1450 JR Z, CURSOF                      | 60C0 3A B0 3B B7 20 FA 2A 11 61 ED 5B 1E 40 22 1E 40 |
| 1460 LD (HL), A ; MOVE CURSOR.         | 60D0 ED 53 11 61 3A EA 60 EE 27 32 EA 60 F1 FE 41 D8 |
| 1470 CURSOF LD A, C ; ASCII BYTE       | 60E0 FE 7B D0 FE 5B 38 03 FE 61 D8 C9 20 C9 D0 6E 03 |
| 1480 CP 24H ; DOLLAR SIGN?             | 60F0 DD 66 04 DA 9A 04 DD 7E 05 B7 28 01 77 79 FE 24 |
| 1490 POFFON JR NODDL                   | 6100 18 02 3E 60 FE 20 DA 06 05 FE 80 D2 A6 04 C3 7D |
|  | 6110 04  |

## Road racing

IN ROAD RACE, from John Taylor of Orpington, Kent, two players race each other to finish the track first. As they move, each player collects a score.

There are two different levels of difficulty in this game: to leave a trail or not to leave a trail. If you leave a trail you increase your score more quickly, but you lose if you touch your track or your

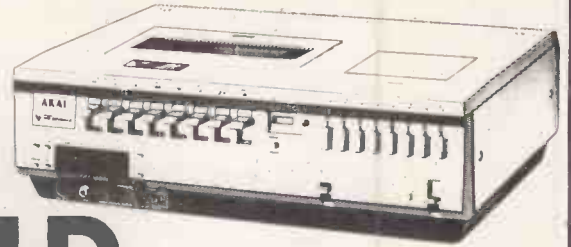
opponent's track. You also lose if you hit the side of the track.

The object of Road Race is to move your car from the start of the track to the bottom, or finish, of the track.

```

10 REM ** SET UP GAME **
15 CLS: CLEAR 400: P=15360
20 REM ** INSTRUCTIONS **
25 PRINT "ROAD RACE. I PRINT I PRINT I PRINT I PRINT
30 INPUT "DO YOU WISH TO LEAVE A TRAIL (YES/NO) " : Y$
35 IF Y$="YES" THEN Y$="Y": GOTO 50
40 IF Y$="NO" THEN Y$="N": GOTO 50
45 PRINT "INCORRECT - TYPE YES OR NO: GOTO 30
50 CLS: PRINT "ROAD RACE. I PRINT I BY .... JOHN TAYLOR. I PRINT
55 PRINT "DIRECTIONS: -"
60 PRINT "1 2 3 I PRINT 4 5 6 I PRINT 7 8 9 "
65 PRINT "WHEN ASKED TO ENTER YOUR SPEED (10 - 70 M.P.H.): "
75 PRINT "AND DIRECTION (AS SHOWN ABOVE) "
80 PRINT "YOUR TURN IS INDICATED BY A CHR$(191): " BY YOUR "
90 PRINT "PLAYER TWO ? I INPUT TYPE 1 OR 2 I ASIA=VAL(A$)
95 IF A<1 AND A<2 THEN PRINT "PLAYER ONE OR " : GOTO 90
100 PRINT "IF YOU HIT OR CRASH INTO THE TRACK WALL OR THE
105 PRINT "OTHER PLAYERS TRAIL (IF OPTED) - YOU WILL LOSE"
110 PRINT "HIT ANY KEY TO START I PRINT
115 I$=INKEY$: IF I$="" THEN 115 ELSE CLS
120 REM ** SET UP STRINGS **
125 F$=STRING$(32,32): B$=CHR$(191)
130 T$=" INVALID - TRY AGAIN I "
135 REM ** TRAIL ? **
140 IF Y$="N" THEN TR=1 ELSE TR=10
145 REM ** PRINT TITLES **
150 PRINT "PLAYER ONE I PRINT I PLAYER TWO I
155 PRINT "SCORE I PRINT 114 I SCORE I I
160 PRINT "SPEED (10 - 70 M.P.H.): I PRINT " B$ I DIRECTION (1,2,3,4,6,7,8,9) I "
165 REM ** PART OF TRACK FIXED **
170 PRINT "259 I B$ I PRINT " 099 I F$ I PRINT " 0195 I B$ I PRINT " 0323 I B$ I PRINT " 0835 I B$ I
175 PRINT " 0903 I B$ I
180 FOR ZZ=11 TO 15: SET(4,ZZ): SET(5,ZZ): NEXT ZZ
185 FOR ZZ=8 TO 10: SET(2,ZZ): SET(3,ZZ): SET(7,ZZ): SET(8,ZZ): SET(9,ZZ): NEXT ZZ
190 REM ** CO-ORDINATES OF PLAYERS **
195 X1=10: X2=10: Y1=11: Y2=15
200 REM ** X1, Y1 - PLAYER ONE . PLAYER TWO = X2, Y2 **
205 REM ** PLOT TRACK FROM DATA **
210 REM ** FIRST TWO X, LAST TWO Y **
215 READ Z:B,C:V:28:14:4:9:7
220 IF Z=1 THEN 400
225 REM ** TEST FOR END OF DATA . (ADD -1,-1,-1,-1 TO END OF YOUR DATA ) **
230 FOR E=Z TO BIFOR F=C TO D
235 SET(E,F): NEXT F: NEXT E: GOTO 215
240 DATA 80,99,32,42,36,36,9,25
245 DATA 36,49,25,25,49,49,15,20
250 DATA 49,25,25,28,14,4,9,7
255 DATA 60,60,9,14,60,108,14,14
260 DATA 108,108,14,47,14,108,47,47
265 DATA 14,71,39,39,71,71,27,39
270 DATA 71,93,27,27,93,93,20,27
275 DATA 14,26,17,17,26,26,17,29
280 DATA 26,67,29,29,67,67,20,29
285 DATA -1,-1,-1,-1,-1,-1
290 REM ** PLOT CARS **
400 SET(X1,Y1): SET(X2,Y2)
410 REM ** FIXED DATA **
415 M1=0: M2=0: S1=0: S2=0: ZZ=46: ZA=110
420 REM ** INDICATE WHO PLAYS NOW **
425 IF A=2 THEN 450
430 X=X1: Y=Y1: M1=M1+1
435 POKE P, 191: POKE P+13, 191
440 POKE P+64, 32: POKE P+77, 32
441 GOTO 470
445 REM ** PLAYER ONE INDICATED **
450 X=X2: Y=Y2: M2=M2+1
455 POKE P, 32: POKE P+13, 32
460 POKE P+64, 191: POKE P+77, 191
465 REM ** PLAYER TWO INDICATED **
470 REM ** GET SPEED **
472 DD=1
475 PP=ZZ: COSUB 900
478 DD=0
480 IF ZP>0 THEN COSUB 900: GOTO 470: REM ** INVALID **
485 REM ** GET SPEED FOR DISPLAY **
490 SPEED=INT(ZP/5)
495 REM ** GET DIRECTION (NOT 5) **
500 PP=ZA: COSUB 900
505 REM ** MAKE A MOVE **
510 FOR ZT=1 TO SPEED
515 IF TR=1 THEN RESET(X,Y)
520 IF Z0=1 THEN X=X+1: Y=Y-1
525 IF Z0=2 THEN Y=Y-1
530 IF Z0=3 THEN X=X+1: Y=Y-1
535 IF Z0=4 THEN X=X-1
540 IF Z0=6 THEN X=X+1
545 IF Z0=7 THEN X=X+1: Y=Y+1
550 IF X0=8 THEN Y=Y+1
555 IF X0=9 THEN X=X+1: Y=Y+1
560 COSUB 200: REM ** TEST FOR A WIN **
565 IF POINT(X,Y)=1 THEN 1000: REM ** CRASH **
570 SET(X,Y): NEXT ZT
575 REM ** RETURN CO-ORDINATES **
580 IF A=1 THEN X1=X: Y1=Y
585 IF A=2 THEN X2=X: Y2=Y
590 REM ** SCORE **
595 IF A=1 THEN S1=S1 ELSE I1=S2
600 I1=I1+ABS(SPEED*TRAIL/Z0*Z0-Z0)
605 REM ** DISPLAY SCORE **
610 IF A=1 THEN S1=I1: PRINT 256, INT(S1)
615 IF A=2 THEN S2=I1: PRINT 0120, INT(S2)
620 REM ** THE OTHER PLAYERS GO **
625 A=A+1: IF A=3 THEN A=1
630 GOTO 420
640 REM ** DISPLAY INVALID **
800 REM ** DISPLAY INVALID **
805 PRINT 0138, T$:
810 FOR Z0=1 TO 500: NEXT Z0
815 PRINT 0138, F$:
820 RETURN
900 REM ** FLASH CHR$(191) ON AND OFF **
905 I$="" : ZP=IF I$:
910 PRINT "PP, CHR$(191):
915 I$=INKEY$: IF I$<>"" THEN 935
920 FOR Z0=1 TO 100: NEXT Z0
925 PRINT "PP, CHR$(32):
930 FOR Z0=1 TO 100: NEXT Z0: GOTO 910
935 REM ** GET SPEED OR DIRECTION **
940 Z0=VAL(I$)
941 IF Z0<1 AND Z0>1 AND I$="0" THEN COSUB 800: GOTO 910
945 REM ** RETURN INVALID KEYS **
950 IF PP=ZZ AND ZP=0 THEN ZP=1: TF=I$: GOTO 910
954 REM ** SPEED FIRST PASS **
955 IF PP=ZZ AND ZP=1 THEN TF=TF+I$: PRINT "PP, CHR$(32): ZP=VAL(TF): RETURN
970 ZP=Z0: PRINT "PP, CHR$(32): RETURN
975 REM ** DIRECTION FALL **
1000 REM ** CRASH - DISPLAY " BANG CRASH FIZZ " **
1005 CLS: FOR T=1 TO 10
1010 PRINT "I PRINT I CRASH-BANG-FIZZ "
1015 NEXT T: PRINT: PRINT
1020 PRINT "PLAYER NUMBER 'A' LOST AS HE HAD "
1025 PRINT "A KEEN INTENTION TO FLY - AND CRASHED I I "
1027 PRINT: PRINT
1030 REM ** SCORE **
1035 PRINT "ROAD RACE SCORE: -"
1040 PRINT "PLAYER ONE SCORED 'S1' IN 'M1' MOVES "
1045 PRINT: PRINT
1050 PRINT "PLAYER TWO SCORED 'S2' IN 'M2' MOVES "
1055 PRINT "HIT ANY KEY TO CONTINUE: I$=INKEY$
1060 REM ** FIRST INKEY$ AS A STOP **
1065 I$=INKEY$: IF I$="" THEN 1065
1070 CLS: REM ** NEW GAME **
1075 PRINT "DO YOU WISH TO PLAY ROAD RACE AGAIN ? I PRINT: PRINT
1080 INPUT " TYPE YES/NO " : Y$
1085 IF Y$="NO" THEN 9999
1090 IF Y$="YES" THEN RUN
1095 PRINT "INVALID - TYPE YES OR NO I I " : PRINT
1100 INPUT " DO YOU WANT ANOTHER GAME ? I GOTO 1085
2000 REM ** TEST FOR A WIN **
2005 IF PEEK(16196)<131 OR PEEK(16260)<32 OR PEEK(16324)<176 THEN 2020
2015 RETURN
2020 CLS: PRINT "I PRINT I PLAYER NUMBER 'A' WON I "
2025 GOTO 1027
9999 CLS: PRINT "450, PROGRAMME FINISHED. I PRINT " " : END

```



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# ZX-80s on the brain

The family trait that Son of Thezeus inherited from his father, Thezeus, is the use of a ZX-80 for a brain. Both mice were built from pieces that Alan Dibley found in his junk box. Nick Smith reports.

ONE OF the major advantages of using a ZX-80 as a Micromouse brain is the built-in sensor interface — otherwise known as the keyboard. The keyboard can be regarded as a set of switches which are continually scanned by software. There is nothing to stop you mounting extra switches across the keyboard contacts and using them for sensors. This is best achieved by soldering extra wires on to the printed-circuit board rather than to the key contacts themselves.

The ZX-80 cannot distinguish between a pressed key and a closed sensor which is not normally a problem because Alan Dibley has sawn off the keyboard and only connects it when the mouse is not running. His problems start when setting up a mouse. The ZX-80 input routine waits for the last key to be released, before it will accept the next one, so all the sensors must be open-circuit before the keyboard can be used.

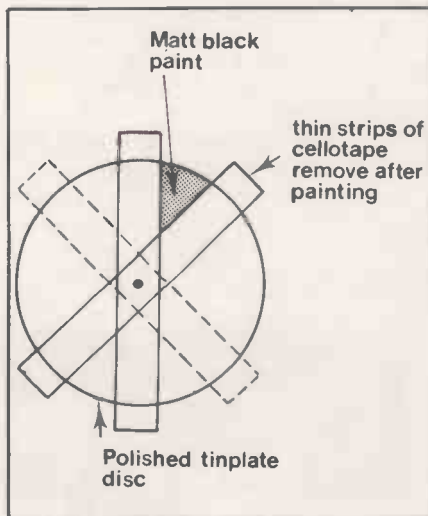


Figure 1.

Dibley's sensors are connected to the 6, 7, 8, 9 and 0 keys at the top right-hand side of the keyboard. The software to read the keys is shown in table 1. The result of the first three instructions is to set the status of the keys in the accumulator. Bit 4 = key 6; bit 3 = key 7; bit 0 = key 0. An open key sets the bit, while a closed key clears it. The complement instruction reverses the process so that a closed key sets the bit.

Apart from microswitches for wall-

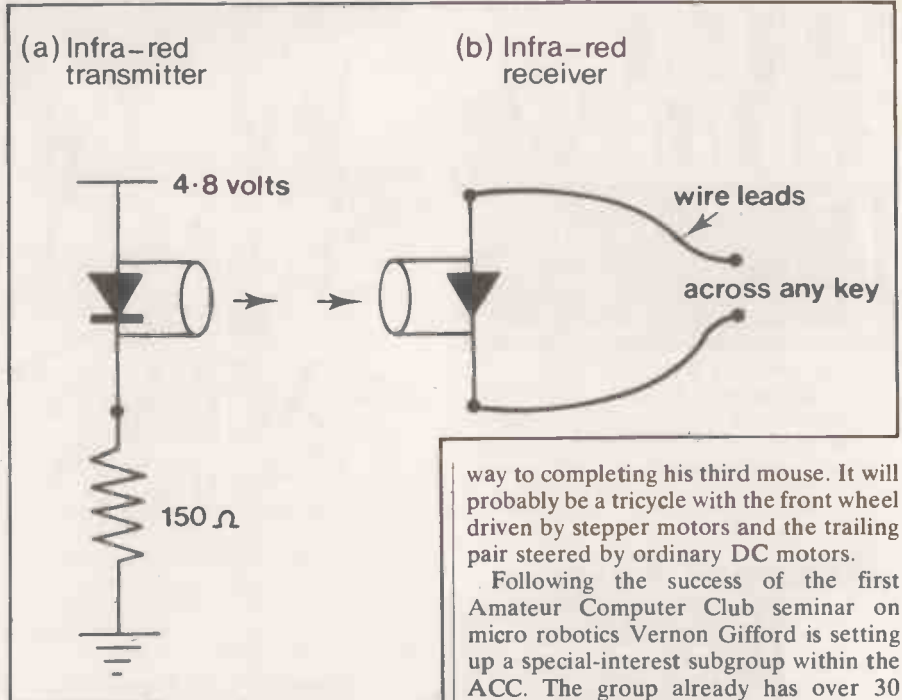


Figure 2.

sensing, Dibley uses infra-red sensing for counting wheel revolutions on Son of Thezeus. A disc resembling a spoked wheel with high-polished spokes and matt black in between is connected to the disc gear — see figure 1. An infra-red LED with a lens is positioned to pick up reflections. The receiver can be connected across any key and is equivalent to a pressed key when it is receiving infra-red — see figure 2. Distance is calculated by counting the number of "spokes" that go past the receiver, i.e., the number of times the "key" appears to be pressed and released.

With this type of circuit the sensor must be checked much more rapidly than the disc can turn, otherwise you start losing distance. The surrounding area is painted matt black, and the sensors and disc are boxed in to protect them from external sources of light.

If you ever see Alan Dibley turning one of the wheels of his mice when they are off the maze, he is probably trying to move the sensor disc so that the receiver is switched off, to allow the keyboard to be used.

When this technique is being used for distance sensing, it is best to fit the sensor to a non-driven wheel, to avoid skidding and similar problems. Otherwise, when the mouse jams itself against a wall, the mouse brain may think it is moving if the driven wheels continue to revolve. One American mouse has a crash-recovery routine which is activated if the distance sensor remains static for a second or more.

Rumour has it that Dibley is well on the

way to completing his third mouse. It will probably be a tricycle with the front wheel driven by stepper motors and the trailing pair steered by ordinary DC motors.

Following the success of the first Amateur Computer Club seminar on micro robotics Vernon Gifford is setting up a special-interest subgroup within the ACC. The group already has over 30 members including amateurs, academics, civil servants and manufacturers. If you are interested, write to Vernon Gifford, ACC Micro-Robotics, 111 Selhurst Road, London SE25 6LH, or telephone 01-653 3207.

Over 70 people attended the ACC seminar to listen to speakers on various aspects of robotics. The morning was devoted to constructing Micromouse, and in the afternoon Colne Robotics and Powertran Cybernetics demonstrated and talked about their robot arms.

As a warning to people designing mice, it was announced that a rule may be introduced for the 1983 competition that mice can only touch the tops of walls. Square mice will then no longer be able to use the walls to straighten themselves up: in other

| Hex code | Pseudo-mnemonic | Comment                             |
|----------|-----------------|-------------------------------------|
| 06EF     | B←EF            | The 0 in bit 4 specifies the top.   |
| 0E00     | C←00            | Might not be necessary.             |
| ED78     | IN A, (C)       | Read the keys into the accumulator. |
| 2F       | CPL             | Complements the accumulator.        |

Table 1.

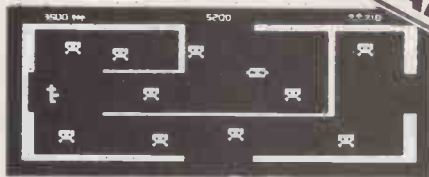
words, your mouse must steer itself.

In the more immediate future, the 1982 British Micromouse finals will take place from 23 to 25 April at the Computer Fair, Earls Court, London. Details are available from John Billingsly, Department of Electrical and Electronic Engineering, Anglesea Building, Anglesea Road, Portsmouth PO1 3DJ. The European finals will take place in Israel in September.

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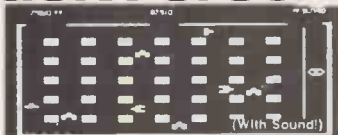
## ROBOT ATTACK



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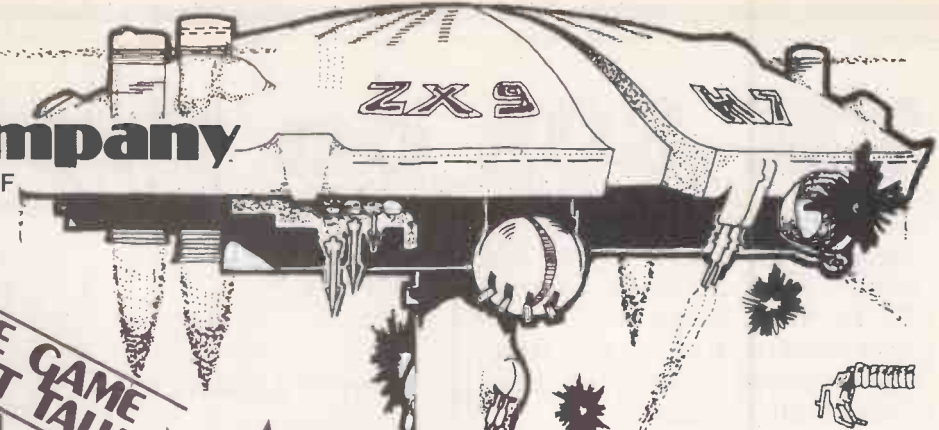


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Watch out behind you! As you hurry through the maze collecting moques you score points. But don't let the Gobblemen catch you. If you are crafty, sneak up behind them and neutralise them to gain extra points. Just keep a watch. When they attack you they come in fast. Just don't lose your nerve.

TRS 80 Levels I & II 16 K Tape  
Video Genie 16 K Tape

## Cosmic Fighter

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The command sets are extensive and sophisticated. Dozens of objects are scattered throughout the mazes and buildings. You can pick them up, burn them, throw them, etc. You may need the sword to fight off an ugly little man. Or a steel rod to hold apart crushing walls. Deathmaze 5000 and Labyrinth allow the traditional one and two word commands.

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## 16-Bit Microprocessors

By Johnathon Titus, Christopher Titus, Alan Baldwin, W. N. Hubin and Leo Scanlon. Published by Howard W. Sams, 350 pages, paperback. ISBN 0 672 21805 4.

THIS IS UNLIKELY to be the most stimulating read you have ever had, but if you are about to implement a system based on a 16-bit microprocessor and wish to determine which processor will best suit your purposes then this may well be the book for you.

It represents a survey of the six microprocessors which the authors feel are, or could become, the most popular: the 8086, Z-8001/2, 68000, 9900, LSI-11 and the 16000. It is an attempt to reduce the documentation of each into a manageable form to provide a means whereby the processors may be more easily compared.

After an introductory chapter explaining basic microprocessor concepts there are chapters devoted to each processor, providing information on registers, pointers, addressing, the instruction set, chip hardware, software, benchmarks, interfacing and special function chips. Sources of additional information are given after each chapter.

The authors have used four benchmarks in comparing the processors: bubble sort, ASCII string search, multiply/divide, and look-up table. The specifications are provided in an appendix and program listings are included in the main text.

Information is also provided on suppliers of microcomputer boards and software and there are plenty of tables and schematic diagrams. No attempt is made to determine which is the "best" processor but the concluding section of each chapter suggests suitable applications for that processor.

### Conclusions

● As the authors make clear, this is not a book for beginners. It is aimed at those with experience of 8-bit processors about to move on to 16-bit implementation.

● For such a person this survey is a reasonably good starting point.

Michael Trott

## Programming Your Microcomputer in Basic

By Peter Gosling. £3.95. Macmillan Press.

THERE SEEMS to be a never ending stream of books introducing Basic programming. Inevitably there is little to distinguish one from another but occasionally there is one that makes its mark. It may be due to originality of presentation or, as in this case, price.

Peter Gosling has written a book that is clear, concise and in the main accurate. The text is in the usual format of a description of one or two keywords and then a short program to illustrate their function.

In fact the book gives a feeling that it is really intended to accompany a course in Basic programming, even though the preface suggests that it was written to overcome the lack of clarity of many manuals. The suspicion is strengthened when it is realised that the author is a lecturer at a technical college. The book is admirably suited to such a purpose.

Although short, this book covers more of the language than many competitors and also provides several useful routines for common requirements such as sorting and the alignment of decimal values when printing.

### Conclusions

● A straightforward little book which will provide a useful introduction to Basic especially if used in conjunction with the manufacturer's manuals or as a course text-book.

● At £3.95 it would be a worthwhile purchase for a newcomer to Basic.

Martin Wilson

## Software Metrics

By Alan J Perlis, Frederick G Sayward and Mary Shaw (editors). £17.50. MIT Press.

IN 1979 the editors of this book were asked to evaluate the current state of the art in software metrics by the U.S. Office of Naval Research. Software metrics is the quantitative measurement of the quality of software. If this goal were attainable then the whole basis of many of the arguments about languages, operating

systems and their merits would be changed completely. We would have concrete criteria for evaluating which language was best, which program design techniques were best and what constituted good software.

As the authors admit, the computer-science research community has a very low opinion of software metrics. The idea that it is possible to derive some invariant laws of software, like the laws of physics, is an appealing one. Unfortunately, there is little or no evidence that this is attainable. Software production is a human activity, the psychology of which is as yet unfathomable. The field has not been helped by the lack of a coherent methodology and the poor quality of much of the limited academic research that has been done.

As to the central theme of the text, this is best summed up in a quote attributed to E W Dijkstra on page 92 which simply says "Metrics is crap". This book offers little evidence to the contrary and plenty of confirmation. Unfortunately all the new initiatives suggested are either unworkable or methodologically unsound or both. On the strength of this book software metrics will remain in its current dire state for the foreseeable future.

### Conclusions

● The bibliography is the most useful section of the book.  
● Given the dubious status of metrics, this book cannot be recommended.

J Cookson

## Using The Radio Shack TRS-80 in Your Home

By Kenniston W Lord Jr; Hardback 457 pages, £18.65. Van Nostrand Reinhold ISBN 0 442 25707 4

WHAT THIS BOOK DOES, it does reasonably well in dealing with programming in level I Basic from novice to competent amateur standard. However, the book must be judged on its rather unexciting presentation and the fact that it is clearly aimed at the American market, making several of the programs inappropriate and in need of much revision.

After an introductory chapter providing a mid-1970s

view how computers will be used in the future, and suggesting applications for the home user, comes a chapter misleadingly headed How Computers Work. It does not tell the reader how computers work at all, though it does provide a good extension to the level I handbook, in explaining how to use a TRS-80 covering programming principles, use of variables, arrays, memory, relational operators, subroutines and the use of tape for storing data.

Chapters three and four develop these techniques and explain thoroughly the use of level I screen graphics. Sample programs are provided in both chapters and these are clearly explained. It should be noted that both arrays and graphics in level I are severely limited by today's standards. However, the author provides good advice on how to make the most of the facilities offered.

Chapter six provides programs for a shopping list, skiers wind-chill chart, drinks recipes, central heating oil consumption, household chores, car expenses and two novelty programs. The final two chapters deal with using the TRS-80 for games and a U.S. orientated personal accounts payable system.

The author claims that all the programs work and, most of those that were tried did run first time. He also admits that they could be written in a more efficient fashion. However, he may be right to point out that his style of developmental programming helps the novice to understand the stages more clearly. What is disappointing is the lack of information on control applications which many home users might have found interesting.

### Conclusions

● The limitations of level I Basic are, as the author admits, the real bugbear. However, if you are a novice and cannot afford an upgrade to level II this book will help you to make the most of level I.

● A book on TRS-80 Basic programming for £18.65 should be revised for the U.K. market and should either be level II based or provide more information on conversion.

Michael Trott

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# All the fun of the computing fair

by Tony Roberts

AT THE recent Alternative Technology (Computing) Fair there were five stands, arranged in a row opposite the free bar. When I arrived back the boss asked me to tell him about the products — but I find I have a bit of a problem remembering who's who.

I have listed all I can remember:

- The fluorescent yellow machine was next to the one that kept on changing colour which must have been the Chameleon. The Chameleon stand was next to the Beta stand.
- The Audromeda stand was on the end of the row, and stood next to the machine that was driven by clockwork and had the voice-generator that hiccupped.
- None of the machines had more than one input and one output device, or more than one source of power.
- The two with printers were on opposite ends of the row, and one had an optical scanner.



- The wind-powered machine had a liquid-crystal display.
- The elastic-driven machine was having difficulties because of the heat of the adjacent boiler on the steam-driven machine, which was so grimy its colour could not be seen.
- The ones with paper-tape reader, VDU input and output, and a keyboard stood next to each other in that order.
- The red-striped machine had a voice-recognition device and was to the right of the machine with ghostly blue polkadots.

Which machine was solar powered, and how did Epsilon produce its output?

### Solution to January puzzle

THE SOLUTION to the Flowchart puzzle, which appeared in the January edition of *Practical Computing*, is that Y is an approximation within  $\pm 1$  to the square root of X. □

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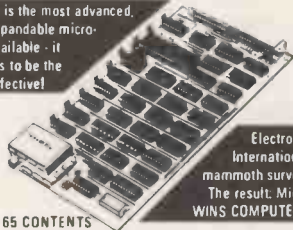
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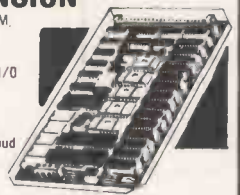
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| 1   | UR    | ADVANTAGE      | 19.72  | 14.49   | Y  | 100Z ACRILAN              |
| 2   | JC    | ALPHA          | 16.77  | 14.02   | Y  | 100Z ACRILAN              |
| 3   | JH    | ANDROS         | 4.28   | 3.58    | Y  | 100Z NYLON                |
| 4   | LC    | APPLAUSE       | 12.51  | 10.46   | Y  | 80ZPOLYESTER/20ZNYLON     |
| 5   | CR    | ARENA          | 16.73  | 13.99   | Y  | 80ZACRYLIC/20ZNYLON       |
| 6   | UR    | ARROW TWIST    | 12.16  | 10.17   | Y  | 100Z ACRILAN              |
| 7   | JH    | ASHLEY         | 9.75   | 8.15    | Y  | 100Z NYLON                |
| 8   | CR    | ASTOR          | 13.46  | 11.25   | Y  | 80ZACRYLIC/20ZNYLON       |
| 9   | UR    | ATLANTIC       | 16.13  | 13.49   | Y  | 100Z ACRILAN              |
| 10  | BR    | AXMOR          | 14.49  | 12.12   | Y  | 40/40/20-UDOL/EVLAW/NYLON |
| 11  | BR    | BALNOVAL       | 15.08  | 12.61   | Y  | 50ZUDOL/50ZPOLYPROPYLENE  |
| 12  | UR    | BASSETT        | 19.08  | 15.95   | Y  | 80ZUDOL/20ZNYLON          |
| 13  | LC    | BATHRODN BLISS | 12.51  | 10.46   | Y  | 80ZPOLYESTER/20ZNYLON     |
| 14  | LC    | BLISS          | 9.49   | 7.93    | Y  | 80ZPOLYESTER/20ZNYLON     |
| 15  | UR    | BROADLANDS     | 10.09  | 8.44    | Y  | 100Z POLYESTER            |
| 16  | JC    | CABARET        | 6.61   | 5.53    | Y  | 100Z NYLON                |
| 17  | LC    | CACHET         | 7.33   | 6.13    | Y  | 100Z POLYPROPYLENE        |
| 18  | JC    | CAIRNGORN      | 7.38   | 6.17    | Y  | 100Z NYLON                |

## from a Pet

The tedious, repetitive and costly task of keeping a carpet warehouse abreast of rising prices has been handed over to a micro. Mervyn Axon tells the story of how it was done.

IN ANY BUSINESS it is important for the staff to have an up-to-date price list. Maintaining these lists can be a very time-consuming task, particularly under the inflationary conditions of the last few years, and continual amendments can introduce expensive errors.

The problem described here concerns a carpet price list in a retail furniture business. A number of stock lines are carried, presenting no great difficulties, but in order to offer the widest possible selection to customers, the firm holds a large number of samples, from which special orders can be obtained as required. These come from about a dozen suppliers, each of which offers up to 15 different qualities, all at varying prices.

The price list contains details of approximately 150 items, including:

- Reference number,
- Code for the supplier,
- Quality name,
- Retail price per square metre,
- Comparative price per square yard,
- Whether or not the supplier is an approved supplier,
- Composition of the pile yarn.

Both prices are required because the trade has gone metric, while most customers still prefer imperial measures.

Once the initial list has been prepared, a number of copies are made for sales-

men, offices, etc. Three possible updates are required:

The supplier's price could be changed. The mark-up required and VAT must be added to the new price to give the metric price; multiplying this by 0.8361 gives the imperial price. A quality could be withdrawn.

A new quality could be introduced. Full details then have to be inserted in the correct alphabetical position.

None of this is difficult to carry out, but it is very tedious and time-consuming, particularly since amendments can arrive from suppliers at any time.

It is not satisfactory simply to alter the existing lists by hand. The whole of the master list must be retyped each time and then carefully checked to ensure that no new errors have been introduced. New price lists arrive from suppliers every few days, so the whole process must be repeated frequently.

### Choice of hardware

Though this is just the sort of task that could be carried out most efficiently by a microcomputer, no commercially-available program could be found in 1978, when it was decided to computerise the price list. The hardware selected was an 8K Pet with calculator-type keyboard and a built-in cassette recorder, together with an external cassette recorder — disc drives were not available at that time — and a Teletype 43 printer with a suitable interface.

The first step in developing the software was to store the initial data on a cassette tape in the form of a file. This was done by entering the data as a program as

(continued on next page)



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(continued from previous page)  
in listing 1. The process was repeated until all the data had been input, when the closing sequence was entered:

```
1000 PRINT 1, 0
1001 PRINT 1, "XX"
1002 PRINT 1, "END"
1003 PRINT 1, "XX"
1004 PRINT 1, "XX"
1005 PRINT 1, 0
1006 CLOSE 5
```

A blank cassette was loaded into recorder 1 and the program was run to create the initial file.

Having stored the price-list data on a cassette, the next step was to write a program to print it out. Note that operating instructions are given on the VDU — see listing 2.

Some formatting of the output is required to produce an easily-readable and well laid-out list, which should preferably be in a convenient-sized page format rather than a continuous sheet. The

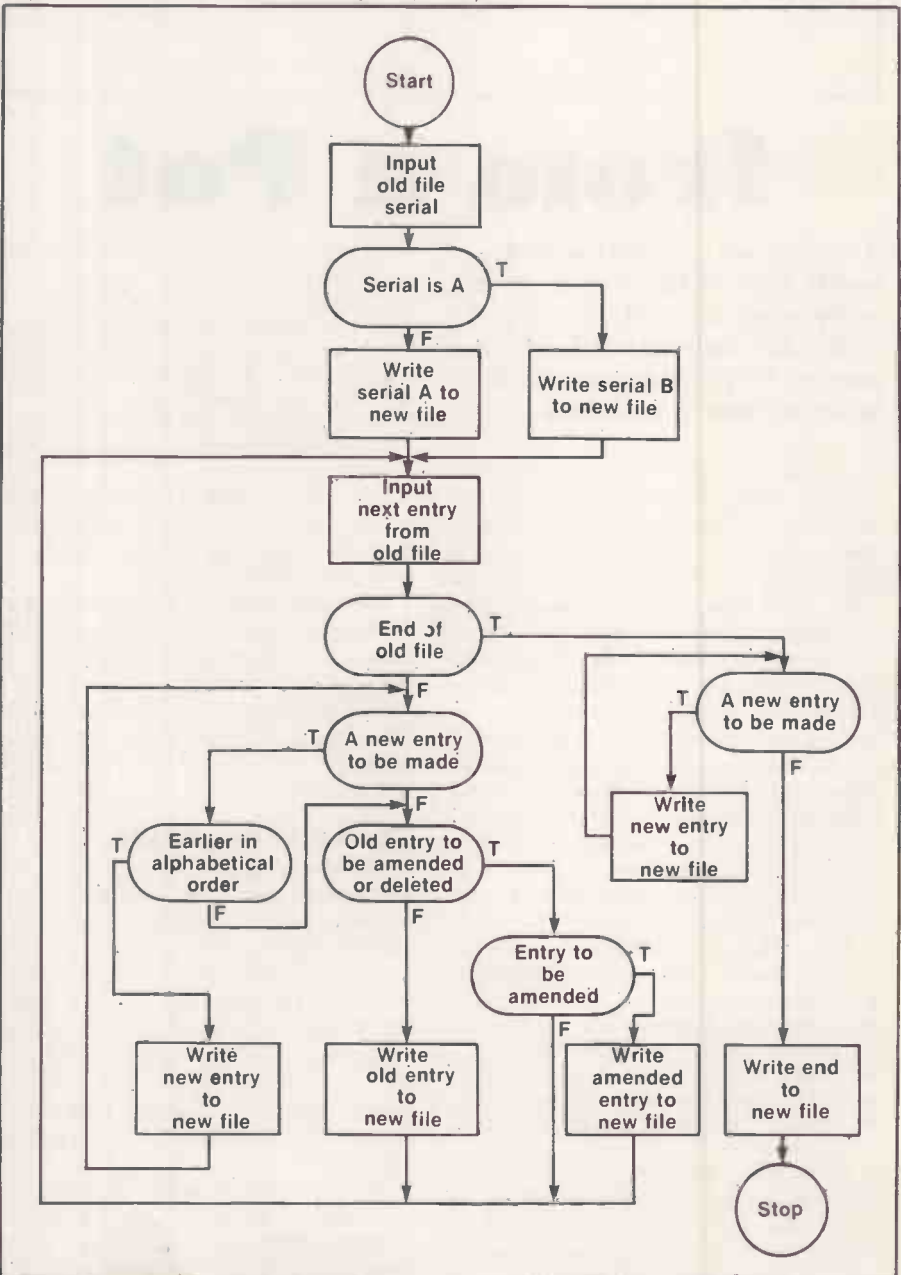
head of this article shows the output from the system.

The principle used for updating the files is similar to that used for creating them. The original data file, serial A, is updated to produce a new data file, serial B.

### Amending entries

The first entry on file A is loaded from cassette recorder 1 and displayed on the screen. It can then be inspected, and any necessary amendments are entered through the keyboard. The entry is then written to a new cassette in recorder 2, creating the new updated file B. The operation is then repeated until all the entries have been dealt with. Read/write operations with cassettes are slow, and an update usually affects 10 percent or less of the file entries, so the update program is divided into two parts to reduce the time spent creating the new file.

Figure 1. Flowchart of automatic update sequence.





## Listing 1.

```

100 OPEN 5,1,0           Opens file 5 to read on 1
110 OPEN 6,4,1           Opens file 6 to write on printer
120 INPUT "TYPE TODAY'S DATE IN FORM XX.XX.XX": B$
130 INPUT "MARK-UP REQUIRED": U
140 INPUT 5, M$          File serial reference.
150 PRINT 6, "REF", "MAKER", "QUALITY", "SO.M", "SO.YD.", "FL", "FILE YARN"
160 INPUT 5, E, D$, E$, F$, G$, F
170 IF E$ = "END" THEN 220
180 LET F1 = F*U
190 LET F2 = F1*0.8361
200 PRINT 6, E, D$, E$, F1, F2, F$, G$
210 GOTO 160
220 PRINT 6, B$, "FILE "/M$
230 PRINT "FINISHED"
    
```

## Listing 2.

```

10 OPEN 5,1,1           Opens a file called 5 on cassette 1 to write.
15 PRINT 1, "A"         File serial reference.
20 PRINT 1, 1           Entry reference number.
21 PRINT 1, "NR"        Suppliers code.
22 PRINT 1, "ADVANTAGE" Quality name
23 PRINT 1, "U"         Is a group supplier
24 PRINT 1, "100% ACRYLAN" File Yarn
25 PRINT 1, 13.15       Cost price per square metre
    
```

The main update program appears in listing 3.

Lines 100 to 290 contain data and instructions to set up the operation, the first part of which is in lines 300 to 530.

Initially this requests the reference numbers of entries to be amended or deleted and stores them in array C(B) — line 410.

If the entry is to be amended, the new cost price is stored in an array D(B) — line 510.

The program then goes on to request details of any new entries which are stored in arrays O\$(N), P\$(N), Q\$(N), R\$(N) and Q(N) — lines 660 to 700.

The other lines in this section are mainly concerned with validating the inputs and giving instructions to the operator on procedure, the exceptions being lines 370 to 380 which form a loop used to display the instruction in lines 350 to 360 for a reasonable period.

Print CHR\$(147) is the Clear Screen instruction.

Since the data on a cassette tape can only be accessed in serial form, the reference numbers of entries to be amended or deleted must be entered in ascending numerical order and new entries must be entered in alphabetical order. Entering the changes only takes a few minutes, after which the operator can leave the machine to create file B. The flow chart of this operation — see figure 1 — describes the procedure, which is coded in lines 1020 to 1720.

## Number reference

Variables G and S are needed to keep the reference numbers of the entries in the new file in sequence. G counts the number of deletions made and S the number of new entries. Suppose the reference number E of the current entry from the old file is 100, and that prior to this four deletions have been made and six new entries inserted, then E - G + S is interpreted as 100 - 4 + 6 = 102, which is the reference number to be written to the new file.

File serials alternate between A and B — lines 1090 and 1100 — they could just as easily have run from A to Z and then reverted to A to start the sequence again. Simply change the lines to:

```

1090 LET X = ASC(M$) + 1
1100 IF X = 91 THEN X = 65
    
```

Lines 750 to 1010 are included as a matter of convenience: they give a print-out of the alterations made to the file which can be kept as a permanent record of the alterations which have been made.

A small snag was encountered while creating the initial data tape, caused by the 8K memory capacity. Each entry requires about 80 bytes of store, so the full list of 150 entries could not be held in store at the same time. This was overcome by only entering the first 80 records before running the program to create a preliminary file which was then used in conjunction with the update program to complete the initial file. DIM C(50) and DIM D(50) were temporarily removed from line 280 of the update program and the remaining Dim statements changed to C\$(80), etc. to allow this operation to be carried out.

## Listing 3.

```

100 PRINTCHR$(147)
110 PRINT"UPDATE CARPET PRICE LIST - #JAZ20180
120 PRINT
130 INPUT"TYPE TO-DAY'S DATE IN FORM XX.XX.XX":B$
140 IF LEN(B$)<>8 THEN PRINT"ERROR":GOTO 130
150 PRINT
160 PRINT
170 PRINT"LOAD CURRENT FILE IN CASSETTE 1"
180 PRINT"AND NEW FILE IN CASSETTE 2"
190 PRINT
210 PRINT"PRESS DATA KEY ON TELETYPE"
220 PRINT
230 PRINT"TYPE 1 WHEN YOU ARE READY"
240 INPUTZZ
250 OPEN5,1,0
260 POKE243,58:POKE244,3
270 OPEN6,2,1
280 DIMC(50),D(50),C$(10),O$(50),P$(50),Q$(50),R$(50),Q(50)
290 PRINTCHR$(147)
300 PRINT"TYPE TOTAL NUMBER OF ENTRIES TO BE"
310 PRINT"AMENDED OR DELETED. (LESS THAN 50).":
320 INPUT A
330 IFA>49 THEN 00310
340 IFA=0 THEN 00540
350 PRINT"TYPE REF NOS IN SERIAL ORDER AS EACH"
360 PRINT"IS REQUESTED."
370 FOR I=1 TO 1200
380 NEXT I
390 FORB=1 TO A
400 PRINTCHR$(147)
410 INPUT"SERIAL NO ":C(B)
420 IFC(B)=C(B-1) THEN PRINT"ERROR":GOTO00410
430 PRINT"IS THIS TO BE AMENDED OR DELETED?":
440 PRINT"TYPE A OR D."
450 INPUT C$(B)
460 IF C$(B)="A" THEN 00500
470 IF C$(B)="D" THEN 00520
480 PRINT"ANSWER NOT UNDERSTOOD."
490 GOTO 00430
500 PRINT"TYPE IN NEW PRICE PER SQ.M.":
510 INPUT D(B)
520 NEXT B
530 PRINT"ENTRIES COMPLETED"
540 PRINT
    
```

(continued on next page)

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(continued from previous page)

```

550 PRINT"HOW MANY ADDITIONS TO BE MADE ? (NOT MORE THAN 50)."
560 INPUT M
570 IF M>49 THEN 00550
580 IF M=0 THEN 00730
590 PRINT"ARRANGE THE ENTRIES IN ALPHABETICAL"
600 PRINT"ORDER."
610 PRINT"ENTER THE DETAILS AS REQUESTED."
620 PRINT"TYPE 1 WHEN YOU ARE READY."
630 INPUT ZY
640 PRINTCHR$(147)
650 FOR N=1 TO M
660 INPUT"MAKER";D$(N)
670 INPUT"QUALITY NAME";P$(N)
680 INPUT"PILE YARN";Q$(N)
690 INPUT"FLOREAT - Y OR N";R$(N)
700 INPUT"COST PRICE PER SQ.M.";O$(N)
710 PRINT
720 NEXT N
730 PRINT"ENTRIES COMPLETED."
740 OPEN 1,4
750 PRINT#1,"ALTERATIONS MADE TO FILE ON ";B1$
760 PRINT#1:PRINT#1:PRINT#1
770 IF B=0 THEN 00880
780 AA=3
790 FOR B = 1 TO A
800 PRINT#1,"REF ";C(B);
810 IF C$(B)="A" THEN 00840
820 PRINT#1,TAB(10);"DELETED":AA=AA+1: NEXT B
830 GOTO 00860
840 PRINT#1,TAB(10);"C.P. AMENDED TO ";D(B):AA=AA+1
850 NEXT B
860 PRINT#1
870 AA=AA+1
880 IF N=0 THEN 00990
890 FOR N = 1 TO M
900 PRINT#1,P$(N);" ADDED TO LIST. ";
910 PRINT#1,"MAKER ";D$(N);". PILE YARN ";Q$(N);
920 PRINT#1,". CP PER SM ";O$(N);". ";
930 IF R$(N)="N" THEN 00960
940 PRINT#1,"FLOREAT."

950 BOTO 00970
960 PRINT#1,"NOT FLOREAT."
970 AA=AA+1
980 NEXT N
990 FORAB=1 TO (47-AA)
1000 PRINT#1
1010 NEXT AB
1020 PRINT#1,CHR$(147)
1030 PRINT"THE FILE WILL NOW BE UPDATED."
1040 B=1
1050 N=1
1060 G=0
1070 S=0
1080 INPUT#5,M$
1090 IF M$="A" THEN M$="B":GOTO 01110
1100 IF M$="B" THEN M$="A"
1110 PRINT#6,M$
1120 INPUT#5,E,D$,E$,F$,G$,F
1130 IF E$="END" THEN 01460
1140 W=E
1150 IF N>M THEN 01170
1160 IF E$>P$(N) THEN 01370
1170 IF E=C(B) THEN 01250
1180 PRINT#6,E-G+S
1190 PRINT#6,D$
1200 PRINT#6,E$
1210 PRINT#6,F$
1220 PRINT#6,G$
1230 PRINT#6,F
1240 GOTO 01120
1250 IF C$(B)="D" THEN 01340
1260 PRINT#6,E-G+S
1270 PRINT#6,D$
1280 PRINT#6,E$
1290 PRINT#6,F$
1300 PRINT#6,G$

1310 PRINT#6,D(B)
1320 B=B+1
1330 GOTO 01120
1340 G=G+1
1350 B=B+1
1360 GOTO 01120
1370 PRINT#6,E-G+S
1380 PRINT#6,D$(N)
1390 PRINT#6,P$(N)
1400 PRINT#6,Q$(N)
1410 PRINT#6,R$(N)
1420 PRINT#6,O$(N)
1430 N=N+1
1440 S=S+1
1450 GOTO 01150
1460 IF N<M THEN 01480
1470 GOTO 01590
1480 E=W-G+S+1
1490 FOR V=N TO M
1500 PRINT#6,E
1510 PRINT#6,D$(N)
1520 PRINT#6,P$(N)
1530 PRINT#6,Q$(N)
1540 PRINT#6,R$(N)
1550 PRINT#6,O$(N)
1560 N=N+1
1570 E=E+1
1580 NEXT V
1590 PRINT#6,O
1600 PRINT#6,"XX"
1610 PRINT#6,"END"
1620 PRINT#6,"XX"
1630 PRINT#6,"XX"
1640 PRINT#6,O
1650 CLOSES

1660 CLOSE6
1670 PRINTCHR$(147)
1680 PRINT"FILE NOW UPDATED"
1690 PRINT"REWIND BOTH CASSETTES"
1700 PRINT"STORE CASSETTE 1 AS 'OLD FILE'"
1710 PRINT:PRINT"STORE CASSETTE 2 AS 'CURRENT FILE'"
1720 PRINT:PRINT:PRINT"FINISHED"

```

# The Unix road to power

Unix is pretender to the throne of the most-used operating system whose present incumbent, CP/M, has ruled virtually uncontested for the last two years. Before modular Unix can overthrow this reign, it must improve the image it presents to the user — or so argues Donald Norman.

UNIX was developed by Dennis Ritchie and Ken Thompson of Bell Laboratories. Unix is trademarked by Bell and is available under licence from Western Electric. Although it is a relatively small operating system, it is quite powerful and general. It has found considerable favour among programming groups, especially in universities, where it is primarily used with DEC computers — various versions of the DEC PDP-11 and the Vax.

The operating system and its software are written in a high-level programming language called C, and most of the source code and documentation is available on-line. For programmers, Unix is easy to understand and to modify.

## Hierarchical structure

For the non-expert programmer, the important aspect of Unix is that it is constructed from a small, basic set of concepts and programming modules, with a flexible method for interconnecting existing modules to make new functions.

All system objects — including all I/O channels — look like files. Thus, it is possible to cause input and output for almost any program to be taken from or to go to files, terminals, or other devices, at any time, without any particular planning on the part of the module writer.

Unix has a hierarchical file structure. Users can add and delete file directories at will and then "position" themselves at different locations in the resulting hierarchy to make it easy to manipulate the files in the neighbourhood.

The command interpreter of the operating system interface — called the "shell" — can take its input from a file, which means that it is possible to put frequently used sequences of commands into a file and then invoke that file just by typing its name, thereby executing the command strings.



In this way, the user can extend the range of commands that are readily available. Many users end up with a large set of specialised shell command files. Because the shell includes facilities for passing arguments, for iterations, and for conditional operations, these "shell programs" have many uses, essentially calling upon all system resources — including the editors — as subroutines. Many non-programmers have discovered that they can write powerful shell programs, significantly enhancing the power of the overall system.

## Modular concept

By means of a communication channel known as a pipe, the output from one program can easily be directed — piped — to the input of another, allowing a sequence of programming modules to be strung together to do some task that in other systems would have to be done by a special-purpose program. Unix does not provide special-purpose programs. Instead, it attempts to provide a set of basic software tools that can be strung together in flexible ways using I/O redirection, pipes, and shell programs.

Technically, Unix is just the operating system. However, because of the way the system has been packaged, many people use the name to include all of the programs that come on the distribution tape.

(continued on next page)



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Many people have found it easy to modify the Unix system and have done so, which has resulted in hordes of variations on various kinds of computers.

The "standard Unix" discussed here is BTL Unix version 6 May 1975. The Fourth Berkeley Edition of Unix is more or less derived from BTL Unix version 7 September 1978 — with considerable parallel development at the University of California, Berkeley and some input from other BTL Unix versions. I am told that some of the Unix's failings raised in the article have been remedied; however, version 6 is still used by many people.

It may be difficult to discern that I am a friend of Unix. The negative tone should not obscure the beauty and power of the operating system, file structure, and the shell. Unix is indeed a superior operating system. I would not use any other.

Some of the difficulties detailed result from the fact that many of the system modules were written by the early users of Unix, not by the system designers. Many individual idiosyncrasies have entered the system.

For all of its virtues as a system — and it is indeed an elegant system — Unix is a disaster for the casual user. It fails both on the scientific principles of human engineering and even in just plain common sense.

If Unix is really to become a general system, then it must be improved. I urge correction to make the elegance of the system design be reflected as friendliness towards the user, especially the casual user. Although I have learned to accept the vagaries of Unix's user interface, our secretarial staff persists only because we insist.

### Crucial failings

Even I, a heavy user of computer systems for 20 years, have had difficulties: copying the old file over the new, transferring a file into itself until the system collapsed, and removing all the files from a directory simply because an extra space was typed in the argument string. The problem is that Unix fails several simple tests.

**Consistency.** Command names, language, functions and syntax are inconsistent.

**Functionality.** The command names, formats, and syntax seem to have no relationship to their functions.

**Friendliness.** Unix is a recluse, hidden from the user, silent in operation. The lack of interaction makes it hard to tell what state the system is in, and the absence of mnemonic structures puts a burden on the user's memory.

What is good about Unix? The system design, the generality of programs, the file structure, the job structure, the powerful operating system command language — the "shell". Too bad the concern for system design was not matched by an equal concern for the human interface.

One of the first things you learn when you start to decipher Unix is how to list

| Function                 | Unix command name |
|--------------------------|-------------------|
| c compiler               | cc                |
| change working directory | chdir             |
| change password          | passwd            |
| concatenate              | cat               |
| copy                     | cp                |
| date                     | date              |
| echo                     | echo              |
| editor                   | ed                |
| link                     | ln                |
| move                     | mv                |
| remove                   | rm                |
| search file for pattern  | grep              |

Table 1.

the contents of a file on to your terminal. Now this sounds straightforward enough, but in Unix even this simple operation has its drawbacks.

Suppose I have a file called Testfile. I want to see what is inside of it. How would you design a system to do it? I would have written a program that listed the contents on to the terminal, perhaps stopping every 24 lines if you had signified that you were on a display terminal with only a 24-line display. Unix, however, has no basic listing command, and instead uses a program meant to do something else.

### Side-effects

Thus if you want to list the contents of a file called HappyDays, you use the command named Cat:

```
cat HappyDays
```

Why Cat? Why not? After all, as Humpty Dumpty said to Alice, who is to be the boss, words or us? Cat, short for "concatenate" as in, take file 1 and concatenate it with file 2 — yielding one file, with the first part file 1, the second file 2 and put the result on the "standard output", which is usually the terminal:

```
cat file 1 file 2
```

If you have only one file, Cat will put it on the standard output — the terminal. That accomplishes the goal, except for those of us with video terminals, who watch helplessly as the text goes streaming off the display.

The Unix designers believe in the principle that special-purpose functions can be avoided by clever use of a small set of system primitives. Why make a special function when the side-effects of other functions will do what you want? Well, for several reasons:

- Meaningful terms are considerably easier to learn than non-meaningful ones. In computer systems, this means that names should reflect function, otherwise the names for the function will be difficult to recall.
- Making use of the side-effects of system primitives can be risky. If cat is used unwisely, it will destroy files.
- Special functions can do useful things for users, such as stop at the end of screens, or put on page headings, or transform non-printing characters into printing ones, or get



rid of underlines for terminals that cannot perform them.

Cat, of course, will not stop at terminal or page boundaries, because doing so would disrupt the concatenation feature. But still, it is elegant to use Cat for listing. Who needs a print or a list command?

Notice the lack of consistency in forming the command name from the function table 1. Some names are formed by using the first two consonants of the function name. Editor, however, is Ed, concatenate is Cat, and Date and Echo are not abbreviated at all. Note how useful those two-letter abbreviations are. They save almost 400ms. per command.

Similar problems exist with the names of the file directories. Unix is a file-oriented system, with hierarchical directory structures, so the directory names are very important. This paper was written on a file named Unix and whose path is /cs1/norman/papers/CogEngineering/unix. The name of the top directory is "/", and cs1, norman, papers, and CogEngineering are the names of directories hierarchically placed beneath "/".

Note that the symbol "/" has two meanings: the name of the top-level directory and the symbol that separates levels of the directories. This is very difficult to justify to new users. And those names: the directory for Users and Mount are called, of course, Usr and Mnt. And there are Bin, Lib, and Tmp binary, library, and temp. Unix loves abbreviations, even when the original name is already very short. To write "user" as Usr or "temp" as Tmp saves only one letter. But Unix is inconsistent; it keeps Grep at its full four letters, when it could have been abbreviated as Gr or Gp.

Another important routine goes by the name of Dsw. Suppose you accidentally create a file whose name has a non-printing character in it. How can you remove it? The command that lists the files on your directory will not show non-printing characters. Also, if the character is a space — or worse, a "\*" — the program that removes files will not accept it. The name Dsw was evidently written by someone at Bell Labs who felt frustrated by this problem and hacked up a quick solution. Dsw goes to each file in your directory and asks you to respond "Yes" or "No," whether to delete the file or keep it.

## Yes means no

How do you remember Dsw? What on earth does the name stand for? The Unix people will not tell; the manual smiles the wry smile of the professional programmer and says: "The name Dsw is a carry-over from the ancient past. Its etymology is amusing".

If you say "Yes", the file is deleted, of course. So if you go through your files and see important-file, you nod to yourself and say: "Yes, I had better keep that one". You type in "Yes," and destroy it

forever. There is no warning; Dsw doesn't even document itself when it starts, to remind you of which way is which. Berkeley Unix has finally killed Dsw, saying "This little-known, but indispensable facility has been taken over..." That is a fitting commentary on standard Unix: a system that allows an "indispensable facility" to be "little known."

## Beware the glob

The symbol "\*" means "glob" — a typical Unix name. Let me illustrate with our friend, Cat. Suppose I want to collect a set of files named paper.1 paper.2 paper.3 and paper.4 into one file. I can do this with cat:

```
cat paper.1 paper.2 paper.3
  paper.4 > newfilename
```

Unix provides "glob" to make the job even easier. Glob means to expand the file name by examining all files in the directory to find all that fit. Thus, I can redo my command as

```
cat paper* > newfilename
```

where paper\* expands to  
paper.1 paper.2 paper.3 paper.4

This is one of the typical virtues of Unix; there are a number of quite helpful functions. But suppose I had decided to name this new file "paper.all".

```
cat paper* > paper.all
```

In this case, paper\* expands to paper.1 paper.2 paper.3 paper.4 paper.all, and so I am filling up a file from itself:

```
cat paper.1 paper.2 paper.3 paper.4
  paper.all > paper.all
```

Eventually the file will burst.

Does Unix check against this, or at least give a warning? No such luck. The manual does not alert users to this either, although it does warn of another, related infelicity: "Beware of 'cat a b > a' and 'cat b a > a', which destroy the input files before reading them".

The command to remove all files that start with the word "paper"

```
rm paper*
```

becomes a disaster if a space is inserted by accident:

```
rm paper *
```

for now the file "paper" is removed, as well as every file in the entire directory — the power of glob.

Why is there not a check against such things? I finally had to alter my version of Rm so that when I said to remove files, they were moved to a special directory named "deleted" and preserved there until I logged off, leaving me lots of time for second thoughts and catching errors. This illustrates the power of Unix: what other operating system would make it so easy for someone to completely change the operation of a system command? It also illustrates the trouble with Unix: what other operating system would make it so necessary to do so?

The standard text editor is called Ed. I spent a year using it as an experimental vehicle to see how people deal with such confusing things. Ed's major property is

(continued on next page)

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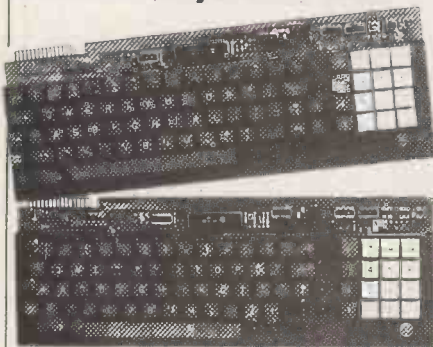
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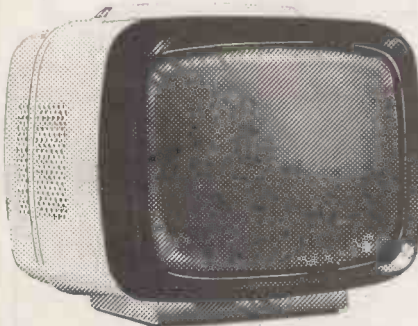


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shyness; he does not like to talk.

You invoke Ed by saying, reasonably enough, "Ed." The result is silence: no response, no prompt, no message, just silence. Novices are never sure what that silence means. Ed would be a little more likeable if he answered, "thank you, here I am," or at least produced a prompt character, but in Unix silence is golden. No response means that everything is alright. If something had gone wrong, it would have told you.

Then there is the famous append mode error. To add text into the buffer, you have to enter "append mode." To do this, you simply type "a," followed by Return. Now everything that is typed on the terminal goes into the buffer. Ed, true to form, does not inform you that it is now in append mode: when you type "a" followed by Return the result is silence. When you have finished adding text, you are supposed to type a line that "contains only a . on it" to get you out of append mode. Ed does not tell you when have left append mode. This problem is so obvious that even the designers recognised it, but their reaction, in the tutorial introduction to Ed, is merely to note wryly that even experienced programmers make this mistake. While they may be able to see humour in the problem, it is devastating to the inexperienced secretary, research assistant or student trying to use Unix as a word processor. an experienced tool, or

just to help them learn about computers.

Suppose you have been working on a file for an hour and then decide to finish work, exiting Ed by saying "q." The problem is that Ed would promptly quit, destroying your last hour's work. Thank goodness for all those people across the country who immediately rewrote the text editor so that we normal people — who make errors — have some other choices besides Ed, editors that tell you politely when they are working, that tell you if they are in append or command mode, and that do not let you finish without saving your file unless you are first warned, and then only if you say you really mean it.

### Users' pet hates

As I wrote this paper I asked my colleagues to tell me of their favorite grouses. I got a lot of responses, all with much the same flavour, mostly commenting about the lack of consistency and the lack of interactive feedback. Thus, there is no standardisation of means to exit programs and because the "shell" is just another program as far as the system is concerned, it is very easy to log yourself off the system by accident.

There are very useful pattern matching features — such as the "\*" function — but the shell and the different programs use the symbols in inconsistent ways. The Unix copy command — Cp — and the related C programming language "string-

## BELL LABS' VIEW

WHILE PRAISING the Unix system design, Donald Norman makes a number of caustic remarks about command names and other aspects of the human interface. These might be ignored, since he has no experimental tests to justify them; or they might even be taken as flattery of Unix, since he does not name any system he likes better; but some of his comments are worth discussing.

Most of the command names Norman points to are indeed strange; some such as

comma on the last one" just like subjects who had learned the ordinary version of the editor."

In addition to the amusing but secondary discussions of command names, Norman does raise some significant issues:

- whether systems should be verbose or terse;
- whether they should have a few general commands or many special-purpose ones;
- whether they should try to anticipate typical mistakes.

Unix is undoubtedly near an extreme of terseness, partly because it was originally designed for slow hard copy terminals. However, the terseness is very valuable when connecting processes. If the command that lists the logged-on users prints a heading above the list, you cannot tell how many users are on by feeding the command output to a line counter. If the editor types acknowledgements now and then, its output may not be directly usable as input somewhere else.

Norman complains about using Cat for a command which prints files, rather than having a special-purpose command for the purpose — there is one, by the way; it is Pg. Having a few general-purpose commands is a definite aid to system learning. In practice, it is not the novices who use

### by Michael Lesk of Bell Laboratories

Dsw, were removed several years ago — by the way, to repair the discourtesy of the manual, Dsw meant "delete from switches". However, it is not clear that it makes much difference what the command names are. T K Landauer, K Galotti and S Hartwell recently tried teaching people a version of the editor in which append, "delete," and "substitute" were called "allege," "cypher," and "deliberate." It did not seem to have much effect on learning time, and afterwards the users would say things like "I alleged three lines and deliberated a





copy" — strcpy — reverse the meaning of their arguments, and Unix move — Mv — and copy — Cp — operations destroy existing files without any warning. Many programs take special "argument flags" but the manner of specifying the flags is inconsistent, varying from program to program.

The version of Unix I now use is called the Fourth Berkeley Edition for the Vax, distributed by Joy, Babaoglu, Fabry, and Sklower at the University of California, Berkeley — henceforth, Berkeley Unix.

Among the advantages are: history lists, aliases, a richer and more intelligent set of system programs — including a list program, an intelligent screen editor, an intelligent set of routines for interacting with terminals according to their capabilities. It includes a job control that allows you to stop jobs in the middle, start up new ones, move things from background to foreground and vice versa, examine files, and then resume jobs. The shell has been amplified to be a more powerful programming language, complete with file-handling capabilities, If Then Else statements, While, Case and other goodies of structured programming.

Aliases are worthy of special comment. They let users tailor the system to their own needs, naming things in ways they can remember. Names you devise yourself are easier to recall than names provided to you. Aliases also allow abbrevia-

tions that are comprehensible to the individual, without burdening everyone else with your cleverness or difficulties.

To work on this paper, I need only type the word "unix," for I have set up an alias called Unix that is defined to be equal to the correct command to change directories, combined with a call to the editor — called Vi for "visual" on this system — on the file:

```
alias unix "chdir /cs1/norman/papers/
CogEngineering; vi unix"
```

These Berkeley Unix features have proved to be indispensable: the people in my laboratory would probably refuse to go back to standard Unix.

## Outside system

The bad news is that Berkeley Unix is jury-rigged on top of regular Unix, so it can only patch up the faults: it does not remedy them. Grep is not only still Grep, but there is an Egrep and an Fgrep.

The generators of Berkeley Unix have their problems: if Bell Labs people are smug and lean, Berkeley people are cute and overweight. Programs are wordy and special features proliferate. The system is so large that it no longer fits on the smaller machines: our laboratory machine, a DEC-11/45, cannot hold the latest release of Berkeley Unix even with a full complement of memory and a reasonable amount of disc. I wrote this paper on a Vax.

(continued on next page)

the alternatives to Cat; it is the experts, who want something better-adapted to their special needs and are willing to learn another command.

In general, people are quite good at recognising special uses of commands in context, probably because it is a lot like things they have to do every day in English. To take an analogy from programming languages, one doubts that Norman would advocate a separate operator for "+" in integer arithmetic and "+" in floating-point arithmetic. There are many advantages to a small, general-purpose set of commands. Having only one way to do any given task minimises software maintenance while maximising the ability of two users to help each other with advice. But this implies that whenever a general command and a specific command do the same thing, the specific command should be removed.

## Choices to be made

It would be a definite service if the cognitive engineers could tell us how many commands are reasonable, to give some guidance on, for example, whether "merge" should be a separate command or an option on "sort" — on Unix it is a sort option — and whether the terminal drivers should be separate commands or options on a graphics output command — on Unix they are separate. The best rule

of thumb we have today is that designing the system so that the manual will be as short as possible minimises learning effort.

Norman seems to think that the computer should try to anticipate user problems, and refuse commands that appear dangerous. The computer world is undoubtedly moving in this direction; strong typing in programming languages is a good example. The Ed editor has for some years provided a warning if the user tries to quit without writing a file. The Vi editor has an Undo feature, regardless of the complexity of the command which has been executed. Such a facility is undoubtedly the best solution.

A large number of Norman's comments are pleas for consistency. Unix has grown more than it has been built, with many people from many places tossing software into the system. The ability of the system to accept commands so easily is one of its main strengths.

The thought of a Unix Command Standardisation Committee trying to impose rules on names is a frightening alternative. Much of the attractiveness of Unix derives from its hospitality to new commands and features. This has also meant a diversity of names and styles. To some of us this diversity is attractive, while to others it is frustrating, but to hope for the hospitality without the diversity is unrealistic.

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(continued from previous page)

Learning the system for setting up aliases is not easy for beginners, who may be the people who need them most. You have to set them up in a file called .Cshrc, not a name that inspires confidence. The full stop in the file name means that it is invisible — the normal method of directory listing program will not show it.

The directory listing program, 1s, comes with 19 possible argument flags, which can be used singly or in combinations. The number of special files that must be set up to use all the facilities is horrendous, and they get more complex with each new release from Berkeley.

### Too much bitching

It is very difficult for new users. The program names are whimsical rather than systematic. Whimsicality is probably better than standard Unix's lack of meaning, but there are limits. The listing program is called More — as in, "give me more". The program that tells you who is on the system is called Finger, and a keyword help file — most helpful, by the way — is called Apropos. I used the alias feature to rename it Help.

One reader of a draft of this paper — a systems programmer — complained bitterly: "Such whining, hand-wringing, and general bitchiness will cause most people to dismiss it as over-emotional nonsense . . . . The Unix system was originally designed by systems programmers for their own use and with no intention for others using it. Other hackers liked it so much that eventually a lot of them started using it. Word spread about this wonderful system, and the rest you probably know. I think that Ken Thompson and Dennis Ritchie could easily shrug their shoulders and say 'But we never intended it for other than our personal use'".

This was the only complaint, and I sympathise with its spirit. It should be remembered, though, that Unix is nationally distributed in the U.S. under strict licensing agreements. Western Electric's motives are not altogether altruistic. If Unix had remained a simple experiment on the development of operating systems, then complaints could be made in a more friendly, constructive manner. But Unix is more than that. It is taken as the very model of a proper operating system, and that is exactly what it is not.

In the development of the system aspects of Unix, the designers have done a magnificent job. They have been creative, and systematic. A common theme runs through the development of programs, and by means of their file structure, the development of "pipes" and "redirection" of both input and output, plus the power of the iterative "shell" system-level commands, you can easily combine system-level programs into self-tailored systems of remarkable power. For system programmers, Unix is a delight. It is well structured, with a consistent, powerful

philosophy of control and structure.

Why was the same effort not put into the design at the level of the user? The answer is complex, but one reason is the fact that there really are no well-known principles of design at the level of the user interface.

The three most important concepts for system design are:

- Be consistent. A fundamental set of principles ought to be evolved and followed consistently throughout all phases of the design.
- Provide the user with an explicit model. Users develop mental models of the devices with which they interact. If you do not provide them with one, they will make one up themselves, and the one they create is likely to be wrong.

Do not count on the user fully understanding the mechanics of the device. Both secretaries and scientists may be ignorant of the difference between the buffer, the working memory, the working files, and the permanent files of a text editor. They are likely to believe that once they have typed something into the system, it is permanently in their files. They are likely to expect more intelligence from the system than the designer knows is there. And they are likely to read into comments — or the lack of comments — more than you have intended.

Feedback is of critical importance in helping establish the appropriate mental model and in letting the user keep its current state in synchrony with the actual system.

- Provide mnemonic aids. For most purposes it is convenient to think of human memory as consisting of two parts: a short-term memory and a long-term memory — modern cognitive psychology is developing more sophisticated notions, but this is still a valid approximation. Five to seven items is about the limit for short-term memory, so do not expect a user to remember the contents of a message for much longer than it is visible on the terminal. Long-term memory is robust, but it faces two difficulties: getting stuff in so that it is properly organised, and getting stuff out when it is needed. Learning is difficult, unless there is a good structure and it is visible to the learner.

There are lots of sensible memory aids that can be provided, but the most powerful and sensible of all is understanding. Make the command names describe the function that is desired. If abbreviations must be used, adopt a consistent policy of forming them. Do not deviate from the policy, even when it appears that a particular command warrants doing so.

System designers take note. Design the system for the person, not for the computer, not even for yourself. People are also information-processing systems, with varying degrees of knowledge and experience. Friendly systems treat users as normal, intelligent adults who are sometimes forgetful and are rarely as knowledgeable about the world as they would like to be. There is no need to talk down to the user, nor to explain everything. But give the users a share in understanding by presenting a consistent view of the system. Their response will be your reward.

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# BUYERS' GUIDE

## Printers

The Peripherals Buyers' Guide is a survey of printers suitable for small computers. We have excluded any system which costs significantly more than £2,000. The printers are listed in alphabetical order. The addresses of the main suppliers are listed at the end of the guide.

Printers may be divided into several categories. The highest-quality printing is produced by the daisywheel-type which creates text in various type-faces, according to the wheel used. The quality ranges from excellent typing to rather poor book printing and generally there is a proportional-spacing facility. Those machines tend to be expensive and slow. Daisywheels can be either plastic — inexpensive, but must be replaced often — or metal — expensive but durable.

For faster printing, you must turn to dot-matrix machines. The print quality tends to be poor and the machines noisy. Older machines use a 7-by-5 matrix which puts the descenders of letters such as 'y' above the line. That makes bulk text difficult to read. Better printers use a matrix nine dots deep to give true descenders. Recently, several firms have produced dot-matrix printers which give an approximation to typewriter printing and proportional spacing. They are less expensive than daisywheel machines, work faster and could well be used for correspondence-quality work.

Some dot-matrix printers employ sensitised paper to produce printing by more direct electrical effects. They are often quiet and fast, but the paper can be expensive, unpleasant to handle and hard to obtain.

The trend is to build more processing power into printers. That means they offer increasingly varied features, so it is hard to categorise them precisely.

A printer has to be connected to the computer by a cable and a more or less standard interface. The normal interfaces are the Centronics parallel, RS232 serial port — also known as the V-24 — and 20mA current loop. IEEE is a parallel interface used by Pet; 'cpl' means characters per line, 'cps' means printing speed in characters per second. Allow five characters to the word.

The more intelligent printer prints as its head moves in both directions across the paper — bi-directional printing. Still more intelligent ones end the head movement at the ends of short lines. These two features can more than treble the working speed.

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P.O.A.

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## RICOH

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Impact matrix printer, uses pin-feed or friction-feed, dual RS232C and 20mA current loop interfaces, 132 cpl, 30 cps, 4x7 matrix on nine-wire printhead. Main U.K. agent Geveke Electronics Ltd.

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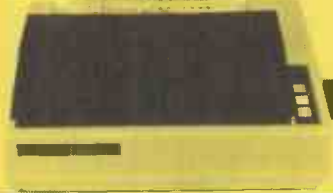
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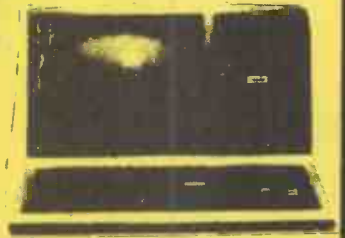


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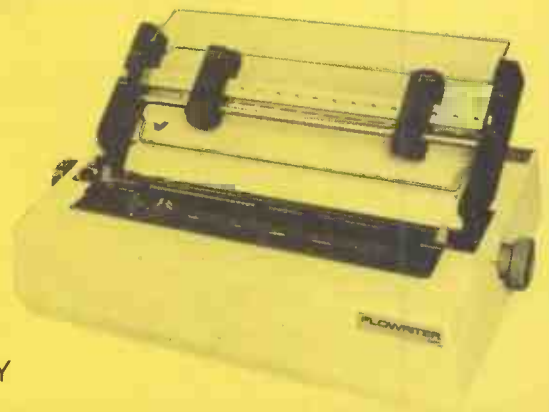
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Continuing our series from *The War Machine*, Chris Dempsey reviews a historical simulation.



# D-DAY

GAMES PLAYERS look to their computers to provide a ready-made opponent at any time of the day or night. The computers themselves are always ready to oblige, of course, but many commercial games programs turn out to be a sad disappointment. The D-Day program from Computer Simulations is a welcome exception to this pattern which goes some way to redress the balance.

D-Day is a historically faithful simulation of the Allied landings in 1944. The human player controls the Allied forces, while the computer controls the German ones. It is played on two overlapping maps of northern France that show differing terrain and towns, which are depicted by various alphabetic characters. It is somewhat confusing at first, but you soon understand what each character means.

## Victory tables

The package consists of three separate programs: an historical descriptive program of about 9K, which is really quite superfluous; an animated 12.3K rules program; and the main game program of 13.1K. All will run on a 16K TRS-80 with no problems, though the main game program will require Dirtop/Zap to be run first if loaded from floppy tape.

Also included are written scene settings, explanations of commands, game rules, combat and victory tables, plus unit-strength charts. All programs load without any problems. Though the rules were well set out, the game is so complex that they fail to cover every contingency, which leads to some head-scratching and ad-hoc personal rule-making.

D-Day is a long, complex game which

takes a beginner six hours to play through. It lasts from June 6, 1944 until the end of that month, each game turn lasting two days. At the start the human player has to decide where the five landing beaches are to be situated, and where initially to place the units at his command — he can either land units where and when he wishes, or follow the historical timetable which is included in the documentation. Turns then alternate between player and computer. Each moves its units until they are adjacent to an opponent's unit. In this position they can choose to attack the other or not.

Attacks also involve allocating air and naval support, which are in turn affected by the weather conditions and the amount

of supplies that the navy can land. The outcome of such attacks is either that both units' strengths are diminished or one unit is wiped out, which happens after a unit's strength has been considerably worn down, or a unit retreats.

Gradually, both sides' units are worn down, wiped out or forced to retreat. The German side has only a limited number of units on the screen when the invasion commences, but they are constantly being reinforced by other units arriving from the south and from Germany. Allied forces, on the other hand, are all available from the beginning, but each unit's individual strength can be reinforced overnight.

The aim of the simulation is for the Allied player to capture both Cherbourg and Caen, plus as many other towns as possible — a look-up table at various dates tells you how well you are doing.

D-Day is an extremely complex game which requires a considerable amount of understanding. Unfortunately, the battle program is so long that there does not appear to be any room left for error checking, etc. The program therefore relies on the human player's honesty; apart from preventing two units being stacked in the same location on the map, it checks nothing that the human player inputs. It is, therefore, easy to cheat, though the game's designer probably hoped that such low thoughts would never enter the head of prospective purchasers of this type of program.

## Aggressive role

The computer logic is also somewhat disappointing in that it does not play a particularly aggressive role, though this may have been a conscious programming decision due to the German side's inferior manpower position. A facility to play either side would have improved the program, as the German position seems to be the more challenging one to play.

The rules themselves are complicated and at times anomalous. However, the lack of error-checking by the program allows you to modify the simulation to some extent. A shorter game can be played by assuming the Americans never entered the war.

The terrain/combat/supply rules appear to have little real effect on the outcome of the battles: they should have more obvious effects and handicap both sides more effectively than they do. Attacks themselves can be light, medium or heavy, but too often players use the latter, and overwhelming force always seems to win.

## Conclusions

- D-Day is a complex game which offers the player a substantial challenge. It calls for tactical skill, planning and forward thinking which makes it very absorbing.
- The game's realism and the sense of playing against a real opponent are considerable assets.
- The simulation can be recommended to anybody interested in tactical war games. Along with other campaign games in the same series it appears to be the nearest approximation to real war-gaming simulation available for the TRS-80.
- The program appears to be bug-free.
- Ratings:
 

|                      |           |
|----------------------|-----------|
| Physical quality     | Fair      |
| Perceived complexity | Good      |
| Subject complexity   | Fair      |
| Realism              | Fair      |
| Play balance         | Good      |
| Overall              | Very good |

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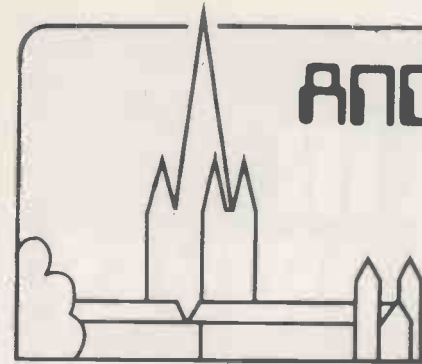
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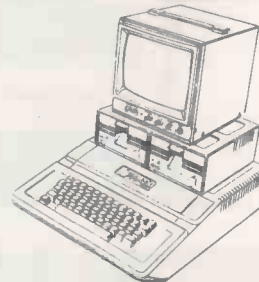
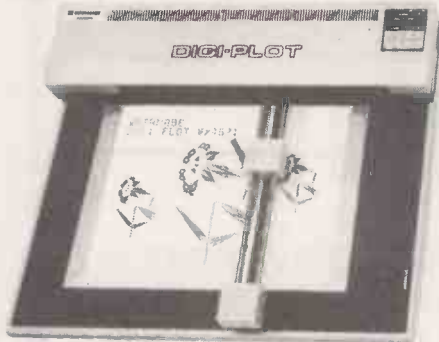
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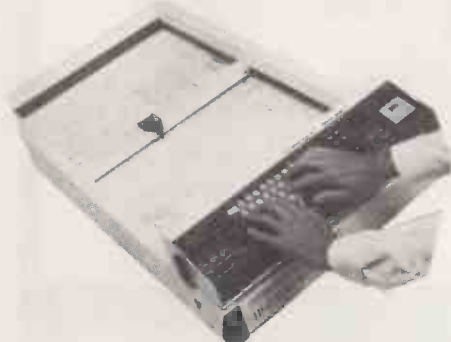


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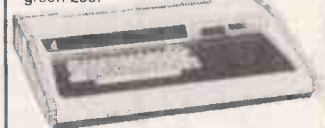
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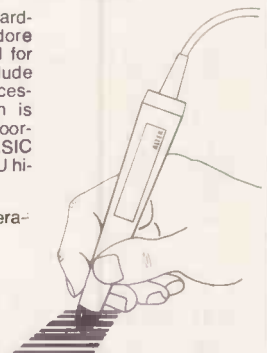
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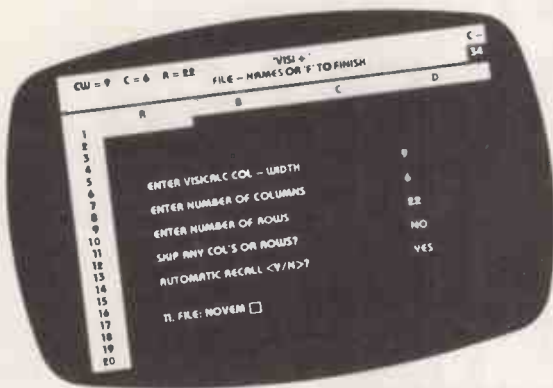
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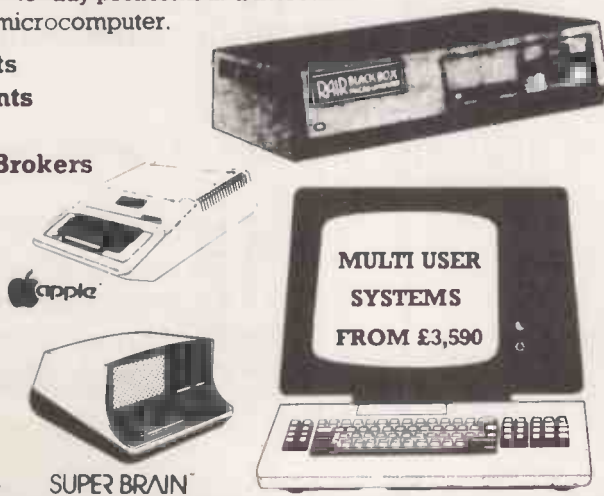
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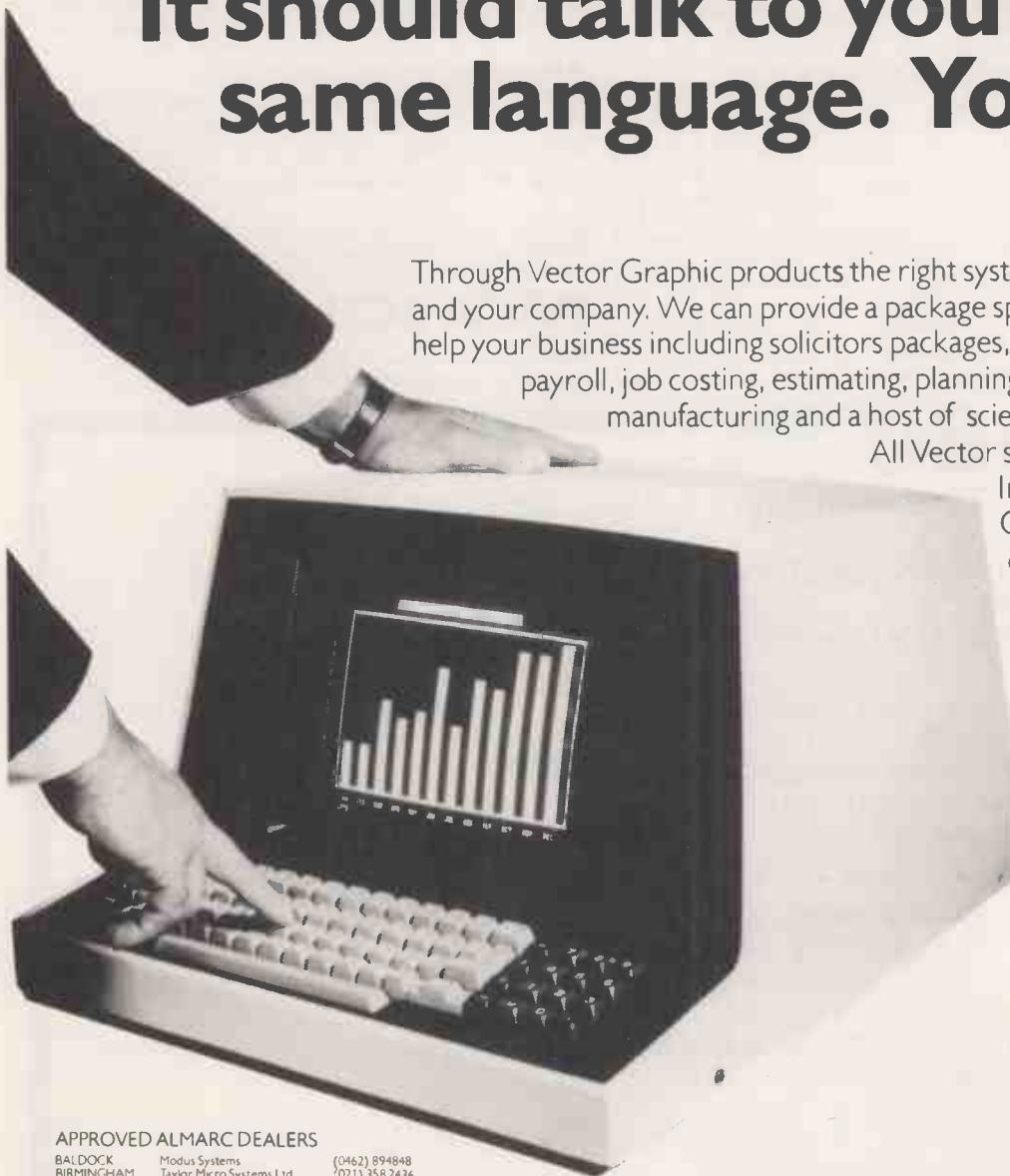
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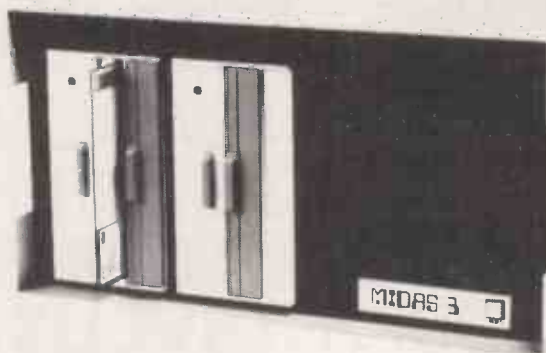
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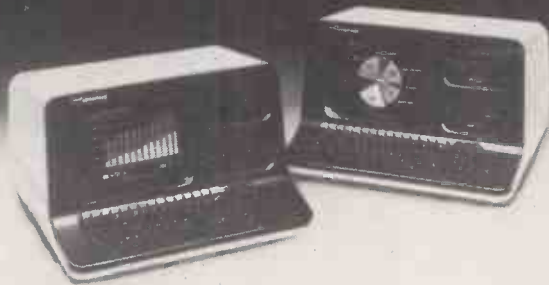
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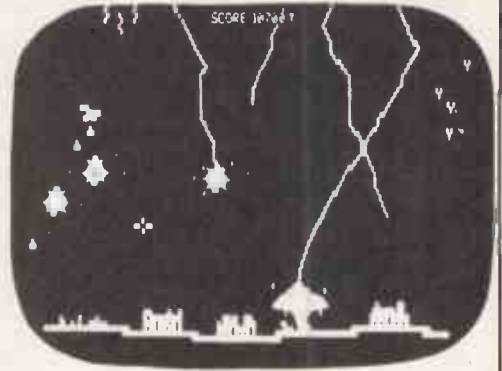
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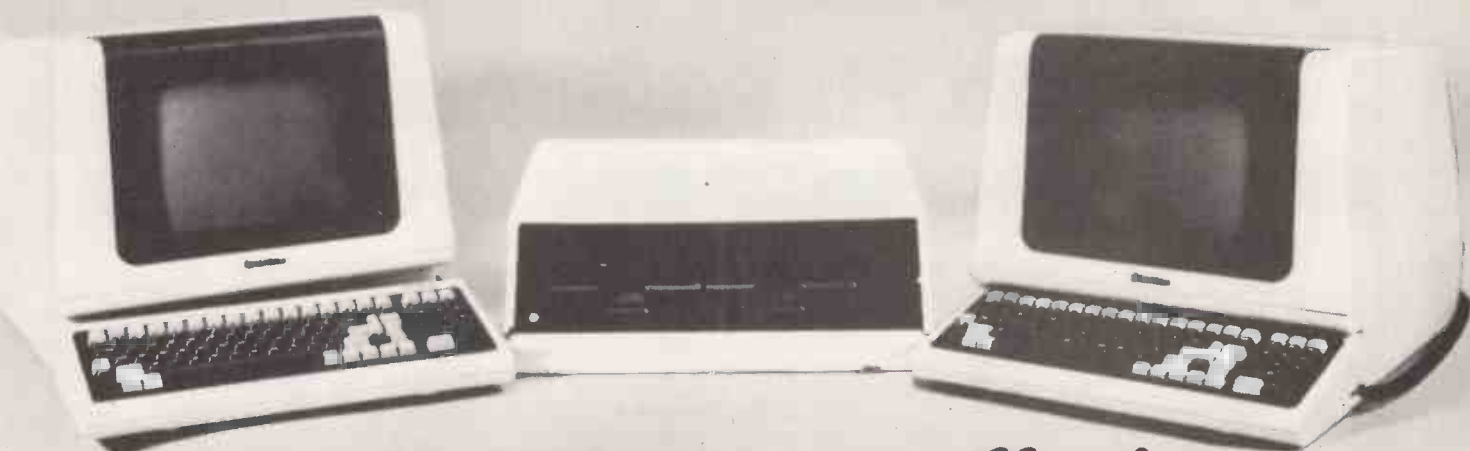
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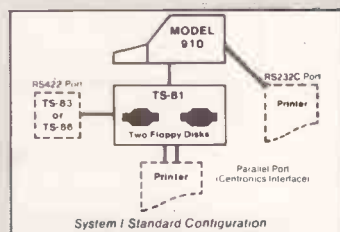
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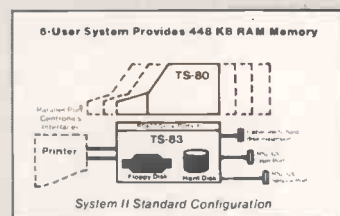
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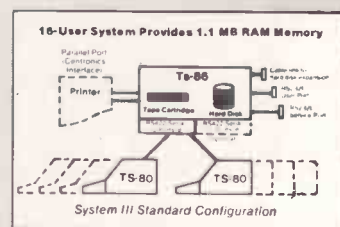
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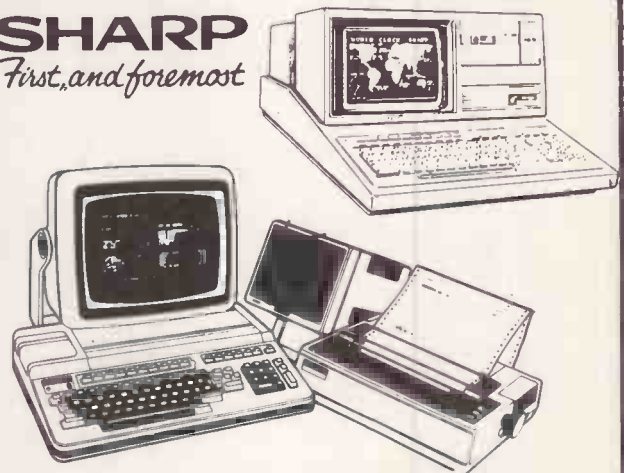
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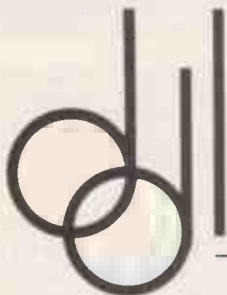
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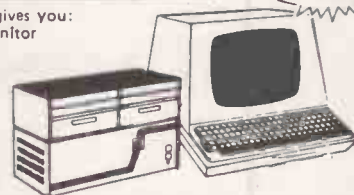
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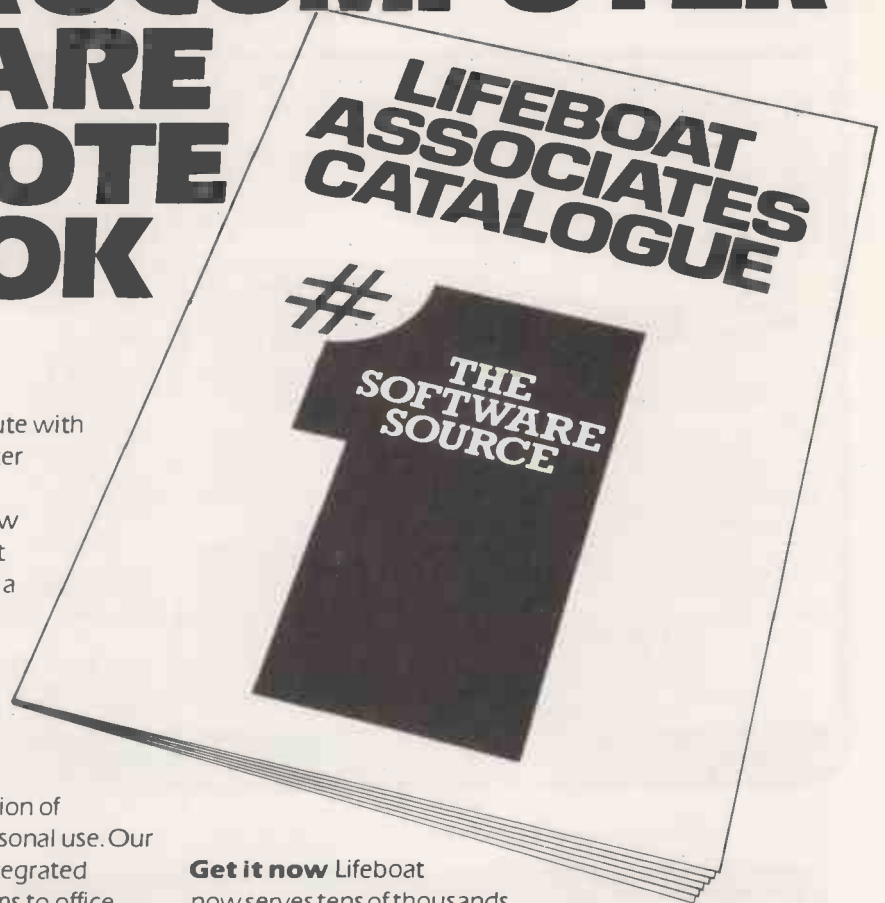
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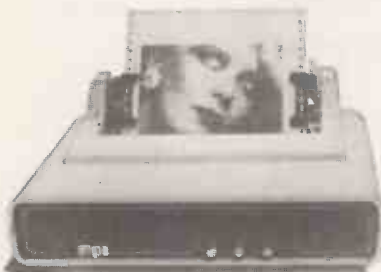
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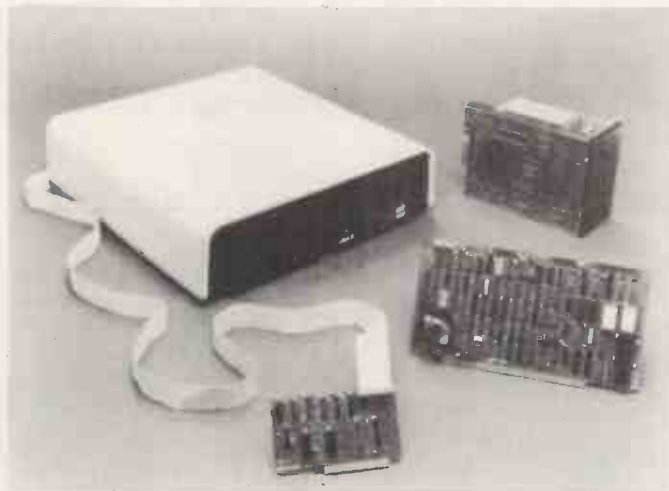


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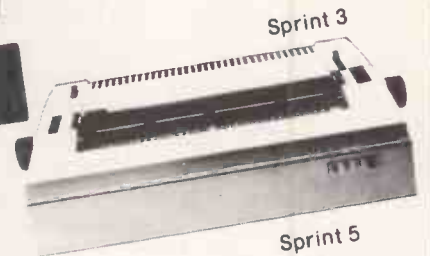
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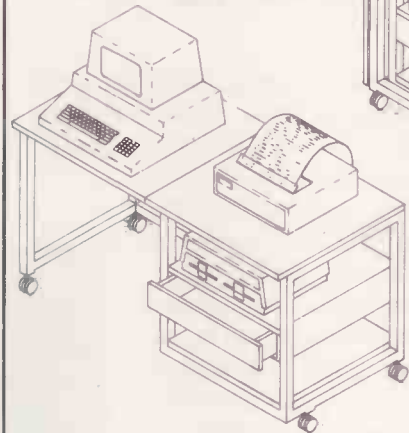
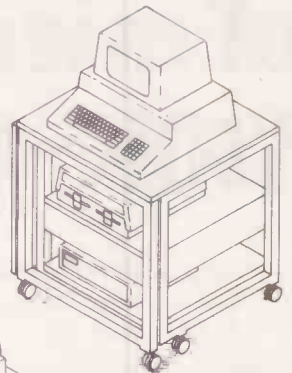


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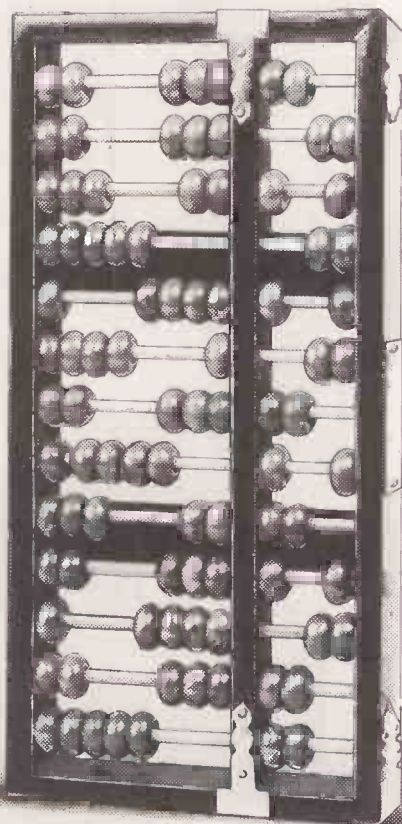
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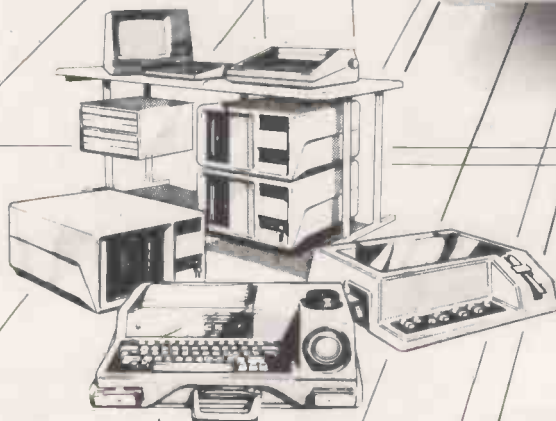
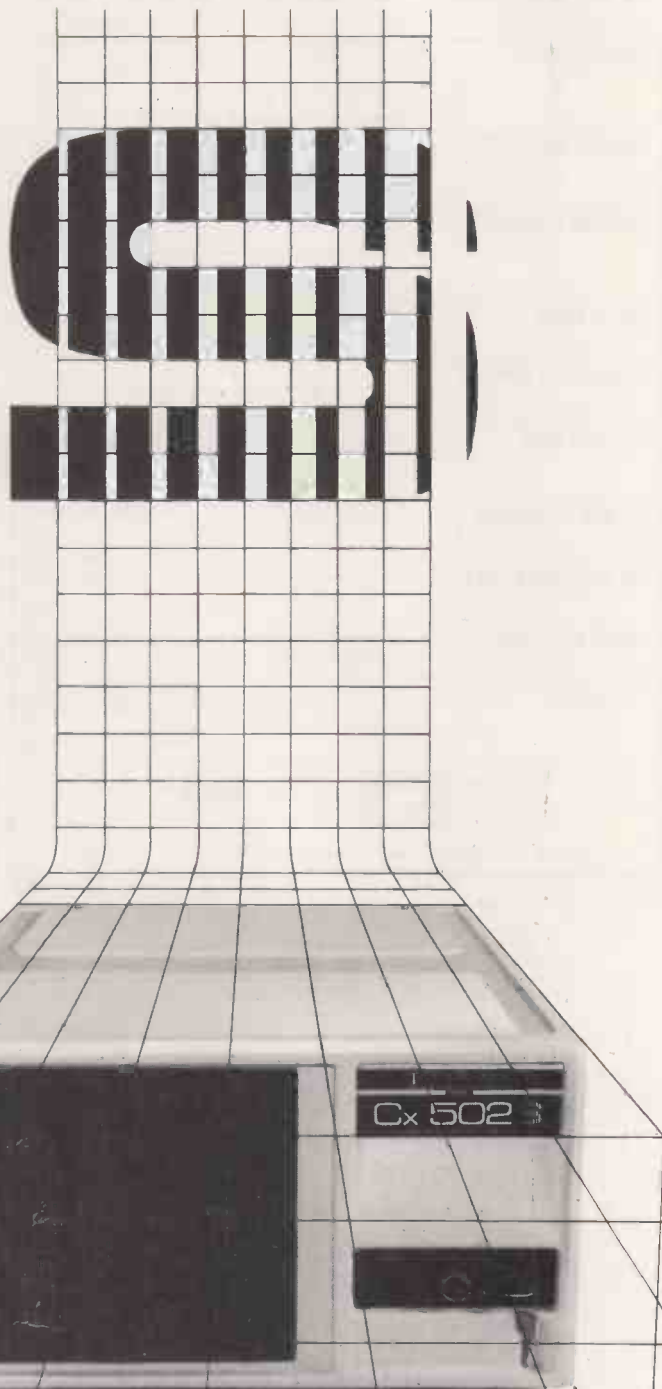
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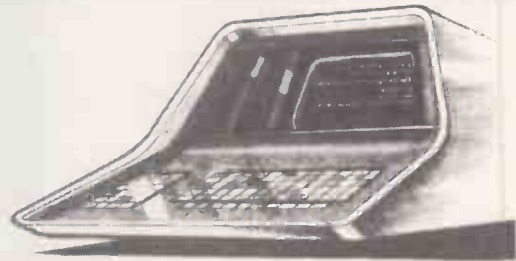
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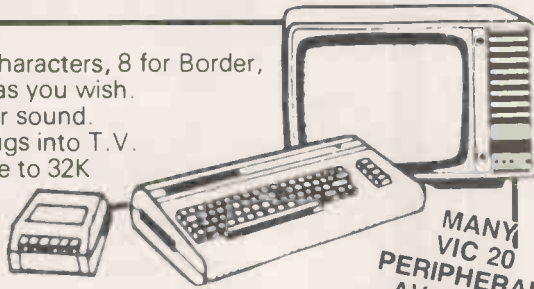
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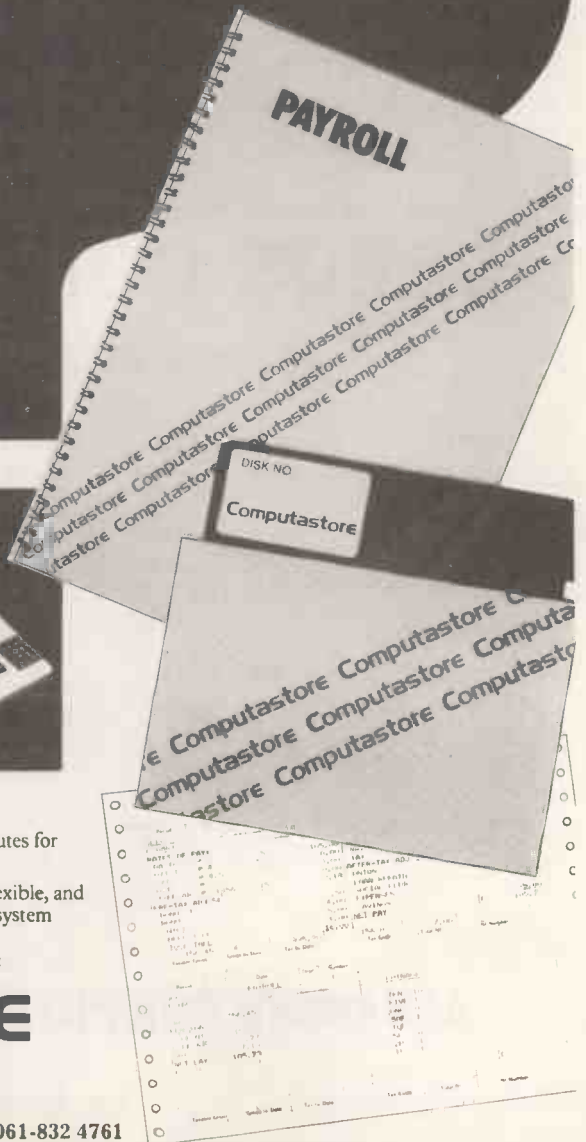
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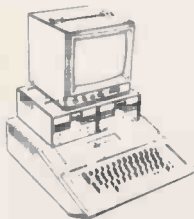
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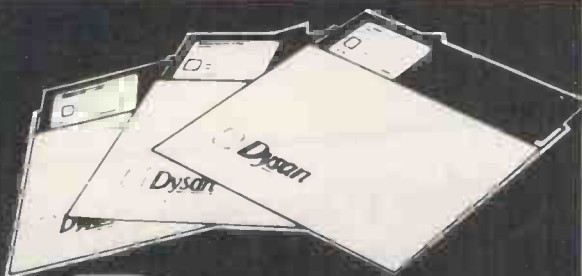
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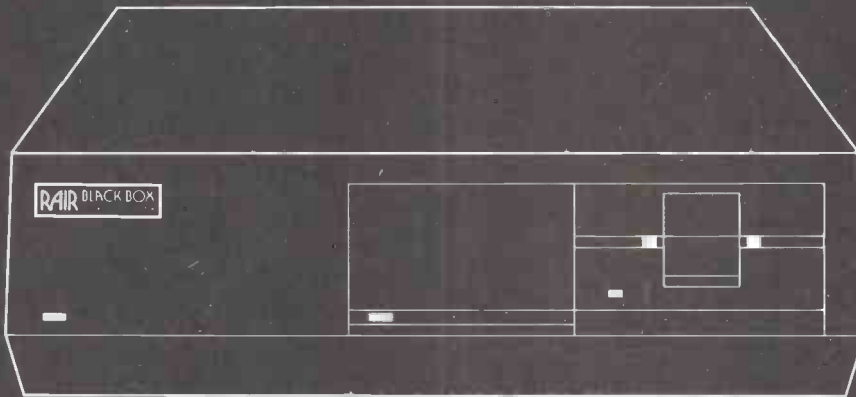


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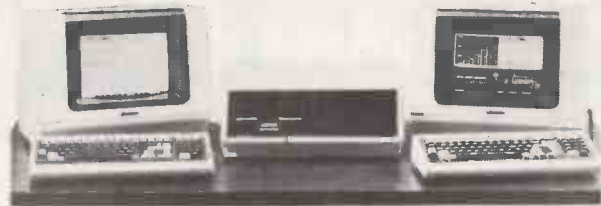
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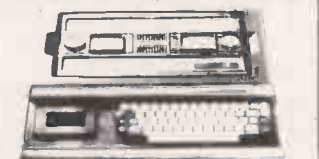


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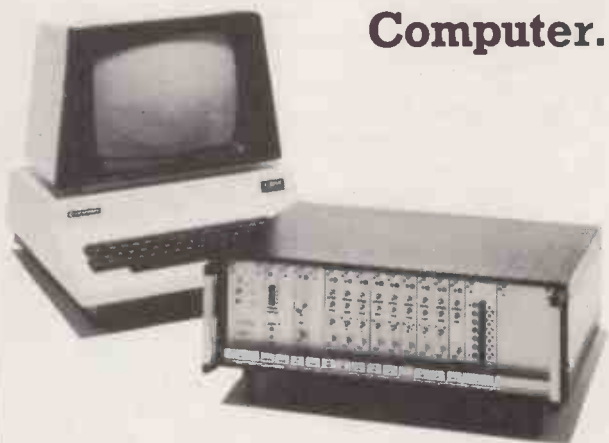
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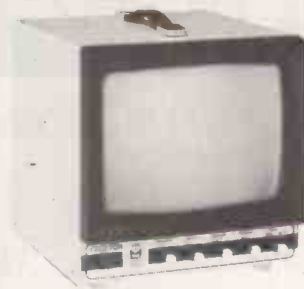
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