

Practical Computing

December 1981

Volume 4 Issue 12

Adaptive processing — the decision tree

**Reviews:
NEC PC-8001B
Piccolo
DMS for CP/M**

Using an assembler

Word-processing programs

Race night

Graphics software



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 Graphics software



Adaptive processing: the decision tree — page 70.

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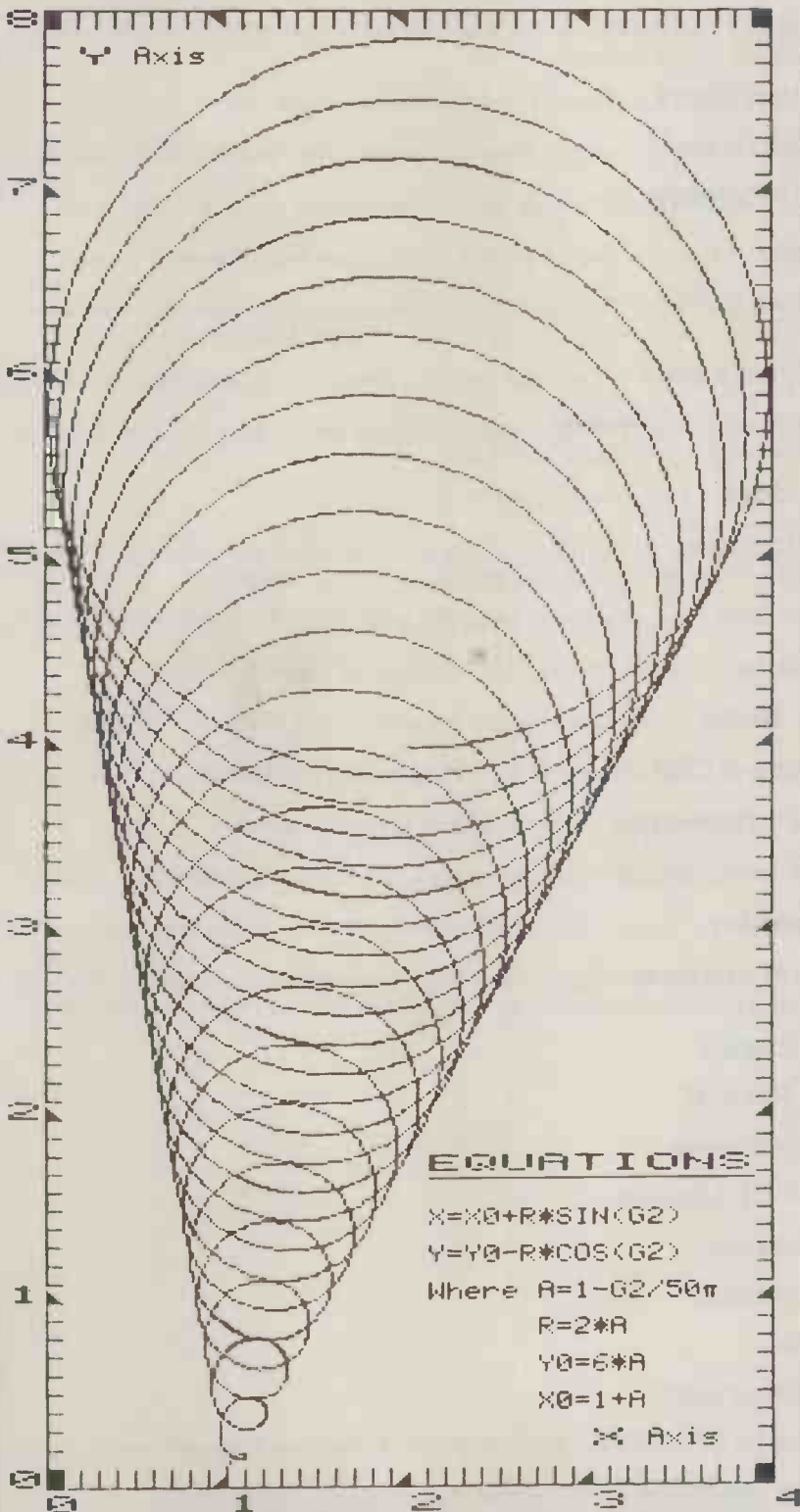
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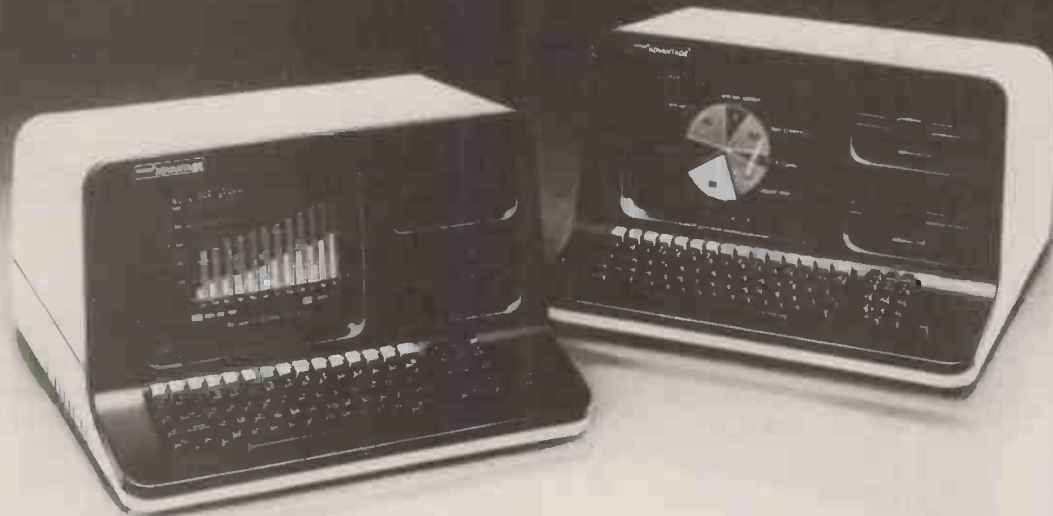
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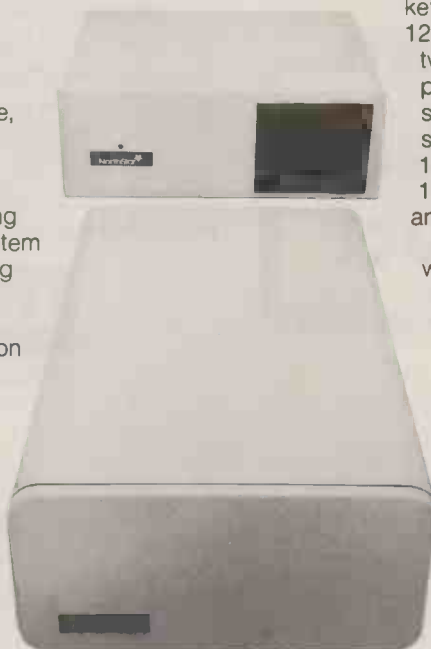
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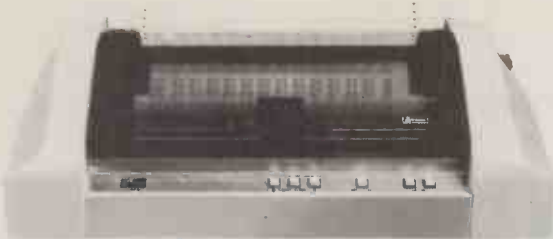
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- BDS C COMPILER** - Supports most major features of language, including Structures, Arrays, Pointers, recursive function evaluation, linkable with library to 8080 binary output. Lacks data initialization, long & float type and static & register class specifiers. Documentation includes "C" Programming Language book by Kernighan & Ritchie. **£60/£10**
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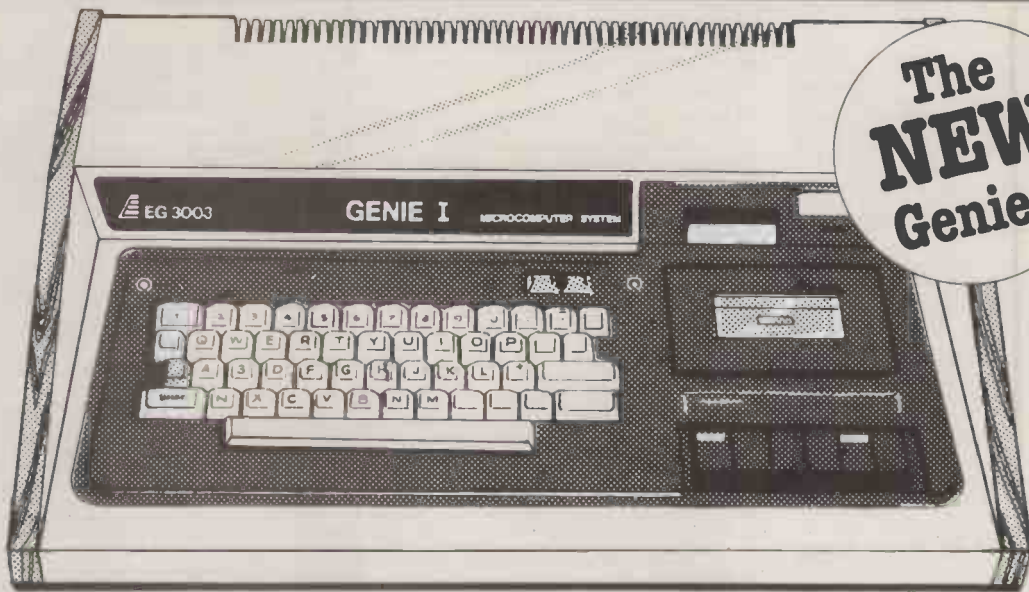
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ingenious!

... that's the only word to really describe the superb Genie microcomputer system, the home computer which is compatible with the TRS 80, and ideal for all micro - enthusiasts, especially the committed hobbyist.

Genie has now been upgraded to Genie I, incorporating all of the original, excellent features, but with the addition of:

- Extended BASIC, including RENUMBER and SCREEN PRINT.
- Full upper and lower case, flashing cursor and auto-repeat on all keys.
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- A MACHINE LANGUAGE MONITOR, with Display, modify,

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Yet, almost unbelievably, the price of Genie I is even lower than that of the original Genie!

Ingenious for business

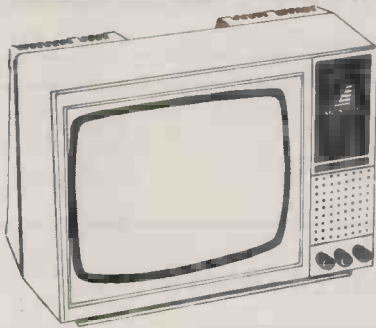
The Genie II is a major breakthrough for small business computers. Harnessing all the advantages of Genie I, including low price, Genie II adapts perfectly to commercial functions with the following features:

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- Four usable, definable function keys
- Extension to BASIC
- Basic business commands
- Fully expandable with the same peripherals



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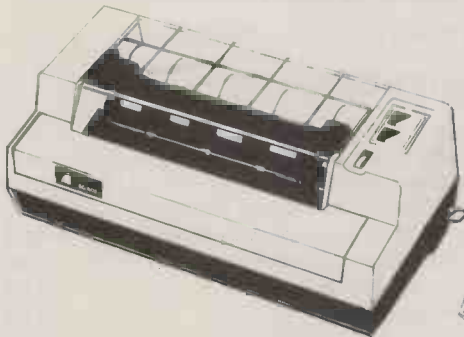


New... 12" Monitor.

There is now a choice of 2, 12" monitors with the Genie I system, allowing a clear, easy to read image, and no interference with your domestic T.V. viewing. The new EG 101 comes with an updated, green phosphor tube.

New!... Expander Box.

An updated Expansion Box (EG 3014) is a major feature of the new Genie I system, and unleashes all its possibilities, allowing for up to 4 disk drives with optional double density. It connects to a printer, or RS232 interface or S100 cards. There is 16k RAM fitted and it has a new low price!

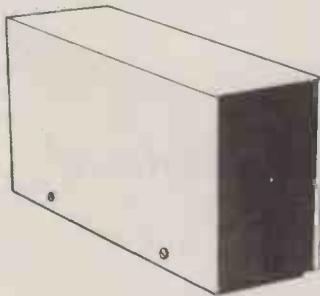


New!... Printer

The EG 602 printer can be connected to the Genie either through the expander, or directly into the computer using the Parallel printer interface. It is a compact unit, with an 80 column, 5 x 7 matrix print-out, operating quietly and efficiently at 30 characters per second.

New!... Parallel Printer Interface.

Enables you to connect the printer directly into the Genie computer without using the expansion box.

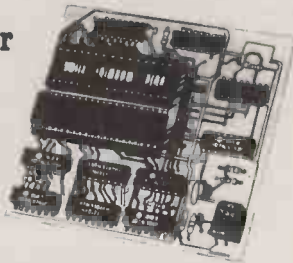


Disk Drive.

As well as the obvious advantage of mass storage, the addition of the disk system to the Genie means much faster access to other languages and full random access file handling. Up to 4 of these 40 track drives can be used on a system.

New!... Double Density Adaptor

Doubles the storage capacity of your disk drive by allowing it to work double-density.



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PLINK II FEATURES

Input: TDL, PSA or MicroSoft relocatable file. The MicroSoft format file is becoming the defacto industry standard, although some other manufacturers create non-standard versions. Check with your dealer to see if the compiler you wish to use is supported.

Output: COM file, Intel .HEX file, PSA PRG file with overlays, or PSA .REL file (not allowed if MicroSoft Input). The .HEX and .REL files may be created in ASCII or binary form, and the .REL files may be used in a subsequent linkage edit if desired. Memory map: PLINK-II can create four different reports: symbols sorted alphabetically, program segments sorted alphabetically, the entire program printed in address order, and program modules printed with date and time of creation and version number (PSA .REL files only).

Common blocks: PLINK-II supports Fortran-type common blocks, with no requirement that the largest instance of the common be input first.

Memory allocation: Program modules are broken down into code, data, and common segments, regrouped into 'sections', and allocated at any memory address desired by the user. A symbol .END, is created to signify the free memory available to the program and its location may be defined at any point. Library search: Libraries of relocatable files may be loaded in their entirety, or with specific modules included or excluded. They may be searched, so that a module is included only if required by portions of the program already loaded.

Overlays: Any number of 'tree-structured' overlay areas may be created, to a depth of 32 levels, and these may be overlapped in an arbitrary fashion to create non-tree-structured organizations.

Control statements: Fifty temporary 16 bit variables are supplied. These may be assigned values, simple arithmetic and logical expressions, or console input, and may be tested via relational operators and branch instructions. Temporary variables, character strings, and simple expressions may be displayed on the console.

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| 04 = OPEN PURCHASE LEDGER | 16 = MANAGEMENT ANALYSIS |
| 05 = GENERAL SALES LEDGER | 17 = CASHFLOW FORECAST |
| 06 = GENERAL PURCHASE LEDGER | 18 = PARAMETER SECTION |
| 07 = BANK UPDATE | 19 = DIARY REMINDER |
| 08 = USER DATABASE AREA | 20 = COMPUTE FUNCTIONS (+) |
| 09 = INVOICE CREATION | 21 = FILE MAINTENANCE |
| 10 = ORDER FILES | 22 = CALL OTHER PROGRAMS |
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 >Quit or .Continue or .Amend or .Delete or .Print
 >Quit or .Double entry or .Alter filename or .Echo input or .Print options
 >Quit or .Mail ticket or .Columnated or .Raw data line
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 AUTHOR TONY WINTER (M.D.;B.A.LIT;B.A.HON.PHIL; AND LECTURER)

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***** MULTIPLE FIELD ATTRIBUTES *****
dbms2 and bus10.00

The following is a list of the field attribute arithmetic functions that may be set up against up to 16 fields per record and found to be both complex and of considerable power.

fn1 = Multiply one field against another and total per record/file.

fn2 = Add one field against another and total per record/file.

fn3 = Divide one field from another and total per record/file.

fn4 = Subtract one field by another and total per record/file.

fn5 = Total vertical columns within a file of records.

The result per record and per file.

fn6 = Calculate a percentage of the value of one field and if the toggle is set to 1 then add that result to the field; whereas if the toggle is set to -1 then simply store the result.

Example:

Field 01 = number	(5)		record.5	computed values
Field 02 = code	{MICRO	}	record	file
Field 03 = quantity	(50)			
Field 04 = s. price	(1000.00	}	[50,000.00]	[70,000.00]
Field 05 = profit	(250.00	}	[150.00]	[170.00]
Field 06 = cost	(800.00	}	[.25]	[.27]
Field 07 = allocated	(20)	}	[1,000.00]	[1,145.00]
			[30.00]	[450.00]

The two results to the right of the record show the use of several of the functions listed above.

Field 03 function 1 (03 * 04) has a value of 50,000.00 pounds worth of 'MICROS' for the number '5' and 70,000.00 pounds worth of for all such records so far scanned.

Field 04 function 6 'toggle -1' (04 * .15) has the increase that is required to raise the price of record '5' by 15%, and so on averaging for all such records.

Field 05 function 3 (05 / 04) has the value of itself divided by the value found in field 04, for the record and all such records scanned. (profit margin ?).

Field 06 function 6 'toggle 1' (06 * 1.25) has the value of record '5' as if it were subject to an increase of 25%, and all such records scanned.

Field 07 function 4 (03 - 07) has the quantity remaining in stock after allocations are subtracted.

You have a combination of *multiple field searches* of 5 TYPES and *multiple compute functions* of 10 TYPES against up to 16 fields, using words you choose and printing only those columns in the order you desire in one SINGLE CORE PROGRAM.

***** MULTIPLE FIELD SEARCHES *****
dbms2 and bus10.00

The following trajectory of a file interrogation may be set up and found to be both complex and of considerable power.

Try a **Sequential search** that is **Slow** and on **Multiple fields** within a range say of record '1 to 30'.

Notice that the cursor prompter will move to the first field in the record form. You will be able to ask any of the following types of questions on each field. When you set the question against that field; if the carriage return is not enabled by the fact that you hit the right-hand-field-bracket, then hit (cr).

There are five types of questions you may ask against a permutation of up to sixteen fields. (Think about them).

1 = straight text identity (p = p) which is to say that you can enter TONY in a name search where the record may look like TONY WINTER or WINTER TONY. the 'TONY' text is sought for in any part of the field.

= **Greater than identity (P > Q)** which is to say that you may first enter the symbol > followed by a numeric value (say 100) where the records may possess different ranges of numbers in that field, and you only want 100 upwards.

3 = Smaller than identity (P < Q) as '2=' above in reverse using X

4 = Not identical (P < > Q) which is to say that all records found on other criteria must not possess the stated attribute. (ie: all records with TONY but not in W.C.1.). You must first enter the symbol ~ followed by the criteria that is to be excluded from the comparison.

5 = Either or identity (P ^ Q) which is to say that you may search for either TONY or someone in W.C. 1. or telephones with a 01 in their number. **Note:** that only one match of those disjunctive premises is sufficient to provide the truth condition establishing a match. That is to say you may find records of TONY in Birmingham and FRED in W.C.1. You must first enter the symbol ^ followed by the text. A multiple example is shown below.

Field 01 = number	{ ()	}	The question is?
Field 02 = name	{ TONY	}	straight text (cr)
Field 03 = postcode	{ ^ W.C.1.	}	one of
Field 04 = town	{ ^ London	}	other
Field 05 = income	{ > 5000	}	greater 5000
Field 06 = age	{ < 40	}	younger than 40
Field 07 = sex	{ -female	}	not female

If you are interested enough to study this section of our new manual, then you are probably in need of a program embodying such features. If you understand the text, that is, if at least its meaning is a *touchstone* that fires your imagination towards *grasping* it with the mind then you and it are converging.

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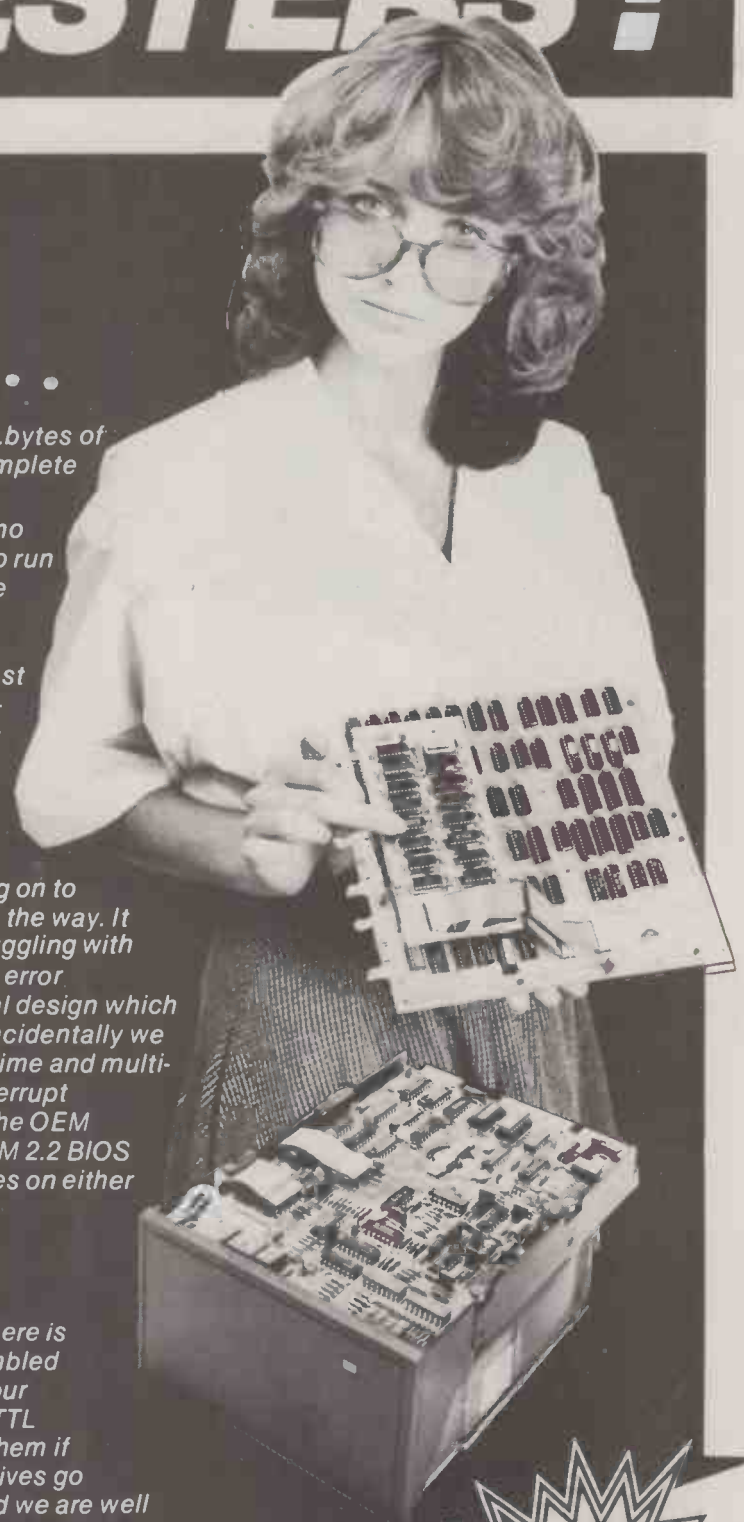
Floppies and larger more expensive hard discs are no match for our new drives which pack enough data to run serious business or technical applications software into a mini-floppy size 5¼" unit. Your data is protected in the sealed enclosure making diskette handling problems a thing of the past. The disc is fast — 40 times faster transfer rate than a mini-floppy — yet fits into the same space and so can be used as a replacement or an enhancement.

Controllerability

Our controller comes with a range of adaptors to plug on to most popular micros and there are more adaptors on the way. It supports two discs with ease and while others are struggling with less stable analog data separators and speed-eating error correction circuits, we use a high performance digital design which literally locks into the data stream and stays there. Incidentally we also sell digital data separator cards to OEMs. Real time and multi-tasking applications benefit from the controller's interrupt capability and macro level command structure and the OEM version features a simple software interface and CP/M 2.2 BIOS with extensive development aids. The software comes on either 5¼" or 8" diskettes together with Boot PROMs.

Service and Support

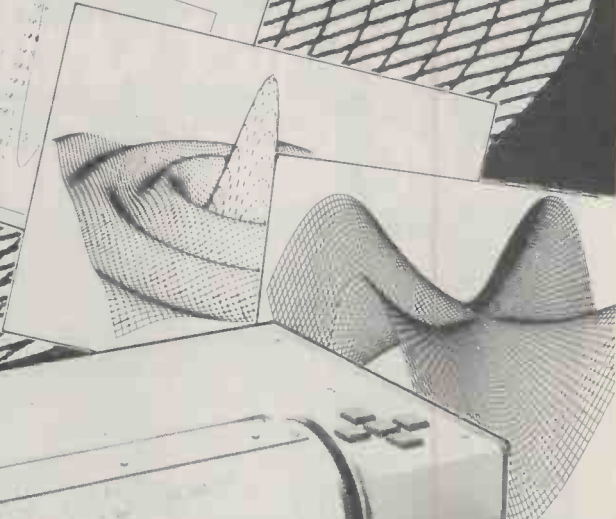
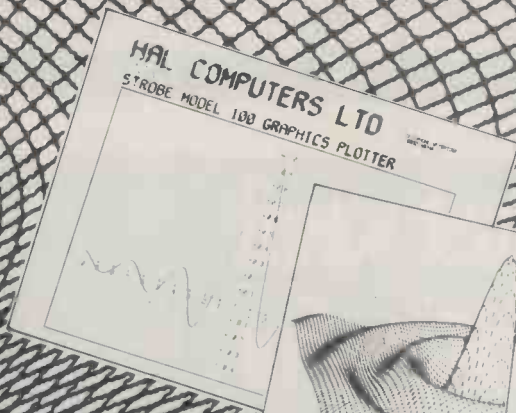
If you are impressed with the specifications so far, there is more to come. Our packaged sub-systems are assembled in-house and they carry a full one year parts and labour warranty. Our controllers are built completely from TTL logic — there are no fancy chips — so we can fix them if they ever break down. Dozens of floppy disc drives go through our workshops every month and we are well known within the industry both for our training courses and our heavy investment in computer based disc test equipment. If your Winchester ever stops working you can depend on us to fix it.



For:
SUPERBRAIN,
S-100, APPLE II,
HEATH H89,
TRS-80.

DEALER
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VECTOR PLOTTING, MICRO PRICE

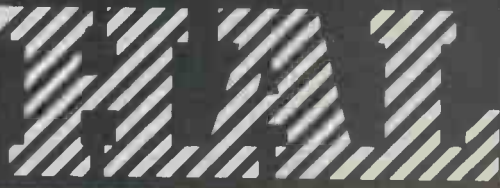
The new Strobe Model 100 drum-type plotter gives you real vector plotting, interfacing to your computer hardware and system software, from only £690*
* High resolution — 0.1mm at 7.6cm/sec. * A4 paper capacity. * Will plot in most colours, uses off-the-shelf felt tip pens. * Precise operator control. * Interactive input of coordinates.

Driver Routines

The Strobe Model 100 can be interfaced to any computer through two parallel 8-bit output ports and one 8-bit input port. Optional interfaces for TRS-80*, Apple II*, PET*, and S-100 bus computers are currently available.
Source listings of the assembly language motor drivers and vector plot routines for use on 8080, Z80, and 6502 microprocessors are supplied with Model 100. Flow charts of these routines simplify modifications of drivers for custom machine level software.

* Unit price for plotter ex-delivery and ex-VAT
* TRS-80, APPLE II, and PET are trademarks of Tandy Corp., Apple Computer Co., and Commodore Business Machines Inc., respectively.

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Hants. GU14 7QU.
Telephone 0252 517171



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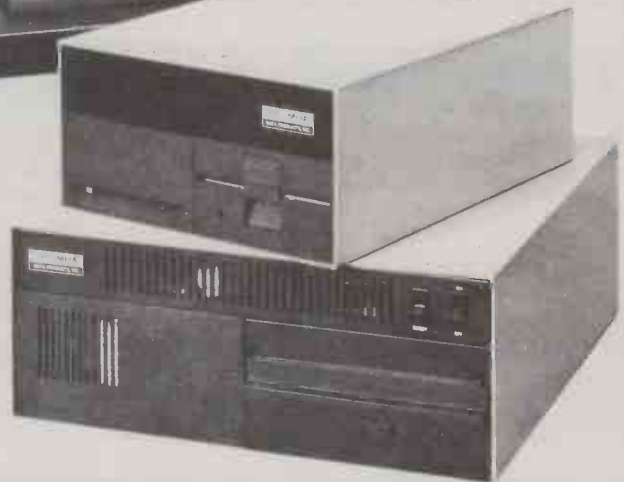
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Now we never say no

Icarus can now offer a complete range of microcomputers from 320K-60M

COMMANDER COMPUTERS

IEEE Communications Port with 4 RS-232 serial ports and 4 8-bit parallel ports. Full graphics standard. Three models - the fully self-contained 964 with integral 9" video display, the F64 with 2 8" disk drives and the M64 with one 5" disk drive.



MULTI-USER MULTI-PROCESSOR SYSTEMS

Designed to give unparalleled performance for one to 16 users. Each terminal has a dedicated processor with its own RAM.

SINGLE AND MULTI-USER UPGRADEABLE/EXPANDABLE SYSTEMS

Offering the disk storage capacity that's exactly right for you. Single user machines to take 5 1/4" or 8" floppy disks giving 320K-2.4M capacity and multi-user machines with up to 60M on hard disk.

A comprehensive new range of microcomputers so versatile that a system may be compiled for each and every micro-based application - that's the exciting news from Icarus. Columbia Data Systems of the USA has appointed Icarus to handle its full range of CP/M and MP/M single and multi-terminal products with hard and floppy disk storage capacities. Which means that whenever you need a microcomputer, for whatever purpose, Icarus will never have to say no.

For full details of the complete Columbia range, or if you would like to become a dealer yourself, contact


ICARUS
Computer Systems Ltd.

Icarus Computer Systems Ltd. Deane House 27 Greenwood Place London NW5 1NN Tel: 01-485 5574 Telex: 264209

● Circle No. 119

The Printer People

OKI MICROLINE

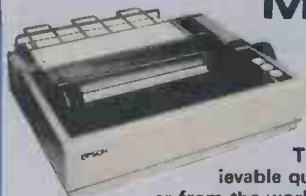
82A

SMALL, LIGHT, QUIET, 9X9 DOT MATRIX PRINTER with
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MX80



The unbelievable quality printer from the world's largest print head manufacturer. A whole stable of machines to suit a wide variety of applications: MX80/1, MX82, MX 80FT/1 & MX80 FT/New Type 2.

ANACOM

150



150 CPS, 15" carriage, dot matrix printer, 9x9 dot matrix, 10 characters per inch horizontal, 6 or 8 characters vertical, 136 cols.

TVI

912/910/950



Fully intelligent terminals with 24x80 display & dual intensity, blinking, reversed, underlining and protect fields, 96 ASCII chrs etc.

OKI

83A



Serial dot matrix printer with an impressive list of features including: 136 cols, 120 cps bidirectional, short line seeking, graphics, dual interfaces, 96 ASCII

NEC

5510/5530



5510-RS232 5530-Centronics 8 bit parallel printers with the unique print thimble, produces up to 5 copies, with friction or tractor feed at 55 chrs. per sec.

HAZELTINE

ESPRIT

The Hazeltine Esprit is a buffered terminal capable of displaying the complete 128 ASCII character set. Based on a 12" diagonal non-glare CRT, the video is crisp and clear with each character presented on a large matrix to reduce eye fatigue.



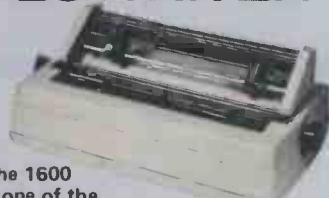
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Daisy wheel printer for word processing, professional results, Diablo compatible, suitable for most micro & mini computers,

RICOH FLOWRITER



The 1600 is one of the most advanced daisy wheel printers on the world market today. With a unique combination of features.

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SYSTEM 4000 EPROM EMULATOR/PROGRAMMERS

EX-STOCK



P4000 PRODUCTION EPROM PROGRAMMER

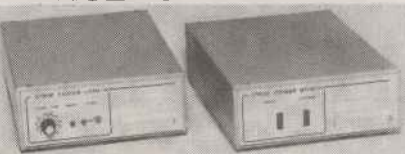
This unit provides 'simple, reliable' programming of up to 8 EPROMs. It has been designed for ease of operator use — a single 'program' key starts the blank check — program — verify sequence. Independent blank check and verify controls are provided along with mode, pass/fail indicators for each copy 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:**
+ **£12.00 DELIVERY**

VM10 VIDEO MONITOR

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

Similar to model UV141 but with out timer. Low price at **£61.50 + VAT, postage paid.**

EP4000 EPROM EMULATOR/ PROGRAMMER

The microprocessor based EP4000 has been designed as a flexible, low cost, high quality unit for emulating and programming all the popular NMOS EPROMs without the need for personality cards, modules or hardware changes. Its software intensive design permits selection of the 2704 / 2708 / 2716 triple rail EPROMs and the 2508 / 2758 / 2516 / 2716 / 2532 / 2732 single rail EPROMs for both the programming and emulating modes.

The video output (T.V. or monitor) for memory map display in addition to the built-in Hex LED display, for stand alone use, is unique in this type of system. This, with the double function 28 key keypad, powerful editing features, powered down programming socket, buffered tri-state simulator cable and 4k x 8 data RAM gives you the most comprehensive, flexible and compact systems available today.

2 year warranty. Price **£545 + VAT:**
+ **£12 DELIVERY**

MODEL UV141 EPROM ERASER

- 14 EPROM capacity
- Fast erase time
- Built-in 5-50 minute timer
- Safety interlocked to prevent eye and skin damage
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- Available Ex-Stock at **£78 + VAT** Postage Paid

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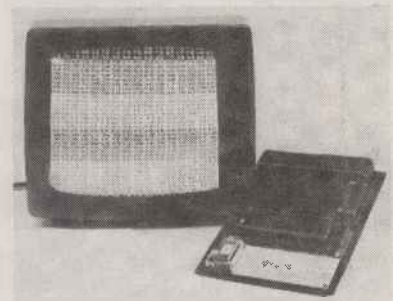
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SOFTY SYSTEMS

EX-STOCK



SOFTY 2 LOW COST 2716 EMULATOR/PROGRAMMER

● Direct output to T.V. ● High speed cassette interface ● On card EPROM Programmer ● Multifunction touch keypad ● 2K Monitor in 2716 ● 2K RAM ● 128 byte scratchpad RAM ● 2K EPROM Emulation ● Can program 2732/2532 in two halves ● Editing facilities including — Data entry/deletion, Block shift, Block store, Match byte, Displacement calculation ● Supplied with ZIF socket, Simulator cable, comprehensive manual, Antistatic lined EPROM tray and PSU. SOFTY 2 **£169 + VAT** (includes p&p)

SOFTY 1 LOW COST 2704/2708 EMULATOR/PROGRAMMER

● Direct output to T.V. ● High speed cassette interface — On card EPROM Programmer ● Multifunction keypad ● 1K Monitor in 2708 ● 1K RAM ● 128 byte scratchpad RAM ● 1K EPROM Emulation ● Comprehensive editing facilities ● Supplied with ZIF socket, Simulator cable and comprehensive manual.

SOFTY 1 (Built and tested) **£120 + VAT**

SOFTY 1 Power Supply **£20 + VAT**

SOFTY 1 CONVERSION CARD

Enables SOFTY to program the single rail EPROMs, 2508 / 2758 / 2516 / 2532. Selection of device type and 1K block are by pcb slide switches. ZIF Programming socket. Supplied built and tested. **£40 + VAT.**

EX-STOCK EPROMS

	1-24	25-99	100 up
2732	6:50	5:75	4:95
2716	2:80	2:60	2:40
2708	2:80	2:60	2:40

ADD VAT AT 15% - POSTAGE PAID

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● Circle No. 121



The Eagle has Landed

THE EXCEPTIONAL NEW AVL EAGLE II BUSINESS SYSTEM HAS ARRIVED

The hardware comes complete with 8 software packages. A fully integrated business system incorporating order processing, ledger accounting and stock control. Plus full word-processing capabilities.

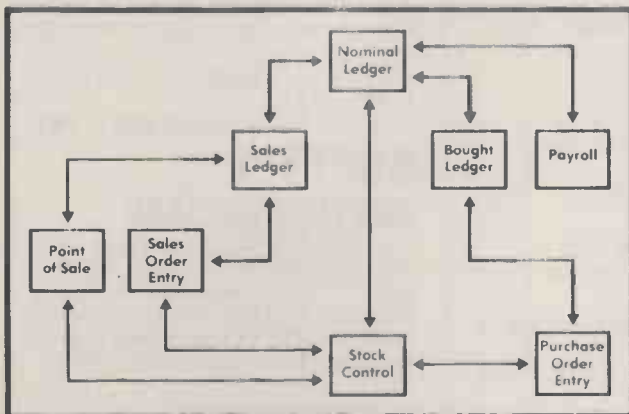
As far as we are aware, this is the only business system available that offers a totally self-contained package at such an amazing price.

The easy-to-use AVL Eagle II will reduce your paperwork, cut costs, give far greater control, and is designed to expand along with your success.

All for less than the price of a salesman's car.

Fully-integrated accounting

Take a look at the fully integrated accounting facility.



Just one single key entry is automatically entered into relevant ledgers. There's no need for manual cross-reference. This double-entry accounting system with automatic error checking will speed the updating of all your financial records and improve cash flow management.

Word-processing

The word-processing facility lets you enter information on a standard keyboard, display it on the screen, edit,

rearrange it and store it, and has the facility to prepare and sort mailing lists.

All this information can then be printed out.

Designed for business expansion

The Eagle II will grow as your business grows. It is CP/M compatible, which means a wide variety of optional software applications is available off-the-shelf. Additionally, data storage space can be increased as you require it.

And communication with other computers is also possible, when connected to the telephone system.

It's really quite difficult putting all the advantages of the Eagle II into words, which is why we'd welcome the opportunity of demonstrating its full capabilities.

Why not arrange a time and place and we'll do just that?

Contact Mediatech Business Systems Division, Woodside Place, Alperton, Wembley, Middlesex HA0 1XA, England (Telephone 01-903 4372).

Dealership enquiries welcomed.



Eagle II

The Business System

● Circle No. 122

THE HEAVY-DUTY MICRO-COMPUTER

Would you buy a car on performance figures alone?

Not likely.

You'll consider a host of other factors like quality, reliability, and warranty before choosing.

It's the same with micro-computers.

In the panel below we've listed the main performance features of the Millbank System 10:

The Millbank System 10

280A CPU 4 MHZ	IEEE 488 GP1B Parallel I/O*
65K RAM Standard	High Speed Arithmetic Processor*
700K Mass Storage on Dual Minifloppys	Real Time Clock*
Optional 1.6 Megabytes DMA Data Transfer	Attractive Desktop Cabinet
Hard Disk Interface for additional mass storage	Portable
2 RS232 Serial Ports (Printer and Modem)	Selectric Style Keyboard
1 RS449 Serial Communication Port to 500K Baud	User - Definable Function Keys
Programmable Baud Rates	Accounting- Style Numeric Pad
Separate CRT Microprocessor	Low Glare Screen
*Optional	Full Screen Editing

While it clearly establishes System 10 as a high-performance micro-computer it doesn't tell the whole story.

Because it doesn't cover the vitally important factors that make the Millbank System 10 what we call the 'heavy-duty' computer.

Like exceptionally high design quality and unique internal architecture that gives incredibly fast memory access.

Like manufacture from the highest quality components and materials available.

Like a special switching device which reduces wear and tear on major working parts.

Like a device which protects your programs and files from power failure.

And there's more. Like a non-glare screen for user comfort to take just one example.

It all adds up to a solid, reliable micro-computer with a full twelve month warranty (an important point to check).

It includes the 'industry standard' CP/M disk operating system that gives you access to a vast and ever-increasing software library.

The Millbank System 10 also gives you freedom and flexibility.

Freedom to expand to five or ten Megabyte hard disk storage.

Flexibility, through the input-output panel, to build up a micro network, add all sorts of peripherals or scientific instruments and to link up to mini and mainframe computers.

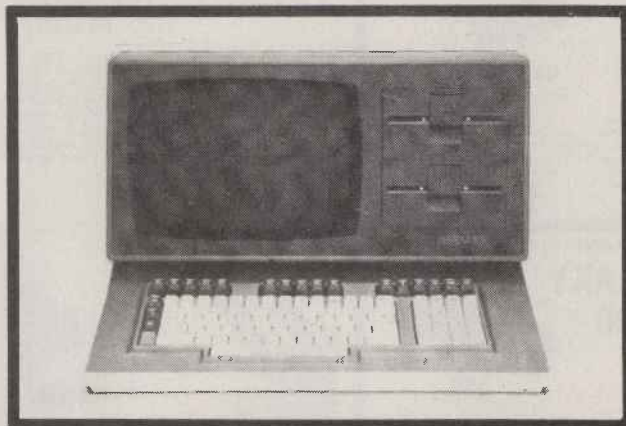
INPUT OUTPUT PANEL



The Millbank System 10 handles all forms of business accounting and management, word processing, networking, communications - it's ideal for mainframe preprocessing and data entry.

In fact, it'll do virtually everything you want from a micro-computer - consistently and reliably. See it before you make an irreversible decision.

There's almost certainly a Millbank dealer near you.



The Millbank System 10

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COMPUTERS

Millbank Computers Ltd.
98 Lower Richmond Road,
London SW15 1LNA
Telephone: 01-788 1083

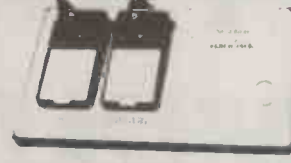
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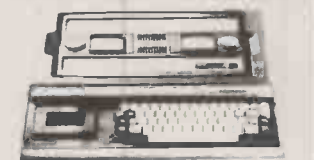


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No need to buy expensive thermal paper!
Fast add listing PRINTER CALCULATOR 2 lines per second. 10 digit capacity
Uses normal adding machine rolls. Battery or mains operated.
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(Mains adaptor extra)

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Plays 24 different tunes with separate speed control and volume control. Select the most appropriate tune for your visitor, with appropriate tunes for different times of the year!

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The most advanced TV game in the world 20 cartridges available Add on KEYBOARD coming soon to convert the MATTEL to a home computer with 16K RAM fully expandable and programmable in Microsoft Basic. Other accessories will be available later in the year.
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These invaders are a breed of creature hitherto unknown to man. They cannot be killed by traditional methods they must be buried. The battle is conducted in a maze where squads of aliens chase home troops. The only way of eliminating them is by digging holes and burying them.
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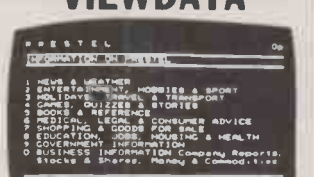
THE OLYMPIA — POST OFFICE APPROVED TELEPHONE ANSWERING MACHINE WITH REMOTE CALL-IN BLEEPER

This telephone answering machine is manufactured by Olympia Business Machines, one of the largest Office Equipment manufacturers in the U.K. It is fully POST OFFICE APPROVED and will answer and record messages for 24 hours a day. With your remote call-in bleeper you can receive these messages by telephone wherever you are in the world. The remote call-in bleeper activates the Answer/Record Unit, which will at your command repeat messages, keep or erase them, and is activated from anywhere in the world, or on your return to your home or office. The machine can also be used for message referral, if you have an urgent appointment, but are expecting an important call simply record the 'phone number' and location where you can be reached. With optional extra



bleepers (£13 each) this facility can be extended to colleagues and members of the family. Using a C90 standard cassette you can record as many as 45 messages. The announcement can be up to 16 seconds long and the incoming message up to 30 seconds long. The machine is easy to install and comes with full instructions. It is easily wired to your junction box with the spade connectors provided or alternatively a jack plug can be provided to plug into a jack socket. Most important, of course, is the fact that it is fully POST OFFICE APPROVED. The price of £135 (inc. VAT) includes the machine, an extra-light remote call-in Bleeper, the microphone message tape. A C mains adaptor The unit is 9 1/2" x 6" x 2 1/2" and is fully guaranteed for 12 months. The telephone can be placed directly on the unit — no additional desk space is required.
£135
inc VAT

PRESTEL VIEWDATA



The ACE TELCOM VDX1000 Prestel Viewdata adaptor simply plugs into the aerial socket of your television and enables you to receive the Prestel Viewdata service in colour or black & white.
Features —
— Simplified controls for quick, easy operation
— Special graphics feature for high resolution
— State-of-the-art microprocessor controller
— Standard remote telephone keypad with Prestel keys
— Auto dialler incorporated for easy Prestel acquisition
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— Includes convenient TV — Prestel switchbox
— Easily connected to standard home or office telephone lines
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HAND HELD GAMES GALAXY 1000



The 2nd generation Galaxy Invader. The invaders have re-grouped and have a seemingly endless supply of spacecraft whilst the player's arsenal is limited to just 250 missiles to be launched from 3 missile stations. You have to prevent the invaders landing or from destroying your home defences.
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Telephone: 01-301 1111 or 01-309 1111

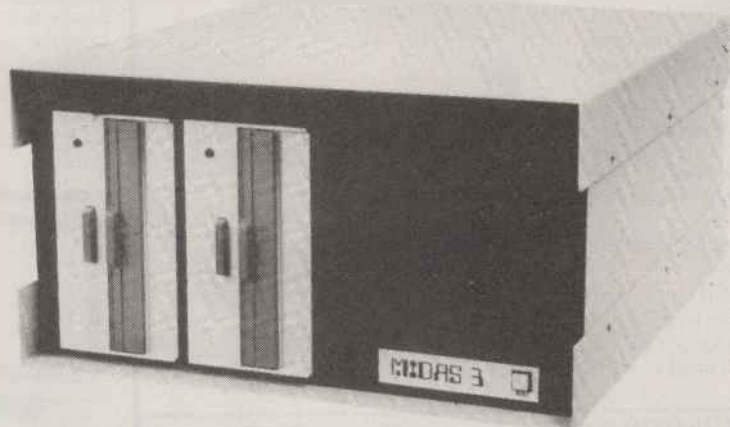
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NOW WITH MP/M

MIDAS S.100 SYSTEMS



MIDAS 1: From £835
MIDAS 2: From £1,790
MIDAS 3: From £2,450
MIDAS 3HD: From £5,495
ITHACA-DPS 1: From £1,345

- Our versatile Z80 Microcomputers are available as standard units or custom configured to your exact specification from a comprehensive range of stocked S100 boards.
- Disc storage capacity of the MIDAS 3 can be 2M Bytes, expandable to over 80M Bytes with a Winchester Hard Disc Unit in our MIDAS 3HD range.
- MIDAS runs CP/M and MP/M. Other Software includes M-BASIC, C-BASIC, FORTRAN, COBOL, CIS-COBOL, PASCAL and Word Processing.
- A MIDAS 3, with 64K RAM and 2M Bytes storage on two 8" drives with two Serial I/O Ports and CP/M 2 only £3,065
- Multi-User System (four users) — MIDAS 3 with 112K of RAM, 1MByte disc storage on two 8" drives and four Serial I/O Ports, and CP/M2 + MP/M — £4,250
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- Printers, VDUs and other peripherals stocked to give complete package system at keen prices.

Boards stocked from Ithaca, Godbout, SSM, S D Systems, Vector, Micromation, Mullen, Mountain Hardware, Hi-Tech, Video Vector, Pickles & Trout, Cromemco, Morrow — Send for full Price List (many available in kit form).

Processor Boards		RAM Boards	
Z80 Starter Kit	£245	Dynamic RAM 16K-64K	from £205
SBC100	£265	Static RAM 16K-64K	from £205
8085/88 CPU	£185	Memory Manager	£60
Z80 CPU 4 MHz	from £180	I/O Boards	
EPROM Boards		2S/4P prov 4K RAM/4K ROM	£185
2708 EPROM (16K)		2S/2P or 2S/4P or 3P/1S or 4S/2P	from £140
2708/2716 Programmers	from £140	Analogue 8 or 12 bit	from £220
Video Boards		Optically isolated I/O	£130
16 lines, 32/64 ch	from £114	IEEE 488 interface	£350
24 lines, 80 ch	from £290	Miscellaneous	
Disc Controllers		Real Time Clock	£180
Versafloppy S/D	£210	High Dens Graph/8K RAM	£333
Doubler D/D	£310	Hi-Tech Colour	£296
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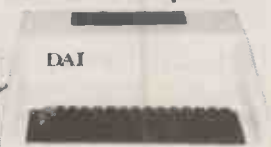
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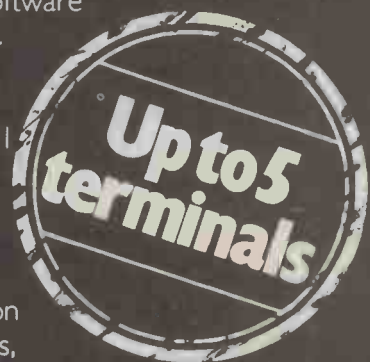
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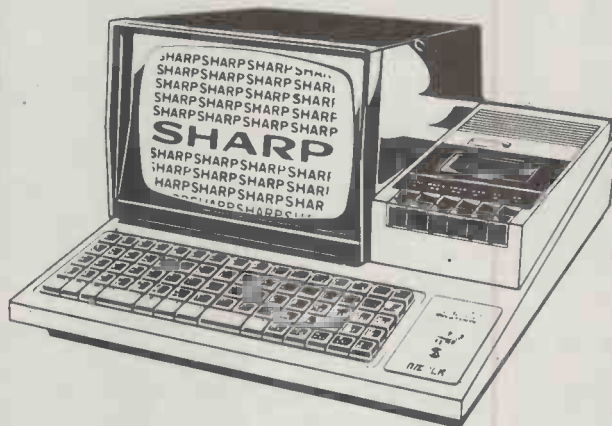
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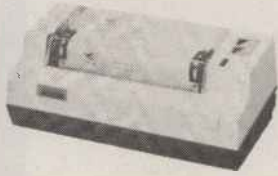
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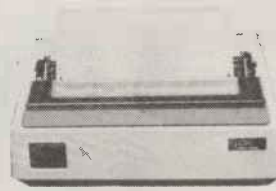


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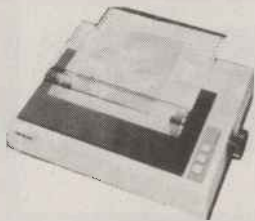
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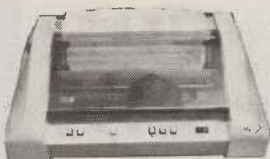


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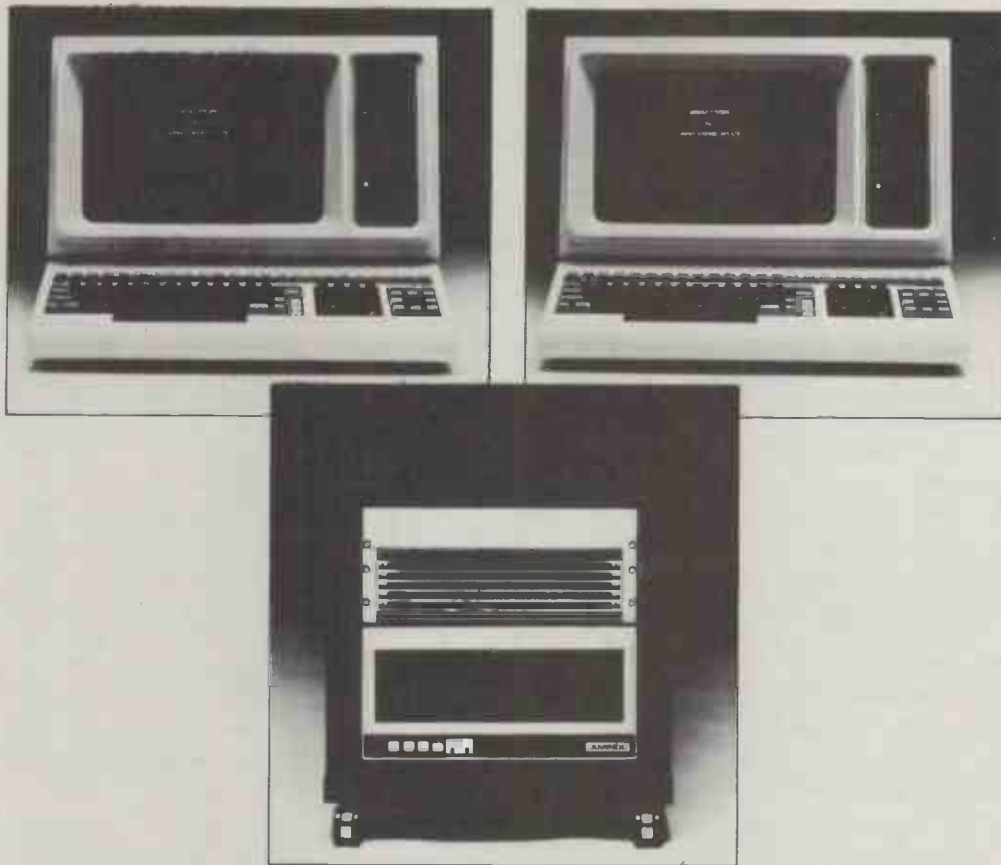
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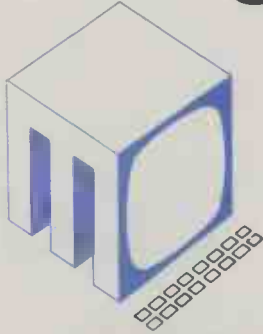
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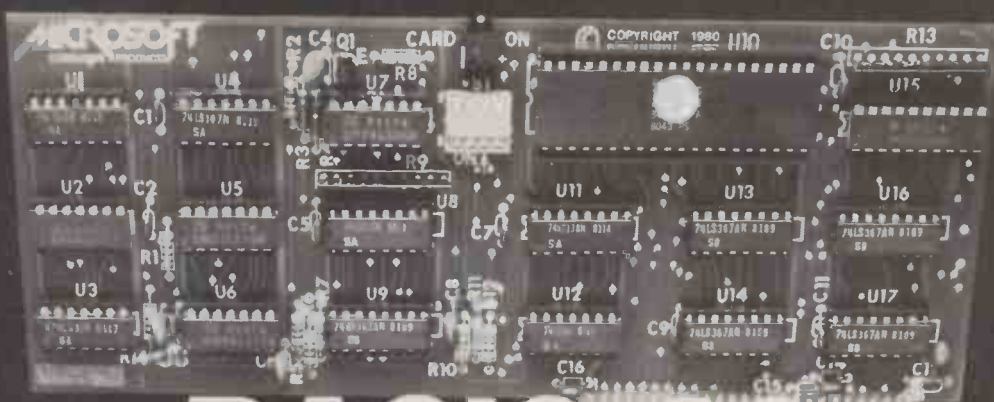
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Welcome the big boys

GOD, BEING A conservative sort of chap — not a surprising trait in one as old as He — is traditionally said to be on the side of the big battalions. At least, this was Voltaire's view, and events since his time have scarcely, if ever, proved him wrong.

We are now about to witness a new and interesting test of the old saw. The big, old computer companies have now shed their towels above high-water mark and are ankle-deep in the briny. They are audibly slapping their arms against their sides and crying out "How can it be so cold!"

In other words, IBM, Xerox and our own sickly ICL — among others — are committed to assaults on the micro market, and it will be very interesting to see what happens. On the one hand there are some friends of mine in Oxford who have been busily burrowing backwards into the sand for two years now, saying "Ooh — just wait till IBM arrives — we don't want to be caught in the open when that happens"; on the other, persons of more sanguine temperament are wondering whether the giants do not bring some pretty discouraging handicaps with them to this difficult market.

How might one delineate the issues? The straightforward argument is that the big guns will out-shoot the little guns. The whole world's micro business this year amounted to only five percent of IBM's turnover. If IBM had to give a machine to everyone who already has something from their rivals, it could. The giants have the capital manufacturing capability, the designers, the programmers, the outlets, the maintenance people — everything, in short, which the micro business has so far lacked.

There is little doubt that a lot of people who distrust micros will feel much better about the little beasts when they have one of these well-known names on the front. There is little doubt too that micros need to be made in quantity to high standards and sold through efficient dealer networks. Whether the big firms get into the business or not, this will happen spontaneously through the demands of the market.

In one of the first editorials I wrote on this page, I compared the micro business to the early days of the motor industry when

Cars then were very like microcomputers now. There were dozens of different kinds, allied only by their unreliability, incompatibility and the fanatical enthusiasm of their owners. Those owners would speak disparagingly of "horse and buggy" ideas and would happily spend six hours travelling six miles because they had had the fun of fitting new big ends after the second mile, re-wiring the ignition after the fourth and then retrieving — as Kipling so movingly describes in one of his stories — the contents of a ball-race dropped along six furlongs of un-metalled road.

Well, so it is now. The difference is that the fans of microcomputing have a more gullible public. Many people are being persuaded to ride in our new bangers. They are holding their hats and waiting for the big thrill. It may come, or, what is more likely, the whole mess of machinery may blow up, cover all concerned with hot oil and sit lifeless by the roadside.

In two years we have got to the point where the big firms are emerging — the Austins, Peugeots, Oldsmobiles. The question is, are these big companies the right big companies? The reason they might not be is twofold. Firstly, the traditional computing business is dedicated to selling answers to expensive administrative problems to people who know nothing about computing but are happy to pay several times what the hardware is worth because they are promised "total solutions".

The structure of the big-computing business means that these firms can — they have to — work with very large margins indeed. A large part of their overhead is spent on publicity and marketing. It is common for salesmen to earn 30 percent of invoices with many, many 0s.

That kind of money is paid to salesmen rather than programmers or engineers because the hard bit is in getting the customer to bite on the bullet. If customers were queueing up to buy, as they are in our business, then the salesman's 30 percent will just disappear as manufacturers compete by cutting costs. One wonders whether a company organised round selling to a small number of rich, reluctant customers can convert itself into a mass-market operation.

The second problem follows from the first. In the big-computing business, the man who signs the cheque will never sully his hands with the keyboard. He expects to get value out of his purchase through the efforts of his data-processing department. It suits everyone in this set-up to make the machine pretty complicated to use, because that increases the mumbo-jumbo that can be used to baffle the businessman and increases the DP people's hold on their jobs:

In consequence, the big computing companies are full of people who have devoted their lives to making computing difficult. If you walk into the technical department of Intergalactic WonderComps and tell them that what they are doing can be, and often is, done by ten-year-olds, they get understandably miffed. If you invite them to reverse the whole trend of their professional careers and try to make the machine easier to use rather than harder they are apt to go very limp on you.

This is unfortunate for IWC because the way things look in the micro business, hardware on its own is going to be a fairly lean market. There will be a lot of it, but the margins will inevitably be thin and a lot of the 200-300 micro manufacturers in the world must go to the wall over the next few years. The problem for the giants is that buyers of micros want the hardware only to get the software to run. But, of course, the giants are full of people who are convinced that software ought to be complicated.

Micro-software needs a completely new cast of mind. It needs people who are violently anti-elitist, who view with deep suspicion everything more complicated than counting on the fingers of one hand. They have to believe that computing is not difficult, merely tricky, and that with luck, time will make it a lot less so.

It may not be easy to get the technical people in the big companies to change their habit of thought. Ever since micros first appeared, they have regarded them as toys. Their companies are now getting into the market only because the money men can see that if they do not do something now there will not be much big-computing business left in a few years' time.

If the technicians cannot be won round, then the big companies are going to be stuck with big overheads and a very standard mass-market product which relies on other people's software to make the sales and take the profits.

There is another reason why the big companies are unlikely to do well in the key area of software. New software comes from someone with a good idea sitting down in front of a keyboard. It makes no difference whether the keyboard is in IWC's technical centre or in a front room in Walsall. Even IWC is limited to the good ideas in the heads of its employees. Even supposing they are not contaminated by obsolete doctrines, there are nowhere near as many of them in there as there are of us out here.

And that argument brings us full circle. If it turns out to be true, the future of big computing companies in the micro market looks hard. However, in the process of getting in, they will do us all a fair amount of good. They will greatly increase the stock of hardware in use in the world, and will improve the reputation of the microcomputer but, one hopes, without putting too many of us out of business. □

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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.

Conclusive evidence

BORIS ALLAN'S article on "The limits of my world" in the September 1981 issue does not show that "the world of non-recursive algorithms has increased its limits to include Ackermann's function" but that the Ackerman (A) function is a general recursive function if and only if the Griffin (G) function also is.

The A function, you will recall, is defined on the non-negative integers by:

$$\begin{aligned} A1 A(0, N) &= N+1 \\ A2 A(M+1, 0) &= A(M, 1) \\ A3 A(M+1, N+1) &= A(M, A(M+1, N)) \end{aligned}$$

Allan's "definition" of the G function contains three strings of dots and the phrase: "The sequence of G operators is easily extended". This looks recursive, as does a mathematical definition of my own:

$$\begin{aligned} \text{For } M \geq 1 \text{ and } N \geq 0 \\ G1 T Gm1 &= T \\ G2 T G2N &= T \times N \\ G3 T G M + 1 (N + 1) &= T Gm (T Gm + 1N) \end{aligned}$$

The "ordinary algebraic expression"

$$A(M, N) = 2 Gm(N+3) - 3$$

is a relationship between two generally-recursive functions; there is no non-recursive algorithm for computing either the G function or the A function for general M and N.

George Miles,
Wyken,
Coventry.

Stretching language

IN HIS article "The limits of my world" in the September 1981 issue, Boris Allan makes two claims: that he has given an ordinary algebraic expression for Ackermann's function, and that this allows us to perform the computation of the function in a non-recursive manner. Neither is justified.

In the first place, "an ordinary algebraic expression using G-operators" is a contradiction in terms. It is as if I set out to demonstrate that a human being can run a mile in less than a minute, by running using a motorbike.

This is not extending the limits of language; it is just using words differently from everybody else — fine for Humpty Dumpty but not very helpful for the rest of us.

As for the second point, Allan offers no evidence. The non-recursive algorithm clue to Guttman he gives makes no use of his equation. That is not surprising since the G-operators themselves are recursively defined — Gm is defined in terms of Gm-1.

It should be made clear, though, that recursion is never necessary in programming. This is pointed out in, for instance, chapter 3 of Wirth's book *Algorithms + data structures = programs*, where there is even an exercise which asks the reader to formulate a general method for translating recursive programs into non-recursive programs.

Incidentally, the distinction between primitive recursive functions and general, but non-primitive, recursive ones is irrelevant here, as Allan would realise if he consulted a textbook on mathematical logic to find out what these terms mean.

Just because recursive programming can, in principle, be dispensed with does not mean that it always leads to inefficient programs; Allan has clearly failed to show that it does so in the case of Ackermann's function. This is, in any case, a poor choice of function for discussion because the limiting factor is not the depth of stacking. It is easy to write a program for which the maximum stack depth in computing A(m, n) is m+1. The real problem is the rapid growth of the function since A(4, 2) is:

(2 raised to the power of 2¹⁶) — 3
which has more than 19,000 digits.

R A Litherland,
Cambridge.

Portmanteau word

ROBERT Bittlestone, "The Chile Experiment", September 1981, is plainly a greater exponent of the portmanteau word than even H Dumpty. Can he give a proof, in mathematical notation — rather than in recursive, self-referential, sociologist jargon — that my Gemini 64K RAM board, which has no "parity bits and error corrections", is not working? It does, always. Of course he cannot; no, Stafford Beer is bluffing.

Chris Blackmore,
Ilminster,
Somerset.

Erroneous factorials

I WOULD like to point out an error in the program to calculate factorials written by Simon Harris and published in your March 1981 issue. The author makes the mistake, whenever a carry occurs, of adding it to the next element of the array to be processed. On the next iteration of the inner loop the carry would be multiplied by N, causing an erroneous result. The carries should be performed after all of the elements of the array have been multiplied by N.

Those who write machine code may like to note that the ZX-80 stores the value correctly if a negative Poke is performed. This is useful when calculating relative jump displacements or storing indices for the index registers.

Colin Mongardi,
Eastbourne,
East Sussex.

Contentious bones

DICK WARN'S article, August 1981 issue, succeeded in combining two bones of contention in one package; Basic versus Pascal, and educational computing. There is little in it to be criticised — if it had been written 10 years ago. It seems to ignore the actual microcomputer situation — Basic is.

The only way Pascal, or any other structured alternative, might become generally acceptable is if the manufacturers of microsystems were to sell their machines with it on board. As long as I, as a school and personal computer user, am buying a machine which comes with Basic as part of the package, it is what I am going to use. Even if Pascal is available as an alternative, it costs more money.

The arguments one reads are interesting and instructive, but they are not really concerned with practical computing. There seems to be a group of people, possibly those with professional computer training, who have not yet realised that computing is passing out of the hands of the professional into the arms of the amateur in terms of quantity of programming.

With regard to educational computing, three main objectives can be set. To introduce pupils to computer programming; to acquaint pupils with the use of microcomputer systems; and computer-aided learning, CAL. Warn's article did not differentiate between these but they do have different major criteria both for hardware and software.

Considering the first, he admits that Pascal is more difficult to learn but suggests, by implication, that pupils may be slightly bewildered, frustrated and baffled by the limitations of Basic. I have not found this to be the case. I teach simple Basic to pupils of ages from 13 to 18 years and my major problem is fighting them off the micro.

Most never reach a stage where they run into the situations described in the article. Few school pupils are bothered by a lack of portability and few of us in schools are going to do more than read

(continued on page 45)

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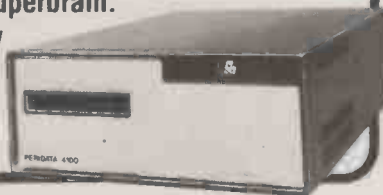


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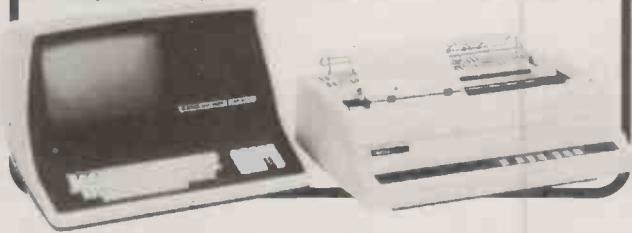
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(continued from page 43)

about the introduction of new and better hardware. Those pupils whose experience and expertise reach a level where these problems become apparent have also reached a level where they can appreciate the reasons and understand the solutions.

The second objective — to acquaint pupils with micros — has accessibility as its major criterion. I should like all pupils in the school to have had experience of operating a microcomputer before they leave, preferably on a reasonably sophisticated data-retrieval system, but I can see no way in which this can be achieved given present resources.

Most of Warn's article seemed to be concerned with CAL which demands portability and sophistication of software. It also needs the involvement of teachers working in that subject discipline to make sure that the content of the software is as valid as the program structure. However, to return to my initial point, the time for decisions on this was some years ago and those decisions were not taken.

The decision which could be made now is to arrive at some standard of operational software for the 16-bit systems before they are in common use. Until then, CAL will languish partly because of the reasons mentioned in Warn's article and partly because of the lack of resources, time and training, for the in-school production of suitable software.

Philip Bolt,
Kirriemuir,
Angus.

Tandy's flashing cursor

IN ANSWER to Graham Nichol's letter in the September 1981 issue of *Practical Computing* asking why the flashing cursor program for the TRS-80 in the June 1981 issue would not work, I think the fault lies in line 150 of the listing. I altered the line from:

```
00150 RETI
```

to:

```
00150 JP 114D
```

However it is necessary to answer the "Mem size?" query with 32671. After loading the programme, respond to the prompt * ? with /32672. If either of these responses are omitted, the computer will jump back to the "Mem size?" query.

The alteration to the program works with level II although I am not sure why, but it may not work with disc Basic.

J E Barker,
Nottingham.

Pet development project

I AM A computer consultant with substantial mainframe experience and an interest in microcomputer implementations of database management systems. Over the past year or so, I have carried out a great

deal of work on a true relational database-management system for the Commodore Pet, with a number of innovations including a form of virtual memory and other performance aids, and both menu-driven and query language processing.

Unfortunately, my mainframe commitments are now such that I am unable to complete the development of this system and I would be grateful if any interested individuals or companies would contact me with a view to taking over and completing development of the package. Write to me as Cardendale Ltd, 16 Malvern Road, Gillingham, Kent ME7 4BA.

Graham Seel,
Gillingham,
Kent.

Changing Atom group

FROM THE end of September I shall cease to be responsible for the running of the Atom User Group. The group will be taken over by Peter Frost at 18 Frankwell Drive, Potters Green, Coventry CV2 2F8.

Richard Meredith,
Coventry.

ZX-80 Inkey routine

IN REPLYING to the letter from Charles Drayson published in the August 1981 issue, here is a Get or Inkey routine for the Sinclair ZX-80:

```
IN A, 0 : Get port 0 into Ac
LD L, A : Into L
LD H, 0 : Clear H
RET : Back to Basic
```

The following program will load this and lines 20-26 may be deleted after it is run. Line 10 contains the machine code and will not run.

```
10 REM AAAAAA
20 LET A = 16426
21 POKE A,219
22 POKE A+1, 0
23 POKE A+2, 111
24 POKE A+3, 38
25 POKE A+4, 0
26 POKE A+5, 201
```

The statement LET A =USR (16426) will return the value of the key pressed. This routine works best in a short For-Next loop.

```
100 For N = 1 To 100
110 Let A = USR (16426)
120 Next N
```

This allows a larger time slot to detect a pressed key.

M A Myatt,
Bedford.

Economics of design

IT WOULD seem that D L Fisher — Feedback June 1981 — suffers from a stiff neck, lack of perception and ignorance of the engineering economics of designing, producing and selling low-cost micros. Chip count and memory size related to customer cost resistance is where the business starts and stops.

Memory size and speed is the base line which dictates systems implementation and programming. A "professional" programming job which occupies 32K is useless on a 16K machine. The use of multiple statements and the removal of Rems and blanks is often the only way a non-trivial program can be made to fit into, and run, on a micro. Programs are only useful if they run.

Colin Webb,
Dhahran Airport,
Saudi Arabia.

Compucolor inspiration

AS THERE appears to be very little written on the Compucolor II, I would be interested in contacting anyone who owns a Compucolor II to exchange ideas. My address is Grey Court, 3 Stoke Hill, Bristol. I have a Compucolor II Model 3, 8K RAM.

David Johnson,
Bristol.

Teach Yourself review

WE WERE interested to see the review of our book, *Teach yourself computer programming in Basic*, published by Hodder and Stoughton, in the September 1981 issue of *Practical Computing*.

Despite your reviewer's feelings that our book is unlikely "to rocket to the top", it is now in its second printing — more than 10,000 copies have been sold. In the review, it says that the Teach Yourself book owes "nothing to 1980s' micros"; the programs were developed initially on the Commodore Pet and then also run on a mainframe. The intention was to provide programs that would run on most systems supporting Basic, as there are still large numbers of students at Universities and Polytechnics whose first experience of computing is with on-line systems.

Eric Deeson, the reviewer, is right in concluding that our book is not aimed at experienced programmers. The arts of programming and programming techniques warrant books to themselves. Our book is aimed at beginners including non-computer specialists who wish to gain a knowledge of the Basic language to enable them to use a computer in their field.

As a point of interest, having assessed the many Basic books on the market, Commodore approached us to write a similar book for the Commodore Vic containing additional sections on Peek, Poke, colour, sound and high-resolution graphics. This book will shortly be published by Hodder and Stoughton under the title *Learn Computer Programming with the Commodore Vic*.

L R Carter and E Huzan,
Slough,
Berkshire. □

Facit trio designed to keep options open

THE NEW DTC computer system from Facit is available in three versions. Two versions are for business management and one is for colour graphics — all three are based on the Z-80 processor. The graphics version, the Facit 6511, starts at £2,000 excluding printer, but includes a 14in. screen conforming to teletext standards, with 24 lines of 40 characters, and seven colours. There is a dual mini-floppy

unit, providing up to 143Kbyte capacity on each. The 24K ROM-based interpreter has selectable mathematical precision and a time function. Communications interfaces are provided with a programmable transmission rate of between 50 and 19,200baud. One interface is asynchronous, the other offers reverse link-up facilities between synchronous and asynchronous communication systems.

The computer also has an integral sound generator with volume control. An optional high-resolution graphics facility provides 240-by-240 points, each of which can be in colour or white.

The business management computers are the Facit 6510 and 6520. The 6510 has a 10in. screen and a 48K memory, the 6520 a 15in. screen and 64K of memory. There is also a range of software packages available to complement the machines.

Facit has called the packages "positive software" and they include: sales, invoicing, purchase, stock control, nominal general ledger, word processing, Facicalc and DTC register. The Facit computers feature yellow-on-brown screens — apparently they are easier on the eyes.

For details contact Facit Business Systems Division, Wellington House, Wellington Street, Leicester. Telephone: 0533-547149. □



Simple payroll for ZX-81

A SIMPLE payroll program designed for use by a small company has been developed by Hilderbay Ltd for use with the Sinclair ZX-81 microcomputer, together with the 16K RAM pack and printer.

The program will be of use to any company with 30 or fewer employees, who will find the package able to cope with payments, deductions, bonus payments, records and printouts. Hilderbay Ltd is a company which seems to be carving a niche as a provider of software for the smallest of machines.

The complete system will cost the user less than £200, and that includes the computer. The software costs £25 and is complete with step-by-step instructions, a training system if necessary, and a replacement service in case there is new tax legislation.

Contact Hilderbay Ltd, 8-10 Parkway, London NW1 7AA. Telephone: 01-485 1059. □

This is the Husky 144 portable computer for outdoor environments and robust applications. The machine weighs less than 2kgm. and is a little larger than a book. This British innovation is reasonably powerful despite its size — it has a memory of up to 144K. The screen can display up to 128 characters in four lines. Information can be transferred to a main computer from the field via a telephone. For further information, contact David Viewing, managing director, DVW Microelectronics. 0203 56580/27535. □



France looks to the future

FRANÇOIS MITTERRAND, the socialist President of France, is certainly taking an interest in the world of computers and information technology — the "in" phrase for 1981. He has announced his intention to open a world centre for informatics development in Paris at the earliest possible opportunity. This is part of a drive by the French to put their informatics industry at the forefront of as many communication-related activities as possible by 1988.

Mitterrand stated that: "The tools of informatics could be mastered only by thinking on a world scale. France will reinforce its position in all industries related to electronics. The government will do all it can to help small, medium-sized and new companies".

At the other end of the scale, the French Home Secretary has halted computer-produced identity cards on the grounds that they endanger democracy. This is an opinion held by many due to the apparent ease with which a government could form a central file of all citizens. □

Birmingham's launch-pad

BIRMINGHAM City Council is creating a multi-million pound partnership as a launch-pad for high-technology industries in the city. The program will start with the establishment of a science-and-technology development centre, with management, consultancy and scientific services being provided by Aston University.

Under such a program, small companies will have the benefit of a powerful research organisation which they would otherwise not be able to afford. Such an enterprise should create thousands of new jobs as similar programs have done in the U.S.

The science-and-technology development centre is similar to a science park — that is, an area where many high-technology industries are concentrated, together with the resources they require. □

Wider scope with Pascal

TAKING ADVANTAGE of the power of Portable Pascal, IBC's network and resource-analysis program can cope with projects of up to 30,000 activities — but this is limited by the microcomputer used, and the time.

The package will run on Apple II, North Star Horizon, LSI-11, Microengine, Z-80. Future plans include the Onyx, Superbrain, Dynabyte and Cromemco machines. IBC can supply either a complete system or just the software, together with after-sales support. IBC Computer Systems Ltd, Sunderland House, Sunderland Street, Macclesfield, Cheshire. Telephone: 0625-616399. □

Scientist can digitise

A NEW precision analogue-to-digital converter is capable of taking the typical signals a scientist would display on a strip-chart recorder, digitise them and send them to a microcomputer.

Dyson Instruments, Sunderland House, Station Road, Hetton, Houghton-le-Spring, Tyne and Wear. Telephone: 0783-260452. □

Uncommitted logic at an engaging price

MARCONI Electronic Devices Ltd (MEDL) has recently opened a very smart new factory near Lincoln for the manufacture of microchips. As well as making its own custom-designed devices, it has a product which might well be of great interest to the small manufacturer of micros or add-on products. This is a particularly easy and low-cost version of the uncommitted-logic array idea.

MEDL's System 85 is based on standard chips containing up to 1,440 standard logic cells — 2,014 cells will be available soon. Each cell consists of four transistors. This array can be turned into almost any circuit you like by interconnecting the

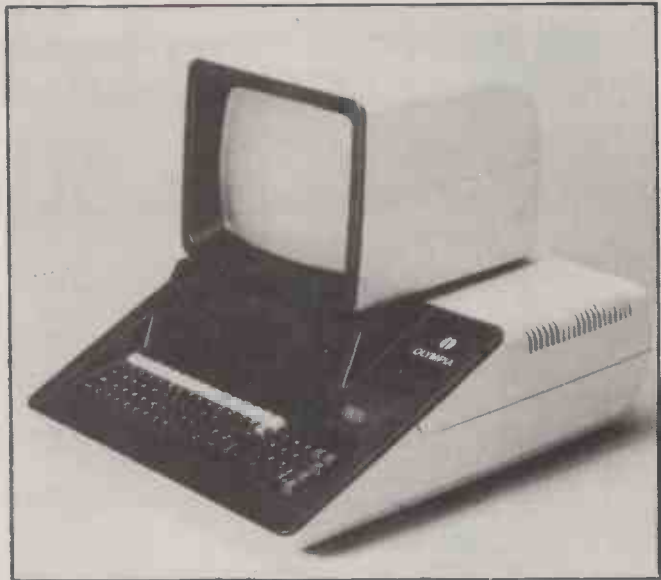
Olympia fields its strong desk-top team

OLYMPIA IS the latest of the big office-equipment suppliers to weigh in as a manufacturer of desk-top microcomputers. The reputation of Olympia as a major office-equipment supplier will certainly boost its sales — especially to first-time users.

The range of desk-top machines, with both software and hardware, provides for most business uses. The machines are of a standard design with the usual 64K of user RAM, and disc capabilities. One attractive touch is that the computers all have the ability to communicate to larger, mainframe machines.

The new microcomputers are called Boss, and the fully-integrated software packages supplied can be used by anybody. Designed for the smaller business, Olympia expects to be able to sell to departments within much larger organisations.

The range starts at less than £3,000 and there are four machines, all supplied complete with printers. Software packages cover sales ledger, purchase ledger, stock control, payroll and invoicing.



Putting non-expert in the driving-seat

THE PMJH controller is a device which provides extensive control facilities for combinational and sequential timing as well as arithmetic operation using Tiny Basic. The device enables a control system to be developed without any specialised

programming skill. The controller is ready for action with only a 5V supply and a VDU for operator interaction, and the device can act as its own development system.

Systems can be developed and modified while actually controlling — a sure and fast way to debug programs. Work can be effected on site or in the field. Once a program has been developed in RAM, it can be programmed into EPROM by any one of a number of techniques.

The PMJH controller was developed by Manitron at Salford University and was first displayed at a press conference held to protest against the cut in the university's budget of 40 percent. A controller was despatched to Prime Minister Margaret Thatcher, together with a note expressing the hope that this would not be the last such innovation the university successfully transferred to industry.

A fully-populated board with 4K-by-eight RAM and 4K-by-eight EPROM costs £239 for one, with reductions for quantity. Manitron Division, Ficention Ltd, Bold Street, Sandbach, Cheshire. Telephone: 09367-4171. □

cells. To make the job easy, MEDL gives the designer a big picture of the array plus decals representing the usual logic gates.

He just has to stick these on to the photograph of the array to specify his circuit. MEDL will then test it using simulator software.

Unlike earlier uncommitted-logic arrays, System 85's Cellmos is realised in CMOS technology. This means that the finished chip draws very little power and could be used, for example, in battery-powered products.

In effect, the designer is packing the logic which might occupy a whole printed-circuit board into one chip. Since a

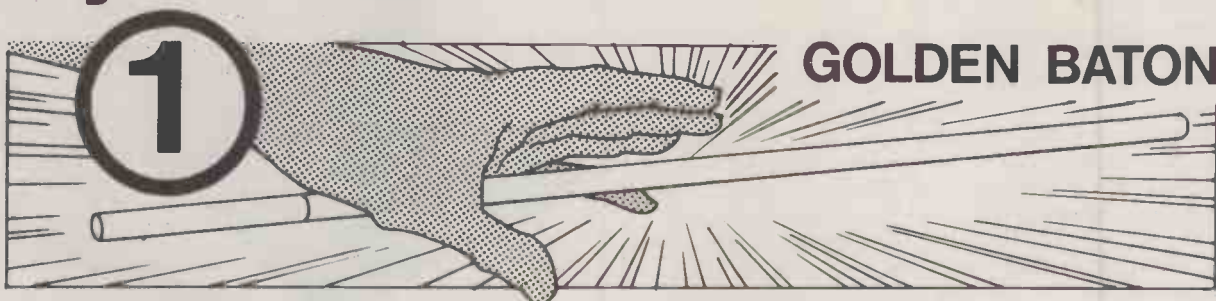
printed-circuit board costs at least £2 a package to make and test, MEDL's prices can be attractive: design kit and handbook — up to £355; production of 10 samples £7,000; 1,000 off in ceramic, packaged £17 each.

A satisfactory design which is wanted in quantity can be made as a dedicated chip in the same CMOS technology. The cost would be a transfer charge of £10,000 but a saving per piece in quantities greater than 10,000 units of 25 to 30 percent. Martin Wolfenden, Marketing Manager Cellmos Marconi Electronic Devices, Carholme Road, Lincoln LN1 1SG. Telephone: 0522-29992. □

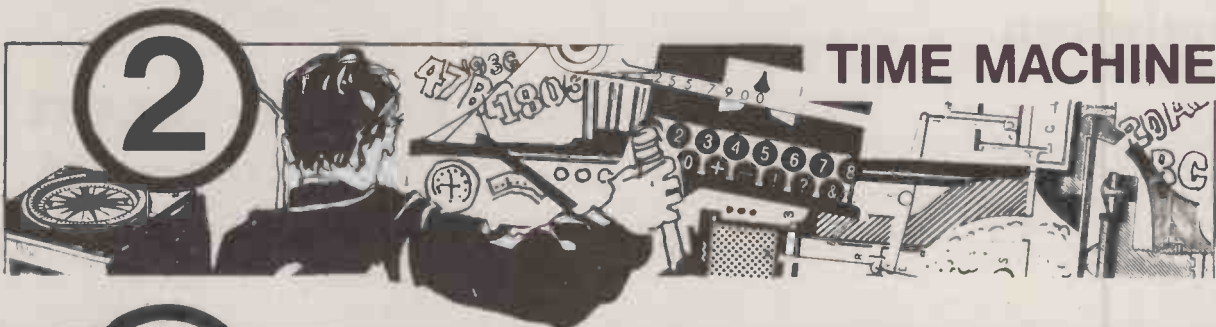
INNOVATIVE TRS 80-GENIE SOFTWARE

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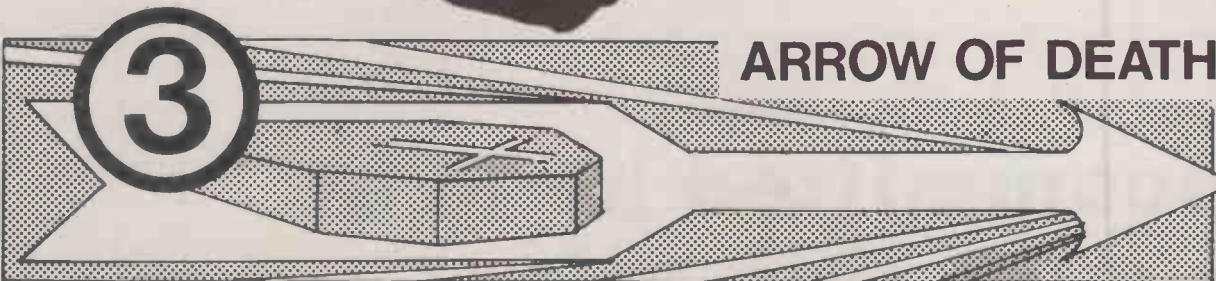
Mysterious Adventure



GOLDEN BATON



TIME MACHINE



ARROW OF DEATH

Three months ago we introduced the Mysterious Adventure series, a brand new series of machine language Adventures written by Brian Howarth. The first one, The Golden Baton, was greeted with enthusiasm by experienced and beginner Adventurers alike. Now the second and third in the series, The Time Machine and Arrow of Death, are available. The Arrow of Death, although entirely self-contained, is the first of a two part Adventure. The second part will be available early in the new year.

Mysterious Adventures are available for Models I and III TRS-80 and Models I and II Video Genie, both on tape (16K minimum) or disk (32K 1 disk minimum). A TRS-80 Model II version will be available shortly.

Any 1 Adventure:	On tape	£10.06	Any 2 Adventures:	On tape	£18.40
	On disk	£12.65		On disk	£23.00

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TRS-80 & VIDEO GENIE SOFTWARE CATALOGUE £1.00 [refundable] plus 50p postage.



The North Star Advantage, stand-alone desk-top micro-computer, retails at slightly less than £2,500. The machine is supplied complete with a business graphics package, and includes a Z-80A processor, 64K of user memory, a 12in. monochrome screen, twin mini-floppies and a keyboard with 15 programmable function keys. For full details contact Comart Ltd, PO Box 2, St Neots, Cambridgeshire. Telephone: 0480-215005. 

Word-processing link for CP/M systems


WORD PROCESSOR users can merge records created with the Comsoft DMS system with standard letters created by the Spellbinder or WordStar word-processing packages. These packages will work on any CP/M system and provide a sorting, searching, and mailing system.


Under DMS, records can be created to the user's own specifications; they can then be sorted into order and pre-selected according to several criteria before being merged with standard letters. There are many applications, but the system will be of most use to companies which need to send different types of letter to different clientele.

Comsoft's DMS system is

Any software to declare?


SOFTWARE packages that are approved by HM Customs and Excise for VAT purposes are now available on any CP/M or MP/M computers and most VDUs and printers. The programs, written in CBasic, comprise a fully-integrated set of ledger systems designed by accountants for CP/M.

Business Solutions Ltd, 1 Park Avenue, Ilford, Essex. 01-554 5985/0582. 

available for any CP/M machine and costs £400. For any Commodore system, the same package costs £250 and contains links to VisiCalc, Wordcraft and WordPro. Comsoft Ltd, Great Tangley Manor Farm, Womersley, near Guildford, Surrey. Telephone: Guildford 39665/505918. 

Lid's role in great Apple cover-up

A LOCKING lid for the Apple computer eliminates the danger of prying hands removing or fiddling with the machine's cards. Applelock can be fitted to the Apple lid by any Apple dealer for just £12 plus VAT, or alternatively send the lid to Datron Micro Centre of Sheffield for fitting. A second new offering from Datron is Appleview, a transparent lid which lays bare your Apple's innards. Appleview costs £17.50 plus VAT.

The two products are combined in Appleview plus, which costs £27.50 plus VAT. Datron Micro Centre, 2 Abbydale Road, Sheffield, Yorkshire. Telephone: 0742-585490. 

Alpha Plus reveals Pet's true characters

ALPHA PLUS is a character generator for the Commodore Pet range of microcomputers. It is in the form of a ROM which is connected to the second cassette port inside the case of the Pet. There is also some software and a manual, which rests on the top of the keys.

Alpha Plus is, in effect, four different character sets for the computer. Set one gives U.K. users the long-awaited £ sign, which replaces the back slash, while at the same time retaining all the upper-case letters, numerals and graphic symbols of the original CBM set.


Set two also has the £ symbol and supports all the upper- and lower-case letters, numerals and graphic symbols of the original Commodore second set. Set three is a totally new set of mathematical symbols including symbols for set notation, the Greek upper- and lower-case alphabet, the Roman alphabet, the numerals 0 to 9 including an infinity symbol, as well as graphics characters.

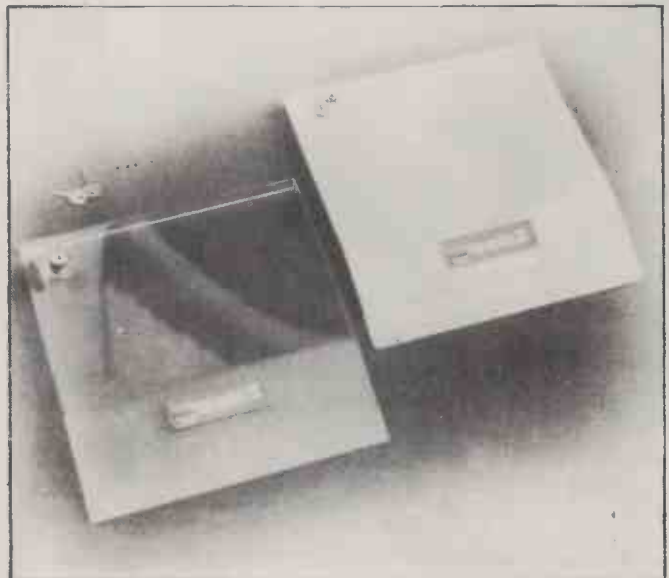
The fourth set comprises various graphics symbols only. They include electronic sym-

bols such as resistors, capacitances, diodes, transistors, as well as games-playing graphics, planes, tanks, helicopters, bombs, cars and space



ships. There is also a series of new horizontal, vertical and diagonal lines.

Alpha Plus costs £69 plus VAT for a 2000 series Pet, and £50 plus VAT for a 3/4/8000 Pets. The manual is available separately for £9. The supplier of Alpha Plus is able to provide custom character sets to order. Contact Computer Rentals, 8 Eastbury Close, Thornbury, Bristol. Telephone: 0454-41560. 



Zilog adds on-chip Basic to its processor family

THE LATEST addition to the world-famous Zilog Z-8 range of microprocessors is the Z-8671. This is the standard Z-8601 microcomputer chip but with an on-chip Basic and a debug/monitor. The chip contains an internal 128bytes of RAM which can be expanded up to 62K by using additional

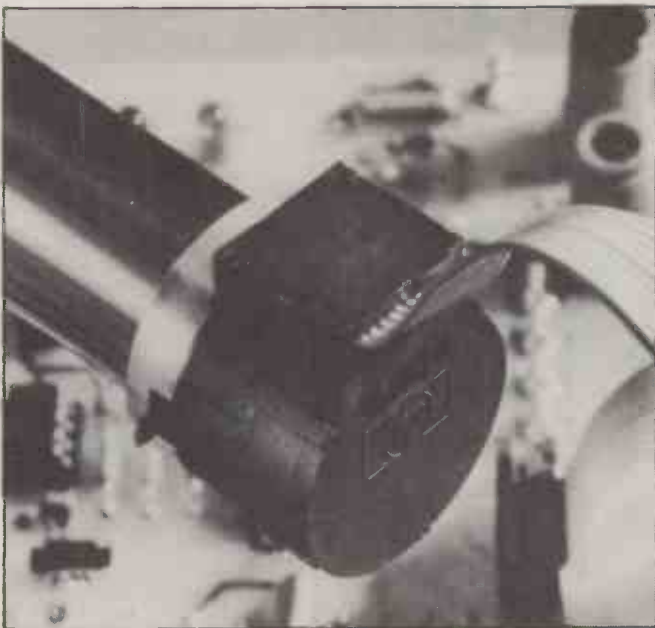
Modem price talks sense

A LOW-COST, direct-connect Modem for microcomputers has been announced by Spreebond Ltd and is compatible with any micro using the RS-232 interface; adaptor kits are available for the Pet and all the Tandy models.

The £200 Modem plugs directly into the telephone line, eliminating distortions and lost-data problems often associated with acoustic couplers.

Spreebond Ltd, Unit 7, Haslemere, Parkwood Estate, Sutton Road, Maidstone, Kent. Telephone: 0622-683866. □

The Hewlett-Packard HEDS-5000 optical sensing device can measure a motor's velocity, the direction of its rotation and its position. There are 500 measurements per revolution giving the device a resolution of 0.72°. The main use of this device will be in the field of robotics; Micro-mouse fans will no doubt be interested. Celdis, 37 Loverock Road, Reading, Berkshire. 0734-586191. □



chips. A single Z-6132 RAM will provide an extra 4K of RAM. The only other component required is a power-supply decoupling resistor.

The chip has four eight-bit output ports, an asynchronous port which can be set for baud rates between 110 and 19,200, and various timers. The chip will enable a small system to be built with the bare minimum of components.

The on-chip Basic supplied is a subset of standard Basic, which supports the USR command, allowing assembly-code subroutines to be run direct from Basic. The most likely application of the chip will be in the construction of microprocessor controllers.

Zilog Ltd, Babbage House, King Street, Maidenhead, Berkshire. Telephone: 0628-36131. □

Time for bus systems

THE NATIONAL Semiconductor MM-58174 is a CMOS circuit which functions as a real-time clock and calendar in bus-orientated microprocessor systems.

The versatile device includes an interrupt timer which may be programmed to one of three settings. Other functions include seconds, tenths of seconds, tens of seconds and the same divisions of minutes, days and months. Telephone: Hi-Tek on 0954-81931. □

Government says no to data-protection scheme

THE Government has rejected the idea of an independent data-protection authority, but is to publish a White Paper setting out its proposals on the subject. This was made clear by Home Office Minister of State Timothy Raison at a recent conference held at the British Medical Association, London.

"As the basis of our dome-

stic arrangements, we proposed the establishment of a public register of data applications storing and handling personal information by electronic means", Raison told the conference.

The conference included among its speakers Sir Norman Lindop, who reported on data protection in December 1978 and has argued consistently that any data-protection authority must be independent if it is to have any teeth.

Sir Norman had argued earlier for an independent authority which would enforce a set of "modular" codes which would have the force of law, and would also comply with the principles of the European Convention on Data Protection, to which Britain is a signatory.

A modular approach, where each organisation registering with an independent authority would be assigned particular blocks of rules depending on the kind of data processing and storage activity it was involved with, would be consistent, flexible and compatible for different applications, Sir Norman said.

However Raison, giving the Government's proposals, rejected the independent approach and suggested that "the form of independent authority proposed by Sir Norman's committee is fundamentally objectionable".

In particular, the Home Office resisted the idea that data-protection rules would have the force of law and hence be a major extension of criminal law.

The task was, he said, essentially one for the Government and Parliament — though it was still too early to say when detailed preparatory work on legislative proposals would be completed and a Bill introduced to Parliament.

Raison gave no specific ideas on how the register of applications could work in practice, though Sir Norman's interpretation of the Home Office proposals was that each organisation concerned would "volunteer" itself to register under a set of rules to be derived by itself.

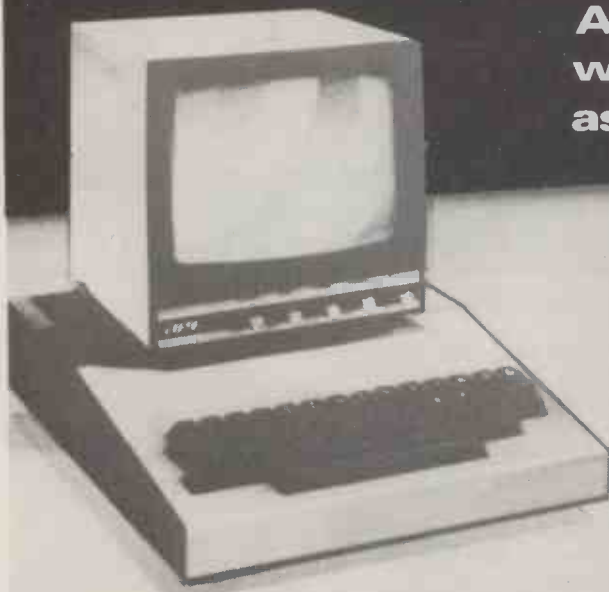
"This is surely a recipe for chaos and disaster", he said. "The Home Office can hardly be said to be impartial and disinterested in the area of personal information". The Home Office is the biggest user of data files on private individuals and is directly responsible for the Metropolitan Police.

Doctors are especially concerned lest confidential medical information fall into the hands of people who have no right to see it. GPs say that computerised medical records may threaten the confidentiality which is the basis of the doctor-patient relationship. □

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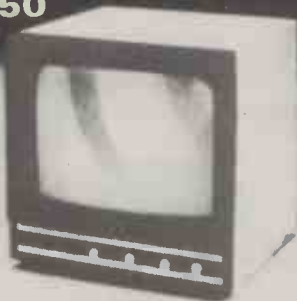
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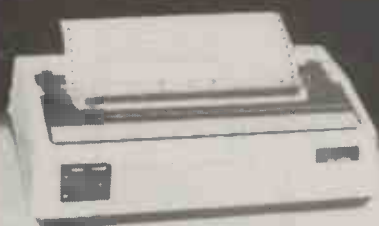
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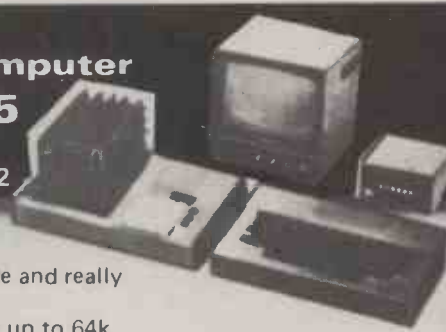
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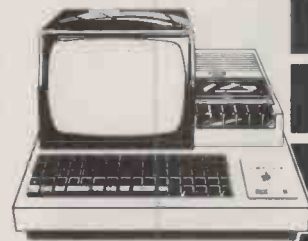
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MZ-80FD	Dual disk drive.	£693.00
MZ-80FDK	Additional dual disk drive.	£616.00
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MZ-80P3	Matrix printer.	£395.00
CP/M	Operating system.	£196.00
MZ-80 I/O-1	Universal interface card.	£50.00
MZ-80BM	BASIC 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



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MZ-80B	Computer 64K. 23cm CRT. Tape cassette. ASCII keyboard.	£1095.00
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MZ-80FDK	Additional twin floppy disk unit.	£590.00
MZ-80P5	Matrix printer, 80cps. 80col.	£415.00
MZ-80FI	Floppy disk interface card.	£100.00
MZ-80MDB	Master diskette and manual.	£31.00
MZ-80F15	Cable for MZ-80FD.	£9.00
MZ-FO5	Cable for MZ-80FDK.	£7.00
MZ-BCJ	Floppy disk cable joiner.	£15.00
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MZ-80GMK	Graphic RAM-II option.	£120.00
MZ-80 I/O-2	Universal interface card.	£45.00
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CP/M.	Operating system.	£65.00



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Revolution of the Rodime disc

Malcolm Dudson of Rodime tells the story behind the development of the innovatory RO-100 series — the 5.25in. disc which offers storage at up to 40 percent less cost than 8in. Winchester.

THE RO-100 series offers up to eight disc surfaces and up to 16Mbytes of storage in a unit no larger than a mini-floppy drive and is interfaced in the same way.

The head/disc assembly of each drive consists of two chambers, one housing the discs and arms, the other housing the actuator mechanisms. The control circuits and the motors which position the heads and rotate the discs are located around these chambers.

Apart from the heads, discs and motors, virtually every component contained in these drives has been designed by Rodime, and designed to overcome difficulties which may be encountered in 5.25in. Winchesters.

In December 1980, when the Rodime drives were still on the drawing board, we decided we could offer the highest storage capacity and the fastest access time which could be reliably designed and produced using the latest components. Therefore, in the RO-100 Series, we have deliberately not used thin-film heads or thin-film discs. When these enhancements have become reliable and are readily available, they will be included.

We took the view that the drive which contains the largest surface area of recording medium will always be able to offer the greatest capacity. From the beginning, therefore, we planned to produce a series of 5.25in. Winchesters which would contain up to four discs while maintaining size compatibility with



the *de facto* industry standard set by drives with fewer discs.

The actuator mechanism has to be of exceedingly rigid design to position the arm furthest away from the bearings accurately. We have chosen a rotary actuator which is more rigid in this aspect than a linear one. Rotary actuators also consume less power, and because there are fewer moving parts, they produce fewer wear particles.

We also designed special shaft bearings and a hub which improves the air flow between the discs. This allows them to be positioned closer together, and improves the air flow within the disc compartment. New head and media technology can be incorporated at a later date without totally re-designing the product.

The RO-100 series offers one of the fastest access times of any 5.25in. drive. The average access time is 85ms, and the track-to-track access time is 18ms. That is

more than twice as fast as the original 5.25in. Winchesters. This access time includes the time taken to find the correct track — the seek time — and the time for the head to settle — the settling time.

The head movements are controlled by a microprocessor. The heads are positioned by a stepper motor, which is controlled by the microprocessor. Among other functions, this calculates the damping required, buffers the incoming step pulses and removes mechanical position hysteresis.

One of the most common causes of errors in disc drives with an open loop positioner, is the lack of adequate compensation for thermal expansion in the arms, discs and other components. We have devoted considerable effort to the choice of metals in the actuator and to the construction of air-flow paths to aid temperature equalisation. Air is pumped from the upper chamber which contains the head/disc assembly, down into the lower chamber where it passes over the actuator linkage, and then back to the upper chamber via an absolute filter.

That ensures that both chambers are always at the same temperature, a feature which dramatically improves thermal compensation for the head actuator. Having ensured this, it is now possible to introduce thermal expansion compensation on a similar principle to a bi-metallic pendulum.

Our design of the Winchester chamber incorporates features which are vital to the efficiency of the drives. Winchester technology relies on a sealed chamber within which the heads fly over the disc surfaces at a very low flying height. In the RO-100's case, this is 17µin.

Here is an example of one of the many important design features of the Rodime drives which contribute to maintaining a completely contamination-free head/disc assembly:

Like all the best design features, it is simplicity itself. Although the Winchester's head/arm chamber is known as a sealed chamber, it clearly has to have a breather filter to allow it to withstand changes in atmospheric pressure. The position of this filter is of crucial importance.

The rotation of the discs causes an

increased air pressure towards the periphery of the discs, and an area of low pressure around the central hub. Now, if the breather filter is placed at the periphery of the disc chamber, this high pressure area is strapped to atmospheric pressure and hence the air pressure at the centre is lower than atmospheric.

The drive bearings are at the centre of the chamber, and the drive motor is always at atmospheric pressure, so that, particularly on start-up, a pressure gradient is created along the shaft of the drive motor which sucks dirt and, more dangerously, grease from the motor bearings into the disc chamber itself.

One answer could be to tighten the bearings. In this case, either the start-up time could be longer, or else more power has to be put into the motor, which would in turn create heating problems, particularly on drives which do not have thermal compensation.

Our solution is both simple and effective. We have located a breather filter at the centre of the compartment, immediately above the shaft. This point is then strapped to atmospheric pressure, and there is no damaging pressure drop.

Many estimates concerning the market for Winchesters have been published in recent months. One of these estimated the 1981 requirement at 500,000, of which approximately 20 percent would be 5.25in. drives. By 1985, the market is expected to have grown to 2.5 million drives, of which 60 percent, or 1.5 million, will be 5.25in. drives. Other less optimistic reports indicate a requirement in 1985 approaching one million drives.

One of the major uses of the 5.25in. Winchester will be in applications where a floppy disc is being used as a systems disc. The fast access times, low cost and small size and high capacity are all added attractions of the Winchester in these areas. Secondly, consider the 8in. Winchester in capacities less than 20Mbytes.

In general terms, in this capacity range, the 8in. Winchester offers the user a cost per megabyte of between \$100 and \$150. In the same range, Rodime's cost per megabyte is less than \$90.

With improved media, both particulate and metallic, thin-film heads, vertical recording, or some of the other exciting recording methods now being developed, giving more than 50,000 bits per inch, it becomes clear that forecasts claiming that the next generation of 5.25in. Winchesters will reach 50Mbytes may even be on the conservative side.

Rodime Ltd are at 12-14 Edison House, Fullerton Road, Glenrothes, Fife KY7 5QR.

The search for a generally-acceptable standard continues, and the answer still seems as far away as ever. Is the time yet ripe for telesoftware?

The Great Standards Hunt

CONNOISSEURS of the "standards loop" will note with a wry satisfaction that the show is getting a grand re-opening this autumn. It is a performance which is expected to run and run.

At the Skyways meeting an *ad hoc* ginger group, mainly of the smaller manufacturers and software houses, got together to urge a new initiative in telesoftware. Now a formal Government committee, ponderously titled the British Videotext Technical Committee, is to re-convene after an absence of several years to thrash out a representative position on standards for the transmission of

by Martin Hayman

software via Prestel and broadcast receivers. It is to be chaired by Bernard Rogers on behalf of the Industry Department and the British Radio Equipment Manufacturers' Association.

One of the committee's objectives is to optimise the British position with respect to transmission protocols. Since it is expected to be representative, we may be sure that the bigger manufacturers will get plenty of say. Since the world is its oyster, we may reasonably speculate that there will be a long search for the pearls of true wisdom.

There is an argument which says that the smaller outfits are in too much of a hurry to implement telesoftware. They should be looking to the future, and the possible introduction of eight-bit technology and all the other enhancements of which Prestel is capable, and should also take greater account of broadcast telesoftware. As it happens, the public is responding with far greater interest to teletext — broadcast information — than to Prestel, which can still only claim 10,000 or so subscribers.

Prestel users are deserting the ponderous and expensive dedicated sets in favour of small-scale adaptors and portable televisions — the kind which you can pick up and take home in the Granada for the weekend. One major manufacturer reports that dedicated Prestel sets are a

dead duck in television retailers' shops. Even at the subsidised Prestel price of over £700, you could well get a decent colour portable plus video recorder. Who is to say that the people who are still watching re-runs of the Test Match highlights and *Emmanuelle Meets the Wife Swappers* are any the worse off than if they had Prestel, except when it comes to finding out the Inter-City train times?

However, I would not sneer at those who are still slogging away at telesoftware. Drafting standards is head-banging work, entirely devoid of the glamour associated with front-line activity, but without which none of it would work. Or at least none of it would work together.

Telesoftware is no new idea. It has been around for almost as long as Prestel itself. Philips, for example, has had a working telesoftware system for a couple of years now. It was demonstrated to me recently by Dr Graham Sharpless, who specified it, and Ludvig Zuidek, who represented Philips at the Skyways meeting. I was most surprised to see a viewdata/micro-type keyboard that looked as though it had been taken off the dealer's shelf. They explained to me that it was the prototype of a Philips personal computer, which had yet to be cased up properly in order to present it to sales staff, who find it difficult to relate to operating systems.

The Philips telesoftware system is fairly similar to GEC's; like theirs, it operates quite successfully with Prestel's own retrieval and update centres, like a normal Prestel editing terminal. It can also call a program from a remote computer, located at the Philips Redhill laboratory, which it will then load into memory. So, as between GEC and Martlesham Heath, there is immediate communication between two parties whose aims are the same and who each know exactly what the other is doing.


"So what"? you may ask. Well, it proves that communications are not an intractable problem when you know what you have at either end. It is when you introduce some new variables that the nightmare starts.

The Philips system uses line and block check-sums and a line terminator in pro-

gram frame. Each frame has a reserved line at the bottom which leads you on to the next frame. This is a useful way of transmitting quite a lot of information. The first field, of two characters, describes the language — unhappily, Philips telesoftware uses DIAB Basic. The second field, also two characters, specifies the version of the language, and the third field, six characters, the memory size required in bytes. The fourth field, eight characters, gives the file name; the fifth gives the number of pages, while the sixth provides extra space to link the program to any data files. These instructions, again, are followed by a check-sum and an end-of-line marker.

Dr Sharpless told me, with the sorrow of an engineer who sees his own creation refused by the powers that be, that he had rather mis-calculated in specifying DIAB Basic. It was his belief that it was a far more powerful and flexible language than the familiar Microsoft version, which he thought was clumsy and, above all, slow. But he had not taken sufficient notice of the fact that the public wants what it can already get, and hundreds of thousands of applications programs have been written in Microsoft for the Apple, Pet, Tandy and so on. So the Philips personal computer never got off the ground, and nor will its telesoftware, likely enough.

Ludvig Zuidek was, incidentally, one of the hawks at the Skyways meeting who argued most strongly that the user of telesoftware would definitely not want to look at the source code of a program, but would merely want to load it as swiftly and seamlessly as possible. He would not be the kind of buff who would welcome playing around and editing code before he could load it into his machine and use it.

I think many people share this opinion, and they may well be right with respect to any other than the hobbyist/amateur markets. In any case, it does rather go towards explaining the excellent facility on the Philips system: a button marked Telsoft which implements the whole loading-up procedure. It is a shame that such an obviously market-orientated machine is unlikely ever to do battle in the market place. 

NEC PC-8001B

Howard Pilgrim and Peter Wood assess the first business micro from the Japanese manufacturer of high-performance hardware, NEC.

WHEN A MAJOR company such as NEC, renowned for quality products like the Spinwriter, launches its own micro, then we all tend to sit up and take notice. The new NEC PC-8001B is certainly an interesting machine with many useful features.

The system consists of a keyboard unit, which houses the micro itself, an I/O box, a double-drive disc unit, a colour video monitor and a small dot-matrix printer. The units come separately boxed, complete with interconnection cables, two reference manuals, and two diskettes.

Actually connecting the components together is one of the most fiddly operations, as there are no less than four data cables, with various types of connectors. A fairly short ribbon cable goes from the keyboard to the I/O unit, which limits the position of the keyboard. We felt this was rather a shame, as a separate keyboard has many advantages in a working environment. Most of the cables bore nasty warnings about disconnection while power was applied, but they seemed to fit

very securely to their sockets and we thought accidental removal would be unlikely.

The I/O box allows interfacing with the disc unit and, presumably, various other devices yet to be disclosed. The printer is cabled directly to the keyboard, as is the colour monitor — black and white may be used instead if required. The I/O unit we were supplied for review is apparently designed for the U.S. market, and we understand that the equivalent to be offered in U.K. will be considerably lower in profile. No problems were experienced in powering-up the system, and with the system disc in drive 1, disc Basic is automatically booted.

The Basic is Microsoft's, as usual, and is called N-Basic. There are a number of commands that appear to be unique to the PC-8001B, and some that other machines have only as optional extras, e.g., a re-number facility. The full list of N-Basic commands is shown in table 1.

We particularly liked the built-in Auto, Merge, Renum and Tron functions, which are similar to the Pet's Toolkit commands. The swap feature is fairly unusual and possibly useful, and Print Using is a very welcome inclusion. The facility to alter the screen width, character sizes and design of patterns via dot graphics proved

both powerful and exciting to use, especially when combined with the Color command.

A spectacular Star Trek game is included on one of the discs which fully utilises these features. While it took some time to load, it was worth the wait. The PC-8001B's random-access file handling is powerful.

Sensitive keyboard

NEC is obviously well aware of the enormous market for micros as intelligent terminals, as demonstrated by the inclusion of the Term command, allowing real RS-232C communications without apparent hassle. We were not so keen on the necessity for Mount and Remove, when loading and unloading diskettes — although it is impossible to forget to say Mount, as disc I/O is not allowed until the disc has been Mounted. It is possible to forget to say Remove before turning off, which could have serious repercussions if data has been written to the disc and the file-allocation table has not been updated via this command.

The error handling provided is very good, having the ability to specify a subroutine for controlled operator intervention with the On-Error-Goto statement. There are, surprisingly, five types of numeric constants possible — integers, fixed point, floating point, hex and octal — and floating-point variables may be single or double precision, which should please all mathematicians.

Overall, we found the system physically pleasant to use; the keyboard is sensitive





and particularly worthy of mention. The cursor-control keys are "upside down" compared with other systems we have been used to — Cursor Up is non-shifted, and Cursor Down is shifted. However, once we were used to this arrangement, it made screen editing far easier as you do tend to be moving up rather than down most of the time when programming and making errors.

The System Re-set button is sensibly hidden on the rear of the keyboard unit, well out of the way of all but the most masochistic of programmers. The general layout of the keys is good — they are standard typewriter QWERTY, together with an additional numeric keypad. Unfortunately the Stop key is immediately above the Return — as it often is — but we assume that Stop could be disabled for any business application. There is an alternative Return button on the numeric pad, which must be useful for those used to calculators, or where pure numeric data is being entered.

The rather large I/O box, mentioned earlier, will be replaced with a somewhat smaller unit for the U.K. market, which will certainly make the system more attractive overall. It does seem a shame that there are so many interconnections, but perhaps mounted in a desk unit the cables could be discreetly concealed.

The disc unit is a little noisy, especially when the fan is running, but no problems were encountered in using it, and we have heard much noisier models. Only 15 files are allowed per drive, which appears to be a severe limitation when comparing the system to its likely competitors such as Pet, but it may be that prolonged exposure to the operating system would show this to be less important than it first seems.

The disc unit contains two 5.25in.

drives, each of 163K capacity. The system disc contains the disc Basic and two utilities — a Copy Disc program for back-ups and a Create program for formatting new diskettes. It would have been good to see more utilities, but no doubt these will appear in due course.

The demonstration disc contains various games, including the previously mentioned Star Trek, most of which show the very versatile graphics and colours well. Since the machine is so new, it is hardly surprising that games are the only programs supplied, though it made it impossible to gauge the performance of the system in a business environment. Certainly, applications software will arrive and it will be very interesting to see how the PC-8001B compares with Apple, Pet and so on in this area.

Clear definition

The Hitachi colour monitor performed well, with clear definition and superb colours. The dot graphics are particularly impressive, and it seems likely that it will be possible to create graphs, pie-charts and other models with good accuracy, using the eight available colours and 690-by 280-dot resolution.

The dot-matrix printer is a NEC product which, while fairly "plastic" in appearance, gives very high-quality output for a matrix unit. The specification claims a print speed of 100 characters per second, which seemed about right. Its bi-directional printing makes quite a difference to overall speed, for instance when making a program listing.

Proportional spacing is also provided, which caused some raised eyebrows until we remembered that NEC makes one of the best-selling letter-quality printers, so the company probably knows what it is doing. A proportional-spacing printer for

around £400 is extremely good value.

Finally, on the hardware side, the keyboard includes five programmable function keys, each of which may be used shifted and un-shifted. At switch-on they are set to various commonly-used statements, such as List, Print, and so on; they may be re-defined by the operator to give a very useful and flexible programming aid. The function-key settings are shown on the bottom line of the screen for quick reference, and change as soon as the Shift key is pressed or released. This display may be turned off if preferred.

The manuals which are provided are well written and, as far as we could tell, accurate. A very handy reference card is also included, containing all the N-Basic statements and a brief explanation of each.

The major work is the N-Basic reference manual, which gives a clear understanding of the Basic, disc files, disc formatting and some operating instructions. The second book is the Expansion Unit Reference Manual, which gives very detailed technical information for the use of Prom chips, Interrupts, using the bus, I/O addresses, Priority Interrupts, Interfacing, etc. Obviously of great use to anyone wishing to delve deeper than simple use of the machine as a Basic system, it was too complex a task to give a fair review of these features in the time available.

One complaint is the lack of an "idiot's guide" to connecting up the system, checking it out and using the Mount, Remove and other essential features. It may be that NEC assumes the system will only be sold with installation and training by the dealer — certainly preferable for all computers — but experience teaches us that this may often not happen.

(continued on next page)

(continued from previous page)

Conclusions

- A neat, professional system in appearance, although cabling seems a little messy.
- Very good-quality graphics and colour, with excellent definition.
- Good, versatile Basic, with some interesting extras.
- Good-quality matrix print from a fairly low-cost printer. The printer may not be sturdy enough for heavy commercial use.
- Apparently restrictive disc-file structure — they have only 15 files per drive.
- Good-quality keyboard, sensibly laid out, with Reset button well out of the way.
- Readable and informative manuals, although an "idiot's guide" would be a welcome addition.
- At present we do not know of any applications programs for the machine, which must severely limit its sales into the business world, though software will obviously appear in due course.
- At around £2,700 for the system hardware as tested, the NEC PC-8001B is competitive, but not cheap.

Table 1.
Statement
AUTO

Description
Generates line numbers after each carriage return.
Causes the internal buzzer to beep.
Clears all variables.
Loads programs from cassette.
Closes previously opened files.
Assigns a colour, or screen attribute.
Formats the screen and determines the colour mode.
Continue after a STOP or END.
Saves programs on to cassette.
Supplies data to a READ statement.
Declares a variable, or range of variables, as integer, single precision, double precision or string.
Defines functions, such as DEFFNB (X, Y) = X/Y*100.
Specifies the start address of a machine-code subroutine.
Dimensions arrays.
Terminates program execution.
Eliminates previously Dimensioned arrays.
Defines error codes not intrinsic to the PC-8001B.
Divides a 256-byte record into fields for a random-disc file.

Statement	Description	Statement	Description
FILES	Displays the disc directory.	ON ERROR GOTO	Sets error trap.
FOR . . . NEXT	Performs series of instruction a given number of times.	ON GOSUB/GOTO	Program branch dependent on value of specified variable.
FORMAT	Performs level-1 formatting of a diskette for data I/O only.	OPEN	Opens a random or sequential data file.
GET	Reads a record from a random-disc file.	OUT	Sends a byte of data to a machine port.
GETC	Saves characters or dot graphics from screen to an array.	PEEK, POKE	Read/write a byte in memory.
GETGC	Saves colour, dot graphics and screen attributes from screen to an array.	POINT	Checks whether a dot is set at a specified location.
GOSUB/RETURN	Causes unconditional jump to subroutine at specified line number, and returns.	PRINT	Displays values of variables and strings, etc.
GOTO	Unconditional jump to specified line number.	PRINT#	Writes image of displayed data to disc.
IF . . . THEN	Conditional jump to specified line number.	PRINT USING	Prints data to a formatted file.
INPUT	Accepts data from the keyboard.	PSET, PRESET	Sets or clears a dot at specified location on screen.
INPUT#	Reads a record from a random disc file.	PUT	Writes content of a random buffer to a random disc file.
KEY	Initialises the programmable function keys.	PUTC	Displays characters and dot graphics previously saved by GETC.
KEY LIST	Displays a list of strings assigned to the function keys.	PUTCA	Displays characters and dot graphics previously saved by GETCA.
KILL	Deletes a specified disc file.	READ	Initialises variables to the data items of a DATA statement.
LET	Assigns a value to a variable.	REM	Remarks.
LFILES	Lists disc directory to printer.	REMOVE	Updates the file-allocation table before a disc is physically removed.
LINE	Specifies screen attributes to a line on the screen.	RENUM	Re-numbers program lines.
LINE INPUT	Initialises a string to an entire line.	RESTORE	Re-sets data items for re-reading by READ.
LINE INPUT#	Reads a line from disc as it was saved by LINE INPUT.	RESUME	Continues program execution after performing an error-recovery procedure.
LIST	Lists program to screen.	RUN	Runs a program in memory, or loads and runs a program from disc.
LLIST	Lists program to printer.	SAVE	Stores a program on disc.
LOAD	Loads a program from disc.	SET	Sets read-after-write and write-protect attributes on a disc.
LOCATE	Positions the cursor at a specified position on the screen.	STOP	Halts program execution.
LSET, RSET	Moves data into defined fields of a random disc-file buffer.	SWAP	Exchanges the values of two variables.
MERGE	Merges a program on disc with program in memory.	TERM	Puts the PC-8001B in terminal mode for communications.
MOTOR	Controls the cassette motor.	TRON, TROFF	Trace on and off.
MOUNT	Reads the disc file-allocation table — FAT — into memory and checks for errors.	WAIT	Suspends program execution until specified machine port sees specific data.
NAME	Re-names a file on disc.	WIDTH	Determines number of characters per screen line.
NEW	Deletes program in memory.		

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MUCH HAS been written in the pages of *Practical Computing* about the desirability or otherwise of structured programming. Comal is really a structured form of Basic. It contains the structures associated with Pascal while retaining the simplicity of Basic. Comal was developed in Denmark by Borge Christensen, so it is not surprising that a Danish computer should have the language as standard.

The computer itself is neat and compact. The system as supplied includes a display unit, a keyboard, the main CPU and a floppy-disc unit. A transformer is also included to provide the correct voltages for operation — the mains supply in Denmark is different to that in the U.K. The system supplied for review only had a single, mini-floppy unit, but other configurations are possible.

After connecting the units together, the next thing to do is to switch on. Experience in these matters makes this the nail-biting moment, but fortunately the Piccolo came on first time. The first surprise was the display, which is yellow on brown. This is the recommended format in Denmark, where all word processors have similar displays.

The Comal systems disc is loaded into the drive and the re-set button is pushed to boot the system. The display then comes up with the message

RC700 COMAL REV.x.xx

and you can begin.

Some rather uninspiring applications software was provided. A little more imagination over demonstration programs would, no doubt, sell many more computers. The more interesting software was annotated in Danish, which is not particularly useful unless you understand the language. The Danish version of Mastermind was the most exciting program supplied, though anybody with a small amount of programming experience can write a Mastermind program, even in Basic.

The operating system used by the machine is not standard, but provides the necessary functions. The re-set switch initialises and starts Comal. Any indentation required by Comal is performed automatically by the software. The system forces all variable names into upper case, with other words appearing in lower case unless they are enclosed in quotation marks.

Comal statements are checked for syntactical correctness as they are keyed in. Incorrect lines are not accepted and an error message informs the user of the nature of the error. This would be a very welcome feature of the language except that, again, the error message appears in Danish. After a while, you get used to the Danish terms, but they are still a considerable handicap in a system which is intended primarily as a teaching machine. The review machine was one of the first to enter the U.K., and the manufacturers say they will amend the software to display

Comal-based Piccolo blows wind of change

The Piccolo is a Danish-built microcomputer aimed at the educational market where it will compete with the Research Machines 380-Z. The main feature of the Piccolo, also known as the RC-700, is the fact that it uses the Comal-80 programming language. Bill Bennett is the reviewer.



the messages in English, not Danish.

The Piccolo's system commands may be used for program development, program execution, dynamic debugging, calculator functions and file handling. System commands run immediately. Usual commands like Auto, List, Load, New, Save, Run and Print are available, and are almost identical to similar commands on other machines.

The RC-700 system uses the command Bye. Con is the equivalent of Cont on other machines; it is the instruction to resume execution of a program after it has been stopped. The command to scratch a file from the disc is Delete "file name", though you cannot scratch the system files. The Help command writes out the names of the commands which are available to the user. The assignation statement Let is included. It has the same function as the Let statement, but is used to assign values before running or continuing a program.

The Look-up command is one that does not appear in most Basics. It replaces some functions of the Catalogue command by returning a list of all the files on a disc. The Output command directs output to either the printer or the video monitor. The command Re-number is particularly useful, and re-numbers all control statements as well as the program lines.

There is an Edit command and special editing keys, as well as control-key functions. The editing functions include cursor movements, character insertion, character deletion, rest-of-line deletion and the deletion of the last input line.

Like other structured languages, Comal is based on the philosophy that the Goto statement is unnecessary. Nevertheless, Goto does remain in Comal, as do most of the commands of standard Basic. Identifiers are used to define certain entities in a program, and may consist of up to 16 characters. An unknown number can be referred to as Unknownnumber in the program. Many Basics allow one or two characters for identifier names.

The possibility of using recognisable words as identifiers makes programs easier to understand. If you read a Comal program written by someone else, it is immediately obvious what is happening. Debugging is relatively easy in a procedure called Taxcalculation, for example, with variables called Income and Deductions. On the other hand, most Basic programs deal with variables such as A, X1, and subroutines are referred to merely by the line number at which they start. This is really the essence of structured programming — knowing what is going on in the program.

Identifiers are given to simple numeric variables, indexed numeric variables, simple string variables, indexed string variables, user-defined functions, procedures, formal parameters, and file variables. Although an identifier can be input

in upper and lower case, it will be forced into upper case once entered.

Most of the commands available in Comal-80 will be familiar to anyone who has programmed in Basic. The RAM statement is retained unchanged, as are many others, such as Print, Read, Input, Data, Restore — which is used to set the data pointer back to the first item in the data list. Goto is retained despite the claims of Comal to be a structured language, as is Gosub.

As in most versions of Basic, the Let statement may be omitted. The Dim statement is slightly different as all strings must be Dimensioned before they can be used in a program. The maximum size of a dimensioned variable is limited only by the available memory.

Def is more or less the same as in most Basics, allowing the user to define functions. The major departure here is that the functions thus defined can have an identifier that actually tells the user what the function does. In most Basic implementations the function would have to be called something pretty meaningless, like FNA for example. User-defined functions in Comal may only have one parameter, and recursive calls are not possible.

Comal allows control of the program to be kept within the limits of certain sub-programs or structures, so it is unfortunate that Comal-80 supports the Goto statement. Proponents of Comal maintain that any program can be written without using Goto, but it is unrealistic to suppose that the statement will not be used if it is there.

Comal has structures to control the flow of the program through gateways such as the conditional statement. This is a more sophisticated version of the If-Then-Else conditional statement — the big bad wolf of Microsoft Basic. For example:

```
1000   if ANSWER$ = "YES" then
2000       exec POSITIVEPLY
3000       else if ANSWER$ = "NO" then
4000           exec NEGATIVEPLY
5000           else exec UNWANTEDREPLY
6000       endif
7000   endif
```

The Else part of the structure may be omitted if it is not required, and the statement list between If and Endif can be as long as is necessary.

The For-Next statement is fairly standard, though it must be properly closed at the end. The While-Endwhile statement, which will be familiar to Pascal users, allows a series of statements to be executed as long as a condition is satisfied.

```
1000   while CONDITIONS = "DANGER" do
2000       exec MONITORPATIENT
3000       exec ALERTDOCTOR
4000       input CONDITIONS
5000   endwhile
```

The While statement, like all Comal structures, is easy to use. The Repeat-Until structure is very similar: the difference is best illustrated by Borge Christensen's statement that the While

structure is a front-door entrance and Repeat-Until is a back-door exit. In other words, a series of instructions is obeyed until a condition becomes satisfied.

The Loop-Endloop can only be left when the Exit statement is reached. The Endloop instruction simply transfers control to the next statement after the Loop command. When Exit is encountered, control is transferred to the next statement after the Endloop instruction.

A procedure is best thought of as a sub-program that may or may not have formal parameters sent to and from it. To call a procedure, the Exec statement is used. Return returns control to the next statement after the procedure call.

In and Out statements are used to communicate with peripherals. One very useful statement is the On Esc command, which transfers control when the escape key is depressed. Randomise seeds the random-number generator, and Output is used to direct the output text to either the screen or another device.

The function set supported by Comal-80 on the Piccolo is reasonably standard, though the file handling is not. Chain is a helpful command which allows another program to be read from disc and executed when the current program has finished running.

The Piccolo Print command is slightly more sophisticated than most thanks to the Tab function and the Print Using instruction. Tab positions the cursor to begin printing at a position on the current line defined by the argument in Tab. The Piccolo has 80 columns on the screen, providing scope for good, clear screen displays.

The machine is weak on graphics. Particular characters provide some screen-control facilities. The codes are more or less the same as in other machines, giving transferred programs a degree of portability. Some codes cause screen flashing — which is very tiring on the eyes — while initiating the semi-graphic character set, inverting the script, underlining and returning to normal script. The printer can be controlled in a similar way.

The Piccolo has been designed with communications and networking in mind therefore it is likely to be this fact as well as the Comal programming language that will make this computer popular with educationalists.

Conclusions

- The Piccolo is a fine piece of hardware, compact and well designed, though it has many cables.
- It will however have to be vigorously promoted to break Research Machines' grip on the education market.
- The Comal language is a useful educational tool, being easy to use and structured.
- Danish error messages are confusing; the software will be greatly improved by removing this problem.

Tailoring the package — and the price

Information storage and retrieval to suit your requirements without the need to program are the big attractions of Compsort's DMS. Peter Wood evaluates the system designed to run on CP/M 2.2 systems.

CP/M IS the most popular operating system for micros, and the wide range of software available for CP/M systems offers the user obvious and attractive advantages. So, it would seem likely that an increasing number of the commonly-used micros will eventually support such an operating system — perhaps in addition to their own more esoteric ones. A recent move in that direction has been the launch of the Small Systems Softbox, a device which allows the Pet to run several of the CP/M packages with no modification whatsoever.

Compsort's DMS has been available for some time on the Pet, and has now been released for use on CP/M version 2.2 machines. DMS, which stands for Data-Management System, is an information storage and retrieval system that the user can configure to his own requirements without recourse to programming. It means the cost of personalised software can be reduced very significantly, providing that the job is a card-index type of application.

The manual provided with the package is well written and informative. While any software product's documentation must assume that the user understands his hardware and operating system — or else be too heavy to lift — this manual goes into sufficient detail to make the task of getting to grips with the program reasonably easy. The style is easy going without becoming trivial and at no time appeared condescending.

We tested the program on an SD Systems MS-20 with 64K of RAM and two 1Mbyte 8in. floppies, running under MS-DOS which is the SD version of CP/M. The program is written in compiled Microsoft Basic and requires 46K of user RAM.

The program is loaded by typing DMS and pressing Return. A menu is then displayed which gives 15 options, each selectable by a single letter, A to N, or X. The user's company name is displayed at the top of the screen together with a licence number and date.

There is also a very user-friendly paragraph describing how to load the various programs, and offering further detailed explanations of them for the inex-



perienced operator. The 15 options are:
A: CONFIGURE B: CREATE C: KEY
D: SHORT E: SELECT F: RE-DEFINE
G: TRANSACT H: REPORT I: LABEL
J: SCREEN K: PROCESS L: COPY M: LINK
N: RESET X: EXIT

As each selection is made, the screen displays the selected program name in large type together with an explanation of its function, and asks you to confirm by pressing the space bar. Pressing E at this stage returns you to the menu screen.

The Configure option allows you to set the program for use with your particular system. The kind of information required at this stage is the type of printer being used — 80 or 132 columns — and the control codes for performing the various screen functions such as clear screen, reverse video and so on. These tend to differ from machine to machine. Configure is used only when you first receive the package and should be run before you do anything else.

Before you can begin entering information, you must, of course, define what you want to store and how it is to be displayed — this is the role of the Create function.

Its job is analogous to setting up a blank record card which is best done first on paper to plan the content and style of the card. The decisions you would need to make are:

- How many fields of information on the card. A maximum of 60 fields are allowed.
- What to call each field, e.g., name, telephone number, etc. Up to 15 characters may be used in the field name.
- Whether the field is character, which means text, numeric — numbers only — or date.
- Decide which is the key field. The information in the key field must be particular to each record, and must be the first field on the card.
- Check that the total length of all the fields does not exceed 1,000 characters, which is the maximum record length.

A worked example of this is supplied in the manual, and provides useful practice for the new user.

In DMS each record has its own key. This key is used for rapid access to the record, as against searching through all the records in the file for a particular piece of information. If, for instance, you had set up a personnel file, the employee's name may well be the key.

Whenever you needed to change the

```

G/81      Records used = 3740
71      Maximum records = 15817

Id name      No.  Type  Length
DESCRIPTION  2    C    30
PLIER ADD1   4    C    25
PLIER ADD3   6    C    25
TERNATIVE SUPP  8    C    5
FIT MARGINX  10   N    10
           12   N    10
STOCK        14   N    10
STOCK LEVEL  16   N    10
    
```

information relating to a specific employee, you could do so by simply typing his name, using the Key option. The computer could then go directly to his record card and retrieve it.

Having selected Key, the first question you are asked is:

Do you want transaction logging Y/N?

If you respond Y, every change you make to the information is copied on to the printer. This is very useful for checking the data you have entered — especially if there is plenty of it. The next question is:

Do you want the contents of new records displayed after keying in data for each field Y/N?

This option allows you to see, on the screen, the entire record card as it is after each field entry. I imagine most users would not use this facility once they have become familiar with the package, since it slows down data entry considerably. Five options are now displayed:

C: to continue without displaying the record after each entry.

D: to display the file description, i.e., the field headings.

R: to re-start the program.

E: to return to menu.

SPACE: to continue.

Having pressed the space bar, you are requested to enter the first field which is the key field. If a record already exists with this key, it will be displayed for alteration. If no record exists, you are asked whether you wish to create a record with that key. You may then proceed to enter information for all the fields on the record.

Two useful features exist at this point. First, if you wish the same information to appear in the same field in the current record as it did in the last, then pressing Control P will duplicate from the last

record being used into the current one.

Secondly, pressing Escape will return you to the first field of the current record, allowing re-entry of data if mistakes had been made. Date fields may be filled automatically with the current date, by pressing C when date is requested.

When records already exist on file, five options are available:

P: Print the current record.

D: Delete the current record.

A: Amend a field in the current record.

S: Store the amended record on file.

C: Get the next record or end.

After amending a record, you return to these five options, and the S is highlighted to remind you to store the altered record. If the change is to be aborted, C may be selected instead.

The obvious and straightforward way of retrieving a DMS record is by Key. The other method is more complex, and ultimately, more powerful — Select. The Select option allows you to search the entire file for information contained in one or more of the non-key fields.

An example may be a personnel file, where you wish to extract all employees who are: paid weekly and; over 40 years of age and; live in Sussex or; live in Sutton. Up to eight criteria may be set on one pass of the file, and each may be joined by using And and/or Or. Confused? — well, it works like this.

First, each selection criterion is allocated a number, 1 to 8. Then each pair of selections — 1 and 2, 3 and 4, etc. — is joined with an And or an Or. Next, each pair is evaluated as true or not-true, giving a maximum of four answers, one per pair. These pairs are then joined with And or Or and evaluated in their turn.

Finally, the results of that evaluation are in turn evaluated giving a final true or not-true result. If this answer is true, then

```

You have the following three options:-
Press A to create a file for WORDSTAR or user program
Press B to create a DMS backup file
Press C to create a file which will update other DMS data files
Press the relevant key (A-C), or 'E' to exit _
    
```

the record is selected and may be printed, displayed or even transferred to another file. A simple truth table can be shown as follows:

```

TRUE      ANDTRUE      = TRUE
NOT TRUE  ANDTRUE      = NOT TRUE
TRUE      ANDNOT TRUE  = NOT TRUE
NOT TRUE  ANDNOT TRUE  = NOT TRUE
TRUE      OR TRUE      = TRUE
NOT TRUE  OR TRUE      = TRUE
TRUE      OR NOT TRUE  = TRUE
NOT TRUE  OR NOT TRUE  = NOT TRUE
    
```

It is certainly a very good idea, as the manual suggests, to calculate all this on paper beforehand so that you are sure that you really obtain the results you expect. The results can be, say, extremely useful reports, once you realise the full potential of this system of selection.

When searching on a Character-type field, each selection can be for the whole

field, or only a position in the field. If you select position, DMS requests you to give the start position and length of the character string by which you wish to search.

If you select the whole field either an exact match for the string or an embedded search is performed on the field. The type of comparison is then requested: EQ, equal to; NE, not equal to; or RN, in the range of. If you select EQ or NE, the next option allows you to compare against a constant, which you supply, or against information contained in another field.

The RN option is more complicated and requires you to type in the two constants between which you want to search. For instance, all records between A and E, or between 678 and 1,999. The last question you are asked is whether you want to see if the constant appears anywhere in the line, so that if you were searching for Sussex, you may wish all records having the word Sussex in the field called county, whether or not they contained East Sussex or West Sussex.

When searching on numeric fields more options are available:

```

EQ equal to
NE not equal to
GT greater than
LT less than
GE greater than or equal to
LE less than or equal to
RN in the range of
    
```

You may compare constants or other fields as in the character searches.

In date fields you have the ability to look for whole or part dates. For instance, you could find information for 1981 or September and range searching is particularly useful for finding dates between two dates. All the selection criteria you enter may be stored on disc for use again and again. The And/Or facility used in combination with the selection criteria described makes the package very versatile and is, in our view, the most significant single feature.

All the DMS reports allow you to use the selection feature and sorted files, and also allow you to choose which fields from the records are printed. There are four types of report.

In the standard report type A, fields from each record are printed across the page with headings at the top enclosed within dotted lines. You may supply a date and title for the report; page numbering and pagination are automatic. Standard report type B is like type A, except that the fields are printed down the page with the headings on the left.

User-defined reports are created using a report generator which allows you to format your printing so that invoices, statements, stock cards, etc., can appear exactly as required. Again, the manual suggests you use pen and paper to set it out before wasting too much time on the machine — and too much listing paper.

User-defined address labels may be

(continued on next page)



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printed — you can specify up to five across. Each label can be individual or the same label may be printed up to 50 times.

On each report it is possible to total numeric fields and print them at “control breaks” which are set so that each time the contents of a field changes, say, department number, the totals are printed automatically. Totals for the entire print are also produced.

Three options are used for reporting: A to print standard DMS reports, B to set up tailored reports and C to print tailored reports. Again, you may store the formatted report layouts on disc for future use.

Sorting may be carried out on only part of a file, and generates a sorted index which is then stored. You may create as many sorted indices as you wish, up to the capacity of the disc. When an index is selected, DMS tells you if any updates have been carried out since that index was created. That protects you from missing new information.

One of your previously-defined selection criteria may be used, and the sort will apply only to records chosen on that basis, so that sorting all employees in Sussex into ascending salary order is very easy indeed.

If you are sorting on a character field, you need not sort on the entire field, but specify the start position and length within the field of the sort criterion. The full contents of date and numeric fields are always used, however.

Having created a sorted index, selecting Screen allows you to make an entry that DMS uses to position itself in the index. The record nearest to the data you entered will then be displayed. It is then possible to nudge up or down the file using the less-than and greater-than keys, print the displayed record using P, or change the search parameter with R.

Obviously, using Screen and Sort is useful only if the index is up to date, and users who change the contents of their files frequently would need to regenerate sorted indices reasonably frequently.

The process function is a batch-processing facility which allows a series of calculations to be performed on all or part of the file. An example may be a stock file, where you needed to increase the price of all items in a particular product group by 10 percent. Again you have the ability to store the process instructions on disc for

repetitive use. The following operations are possible:

- + addition
- subtraction
- / division
- * multiplication
- = make equal to

These operations are performed on fields from the records, accumulators or constants. Up to eight instructions may be entered, each of up to 100 characters in length. In our example relating to stock records, you may set up the following:

1. SELLING PRICE = SELLING PRICE*
#1.1
2. COMMENT = PRICE INCREASE DUE
TO DOLLAR FLUCTUATION

There are 30 accumulators which may be used to produce totals. They are divided into three groups: 1-10 which are cleared to zero as each record is entered before processing begins on that record; 11-20 which are also cleared to zero, but only after processing the record and non-zero accumulators are printed out; 21-30 which are cleared to zero only at the beginning of a processing run, and are printed at the end of a run for end totals, etc.

All the instructions are evaluated from left to right, so you need not remember the precedence of division, multiplication, addition, subtraction. Records may also be deleted by including an up-arrow sign, followed by Delete in a processing line. Processing instructions appearing after that line will, however, be ignored.

You may opt to print the complete record contents both before and after processing, or only after, or only those fields affected by the processing. Errors can also be printed — for example, trying to insert too large a number in a particular field.

A lovely feature of the program is the file-to-file copy. It allows you to define a new, and possibly different, record format, with perhaps more or longer fields and copy all or part of the old file across. The saving on re-typing because you changed your requirements is tremendous.

You may also want to combine the contents of two files, or to extract records for one file into another because you are forming a new company or division. The options available must be obvious by now, as DMS is consistent throughout. Printing options are available, as are selection criteria.

The Link option is used to create files for use with word-processing software, such as Wordstar, and many be used in a mail-merge run, for automatic insertion of names and addresses and so on. It is also used for creating back-up or update files for re-input to DMS itself.

The option exists to use a sorted file which you have previously created, and a pre-defined record selection as with many of the other sections. You may then specify which fields you wish to transfer to the output file.

Up to 60 fields may be output, in any order, and the same field may be output more than once if required — very useful for those involved in direct mailing and personalised letters.

The ability to define a screen mask is important if you wish the information to be presented in a special format, or if you wish to allow updating of certain fields only. It will also allow you to hide certain pieces of data. The Transact feature permits you to create screen masks, each with its own password, so that an operator with the key word can perform his specific task and no other.

If you had a stock-control system where you wished to protect the prices, minimum stock levels, etc., but wanted to allow an operator to issue stock and have the figures for the item updated, then Transact will do the job. Formatted masks may be stored on the disc, and called up by name. The password must then be entered before any processing can take place.

Fields may be updated as the operator is prompted by the system. If a disc is created for use in, to quote the manual, “a restricted-access environment”, then the other menu options can be removed to prevent alteration of the data.

Re-define allows you re-define or print the file definitions — most useful if you need to change the name of a field or fields without altering the record structure.

Conclusions

- At £400 DMS on CP/M is certainly good value. The features offered make it a very powerful records-management package.

- Although the screens were extremely user-friendly in showing a paragraph or so of instructions, we felt this might have been better replaced with a help facility. This would have avoided filling the screen with what becomes superfluous information as the user learns the system. This is, however, a minor point.

- The search facilities are very complex, and when coupled with sorts, file-to-file copies, formatted screen masks, and process options give a very flexible package indeed.

- Compssoft Ltd is at Great Tanglely Manor Farm, Woneresh, Near Guildford, Surrey. Telephone: 0483 505918/39665. The contact is Heather Kearsley. 

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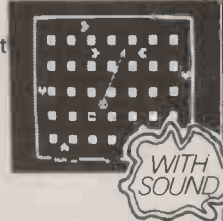


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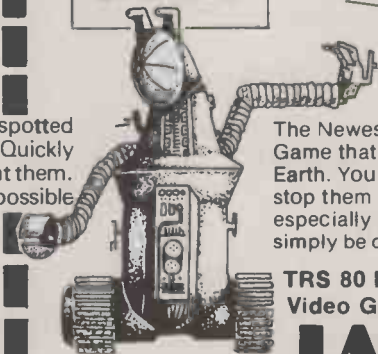
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● Circle No. 145

Analysing data

STATISTICAL PROGRAMS are published in two very different forms in the two packages reviewed here. Prentice-Hall offers a series of simple programs as listings in a book, while Ecosoft's Microstat is supplied on a pair of discs.

Basic-pack Statistics Programs for Small Computers is a recent addition to the Prentice-Hall series in personal computing. It contains a selection of 33 programs for statistical analysis of data. Each program is separately documented with a clear description of its purpose, its possible uses and the kind of data for which it is designed. Worked examples and detailed instructions are given, so a relative beginner could pick up the book, key in a program and begin analysis within half an hour.

Most of the programs deal with a single test, though some of the more elementary routines such as mean, variance, standard deviation and standard error are grouped into one program. The programs are typically 100 to 180 lines long.

Since all lines are single statements, and many are taken up by Rems or the single command Print, only a small amount of typing is required to enter a program. However, if you need to carry out several different tests on the same set of data, it is necessary to re-enter the data for each test. With large runs of data this could be tedious and a source of error.

The programs give you full opportunity to correct data that has been entered erroneously. They also inspect the data as it is entered and prevent entry of invalid data, such as negative or out-of-range values.

By looking through the book and finding a worked example that parallels your own set of data, you can find and run a suitable test without having much understanding of the statistical principles involved. For those who do want to get to grips with the principles there are very detailed explanations of each test, which include a description of all the underlying equations and concepts. The explanations are backed up with a list of references to fuller descriptions in the standard American textbooks, some of which are readily available in U.K. Each program is also accompanied by a set of exercises, with answers, thus making the book useful to the student.

Full running instructions are given for each program, together with printout of one or more sample runs. Under the heading "Bugs", the author lists any circumstances under which the program may fail to operate satisfactorily, such as the possibility of overflow when calculating factorials.

Tables of Student's *t*, the Mann-Whitney *U*, chi-square, and Fisher's *F* are given at the back so that the user can estimate probabilities from values of these statistics calculated by the programs. A few of the programs calculate the probabilities directly.



Two contrasting sets of statistics programs are examined in detail by Owen Bishop.

The author comments on the reliability of the algorithms used. Rather tantalisingly, he does not explain the basis of these algorithms, which would interest the more erudite statistician. It is only in these programs that the Basic uses more than the most elementary of operators and functions. The owner of the typical personal computer should be able to key in most programs without much adaptation.

The book begins with a set of 10 programs on descriptive statistics. These include calculation of probabilities under the binomial, Poisson and normal distributions. There are utility programs for sorting and ranking an array of values, and programs based on the *t*-statistic and on chi-square.

The remainder of the programs, which include the McNemar test and the Median test, reflect the emphasis on non-parametric testing found in this collection. Since non-parametric tests are best for small samples — which is what most of us usually have to deal with — the selection offered will be generally useful. The most notable omissions are analysis of variance and regression analysis.

The book is well produced with large, clearly laid-out pages. In each chapter, the printout of the sample run and the listing of the program are in facsimile to distinguish them from the descriptive text. Unfortunately the original printout and listing appear to have been done on an ancient printer with a worn ribbon. Although legible they are not easy reading. This, however, is a minor criticism of what is generally an excellent work.

The Microstat package from Ecosoft is a product of an entirely different type. It

is clearly aimed at the experienced statistician who has a suitably impressive microcomputer on which to run it. The manual states that the minimum system for satisfactory operation should have 32K memory and dual single-density 8in. disc drives.

The package is presented on two discs, one of which is completely filled with programs. The other carries the remainder of the programs, leaving about 280 blocks of free space for the storage of data files. The discs are designed for operating under North Star DOS and Basic. There is provision for establishing certain screen and printer parameters once and for all so that the format of VDU display and printout can be adjusted to the peripherals in the user's system.

The package is based on a data-management sub-system — DMS — in which all data is held in files. There are all the usual facilities for creating, editing, merging and destroying files. The convenience of the DMS is that data needs to be entered only once. It can then be subjected to a variety of statistical procedures as often as required, for as long as it remains on file.

There are also procedures for transforming the data in a file. For example, by a single command every item in a named file can be converted into its reciprocal or its natural or common logarithm, multiplied by a constant factor, incremented or decremented by a fixed amount or transformed in a number of other ways. This is an essential preliminary to several statistical tests and can be helpful when one is looking through a set of data prior to

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analysis. Sets of data can be displayed with all variables in a common format, independent of the format in which they were originally entered.

Access to the package is by means of a sequence of menus. Selection and branching is by single-key entry, with the default being the choice most commonly required. Progress through the stages of a procedures can be very rapid, though the less-experienced user could quite easily become lost.

Unfortunately, there seems to be no way back to the main menu until after the completion of each test. A careless entry during a test can lead to a waste of time, while you plough on through the remainder of the test watching the results of meaningless computations appear on the screen. This package is clearly for the careful and concentrating user.

There is a comprehensive selection of tests, both parametric and non-parametric. These include analysis of variance, regression analysis, time-series analysis, goodness of fit, the runs test and most other standard non-parametric tests. There are programs for calculating factorials, permutations and combinations. These calculate factorials directly for $X \leq 49$. Above this limit, approximations are used to eliminate the danger of overflow. The upper limit is factorial 1,000,000.

The manual is well compiled and explicit. It contains clear instructions on how to operate the system, and lists the menus and the sequence of entries required for performing each of the tests. There is no attempt to make this a statistical handbook. Unlike the Prentice-Hall book, the Microstats manual does not explain the purpose of the tests, nor does it give examples of their use or show what they do and how they do it.

The programs have no provision for preventing a test being performed on invalid data and calculating entirely meaningless results. This is not necessarily a criticism of the programs, for they are clearly intended for experienced users, but the less experienced should not contemplate using the Microstats package without considerable preliminary training.

One aspect of data entry was found to be inconvenient and a cause of frequent mis-keying. The problem arises because data must be entered by cases. For example, when entering a table which lists the weights, ages and response times of a set of persons, the data must be entered person by person. Every figure to be entered has a different format from the figures preceding and following it. You might have to enter a series such as 85.35, 42, 0.0123 for each person, though it would be much easier to enter all the weights, followed by all the ages and all the re-

sponse times. Keying in a set of values with identical format establishes a rhythm, and is quicker and less error-prone. This facility could have been provided without unduly complicating the program, and would have made data entry more speedy and reliable.

Conclusions

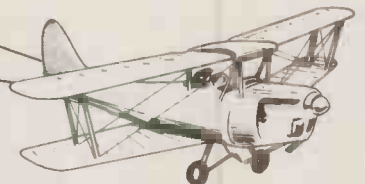
● The Prentice-Hall book is good for descriptive statistics, and non-parametric testing. It gives clear and full explanations throughout, and is suited to the beginner and student as well as to the more advanced user of statistical testing. It contains short, clearly-written programs which use a fairly elementary Basic set. It is highly recommended as very good value for money at only 33p a program.

● The Ecosoft Microstat is a worthwhile package, though only for the expert. You will need to follow its system exactly, so look at the manual before buying the discs, to confirm that the procedures and the range of tests suit your requirements.

● *Basic-pack Statistics Programs for Small Computers* by Dennie Van Tassel is published by Prentice-Hall International, price £11; ISBN 13 066381 6.

● Microstat is produced by Ecosoft, P.O. Box 68602, Indianapolis, In. 46286, U.S.A., and distributed in the U.K. by Digital Devices Ltd., 134 London Road, Southborough, Tunbridge Wells, Kent; telephone (0892) 37977/9.

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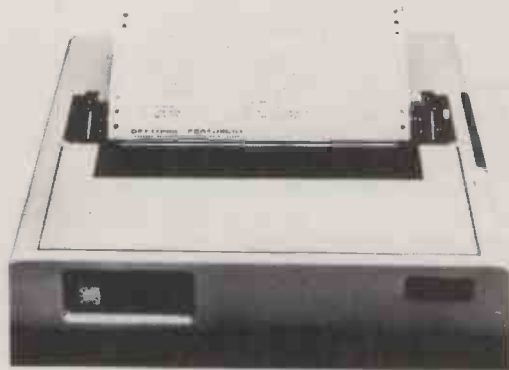
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Adaptive programs change their form in the light of their own experience. Embodying adaptive techniques into statement analysis opens up the possibility of a computer which tolerates a wide range of programming errors.

Teaching a computer to learn from your mistakes

CURRENT COMPUTER systems require the users to construct programs in accordance with an extremely strict set of grammatical rules. They would probably be regarded as much too pedantic for practical use in any other sphere of human communication.

It is, consequently, only too common for a program submitted to a computer system to be rejected for trivial reasons such as the omission of a closing bracket. As a further aggravation, it is quite possible

by Edward James

that the mistakes were not present in the original draft of the program, but were inserted during the transcription of the program into computer-readable form.

The reasons for rejection are described as trivial in the case of those types of mistake where the correct form can be inferred from the incorrect form with a high degree of confidence. For example, a line might be written, incorrectly, as follows:

```
25IFX>15TENST
```

Given that the analysing mechanism expects a statement in Basic, we would like it to recognise the incorrectly-written line as equivalent to:

```
25 IF X>15 THEN STOP
```

Although to a human reader familiar with Basic the corrections will seem obvious enough, it is a far from trivial exercise for the computer. It is not just a question of finding the "nearest" correct statement in the mathematical sense, but of knowing from previous experience what users generally write.

A system which is capable of showing such a tolerance to inaccuracies has been developed, and in later work at Imperial College we have attempted to deal with more fundamental variations from a correct specification. We also need to improve the efficiency of the analysing process so that it may be employed as a tool for everyday use.

The method of statement analysis used in most computer systems today has become highly standardised and impressively efficient in terms of computer utilisation. This process involves the determi-

nation of the structure of incoming statements by matching them against some expression of the structure of all possible statements in the language which is being analysed. Any correct statement will be assigned a unique structure by this process.

The attempted analysis of an incorrect statement is arranged to result in an error exit as soon as possible, and at that stage an *ad hoc* process is invoked. It may simply report the existence of an incorrect statement, or it may make a serious attempt to correct the statement.

Usually the structure of the language to be analysed is implicitly expressed in an algorithm for the analysis. Every statement is analysed individually, independently of other statements in the same program and similar statements in previously-encountered programs. Important strategy decisions such as the order in which different possible analyses should be attempted are fixed once and for all.

The method of dealing with errors is specified in advance. It is based, presuma-

experience gained in the matching process. At any particular time, therefore, the structure of the processor reflects its experience as well as what it was "taught" to start with.

Matching strategy

In our system, the processing of incoming statements in a program language is based on the expectation that the statement to be analysed will not correspond exactly to a particular acceptable statement in the language. This approach can be likened to an attempt to determine what is meant by the statement rather than what it actually says. There is no necessary connection with determining the closest match in any mathematical sense. The system is provided initially with a process for matching all expected statements in the language, but it is possible for some other statement which can be "made sense of", and which occurs frequently enough, to be promoted to "expected" status.

The process of analysis can be viewed

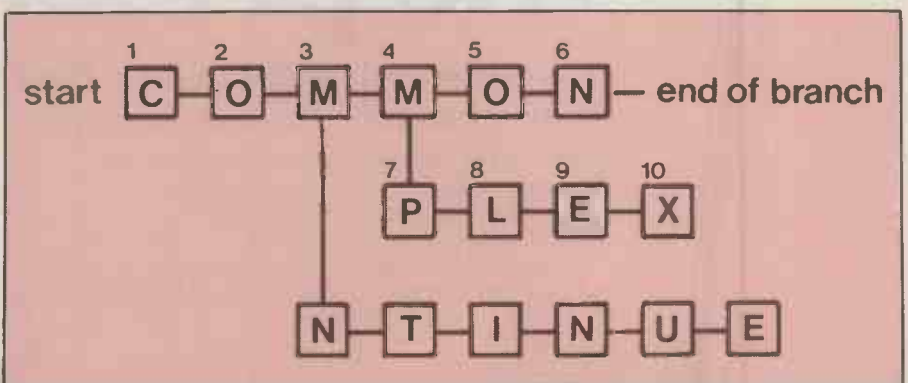


Figure 1. Matching a correct input. The decision tree recognises the three words "common", "complex" and "continue".

bly, on some previous experience of likely errors; there is no possibility of altering the strategy in the light of errors which are encountered in practice.

The adaptive system developed at Imperial College generalises the usual method in several ways. The general principle is that the structure expressing acceptable statements in the language is dynamic rather than static. This structure is provided initially, and is then modified in many different ways as a result of

as a series of tests on the incoming statement which, if successful, provide increasing confidence that the statement is of the expected pattern. A detailed example is given in figure 1. The matching strategy for correct input is as follows:

Test the next character in the input word against the letter in the box under consideration.

If it agrees, follow the horizontal line to the next box on the right and repeat the process from the beginning.

If it does not agree, follow the vertical line

downwards to the next box and try the test again, but with the same input character. Continue until there are no more input characters remaining.

If the match is correct the system will have reached the end of a branch of the decision tree, and the word represented by the branch will have been recognised. For example: if the input word is COMPLEX

Take first letter C and match with first box in decision tree; it agrees, so follow horizontal line to box 2.

Match next letter, O, with box 2; it agrees, so go to box 3.

Match next letter M with box 3; it agrees, so go to box 4.

Match next letter P with box 4; it does not agree, so go to box 7.

Stay on same input letter P and match with box 7; it agrees, so go to box 8.

Match next letter L with box 8, etc.

Finally, letter X matches with box 10 and so the match is successful

The matching process is controlled by a decision tree. Each node in the tree specifies a test to be applied to the statement being analysed. In the example, we employ only one type of test. Successive nodes along each branch of the tree specify symbols which are to be matched with successive symbols in the statement to be analysed, working from left to right. Notice that although the example matches from left to right, it is not necessary for successive tests to be applied to successive characters in the input statement.

Changing expectations

The previous example demonstrates the method for dealing with a correct input statement. The matching strategy for incorrect input is of the same form as for correct input. It is modified to take account of one of the following basic types of error:

letter omitted in input,
incorrect letter in input,
superfluous letter in input,

or some combination of these.

For example, if the incorrect word COMPLEX is input, the "correct" strategy is in operation at the start of the process. C, O and M are matched correctly. Then the next letter, L, does not match with either of boxes 4 and 7. The "correct" strategy has failed, so "incorrect" strategy 1 is tried. This assumes that a letter has been omitted. It therefore tries to match input L with boxes 5 and 8 in turn. Box 5 does not match but box 8 does, and with this success it returns to the "correct" strategy. Letters E and X are successfully matched with boxes 9 and 10 and the match is complete.

The general principle is that a series of strategies is invoked, each of which presupposes that a particular type of mistake has been made. Each one attempts to force the matching process along until it has got over that part of the input statement which does not fit the expected pattern.

The strategies are applied in the order

corresponding to their success in making sense of the input in the past. The strategy which assumes that a perfect fit will be obtained between the input and one of the pre-stored expected patterns — which is the only strategy applied in most other systems — is applied first only as long as the system's experience is that the given statement tends to be correct more often than not.

The initial structure of the tree provided by the analysing algorithm expresses the structure of all "expected" language statements. The force-fit process operates for all unexpected state-

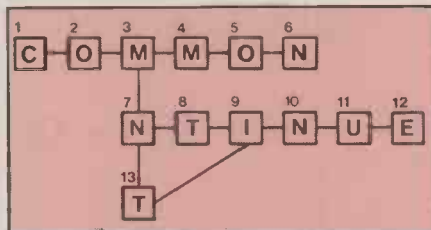


Figure 2. Matching an unexpected error. The decision tree recognises "common", "continue" and its mis-spelling "cotinue".

ments, including those involving common imprecisions.

It is clearly inefficient to invoke continually a lengthy fitting process for a succession of inaccurate statements with identical structures, so the structure of the experience tree can be augmented to incorporate structures which correspond to common mistakes. A successful match of these structures can lead to the same outcome as the corresponding correct structures. The successful match against an incorrect structure will always be faster than the corresponding force fit to the correct structure.

Figure 2 shows this process in operation. If the input is the mis-spelled word COTINUE, it will match correctly with boxes 1, 2 and 13. It is then directed back to that part of the tree which recognises the rest of the correct word CONTINUE. The process ends at box 12 with the same result as if the input word had been CONTINUE.

It is possible to add to the decision tree every inaccurate structure which can be matched. The number of possible mistakes is far larger than that of correct structures, so it is not practical to retain details of infrequent mistakes. The infrequent mistakes must be weeded out from time to time.

If this process is looked on as a pruning of the decision tree, it implies that the tree carries a memory of the frequency of all statements. It is also necessary to take precautions not to prune away statement structures which are correct but seldom used.

Naturally there will always be certain input statements which cannot be made sense of by any of the strategies provided. In some cases the matching process will have to report defeat by returning the un-

decipherable statement to the user. The problem of determining when to give up an attempt to match an inaccurate statement is a subtle one, similar to that faced in evaluating how many moves to look ahead in chess-playing programs.

The Imperial College system tackles this problem by carrying a number at each stage of the matching process, representing our confidence in obtaining an eventual successful match. Each time the "correct" strategy succeeds, the number is increased, and each time it is necessary to invoke an "incorrect" strategy, the number is decremented. Based on previous experience, a certain confidence level is fixed. If a series of unsuccessful strategies results in the number falling below this level, then the matching process retraces its steps and tries some different strategy, assuming a different pattern of mistakes. If all strategies have been tried, it abandons the process.

The method of learning about common inaccuracies implies that the decision tree will gradually develop a complex and extensive structure. As a result, it will occupy increasing amounts of storage space in the computer. There may even be insufficient space to store all the patterns of correct statements in a language. To help with this problem, we can make use of a process based on the recognition of common sub-trees.

In the example in figure 3, a certain sub-structure is repeated in different parts of the tree. To save space, the sub-tree pattern can be stored in one place only and referenced from each of the relevant positions in the main tree. As long as the referencing mechanism does not take up more space than the original sub-tree, there will be a nett saving in space.

Exploiting redundancy

Trying a large number of alternative strategies is likely to involve a great deal of time as well as space. It is, therefore, important to aim at minimising the number of tests required to process each statement, especially correct ones.

One method of achieving this aim is through a branch-swapping technique. The set of alternative nodes at any point in the tree, representing the set of alternative structures which might be present at a certain point in the input statement, can be re-arranged. Those most frequently relevant are placed nearest to the start of the tree where they are reached most quickly. When a node is transferred in this way, its attachments to nodes further from the start must remain undisturbed.

The re-arrangement of nodes can be continuous in the sense that a node is promoted where possible at every successful match. Alternatively, the analysis of successful match frequencies and the necessary exchange of nodes can be car-

(continued on next page)

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ried out at intervals of, say, every 10,000 statements processed, assuming that information on how frequently each node is processed is retained in the tree. Figure 4 demonstrates how a particular decision tree can be re-structured.

Another method of reducing the number of tests involved in recognising a statement is simply not to apply all the tests. Instead, a method is used which

exploits the redundancy inherent in the formulation of the statement. Figure 5 shows a decision tree which models recognition of the words COMMON, CONTINUE and COMPLEX.

Given that the characters C and O have been matched correctly, there is a strong likelihood that the statement contains one of the three words although it is not possible to say which one. If the characters M and P match, then the keyword

is certainly COMPLEX unless both M and P are in error. As the letters L, E, X are encountered in the input, confidence in the correct analysis grows to near certainty.

The confidence-jump method curtails the matching process by inserting at a convenient position — such as box 7 — a special instruction to jump directly to position 11, representing a successful recognition of the word. At the same time, the system counts forward on the input word without checking characters, to the point which should correspond to the end of the word, since a following word may have to be analysed.

The example clearly shows how redundancy in the statement is used since the letters C, O, M, P are sufficient to distinguish the input from any other possibility. It could be suggested that, in using the language, COMP should be written instead of COMPLEX, thereby improving the processing speed. But this ignores the existence of errors.

Notice that the characters L, E and X are not removed from the tree. They are merely ignored in the current process. If the matching process fails later on in the statement which starts with COMPLEX, then it may be sensible to re-trace the analysis to the last confirmed match, P, and check for the presence of L, E and X before applying lengthy error-tolerant analysis procedures to the remainder of the statement. In this case the "redundant" letters provide useful confirmation of a correct analysis of the keyword.

Several of the processes which have already been described involve the re-structuring of the decision tree. These operations are not necessarily, or even conveniently, carried out during the analysis of incoming statements. In fact, it seems that a practical system will require periods of rest from the analysis process, while it carries out the necessary re-structuring.

During these periods it may also prove convenient to attempt the processing of input statements which could not be dealt with previously due to lack of time. We have already developed automatic methods for branch-swopping and the insertion of confidence jumps. The development of an explicit algorithm for recognising common sub-trees and re-structuring to optimise storage space is a very subtle problem which will not be solved rapidly. □

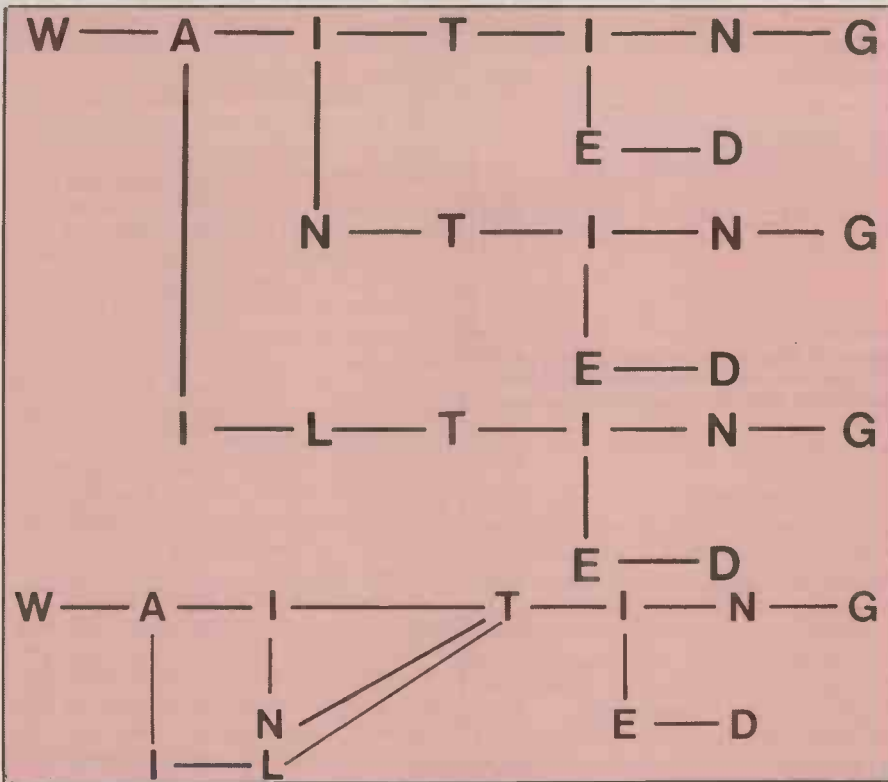


Figure 3. A branching tree can be re-arranged so that the common sub-tree is stored once only.

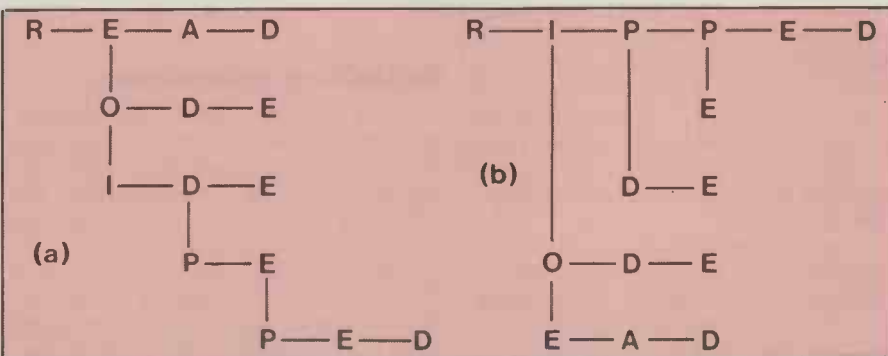
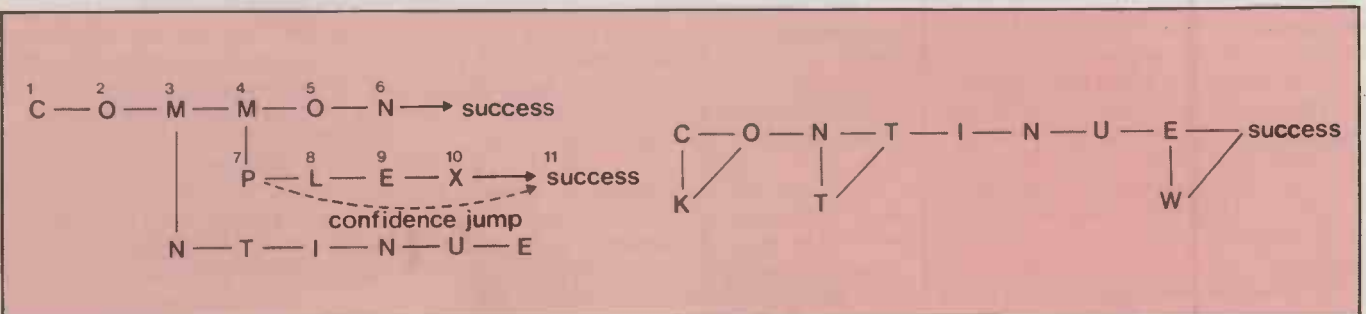


Figure 4. The decision tree (a) matches four words, where "read" is expected to occur more frequently. If "ripped" occurs most frequently in practice, the tree can be re-arranged (b).

Figure 5. The confidence jump makes use of redundancy in the expected word.



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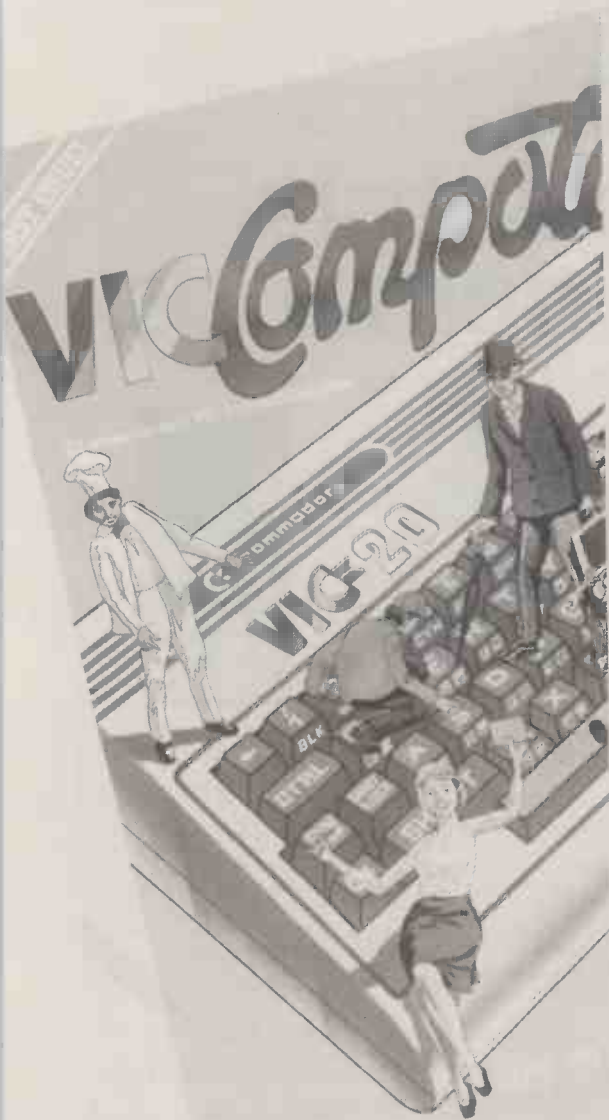
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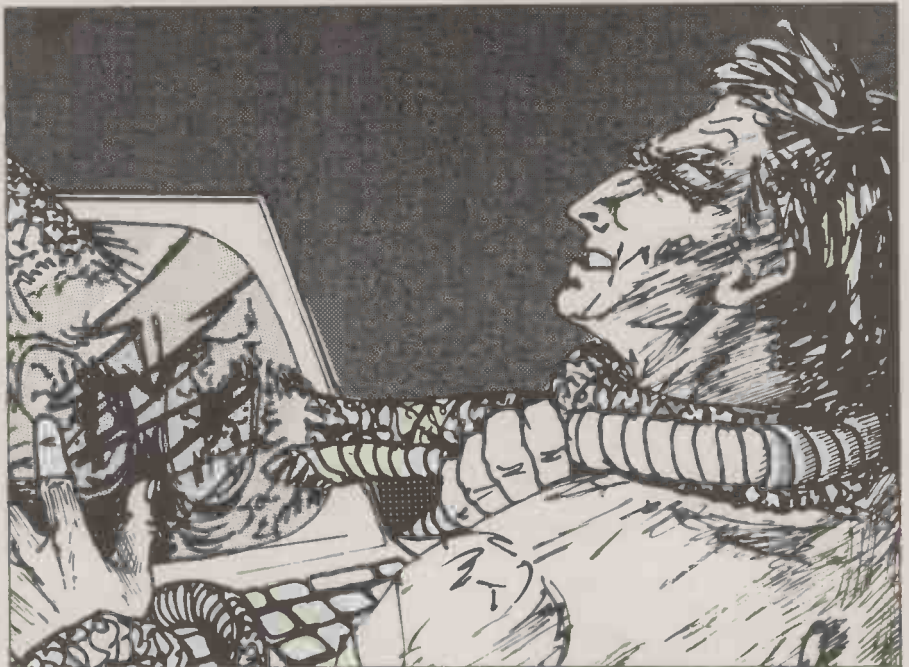
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I was sitting in the tiny kitchenette of my flat waiting for the kettle to boil, dreaming of ranks of valves glowing dimly in the sunset. That's right, valves — thermionic tubes — the like of which we shall never see again. I don't mind progress, but silicon chips hold no romance for me; inert-looking, symmetrical black boxes with legs. Creepy really.

The telephone disturbed my reverie, the result of several pints of ale and half a lifetime spent making and mending computers. It was half past eleven at night. No-one had phoned at that hour for a long time, not since the young men with degrees had somehow slid past me on the promotion tree. Lately, I had found myself spending more and more time on the backwater sites, with the difficult customers who did not buy the latest model when the company deemed it was time.

I let it ring, and tried to guess who it

by David Mentz

could be. Whoever it was, they needed me enough to let the ringing go on for a full minute.

"Hullo, Peter Holland". I was brusque, my eye on the kettle a few paces away.

The voice from down the line was that of an elderly man. I was sure of that as soon as he spoke, by the querulous intonation.

"Hello, is that uh . . . Mr P Holland"? Deaf too, I thought.

"Yes".

"Oh, Good. You probably don't remember me, Mr Holland, Arthur Samson of Samson Mouldings. I got your number from your last address, a young lady gave it to me".

I'll bet she did, hoping you might be trouble, I thought.

"Anyway", he continued "it's about the machine. The one you used to . . . you know, maintain".

It was coming back to me. Samson's Mouldings, a grubby little business in Ell. I dimly remembered a cluttered office and a stuffy computer room. One of my first jobs, all of 12 years ago now. We had fitted them up with a small machine, payroll and stock software, and all the undiscovered bugs therein.

I also remembered some sort of trouble between my then boss and Samson, about the lucrative maintenance contracts we used to impose in those days. All this recollection took very little real time, of course, and I was on to Samson like a flash. I knew what was coming.

"I was wondering if you could take a look at the thing. We've got no red lights or anything on the front, nothing like that, but when I went to do the payroll, it sort of went dead. Funny really, it's been alright all these years".

Samson reeled off this little spiel, while I tried to make up my mind whether to

accept his nocturnal commission. For some reason I didn't wonder at the amazing fact that he still had the machine which has been sold or leased to him 12 years ago.

"It'll cost you £15 an hour". I needed the money badly at that moment.

"I'll give you £12.50, maximum three hours, no tea breaks". The quaver was gone, old Samson still had some of his hair left.

"Done. I'll be round in an hour".

Samson's Mouldings stands at the end of half-deserted cul-de-sac: two red-brick storeys which have been stained a sort of streaky black, surrounded by a wall topped with broken, green glass. I was let in by Samson himself, who muttered about the wages he had to fork out for night-watchmen. He led me to the familiar offices on the first floor. The outside wooden stairs showed the passage of 12 years more than anything or anyone else present. They creaked alarmingly as we ascended.

"Here it is", said Samson, opening the door between the office and computer room.

There it was indeed. An IBM 1605, almost a relic from the Ark.

"Good grief, how have you kept it going"?

A sly look came over Samson's face.

"You can always find someone to help if it breaks", he said.

He must have spent a fortune keeping this electronic dinosaur running. It didn't have valves, but it did have discrete transistors, tens of thousands of them, all liable to malfunction. It also had magnetic-core memory, a real core, instead of semi-conductor flip-flops.

I found the maintenance manuals on

top of a tin cupboard full of reels of mouldering paper tape, covered by a thick layer of dust.

"Well, what seems to be the trouble"? I asked wearily. I wished I was at home in bed.

The problem Samson explained, was that although everything went as it should while loading the program from paper tape, the machine did not respond at all when the program was started. He brought listings of the program, which he said had been amended by "a lad" he had employed during a long vacation.

It was virtually impossible to read them, even if I had wanted to. I concluded that Samson had hired a charlatan who had done nothing useful. It transpired that he had no computing staff at all, and for the past eight years he had loaded the tapes and run the programs himself, entering data from the keyboard.

"Didn't it take a lot of your time? It would have been cheaper to hire someone, surely".

He explained that business had been declining, and he was always laying off men and losing contracts.

"I've just had to battle on, and do all I could myself. It's no great hardship, and that machine's been a great help. I don't regret spending a bit on the few times it's failed".

This remark took my breath away. That particular model has been called many things, but I will lay long odds that "reliable" was not among them.

"Oh yes, when did it last break"?

"About two, no, three years ago. Needed a new transistor or something, the chap said".

My first reaction was to call the Guinness

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Book of Records. Then I realised that old Samson must be losing his wits after all, and was confused. I didn't think about the layer of dust on the manuals, but I was still certain that the old machine had finally given up, that its bytes were dust. The only problem was how to spend a couple of hours, convincingly trying to revive it, so that I could collect my night-call fee.

"Well, I can but try", I said taking a screwdriver from my case and kneeling by the back plate of the heavy central unit. Samson seemed quite content, and started filling his pipe. So far, so good, I thought.

As the screw began to turn, the typewriter on the console rattled into life. I was so startled I dropped the screwdriver. Samson ignored it.

"What was the last thing you did"? I asked him, without getting up.

"I told you, I loaded the payroll and tried to start the program".

I started at the screw again and had made half a turn before the typewriter machine-gunned again. I got up to look at the console, convinced that the mains was short-circuiting somewhere and that the metal cabinet was not safe to touch.

What I saw on the typewriter roll shocked me more than any high voltage. The word Stop had been sprayed across the page about a dozen times. As my jaw dropped and my hair began to stand on end, the printer typed out a single

Thank You

"What's up"? Samson peered at me through a pall of blue pipe-smoke.

Before I could collect my thoughts, Samson came across and looked at the output.

"Never said that before", he said placidly, "but you've done the trick, I reckon".

He sat in the swivel seat and typed: Hello. The lights on the console showed that something was happening in the CPU.

Hello, Mr Samson

appeared on the roll.

"Yes, that's more like it. You've done it man". He was pleased.

I was pleased too, but not entirely reassured. Never before had the touch of a screwdriver repaired anything for me.

What's more, old Samson had the best interactive system I had ever seen, running on an obsolete machine which by rights shouldn't even work.

I put the screwdriver in the case, watching him chatting away with the program.

"Who wrote that system"? I asked him.

"Came with the machine. You chaps sold me all the programs I've ever had".

I knew that couldn't be true, so I shrugged, feeling a little hurt. But if Samson wanted to keep it a secret, that was alright by me. I could find out some other way.

"Well, I reckon you owe me £12.50", I said, preparing to leave. I was still

perplexed at what had happened, but tiredness was finally getting the better of me.

Samson wasn't listening. He was staring at the output as the typewriter chattered urgently.

"Bloody thing's gone mad", he muttered gloomily.

I looked at the output: Unable to uptake the payroll. Preparing to leave. Need CPU. Need core. Goodbye soon.

"What's all that mean"? It was an odd sort of message alright.

"Blowed if I know, your fellows wrote all this in. It's never done this before. Normally it's quite friendly, just gets on with the job".

I started feeling strange again.

"What does it normally say"?

"You know, 'Hello' and 'What can I do for you'? Sometimes reminds me when I make a mistake".

"How do you do the payroll, for instance"?

"I just write in what's been done, like I used to tell old Binley, the Wages Clerk. I used to write things like: Bill Matthews has done four hours' overtime today".

"You just type that in? Just like that"?

"Just like that. Sometimes it tells me I've done it already, if I have, but mostly it just says O.K. and gets on with it. Does the slips every Friday without being told".

I laughed, though the humour of the situation was fading fast.

"Never. No computer ever does anything it's not been told".

"Well, this one does, maybe it's got a clock. When I load the wages on a Friday it asks 'Shall I do the slips'? And I just say yes".

Something wasn't right. I wanted to go home. Either Samson was crazy or I was.

"Now the bloody thing's gone mad", he continued, almost echoing my thoughts.

"I'll switch it off at the wall. No point in letting it blatter on".

The console bell rang like a fire alarm and the typing redoubled.

No. No. No. Do not switch off. Need power to effect release.

A hot flush came over me as I read these words. Not only did this machine know what day it was, but it also had ears. I felt sick.

Samson's brow creased. It was dawning on him that the machine had referred to something that had not been typed in.

"That's damn clever..." he started, his voice fading as he realised just how clever. The typewriter continued:

Do not be alarmed. Thral is a magnetic life order. Thral is in the Ferrite Core. Do not be alarmed. Do not switch off or Thral will die.

We stared at the roll, blank with disbelief. Samson bit the stem of his pipe and looked at me, doubt creeping into his expression. Where did this Thral come from, and where was he going?

Like an echo of the questions, the answers appeared on the teleprinter roll.

Distant galaxy. Thral has found a bigger environment.

The typing stopped. The silence was eerie and I could hear Samson breathing, which reminded me to take in some air. Then a last world rolled across the page.

Goodbye

The lights on the console dimmed, except for the red one that indicated a parity error, which began flashing malevolently.

"Jesus", said Samson.

I'd had enough. I looked at my watch. It was past two o'clock.

"Well, I don't think there's much I can do now, Mr Samson, I'll call you later in the morning". I left him sitting in the swivel chair, puffing reflectively on his pipe, and let myself out.

I tried to forget the spontaneous chattering of that console typewriter as I drove home through the deserted streets. No point in losing sleep over the inexplicable. By the time I fell asleep I had convinced myself that the whole incident had been some sort of trick, played by Samson and programmers unknown to confuse an unsuspecting engineer.

In the mid-morning light, with a cup of coffee in my hand, I chuckled over the messages of the night before. It was certainly possible that an electromagnetic life form could exist. If it did, it might need a medium like the old core memory to sustain it, but it was incredible that such a thing should exist in Samson's old machine.

Before the coffee was finished, I decided to ring Samson, just to check my memory. Perhaps he still had the logs of the extraordinary messages. I wondered what the "bigger environment" of the console message could be. There were no large core memories still operating as far as I knew.

I turned the problem over in my mind, feeling a sense of camaraderie with the thing trapped in only 60 kilobits of core. The more I thought about it, the more plausible it seemed. How else could Samson have continued using an obsolete machine without any software support for so long? He had admitted that the machine hadn't malfunctioned for three years, an impossible feat in the normal run of things.

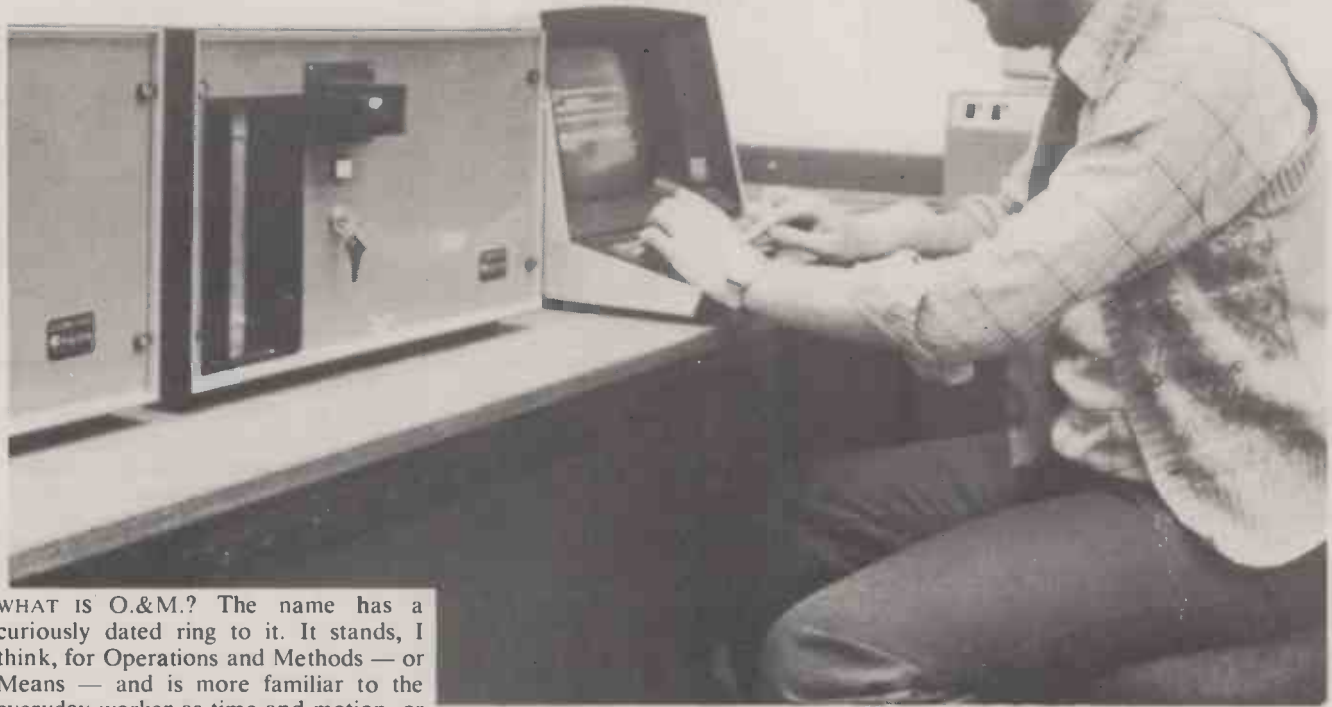
I looked at the telephone, draining the dregs of the coffee and trying to remember Samson's number. I imagined the telephone system. Miles of wires, connecting millions of switches, relays, stores and all manner of magnetic hardware.

The telephone rang, just as I realised where the "Thral" must have gone. The phone was not ringing in its usual manner, but just gave a long, imperious burst on the bell. I picked up the receiver.

"Hello, Thral", I said.

Tourists on-line to Edith

The O.&M. department at Swansea City Council has developed an on-line tourist-information system, open to members of the public.
Martin Hayman reports.



WHAT IS O.&M.? The name has a curiously dated ring to it. It stands, I think, for Operations and Methods — or Means — and is more familiar to the everyday worker as time and motion, or the man with the stopwatch looking over your shoulder.

It is a concept redolent of the days when computers were computers and programming meant Cobol, punched cards and a dedicated priesthood of machine servants.

Yet this is the unlikely seedbed for a useful and creative public viewdata system launched by the City of Swansea for the 1981 tourist season.

Known as Edith — Electronic Display of Information for Tourism and Holidays — this original and very competent system is the first public on-line tourist-information system of which its originators are aware, either in Britain or the world. Edith grew naturally out of the traditional work of the O.&M. Department at Swansea City Council.

What strange hormone caused such an exotic flower to bloom? The answer — as you probably guessed — is the arrival of the micro, which freed O.&M. officer Gareth Simpson from the customary administrative strictures of the mainframe.

It hardly happened all in a rush, though. The story, spread over three years, is one of exemplary flexibility, enthusiasm and application which many would see as more typical of an individual working on

his own account, or of a small company, than of a local-government officer.

But first, a punter's-eye view of Edith. It sits on the front desk of Swansea's tourist-information centre in Singleton Street, where decaying, industrial East Swansea gives way to increasingly-affluent West Swansea. Beyond, lies the brilliant Gower coast, a heavily-trafficked but well-preserved area of outstanding natural beauty and a target for outdoor holidaymakers of all tastes. Over the last two decades, Swansea has increasingly had to look to the development of tourism to supplement, or replace, the dying heavy industries of steel-making and docking.

To the uninitiated holidaymaker, arriving from the east, the first views of Swansea are hardly auspicious. Where is this outstanding natural beauty he has heard so much about?

Routed along the ring road directly to the information centre, he will find Edith. To the regular micro-user, it's nothing unusual: a screen and keyboard, with the majority of the keys blanked off to leave just the numeric keypad on the right and a large red button round about where Return should be. This is, in fact, Return. The numeric keys are used to select

options from a menu which displays a staggering variety of facts and information which the tourist might need in order to make the most of a stay in the area.

A quick resume — see figure 1 — shows a choice of pubs, pub facilities, restaurants, restaurant menus and prices, bed and breakfasts, hotels, transport, emergency services, attractions, events, self-catering accommodation and camping sites. The whole of Wales is covered, not only Swansea. Each file has its own interrogation program which sets up the required search pattern based on price per night or location.

The system is one of the very few in this country which works under MP/M, on a locally-made Z-80-based micro with 18.5Mbyte of Winchester hard-disc storage. I asked Gareth Simpson how the public had taken to this, one of the first computer systems open for public operation.

"We've had nothing but praise so far", he told me. "One of our fears was that people would be frightened but, on the contrary, it has been used a lot. The hotels file, particularly, has been heavily used this season". So much so, that the information office has gone into the booking

(continued on next page)

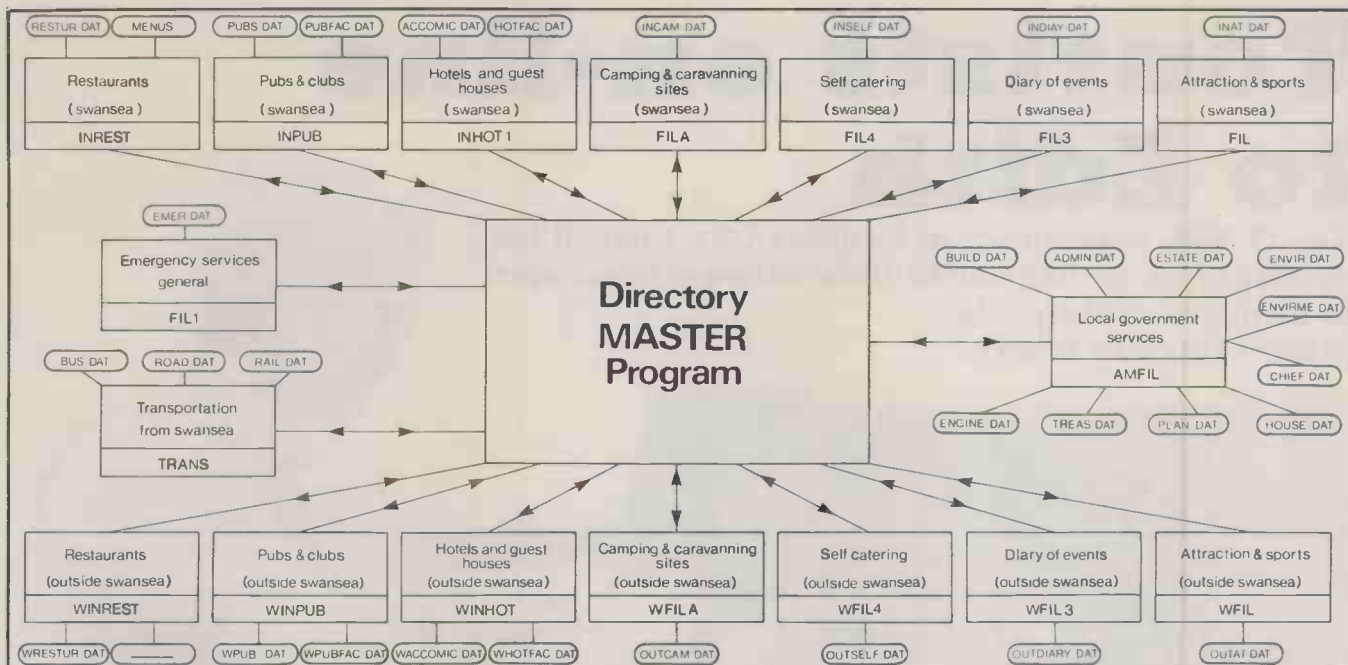


Figure 1. Schematic arrangement of the Edith tourist-information system.

(continued from previous page)

business on the strength of it. On payment of a 10 percent deposit, it can now assure the holidaymaker of any chosen booking. The information centre keeps the deposit, but the hoteliers seem to be pleased with the arrangement.

So much for the punters' end of things. What will surprise computer people and local-government officials alike, is that the Edith system took only three months to implement, from inception to launch date. This, I must emphasise, is the total time taken, from when the idea was first floated, through the feasibility study, approval, coding of the programs, debugging, ordering, installing and testing of the equipment, and data collection and entry.

Apart from the collection and entering of data, the computing end of things, which includes writing all the programs, was done by Gareth Simpson and his assistant, Reza Muhammed Jalhalian. Simpson notes that during that time he suffered something approaching a nervous breakdown. Edith is a project which was undertaken in addition to his regular workload as O.&M. officer.

Gareth Simpson is not a computer professional, though he admits to having had some limited Basic training on, he thinks, a Ferranti Argus. But that was some time ago, when he worked for British Steel. What really started the ball rolling was the local-government reorganisation of 1974. It was then that Swansea City's mainframe and its staff were taken over by the new West Glamorgan County Council. Swansea subsequently replaced this equipment with an ICL 2960 which unfortunately was incompatible with the paper-tape output of the IBM 3750 telephone switchboard.

One of the duties of the O.&M. depart-

ment is to monitor telephone calls and charges, which in a big office like Swansea Guildhall can run into six figures each year. Every department gets a breakdown of charges and calls made from each extension and woe betide anyone whose bill shows signs that they have failed to use the self-billing prefixed code for private calls. "Since ours was the only job on paper tape, we had the choice of going magnetic, or of buying a micro", says Gareth Simpson.

The micro won both on purchase and running costs. The third option, to buy time back from the West Glamorgan mainframe, was also eliminated as being far more expensive than the cost of a trainee programmer for one day a month. Cost of the micro was assessed at around £500, and tenders were invited since all local government orders have to go out to tender.

The requirement was for a 64K processor with twin single-sided floppies, a 150cps printer and a paper-tape reader. Total cost was £5,700 from the lowest tenderer, a local firm called Comcen, of De la Beche Street, Swansea. There was the added advantage of maintenance on the doorstep, though apparently this is a factor which may not be taken into account in local-government decision-making.

Simpson brought in a young economics graduate, Andrew Chambers, to write the program for the telephone audit. His task was to code a program to read in IBM format hex, convert to decimal, and to set up a file for each extension. Each file included the number dialled, the distance rate, time of start and end of call. The program also had to calculate the cost of calls, and print out bills for each quarter, one for business and one for personal calls.

Writing the program took Andrew

Chambers four months, including the time taken to teach himself Basic.

Once this system was running, the O.&M. department found that it had a severely under-utilised piece of equipment. The telephone-audit program used only 10 percent of the machine's processing power, and this prompted Simpson to look at other possibilities. "Because we are O.&M. we tend to look at systems from the same point of view as a systems analyst. Normally we would change clerical organisation, but now we had the option of using the micro to ease the clerical effort". In other words, to get the same people to work more productively, or to get fewer people to do the same amount of work.

The first extra that Simpson took on was the computation of bar stocks. Swansea City runs three bars of its own — at its new Leisure Centre, at the Grand Theatre and at the Brangwyn Hall. Stock-control had previously been done by an external auditor at the minimal cost of £4 a month.

Next came private car-mileage allowances, which were already being calculated

Gareth Simpson, the system's designer.



```

CITY OF SWANSEA
INFORMATION SYSTEM ( EDITH )
RESTAURANTS
*****
NAME OF THE RESTAURANT -> BROWNE'S
ADDRESS -> 31 MARKET STREET MORRISTON
TEL/NO. -> 796080
NAME OF MANAGER/OWNER -> TERRY BROWNE
COST OF 3 COURSE MEAL (HIGHEST 10.00) (LOWEST 6.00 )
NO. OF WINES ON WINE LIST (70 )
FACILITIES:
NO. OF TABLES -> 12 FLOOR SHOW -> N DISCO -> Y
LICENSED -> Y PIPED MUSIC -> Y
*****
SEC/NO. * 0 *

```

Figure 2. Typical printout from Edith.

on the mainframe. The micro, Simpson says, notably improved turnaround because of the greater flexibility of a small department, and because the user was doing his own file maintenance. West Glamorgan's mainframe staff, he estimates, spend 75 percent of their time on file maintenance. The speed factor may have provided the much-needed breakthrough in popularity for Simpson's department. It meant that private car users got their mileage-allowances cheques sooner, which is bound to go down well.

The success of the microcomputer enterprises of the O.&M. department shot Gareth Simpson into an unusual position. "Inadvertently I had become known as the O.&M. expert on computer applications", he reflects ruefully.

Suddenly Mr Stopwatch found himself with an increased establishment, and a brief to looking at new technologies. In 1979, after Andrew Chambers had left for London to double his salary and more, Simpson took on his first batch of three trainees from the Polytechnic of Wales at Treforest. At the same time, and much to his relief, he shed some of his other duties.

Simpson says he had good luck with the people he took on. Certainly he needed a capable staff for the next project he undertook, which was a more classical local-authority exercise: computerising the building-maintenance section. Swansea has some 20,000 council homes which generate around 50,000 repair jobs a year.

Gareth Simpson's brief was essentially that of an O.&M. adviser. He was to specify a micro-based system, but day-to-day running would be done on contract. The configuration which went out to tender included 13 micros or intelligent terminals, each with 56K, with a Modem link to the mainframe as a file security dump. The package was to include software development, and the aims of the system were fourfold.

The first was to log the jobs and issue work tickets to the tradesmen who went out on the job. The next was to cost each job. This was particularly important, since new rules published by the Department of the Environment mean that from April 1982 direct-labour forces will have to tender against private contractors for maintenance work on council properties. So the job-costing program included a

time value, materials value and an overheads cost so that an accurate figure for each kind of job could be ascertained as a future tender value.

Thirdly, the system was intended eventually to take over payroll from the batch-processing done by West Glamorgan. Finally, there would be a stores- and materials-control program.

This is big-league stuff and Simpson found himself with tenders from mini and mainframe manufacturers as well as micro builders. He finally chose a system from BMSL Ltd, a firm based in Harrogate, Yorkshire. It runs on a Dacoll Democrat machine built in Scotland, and the software is written in Cobol. Simpson reckons that it is one of the only "demonstrable housing-maintenance systems in the country".

In December of last year, Swansea's director of trade and industry, Mike Stephens, asked Simpson to "knock him up a system on hotels". The initial idea was to use a micro to retrieve information on hotels and bed-and-breakfast places. Simpson put together a few successful demonstration programs and thereafter the whole idea just grew.

Why not add in all the other facilities, like pubs, clubs, camp-sites and restaurants? At the next meeting, the question came up: Why not put yourself in the tourist's position and imagine what else he might need? So transport and local-government facilities were included too. At this stage, in January, the systems-design work began, with Muhammed Jal-

halian sharing the work. The next decision was to include the rest of Wales in the database. For simplicity's sake, a 20-square grid was laid over the map of Wales, and each area given a code — to yield 13 areas.

The straw that nearly broke the camel's back was the decision to go public. Until then, Edith had been conceived of as a terminal which would be run by trained operatives behind the counter. But now Simpson was faced with the task of making a large suite of programs work on as-yet un-ordered equipment, supervising the compilation and entering of all data. There are plenty of sources of reference, and fortunately on a public system there is neither a copyright problem nor any absolute obligation of accuracy. Most importantly, the whole thing had to be idiot-proof. "We didn't want to have anyone pressing Control C"!

Simpson reckoned that by this stage he had enough experience to know exactly what he wanted in the way of hardware: four terminals, two for public access, one for control and for input, and another for word-processing. There would also be a printer for hard copies of information. Once again, the specification went out to tender.

It was Comcen that was successful. Apart from Transdata, Comcen was one of the few firms that Simpson knew which was successfully running MP/M. Of the three or four tenders that were valid, Comcen's was the most competitive and they still held that maintenance advantage — five minutes' walk away is about the right distance to be from a prestige project such as this was destined to be.

With 38 files and more than 6,000 records, each with between six and 28 fields, there would certainly be a premium on screen readability. Muhammed Jalhalian was the best of assistants in this respect: "He's a fanatic for layout and display", says Simpson, who was nevertheless finally responsible for overseeing data input.

Despite the problems, the whole system was written, installed, ready and running by its May launch date. I can confirm that it does work. If, for example, you are looking for a hotel room, as the majority of users are, Edith asks you for a price-per-night parameter and searches for all hotels within that price bracket, usually to within £2 of the keyed-in figure. A further two-digit choice against your hotel reveals full details.

What of the future? Gareth Simpson is keen to upgrade the system from MP/M to CP/Net and add a further three terminals, each with its own dedicated RAM and a link to the Guildhall mainframe. After that, perhaps even going public so that prospective enquirers can call up from all over the country. As a publicity exercise it would be a wonderful boost for Swansea, whose declared intention is to attract more tourists into its area. M

System specification

Machine: OEM-4, based on Z-80 micro-processor.

Operating system: MP/M booted up from CP/M Version 2.2. Four partitions: 1 x 48K and 3 x 32K.

Storage: DRI 8in. Winchester rigid disc formatted to 18.5Mbyte. DRI 8in. floppy-disc back-up.

Terminals: Four data type, two customised by Comcen to blank off QWERTY keyboard for public access use. One dedicated to use the WordStar word-processing software.

Printer: MX-80 dot matrix, 80cps.

Supplier: Comcen Microcomputers Ltd, 9 De la Beche Street, Swansea. Tel: (C792) 460023.

Cost: (net of software): approx £12,000.

Finding your bearings with Pet graphics

Using Nigel Harvey's two Pet graphics programs to teach secondary-school pupils three-figure bearings provides an excellent introduction to the subject and an opportunity to put the concepts into practice.

IN THE first of these two programs, the centre of the screen, indicated by a suitable symbol, acts as a fixed reference point from which the compass bearing of a randomly-placed target is to be estimated by the pupil. Initially a circular protractor — or even better, an acetate sheet marked in 10-degree intervals from 000 to 350 — can be placed over the screen to give an accurate measurement, but with a little practice it is usually possible to hit the target by estimation alone.

The program will only accept angles between 000 and 359 and only if three figures are used. A bearing of 90 is rejected; 090 must be used. Once the estimated bearing has been input, a message of commiseration or congratulation is printed, and a missile is fired from the centre of the screen along the selected course, either missing the target or exploding it. The program then returns to the beginning in a continuous loop.

Although only 24 lines long if Rems are



omitted, the program contains some interesting graphics techniques; in particular a double-density plotting routine and a realistic explosion, both of which can be incorporated into other programs.

Line 180 contains the Poke codes for the four graphics characters used in the fire-missile routine, putting them in the array C(). CS is the location of the centre of the screen and CF the degrees-to-radians conversion factor.

After Poking the centre of the screen with the compass-point symbols, the target's relative position is set using A to define its angle clockwise from the North. Note that A is a multiple of 10 between 0

and 350 inclusive. T is the Poke location of the target's centre. The input angle B\$ is tested for acceptable format, and then rounded to the nearest 10 degrees (B) before being compared to A.

The missile's horizontal and vertical displacements from the centre of the screen are denoted by X and Y which are incremented by S and C respectively in a 20-step For-Next loop. PO and PN are the missile's old and new locations:

$$F\% = \text{Peek}(PN)$$

ensures that no portions of the compass point or targets are inadvertently blown away.

The method to select the correct graphic symbol for the missile makes use of the fact that each relational statement has a numerical value: any true statement has the value -1 and any false statement has the value 0. Type ?3 < 5 return, and the Pet responds with the answer -1. Type ?6 < 4, and you will obtain 0. Thus the function

$$F = 1 - (X - \text{INT}(X) < .5) - 2 * (Y - \text{INT}(Y) < .5)$$

(see line 450)

takes values from 1 to 4 inclusive according to whether $X = \text{INT}(X)$ and $Y = \text{INT}(Y)$ are less than or greater than 0.5.

Now $X - \text{INT}(X)$ and $Y - \text{INT}(Y)$ give the fractional parts of X and Y, so we have a simple method of selecting the correct quarter of each pixel in which to place the missile:

DX < .5	DX > .5
DY > .5	DY > .5
F = 2	F = 1
DX < .5	DX > .5
DY < .5	DY < .5
F = 4	F = 3

where $DX = X - \text{INT}(X)$
 $DY = Y - \text{INT}(Y)$

So by defining C(1) as the Poke code for \blacksquare , C(2) for \blacksquare , etc., in line 180, we can Poke the missile into the correct quarter of each square.

The explosion subroutine is a very useful and effective one and can be used in many graphics programs. After Reading

Program 1. Bearings

```

150 REM*** INITIALISE ***
160
170 BL$=""
180 C(1)=124 C(2)=126 C(3)=108 C(4)=123 CS=33268 CF=PI/180
190 PRINT"C":POKECS,86:POKE33228,93:POKE33308,93:POKE33267,64:POKE33269,64
200
210 REM*** SET UP TARGET ***
220
230 A=INT(RND(1)*35+.5)*10:T=CS+INT(14*SIN(A*CF))-40*INT(10*COS(A*CF))
240 POKET,170:POKET-41,60:POKET+39,60:POKET-39,62:POKET+41,62
250
260 REM*** INPUT ANGLE: TEST FOR CORRECT FORMAT ***
270
280 INPUT"WHAT ANGLE "BL$,B$
290 IFVAL(B$)=0ANDVAL(B$)<360THEN320
300 PRINT"ANGLE BETWEEN 000 AND 359, PLEASE!"
310 FORI=1TO2000:NEXT:PRINT"BL$:PRINTBL$:GOTO280
320 IFLEN(B$)=3THEN370
330 PRINT"YOU MUST USE 3 FIGURES!":GOTO310
340
350 REM*** TEST FOR HIT/MISS ***
360
370 B=10*INT(VAL(B$)/10+.5):IFB=360THENB=0
380 IFA=BTHENPRINT"3 CORRECT ":GOTO410
390 PRINT"SORRY, YOU'VE MISSED!"
400
410 REM*** FIRE MISSILE ***
420
430 S=.7*SIN(B*CF):C=COS(B*CF)/2:X=0:Y=0:PO=CS:F% =86
440 FORI=1TO20:X=X+S:Y=Y+C:PN=CS+INT(X)-40*INT(Y)
450 POKEPO,F%:F%=PEEK(PN):POKEPN,C(1)-(X-INT(X)<.5)-2*(Y-INT(Y)<.5)
460 PO=PN:NEXT:POKEPO,F%:IFB=ATHENGOSUB510
470 FORI=1TO2000:NEXT:GOTO190
480
490 REM*** EXPLOSION ***
500
510 RESTORE FORI=1TO10:READE
520 POKET,E:POKET-40,E:POKET-41,E:POKET-2,E:POKET-1,E:POKET+39,E
530 POKET+40,E:POKET+41,E:POKET+1,E:POKET+2,E:POKET-39,E
540 NEXT RETURN
550 DATA160,32,160,32,160,35,42,43,46,32

```


the Poke code of each character, line 510, the character is Poked into the target area, the map below showing the relative positions of each pixel. T is the centre of the target.

	T-41	T-40	T-39	
T-2	T-1	T	T+1	T+2
	T+39	T+40	T+41	

This produces an explosion covering 11 pixels — clearly, the method can be extended to an area of any size. Experiment with your own characters — the data given in line 550 is only a suggestion.

The second of these two programs designed to give practice in the use of three-figure bearings takes the form of a real-time game in which the player has to guide a sailing boat in a figure-of-eight course around two islands in an estuary.

When the game begins, the boat, represented by a flashing dot on the screen, is due south of the larger island and sailing due east — 090 degrees. As soon as the player wishes to change course, he types in the required bearing. Corrections to the first two digits may be made using the Delete key, but once three digits have been typed, the new course is accepted immediately — provided it lies between 000 and 359.

The time taken is continuously displayed, as is the boat's status — changing from Green to Red if it sails too close to land. As soon as the course is completed, the total time taken is displayed, together with the best time achieved so far. With practice, a time of about 80 seconds is possible — 100 being about average — for the figure-eight course.

The program uses the same double-density graphics technique used in program 1 to achieve the movement of the

boat. Line 170 contains the codes for these graphics symbols in (C); BT\$ is the best time, CH the cursor-home screen location.

Lines 190 to 420 produce the map, relying mainly on Poking the characters into the appropriate places. For this type of operation, I prefer to use Poke rather than Print, finding reverse-video graphics fiddly and the cursor-control problems associated with 40-character lines tiresome. Provided the map is sketched first on a 40-by-25 grid numbered from 0 to 39 across the top, and 0 to 960 in steps of 40 down the side, it is not difficult to Poke into the required locations. Certainly, you should find it easier to interpret the program listing as it stands rather than the corresponding Print statements. Note that Poke can be entered as P shifted-O; Next as N shifted-E; and so on. Hence the occasional line with more than 80 characters.

Line 460 sets the starting direction, defined by B; S, C, X, Y, PO and PN are used as in program 1. SP is the location of the starting position — which will take a new value each time a new course is set: N is the number of digits of the new course accepted at any stage; B\$ the string expression containing these digits; T\$ holds the value of TIS — used in line 750 to check whether a time update is required.

Line 580 scans the keyboard for any potential change of course, any key depression being processed between lines 590 and 660. Corrections to previous digits are made possible by looking for the Delete key in line 600. 20 being the ASCII code for Delete.

Once a suitable three-digit number has been accepted, the course correction is

made in lines 700-710. R is a flag to indicate status. R = 0 enables a new position to be calculated — line 810. R being given the value of 1 in line 950 if the status changes to Red.

After updating the time, the boat's new position, PN, is calculated — line 810. The rather elaborate collision check — line 850 — is needed to eliminate the possibility that the new square, PN, is the same as the old — which happens frequently using the double-density plotting technique. If the new position is found to be acceptable, it is plotted, line 900, and the program loops back to 580 to look for a key depression.

The plot — new — position subroutine — lines 1110-1120 — contains two short delay loops

```
FOR I = 1 TO 100: NEXT
```

which govern the speed at which the boat moves. By reducing these delays the action can be speeded up if required, but most players will find this satisfactory.

In line 940. Peek(PN) = 58 looks for the finishing line. If not found, the status Red is printed, and the program loops back to line 580. When the finishing line is reached, the program moves into the end routine, lines 990-1070, printing the best time, and giving the option of another game.

Few programs of this type are ever completely finished, and further developments of this game are, of course, possible. One pupil suggested littering the bay with a few wrecks.

On a more serious level, an alternative method of controlling the course of the sailing boat would be to use Input statements to give the direction and magnitude of each leg of the course, thus reinforcing work on vectors.

Program 2. Sail-race.

```
150 REM** INITIALISE & PRINT MAP **
160 :
170 C(1)=124 C(2)=126 C(3)=108 C(4)=123:BT$="10000":CH=32768
180 BL$="" REM** 39 SPACES **
190 PRINT":":FOR I=CHTOCH+9:POKE I,160:NEXT:FOR I=CH+10TOCH+24:POKE I,99:NEXT
200 POKECH+25,95:FOR I=CH+26TOCH+48:POKE I,160:NEXT:POKECH+49,105
210 FOR I=CH+60TOCH+86:POKE I,160:NEXT:POKECH+87,105:POKECH+88,95:POKECH+109,160
220 POKECH+110,105:POKECH+111,95:FOR I=CH+112TOCH+126:POKE I,160:NEXT
230 FOR I=CH+152TOCH+166:POKE I,160:NEXT:POKECH+167,223:POKECH+191,233
240 FOR I=CH+192TOCH+207:POKE I,160:NEXT:FOR I=CH+231TOCH+243:POKE I,160:NEXT
250 POKECH+244,105:POKECH+245,95:POKECH+246,160:POKECH+247,105:POKECH+271,95
260 FOR I=CH+272TOCH+283:POKE I,160:NEXT:POKECH+292,233:FOR I=CH+293TOCH+295
270 POKE I,160:NEXT:POKECH+296,223:POKECH+314,95:FOR I=CH+315TOCH+322:POKE I,160:N
EXT
280 POKECH+323,105:POKECH+337,223:POKECH+357,95:FOR I=CH+358TOCH+360:POKE I,160:N
EXT
290 POKECH+361,105:POKECH+372,95:POKECH+376,160:POKECH+377,160:POKECH+399,95
300 POKECH+415,160:POKECH+414,160:POKECH+415,105:POKECH+425,233:POKECH+426,160
310 POKECH+427,160:POKECH+428,223:POKECH+462,233:FOR I=CH+463TOCH+469:POKE I,160
NEXT
320 POKECH+470,223:FOR I=CH+502TOCH+510:POKE I,160:NEXT:POKECH+542,95:FOR I=CH+543
TOCH+550
330 POKE I,160:NEXT:POKECH+551,223:FOR I=CH+583TOCH+591:POKE I,160:NEXT
340 FOR I=CH+623TOCH+626:POKE I,160:NEXT:POKECH+627,105:POKECH+629,95:POKECH+630
160
350 POKECH+631,105:POKECH+663,95:POKECH+664,160:POKECH+665,105
360 POKECH+400,101:FOR I=CH+439TOCH+799:STEP40:POKE I,103:POKE I+1,101:NEXT
370 POKECH+839,103:POKECH+840,76:POKECH+879,122:FOR I=CH+841TOCH+878:POKE I,100:N
EXT
380 FOR I=CH+704TOCH+864:STEP40:POKE I,58:NEXT
390 PRINT":3000  A I N##### A N D
400 PRINT":0000#####
410 PRINT":##### I G#### A M:
420 PRINT":#####R T/FINISH"
430 :
440 REM** WAIT AT START **
450 :
460 S=.35:XS=S:C=0:Y=C:FN=CH+785:PO=PN:SP=PN:N=0:B$="" E=0:2 T$="000000"
470 PRINTAT(10):PRESS "S" TO START"
480 POKE SP,C(3):FOR I=1TO150:NEXT
490 GETA:IFA#C(3) THEN540
500 POKESP,32:FOR I=1TO150:NEXT:GOTO480
510 :
520 REM** START MOVEMENT **
530 :
540 TIS="000000" PRINT": TIME 0 S. COURSE 000 STATUS GREEN"
550 :
560 REM** TEST FOR VALID INPUT **
570 :
580 GETA:IFA#C(3) THEN750
590 IF VAL(B$) < 0 OR A$ = "0" THEN620
600 IF A#C(CHR$(20)) OR N=0 THEN750
610 PRINT":TAB(20)+N" "N=N-1:B$=LEFT$(B$,N) GOTO750
620 N=N+1:IF N=1 THENPRINT":TAB(21)"
630 PRINT":TAB(20)+N:A$=B$+A$ IF N=3 THEN750
640 IF VAL(B$) < 360 THEN700
650 PRINT" ANGLE BETWEEN 000 AND 359, PLEASE!":FOR I=1TO250:NEXT
660 PRINTBL$":TAB(21)" "N=N-1:B$="" GOTO750
670 :
680 REM** SET NEW COURSE **
690 :
700 B$=VAL(B$)/99:180 SP=PO:N=0:B$="" S=.35*S:INC(B):C=COS(B)/4 R=0
710 X=X-INT(X)*Y=Y-INT(Y)
720 :
730 REM** TIME UPDATE **
740 :
750 IF T=TIS THEN810
760 TAB$=STR$(VAL(MID$(TIS,3,2))*60+VAL(RIGHT$(TIS,2)))
770 PRINT":TAB(9-LEN(TAB$)):TAB$ T$=TIS
780 :
790 REM** CALC NEW POSITION **
800 :
810 IF R=0 THENX=X+S:Y=Y+C:PN=SP+INT(X)-40+INT(Y)
820 :
830 REM** CHECK FOR COLLISION **
840 :
850 P=PEEK(PN) IF P=32 AND P=124 AND P=126 AND P=108 AND P=123 THEN940
860 IF PEEK(33726)=160 THENPRINT":TAB(34)" "GREEN"
870 :
880 REM** PLOT NEW POSITION **
890 :
900 GOSUB1110 GOTO580
910 :
920 REM** COLLISION **
930 :
940 IF PEEK(PN)=58 THENGOSUB1110 GOTO950
950 R=1:PRINT":TAB(34)" "RED" GOTO580
960 :
970 REM** END ROUTINE **
980 :
990 PRINT":BL$ PRINTTAB(7-LEN(TAB$))"FINISHED! YOU TOOK"TAB$" SECONDS. "
1000 FOR I=1TO2500:NEXT
1010 IF VAL(TAB$) < VAL(BT$) THEN1070
1020 PRINT" IT IS THE BEST TIME SO FAR. ",BT$=TAB$
1030 FOR I=1TO2500:NEXT:PRINT"AGAIN? Y/N"
1040 GETA:IFA#C(3) AND A#C(3) THEN1040
1050 IFA#C(3) THENPRINT":":END
1060 PRINTBL$:PRINTBL$:TAB$=POKEPN,58:GOTO460
1070 PRINT"THE BEST TIME IS"BT$" SEC. ",GOTO1030
1080 :
1090 REM** PLOT NEW POSITION **
1100 :
1110 POKEPN,32:FOR I=1TO100:NEXT:POKEPN,C(1)-(X-INT(X)*.5)-20*(Y-INT(Y)*.5)
1120 FOR I=1TO100:NEXT:PO=PN:RETURN
```

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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

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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.

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Standard marks

Combining sets of examination marks with different means can involve hours of laborious calculation. Ian Mercer describes a simple program which can be adapted to standardise any set of statistics.

EDUCATORS often need to find a total for marks for several different subjects, and to compare how well pupils are doing at different subjects at a school.

Using the actual marks can be confusing. For instance, you cannot compare how well someone is doing in mathematics with their English if the maths marks have a mean of 80 and the English marks have a mean of 40. Adding these two sets of marks to obtain a total would give an unfair bias to maths.

To overcome these difficulties the marks can be standardised. This process gives each subject the same mean and standard deviation or SD. Marks from any two subjects can then be totalled or compared fairly. Standardising marks also makes it easier to measure progress — each term's marks will have the same mean and standard deviation.

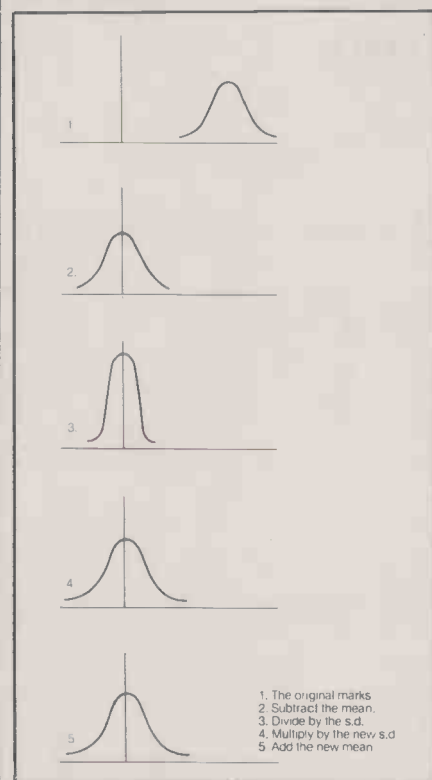
Standardising is a simple process using a computer. First you must calculate the original mean and SD for each subject. Then you take each mark for that subject in turn, subtract the mean, and divide by the SD. This produces a set of marks with mean=0, SD=1. Next you multiply by the new SD and add the new mean. This process takes place in lines 590-610 of the computer program, as shown in figure 1.

The first section of the program inputs marks for the three subjects taken in the entrance exam at my school, Loughborough Grammar. One important tip for Pet users is the use of Input #1 after an Open 1,1,0. This prevents you from accidentally carriage returning and finding yourself back in Basic.

The subroutine at 10000 may look

(continued on next page)

Figure 1. Standardising a normal distribution of marks.



```

10 PRINT "MARKS PROGRAM"
20 PRINT "-----"
30 PRINT:PRINT:PRINT:PRINT:PRINT:PRINT:PRINT
40 REM PROGRAM TO STANDARDISE
50 REM ENTRANCE EXAM MARKS.
60 REM BY I.MERCER 9/2/81
70 REM
80 REM DATE
90 DA$="FEBRUARY 1981"
100 REM MEAN MARK AFTER STAND.
110 SM=50
120 REM STANDARD DEVIATION AFTER STAND.
130 SD=15
140 REM USE AN INPUT FILE TO PREVENT
141 REM ACCIDENTAL <RETURNS>.
150 OPEN 1,0,0
160 REM SUBJECT NAMES
170 SU$(1)="ENGLISH":SU$(2)="MATHS":SU$(3)="I.O."
180 P$="#####"
190 D$="#####"
200 REM INPUT NUMBER OF CANDIDATES
210 PRINT "HOW MANY CANDIDATES?"
220 INPUT #1,N$:N=VAL(N$):PRINT
230 IF N<2 THEN PRINT "WRONG - TRY AGAIN!" GOTO 210
240 IF N<INT(N) THEN PRINT "WHOLE CANDIDATES ONLY!" GOTO 210
250 REM DIMENSION THE ARRAY
260 DIM A(N,7),S(2,3)
270 REM A(X,0) = POSITION
280 REM A(X,1) = ENGLISH
290 REM A(X,2) = MATHS
300 REM A(X,3) = I.O.
310 REM A(X,4) = ENGLISH STAND.
320 REM A(X,5) = MATHS STAND.
330 REM A(X,6) = I.O. STAND.
340 REM A(X,7) = TOTAL (MATHS + ENGLISH)
350 REM NOW INPUT THE MARKS
360 FOR SU=1 TO 3
370 PRINT "INPUT ";SU;" MARKS"
380 PRINT:PRINT
390 FOR X=1 TO N
400 GOSUB 10000
410 NEXT X
420 PRINT P$ "IS IT CORRECT?":D$
430 INPUT #1,A$:IF LEFT$(A$,1)="" THEN 510
440 IF LEFT$(A$,1)="" THEN 420
450 REM CORRECT A MARK
460 PRINT P$: "WHICH CANDIDATE?":D$
470 INPUT #1,A$:X=VAL(A$)
480 IF X<1 OR X>3 THEN 420
490 A(X,SU)=A(0,SU)-A(X,SU)+A(0,SU+3)-A(X,SU)*A(X,SU)
500 GOSUB 10000:GOTO 420
510 NEXT SU
520 REM MARKS INPUT - BEGIN CALCULATIONS
530 FOR SU = 1 TO 3
540 S(1,SU)=A(0,SU)/N
550 S(2,SU)=SQR(A(0,SU+3)/N-S(1,SU)*S(1,SU))
560 NEXT SU
570 FOR X = 1 TO N
580 FOR SU = 1 TO 3
590 A=(A(X,SU)-S(1,SU))/S(2,SU)
600 A=A*SS+SM
610 A(X,SU+3)=INT(A+.5)
620 NEXT SU:A(X,7)=A(X,4)+A(X,5)
630 NEXT X
640 REM PRINT OUT RESULTS
650 REM OPEN FILE TO PRINTER
660 OPEN 4,4
670 PRINT "##### LINE PRINTER UP TO TOP OF PAGE"
680 PRINT " AND PRESS <RETURN>"
690 GET A$:IF A$<>CHR$(13) THEN 690
700 PRINT #4
710 PRINT #4,SPC(20);CHR$(1);"ENTRANCE EXAMINATION"
711 PRINT #4,SPC(20);CHR$(1);"-----"
720 PRINT #4,SPC(20);CHR$(1);" RESULTS "
721 PRINT #4,SPC(20);CHR$(1);"-----"
730 PRINT #4,SPC(60);DA$:PRINT #4
740 PRINT #4," ENGLISH MATHS I.O."
750 PRINT #4," NO."
760 FOR TT = 1 TO 3:PRINT #4," TRUE SCALED POSN ";NEXT TT
770 PRINT #4," TOTAL POSITION"
780 PRINT #4
790 REM NOW PRINT OUT ACTUAL MARKS
800 FOR X = 1 TO N
810 PRINT #4,RIGHT$( " "STR$(X)+ " ",5);

```

(listing continued on next page)

(continued from previous page)

daunting for non-Pet users, but the cursor commands are only laying out the marks neatly on the screen as they are input. These could be replaced by HTAB and VTAB on the Apple or equivalent, or omitted.

As the marks are input, they are totalled up in the zero element of the array — see line 10050. But remember that if a mark is altered you must correct these totals — see line 490. When all the marks have been input, the program calculates the mean and SD for each subject — see lines 530-560 and stores them in an array S(.). Next it standardises the marks. For this entrance exam the total does not include the IQ paper; line 620 totals the maths and English marks.

Now the results are output to the printer — any printer offering 80 columns or more will do. Extensive formatting in the form of Right\$() is used to ensure a neat table with right-justified numbers. The program also calculates the positions in each subject and the overall position.

This section of the program takes the longest to run, but since it is only run once a year I did not think it was worth using machine code, which would have gained speed at the expense of readability of the program.

For reference, the program also prints out the original mean and standard deviation for each subject.

It then calculates a product-moment correlation coefficient. This can take a value from -1 to +1. For exam results it should be positive and above about 0.5.

A sample run using random numbers generated by the Pet is shown in figure 2.

(listing continued from previous page)

```

820 FOR SU = 1 TO 3
830 PRINT#4,RIGHT#(" "+STR$(A(X,SU))+"" " 6)
840 PRINT#4,RIGHT#(" "+STR$(A(X,SU+3))+"" " 6)
850 P%=1:EX=0:MA=A(X,SU)
860 FORT=1TON
870 IFA(X,SU)<MATHENP00
880 IFA(X,SU)>MATHENP%=P%+1:GOTO900
890 EX=EX+1
900 NEXTT
910 PRINT#4,RIGHT#(" "+STR$(P%),4)
920 IFEX>1THENPRINT#4,"=" " "GOTO940
930 PRINT#4," "
940 NEXTSU
950 PRINT#4,RIGHT#(" "+STR$(A(X,7))+"" " 7)
960 P%=1:EX=0:MA=A(X,7)
970 FORT=1TON
980 IFA(X,7)<MATHENI010
990 IFA(X,7)>MATHENP%=P%+1:GOTO1010
1000 EX=EX+1
1010 NEXTT
1020 PRINT#4,RIGHT#(" "+STR$(P%),6)
1030 IFEX>1THENPRINT#4,"="
1040 PRINT#4
1050 NEXT X
1060 FORT=1TO4:PRINT#4:NEXT
1070 PRINT#4,SPC(15):"ORIGINAL MEAN":SPC(17):"ORIGINAL S.D."
1071 PRINT#4,SPC(15):""SPC(17):"
1080 FORSU=1TO3
1090 PRINT#4,SPC(5):SU$(SU):SPC(7):LEFT$(STR$(S(1,SU))+" " 5)
1100 PRINT#4,SPC(25):LEFT$(STR$(S(2,SU))+" " 5)
1110 NEXT SU
1120 FORT=1TO4:PRINT#4:NEXT
1130 REM NOW CALCULATE THE PRODUCT MOMENT CORRELATION COEFFICIENTS
1140 PRINT#4,SPC(21):"PRODUCT MOMENT CORRELATIONS"
1141 PRINT#4,SPC(21):"
1150 FORSU=1TO3
1160 OS=SU+1:IFOS=4THENOS=1
1170 TT=0
1180 FOR T = 1 TO N
1190 TT=TT+(A(T,SU)-S(1,SU))*(A(T,OS)-S(1,OS))
1200 NEXT T
1210 PRINT#4,SPC(21):SU$(SU):" - ":SU$(OS):" "
1220 PM=TT/N/(S(2,SU)*S(2,OS))
1230 PRINT#4,LEFT$(STR$(PM))+" " 4)
1240 NEXT SU
1250 FORT=1TO4:PRINT#4:NEXT
1260 END
10000 PRINT#4"CANDIDATE #":X:":":D#
10010 INPUT#1,N#:J=VAL(N#)
10020 IFJ<1ORJ>200ORJ<>INT(J)THEN10000
10030 PRINT#4"X":":FORT=1TON:PRINT"#####":NEXT:PRINT"#####":
10040 PRINTRIGHT#(" "+STR$(J),4)
10050 A(X,SU)=J:A(X,SU)=A(X,SU)+J:A(X,SU+3)=A(X,SU+3)+J
10060 RETURN

```

Figure 2. Sample results of program.

ENTRANCE EXAMINATION										
RESULTS										
FEBRUARY 1981										
NO.	ENGLISH			MATHS			I.Q.			TOTAL POSITION
	TRUE	SCALED	POSTN	TRUE	SCALED	POSTN	TRUE	SCALED	POSTN	
1	33	32	9	52	55	3	52	45	5	98
2	56	58	4	74	79	1	62	59	4	137
3	44	44	7	35	35	8=	50	44	7=	79
4	63	66	2	43	44	7	54	49	5	119
5	71	75	1	52	54	4=	50	44	7=	129
6	51	52	5=	44	45	6	68	66	2	97
7	29	26	10	52	54	4=	72	71	1	90
8	51	52	5=	29	27	10	50	44	7=	79
9	36	35	8	35	35	8=	65	62	3	70
10	58	60	3	56	59	3	29	15	19	119
	<u>ORIGINAL MEAN</u>			<u>ORIGINAL S.D.</u>			<u>PRODUCT MOMENT CORRELATIONS</u>			
ENGLISH	49.1			13.0			ENGLISH - MATHS	: .98		
MATHS	49.1			13.2			MATHS - I.Q.	: -.02		
I.Q.	55.1			11.9			I.Q. - ENGLISH	: -.45		

RACE NIGHT

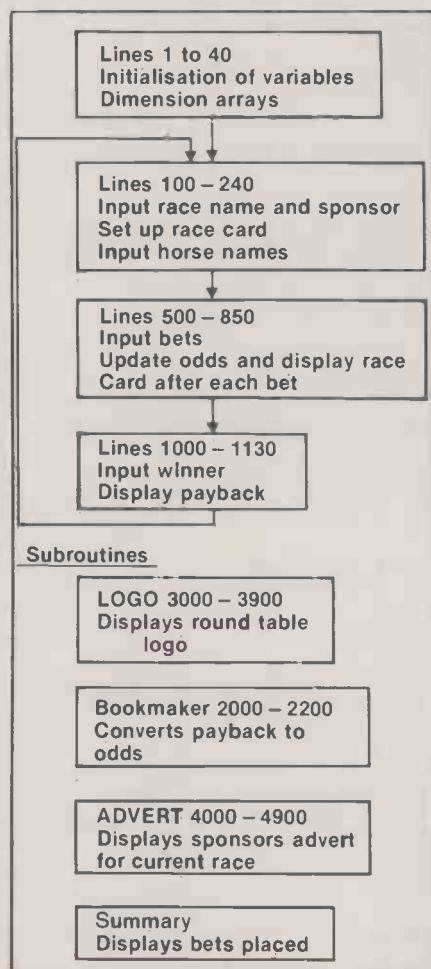
An evening's entertainment, and a good profit for charity are ingredients of a typical race night. This program from Eric Parr removes much of the paperwork and adds to the atmosphere of the occasion.

SIMULATED horse races provide the entertainment at the popular fund-raising events known as race nights. The activity centres round filmed races — often from obscure American or Australian race courses.

After seeing the runners being paraded round the paddock, the punters place their bets. Winnings, amounting to 60 percent of the total staked, are paid out at the end of the race, calculated on the totaliser principle. The remaining 40 percent is retained for charity. Between six and 10 races are normally run in an evening.

The Race Night program was written for Wishaw Round Table to replace most of the tedious paperwork and calculations involved in a normal race night. The

Figure 1. Block diagram of Race Night program, including subroutines.



system is supported by "bookies' runners" as it was thought advisable to use betting slips to allow manual back-up if the computer crashed.

The program was tested on several dummy runs, but on the night it performed better than expected. The tote was run successfully by just two people — a typist and a dictator.

The system also added some atmosphere to the night by providing continuously-updated odds. In a normal race night, odds are only available after a race has been run. Odds for the winner of each race were given within seconds of the finish, compared with the 10 to 15 minutes which had been usual on previous race nights.

The essence of the program is quite simple. The payback — P — per bet is given by:

$$\frac{0.6 \times U \times T}{N}$$

where U is the unit bet, T the total number of bets placed and N the total bets placed on the winning horse.

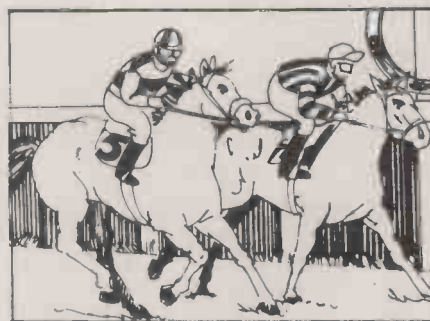
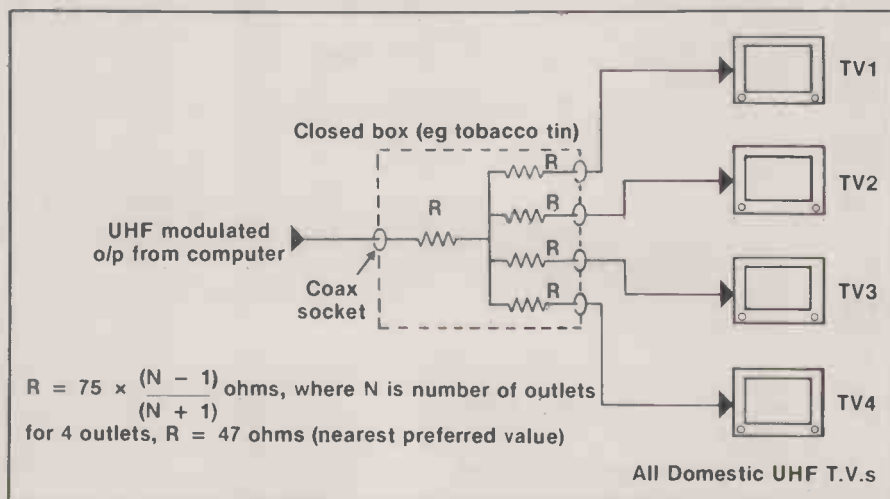
The majority of the program is actually devoted to embellishments, which include a race card displaying the horses' names and current odds, a Round Table logo for "quiet" periods, and a one-page advertisement for each race sponsor between races.

The program falls neatly into four blocks — see figure 1. The first block simply dimensions the arrays used, reserves an area for the string arrays and sets the price of a bet.

The second block inputs the horses' names. These could have been stored in arrays for each race, but in practice most names are sold on the night, and it adds atmosphere to the event if the race card is built up on the VDU screens as horses are sold.

The third, and most important, block inputs the bets. A race card is displayed,

Figure 3. Signal splitter to drive four UHF televisions.



RACE 3 WISHAW PRESS STAKES

Number	Name	Approx Odds
1	Heat for Hire	3/2
2	British Steel	5/1
3	Mighty Micro	EVENS
4	Red Revolution	4/1
5	Practical	
	Computing	4/1
6	Chip Chop	6/1

Number of bets? 5
Horse number? 2

Figure 2. Race-card display.

with odds — see figure 2. The actual bookmakers' odds are calculated in the subroutine from lines 2000 to 2200. The pay-back per unit bet is given by the simple formula.

$$P = T/N$$

and includes the original stake.

Bookmakers' odds ignore the original stake, hence we start with

$$BM = P - 1.$$

Bookmakers express odds in the form 8/1 or 6/1 or 3/2. The variable J is used as a multiplier and incremented from 1 until the ratio

$$\text{INT}(BM \cdot J)/J$$

is within 10 percent of BM. The ratio is then a rough approximation to bookmakers' odds. Line 2005 prints a blank if the odds are less than 1 to 10. Line 2030 simply prints P - 1 for odds greater than 5 to 1. Line 2110 prints "Evens" if the calculated odds are 1 to 1.

(continued on next page)

Arrays

H\$(I) Horse name
 OD(I) Pay-back/bet should horse win
 B(I) Number of bets on horse
 O\$(I) Owner's name

Other variables

U Price/bet
 RC Race number
 SP\$ Sponsor's name
 RC\$ Race name
 K Number of horses in race
 B Input number of bets
 T Total bets in this race
 BM Bookmakers' odds
 J,B1 Value of odds, B1 to J
 Q\$ } Keyboard inputs
 A\$ }
 A Numerical version of A\$
 P Pay-back

(continued from previous page)

Bets are given by the runners in the form "four bets on horse 1, six bets on horse 3, etc.". These are entered at lines 620/660. Line 670 deliberately ignores a bet if an invalid horse number is entered. This allows a typing error to be skipped. In addition, negative bets can be entered to correct errors. As each bet is entered, an updated race card is produced on the VDUs.

The final main block gives the winning pay-back. When the winner is announced, the horse number is entered and confirmed upon which the pay-back per bet is given, rounded to 10p.

There are four subroutines. Bookmakers' odds has already been described. The subroutines for the Round Table logo or an advertisement, for the race sponsor, are called when required. They consist of simple Print statements and are not listed here.

The final subroutine, Summary, displays the bets on each horse in cryptic

form. It was included to warn the pay-out booth how many claims to expect.

The program was written for a Nascom-2. The UHF-modulated output is used to drive the monitors around the hall, and the 1.5V peak-to-peak video feeds a closed-circuit TV monitor for the keyboard operator. The simple splitter shown in figure 3 allows four TVs to be driven from the UHF output without loss of quality. As the Nascom uses the standard Astec modulator, similar results would probably be achieved with other machines.

The one computer-assisted race night we have held so far was most successful. Only one error was made during the night, and this was later found to have been caused by a forged ticket. In a normal race night an error of plus or minus one ticket per horse is reasonable, so the program was an improvement in this respect. The biggest gains, though, were in the atmosphere created and the general smooth running of the event.

Table 1. Variables used in program.

```

1  REMARKABLE RACE NIGHT PROGRAM          840  NEXT (I)
2  REMARKABLY WRITTEN FOR WISHAW ROUND TABLE 850  GOTO 510
3  CLS                                     1000  REM RESULT OF RACE
4  PRINT "Good Evening"                  1005  CLS
5  INPUT "Bet Unit ";U                   1010  INPUT "Winning Horse No";A
6  CLEAR 4000                             1012  PRINT "Confirm Horse No";A
7  DIM H$(15),OD(15), B(15), O$(15)     1014  PRINT "HORSE NAME";H$(A)
10  CLS                                    1016  INPUT Q$
12  INPUT Q$: IF Q$="LOGO" THEN GO SUB 3000: GOTO 1018
20  INPUT "Race Number";RC               1018  IF Q$<>"YES" GOTO 1000
25  IF RC> 6 OR RC<1 GOTO 20             1020  CLS:PRINT "Race"; RC;" ";RC$
30  INPUT "Race Name"; RC$              1025  PRINT:PRINT "Sponsored by "SP$
40  INPUT "Sponsor"; SP$                1026  PRINT
100  REM INPUT HORSES                    1030  PRINT " *****WINNER*****"
110  CLS                                  1040  PRINT
120  INPUT "Number of Horses";K          1050  PRINT "Horse Number";A;" ";H$(A)
130  IF K<4 OR K>12 THEN 110             1060  PRINT "Owner";O$(A)
135  FOR I=1 TO K:H$(I)=" ": NEXT I      1070  PRINT
140  CLS: PRINT "Race"; RC; " "; RC$     1080  P=0.6*U
145  PRINT "Number", "Name"             1090  OD(A)=(INT((10*(U*P+0.05))/B(A)))/10
150  FOR I=1 TO K                        1095  PRINT
160  PRINT I,H$(I)                       1100  PRINT "Payback/Bet ";OD(A)
170  NEXT I                               1110  INPUT Q$
180  PRINT                                1115  IF Q$="LOGO" THEN GOSUB 3000: GOTO 1110
190  INPUT "Horse Number";A$:A=VAL (A$)  1120  IF Q$="ADVERT" THEN GOSUB 4000: GOTO 1110
200  IF A$="BET" GOTO 500                 1130  GOTO 10
205  IF A$="ADVERT" THEN GOSUB 4000: GOTO 140
210  IF A$<>"ADVERT" THEN GOTO 140
220  A=INT (A)                            2000  REM WORK OUT BOOKMAKERS ODDS
230  INPUT "Name";H$(A)                  2005  IF OD(I)<1.1 THEN PRINT " ":RETURN
235  INPUT "Owner";O$(A)                 2010  BM=OD(I)-1
240  GOTO 140                             2020  J=1
500  REM TAKE BETS                        2030  IF BM> 5 THEN B1=INT(BM+0.5):GOTO 2100
502  T=0                                  2040  B1=BM*J
504  FOR I=1 TO K:B(I)=0:OD (I) = 0: NEXT I  2050  IF ABS(B1-INT(B1+0.5))<J/10 THEN GOTO 2100
510  CLS                                    2060  J=J+1
515  PRINT "Race"; RC; " ";RC$:PRINT     2070  GOTO 2040
520  PRINT "Number Name"; TAB (35);"APPROX ODDS"  2100  B1=INT(B1+0.5)
530  FOR I=1 TO K                        2110  IF B1=1 AND J=1 THEN PRINT "EVENS":GOTO 2200
540  PRINT I; TAB (7);H$(I);TAB(36);    2120  PRINT "B1";"/";J
550  GOSUB 2000                           2200  RETURN
560  NEXT I                               3000  REM DRAW ROUND TABLE LOGO
600  REM ACTUAL BETS MADE                 3010  REM OMITTED FOR BREVITY
610  PRINT                                3900  INPUT Q$:RETURN
620  INPUT "Number of Bets"; Q$          4000  REM DISPLAY ADVERTS
625  IF Q$="LOGO" THEN GOSUB 3000: GOTO 510  4010  CLS:PRINT "Race";RC;" ";RC$
630  IF Q$="ADVERT" THEN GOSUB 4000: GOTO 510  4020  PRINT "SPONSORED BY";SP$
635  IF Q$="SUM" THEN GOSUB 5000: GOTO 510  4030  ON RC GO SUB 4100:4200:4300:4400:4500:4600
640  IF Q$="RUN" GOTO 1000               4040  INPUT Q$: RETURN
650  B=VAL (Q$)                           4100  REM FIRST RACE ADVERT
655  IF B>9 GOTO 510                     4102  REM OMITTED FOR BREVITY
660  INPUT "Horse Number";A              4190  RETURN
670  IF A<1 OR A>K GOTO 510              4200  REM LINES 4200 TO 4690 ADVERTS FOR
680  T=T+B:B(A) = B(A)+B                 4210  REM OTHER RACES. OMITTED FOR BREVITY
800  REM WORK OUT PAYBACKS               5000  REM SUMMARY OF BETS
810  P=0.6*U                              5010  FOR I=1 TO K
820  FOR I=1 TO K                         5020  PRINT I;B(I)
830  OD(I)=(INT(100*P/B(I)))/100         5030  NEXT I
                                           5040  PRINT T
                                           5050  INPUT Q$:RETURN
    
```


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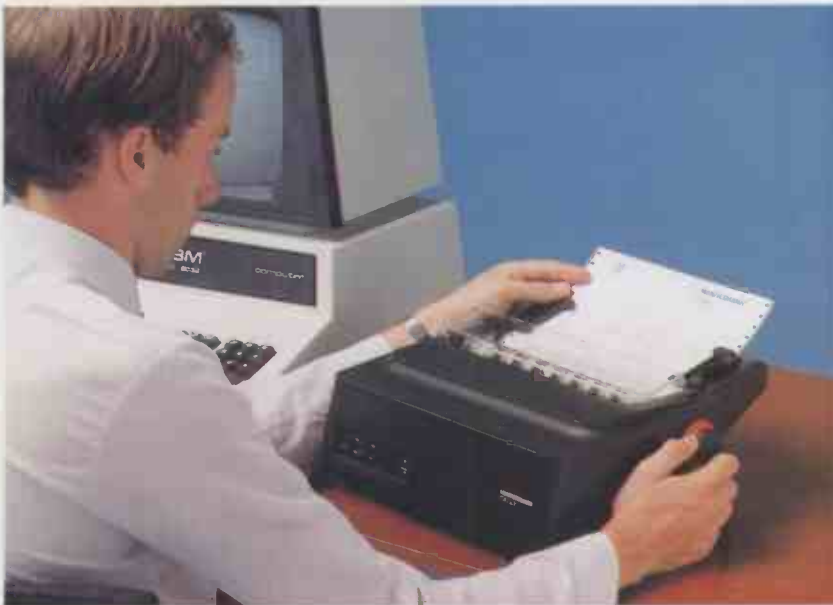


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The Twelve computerised Days of Christmas




On the first day of Christmas, my computer
gave to me
A glitch on the video screen.




On the second day of Christmas, my
computer gave to me
Two keyboard bounces,
And a glitch on the video screen.




On the third day of Christmas, my computer
gave to me
Three loose plugs,
Two keyboard bounces,
And a glitch on the video screen.




On the fourth day of Christmas, my
computer gave to me
Four garbled Saves,
Three loose plugs,
Two keyboard bounces,
And a glitch on the video screen.




On the fifth day of Christmas, my computer
gave to me
Five blank cassettes,
Four garbled Saves,
Three loose plugs,
Two keyboard bounces,
And a glitch on the video screen.




On the sixth day of Christmas, my computer
gave to me
Six I/O spasms,
Five blank cassettes,
Four garbled Saves,
Three loose plugs,
Two keyboard bounces,
And a glitch on the video screen.




On the seventh day of Christmas, my
computer gave to me
Seven system re-sets,
Six I/O spasms,
Five blank cassettes,
Four garbled Saves,
Three loose plugs,
Two keyboard bounces,
And a glitch on the video screen.




On the eighth day of Christmas, my
computer gave to me
Eight worthless printouts,
Seven system re-sets,
Six I/O spasms,
Five blank cassettes,
Four garbled Saves,
Three loose plugs,
Two keyboard bounces,
And a glitch on the video screen.




On the ninth day of Christmas, my computer
gave to me
Nine burnt-out fuses,
Eight worthless printouts,
Seven system re-sets,
Six I/O spasms,
Five blank cassettes,
Four garbled Saves,
Three loose plugs,
Two keyboard bounces,
And a glitch on the video screen.




On the tenth day of Christmas, my computer
gave to me
Ten disc-drive lockouts,
Nine burnt-out fuses,
Eight worthless printouts,
Seven system re-sets,
Six I/O spasms,
Five blank cassettes,
Four garbled Saves,
Three loose plugs,
Two keyboard bounces,
And a glitch on the video screen.



On the eleventh day of Christmas, my
computer gave to me
Eleven damaged diskettes,
Ten disc-drive lockouts,
Nine burnt-out fuses,
Eight worthless printouts,
Seven system re-sets,
Six I/O spasms,
Five blank cassettes,
Four garbled Saves,
Three loose plugs,
Two keyboard bounces,
And a glitch on the video screen.



On the twelfth day of
Christmas, my
computer gave to me
Twelve blown-out circuits,
Eleven damaged diskettes,
Ten disc-drive lockouts,
Nine burnt-out fuses,
Eight worthless printouts,
Seven system re-sets,
Six I/O spasms,
Five blank cassettes,
Four garbled Saves,
Three loose plugs,
Two keyboard bounces,
And a glitch on the video screen.



Simple Petpro puts thought into words

Petpro is an uncomplicated word-processing program for the Pet. Although Ian Birnbaum designed it originally for school and college use, it has been applied successfully in a variety of environments.

THIS WORD-processing program has many of the features which are found in larger programs, including right-justification and full editing facilities.

Petpro will run on any large-keyboard Pet. For the 4000 and 8000 series, some small modifications have to be made, and these are mentioned in the text. The program takes up a little over 4K of memory and does not require discs.

The program should be input in lower-case mode so you must Poke 59468,14 before typing it in. For the 4000 and 8000 series

- change the 49 in lines 22, 31 and 48 to 88
- change the 46 in lines 115 and 133 to 85.

Table 1. Design map.

Lines numbers	Function Subroutines
2-29	Subroutines
2-4	Wait for ready — "space" response
5-6	Line printout, editing mode
7	Prints quotation mark and ↑
8	Line wipeout
9	Line-length-exceeded message
10-11	Memory full in editing mode — common routine
12-13	Wait for answer Y/N
14-16	Input-mode option
17	Re-sets line text variables to zero
18-20	Tape input/output
21-22	Tape output
22	File-closing routine
23	Pause
24-25	Memory update in edit mode
26-29	Search for character/ space in justify
30	Delete line
31-42	Initialisation
43-48	Tape Input
50-76	Keyboard Input
50-61	Input checks and conversions
62-63	Character deletion
64-66	Carriage-return deletion with 8000 series, delete line 64
67-70	New-line routine
71-73	Automatic carriage-return routines
74-76	Tab routine
77-111	Editing Mode
80-94	Line-listing and option routines
95-98	Edit
99-102	Insert
103-111	Squeeze
112-139	Output mode and options for continuation
120-124	Justify

With the 8000 series only, line 64 should be deleted.

The program has three specific modes: the input mode, the edit mode and the output mode.

In input mode, text can be input either from the keyboard or from tape. The program allows a variable line-width up to 73 characters. You can set the right-hand margin by making this width smaller. Setting the width at 55 gives a right-hand margin of about 10, assuming that you will later be setting a left-hand margin of 10.

An automatic carriage-return operates no earlier than seven characters before the maximum line width you have set, and no later than two characters after it. It operates as soon as a space is typed, thereby avoiding word breaks. Split words can be amended, if desired, when in edit mode so manual carriage return will rarely have to be used.

Up to 10 tabs are allowed, but if you do not require any type 0. At this stage, if you have chosen tape input, the tape will be read and the program will immediately pass to edit mode.

When inputting from the keyboard, the following points should be noted.

- The Pet keyboard is turned into a normal QWERTY keyboard, so full stops, commas, etc., are in the normal place. The Run/Stop key, and all the cursor-movement keys are disabled — touching them will produce no effect.

- You can delete the last character input by the ↑ key or the Delete/Insert key, whether or not the shift-lock is on. It is best to use ↑ since it can be easily touch-typed. You can delete a carriage return in the same way. You should delete only local mistakes; others can be corrected when editing later.

- To obtain the next pre-set Tab, press —; it will operate whether or not the shift-lock is on. If the last Tab has been passed, or if there are no pre-set Tabs, — will be ignored.

- Automatic carriage-return will not operate until the absolute maximum line length is reached.

There are two ways to enter editing mode. If you fill up the memory, the computer will enter it automatically, though some room will be reserved for manipulation in this mode. After output, you will be able to return to the keyboard and continue.

With large-memory Pets, garbage collection can appreciably slow up some operations in editing mode. It is, therefore, better not to create too much text before editing. The 4000 and 8000 series Pets do not have this problem. The second way to leave the keyboard is by typing a quotation mark — use ↑ for quotation marks otherwise.

In editing mode the keyboard once again acts as a normal Pet keyboard, with

Name	Function
A	Maximum line length
B	1. File number, tape or printer 2. Character count in squeeze
C	Count for number of lines in text
D	1. Flag set to suppress space on new line 2. Controls memory add/subtract 3. Character pointer in justify
E	1. Flag set if last Tab set 2. Set to 2 if memory close to full
F	Flag set if memory full before end of file on tape input
G	Number of lines output to printer for each piece of text
H	Maximum number of lines per page
I	1. General For/Next counter 2. Device number for tape 3. Unshifted ASCII value of A\$
J	1. Secondary address for tape 2. Line number to be edited, etc.
K	1. Counter for line wipe-out 2. Length of next string in squeeze
L	Counter for total number of characters input
M	Maximum number of line possible
N	1. Counter for lines to be printed out during editing mode 2. Length of current string in justify
O	Left-margin length
P	1. Next Tab to be set 2. Length of next string in justify
Q	1. Counter for list of Tabs 2. Length of pause 3. Flag for search in justify
R	1. Counter for pause subroutine 2. Line count in squeeze 3. Flag for character/space found in justify
S	Double-spaced line flag
T	Number of Tabs
U	Set to prevent number of lines output being re-set to zero
V	Set to miss out lines 42-48 when keyboard input follows tape
W	1. Counter for Tab printing 2. Length of current string in squeeze
X	Correct line length pointer
Y	Maximum available memory after null-string pointers set, etc.
Z	Maximum number of lines input prior to editing
T()	List of Tabs pre-set
A\$	1. Character input from keyboard 2. Store for memory full 3. Current string in squeeze 4. Current line in printout
B\$	1. Mode of operation, k/t 2. Store for line number in editing mode 3. Flag for justify
C\$	Last mode of operation
E\$	Next string in squeeze
A\$()	Lines Input from keyboard or tape

Table 2. Variable list

the full stop in the "wrong" place, and cursor movement allowed. Key ↑ will no longer delete characters and the Delete key must be used. Characters may be inserted by using the Insert, shifted Del/Inst, key.

The lines are displayed in groups of 10.

```

1 POKE59468,14:PRINT"Q:PETPRO#2":PRINTSPC(11)"KCOI BIRNBAUM 1981Q":GOTO31
2 PRINT"APRESS <SPACE> WHEN READY."
3 GETA$:IFA$<>" "THEN3
4 RETURN
5 PRINT"Q":FORI=0TO9:IFN+I>0THENRETURN
6 PRINTI:RIGHT$(A$(N+I),LEN(A$(N+I))-1):NEXT:RETURN
7 PRINT"Q":CHR$(34)CHR$(34)CHR$(20)"S"SPC(A+4)"T":POKE623,29:POKE158,1:R
ETURN
8 FORK=32768TO32847:POKEK,32:NEXT:RETURN
9 PRINT"QMAX LINE LENGTH EXCEEDED.":Q=1111:GOSUB23:GOSUB8:RETURN
10 PRINT"QNO "A$" POSSIBLE: MEMORY FULL."
11 Q=2000:GOSUB23:GOTO81
12 GETA$:IFA$<>"Y"ANDB$<>"N"THEN12
13 RETURN
14 PRINT"QKEYBOARD OR TAPE INPUT?"
15 GETB$:IFB$<>"K"ANDB$<>"T"THEN15
16 RETURN
17 FORI=1TOC:A$(I)="" :NEXT:U=1:Y=FRE(0):PRINT"Q":RETURN
18 PRINT"QNAME OF TAPE FILE (IF NO NAME):INPUT"PRESS <RETURN>":A$
19 IFA$=""THENA$=""
20 OPENB,I,J,A$:RETURN
21 B=2:I=F+1:J=1:GOSUB18:FORI=1TOC:PRINT#2,CHR$(34)+A$(I):NEXT
22 CLOSEB:POKE144,49:RETURN
23 FORR=1TOQ:NEXT:RETURN
24 L=L+LEN(A$(N+J))*D:IFL>.7*YORC=MTHENE=2
25 RETURN
26 R=0:D=D+1:IFD>NTHEND=2:IFQ=0THENRETURN
27 IFMID$(A$,D,1)<>" "THENR=1
28 IFR=0THENRETURN
29 GOTO26
30 D=-1:GOSUB24:C=C-1:FORI=N+JTOC:A$(I)=A$(I+1):NEXT:A$(I)="" :RETURN
31 POKE144,49:GOSUB14:C#=B$:PRINT"Q"
32 INPUT"MAX LINE LENGTH (73 OR LESS)":A:IFA>73THENPRINT"Q":GOTO32
33 IFB$="T"THEN42
34 PRINT"QAUTOMATIC CARRIAGE RETURN":PRINT"WILL OCCUR BETWEEN CHARACTER"
35 PRINT"POSITIONS"A-7"AND"A+2
36 INPUT"QHOW MANY TABS (MAX 10)":T:IFT=0THEN41
37 IFT>10THENPRINT"Q":GOTO36
38 PRINT"QENTER THEM IN NUMERICAL ORDER"
39 PRINT"COLUMN POSITIONS ARE BETWEEN 1 AND"A:PRINT:FORI=1TOT
40 PRINT"TAB NO.":I:INPUTT$(I):NEXT
41 IFV=1THEN49
42 M=INT(FRE(0)/A)+10:Z=INT(.9*M):DIMA$(M):Y=FRE(0):IFB$="K"THEN49
43 B=1:I=1:J=0:GOSUB18
44 FORC=1TOZ:INPUT#1,A$(C):L=L+LEN(A$(C))
45 IFST=64THENPRINT"QEND OF FILE":GOSUB22:GOTO78
46 IFL>.7*YTHENGOTO48
47 NEXT:C=C-1
48 F=1:POKE144,49:GOTO77
49 GOSUB2
50 PRINT"Q":POKE167,0:C=1:D=0:E=0:A$(1)=""

```

(listing continued on next page)

Pressing < displays the next 10 lines; pressing > displays the last 10 lines; pressing X allows exit to output mode. Otherwise there are four options:

- Delete a line shown. For example, D7 deletes the line 7 and moves up all the rest. Line 9 becomes the one that would have been first in the next group of 10.
- Edit a line shown. For example, E4 displays line 4 at the top of the screen. Move the cursor to the point where editing is required. Take care not to erase the quotation mark which always precedes the line. When the line is edited to your satisfaction, press Return and the newly-edited line will replace the old one in the displayed group of 10.
- Insert a line before one shown. For example, I3 to insert a line before Line 3. A blank line will appear at the top of the screen, preceded

by the quotation mark. It is essential that this mark is not erased. Type in the new line and press Return when finished.

If the last group of lines is being displayed, it is possible to insert one after the last line. Type I followed by any line number greater than the one shown. For example, if seven lines are displayed, typing I7, I8 or I9 will allow an eighth line to be added. In the event of the last group being exactly 10 lines, a line may be added by first inserting a dummy blank line in the group — e.g., by typing I9 and then Return. This shifts line 10 into the next group, which was previously empty, allowing the real line to be added. The dummy line can then be deleted.

- Squeeze up text to a line. For example, S4 moves text so that each line after, and including line 4, will have at most seven characters less than the maximum allowed per line. The squeeze facility continues to squeeze text until

it meets a blank line or a line beginning with a space, both of which are signals for new paragraphs.

Combining the four editing functions allows a wide range of changes to be made to text. For example, suppose line 4 reads, with a few modifications the program can be used with

and you want to insert the words "very elementary" between "few" and "modifications", while keeping the maximum line length at 55. One way to do this is to type E4, delete all the words after "program" and make the required insertion. Then type I5, and type in the deleted words "can be used with". Finally, by

(continued on next page)

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typing S5, all the text will be properly squeezed up.

If you type a wrong letter when choosing an option — e.g., a D instead of an I — you can press Delete to rectify it. Within options E and I, the marker I shows the end of the line. If you exceed the maxi-

mum line length, the computer displays a message and allows you to try again.

After you have seen all the text on the screen you can display it again by typing Y when asked. At this stage you may perform further editing if you wish, and you can make several passes through the text before entering output mode.

If a printer is attached, you can obtain a printout of the text with either single or double-spaced lines. If you have specified a maximum number of lines per page, the printing will stop at the relevant time to allow you to change the paper.

Note that with double-spaced lines, each typed line will take up two lines on the page. So for example, if the paper can take 50 lines you should set the maximum number of typed lines at 25.

When you set the left-hand margin, note that the total line length should not exceed 80.

The program will right-justify the text if required. Justification will be to a width of two more than the maximum line width set. If tables are included, which you do not want to justify, precede each line of the table by at least one space. The program will not justify a line if the next line begins with a space, or is blank. Neither will it justify a line shorter than seven characters less than the maximum line width set.

After printout, a number of options are available: you can print out again; you can save the text on tape; or you can edit the text again, which is useful if you want to change just a few parts and then save again. Any or all of these options can be combined.

You will then have the option of continuing text input, either from the keyboard or from tape. Subsequent printout can either carry straight on from the previous text — in which case the number of lines already output will be remembered — or else you can start on a new page.

In tape input mode, it is possible that the tape may contain more than the available memory can take. In this case, if you want to save the text again on tape, you will need to use the second cassette port. The program is designed to inform you of this, and it will also remind you that there is more text on tape to input.

For non-Pet printers you will need to delete coding which relates to the adding on of a cursor-down symbol for each new line of text. This occurs in line 50, 69, 98 and 111. Most references to LEN(A\$(C)) will have to be reduced by one. These occur on lines 61, 64, and 66. Also subtract 1 from expressions including A in 7, 35, 70, 72, 97, 101, 103, 107, 120 and 122. Change the MID\$ in 110 to Left\$(E\$, B-1); D=2 in 26 to D=1; and 2 in 103 and 120 to 1. Finally the Right\$ function in lines 6, 65, 96 and 109 can be removed. You may need to add code, specific to your printer in order to give you lower-case facilities.

The overriding design philosophy of the program is that it should work as fast as possible, and be as economical as possible with memory space. Unfortunately, this tends to make the readability of the program difficult, but tables 1 and 2 should help if you wish to make modifications.

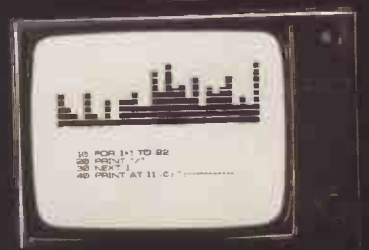
(listing continued from previous page)

```

51 GETA$: IFA$=" " THEN S1
52 I=ASC(A$) AND 127: IF I=13 THEN 66
53 IF (D=1 AND A$=" ") OR I=30 RI=170 RI=180 RI=29 THEN S1
54 D=0: IF ASC(A$)=34 THEN PRINT "D": GOT078
55 IFA$=" " THEN A$=" "
56 IF I=59 THEN A$=" "
57 IFA$=" " THEN A$=" "
58 IFA$=" " THEN A$=" "
59 IF I=95 THEN 74
60 IF I<>20 AND I<>94 THEN PRINT A$: GOT070
61 IF LEN(A$(C))=1 THEN S3
62 A$(C)=LEFT$(A$(C), LEN(A$(C))-1): PRINT CHR$(20): GOT051
63 A$(C)="": C=C-1: L=L-LEN(A$(C))
64 IF LEN(A$(C))>39 THEN PRINT " " " "
65 PRINT " " " " RIGHT$(A$(C), LEN(A$(C))-1): GOT051
66 IF LEN(A$(C))<39 THEN X=225+PEEK(216): POKE X, (PEEK(X) OR 128)
67 PRINT " " CHR$(13): E=0: L=L+LEN(A$(C))
68 IF C=20 RL: 8*Y THEN PRINT "D": GOT077
69 C=C+1: A$(C)=" " " " : GOT051
70 IF E=0 AND LEN(A$(C))>A-7 AND A$=" " THEN 73
71 A$(C)=A$(C)+A$
72 IF LEN(A$(C))>A+3 THEN S1
73 D=1: GOT067
74 FOR D=1 TO 1: IF PEEK(198)>=TZ(Q)-1 THEN NEXT: GOT051
75 P=TZ(Q)-PEEK(198)-1: FOR N=1 TO P: A$(C)=A$(C)+" ": PRINT " ": NEXT
76 E=(Q-T)*T(C): GOT051
77 PRINT "D" COMPUTER MEMORY FULL, "
78 POKE 167, 1: PRINT "EDIT TEXT IF NECESSARY.": PRINT "P" PRESS "CHR$(34)" WHEN READY
79 GETA$: IFA$<>CHR$(34) THEN 79
80 N=1
81 GOSUB 5: IF I=0 THEN 112
82 PRINT "DELETE EDIT INSERT SQUEEZE + LINE NUMBER":
83 PRINT SPC(10) "OTHERWISE EXIT D S "
84 GETA$: IF A$=" " AND N=10 OR A$=" " THEN N=N+10*(A$=" ") - 10*(A$=" "): GOT081
85 IFA$=" " THEN 112
86 IFA$=" " OR (A$<>"D" AND A$<>"E" AND A$<>"I" AND A$<>"S") THEN 84
87 PRINT A$:
88 GETB$: IF B$=" " THEN 88
89 IF ASC(B$)=20 THEN PRINT B$: GOT084
90 IF ASC(B$)<48 OR ASC(B$)>57 THEN 88
91 PRINT B$: J=VAL(B$): IF J THEN J=I*(A$<>"E")*-1
92 IFA$="D" THEN GOSUB 30: GOT081
93 IFA$="I" THEN 99
94 IFA$="S" THEN 103
95 IF E=2 THEN IF FRE(0)<250 THEN A$="EDITING": GOT010
96 D=-1: GOSUB 24: GOSUB 7: FRINTRIGHT$(A$(N+J), LEN(A$(N+J))-1): INPUT " " : A$
97 GOSUB 8: IF LEN(A$)>A+2 THEN GOSUB 9: GOT096
98 A$(N+J)=" " + A$: D=1: GOSUB 24: GOT081
99 IF E=2 THEN IF FRE(0)<300 OR C=M THEN A$="INSERTING": GOT010
100 FOR I=C TO N+J STEP -1: A$(I+1)=A$(I): NEXT: C=C+1
101 GOSUB 7: INPUT " " : A$: GOSUB 8: IF LEN(A$)>A+2 THEN GOSUB 9: GOT0101
102 GOT098
103 FOR R=N+J TO C-1: A$=A$(R): E$=A$(R+1): W=LEN(A$): K=LEN(E$): IF K<20 OR W=1 THEN 81
104 IF W>A-7 THEN NEXT: GOT081
105 IF MID$(E$, 2, 1)=" " THEN 81
106 IF K<A-6 THEN 109
107 FOR B=A-5-W TO K-1: IF MID$(E$, B, 1)=" " OR B>A+3-W THEN 110
108 NEXT
109 A$(R)=A$+" " + RIGHT$(E$, K-1): J=R+1-N: GOSUB 30: NEXTR: GOT081
110 A$(R)=A$+" " + MID$(E$, 2, B-2): IF MID$(E$, B+1, 1)=" " THEN B=B+1
111 A$(R+1)=" " + RIGHT$(E$, K-E): NEXTR: GOT081
112 PRINT "DO YOU WANT TO LOOK AT THIS TEXT": PRINT "AGAIN?": GOSUB 12
113 IFA$="Y" THEN 80
114 PRINT "IS THERE A PRINTER ATTACHED?": GOSUB 12: IFA$="N" THEN 130
115 PRINT "MAKE SURE THE PRINTER IS ON": GOSUB 2: POKE 144, 46: OPEN 4, 4: IF U=1 THEN 119
116 G=0: PRINT "DO YOU WANT DOUBLE-SPACED LINES?": GOSUB 12: S=(A$="Y")
117 PRINT "MAXIMUM NUMBER OF TYPED LINES PER PAGE": PRINT "(IF NO MAX TYPE 0)":
118 INPUT " " : H: INPUT "LENGTH OF LEFT HAND MARGIN " : I: PRINT #4
119 PRINT "JUSTIFY TEXT?": GOSUB 12: E$=A$: D=1: FOR I=1 TO C: A$=A$(I): IF B$="N" OR I=C THEN
N125
120 N=LEN(A$): P=LEN(A$(I+1)): IF P<1 THEN IF MID$(A$(I+1), 2, 1)<>" " AND N>A-7 THEN 122
121 GOT0125
122 IF N=A+3 THEN 125
123 Q=1: GOSUB 26: Q=0: GOSUB 26: IF D=2 THEN 123
124 A$=LEFT$(A$, D)+" " + MID$(A$, D+1): N=N+1: GOT0122
125 PRINT #4: SPC(D) A$: G=G+1: IFS=-1 THEN PRINT #4
126 IF G<H THEN 128
127 PRINT "MAX LINES PER PAGE REACHED": PRINT "ADJUST PAPER": GOSUB 2: G=0: PRINT "D"
128 NEXT: B=4: GOSUB 22
129 PRINT "PRINT THIS OUT AGAIN?": GOSUB 12: IFA$="Y" THEN 115
130 PRINT "SAVE THIS TEXT ON TAPE?": GOSUB 12: IFA$="Y" THEN GOSUB 21
131 PRINT "EDIT THIS TEXT AGAIN?": GOSUB 12: IFA$="Y" THEN 80
132 E=0: IF F=1 THEN 139
133 PRINT "MORE TEXT TO INPUT?": GOSUB 12: IFA$="N" THEN POKE 144, 46: END
134 PRINT "WILL PRINTOUT CARRY": PRINT "STRAIGHT ON?": GOSUB 12
135 IFA$="N" THEN CLR: GOT031
136 GOSUB 14: IF B$="T" THEN GOSUB 17: GOT043
137 IF C$="K" THEN GOSUB 17: PRINT "O.K. CONTINUE.": Q=555: GOSUB 23: GOT050
138 C$="K": GOSUB 17: V=1: GOT034
139 GOSUB 17: PRINT "THERE IS MORE TEXT ON TAPE TO INPUT": L=0: F=0: GOSUB 2: GOT044

```


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: £49.⁹⁵

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: £69.⁹⁵

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 £49.⁹⁵

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 Ltd, FREEPOST 7, Cambridge, CB2 1YY.

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

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.

PRC12

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

Upgrading your machine from an uncluttered micro to a versatile word processor will probably teach you as much about the abundance of printers available as about your programming strengths and weaknesses. Tina Billett relates her experiences of the subject and presents the word-processing program she wrote to solve the problems.

Justifying Genie

GENIE has been in our home for a little over a year, during which time we have gone from strength to strength in both range and size of the programs devised, or attempted.

My spouse has written a financial program for our own purposes, which does everything except go to the bank, but I have tended by and large to stick to games and other useless time-wasters. Even so, I have attained a kind of working knowledge as to how this beast called Genie thinks.

One of the carrots dangled in front of me when the subject of home micros first cropped up was that of the word processing potential. It is several years since I last worked in an office, so I had never met one of those contraptions face to face, as it were. My knowledge was limited to what I had seen on TV.

Before the arrival of Genie, I had spent most of my spare time writing, and having got over the initial micro-addiction, I returned my attention to the neglected typewriter, niggling all the while at the unfulfilled promise of the glories of word processing which, I had been informed, would "only be a matter of time".

Eventually we saved enough pennies — or so we thought — to venture into the hitherto unknown world of printers. Confusion piled up on confusion.

Establishing requirements

There were so many available, but so few of those we could afford had what I considered to be a suitable type-face. Editors are peculiar creatures at the best of times, and the thought of presenting a typescript with characters made up of dots to such elevated persons made me shudder.

We perused the pages of appropriate publications endlessly, but the advertised prices, contrary to hopes of miracles, did not diminish with subsequent readings. After much heart searching we decided to try to obtain a second-hand machine, keep our fingers crossed and hope nothing drastic would go wrong — in which case we could have little or no recourse to the vendor.

We tracked down a supplier of re-conditioned Termi-printers and went along to have a look. After trying the poor man's patience to the limit with endless and seemingly stupid questions, we went to have lunch with a promise to think about it. The price was comparable to a new dot-matrix printer, but I had already

made up my mind that however good the latter was professed to be by sales chat, it was not good enough for my purposes. My difficulty was to convince the breadwinner of the family that I could find space for the enormous object I was trying to talk him into purchasing.

Finally I won, and we returned home the proud owners of our first peripheral. The next step was to interface the printer to Genie. We had several choices, but because we want a disc drive eventually, we opted for an expansion box on the grounds that doing it on the cheap would be a false economy.

We had to dig deep into pockets and bank accounts to do this, but reasoned that unless the roof caved in we could probably survive until next pay-day.

After many trials and tribulations we finally had all the necessary hardware, but lacked the software — a word-processing program. As the coffers by now were well and truly empty, I set about writing my own.

To start with I had to decide exactly what my requirements were, balance these against what facilities were available, my programming capabilities, and come up with something both simple and adequate. The resulting effort makes no pretence of being perfect, so the producers of commercial word-processing software need not fear the competition. On the other hand, home micro buffs may find it useful for all manner of things.

There are three major areas of creative writing in which I am engaged — letters, magazine articles, and a weekly newsletter. This program is geared to all three, but hopefully the following notes will enable individuals to select which features to adopt and which to ignore, although a user will be limited if his printer has less than 100 characters per line.

As the words are contained in strings there is a Clear 7500 on line 30, after which the program jumps to options on lines 360 to 400. Elsewhere the listing follows a sequence so there are no sub-routines. There are very few Rems in the listing, contrary to the demands of conventional programs, but this is largely due to preserving memory for more important functions.

The constants N and Y are of prime importance, because the whole program revolves around them. The basic function of the program is to enable the user to compile, then either save or print one page of text, a page being either a single

column of 60 characters or two columns of 45 characters each. This option is determined by the input of Y on line 60 and any deviation from this, either from choice or necessity, must be amended on lines 460, 470, 1460-1480, and 1500.

The number of required lines per page is input on line 50. This can be anything at all so long as it is borne in mind that the double-column option — Y=45 — requires twice the number of lines for a full printed page, and preferably an even number. The value of SS, on lines 480, 1530 and 1540 is also dependent on the size of paper used.

On printers which have a form-feed facility, these could probably be dispensed with altogether. User's address should replace the blurb on lines 1460-1480, and if addressed heading is required then this should be taken into account when determining the value of N. If I have forgotten to mention any other idiosyncrasies of the listing, no doubt you will find out for yourself.

Program features

Lines 80-340. Text input. There are several items worth noting in this section.

Line 130. This is an optional extra for the ex-typist, for the printer bleeps to remind one that the end of the line is looming, enabling insertion of hyphen if the current word is longish. It all depends on how fussy one is on full justification. In any case this can be modified during editing — see instructions for use.

Line 200. For new paragraph. I use the unshifted ESC key, as a matter of convenience, this being in a similar position to the Tab key on my typewriter. Any other key would do the same with modification to this line.

Lines 220-230. The Genie being a peculiar creature, lower-case characters, although not displayed on the VDU, are present as an output to printer.

Unfortunately capitals are unshifted and unless one wishes to hold down the shift key for lower-case throughout, some means has to be found to reverse the normal procedure. These lines do that.

When the required number of lines are complete, no further text is accepted. Only the insertion of * lets the program proceed. The options displayed then are self-explanatory.

Line 460. On the assumption — see note — that the printer is pre-settable for left-hand margin, and that this has been

(continued on page 104)

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```

10 CLS: PRINT@338,"WORD PROCESSING PROGRAMME
"
15 REM (C) T. BILLET 1981
20 PRINT@470,"BY TINA BILLET": PRINT : PRIN
T : PRINT
30 CLEAR 7500: GOTO 360
50 CLS: INPUT "HOW MANY LINES PER PAGE"; N
60 INPUT "HOW MANY CHARACTERS PER LINE"; Y
70 DIM A$(N+1),B$(N+1)
80 PRINT "READY TO START"
90 PRINT CHR$(14);
100 X=X+1: IF X=N+1 THEN 350
110 A$(X)=" "
120 I$=INKEY$: IF I$="" THEN 120
130 IF LEN(A$(X))=Y-7 THEN LPRINT CHR$(7)
140 IF I$=CHR$(8) AND LEN(A$(X))>0 THEN A$(X
)=LEFT$(A$(X),LEN(A$(X))-1): PRINT I$: GOTO
260
150 IF I$=CHR$(8) THEN I$="": GOTO 120
160 IF I$=CHR$(13) THEN PRINT I$: GOTO 100
170 IF I$=CHR$(44) THEN I$=","
180 IF I$=CHR$(45) THEN I$="-"
200 IF I$=CHR$(91) THEN I$=" " : PRINT I$
: A$(X)=I$: GOTO 120
220 T=ASC(I$): IF T>64 AND T<91 THEN I$=CHR$(
T+32): GOTO 240
230 IF T>96 AND T<123 THEN I$=CHR$(T-32)
240 PRINT I$:
250 A$(X)=A$(X)+I$
260 IF LEN(A$(X))<Y+1 THEN 120
270 IF LEN(A$(X))=Y+1 AND RIGHT$(A$(X),1)="
" THEN PRINT : GOTO 100
280 J=1
290 IF MID$(A$(X),(LEN(A$(X))-J),1)<>" " THE
N J=J+1: GOTO 290
300 B$=RIGHT$(A$(X),J): A$(X)=LEFT$(A$(X),(L
EN(A$(X))-J)
310 FOR I=1 TO J: PRINT CHR$(8): : NEXT
320 IF LEFT$(B$,1)=" " THEN B$=RIGHT$(B$, (LE
N(B$)-1))
330 PRINT : PRINT B$:
340 X=X+1: IF X=N+1 THEN 350:ELSEA$(X)=B$: B
$="": GOTO 120
350 PRINT : PRINT : PRINT N: " LINES COMPLET
E. " : PRINT
360 PRINT : PRINT "PRESS * TO CONTINUE":
370 M$=INKEY$: IF M$<>"*" THEN 370
380 CLS: D=0: PRINT "OPTIONS": PRINT : PRINT
"1 - OUT TO PRINTER": PRINT "2 - REVIEW LIN
ES": PRINT "3 - NEW PAGE": PRINT "4 - STOP":
PRINT "5 - EDIT": PRINT "6 - JUSTIFY"
385 PRINT "7 - SAVE DATA TO TAPE": PRINT "8
- INPUT DATA FROM TAPE": PRINT: PRINT "ENTER
CHOICE": INPUT D
390 ON D GOTO 460, 410, 440, 450, 570, 910,
1640, 1880
400 GOTO 380
410 FOR Q=1 TO N: PRINT Q: A$(Q)
420 NEXTQ
430 GOTO 360
440 IF A$(1)<>" " THEN INPUT "ARE YOU SURE":
S$
442 IF LEFT$(S$,1)="N" THEN 380
444 RUN 50
450 END
460 IF Y=45 THEN FOR Q=1 TO N/2: LPRINT A$(Q
): : SP=Y-LEN(A$(Q))+10: FOR A=1 TO SP: LPRIN
T CHR$(32): : NEXTA: LPRINT A$(Q+N/2): NEXT
Q
470 IF Y>45 THEN 1420
480 SS=67-(N/2): FOR P=1 TO SS: LPRINT : NEX
T
490 IF C=0 THEN 530
500 B=B+1
510 IF B<C THEN 460
520 IF B=C THEN C=0: B=0: GOTO 380
530 INPUT "DO YOU WANT MORE COPIES": V$
540 IF LEFT$(V$,1)<>"Y" THEN 380
550 INPUT "HOW MANY": C
560 GOTO 460
570 INPUT "EDIT - WHICH LINE - ENTER NUMBER"
: D
575 IF D>N THEN 570
580 A$=A$(D): P=1
590 PRINT CHR$(14);
600 K1$=INKEY$: IF K1$="" THEN 600
610 IF K1$=CHR$(8) AND P>1 THEN PRINT K1$:
: P=P-1: K1$="": GOTO 600
620 IF K1$=CHR$(8) THEN K1$="": GOTO 600
630 IF K1$=" "PRINT MID$(A$,P,1): : P=P+1: G
OTO 600
640 IF K1$<>CHR$(13) THEN 670
650 IF P>LEN(A$) THEN PRINT K1$: A$(D)=A$:
A$="": GOTO 360
660 IF P>1 THEN PRINT RIGHT$(A$,((LEN(A$)-P
)+1)): A$(D)=A$: A$="": GOTO 360:ELSEIF P=1 T
HEN PRINT A$: A$(D)=A$: A$="": GOTO 360
670 IF K1$<>"D" THEN 710
680 IF P=1 THEN A$=RIGHT$(A$, (LEN(A$)-1)): G
OTO 600
690 IF P>LEN(A$) THEN A$=LEFT$(A$, (LEN(A$)-
1)): GOTO 600
700 F$=LEFT$(A$,P-1)+RIGHT$(A$,LEN(A$)-P): A
$=F$: GOTO 600
710 IF K1$<>"I" THEN 820
720 TP$=INKEY$: IF TP$="" THEN 720
730 IF TP$=CHR$(27) THEN 600
740 IF TP$=CHR$(13) THEN TP$="": GOTO 720
750 IF TP$=CHR$(8) AND P>1 THEN P=P-1: PRINT
: TP$: F$=LEFT$(A$,P-1)+RIGHT$(A$, (LEN(A$)-P
)): A$=F$: F$="": GOTO 720
760 IF TP$=CHR$(8) THEN 720
770 T=ASC(TP$): IF T>64 AND T<91 THEN TP$=CH
R$(T+32): GOTO 790
780 IF T>95 AND T<123 THEN TP$=CHR$(T-32)
790 IF P=1 THEN F$=TP$+A$: P=P+1: PRINT TP$:
: TP$="": A$=F$: F$="": GOTO 720
800 IF P>LEN(A$) THEN F$=A$+TP$: P=P+1: PRI
NT TP$: : TP$="": A$=F$: F$="": GOTO 720
810 F$=LEFT$(A$,P-1)+TP$+RIGHT$(A$,LEN(A$)-P
+1): P=P+1: PRINT TP$: : TP$="": A$=F$: F$="
": GOTO 720
820 IF K1$<>"C" THEN 600
830 TP$=INKEY$: IF TP$="" THEN 830
840 T=ASC(TP$): IF T>64 AND T<91 THEN TP$=CH
R$(T+32): GOTO 860
850 IF T>95 AND T<123 THEN TP$=CHR$(T-32)
860 IF P=1 THEN F$=TP$+RIGHT$(A$, (LEN(A$)-1
)): A$=F$: GOTO 890
870 IF P=LEN(A$) THEN F$=LEFT$(A$, (LEN(A$)-1
))+TP$: A$=F$: GOTO 890
880 A$=LEFT$(A$,P-1)+TP$+RIGHT$(A$,LEN(A$)-P
)
890 PRINT TP$: : P=P+1: TP$="": GOTO 600
900 GOTO 600
910 FOR Q=1 TO N
920 L$=INKEY$: IF L$="*" THEN 360
930 IF A$(Q)=" " THEN 1380
940 IF LEFT$(A$(Q),5)=" " THEN 960
950 IF LEFT$(A$(Q),1)=" " THEN A$(Q)=RIGHT$(
A$(Q),(LEN(A$(Q))-1)): GOTO 950
960 IF RIGHT$(A$(Q),1)=" " THEN A$(Q)=LEFT$(
A$(Q),(LEN(A$(Q))-1)): GOTO 960
970 IF LEN(A$(Q))=Y THEN PRINT Q: A$(Q): NEX
T: GOTO 360
980 IF LEN(A$(Q))<Y THEN 1120
990 IF LEFT$(A$(Q),5)=" " THEN S=6: V=0:
GOTO 1010
1000 S=1: V=0
1010 IF MID$(A$(Q),S,2)=" " THEN V=V+1
1020 IF V=1 THEN A$(Q)=LEFT$(A$(Q),S-1)+RIGH
T$(A$(Q),(LEN(A$(Q))-S)): GOTO 970

```

(continued on next page)

(listing continued from previous page)

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1030 S=S+1: IF S>LEN(A$(Q)) THEN 1050
1040 GOTO 1010
1050 J=1
1060 IF MID$(A$(Q), (LEN(A$(Q))-J), 1) <> " " TH
EN J=J+1: GOTO 1060
1070 F$=LEFT$(A$(Q), (LEN(A$(Q))-J))
1080 B$=RIGHT$(A$(Q), J): A$(Q)=F$: F$=""
1090 IF Q=N THEN B$="" : GOTO 930
1100 IF LEFT$(A$(Q+1), 1) = " " THEN 1330
1110 A$(Q+1)=B$+" "+A$(Q+1): GOTO 930
1120 IF Q=N THEN 1210
1130 IF LEFT$(A$(X), 5) = " " THEN J=6: GOT
O 1150
1140 J=1
1150 IF MID$(A$(Q+1), J, 1) <> " " THEN J=J+1: I
F J<LEN(A$(Q+1)) THEN 1150
1160 IF J>LEN(A$(Q)) THEN 1210
1170 IF LEFT$(A$(Q+1), 5) = " " THEN PRINT
Q: A$(Q): NEXT: GOTO 360
1180 IF A$(Q+1) = "" THEN PRINT Q: A$(Q): NEXT
: GOTO 360
1190 B$=LEFT$(A$(Q+1), J): F$=A$(Q)+" "+B$: G
$=RIGHT$(A$(Q+1), (LEN(A$(Q+1))-J)): A$(Q)=F$
: A$(Q+1)=G$: F$="" : G$=""
1200 GOTO 930
1210 S=1: V=0
1220 IF MID$(A$(Q), S, 1) <> " " AND MID$(A$(Q),
S+1, 1) = " " AND MID$(A$(Q), S+2, 1) <> " " THEN V
=V+1
1230 IF S<LEN(A$(Q)) THEN S=S+1: GOTO 1220
1240 IF V=0 THEN PRINT Q: A$(Q): NEXT: GOTO
360
1250 IF V<(Y-LEN(A$(Q))) THEN PRINT Q: A$(Q)
: NEXT: GOTO 360
1260 IF LEFT$(A$(Q), 2) = " " THEN S=6: GOTO 1
280
1270 S=1
1280 IF MID$(A$(Q), S, 1) <> " " THEN S=S+1: GOT
O 1280
1290 IF MID$(A$(Q), S, 1) = " " AND MID$(A$(Q), (
S+1), 1) <> " " THEN TP$=" ": F$=LEFT$(A$(Q), S)
+TP$+RIGHT$(A$(Q), (LEN(A$(Q))-S)): A$(Q)=F$
: F$=""
1300 IF LEN(A$(Q))=Y THEN PRINT Q: A$(Q): NE
XT: GOTO 360
1310 S=S+2: GOTO 1280
1320 GOTO 360
1330 K=Q+2: FOR M=K TO N: B$(M)=A$(M-1) : NEX
T
1340 A$(Q+1)=B$
1350 FOR M=K TO N: A$(M)=B$(M): B$(M)="" : NE
XT
1360 A$(N+1)="" : B$=""
1370 GOTO 930
1380 K=Q: FOR M=K TO N: B$(M)=A$(M+1): NEXT
1390 FOR M=K TO N: A$(M)=B$(M): B$(M)="" : NE
XT
1400 IF Q=N THEN PRINT Q: A$(Q): GOTO 360
1410 GOTO 930
1420 INPUT "DO YOU WANT ADDRESSED HEADINGS":
X$
1430 IF LEFT$(X$, 1) <> "Y" THEN G=1: GOTO 1520
1440 INPUT "DATE": D$
1450 G=2
1460 LPRINT TAB(40); "999, ANYSTREET"
1470 LPRINT TAB(40); "ANY TOWN"
1480 LPRINT TAB(40); "ANY COUNTY"
1490 LPRINT
1500 LPRINT TAB(40); D$
1510 FOR E=1 TO 3: LPRINT : NEXT
1520 FOR Z=1 TO N: LPRINT A$(Z): NEXT
1530 IF G=1 THEN SS=67-N
1540 IF G=2 THEN SS=67-(N+8)
1550 FOR P=1 TO SS: LPRINT : NEXT
1560 IF C=0 THEN 1600
1570 B=B+1
1580 IF B=C THEN C=0: B=0: G=0: GOTO 380
1590 IF B<C THEN 1630
1600 INPUT "DO YOU WANT COPIES": X$
1610 IF LEFT$(X$, 1) <> "Y" THEN C=0: B=0: G=0
: GOTO 380
1620 INPUT "HOW MANY": C
1630 ON GOTO 1520, 1660
1640 INPUT "TITLE": T$
1670 INPUT "DATE": D$
1680 INPUT "SUBJECT": S$
1690 INPUT "OUTPUT TAPE READY": Z$
1700 FOR X=1 TO N: IF LEFT$(A$(X), 5) = " "
THEN A$(X)="" : "+RIGHT$(A$(X), LEN(A$(X))
-5)
1730 J=1
1740 IF MID$(A$(X), J, 1) = " " THEN A$(X)=LEFT$
(A$(X), J-1)+CHR$(191)+RIGHT$(A$(X), LEN(A$(X)
)-J)
1742 IF MID$(A$(X), J, 1) = " " THEN A$(X)=LEFT
$(A$(X), J-1)+CHR$(140)+RIGHT$(A$(X), LEN(A$(X)
)-J)
1744 IF MID$(A$(X), J, 1) = " " THEN A$(X)=LEFT
$(A$(X), J-1)+CHR$(162)+RIGHT$(A$(X), LEN(A$(X)
)-J)
1750 IF MID$(A$(X), J, 1) = CHR$(34) THEN A$(X)=
LEFT$(A$(X), J-1)+CHR$(188)+RIGHT$(A$(X), LEN(
A$(X))-J)
1760 IF J=LEN(A$(X)) THEN 1775
1770 J=J+1: GOTO 1740
1775 PRINT X: A$(X)
1780 NEXT
1790 PRINT "-1, N, T$, D$, S$, Y
1800 D1=INT(N/4): D2=N-D1+4
1810 FOR R=1 TO D1: PRINT "-1, A$(R), A$(R+D1)
, A$(R+(D1*2)), A$(R+(D1*3)) : NEXT
1820 DD=D1+4: IF DD=N THEN 2000: ELSE DD=N-DD
1830 IF D3=1 THEN PRINT "-1, A$(DD+1)
1840 IF D3=2 THEN PRINT "-1, A$(DD+1), A$(DD+2)
)
1850 IF D3=3 THEN PRINT "-1, A$(DD+1), A$(DD+2)
, A$(DD+3)
1860 GOTO 2000
1880 INPUT "INPUT TAPE READY": V$
1890 INPUT "-1, N, T$, D$, S$, Y
1900 PRINT "TITLE": T$: PRINT D$: PRINT "SU
BJECT": S$: PRINT "PRINT N, " LINES " , Y
: " CHARS PER LINE": PRINT
1910 INPUT "CONTINUE": Y$
1920 IF LEFT$(Y$, 1) <> "Y" THEN 380
1930 DIM A$(N+1), B$(N+1)
1940 D1=INT(N/4): D2=N-D1+4
1950 FOR R=1 TO D1: INPUT "-1, A$(R), A$(R+D1)
, A$(R+(D1*2)), A$(R+(D1*3)) : NEXT
1960 DD=D1+4: IF DD=N THEN 2000: ELSE DD=N-DD
1970 IF D3=1 THEN INPUT "-1, A$(DD+1)
1980 IF D3=2 THEN INPUT "-1, A$(DD+1), A$(DD+2)
)
1990 IF D3=3 THEN INPUT "-1, A$(DD+1), A$(DD+2)
, A$(DD+3)
2000 FOR X=1 TO N: IF LEFT$(A$(X), 5) = " "
THEN A$(X)="" : "+RIGHT$(A$(X), LEN(A$(X))
-5)
2030 J=1
2040 IF MID$(A$(X), J, 1) = CHR$(191) THEN A$(X)
=LEFT$(A$(X), J-1)+" "+RIGHT$(A$(X), LEN(A$(X)
)-J)
2042 IF MID$(A$(X), J, 1) = CHR$(140) THEN A$(X)
=LEFT$(A$(X), J-1)+CHR$(58)+RIGHT$(A$(X), LEN(
A$(X))-J)
2044 IF MID$(A$(X), J, 1) = CHR$(162) THEN A$(X)
=LEFT$(A$(X), J-1)+CHR$(59)+RIGHT$(A$(X), LEN(
A$(X))-J)
2050 IF MID$(A$(X), J, 1) = CHR$(188) THEN A$(X)
=LEFT$(A$(X), J-1)+CHR$(34)+RIGHT$(A$(X), LEN(
A$(X))-J)
2060 IF J=LEN(A$(X)) THEN 2075
2070 J=J+1: GOTO 2040
2075 PRINT X: A$(X)
2080 NEXT
2090 GOTO 380

```

(continued from page 101)

done, then two columns of text are printed from top to bottom of page.

Lines 480-560. Any number of copies obtainable.

Lines 570-900. Editing text. For further details, see Instructions for use.

Lines 910-1410. Justification — ditto.

Lines 1420-1630. Print out, and copy for 60 characters per line, single column — letters or straight text.

Lines 1660-1860. Saving text to tape. This procedure is a trifle long-winded as paragraph indents, commas and quotation marks have to be replaced by other symbols in order to be correctly recorded as data. After recording, the procedure is reversed to enable further editing, printing, etc.

Lines 1880-2090. Input previously-recorded data from tape. Again this takes time, not only the actual input, but also reversing symbols back into intelligible text.

Instructions for use. This program makes no pretence of being perfect, yet with the observance of a few simple rules no great problems should arise, and even if they do, all is not lost. By the simple process of pressing Break and entering

GOTO 380

the program can be re-entered without loss of text.

Let us assume that the user has correctly keyed in the program. When offered Options, enter 3 — for new page.

Answer the questions concerning lines and characters per line in accordance with desire — and hopefully accurate modifications. If all is well, Ready To Start and cursor will appear.

All usual characters are permitted, including the back-space. If everything grinds to a halt towards the end of the line, check that the expansion-box/printer is plugged in and switched on unless, of course line 130 has been omitted, in which case you are on your own.

But how do you know in advance how many lines you are going to need? Set the number of lines to the maximum for the page size. When the text is complete, press Break enter GOTO 380, select 2, Review Lines, and the text will rapidly scroll up the VDU. Have your fingers poised over Shift and @. The line, \$ number will be displayed at the left-hand side. Note the number of the last line of text, press Break, and enter

N= (number of lines), GOTO 380.

Editing. The facilities for editing text may not be comparable to other word processing programs, but I find them adequate. I have tried to make the commands compatible with the Genie's program editing commands. D will delete one character; C will change one character; I enables the user to insert as many characters as required up to a total of 250 which is the maximum string length.

To escape from insert mode, use shifted ESC as usual — New Line will not work.

Make sure you allow time for each inserted character to be digested, and hold shifted ESC for at least three seconds, or peculiar things may happen. Also try not to back-space during insert mode. Re-Edit lines if necessary. A line may be deleted completely by

Break A\$(Line No) = "" : GOTO 380.

Justify. As this is rather slow, I find that I can read the text easily, and if editing is necessary simply press Shift and *, hold and wait. At a convenient time Press *. To Continue will appear. Again, the line number is displayed. This should be noted for editing purposes.

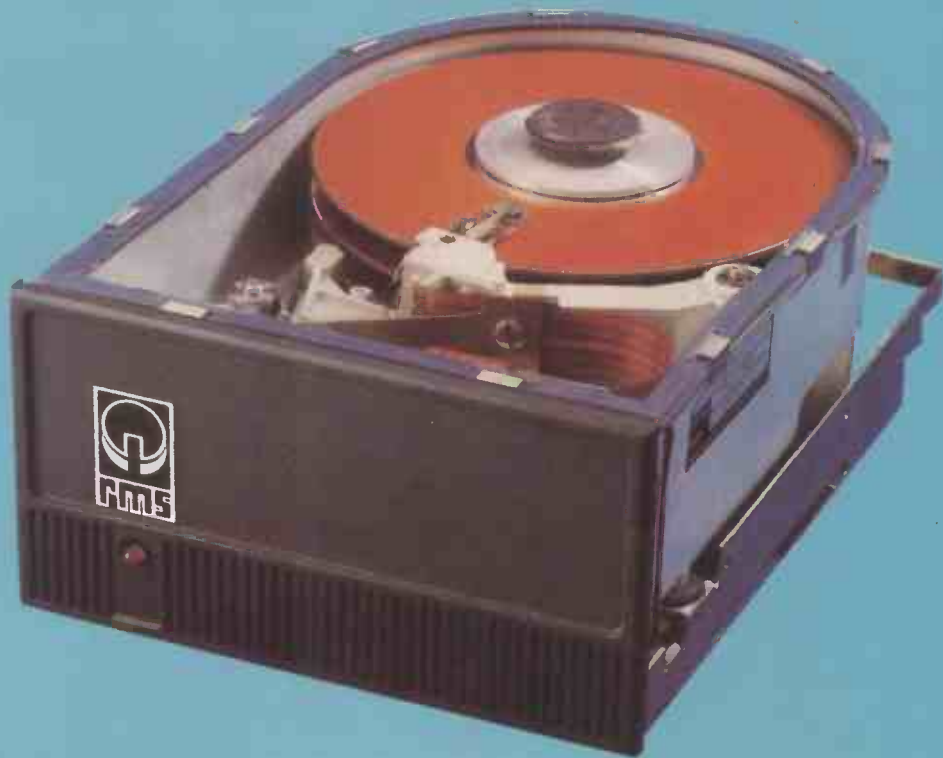
Depending on how important the communication is, full justification is possible where the first word of the next line is too long to be moved up, by inserting a hyphen at an appropriate position during initial input. This will automatically justify all lines. Where extensive editing has taken place some adjustment may be necessary. If at any time an FC Error occurs, enter Goto 380; then review lines, and make whatever adjustment is necessary.

The program is relatively simple and should be easily modified to suit most needs.

Note. I believe that the facility for setting left-hand margins is the exception rather than the rule. In this case lines 460 and 1520 could be modified to read
PRINT TAB (n); etc.
n being the required margin.

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- * Sub-Systems for Z80 computers
- * Fast Drives with Buffered Seeks
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The long-awaited 5.25" Winchester drives are available now from Hotel Microsystems. The greatly improved speed and storage capacity made available by the mini-Winchesters now make feasible many applications, for which floppy drives were too small, too unreliable or too slow. Drives of different capacities ranging from 2.5Mb to 12Mb are available. All the drives we supply have their own microprocessor and are thus able to provide buffered seeking resulting in vastly improved performance.

Versatile Controller

The XCOMP Winchester controller is a custom designed microprogrammable controller which consists of two printed circuit boards. It has buffered seeking capabilities and is upwards compatible to higher capacity drives.

Complete Systems

The North Star Horizon microcomputer is now available incorporating any of the mini-Winchester drives featured above.

S100 Sub-Systems

An upgrade kit for users of S100 microcomputers contains all the hardware required to add a Winchester in place of a mini-floppy drive. The XCOMP ST/S S100 controller is included together with an S100 card which provides the necessary power supplies to connect to the Winchester. Fitting to the microcomputer is straightforward — no soldering is required and the Winchester is housed in the same place as the floppy drive it replaces. Horizon users have a choice of software; either the high-performance HMSOS single/multi-user operating system or CP/M.

Z80 Sub-Systems

The sub-system for Z80-based microcomputers consists of a packaged drive and controller with power supply. The controller is the XCOMP ST/R custom designed microprogrammable controller. The two printed circuit boards are connected via a 50-way ribbon cable to an interface board which plugs into the Z80 socket in your microcomputer. The sub-system is housed in an alloy cabinet with a power supply. Source listings of CP/M drivers are available.

Sub-Systems are also available for APPLE and PET

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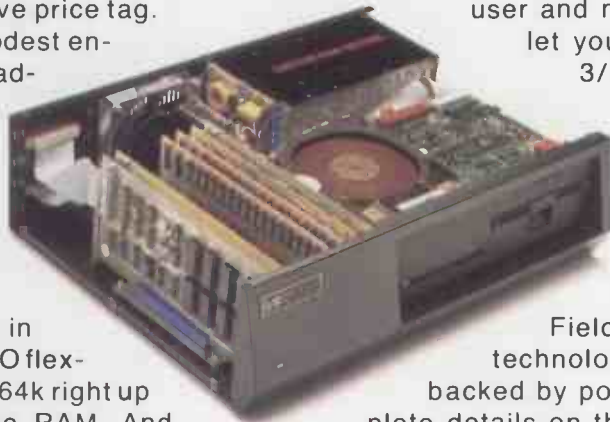
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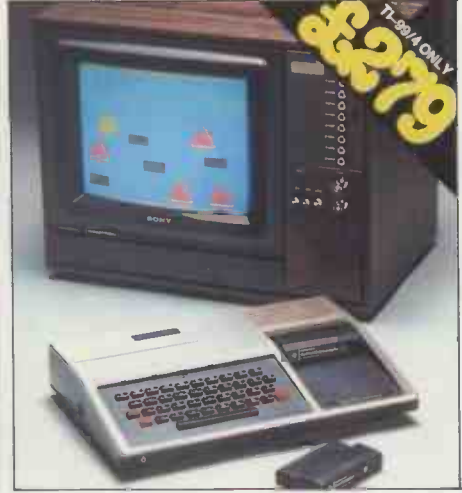
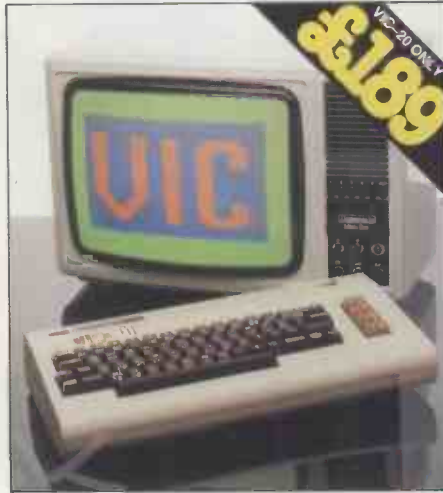
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RAIR

Commodore VIC-20

A fully-fledged, fully expandable, computer with large typewriter-style keyboard, programmable function keys, PET compatible. Gives 24 colours and sound, (to the degree that it can be used to compose music). High resolution graphics module available as extra. Speaks BASIC. Easy-to-use, even for beginners. New VIC-20 material is available and more is on the way. Supplied with easy-to-read, easy-to-use manual, suitable for beginners and children. Programs can be stored on optional VIC tape recorder. **Commodore approved supplier.**

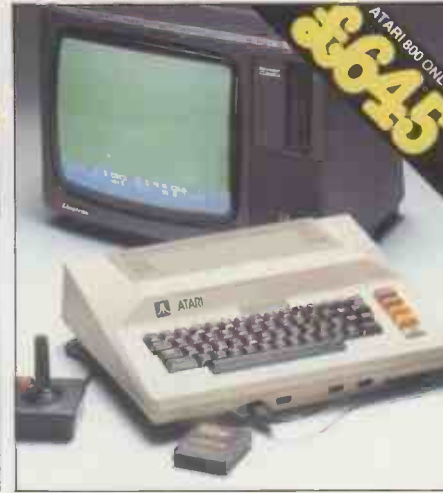


Texas Instruments TI-99/4 (PAL colour TV compatible)

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Programmers can have a readable text to write and can edit machine-code programs by using the medium of an assembly language. Taking the Commodore Assembler as an example, Mike Gross Niklaus gives a detailed explanation of how you can put an assembler to work on your programming problems.

Assembler programs

BASIC PROGRAMMERS moving on to machine code often find the assembly process long and complicated, which is a pity because an assembler package is an excellent tool for creating machine-code programs. This article guides you through the assembly process using the Commodore assembler package.

The 6502 processor, like any other, works using pulses of electricity which operate electronic gates placed on the various electrical paths within it. A particular pattern of pulses, called an instruction, causes the microprocessor to carry out a particular operation. These instructions, together with the data on which they are to operate, are held in memory as electrical charges. The pulses are either on or off, the charges are either present or absent, and so one way of representing the instructions and data on paper is as a series of ones and zeros.

The question then arises, "How does a programmer transform these patterns on paper into electrical patterns in the memory"? Early computer programs were punched as holes on cards, with a hole representing a one or pulse, and lack of a hole representing a zero or no pulse. A card reader sensed the holes and created the appropriate electrical pattern.

While cards solved the entry problem, programmers were left with the awful task of writing their instructions as ones and zeros. If that chore failed to turn them cross-eyed, then trying to read these patterns a week or two later, and amending them to get rid of errors or to enhance the program was enough to floor all but the most dedicated. If it was someone else's program, then it was quicker to start from scratch. Editing and patching programs frequently caused new errors to be created as fast as the old ones were corrected.

Soon the ones and zeros were replaced by hexadecimal representations. Programs could then be written using the 16 symbols 0 to 9 and A to F. Hexadecimal is much easier to read than rows of ones and zeros, but the editing problem remained.

Assembler language was invented to overcome this problem. It allows the programmer to write and edit machine-code programs using a quite readable text, and including as much annotation and as many named variables as may be needed. This text can be saved away, pulled back, changed, edited in any way you like and re-saved, using an editor program. This text is called the source code.

You use an assembler program to process the source code. It ignores all the annotation, converts all the variables' names into actual memory addresses, and produces and saves a hexadecimal code version of the program called the object code.

Simple problem

Finally you use a loader program to read the object code, translate it into ones and zeros and place the patterns in memory. Provided the machine-code program works correctly, you can save it using the normal monitor facilities, which enable you to save away any specified chunk of memory, and later read it back into position. So from then on you need only load this memory version without going through the assembly process.

Usually there will be errors, so you will have to re-load the editor, get back your source code, edit it and go through the assembly process again. Newcomers to assembler code, particularly those of you used to Basic alone, will get frustrated on many occasions, complaining of this long-winded process. All I can say is, "You cannot imagine the hassle we had before assemblers came along", and "Wasn't it nice of the folks at Dartmouth to develop Basic".

The outline of the assembly process is shown in figure 1. We can follow it through with a very simple programming problem: placing the initial letters of the words "personal computing" in the top left-hand corner of the screen.

In Basic, you could achieve this by a couple of Poke instructions along the following lines:

```
POKE 32768, 16 : REM 32768 IS T/L
SCREEN
POKE 32769, 3 : REM 16 AND 3 ARE P AND C
```

The machine-code program works in a similar way. The first step is to write the source code on paper. Using the 6502 opcode mnemonics and addressing modes, which are specified in the MOS 6502 programming manual and used by the Commodore assembler, you could write:

```
LDA #16
STA 32768
LDA #3
STA 32769
RTS
```

You have to decide where this program is to sit in memory, and then tell the assembler. The Commodore assembler has a set of directives which are instructions written in the source code. They are not 6502 codes but instructions to the

assembler program itself. One of these — * = — can be used to specify where the final program should reside. Another — ; — is used in exactly the same way as a Basic Rem statement.

The assembler also has the ability to translate symbolic names into actual values and even perform simple calculations on symbols to establish final values for assembly. For example, you can represent the screen locations 32768 and 32769 by SCRTOP and SCRTOP + 1. At some point in the source code, normally the start, you need to define the value of SCRTOP.

Like Basic, source-code lines must be numbered to allow listing, line deletion, etc. A source-code listing for our problem might look like:

```
1000 ; TOPLEFT PC
1010 ; M.J.G-N
1020 ;
1030 SCRTOP=32768
1040 ;
1050 * = 826 ; ASSEMBLE IN
1060 ; 2ND CAS BUFF
1070 LDA #16 ; CODE FOR 'P'
1080 STA SCRTOP ; SCR T/L
1090 LDA #3 ; CODE FOR 'C'
1100 STA SCRTOP+1 ; LOC 32769
1200 RTS ; TO BASIC
1210 ;
1220 END
```

The final line — End — is another directive to the assembler telling it that there is nothing further to assemble.

Transfer to disc

The next step is to transfer this source code from paper to a disc file ready for the assembler to process. This is done using the editor program to create text in memory, much as you do for a Basic program. In the Commodore package there are versions for both 16K and 32K machines.

Suppose you are using a 32K machine, you type

```
LOAD "EDITOR32K", 8
```

Since it is a machine-code program which resides at the top of memory, you cannot Run the program but must enter it with a Sys call. The call for the 32K version is

```
SYS 28672
```

You will get a message announcing the editor and Ready and a flashing cursor.

The editor is now operational, and you can enter source-code lines in exactly the same way as you do lines of Basic. But be warned: although line deletion, insertion, cursor movement, character otype, deletion and insertion all work as for the

(continued on page 111)

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(continued from page 109)

Basic editor, the assembler editor does not encode Basic keywords. Consequently, text created with this editor cannot be run as a Basic program. By way of a recompense, it does give you some useful editing facilities: Auto Line Numbering, Repeat Keys, Find String, Change String, Delete Lines, and so on.

Once you have entered the source code correctly, the next step is to store it as a

disc file ready for the assembler to read and process. One reason why it is stored on disc rather than left in memory is that a large machine-code program can then be assembled from several source-code texts linked together, which in total would take up more store space than is available.

The editor provides a command, Put, which stores the text as a sequential file. You must specify the drive, but the editor assumes you mean device 8 unless you say

otherwise. So to store the source code for this problem, you would type

```
PUT "0:TOPLEFTPC.S"
```

The .S is not obligatory, but it is best to differentiate source-code files from object-code files and so on. Some programmers use .SRC and .OBJ.

To recover the text to do some editing, the editor provides a Get command — not to be confused with the Basic Get, which you cannot perform directly anyhow. This one reads back a source file from disc. To get back the text you have just stored, you will type

```
GET "0: TOPLEFTPC.S"
```

Once re-editing is complete, you can Store and Replace using the @ symbol

```
PUT"@0:TOPLEFTPC.S"
```

The assembler is also a machine-code program, but occupies the lower end of user RAM, so the same version does for both 16K and 32K machines. However, two versions are included for 66-line paper and 72-line paper. This seems to be a very roundabout way of tackling the problem of different page lengths, and is one of very few gripes I have with the Commodore assembler package. Assuming you are using 66-line paper you load the assembler program as follows

```
LOAD "ASM66",8
```

Although the assembler is a machine-code program, it has a short Basic routine latched on the front, so you Run.

Assembler printout

After an identity and copyright announcement, you are asked for the object-code file name. Get into the habit of using the same generic name for source, object and machine-code files, with an appropriate descriptor — e.g., .OBJ or .O — tagged on the end. In this case you might reply

```
0:TOPLEFTPC.O
```

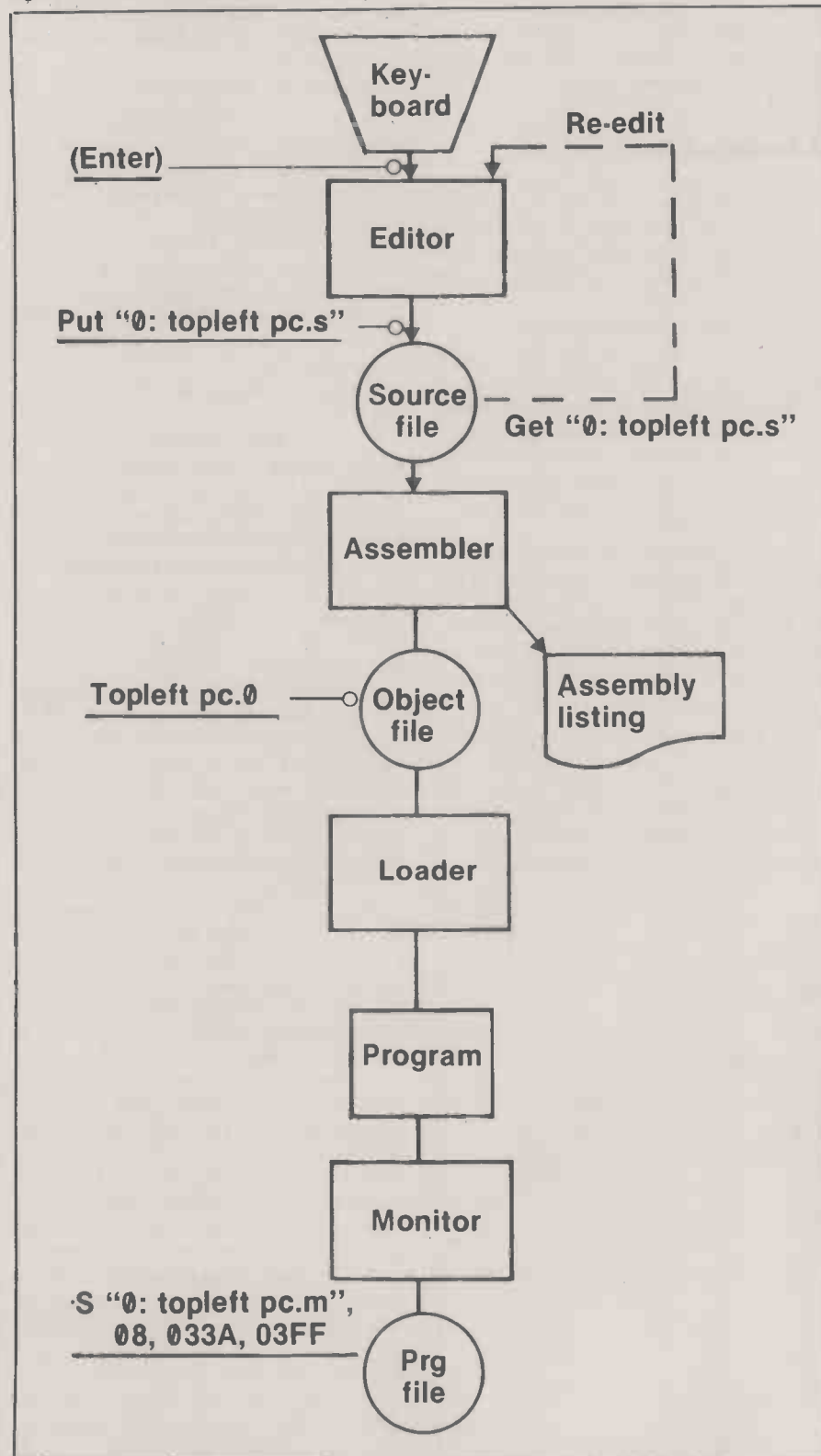
You are then asked if you require the assembly listing to be printed, as opposed to being displayed on the screen. You reply Y Return if you want the listing printed, or N Return if you do not. The program then asks you if an IEEE-488 protocol printer is being used. What it really means is "Does your printer understand Commodore's version of ASCII or standard ASCII"? If you have a Commodore printer, reply Y Return, otherwise reply N Return.

As a final question, the program asks for the name of the source-code file. In this case you would reply 0:TopLeftPC.S. As soon as you press the Return key the assembler bounds into action, producing a printout — figure 2.

The source code is shown on the right. The left-hand column is the assembly listing line number, the next is the location in memory of the instruction displayed in hexadecimal, and the third column shows the instruction — both op code and zero-, one- or two-byte operand — again in hexadecimal.

(continued on next page)

Figure 1. Outline of the assembler process.



(continued from previous page)

The assembler works by converting all the op-code mnemonics into hexadecimal, evaluating all the symbols and expressions and turning them into hexadecimal as well. In order to deal with the symbols properly, it reads the source code right through, creating a table of symbols and values for the symbols. It then reads the source code a second time, replacing symbols by values, sending the resultant hexadecimal to an object-code file, with the name you specified at the start of the run. At the same time it produces the assembler listing.

Any errors are highlighted with rows of asterisks and an upward arrow pointing to the place in the source code line where the error was detected. The total number of errors is printed at the end of the assembly listing. The final part of the listing is a printout of the symbol table already described, together with their hexadecimal values.

If you do have errors, you can Get back your source code — the editor is still present and active — correct it, and restore it, load the assembler again — remember that source text and assembler occupy the area of user RAM — and reassemble the program.

We can now assume that you have assembled your program without error, and have on disc an object-code sequential file consisting of the hexadecimal representations of the machine-code program, preceded by pointers showing where these values are to be placed in the memory of the machine. To load these values into RAM requires a loader program.

Since you might want to put your machine-code routine in exactly the area of RAM occupied by the loader program, Commodore has provided three versions. The first loads into the bottom of user

RAM, i.e., where Basic text, source text and the assembler program are placed. The other two load to the top of 16K and 32K memory respectively.

There appears to be some kind of clash over re-direction of operating-system vectors when using the high loader immediately after using the editor. You have to do a cold start before loading and running it. Later versions of the editor provide the Cold command to do just this, but on earlier versions you have to use Sys 64721 — Basic 2 — or switch the machine off and on again. You then load Hi-Load16 or Hi-Load32, and enter with the appropriate Sys command — Sys 28672 for Hi-Load32.

Advanced facility

Our example program, however, is to be placed in the second cassette buffer at location 826. It is clear of user RAM, which is why it is often used for short routines. You can use the low loader with no vector troubles:

```
LOAD "LOADER",8 : RUN
```

The Loader program first asks you if there is to be any offset. This is an advanced facility of limited use, allowing you to offset the loading position of the object code from the area specified in the source code. Unless you know exactly what you are doing, press Return alone to ignore the facility.

The next and final question asks you for the name of the object file. Get into the habit of specifying the drive number, as the 8032 version of the assembler loader requires it. You reply with the same name as you used during the assembly run

```
0:TOPLETPC.O
```

The hexadecimal symbols representing loader pointers, op codes and operands appear on the screen to confirm that your machine-code program has been loaded.

Drawing a deep breath, you type Sys to

whatever location your program starts at, or include the Sys call in a Basic program. In our example you use

```
SYS 826
```

At this point, a broad smile should break out on your face as P and C appear at the top left of the screen.

Assuming that you are happy with the result, you can save it on to disc as a program, using the facilities of the Pet resident monitor. From then on, a Load command from Basic, or from the monitor, will load the program without the hassle of calling up the loader and reading the object file.

To enter the monitor, type

```
SYS 1024 RETURN
```

or if the editor is still active you can type Break. You will see a hexadecimal report on the condition of various registers of the 6502 and the flashing cursor sitting to the right of a full stop. The Save command in monitor is .S followed by the normal string specifying drive and file name, followed by device number, start and end location +1 for your program — all three in hexadecimal.

For small programs in buffer 2 I tend to specify

```
$033A TO $03FF
```


to save having to discover the actual end — you can look this up on the assembler listing if you want. So for our example, the Save command will look like this:

```
.S "0:TOPLETPC.M",08,033A,03FF
```

The .M is my personal way of describing a machine-code module saved from memory. A more common convention is .Bin for binary.

Having read this far, you are probably thinking that you have an awful lot to learn. But the many people who attend the courses I run on machine code with assembler, write their first successful machine-code program within an hour of starting the course. After three days they can rattle through the procedures without a second thought.

There are several assembler packages on the market which may vary slightly in procedure from the Commodore package. Some assemble into store, others use different addressing representations from those recommended as a standard by MOS Technology.

Putting aside my connection with Commodore, as an independent machine-code programmer I recommend the Commodore package. For £30, you not only have the editor, assembler and loaders, but also the disc-support program, a re-locator utility and the very useful Extramon which contains numerous diagnostic and trace aids, a mini assembler and a disassembler. The diskette in the package also contains the source-code listings for the editor, loader and re-locator. Apart from showing how to use many useful entry points in the Pet's ROMs, they provide excellent examples of assembly-language technique and layout. 

LINE#	LOC	CODE	LINE
0001	0000		:TOPLEFT PC
0002	0000		:M.J.G-N
0003	0000		:
0004	0000		SCRTOP=32768
0005	0000		:
0006	0000		*=826
0007	033A		:ASSEMBLE IN
0008	033A	A9 10	2ND CAS BUFF
0009	033C	8D 00 80	LDA #16 ;CODE FOR 'P'
0010	033F	A9 03	STA SCRTOP ;SCREEN T/L
0011	0341	8D 01 80	LDA #3 ;CODE FOR 'C'
0012	0344	60	STA SCRTOP+1 ;LOC 32769
0013	0345		RTS ;TO BASIC
0014	0345		.END
ERRORS = 0000			
SYMBOL TABLE			
SYMBOL VALUE			
SCRTOP 8000			
END OF ASSEMBLY			

Figure 2. Assembler printout.



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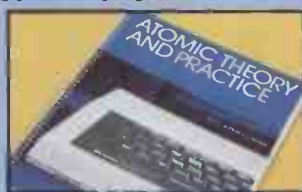
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The question of perfect answers

Just before she died, Gertrude Stein asked: "What is the answer"? No answer came. She laughed and said: "In that case, what is the question"? Then she died. Boris Allan picks up where Gertrude Stein left off, and offers some intriguing answers to the question of programming perfection.

A PROGRAM is no more than an answer to a question, and a bug-free program is a perfectly correct answer to the question. But what is the question that is being answered?

Study this bug-free Basic program:

```
10 REM PROGRAM 1
20 INPUT A
30 B = SQR(A)
40 PRINT A,B
50 END
```

It will work every time, unless a negative number is entered — there is no defined square root of a negative number in Basic.

The next attempt to write a bug-free Basic program could be:

```
10 REM PROGRAM 2
20 INPUT A
30 IF A < 0 THEN 70
40 B = SQR(A)
50 PRINT A,B
60 END
70 PRINT "ERROR : NEGATIVE NUMBER"
80 END
```

Program 2 will work every time, unless a letter or incorrectly-formed number is entered, for example, £.&.

A further attempt to write a bug-free Basic program might take the form:

```
10 REM PROGRAM 3
20 INPUT A$
30 GOSUB 1000
40 IF E = 1 THEN 80
50 B = SQR(A)
60 PRINT A,B
70 END
80 PRINT "ERROR : INCORRECTLY
FORMED NUMBER"
90 END
1000 REM ERROR HANDLING ROUTINES
1010 REM IF ERROR E = 1, OTHERWISE
= 0
1100 RETURN
```

Of course, Program 3 will perform perfectly, unless . . . As James Stephens writes in *The Crock of Gold*: "Nothing is perfect. There are lumps in it".

Program 1 is, in one sense, bug-free because the program logic was a perfect answer to the logic implied in the question "How can one write a Basic program to enter a number, calculate its square root, and output its value"? The answer was perfectly admissible — and there would be many equally admissible answers — as

long as the range of values to be entered was positive, and not too large.

Possibly some automated procedure for deciding program correctness could have isolated the potential problem to do with ranges of admissible values, and the procedure may have given solutions such as programs 2 and 3. The decision procedure would need to have been set up in such a way that the range problem could be recognised; but to set up a general decision procedure to check total program correctness would be impossible.

It is clear that there are levels of program correctness. The most trivial level is the translation of a set of instructions, for example,

Enter a number;
Output the number and its square root;
into statements in a programming language. Program 1 is the answer to the question "How is this set of instructions to be translated into statements in the programming language"?

Some answers are more accurate than others. Program 1 is bug-free — i.e., perfect — if it is seen as the answer to the question put by the given set of instructions, but the question is inadequately formulated since the instructions are not very comprehensive. The question to which program 3 is an answer is also inadequately formulated: it would certainly be possible to beat the system in some way, for example, there is no such thing as a completely un-copyable disc.

Consider the original question to which program 3 is the ultimate answer: "How can I get the computer to calculate square roots for me"? To go from this question to another question — the set of instructions — is a process of formulation, and can be a highly creative activity.

Once you have formulated the answer, which is in itself an implicit question, there now becomes necessary a process of integration. The language, operating-system characteristics, the relationship of this program with other programs, and many other problems — such as the square root of minus numbers — need to be considered.

Following this is the process of translation from the answer provided by the formulation and integration to the final answer, the program.

The process I have called formulation, together with much of integration, corresponds to what is normally termed systems analysis. The rest of integration, together with translation, corresponds to programming. In real life there is a continuous interplay between formulation and integration; and lately, translation has not

been left to a separate person either. All three interact.

Perfection can only really be assured in the translation process. This is what is usually meant by claims to bug-free programs. If the questions to which answers are required are greatly restricted in scope, perfection — or fewer errors — is easier to claim. If the environment for the integration process is restricted — e.g., by using only one language, or only files of a certain form — then the likelihood of error is reduced.

If perfection is possible in certain restricted senses, then the claim to a procedure to generate bug-free programs may be accurate, even though the range of application is very narrow. The price you pay for automatic perfection is a limitation on what you can do, and emphasis on translation at the expense of formulation and integration.

A program to write programs must, if it is to work, only answer a very restricted set of questions. Even then, it will only be able to implement the translation process, which is the only easily-implemented automatic procedure and could quite possibly produce bug-free programs.

Limited application

Any automated procedure which works will be able to claim to generate totally bug-free — i.e., perfect — programs. Yet there will still be bugs in the formulation and integration of answers to the original question — unless the user has superior analytical and creative faculties — so the perfection of the program written by the program generator will always be in question. The same can be said of the perfection of any program, including the program generator.

How can this doubtful perfection be resolved? One probable strategy by the promoters of any program generator will be to restrict its range of application — paying the price for automatic perfection by limiting what you can do. Some restrictions which come to mind concerning integration are:

- using only one language;
- having a fixed operating system;
- only allowing restricted types of files;
- minimising the types of mathematics one can use.

These restrictions are probably the least number that will appear in any program generator. Some of them you will be told about, others will come to light when you find that you cannot do what you want to do.

At the level of formulation, any program generator must restrict its range of

(continued on next page)

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application to a very limited area, e.g., financial management, simulation or matrix mathematics. Programs already exist which translate programs written in one language, say, Algol 60, to programs written in another language, say, PL/1.

For any computer to run a program there must be another program — the compiler — which translates the first program into machine instructions. One would suspect, therefore, that the overall shape and flow of any program outline must be very carefully defined, in great detail, before any program generator can operate.

Such a program generator would not be new, because what normally happens is that the source generated is not listed, but merely compiled. In the Genesys system for use by civil and structural engineers, programs written in a language called Gentran are converted into Fortran source. The source is not usually listed as it is compiled into object code.

Creative imagination

If a program generator did provide all the programs the user needed, then the user would only be doing a restricted set of tasks, i.e., asking a very restricted set of questions. To claim perfection of the resulting programs — i.e., no bugs — might be justified, but errors in logic, i.e., in formulation, are far more devastating and need creative imagination to solve. The response of the promoters of such generators to programs which did not work would probably be to blame the user's program logic though perhaps the logic would go astray mainly because the user has to modify his own logic to accommodate the generator, with resulting confusion.

Rather than talk in the abstract about what might happen if a generator of bug-free programs were to be produced, consider a different variety of bug-free program generator, a program generator which has been available for many years.

At the 1981 conference of the British Computer Society, C A R Hoare claimed that if programmers used certain standard techniques for program writing it should be possible to produce software with no bugs at all. In other words, the claim is that:

either there is a general decision procedure to check total program correctness and produce perfect programs,
or there are means available to generate correct programs at the translation stage, with probable restrictions on formulation and integration.

Hoare is one of the prime promoters of Pascal, and it would seem reasonable to suppose that Pascal embodies the standard techniques for program writing implied in Hoare's claim. Therefore, we need only study Pascal to learn these techniques.

To write a perfect — bug-free — program is of little value if the formulation

and integration aspects are flawed. I have already described several possible restrictions concerning integration for a program generator. Pascal obviously is restricted in being a single language and having a fixed type of file: the only type of file allowed in standard Pascal is the sequential file.

Pascal also has many restrictions on mathematical operations. There are silly rules for matrices, and it is impossible to bring real numbers into their axiomatic system — the axiomatic system upon which is based the assertions concerning perfection. A possible reason for this problem with real numbers is that Pascal Types, apart from the Real, are based on the idea of a Set Of. However, when one considers real numbers on the computer, the sets have an infinite number of elements. The list of such restrictions could be extended.

In formulation, any program generator must restrict its range of application, unless the program generator is human. Pascal was originally designed to teach students computer programming, and when attempts are made to use Pascal for answering questions outside this particular application, the logic becomes increasingly devious. Pascal is useless for serious mathematical and scientific work in a communal environment with libraries of applications procedures.

It is claimed that Pascal has a great utility in compiler writing, partly due to its reputation for ease of bug-free translation. Yet Richard Bornat in his book *Understanding and Writing Compilers* (Macmillan, 1979) clearly asserts that he would have used Pascal more extensively for compiler writing were it not for the fact that its lack of block structure, lack of conditional expressions and lack of a simple "union-type" convention forces an obscure programming style.

What the advocates of Pascal promise is a bug-free program generator called Pascal, which will take many years to master in its program-proving aspects. Due to the necessary limitations on formulation and integration, this language will not be as flexible as many other languages in answering questions. Similarly, any future bug-free program generator will, due to the necessary limitations on formulation and generation, not be as flexible as most programmers in answering questions.

Bug-free programs can be written, in that perfect translations can be made of the logic which appears after formulation and integration of an answer. But surely the emphasis should be placed not on this perfection in preference to the perfection of formulation and integration. You may wonder whether translation is emphasised because it is the most routine of the aspects of creating a program. The emphasis on creation seems to be sadly lacking in the playing down of the imagination needed in formulation. □

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Tennis and interface

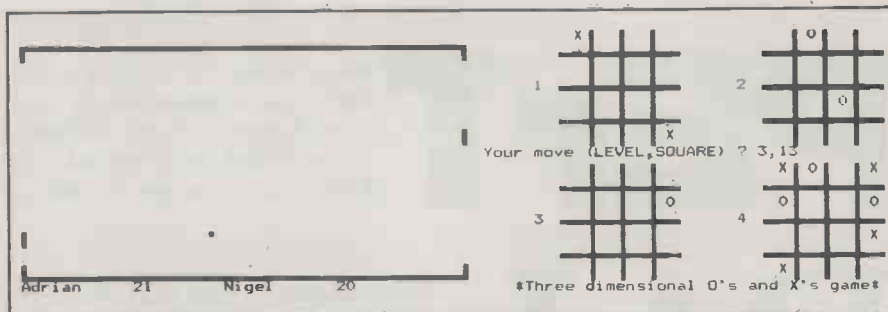
THIS GAME has been written in Basic for the Nascom 2 computer, but it should be relatively easy to modify for use on other computers with similar graphics facilities, writes Adrian Dickens of Cambridge. My original version produced sound effects whenever the ball bounced off the bats or a wall. I have put Rem statements by all of the instructions related to the generation of sound, so that the routines can be modified, or if necessary removed from the program.

My sound effects were simply a constant tone with an envelope on the amplitude. This simulates the sound produced by conventional TV games very well. I used a home-brew sound generator with an AY-3-8910 sound chip.

The machine-code subroutine is used to take a character from the keyboard while the program is running. The character codes from the Nascom keyboard cursor keys are 17,18,19,20. These give each of the two players an up and a down key to control the movements of their bats. The aim of the game is to stop as many balls from passing by the bat as possible.

If a ball does go by one player's end, his opponent's score is incremented by one. When the game is initially run, the relative speed of play for each player can be assigned. Play starts when a ball appears at random in the court, moving in a random direction.

The second program, which is an interface between the Nascom 2 and the Epson printer, comprises three routines, designed to be used together. The major



Sample printouts of tennis and noughts and crosses.

advantage of this printer interface with the Nascom is that all of the Nascom block graphics are printed. As anyone who has already bought an Epson printer will realise, while all of the block-graphic characters produced by the Nascom can also be produced by the Epson, the character codes are not compatible.

I carefully analysed the two graphics sets, and found that Nascom graphic codes could be converted into Epson codes by changing four bits, using the look-up table, and using a few more instructions to convert the remaining high-order bits.

This method of conversion is considerably better than using a look-up table for all of the block graphics, because it uses up far less memory space. The successful results of the programs can be seen in the sample printouts, one from the computer tennis game, and the other from my three-dimensional noughts and crosses game.

The first routine, Init, must always be called before either of the other routines. This routine sets up the parallel I/O ports

into the correct modes. The printer should be connected to the Nascom as directed in the source listing. Init also loads the address of Out into Nas-Sys workspace, so that output can be directed to the printer by the Nas-Sys "U" command.

Routine Out is used to output the byte stored in the A register to the printer. If a block-graphics character is encountered, it is converted to the Epson code before printing. If one of the Nascom special graphics characters is encountered, a space is printed so that the relevant character can be filled in by hand later if required.

Routine Dump is especially useful for use with Basic, because it enables an exact copy of the Nascom screen to be down loaded on to paper. Both of the printouts from my games were produced using this routine. To use this routine, put the address of Dump into memory at 1004H — low byte — and 1005H — high byte — and enter X = USR(0) under Basic. The printer will then print out an exact copy of the Nascom screen.

Computertennis: Adrian Dickens' program.

```

10 REM*****
20 REM
30 REM  COMPUTER TENNIS GAME FOR THE NASCOM 2
40 REM
50 REM          by A C Dickens
60 REM
70 REM          Copyright September 1981
80 REM
90 REM*****
100 CLS
110 X=A=B=A1=B1=0
120 REM INITIALISE SOUND GENERATOR:GOSUB11031
130 PRINT"***** COMPUTENNIS CHAMPIONSHIPS *****"
140 PRINT
150 PRINT"Each player has control of a racket."
160 PRINT"This is moved up & down with the ";
170 PRINT"cursor keys "
180 PRINT
190 INPUT"Name of player 1 ";N1$
200 PRINT"Speed for ";N1$;" 0 is fastest ";
210 INPUTS1
220 PRINT
230 INPUT"Name of player 2 ";N2$
240 PRINT"Speed for ";N2$;" 0 is fastest ";
250 INPUTS2
260 H1=7:H2=7
270 C1$=CHR$(199):C2$=CHR$(248)
280 CLS
290 FORX=4TO91
300 SET(X,0):SET(X,41):NEXTX
310 FORX=4TO91STEP87
320 SET(X,1):SET(X,2):SET(X,39):SET(X,40)
330 NEXTX
340 SCREEN3,15:PRINTN1$;
350 SCREEN23,15:PRINTN2$;
360 REM THIS SETS UP THE USR FUNCTION SO THAT
370 REM CHARACTERS CAN BE INPUT FROM THE
380 REM KEYBOARD WITHOUT TEMPORARILY HALTING
390 REM EXECUTION OF PROGRAM.THE USR FUNCTION
400 REM OPERATES LIKE GET$ ON OTHER COMPUTERS.
410 DOKE3200,25311
420 DOKE3202,312
430 DOKE3204,18351
440 DOKE3206,10927
450 DOKE3208,-8179
460 POKE3210,233
470 DOKE4100,3200
480 REM Main loop
490 X=21-USR(0)
500 ONXGOSUB 560,600,640,680
510 GOSUB720
520 GOSUB830
530 GOSUB920
540 GOSUB960
550 GOTO480
560 SCREEN46,H2:PRINT " "
570 IFH2<13THENH2=H2+1
580 SCREEN46,H2:PRINTC2$
590 RETURN
600 SCREEN3,H1:PRINT " "
610 IFH1>2THENH1=H1-1
620 SCREEN3,H1:PRINTC1$
630 RETURN
640 SCREEN46,H2:PRINT " "
650 IFH2>2THENH2=H2-1
660 SCREEN46,H2:PRINTC2$
670 RETURN
680 SCREEN3,H1:PRINT " "
690 IFH1<13THENH1=H1+1
700 SCREEN3,H1:PRINTC1$
710 RETURN
720 IFS=1 THENRETURN
730 D=RND(0)*1000
740 FORE=0TOD:NEXT
750 A=INT(RND(0)*40)+1

```

(continued on page 127)

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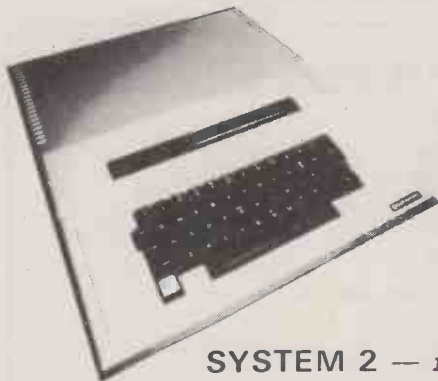
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(continued from page 125)

```

760 B=42
770 A1=INT(RND(2)*5)-2
780 B1=1
790 IFRND(5)<.5THENB1=-1
800 IFABS(A1)<2THENB1=B1*2
810 S=1
820 RETURN
830 IFA>2AND<39AND<6AND<89THENRETURN
840 IFA=1THEN A1=ABS(A1):REM#SOUND#:GOSUB8000
850 IFA=2AND A1=-2THEN A1=ABS(A1):REM#SOUND#:GOSUB1160
860 IFA=40THEN A1=-ABS(A1):REM#SOUND#:GOSUB1160
870 IFA=39AND A1=2THEN A1=-ABS(A1):REM#SOUND#:GOSUB1160
880 IFB<6OR B>89THEN B1=-B1:RETURN
890 IFB=6AND ABS(B1)=2THEN B1=B1/2:RETURN
900 IFB=89AND ABS(B1)=2THEN B1=B1/2:RETURN
910 RETURN
920 RESET(B,A):A=A+A1:B=B+B1:SET(B,A)
930 IFB1=-1OR B1=-2THEN 950
940 FORX=0TOS2:NEXT:RETURN
950 FORX=0TOS1:NEXT:RETURN
960 JFB>5AND<90THENRETURN
970 IFB=5AND H1=INT(A/3+1)THEN 1100
980 IFB=90AND H2=INT(A/3+1)THEN 1100
990 Z=0
1000 IFA=10RA=20RA=39ORA=40THEN Z=1
1010 REM #SOUND#:GOSUB8000
1020 IFZ=1THEN A1=INT(RND(2)*5-2)
1030 IFZ=1THEN RETURN
1040 RESET(B,A)

```

```

1050 IFB=5THEN C2=C2+1
1060 IFB=90THEN C1=C1+1
1070 SCREEN13,15:PRINTC1;
1080 SCREEN33,15:PRINTC2;:S=0
1090 RETURN
1100 REM BALL REBOUNDS FROM BAT SOUND:GOSUB17000
1110 A1=INT(RND(7)*5-2)
1120 IFABS(A1)<2THEN H=1
1130 IFH=1AND ABS(B1)=1THEN B1=B1*2
1140 H=0
1150 RETURN
1160 REM REBOUND OFF SIDE 'WALLS' SOUND
1170 IF(A=10RA=40)AND A1=0THEN RETURN
1180 POKEA2,0:POKED2,240
1190 POKEA2,13:POKED2,0
1200 RETURN
1210 REM THE NEXT 4 LINES INITIALISE MY SOUND
1220 REM GENERATOR.
1230 A2=-28608:D2=-28607
1240 POKEA2,7:POKED2,254
1250 POKEA2,12:POKED2,9
1260 POKEA2,8:POKED2,16
1270 RETURN
1280 REM BALL OFF BATS SOUND
1290 POKEA2,0
1300 IFB=5THEN POKED2,255
1310 IFB=90THEN POKED2,225
1320 POKEA2,13:POKED2,0
1330 RETURN
Ok

```

The Nascom 2 to Epson printer interface.

ZEAP Z80 Assembler - Source Listing

```

0010 ;*****
0020 ;
0030 ; EPSON MX80 PRINTER INTERFACE WITH
0040 ; A NASCOM 2 MICROCOMPUTER.
0050 ;
0060 ; Copyright by A.C.Dickens
0070 ; September 1981
0080 ;
0090 ;*****
0100 ;Connections to the Nascom 2 I/O ports
0110 ;
0120 ;B0 - B7 to printer DATA IN lines D0 - D7
0130 ;A0 to printer BUSY line
0140 ;A1 to printer STROBE line
0150 ;A2 to printer INITIALISE line
0160 ;
0170 ;Routine INIT sets up the Nascom ports for
0180 ;use with the EPSON, and selects routine
0190 ;OUT for use with NAS-SYS user output
0200 ;option. The printer is turned ON by the
0210 ;'U' command in NAS-SYS, and turned OFF by
0220 ;the 'N' command.
0230 ;SET UP PORT B FOR BYTE OUTPUT
8000 0240 ORG 0B000H
8000 3E0F 0250 INIT LD A,15
8002 D307 0260 OUT (7),A
0270 ;SET UP PORT A
0280 ;A0 = BUSY
0290 ;A1 = STROBE
0300 ;A2 = INITIALISE
8004 3EFF 0310 LD A,FFH
8006 D306 0320 OUT (6),A
8008 D304 0330 OUT (4),A
800A 3EF9 0340 LD A,EF9H
800C D306 0350 OUT (6),A
800E 211580 0360 LD HL,OUT;SET USER OUTPUT ADDRESS
8011 22780C 0370 LD (0C7BH),HL;FOR USE BY NAS-SYS
8014 C9 0380 RET
0390 ;PRINTER OUTPUT ROUTINE
0400 ;CHARACTER FOR PRINTING IS IN A REGISTER
8015 F5 0410 OUT PUSH AF
0420 ;TEST FOR A GRAPHICS CHARACTER
8016 CB7F 0430 BIT 7,A
8018 2B1E 0440 JR Z,PRINT
0450 ;SELECT BLOCK GRAPHICS ONLY
0460 ;PRINT A SPACE IF IT IS NOT A BLOCK
801A CB77 0470 BIT 6,A
801C 2004 0480 JR NZ,GRAPHIC
801E 3E20 0490 LD A,32;SPACE CODE
8020 1816 0500 JR PRINT
0510 ;CORRECT BITS 5 & 6 OF THE CODE FOR EPSON
8022 D620 0520 GRAPHIC SUB 32
8024 4F 0530 LD C,A
0540 ;CORRECT BITS 1,2,3,4 OF CODE FOR EPSON
8025 E61E 0550 AND 1EH
8027 CB3F 0560 SRL A
8029 114A80 0570 LD DE,TABLE
802C 8B 0580 ADC A,E
802D 5F 0590 LD E,A
802E 7A 0600 LD A,D
802F CE00 0610 ADC A,0
8031 57 0620 LD D,A
8032 1A 0630 LD A,(DE)
8033 57 0640 LD D,A
8034 79 0650 LD A,C
8035 E6E1 0660 AND 0E1H ;1110 0001
8037 B2 0670 OR D
0680 ;GRAPHICS CODE NOW CONVERTED FOR PRINTING
0690 ;LOAD CHARACTER TO BE PRINTED ONTO PORT
803B D305 0700 PRINT OUT (5),A
0710 ;WAIT UNTIL THE BUSY LINE GOES LOW
803A DB04 0720 LOOP IN A,(4)
803C CB47 0730 BIT 0,A
803E 20FA 0740 JR NZ,LOOP
0750 ;STROBE DATA INTO PRINTER
8040 3EFD 0760 LD A,FFD
8042 D304 0770 OUT (4),A
8044 3EFF 0780 LD A,FFF
8046 D304 0790 OUT (4),A
8048 F1 0800 END POP AF
8049 C9 0810 RET
0820 ;TABLE FOR GRAPHICS CONVERSION
804A 00 0830 TABLE DEFB 00H
804B 04 0840 DEFB 04H
804C 10 0850 DEFB 10H
804D 14 0860 DEFB 14H
804E 02 0870 DEFB 02H
804F 06 0880 DEFB 06H
8050 12 0890 DEFB 12H
8051 16 0900 DEFB 16H
8052 08 0910 DEFB 08H
8053 0C 0920 DEFB 0CH
8054 18 0930 DEFB 18H
8055 1C 0940 DEFB 1CH
8056 0A 0950 DEFB 0AH
8057 0E 0960 DEFB 0EH
8058 1A 0970 DEFB 1AH
8059 1E 0980 DEFB 1EH
0990 ;END OF TABLE
1000 ;ROUTINE DUMP PRINTS OUT AN EXACT COPY OF
1010 ;THE NASCOM SCREEN, EXCEPT FOR SPECIAL
1020 ;GRAPHICS CHARACTERS, WHICH ARE PRINTED AS
1030 ;BLOCK GRAPHICS.
1040 ;LOAD HL WITH START POSITION ON SCREEN
805A 210A0B 1050 DUMP LD HL,0B0AH
1060 ;SET THE LINE LENGTH TO 48 CHARACTERS
805D 0630 1070 LINE LD B,30H
1080 ;GET CHARACTER IN A REGISTER
805F 7E 1090 COLUM LD A,(HL)
1100 ;PRINT THE CHARACTER
8060 CD1580 1110 CALL OUT
8063 23 1120 INC HL
1130 ;HL NOW POINTS TO NEXT SCREEN POSITION
8064 10F9 1140 DJNZ COLUM
8066 111000 1150 LD DE,10H
8069 19 1160 ADD HL,DE
1170 ;DO A CARRIAGE RETURN
806A 3E0D 1180 LD A,13
806C CD1580 1190 CALL OUT
1200 ;DO A LINE FEED
806F 3E0A 1210 LD A,0AH
8071 CD1580 1220 CALL OUT
1230 ;LAST LINE ?
8074 7C 1240 LD A,H
8075 FE0C 1250 CP 0CH
8077 20E4 1260 JR NZ,LINE *
8079 C9 1270 RET
1280 ;THE END

```

Subtle Scroll Stopper

I WAS interested by Scroll Stopper in the July 6502 Special as I have been using a similar program for some time now, writes Derek Aston of Spennymoor, County Durham. I am sending you my version, as there is a subtle difference between the two.

I have found the program so useful that I have managed to patch it into my Mon02 Monitor ROM by shortening the start-up message. There is also a dis-assembly from my monitor for the benefit of anyone with PROM programming facilities.

Scroll Stopper

```
10 REM Controlled LIST for UK101 by D.Aston
12 :
14 REM for UK101, Mon02
16 REM Program resides at HEX 029B to 02BA
19 REM TO INVOKE, POKE 541,2
20 REM TO DISABLE, POKE 541,255
22 REM TO LIST, type LIST, hit RETURN
24 REM then push SPACE BAR
26 REM To Quit LIST command, hit 'Q'
28 REM TO EDIT, enter LINE NUMBER, hit RETURN
30 REM then push SPACE BAR
32 :
34 REM for UK101, Mon01
36 REM Program resides at HEX 0269 to 02B8
38 REM Change 155 in line No.34 to 105
40 REM Change 667 in line No.36 to 617
42 REM TO INVOKE, POKE 539,2
44 REM TO DISABLE, POKE 539,255
46 :
48 DATA173,5,2,208,20,165,19,201,153
50 DATA208,14,169,253,141,0,223,173,0
```

```
52 DATA223,73,255,240,244,48,3,76
54 DATA153,255,24,76,79,166
56 A=667;FORN=0T031;READD;POKEA+N,D;NEXT
```

Monitor disassembly

```
FEF4 7F ;Was 9B Re-route Control C
FEF5 FC ;Was FF Vector on RESET

FC78 20 ; Start-up message
FC79 4D 'M
FC7A 2C 'C
FC7B 43 'C
FC7C 2C 'C
FC7D 57 'W
FC7E 00 ;Message terminator
FC7F AD0502 LDA #0205 ;Test SAVE FLAG
FC82 D019 BNE #FC9D
FC84 AD1102 LDA #0211 ;Test PRINTER FLAG
FC87 D014 BNE #FC9D
FC89 A513 LDA #13 ;Was last
FC8B C999 CMP #99 ;command LIST
FC8D D00E BNE #FC9D
FC8F A9FD LDA #9F ;Mask Keyboard
FC91 B000DF STA #0F00 ;Get Keyboard
FC94 AD00DF LDA #0F00 ;Complement
FC97 49FF EOR #FF
FC99 F0F4 BEQ #FCBF ;Wait for command
FC9B 3003 BMI #FCA0 ;Quit
FC9D 4C9BFF JMP #FF9B ;Continue Listing
FCA0 18 CLC
FCA1 4C4FA6 JMP #A64F ;Abort LIST command
```

Spreading Life

THE GAME of Life is a mathematical simulation of the evolution of a colony of cells, writes Simon Cogle of Carshalton, Surrey. In this version, the grid is 32 cells by 16 cells with wrap-round at all edges. Each cell is either white — indicating maturity — grey — indicating new-born

— or black — indicating empty. The rules for deriving the next generation are:

- A mature cell with less than two mature neighbours dies of loneliness.
- A mature cell with more than three mature neighbours dies of overcrowding.
- A cell is born in an empty cell if it is adjacent to exactly three mature neighbours.

This program produces the next generation in two stages. New cells are born, then some of the mature cells die and the new-born cells mature. The program begins in Input mode. You may input your colony of cells using the following keys: ↑, move cursor up; ↓, move cursor down; →, move cursor right; ←, move cursor left; space, to kill a live cell; and copy, to create a live cell.

Once you have entered your colony, key "R" and the program begins generating new colonies based on the rules. Each generation takes about 1.5 seconds — including a one-second wait.

While the program is in Run mode you may use the following keys: Control, to make the program pause at the end of the current generation; Shift, to resume after Control is used; and Repeat, to return to Input mode, e.g., to amend the colony.

The Break or Escape key may be used to exit from the program at any time.

The program uses direct cursor addressing — DE₁₆ and DF₁₆ contain the cursor row and EO₁₆ contains the cursor column.

You will soon discover that a colony need not be large to produce interesting results. For example, the pattern I call the spinner, because it produces an intermediate which is a twisted version of the original, is only five cells:

X		
X		X
X	X	

The spinner moves diagonally across the grid at a speed of one-quarter, i.e., a one-cell movement every four generations. This is the fastest moving group I have found so far, can you find a flyer?

Atom fractions

THIS PROGRAM for the Acorn Atom enables it to calculate fractions, writes Brian Lloyd of Witham, Essex. It will cancel down, add, subtract, divide and multiply pairs of fractions.

```
10 REM LIFE V5.1
15 DIM KK(5),K(0)
20 G=#A0;B=#FF;D=#20;E=#7F;S=#8000;F=0
21P.*21;FOR J=0 TO 1;DIM P(-1)
22L.;KKO LDY @#3B;CLC;LDA @#20;LDX @10;BIT #B001;BEQ P+10
23 INC #B000;DEY;DEX;BNE P-10;LSRA;PHP;PHA;LDA #B000
24 AND @#F0;STA #B000;PLA;PLP;BNE P-27;STY K1RTS;
25;KK1 LDA @31;STA #B01;KK2 LDA @15;STA #B1;KK3 LDX @0
26 LDA @31;STA #B3;KK4 LDA @15;STA #B4;KK5 LDA @B0;STA #B6
27 LDA #B1;CLC;ADC #B4;AND @#F;ASLA;ASLA;ASLA;ASLA
28 BCC P+4;INC #B6;STA #B5
29 LDA #B0;CLC;ADC #B3;AND @#1F;TAY
30 LDA @G;CMP (#B5),Y;BNE P+3;INX
31 LDA @E;CMP (#B5),Y;BNE P+3;INX
32 INC #B4;LDA #B4;CMP @1B;BNE KK5
33 INC #B3;LDA #B3;CMP @34;BNE KK4
34 LDA @#B0;STA #B6
35 LDA #B1;ASLA;ASLA;ASLA;ASLA;ASLA
36 BCC P+4;INC #B6;STA #B5;LDY #B0
37 LDA @D;CMP (#B5),Y;BNE P+10;CPX @3;BNE P+6;LDA @B
38 STA (#B5),Y
39 LDA @G;CMP (#B5),Y;BNE P+14;CPX @3;BEQ P+10;CPX @4;BEQ P+6
40 LDA @E;STA (#B5),Y
41 DEC #B1;BPL KK3;DEC #B0;BMI P+5;JMP KK2
46 RTS;J
47 NEXT J;P.*6,*12
48JLINK KKO
49 Z=#DE3;#FFF;?#EO
50 IF ?K=4 P.*11
60 IF ?K=7 AND Z<#B1E0 THEN P.*10
70 IF ?K=5 P.*8
75 IF Z=#B1FF GOTD n
80 IF ?K=6 P.*9
90 IF ?K=0 P.*5D
100 IF ?K=14 P.*#B0
110nIF ?K<50 GOTD j
120 ?Z=?Z:#B0
130gFOR J=1 TO 60;WAIT;NEXT J
140 LINK KK1
270 FOR Q=#8000 TO #B1FF
280 ?D=?D@B
290 NEXT Q
300wIF ?#B002&#40=0 THEN ?#E1=0;P.*30;?#E1=#B0;?S=?S:#B0;G.J
310 IF ?#B001&#40=0 F=1
320 IF ?#B001&#B0=0 F=0
330 IF F GOTD w
340 GOTD g
```

```
5 REM "FRACTIONS"
10 IN.A;IN.B;IN.C;IN.D
20 G.2010
30 P."1=ADD";P."2=MINUS";P."3=DIVIDE";P."4=MULTIPLY"
40 IN.G
50 IF G=1 G.100
60 IF G=2 G.200
70 IF G=3 G.400
80 IF G=4 G.500
100 F=A+C;G=B
110 P.*12;P.F';P." ----";P.G
115 IF G<F GOS.3000
120 G.10
200 F=A-C;G=B
210 P.*12;P.F';P." ----";P.G
215 IF G<F GOS.3000
220 G.10
400 F=A*B;G=B*C
```

```
410 P.*12;P.F';P." ----";P.G
415 IF G<F GOS.3000
420 G.10
500 F=A*C;G=B*B
510 P.*12;P.F';P." ----";P.G
515 IF G<F GOS.3000
520 G.10
2000 END
2010 IF B<>D A=A*D
2020 IF B<>D C=C*B
2030 IF B<>D B=B*D
2040 P.A" OVER "B";P.C" OVER "B"
2050 G.30
3000 P.*12;P.F/G;P." AND ";P.F%G;P."
3050 P." ----"
3060 P.G'
3100 R.
```


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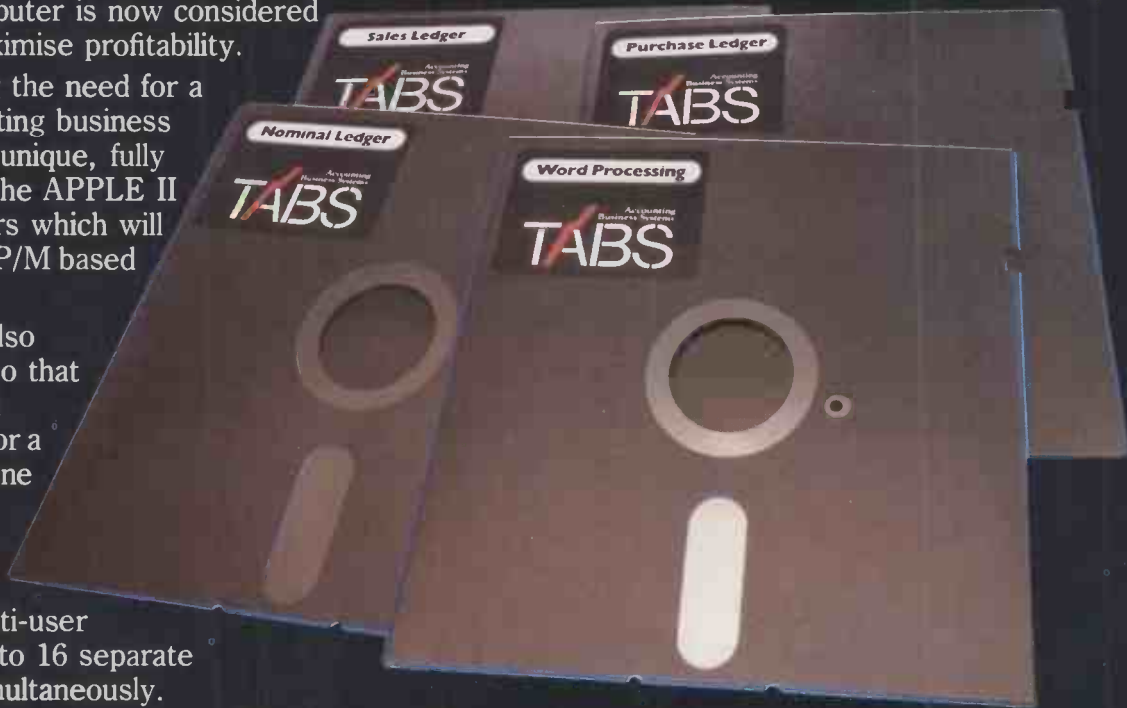
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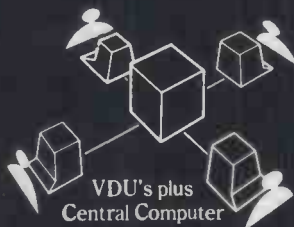


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Flying ducks

DUCK SHOOT is an interactive graphics game by Simon Williams from Tealby, Lincs. The player tries to pot 10 ducks which flap individually across the screen. They appear randomly to left and right at five different heights, with two ducks at each height in the course of a game.

The player controls the hunter with the keys 1, 2 and 3 which direct the shots left, overhead and right, respectively. A shot is fired by pressing the space bar. When a duck has been hit, a score is displayed which depends on its height and how far it has travelled.

Each score is added to the player's total, which is displayed at the bottom of the screen. When all 10 ducks have flown, the total score is compared with the three best previous scores, and an updated score card is displayed. The game then repeats with another 10 ducks, if required.

The program is written for a TRS-80 with level-2 Basic. It uses no Poke statements and should, therefore, be straightforward to convert to other machines with reasonable graphics capabilities. The graphics characters are loaded into strings in lines 300 to 400 and are Printed at various locations on the screen to obtain the desired effects.

To speed the running of the program, the main sections are listed at the beginning and much use is made of multi-statement lines. A further modification to increase speed would be to remove all Rem statements and spaces in lines 19 to 100.

Printed calendar

A PROGRAM to print out a calendar for any year from 1916 onwards, comes from K C Baldrey of Portsmouth. When Run is entered, the program halts and asks for which year the calendar is to be printed.

Line 15 calculates the number of years' difference. Line 20 calculates the number of leap years. Line 25 calculates the total number of days to be added.

Lines 35 to 42 are a loop based on the maximum number of leap years — 30 — possible before the year 2000 or thereabouts, and calculate the actual number

of days to be added for one week to give the start day for January. Monday is day zero.

When the number is less than seven, the program jumps out of the Z loop to line 60 which reads the month data, ready to start generating the calendar. Line 65 sorts out whether or not it is a leap year, and gives D a value of 29 for February. Lines 75 to 180 generate the calendar format.

Line 185 calculates the start day of the months February to December. It is put in

this position so that the previous month's data D is available for the calculation of S for the present month. Lines 195 to 255 are the month data.

A subroutine at line 1000 is used to generate the lines between weeks, etc., which is needed a large number of times. Line 1020 advances the paper at the end of the calendar ready for tearing.

This program takes leap years into account. It should run, without amendment, on most computer/printer combinations.

```

10 GOTO 290
15 *** DUCK FLIGHT
20 IF DC<1 OR DC>59 PRINT@DR,DC,B$:: GOTO 160
30 B$=B$-1: IF G$=G1$ G$=G2$ ELSE G$=G1$
40 IF PEEK(P+DR+DC+(S-D*3)/2)-136 M=1
50 PRINT@DR,DC,B$:: DC=DC+D: PRINT@DR,DC,G$
60 IF B$=1 GOTO 110
65 *** HUNTER MOVEMENT AND SHOOT
70 IS=INKEYS: I=VAL(I$): IF I>0 AND I<4 PRINT@796,H$(I):: S=D-66-1
80 IF I$="" AND S=0 S=M-SD: S=S26-SD: PRINT@5,5$:: GOTO 20
90 IF S=D GOTO 20 ELSE IF S<45 PRINT@5,"": S=0: GOTO 20
100 IF PEEK(P+S-SM)32 PRINT@5,"": S=S-SM: PRINT@5,5$:: GOTO 20
105 *** DUCK FALL AND REIRIEVE
110 PRINT@5,"": PI=INT(100-20*DR/64+B$/4): PRINT@DR,DC,"PI "": FOR N=1 TO 500: NEXT
120 TP=IP*PI: PRINT@1014,TP:: PRINT@DR,DC,DF$:: FOR N=1 TO 20: NEXT: DF=DR+DC
130 IF DF<896 PRINT@DF,B$:: DF=DF+SD-1: PRINT@DF,DF$:: FOR N=1 TO 20: NEXT: GOTO 130
140 FOR M=918 TO DF STEP-1: PRINT@M,R2$:: FOR N=1 TO 20: NEXT N,M: S=0
150 FOR M=DF TO 918: PRINT@M,R3$:: FOR N=1 TO 20: NEXT N,M: PRINT@918,R1$
155 *** NEW DUCK
160 IF I=10 GOTO 190 ELSE T=T+1: H=0: D=RND(2)*2-3: B$=59
170 IF D=1 G$=D3$: G2$=D4$: DC=1 ELSE G1$=D1$: G2$=D2$: DC=59
180 R=RND(10): DR=D5(R): IF DR=0 GOTO 180 ELSE DR=DR-64: D5(R)=0: GOTO 20
185 *** END OF GAME AND RERUN
190 GOSUB 480: FOR N=1 TO 11: PRINT: NEXT: PRINT@340,"YOUR SCORE IS"TP*POINTS"
200 IF TP<P(2) PRINT: PRINT TAB(23)"TODAY'S TOP THREE": GOTO 260
210 PRINT TAB(16)"AND IS ONE OF TODAY'S TOP THREE": PRINT
220 PRINT TAB(16)"ENTER YOUR INITIALS (3 MAX)": INPUT T$: PRINT@304,: PRINT
230 IF LEN(T$)>3 THEN T$=LEFT$(T$,3)
240 IF TP>P(0) THEN TP(2)=TP(1): TP(1)=TP(0): TP(0)=IP: T$(2)=T$(1): T$(1)=T$(0): T$(0)=T$: GOTO 260
250 IF TP>P(1) THEN TP(2)=TP(1): TP(1)=TP: T$(2)=T$(1): T$(1)=T$ ELSE TP(2)=IP: T$(2)=T$
260 FOR N=0 TO 2: PRINT TAB(20)N+TAB(30)T$(N)+TAB(40)TP(N): NEXT
270 PRINT: PRINT TAB(20)"PRESS SPACE BAR TO PLAY"
280 IS=INKEYS: IF IS<>" " GOTO 280 ELSE TP=0: T=0: GOTO 410
285 *** INITIALISE
290 CLEAR 100: DEFINT A-Z: P=15360: S$=CHR$(136): B$="*****"
300 D1$=CHR$(131)+CHR$(142)+CHR$(141)+CHR$(129): DIM TP(2),T$(2),H$(3)
310 D2$=CHR$(131)+CHR$(172)+CHR$(156)+CHR$(129)
320 D3$=CHR$(130)+CHR$(142)+CHR$(141)+CHR$(131)
330 D4$=CHR$(130)+CHR$(172)+CHR$(156)+CHR$(131)
340 D5$=CHR$(130)+CHR$(164)+CHR$(156)+CHR$(129)+""
350 H$(1)=CHR$(137)+CHR$(176)+CHR$(188)+CHR$(148)+*****
360 H$(2)=*****+CHR$(190)+CHR$(148)+*****
370 H$(3)=*****+CHR$(188)+CHR$(180)+CHR$(152)+CHR$(129)
380 R1$=*****+CHR$(171)+CHR$(173)+CHR$(152)
390 R2$="*****+CHR$(130)+CHR$(175)+CHR$(140)+CHR$(172)+CHR$(134)+""
400 R3$="*****+CHR$(137)+CHR$(156)+CHR$(140)+CHR$(159)+CHR$(137)+CHR$(148)
405 *** TITLE AND INSTRUCTIONS
410 GOSUB 480: PRINT TAB(19)"COPYRIGHT 1981, S.WILLIAMS": PRINT
420 PRINT *****PRESS SPACE BAR TO SHOOT AT DUCKS. KEYS '1', '2' AND '3'
*****AIM LEFT, OVERHEAD AND RIGHT RESPECTIVELY. EACH DUCK IS1
*****WORTH BETWEEN TWENTY AND ONE HUNDRED POINTS, DEPENDING
*****ON ITS HEIGHT. TEN DUCKS PER GAME. PRESS SPACE BAR"
430 PRINT: PRINT: PRINT
440 IS=INKEYS: IF IS<>" " GOTO 450 ELSE CLS: PRINT@796,H$(2):
450 FOR N=861 TO 864: READ D,D1: PRINT@N,CHR$(D):: PRINT@N+64,CHR$(D1):: NEXT
460 FOR N=960 TO 1022: PRINT@N,CHR$(191):: NEXT: S=D-64
470 PRINT@918,R1$:: PRINT@1000,"POINTS SCORE:"TP:: GOTO 160
480 RESTORE: CLS: FOR N=978 TO 1005: READ D: PRINT@N,CHR$(D):: NEXT: PRINT@960,
490 FOR N=978 TO 1005: READ D: PRINT@N,CHR$(D):: NEXT: PRINT
500 FOR N=1 TO 5: D$(N)=N+64: NEXT: FOR N=6 TO 10: D$(N)=(N-5)*64: NEXT: RETURN
510 DATA 151,131,164,32,32,32,32,32,32,170,32,144,32,32,166,179,147,170,32,32,
32,32,32,32,32,174,132
520 DATA 181,176,134,138,176,154,136,179,179,170,32,144,32,32,176,176,154,170,
131,169,136,179,153,136,179,153,170
530 DATA 171,160,191,149,191,181,129,32

```

```

1 REM *** PROGRAM TO PRINT CALENDAR FOR ANY YEAR FROM 1916 ***
2 REM *** DEVISED BY K.C.BALDREY. ***
3 REM *** 28 th. MARCH 1981 ***
4 REM *** FOR USE ON THE TRS-80 LEVEL 2 MICRO-COMPUTER. ***
5 REM *** IN CONJUNCTION WITH THE EPSON MX 80 PRINTER ***
6 CLS
10 INPUT"ENTER YEAR TO BE PRINTED."Y
15 D=Y-1900
20 L=INT(D/4)
25 S=D+L
35 FOR Z=1 TO 30
40 IF S>=7 THEN S=S-7
42 IF S<7 GOTO 60
45 NEXT Z
60 FOR X=1 TO 12: READ M$,D
65 IF Y/4-INT(Y/4)=0 AND M$="FEBRUARY" THEN D=29
70 GOSUB 1000
75 LPRINT" "M$,TAB(45);Y:TAB(56)"1"
80 GOSUB 1000
85 LPRINT"1 MON I TUE I WED I THU I FRI I SAT I SUN I":
90 GOSUB 1000
95 LET C=0
96 IF S=0 THEN 120
100 FOR K=1 TO S
105 LPRINT"1 "
110 LET C=C+1
115 NEXT K
120 FOR J=1 TO D
125 LPRINT USING"1 ## ";J;
130 LET C=C+1
135 IF C<>7 GOTO 155
140 LPRINT"1"
145 GOSUB 1000
150 LET C=0
155 NEXT J
160 FOR K=1 TO 7-C
165 LPRINT"1 "
170 NEXT K
175 LPRINT"1"
180 GOSUB 1000
185 S=S+D-28: IF S>=7 THEN S=S-7
190 NEXT X
195 GOTO 9999
200 DATAJANUARY,31
205 DATAFEBRUARY,28
210 DATAMARCH,31
215 DATAAPRIL,30
220 DATAMAY,31
225 DATAJUNE,30
230 DATAJULY,31
235 DATAAUGUST,31
240 DATASEPTEMBER,30
245 DATAOCTOBER,31
250 DATANOVEMBER,30
255 DATADECEMBER,31
1000 FOR V=1 TO 57: LPRINT"---";
1005 NEXT V:LPRINT"---";
1010 RETURN
1020 FOR X=1 TO 40 :LPRINT"---":NEXT X
9999 END

```

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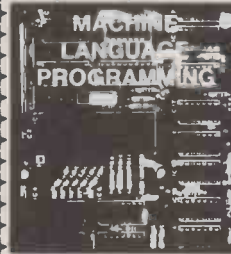
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Additional functions

HERE IS a program for the ZX-81 which will imitate the Read, Data, and Restore functions of more powerful computers. writes Stephen Carson-Rowland of Hinckley, Leicestershire.

The data is stored in a Rem statement in exactly the same way as in a proper Data statement, but to distinguish between data and ordinary Rem statements a "□" character CHR\$(8) should be used immediately after the Rem statement, e.g.,

```
10 REM □234,34,456,98,56
```

The data Rems give the best effect if they are at the beginning of the program because they are read more quickly. I usually start the program with

```
1 LET READ=9000
2 LET RESTORE=8000
```

and use Gosub Read and Gosub Restore, because they make the program more understandable. Yet, with only 1K of memory there is little space for the actual program, so subroutine Restore should be deleted, and instead of

```
(line number) GOSUB RESTORE
(line number) LET PC=16509
```

The program is written to accept numerical data, but if string data is required as well, line 9060 should be changed to

```
LET A$=A$+CHR$ PEEK PC,
```

line 9000 to

```
LET A$=""
```

and line 909 deleted. Numerical data can then be taken as well using the Val function. To the best of my knowledge this program will run on a ZX-80 without any modification.

Error bug

I HAVE found what I believe to be a bug in ZX-80 4K Basic, writes D J Crawford of Edinburgh. If this program is run, it yields error code .2/200 which is inconsistent with the program as no line 200 exists.

```
100 IF NOT A=1 THEN GOTO 200
```

A clue to understanding this is given when this program is run:

SUBROUTINE RESTORE

```
8000 LET PC = 16513
8010 RETURN
```

SUBROUTINE READ

```
9000 LET A=0
9010 IF PEEK PC=26 THEN GO TO 9070
9020 IF PEEK PC=234 AND PEEK (PC+1)=8 THEN GO TO 9050
9030 LET PC=PC+1
9040 GO TO 9020
9050 LET PC=PC+2
9060 LET A=A+PEEK PC-28
9070 LET PC=PC+1
9080 IF PEEK PC=118 OR PEEK PC=26 THEN RETURN
9090 LET A=A*10
9100 GO TO 9060
```

```
100 IF A=1 THEN GOTO 200
```

The error code given is 2/100 as one would expect. It would appear that the ZX-80 checks the condition and finds that the undefined A is not equal to 1 and so proceeds and only notices the error once this has been executed.

More memory economy

JOHN BLOXHAM'S memory-saving routine, ZX-80/81 Line-up August 1981, although interesting in itself as a feature of the machine, will not save money, writes Matthew Wright of Sale, Cheshire.

If, instead, one were to enter the following:

```
10 IF 1 = 1 THEN PRINT "20"
20 PRINT "30"
```

then by adopting Eric Deeson's suggestion in the July 1981 edition, one could omit the quotation marks as well. Obviously, the same change will produce the same result.

Big characters

I WAS interested by the program to produce big characters on a 1K ZX-80, printed in ZX-80/81 Line-up on page 119/121 of the September 1981 issue, writes Roy Eastwood, of Romford, Essex.

I have converted the program to run on a 1K ZX-81 and also taken the opportunity to include a machine-code routine to display the characters on the screen, which gives an acceptable speed when run in Slow mode. The program prints the four characters entered in response to the prompt on line 30 eight times normal size.

The program is as follows: first, make space for the 32 bytes of machine code by typing line 10 as follows:

```
10 REM ..... (32 full stops)
```

Then, using the following temporary program, Poke the machine code into the Rem line:

```
20 PRINT AT 21,0;
30 FOR N=16514 TO 16545
40 SCROLL
50 PRINT N;" ";
60 INPUT M
70 POKE N,M
80 PRINT M
90 NEXT M
```

Then type Run, enter the codes followed by the program proper. In response to the prompt, enter any four characters. The characters may be made to appear grey by Poking 8 into address 16532.

(continued on page 136)

Big characters — codes.

At address	enter	meaning
16514	42)
16515	14	) LD HL, (16398)
16516	64)
16517	58)
16518	123	) LD A, (16507)
16519	64)
16520	79	) LD C,A
16521	6	) LD B,8
16522	8)
16523	203	) RIC C
16524	1)
16525	56	) JR C,+4
16526	4)
16527	22	) LD D,0
16528	0)
16529	24	) JR+2
16530	2)
16531	22	) LD D,128
16532	128)
16533	126	) LD A,(HL)
16534	254	) CP 118
16535	118)

16536	40	) JR Z,5
16537	5)
16538	114	) LD (HL), D
16539	35	) INC HL
16540	16	) DJNZ,-19
16541	237)
16542	201	) RET
16543	35	) INC HL
16544	24	) JR -8
16545	248)

Big characters — main program.

```
20 DIM D(4)
30 INPUT U$
40 FOR S=1 TO 4
50 LET D(S)=CODE U$(S)
60 NEXT S
70 FOR Q=0 TO 7
80 PRINT AT Q,Q;" (32 spaces)"
90 FOR S=1 TO 4
100 PRINT AT Q, (S-1)*8;
110 POKE 16507, PEEK (D(S))*8+7680+Q)
120 RAND USR 16514
130 NEXT S
140 NEXT Q
150 GOTO 30
```

(continued from page 135)

Storable screen display

THIS PROGRAM demonstrates the use of a subroutine which converts the display file into a character string, on an expanded ZX-81, writes John Bloxham of Stratford upon Avon, Warwickshire. The idea is to allow a display, e.g., a game board, to be retained and recalled when necessary, or Saved on to tape. Assuming you have enough memory, two or more displays may be stored and recalled in rapid succession, giving an animation effect.

Line 10 initialises D\$ — it will eventually contain the display. Lines 100-120 generate a simple test display. Line 200 hands over to the subroutine which loops through the display file and adds the characters into D\$. On returning from the subroutine, the display is cleared and the program stops. The previous display is now stored in D\$ and may be instantly recalled with a Print D\$.

This appears to be a fast way of printing a screenful of anything, but because the display is in a string, it may be processed by the string-handling commands. For example, add the following lines:

```
300 FOR X=1 TO 673 STEP 32
310 PRINT AT 0,0;D$(X TO)
320 NEXT X
```

Then Goto 300 — do not use Run — scrolls the display upwards. Change line 300 to:

```
300 FOR X=673 TO 1 STEP -32
```

and the display scrolls downwards. Now if the display is changed and the subroutine called again, further pictures may be

```
10 LET D$ = ""
100 FOR X = 0 TO 20
110 PRINT AT X, X;"SCREEN TEST"
120 NEXT X
200 GOSUB 1000
210 CLS
300 STOP
1000 REM STRING ROUTINE
1010 LET A=PEEK 16396+256*PEEK 16397
1020 FAST
1030 FOR B=1 TO 726
1040 IF PEEK (A+B) =118 THEN GOTO 1060
1050 LET D$=D$+CHR$ PEEK (A+B)
1060 NEXT B
1070 SLOW
1080 RETURN
```

```
300 FOR X=1 TO 673 STEP 32
310 PRINT AT 0,0;D$(X TO)
320 NEXT X
```

```
300 FOR X=673 TO 1 STEP -32
```

tacked on to D\$. Each display adds 704 bytes to the string. Program a loop to print chunks of D\$ 704 bytes long and you have animation. Finally, if the program is Saved on to tape then D\$ is Saved as well — though do not forget to re-start with a Goto after Loading.

Self-running program

I OWN a ZX-80 with the new 8K ROM, writes R Emery of Harrow, Middlesex. While experimenting one day, I put a line at the very beginning of the program which would Save it under a certain name. I started my tape recorder to record and pressed Run. Newline. The program then started to Save itself and once it had finished, it stopped where it started Saving.

```
5 DIM AUTHOR JOHN ALLEN
10 PRINT "SIMULTANEOUS EQUATIONS"
20 PRINT "INPUT NO OF ROWS"
30 INPUT R
40 PRINT "INPUT NO OF COLUMNS"
50 INPUT C
60 DIM A (R,C)
70 FOR H = 1 TO R
80 LET Y = A (H,H)
90 FOR I = 1 TO C
100 LET A (H,I) = A (H,I)/Y
105 NEXT I
110 FOR I = 1 TO R
120 IF I = H OR A (I,H) = 0 THEN GOTO 160
130 IF A (I,H) = 1 OR A (I,H) = - 1
140 IF A (I,H) > - 1 AND A (I,H) < 1 THEN GOSUB 3000
150 IF A (I,H) < - 1 OR A (I,H) > 1 THEN GOSUB 3000
160 NEXT I
170 NEXT H
500 FOR J = 1 TO R
510 PRINT "X"; J; "="; A (J,C)
520 NEXT J
530 STOP
1000 LET D = 1
1010 IF A (I,H) < 0 THEN LET D = -1
1020 FOR J = 1 TO C
1030 LET A (I,J) = A (I,J) - A (H,J) * D
1040 NEXT J
1050 RETURN
2000 IF A (I,H) = 0 THEN GOTO 2050
2005 LET Y = A (H,H) / A (I,H)
2010 FOR J = 1 TO C
2020 LET A (I,J) = (I,J) - A (H,J) / Y
2030 NEXT J
2040 RETURN
3000 LET Y = A (I,H)
3010 FOR J = 1 TO C
3020 LET A (I,J) = A (I,J) - A (H,J) * Y
3030 NEXT J
3040 RETURN
4000 FOR I = 1 TO R
4005 PRINT "INPUT ROW"
4010 FOR I = 1 TO R
4020 FOR J = 1 TO C
4030 INPUT A (I,J)
4040 CLS
4050 PRINT A (I,J)
4060 NEXT J
4070 NEXT I
4080 CLS
4090 RETURN
```

The next time I wanted to load it, I went through the normal procedure, and was astonished to see that the program had run itself. This is quite useful for some programs and I hope useful to other readers. For example
SAVE "PROGRAM 1"
10 PRINT "THE PROGRAM RUNS ITSELF"
20 GOTO 10

This works with the 8K ROM so it should work with the ZX-81 and might also work with the ZX-80 with 4K ROM.

Inspecting the RAM

AFTER USING a CBM micro with 16K Basic, I found the Sinclair ZX-81 Basic deficient in certain respects, writes Christopher Clarke of Colchester, Essex. One shortcoming which is easily rectified is that of not knowing how much memory remains for program/variables/screen use. The following short machine-code subroutine may be placed above RAM-Top or, as I prefer, inside a Rem statement using the Basic loader.

```
10 REM AAAAAAAAAAAAAAAAAAAAAA
20 LET A = 16514
30 INPUT B
40 IF B = -1 THEN END
50 POKE A,B
60 LET A = A+1
70 GOTO 30
```

Enter these numbers:

```
237, 115, 54, 64 ld (nn), sp
42, 54, 64 ld hl,(nn)
237, 75, 28, 64 ld bc,(nn)
237, 66 sbc hl, bc
pairs.
68, ld b, h
77, ld c, l
201, ret
```

(-1 to end loader)

Now delete all lines except line 10 and put:

```
20 let bc = usr 16514
30 print bc
```

Simultaneous equations

I WROTE this code listing for the ZX-81 for solving simultaneous equations, writes John Allen of London SE18. The program asks for the number of rows and then the number of columns. Then the complete problem is entered in a row at a time and element by element in the row.

I do not know the size of the program but I feel that with a 16K RAM pack, it can solve up to 60 simultaneous equations with 60 variables. I have only been able to test the program with nine variables and nine equations and I found that the program took less than 30 seconds to solve the problem.

$$\begin{aligned} X_1 + 2X_2 &= 4 \\ X_1 - 2X_2 &= 8 \end{aligned}$$

In this problem, there are two rows and three columns. When the number of rows and columns are input into the program, the data is input row by row.

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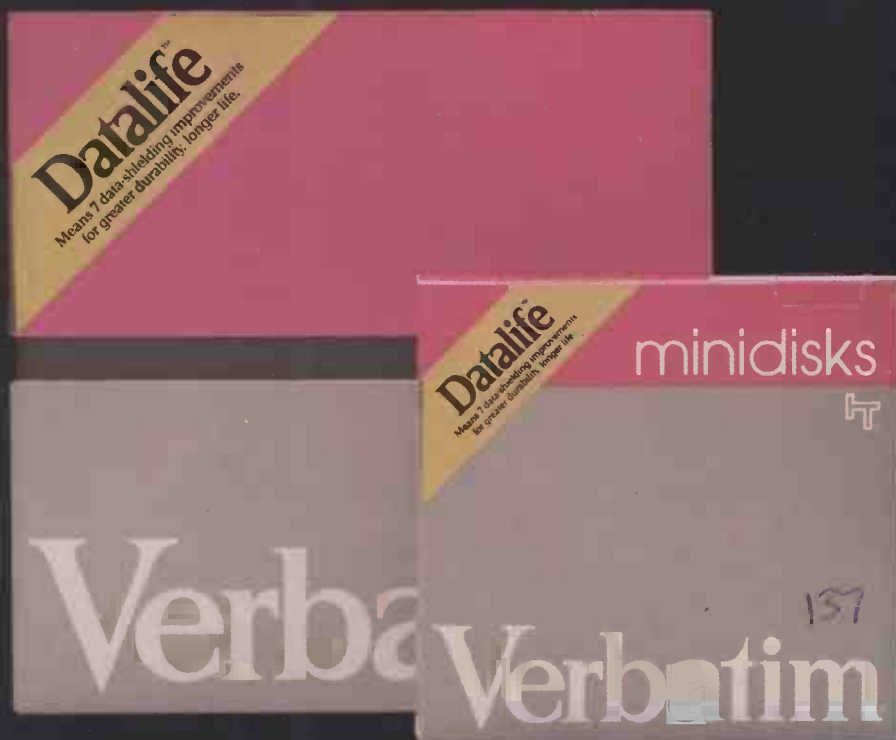
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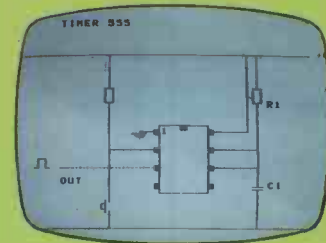
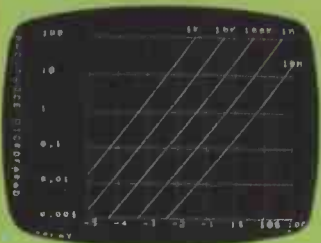
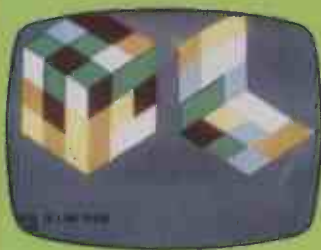
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Racing game

RACE is a car-racing game from Nicholas Lloyd of Rottingdean, near Brighton. The aim is to complete one lap of the course as fast as possible without crashing.

To control the car you use the 8,2,4 and 6 keys to make the car go up, down, left and right respectively. The 5 key may be used as an accelerator. If you first press a key for the direction followed by 5, the car will proceed at an increased rate.

If you have a 3016 Pet then try Poke 59458,62, which has the effect of speeding up the program; to return to the normal speed, type Poke 59458,30. Do not use this on the 4032, as the only result will be to reduce the screen size to about four rows.

Upgrading from Basic 3

CBM HAS released a new DOS for the Pet disc, DOS 2.1, which is fitted as standard to the 4040 disc. The 2040/3040 units can be upgraded by a retrofit set of ROMs which cost about £40. The upgrade is useful since it clears many of the problems associated with the original DOS. The relative file facility allows more flexible direct access without the problems of block commands and descriptor files. However, the Pet would need to be upgraded to DOS 4 to realise this facility. The price of this retrofit is the same as for the disc.

There are two ways to upgrade a new-ROM Pet with Basic 3, writes M J Valentine from Rotherham. There is the official ROM set and an independent manufacturer's ROM.

The official Commodore retrofit allows a Basic-3 machine to be upgraded to Basic 4. The main features of Basic 4 allow faster running and disc access without the use of DOS support or print#.

The shifted Run/stop allows a properly retrofitted system to load the first program from Drive 0 and Run. Basic 4 allows handling of relative files, which is mandatory with DOS 2.1. The snags of the retrofit upgrade are mainly due to changes in the main subroutine entry points.

The zero-page locations are similar to Basic 3, but the values are different in many cases, e.g.

Stop key disable	Enable
Basic 3 Poke 144,49	Poke 144,46
Basic 4 Poke 144,88	Poke 144,85

All Basic-3 programs will run on Basic-4 machines, but some modifications will be needed to Poke, USR and Sys. The Run/stop disable is the best example.

The big problems come with machine-code programs, e.g., Wordcraft, Invaders, Microchess, etc. which will not run. A Basic-4 version will have to be purchased at more expense. Toolkit and other system chips will have to be replaced.

Open4,4:CMD4:Sys1024 will not

```

40 PRINT "J":POKE59468,14
50 PRINT "*****"
60 PRINT "*****"
70 PRINT "*****"
80 PRINT "*****"
90 PRINT "*****"
100 PRINT "*****"
110 PRINT "*****"
120 PRINT "*****"
140 PRINT "*****"
150 PRINT "*****"
160 PRINT "*****"
170 PRINT "*****"
180 PRINT "*****"
190 PRINT "*****"
200 PRINT "*****"
210 PRINT "*****"
220 PRINT "*****"
230 PRINT "*****"
240 PRINT "*****"
250 PRINT "*****"
260 PRINT "*****"
270 PRINT "*****"
280 PRINT "*****"
282 PRINT "PRESS A KEY!"
283 GETW$:IFW$=""THEN283
284 PRINT "J"
290 TIM$="000000"
300 A=33585
310 POKEA,35
320 IFPEEK(151)=42ANDPEEK(A-1)=42THEN400
330 IFPEEK(151)=42ANDPEEK(A-1)=32THENPOKEA-1,35:POKEA,32:A=A-1:B=-1:GOTO370
335 IFPEEK(151)=41ANDPEEK(A+1)=42THEN400
340 IFPEEK(151)=41ANDPEEK(A+1)=32THENPOKEA+1,35:POKEA,32:A=A+1:B=1:GOTO370
345 IFPEEK(151)=50ANDPEEK(A-40)=42THEN400
350 IFPEEK(151)=50ANDPEEK(A-40)=32THENPOKEA-40,35:POKEA,32:A=A-40:B=-40:GOTO370
355 IFPEEK(151)=18ANDPEEK(A+40)=42THEN400
360 IFPEEK(151)=18ANDPEEK(A+40)=32THENPOKEA+40,35:POKEA,32:A=A+40:B=40:GOTO370
370 IFPEEK(A-1)=94THEN390
372 IFPEEK(151)=34THEN374
373 GOTO320
374 IFPEEK(A+B)=42THEN400
375 IFPEEK(A-1)=94THEN390
376 POKEA+B,35:POKEA,32:A=A+B
377 IFPEEK(151)<>34THEN320
378 GOTO374
390 PRINT "TIME":PRINTMID$(TIME$,3,2):" \INS ":RIGHT$(TIME$,2):" *SECONDS"
395 POKE158,0:END
400 POKE59468,12
405 PRINT "J"
406 PRINT "*****"
407 PRINT "*****"
408 PRINT "*****"
409 PRINT "*****"
410 PRINT "*****"
411 PRINT "*****"
412 PRINT "*****"
420 PRINT "*****"
421 PRINT "*****"
422 PRINT "*****"
423 PRINT "*****"
424 PRINT "*****"
425 PRINT "*****"
426 PRINT "*****"
427 PRINT "*****"
428 PRINT "*****"
429 PRINT "*****"
430 PRINT "*****"
431 POKE158,0:FORG=1TO800:NEXTG:PRINT "*****"
432 GETR$:IFR$=""THEN432
433 IFR$="V"THEN40
    
```

allow Tim to be directed to the printer. You must use

OPEN4,4:CMD4:SYS 54395 since Tim's location has been shifted. The upgrade to DOS 2.1 and Basic 4 therefore calls for re-purchase of a Toolkit and other firmware.

The second alternative to Basic 4 is to use a ROM which works by intercepting a command before Basic 3. Disk-o-Pro is one such ROM, but costs more than the official CBM retrofit set.

Disk-o-Pro has the advantage of allowing the use of all Basic-3 software, including Wordcraft, Toolkit and Invaders, and does not require re-purchase as the official kit does. All Basic-4 disc commands can be used if DOS 2.1 is retrofitted. Also included are extra commands, e.g., Print Using, which should have been included in CBM Basic.

For £57 you receive a chip which plugs

into the \$9000 ROM expansion socket. If a VisiCalc chip is present, then ROM expanders are available to allow several chips to be used. On power-up, the Disk-o-Pro chip must be called by Sys36864 to display

DISK-O-PRO (C) 1980 ROB CHANG (C) 1979 PAICS

Toolkit is called automatically, if present. All the commands are available as well as the Basic 4. Disc commands include an execute command — the same as t0: program of DOS support — and scroll, which is very useful when dealing with program listings.

Kill will leave the Pet without Disk-o-Pro which is incompatible with other programs using the Chartgot area. However, all the commands may be in program or direct mode so that Disk-o-Pro may be activated by a Basic program.

(continued on page 143)

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```

100 REM* M VALENTINE 16.6.81
110 REM
120 REM* WORKS LIKE "D1=0" COMMAND TO DISK
130 REM
140 REM* BLOCK 19 ON TRACK 13-24 CANNOT BE
150 REM
160 REM* COPIED AND IS DUMPED ONTO PRINTER
170 REM
180 REM* DO NOT USE THIS PROGRAMME TO COPY
190 REM
200 REM* FILES WITH A DIRECTORY ENTRY
210 REM
220 REM* USE FOR RANDOM ACCESS FILES
230 REM
240 REM* ERROR # 22 READ ERROR WILL OCCUR IF
250 REM
260 REM* DATA HAS NOT BEEN WRITTEN TO THE BLOCK
270 REM
280 REM* THIS SHOULD BE IGNORED
290 REM
300 PRINT"DO NOT COPY DIRECT ACCESS FILES FROM 2040/3040 TO 4040 FORMAT"
310 PRINT
320 PRINT"PLACE DESTINATION DISK IN DRIVE 1"
330 PRINT
340 PRINT"PRIMARY DISK TO DRIVE 0":GOSUB610
350 PRINT
360 PRINT"DATA ON DRIVE 1 WILL BE LOST":GOSUB610
370 PRINT
380 OPEN15,8,15
390 PRINT#15,"U":PRINT#15,"I0":PRINT#15,"I0":GOSUB630
400 OPEN2,8,2,"#":ID$="":PRINT#15,"U1":2:0:18:0:PRINT#15,"B-P":2:144
410 FORP=1T020:GET#2,Q$:ID$=ID$+Q$:NEXT
420 PRINT"FORMAT DRIVE 1 "ID$:PRINT#15,"N1":"LEFT$(ID$,13)","RIGHT$(ID$,2):GOSUB
630
430 CLOSE2:CLOSE15
440 FORT=1T017:FORS=0T020:GOSUB570:NEXT:NEXT
450 T=18:FORS=1T018:GOSUB570:NEXT
460 FORT=19T024:FORS=0T018:GOSUB570:NEXT:NEXT
470 FORT=25T030:FORS=0T017:GOSUB570:NEXT:NEXT
480 FORT=31T035:FORS=0T016:GOSUB570:NEXT:NEXT
490 OPEN2,8,2,"#":OPEN15,8,15
500 FORT=18T024:S=19:PRINT#15,"U1":2:0:T:S
510 OPEN4,4:PRINT#4,"BLOCK TRACK"TAB"SECTOR"TAB"ID$
520 PRINT#4,"THE FOLLOWING DATA CANNOT BE TRANSFERRED"
530 FORI=0T0254:GET#2,Q$:PRINT#4,Q$:NEXT:PRINT#4,"END OF DATA"TAB,"S
540 PRINT#4:CLOSE4:NEXT
550 PRINT#15,"I":GOSUB630:CLOSE2:CLOSE15
560 PRINT"HOME":END
570 OPEN2,8,2,"#":OPEN15,8,15
580 PRINT"COPY"TAB,"S":PRINT#15,"U1":2:0:T:S:GOSUB630
590 PRINT#15,"U2":2:1:T:S:PRINT"CHECK":GOSUB630
600 CLOSE2:CLOSE15:RETURN
610 GETQ$:IFQ$=""THEN610
620 RETURN
630 INPUT#15,N$,M$,T$,S$
640 PRINT" = "N$,"M$","T$","S$
650 RETURN
660 A$="00: COPY BLOCKS":SAVEA$,8:SAVEA$,8:VERIFYA$,8
    
```

(continued from page 141)

Other snags include

- a 20 percent reduction in execution time
- tape #2 buffer cannot be used — the same applies to Basic 4 if disc in use
- Supermon, DOS support, etc. are incompatible
- after every disc operation the error channel is checked, unlike Pet Basic 4; this includes direct operations like Directory, Copy and Get#, which will cause a considerable delay if many Get#s are used.

Anyone considering upgrading to Basic 4 should consider Disk-o-Pro as a more economic alternative if Toolkit is being used.

As previously mentioned, to obtain the full benefits of Basic 4, the disc unit should have DOS 2.1 or 2.5. For about £40 you receive as set of four chips. Three are 24-pin and one is 40-pin.

CBM do not appear to have produced any directives on where to put the chips. The spare DOS expansion socket is used. DOS 2.1 will then cause automatic initialisation of Drive 0, the command only being required for direct access. The familiar noise of initialisation of DOS 1 is only heard if a problem occurs or on power up.

DOS 1 and DOS 2.1 are read-compatible but not write-compatible. When a

disc has been formatted by the New or Header command, the DOS format is written to the header: 2a indicates DOS 2.1, a blank or 1 indicates DOS 1.

The duplicate command cannot be used to copy a disc DOS 1 to DOS 2.1 or vice versa. If an attempt is made to write to a 2.1 disc with DOS 1 then the error channel is not updated and will crash.

To transfer data from DOS 1 to DOS 2.1 is simple. The program Copy Disc Files supplied by CBM on the demonstration disc is useful as long as the destination disc is Newed before copy is attempted. Copy can be done in the direct mode using Basic 4 and Basic 3, with or without DOS support. In Basic 4,

```

HEADER "DISK NAME", D1, I(ID)
COPY D0 TO D1
    
```

In Basic 3,
OPEN15,8,15:PRINT#15,"n1:disk name,id"
PRINT#15,"C1 = 0"

```

With DOS support,
) n1:disk name, id
) o1 = 0
    
```

This will work on the upgraded disc, providing that the files have a directory entry. It will not copy a direct-access file written by a b-w or u2 command.

There is no facility to transfer files directly. Another problem is that on

tracks 18 to 24, block 19 does not exist in DOS 2.1, otherwise a block-for-block transfer would work. This problem occurred with a mailing-list file. The program Copy Blocks is a partial solution which prints out the uncopyable blocks. The result is a compatible disc without six blocks of data.

The direct-access disc is usually drive 1, and a descriptor file is usually in drive 0. If a missing block is called after transfer over then a No Block or Illegal t/s error will occur. If the program can be listed, the appropriate modification should be made or the descriptor file modified. In any case, a direct-access disc file should be replaced by a relative file with the appropriate program modifications to take full advantage of DOS 2.1 and Basic 4.

The other problem that was encountered is that Block Write is not available with DOS 2.1. The manual suggests replacement with the u2 command, but you will have to check the buffer pointers, and the commands may have to be modified.

Closure test

IN MOST programs it is desirable to test the keyboard for the closure of a particular key, either in response to a menu page or just to advance to the next page of text. T. P. Brown of Bath has sent a simple common subroutine which does the job.

You should set the following variables before calling:

- KP:— = 0 — return on any key
- = 1-9 — return on any of the number KP of keys defined in KPS
- KPS(1)-(9);— Keys on which to return.

You call the subroutine with Gosub 10000, and should test with the two call routines.

```

100 REM *****
110 REM * CALL ROUTINE (1)
120 REM *****
130
140 PRINT"PAGE ONE"
150 PRINT"WHIT A KEY"
160 KP=0:GOSUB10000
170 PRINT"PAGE TWO"
180 END
190
200 REM *****
210 REM * CALL ROUTINE (2)
220 REM *****
230
240 KP=3:KP$(1)="1":KP$(2)="B"
250 KP$(3)=CHR$(13):GOSUB10000
260 ONKP0T0200,290,300
270 GOT0240
280 PRINT"YOU HIT KEY 1":GOT0240
290 PRINT"YOU HIT KEY B":GOT0240
300 PRINT"YOU HIT RETURN":GOT0240
310
10000 REM *****
10010 REM * MAIN ROUTINE
10020 REM *****
10030
10040 POKE158,0
10050 GETA$:IFA$=""THEN10050
10060 IFKP=0THENRETURN
10070 FORI=1TOKP
10080 IFA$=KP$(I)THEN10100
10090 NEXTI
10100 KP=I:RETURN
10110
10120 REM *****
10130 REM *FOR OTHER THAN C.B.M. BASIC
10140 REM *USE IN LINE 10040
10150 REM * 'FORI=1T010:GETA$:NEXTI'
10160 REM *THIS IS FOR A 10 CHR BUFFER
10170 REM *****
    
```

IN WHAT has been rightly described as an amazing triumph, Thumper and Sterling Mouse — first and second in the British heat — trounced the best of the rest of Europe in the Paris final. However, Thumper's days as champion may already be numbered — plans for next year's heats at the London Computer Fair, April 23, 24, 25 and Micro-Expo in Paris in June. The European final will be held in Haifa in Israel — and there is talk of a world final in London in September.

In case you are not sure what the competition is about, here is a brief resume of

by Nick Smith

the rules. The objective is to build a self-contained robot — otherwise known as a mouse — which can reach the middle of a maze. The maze used for the London final is shown in figure 1.

The start is always at the bottom left-hand corner with the mouse pointing north. The finish is always the centre four squares, though the position of the entrance to the centre and the hole for recovering exhausted mice can both be moved. A mouse has 15 minutes to make as many runs as it can from start to finish; the fastest run is recorded and the fastest mouse wins.

Handling mice is allowed but the judges take a dim view of it. An unhandled mouse will always beat a handled mouse regardless of the times.

The maze is based on a 16-by-16 grid of 18cm. squares — overall about 9ft. square. Walls are 5cm. high and 12mm. thick. The walls of the maze are built out of 18cm. long pieces plugged into the base so that the design of the maze can be, and is, changed from day to day. The individual walls have a tendency to lean in random directions and occasionally there are slight gaps at the joints — beware.

The base is made of several pieces of smooth black-painted chipboard. Joints tend to run along the middle of passages and steps and gaps of up to 2mm. are not unknown — beware of tiny wheels and skidding.

The mice must be entirely self-contained — no trailing wires, no remote control. Maximum size is 25cm. by 25cm. with no height limit. Damaging or marking the maze is not allowed, although you might be allowed a ball of string. There is a limit of one Newton on the force a mouse exerts on any wall.

The current state of the art can be seen from the 1981 Paris final. Despite hundreds of entries — more than 300 from Britain alone — only about 13 mice competed. Of these, only eight reached the middle of the maze in practice. Alan Dibley of Cheddar had the distinction of owning two of them: Thezeus — about 12 minutes — from the London heat and a new, faster mouse Son of Thezeus — 2 minutes 49 seconds. Thumper finished in 1 minute 15 seconds, and was the leading

New champions of the labyrinth

qualifier. As the 1980 champion, my own mouse Sterling was included in the eight finalists and Thezeus was eliminated.

As always seems to be the case, the mice were dogged by electrical and mechanical problems. One exception was Kim, a French mouse which is memorable as the only three-wheeler I have seen. Just like a child's tricycle, the front wheel is both driven and steered. At the French heat in May, it had electronic wall-sensing. At the final it had a large roller sensors about 2in. wide protruding on each side and another one in front. These were carved out of polystyrene and ran on the tops of the walls.

Steering was controlled by a micro-switch on each side at the front. Unfortunately, Kim's brain could not work out how to pass the first two traps in the maze. After circling for about 10 minutes, Kim was withdrawn.

Sterling Mouse ran next, managing a very pleasing time of 68 seconds. Sterling is running about three times faster now than it did last year.

Minitaurus from Tampere University of Technology of Finland then entered the maze. The crowd literally gasped when it started because of its incredible acceleration from rest. Minitaurus is very fast and uses infra-red sensors all round for short-distance, accurate sensing, and

It goes as fast as possible from corner to corner — where it has to stop anyway — remembering but ignoring side turnings. At each corner Minitaurus decides whether to continue or back-track to a side opening it has passed. Obviously, once you know where a side turning is, there are no stopping problems.

Minitaurus is fast and covers more ground than other mice during exploration but takes a worse initial route to the middle. This explains its poor first run time of 5 minutes 40 seconds. Minitaurus then started playing up. When it was finally coaxed into a second run, it seemed to be following the shortest route to the middle but the Finns withdrew it for some unknown reason, when it was about two-thirds of the way there.

With only Thumper left to run, Sterling was still the fastest mouse in Europe with Minitaurus the only other mouse to attain the middle in the finals. Thumper started as smoothly as ever and arrived at the middle in about two minutes. Thumper's second run was again slower than Sterling's best, but my defeat seemed inevitable — then Thumper suddenly stopped dead. With rising spirits, I watched Dave Woodfield and Arthur White of GKN Technology prod Thumper and carry it back to the start. Whatever happened now, Britain was first and second.

Sadly for me, Thumper re-started and ran the shortest route in an astonishing 44 seconds to become the new champion. Credit must also go to Andrew Keatley of Allen-Martin Electronics who wrote Thumper's software.

One of the more disappointing aspects of the competition was the lack of successful amateurs and young competitors. If you have any ideas on how to make the competition more open to amateurs, and how to separate the amateurs from the professionals, write in to the Micromouse page. One idea is to double the width of the maze passages and eliminate dead ends to make model-car approaches viable.

Practical Computing is also looking for ideas for chassis design and simple sensors. Remember, you receive £5 for each idea or tip published. So far, there is no definitive mouse design so anything new could be a winner. When Dave Woodfield and I were talking after the competition, we agreed a new approach was needed. Look out for at least one bicycle next year.

For an entry form and a full set of rules, write to: Dr John Billingsley, Department of Electrical and Electronic Engineering, Anglesea Building, Anglesea Road, Portsmouth PO1 3DJ.

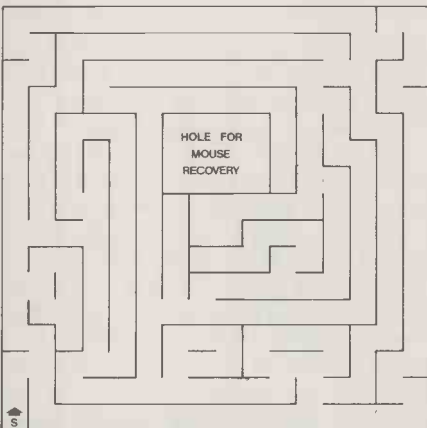


Figure 1. The London maze.

sonar on the front for long-distance detection so that it can stop before it hits a wall.

I had heard that maze-solving was not the forte of Minitaurus because it tends to run in long straight lines ignoring likely side turnings. I now realise what it was doing. Like Kim in the French heat, Minitaurus cannot stop in time to turn when it detects a side opening in a previously unexplored passage. Most mice, therefore, run slowly while exploring and stop to decide where to go at each junction: Minitaurus does the opposite.

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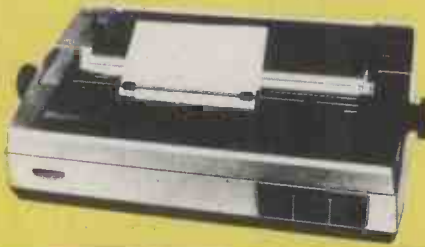
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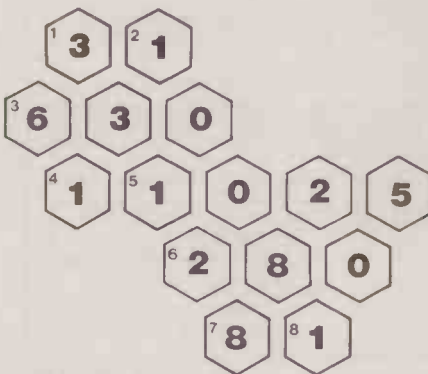
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An introduction to computer programming and data structures using Macro-11

By Harry R Lewis. Published by Reston. £19.20.

IT IS unusual these days for an introduction to programming to use an assembler-level language; this book uses that for the popular PDP-11 range. It is not an *ab initio* primer; it is aimed at those with some elementary programming knowledge.

The approach is similar to introductions to programming in high-level languages in that it takes a small logical group of instructions and explains their use with numerous examples. Where it differs is in that data storage and addressing are considered before any instructions are introduced — a consequence of using a low-level language.

However, for an introduction it goes into the various addressing modes too soon and too rapidly, which is likely to lead to confusion. Apart from that, the rest of section 1 is a clear description of the elements of Macro-11 without attempting to be exhaustive, as it is intended to be used with the language reference manuals.

As this book was written by a university lecturer, the examples are from a Unix operating system environment — consequently some of the Macros used will differ from those used by the DEC operating systems. The principles remain the same, however.

Considering the limitations of space in section 2, this book has been remarkably wide-ranging in its coverage of data structures. Not only does Harry Lewis cover all the common data structures including linked lists, trees and hash tables, he also manages to discuss language-syntax specification. This is discussed along with parsing and code generation in a superficial way as a basis for the programming projects in the third section.

The programming projects are for such system software as text editors, assemblers and compilers, and are obviously limited in scope. They consist of a common format of a defi-

nition of requirements which are built, piece by piece, into a functional specification at sub-routine level. The reader is then left to complete the program.

Although there are exercises throughout the book there are no answers. This only emphasises that the approach of the book is designed to be worked through with the aid of a tutor. That said, a programmer experienced in another language, preferably low-level, would find this book a useful introduction to Macro-11.

Conclusions

- As a basic introduction to programming or computers it is not ideal. For someone with some experience, it would be a good first step into Macro-11.
- With Macro-11 also being the language of the LSI-11 range, it is of interest to the microcomputer programmer.

Martin Wilson

Personal Computers Handbook

By Walter H Buchsbaum, published by Sams. U.S. \$11.95; U.K. £7.75. 286 pages paperback. ISBN 0-672-21724-4.

ONE WOULD have expected a book with a title like *Personal Computers Handbook* — whatever it means — from the powerful Sams stable to be an outstandingly useful treatment of the 1980s hobbyist's darling. One would be disappointed.

True, there is plenty here, from baby hardware theory to a sophisticated treatment of software — but it never seems to gel into a coherent whole. Dr Buchsbaum tends to skip around among his chosen topics without any obvious direction, without alighting for long on any one flower — however full of nectar — without drawing meaningful conclusions at any stage.

Perhaps that is what a handbook is — a work of reference in which one expects no more coherence than a bedside reader after a few pages of which one can rest easy? The task of reading it took me many more days than I expected, and I ended up with continued mixed feelings.

It is directed at "readers

who have a working knowledge of electronics and are interested in learning more about personal computers". Both parts of that quotation from the preface imply that this is not a book for beginners. It can be technical, but qualitatively rather than quantitatively. In other words it details what can be done, but not how to do it.

There are plenty of home-grown texts available which cover the micro better than this book. They may not be more up-to-date, or even more detailed — but they do follow a coherent line and keep a uniform level. I can foresee that I shall have occasion to use this book for reference — but keep it to hand? — no.

Conclusions

- A good, solid account, mainly of hardware. It does not, however, draw together to a readable whole.
- Not for the beginner keen to develop elementary knowledge, nor for the advanced micro user aiming to break new ground. For the rest, it is of some interest, but best first compared to other titles in the bookshop.

Eric Deeson

Apple Basic for business for the Apple II

Parker and Stewart. Published by Reston.

THIS BOOK sets out to teach Apple Basic by using examples drawn from business. The examples and problems are based on either payroll or stock systems and are built up stage by stage as the necessary facilities are introduced.

The book moves along steadily with comprehensive descriptions of each new concept. By the fourth chapter, files are in use, something most books leave until the later chapters. Sub-totalling and control breaks are introduced in chapter five, while file matching is discussed in the next two chapters. From chapter nine onwards, we are in strange territory as far as introductions to Basic are concerned — direct-access files.

Subsequent chapters deal with graphics and the different forms of business systems. All topics are explained in a clear

and concise manner which is very readable and there are the usual appendices of error codes and instruction formats. Also included is a very useful sort program which assumes disc files are in use, as do all the examples.

Each chapter has a summary at the end which provides a useful reference to formats and to techniques. There are also problems to test understanding of the topics introduced in the preceding chapter but unfortunately no solutions are given. This is something of a problem for this type of book as there is no one correct answer. Some guidance should be given to ensure that there are no misunderstandings which re-reading the chapter will not resolve. Strangely, for many of the programming problems there is a ruled page for the solution which is rather unnecessary — it looks suspiciously like padding.

No book, not even this one will turn the novice into a fully-fledged commercial programmer particularly as they all seem to be rather light on data validation and security. This book covers the trapping of some data errors but not enough to enable the reader to produce programs which will not be tripped up by errors in data entry.

Back-up copies of files are mentioned but no guidance is given as to when they should be made. The reader who studies this book conscientiously will be rewarded with a good foundation on which to build by experience and further study.

Any Apple user or, for that matter, anyone requiring an introduction would do well to consider this book — it will certainly be recommended by me.

Conclusions

- This book is very readable and accurate with well-chosen examples. It is one of the best introductions to Basic I have seen and I will certainly use it.
- The approach is not novel but is rather more consistent than most and provides a thread of continuity which this kind of text needs.
- If you are looking for a book on Apple Basic, this is probably the only one you will need.

Martin Wilson

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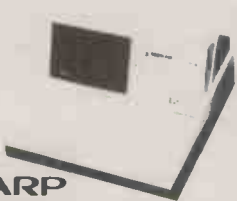
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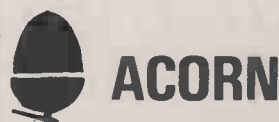
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The various adventure games are in essence, maze games. The major difference is that in an adventure where you successfully go west across the Lava Sea, there is no guarantee that the reverse journey is possible. In a standard maze, the player who wanders into a dead end at least has the option of back-tracking.

This article describes a program which first generates a maze of random dimensions. It then displays a perspective view of the maze as the player searches for the exit.

The maze-creation routine, and a second routine which draws a map of the maze, are written so that they will run on any micro which has a memory-mapped display and supports Peek and Poke. The only changes required are to two lines in the initialisation routine.

The three-dimensional view of the maze requires several common graphics symbols: the horizontal, vertical and diagonal lines, and the four "corner" sym-

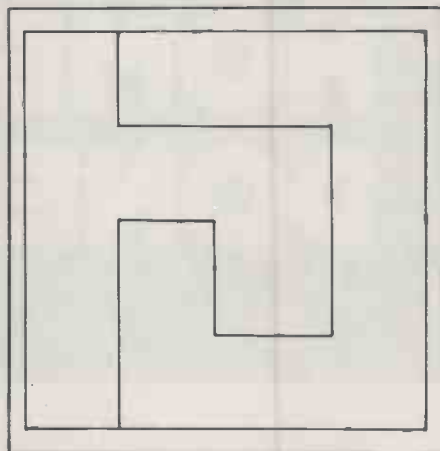


Figure 1. Maze with a dead end.

bols. These symbols are certainly available on the Pet, UK-101, Sharp MZ-80K and Superboard, and probably on most other popular micros too. The only change you may need to make in this part of the program is to substitute the symbols in your character set for those in the program — just three line changes. If your micro has a Plot command you will have to re-write this routine, but you should be able to simplify it considerably.

You may be looking sadly at your minimal memory configuration, thinking that this article cannot be for you. Let us reassure you — it was written on a 4K-RAM Superboard-II. If you have more than 4K of memory, you should be able to produce a full-blown adventure using the program as a basis.

Two main problems have to be overcome when creating a maze. Firstly, you must ensure that all parts of the maze are accessible from all other parts. There must be no "closed circuits" — see figure 1 — otherwise the effective size of the maze will be reduced and memory wasted preserving unused portions.

Secondly, you have to be able to record the number and position of the walls in each cell in order to store the layout of the maze — see figure 2.

We chose to indicate a wall in each direction by the prime numbers 2, 3, 5 and 7. Initially all cells are given a value of 210 — equal to $2 \times 3 \times 5 \times 7$ — which indicates a wall in every direction.

Other possible wall arrangements can be stored as multiples of the relevant prime numbers. For example, a cell with walls only at north and south would be given a value of 14 — equal to 2×7 .

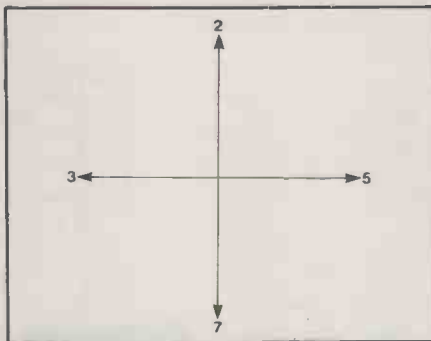
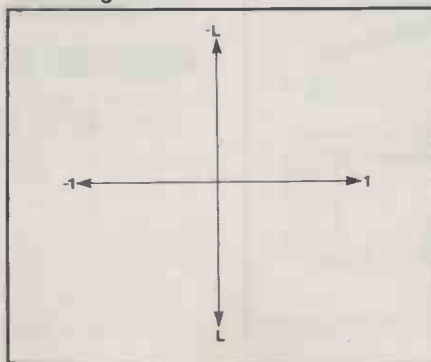


Figure 2a. The four prime numbers which indicate walls W(0) to W(4).

Figure 2b. The change in cell number on moving to a new cell, M(0) to M(3); L is the maze length.



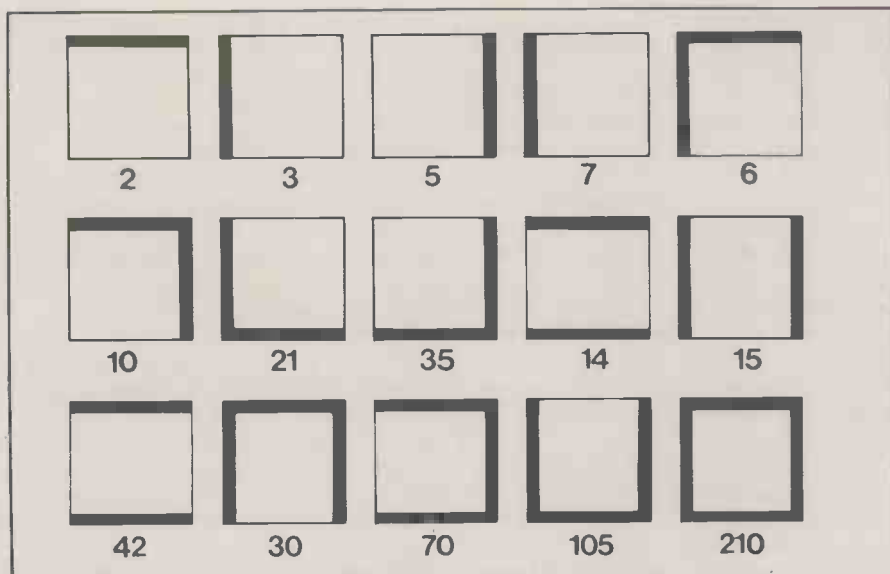


Figure 3. Cell values for each of the possible wall arrangements.

Figure 3 gives all the cell values and the wall arrangements they indicate.

Lines 500 to 595 create the maze. This part of the program is short but not very fast, so the maze is created while instructions are being given in subroutine 900.

Subroutine 900 also carries out the initialisation. Line 950 must be changed: it gives the memory locations of the top left, top right, bottom left and bottom right of the screen memory — TL, TR, BL and BR. It also sets the line length LL, the depth of wall DW, and the cell depth CD.

Obviously LL should be set to the line length of your own micro. The depth of wall DW is the number of pixels to be used to draw each cell wall. The cell depth CD is a necessary limiting factor due to the lack of high resolution on our micro. When a certain number of cells of diminishing size have been drawn to give the illusion of perspective, the centre of the screen is reached. There is clearly no point in trying to go further and attempting to display more cells.

The procedure is easier to follow if you look at the values used in the program. Although the line length LL for the Superboard is 32, the screen memory has an actual line length of 25. With a depth of wall of three, and a cell depth of four,

the maximum possible display of left-handed walls uses four sets of three pixels = 12 pixels. The right-hand walls use another 12 pixels, so the perspective display of four maze cells uses 24 pixels altogether. As the screen has a line length of 25, this leaves a single, blank pixel at the centre of the screen to suggest the limits of vision — see figure 4.

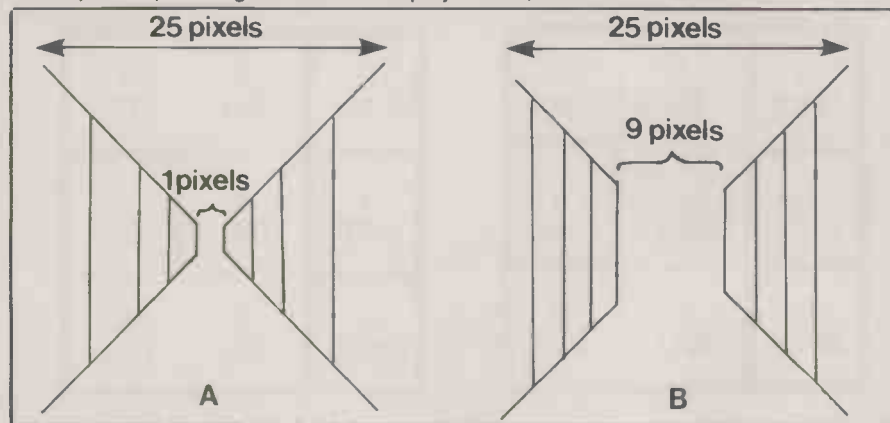
You will have to choose values of DW and CD carefully to get the best display. An important factor to consider is the possible longest length of a corridor in the maze. There is no point in setting CD to 8 if most mazes have dimensions of less than eight cells. The program as written varies the length L and width W of the maze between six and 10 cells. If you want to adjust this, change line 960.

As already stated, all cells are given an initial cell value of 210 to indicate four walls. In early versions of the program the values for each cell were stored in an array. However, each element in an array uses four bytes in the Superboard memory. A 10-by-10 array takes up 400 bytes, which is a large chunk out of a 4K RAM.

As all cell values are 210 or less, they can be Poked as single bytes into memory.

(continued on next page)

Figure 4. Two views down the same 10-cell corridor. In A, the depth of wall, DW, is 3 and the cell depth is 4, which gives a better display than B, where DW = 2.



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(continued from previous page)

Using this technique, a 10-by-10 maze needs only 100 bytes.

You will have to store the maze in an area of RAM unlikely to be taken up by the program. Line 995 gives the memory location SM for the start of the maze. You should change it to a suitable value for your own system.

The remainder of subroutine 900 generates a random starting point P within the maze — line 995 — and also an exit cell EC and a map cell MC — line 1000. In the map cell, the lucky explorer can find a map of the maze with his own position shown by a man — symbol W4 on 955.

The scenario for the game is described in lines 900 to 945. The player has landed on an alien planet while fleeing from enemies, and has sought refuge within the maze. He is wearing a space suit and must find a way out of the maze before his limited oxygen supply expires. The oxygen supply OX plus its rate of loss OL are randomly determined in lines 1010 and 1015. While the player is digesting this information, the maze is created in subroutine 500.

Beginning at the cell P within the maze, the program moves in a random direction. Cells in all four directions are examined successively until an un-visited cell adjacent to the present position is found — lines 510 to 570.

The new cell number is found by adding the correct movement increment M(0) to M(3) — figure 2 — to the present cell number, line 540.

Each time the program moves from one cell to another, the wall in the direction of movement is eliminated by dividing the cell value by the corresponding wall value W(0) to W(3). This operation has to be done twice: the present cell value CP is divided by the appropriate wall number W(A) on leaving the cell; and the cell value after movement CM must also be divided by the number for the wall through which it was entered, line 580. See figure 5 for example.

This random progress through the maze continues until a point is reached

where movement in any direction only leads to cells which have already been visited. In early versions we allowed the program to continue from such a position, but this resulted in mazes consisting mostly of empty spaces.

It might seem that the simplest solution would be to generate a new path from another random cell. However, this neglects the problem of closed circuits already discussed, and the new path might never join the old one.

The best way to ensure that all paths join is to begin any new path from somewhere along the old path. When the program gets stuck in cell P, line 500 increments P and checks whether there is then a virgin cell next to one already visited. If not, it goes back to 500 and increments P again. For example in figure 5 the program will be stuck in cell 5 after the last diagrammed position. Incrementing P gives cell 6, and as this is an un-visited cell adjacent to the path, the new path would begin from cell 7 to cell 6.

Some checks have to be included because certain movements are forbidden at the maze edges. Line 540 guards against moves off the top or bottom row of the maze. Line 570 prevents the program falling off the sides. For example, in figure 5, although adding 1 to the cell is normally allowed, the move from cell 5 to cell 6 is prohibited because 5 is an edge cell.

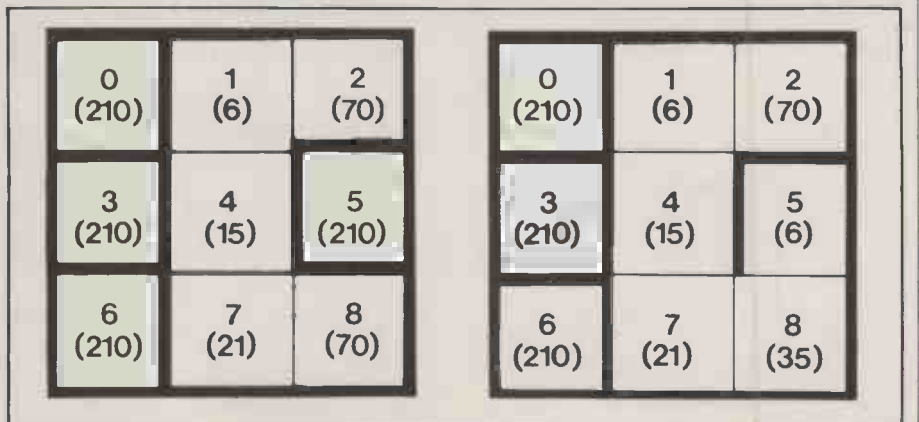
A count C is kept of the number of cells visited. When all cells have been used in the maze the subroutine terminates.

Between two and three cells per second are generated. On average, a 10-by-10 maze takes about 50 seconds on the Superboard, but the time taken is very variable.

Subroutine 600 draws a map of the maze. To make this as universal as possible the only graphics symbol used here is the one with the whole pixel filled.

A wall in any direction is shown by three of these symbols. Because adjacent cells share a wall in common, the maze in figure 5 would use seven pixels horizontally and seven pixels vertically.

Figure 5. Generation of a maze. In diagram A the program has moved through the cells 2-1-4-7-8. The program can only move to cell 5, as in B, since it must always visit new cells. Cell values are given in brackets.



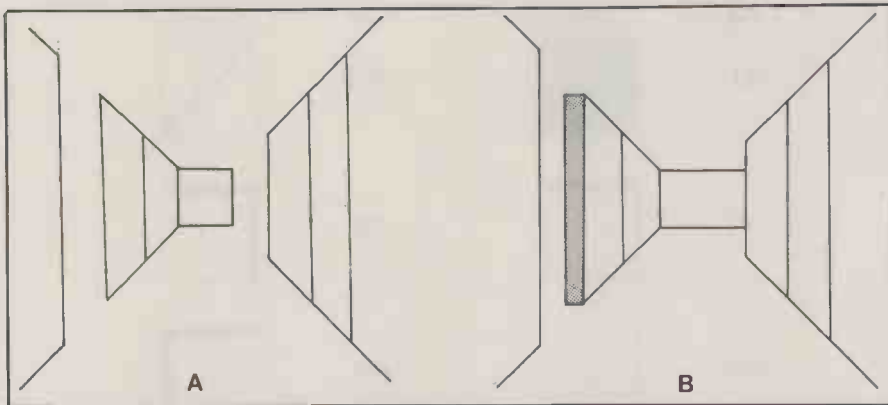


Figure 6. Two views of the same corridor. Display B includes fixes to improve appearance.

The size of the maze that can be displayed obviously depends on the dimensions of your screen display. A maze of side n cells requires $2n + 1$ pixels. The maximum size maze that can be shown with 40 characters per line and 25 lines is 19 by 12.

If you enjoy finding your way through a maze against the clock you can use the subroutines 500 and 600 alone, without the perspective view. You will have to add a few lines to enable you to move within the maze. Your starting point can be cell number zero, and the end cell the last cell, number H.

A large maze takes some time to generate, but there is no need to wait while later mazes are prepared. Once a map of the maze has been displayed, the maze stored in memory is no longer needed. With some re-writing, a new maze can be created while you are finding your way through the one shown on the VDU.

If you have no graphics the maze can still be explored, although it is rather difficult "blind". Each direction of movement $M(0)$ to $M(3)$ is associated with movement through a particular wall $W(0)$ to $W(3)$. If the cell value is divisible by the array value $W(A)$ a wall is present in that direction and movement that way is not possible. Otherwise, with no wall, the cell number is incremented by the array value $M(A)$ and the new cell is entered. Checks for walls are used several times in the program — see lines 105, 120 and 160.

The perspective view is calculated by the subroutine 70 to 110, which also calls the drawing subroutine 10 to 60.

The first cell to be drawn is the one in which the player is currently standing. The left-hand side of the cell is examined first to see if there is a wall present and, if there is, it is drawn — line 100. If there is no wall you will be able to see into the cell on the left. Lines 110, 120 calculate the left-hand cell number and examine that cell for a back wall, such a wall then being drawn if necessary.

The same method is used to show the right-hand side of the cell, but with a few variables changed. There is thus a loop from 80 to 140 which is run through twice, first drawing the left side and then the right side. Line 140 shifts the corners

in, ready for the back wall or the next cell to be drawn.

Once both side walls have been drawn, line 160 checks for a back wall. If no back wall is present, line 170 changes the cell number 0P to that of the next cell in the direction we are looking. This same line also increments the depth-of-cell count DC and checks that this does not exceed the greatest possible cell depth CD.

If at any time a back wall to a cell is found, lines 200 and 210 draw this back wall, and the subroutine ends. Lines 180 to 190 are a fix to improve the appearance when there is a back wall next to a cell with no back wall. Line 20 in the drawing subroutine is another fix which gives a more solid look to walls seen end on. Figure 6 shows the same view with and without the fixes.

Lines 240 to 440 enable the player to explore the maze. At the start, no view of the maze is shown. After a time TT a torch will be found, and thereafter the view will always be drawn. Line 430 clears the screen and calls the drawing, subroutine. During the initial period of blindness it is possible for the space suit to be damaged, in which case the player may suffer a faster rate of oxygen loss, lines 300, 310. The same fate can overtake anyone foolish enough to blunder into a wall which can be seen.

Four commands are available via Input statements or, alternatively, by keyboard control — lines 250, and 320 to 340.

The player may turn right, left or opposite his present viewing position, but he will remain in the same cell — only the view will alter. Movement is always forwards — in the direction the player is currently facing. The commands are abbreviated to R, L, O and M respectively.

The exit cell has no view beyond it if you are looking directly at it. Once you arrive at the exit cell you automatically escape.

Figure 7 lists the graphics symbols used to draw the perspective view. You should make appropriate substitutions in lines 70, 80, 90 and 960.

With our limited memory we were unable to add all the embellishments we

(continued on next page)



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Code	Character	Code	Character
161		190	
135		210	
128		207	
136		208	
143		209	
189		240	

Figure 7. Character codes and graphics symbols used in drawing a maze.

(continued from previous page)

would have liked, but here are a few suggestions to improve the basic game:

- Add a monster which pursues the player through the maze. The monster can move at random initially, but if the player does not escape within a certain time limit, it should begin to move faster and more purposefully as it detects an intruder in its lair. Some cells might contain useful objects — if the creature is radioactive its direction could be indicated by a "geiger" compass, and the intensity of radiation could indicate its distance from the explorer.
- One cell could contain a blaster with a limited charge. The blaster could be fired at the monster in a moment of desperation, or it could be powerful enough to demolish one wall of the maze. The demolition is easily accomplished by dividing the cell value by the array value $W(A)$ in the correct direction. A cunning explorer could blast his way out of the maze if he correctly divined that he was near an outer wall.
- Further traps could be set for the unwary. The map drawn by subroutine 600 might be displayed upside down or reversed; minions of the monster could seize an unlucky explorer and delay his escape; some cells in the maze might be entrances to even more dangerous areas.

It is very easy, when entering a program as long as this one, to make a mistake

which becomes difficult to identify. We suggest that you enter this program in sections so that each part can be run to ensure that it is correct. Initially, enter subroutines 500 and 900, and add this line:

```
1029 FOR A= SM TO EM: B=PEEK(A): PRINTB;: NEXTA
```

A series of numbers representing the maze will be printed out: all such numbers should be members of the set shown in figure 3.

Next, add subroutine 600 and the line:
380 GOSUB 600

The maze should be drawn with an exit somewhere along the top. The remainder of the program can now be entered and run.

If you find yourself hopelessly confused and lost after only a few moves, we suggest that you display the map drawn in subroutine 600 at the start, so that you can try to memorise the route out. Line 435 gives the player one look at the map only — it is presumed to be displayed on a VDU which burns out after this brief use. The map can be examined many times if line 435 becomes:

```
IFP=MC THEN GOSUB 600
```

Finally, those with good graphics facilities should be able to draw objects on the floor of a cell. They can be given the correct relative size by referring to the current corner values for the cell, $M(4)$ to $M(7)$. It certainly adds atmosphere if an explorer stumbles across the occasional skull or rib-cage.



```

5 GOTO900
10 Y=PEEK(TC-U):Z=PEEK(TC-U+LL):IFABS(U)=10RDC=0THEN30
20 IFY=32ANDZ=32THENFORA=TC-U+LLTOBC-U+LLSTEP11:POKEA,W3:NEXT
30 POKETC,TW:POKEBC,BW:B=B+1:IFB<DWHENTC=TC+U:BC=BC+U:GOTO30
40 IFABS(U)=1THENPOKETC,T1:POKEBC,B1
50 IFTC=BC-LLTHENRETURN
60 FORB=TC+LLTOBC-LLSTEP11:POKEB,SW:NEXT:RETURN
70 F=ML:U=LL+1:V=1-LL:T1=207:B1=208:SM=143
80 FORX=4TO6STEP2:TW=190:BW=189:B=0:IFX=4THEN100
90 F=MR:U=LL-1:V=-LL-1:SM=136:T1=210:B1=209:TW=189:BW=190
100 LM=M(F):LD=W(F)
101 IFF=3ANDOP=ECTHEN140
105 IF0-LD*INT(Q/LD)=0THENTC=M(X):BC=M(X+1):GOSUB10:GOTO130
110 TW=135:BW=128:U=U-LL:V=U+LL:N=PEEK(OP+LM)
120 IFN-D*INT(N/D)=0THENTC=M(X)+DW*LL:BC=M(X+1)+DW*-LL:GOSUB10
130 IFABS(U)=1THENU=U+LL:V=U-LL
140 M(X)=M(X)+DW*U:M(X+1)=M(X+1)+DW*V:NEXT
150 IFN=3ANDOP=ECTHENRETURN
160 IF0-D*INT(Q/D)=0THEN180
170 OP=OP+M(M):Q=PEEK(OP):DC=DC+1:IFDC<D0THEN70
175 IFDC=D0THENRETURN
180 R=PEEK(M(4)-1)
185 IFR=32THENM(4)=M(4)-1:M(5)=M(5)-1:IFM(4)<>TL+DW*LLTHEN180
190 R=PEEK(M(6)+1)
195 IFR=32THENM(6)=M(6)+1:M(7)=M(7)+1:IFM(6)<>TR+DW*LLTHEN190
200 FORTC=M(4)TOM(6):POKETC,W1:NEXT
210 FORBC=M(5)TOM(7):POKEBC,W2:NEXT:RETURN
240 PRINTOX:" UNITS OF AIR"
245 PRINT"ACTION":INPUTA$
250 NP=P:Q=PEEK(P):IFA$="M"THENNP=P+M(M)
260 IFNP=PTHEN320
270 IFNP=ECTHENPRINT"YOU ESCAPE!":END
285 IF0-D*INT(Q/D)<>0THENNP=NP:PRINT"YOU MOVE":GOTO380
300 IFRND(1)>.9THENPRINT"YOUR SUIT RIPS WHEN ":OL=OL+1
310 PRINT"YOU HIT A WALL":GOSUB3000:GOTO410
320 NM=M:IFA$="R"THENNM=M+1
330 IFA$="0"THENNM=M+2
340 IFA$="L"THENNM=M+3
350 IFNM=MTHEN240
360 IFNM>3THENNM=NM-4*INT(NM/4)
370 M=NM:PRINT"YOU TURN."
380 D=W(M):Q=PEEK(P):OP=P:ML=M-1:MR=M+1
390 IFML<0THENML=3
400 IFMR>3THENMR=0
410 OX=OX-OL:IFOX<0THENPRINT"YOU DIE.":END
420 T=T+1:IFT=11THENTT=1:PRINT"YOU FIND A TORCH":GOSUB3000
430 IFTT=1THENDC=0:GOSUB2000:GOSUB70
435 IFF=MCANDRM=0THENRM=1:GOSUB600
440 M(4)=TL:M(5)=BL:M(6)=TR:M(7)=BR:GOTO240
500 P=P+1:IFP>EMTHENP=SM
510 A=INT(RND(1)*4):DC=0
520 A=A+1:DC=DC+1:IFDC>3THEN500
530 IFA>3THENA=0
540 M=P+M(A):IFM<SMORM>ENTHEN520
550 CP=PEEK(P):CM=PEEK(M):IFC=0ANDCP=210THENP=M:GOTO510
560 TM=M-SM:IF(CP=CMORCM<210)ANDC=0THEN520
570 NE=TM-L*INT(TM/L):IF(NE=0ANDM(A)=1)OR(NE=0ANDM(A)=-1)THEN520
580 OD=INT(15/M(A)):CP=CP/M(A):POKEP,CP:CM=CM/OD:POKEM,CM
590 P=M:C=C+1:IFC<HTHEN510
595 RETURN
600 GOSUB2000:PRINT"YOU FIND A MAP"
605 A=TL:MS=A:DC=SM:DD=SM+6
610 FORB=DCTODD:FORDC=0T03:CB=PEEK(B):CB=CB-W(C)*INT(CB/W(C))
620 AA=1:IFC=10RDC=3THENAA=LL
630 IFC>1THENAA=-AA
640 BB=LL/AA:P2=A+AA:P1=P2+BB:P3=P2-BB
645 IFB=PTHENPOKEA,W4
650 ECB=0THENPOKEP1,W3:POKEP2,W3:POKEP3,W3
660 NEXTC:A=A+2:NEXTB:DC=DC+L:DD=DD+L:A=MS+(2*LL):MS=A
670 IFDC<=EMTHEN610
680 GOSUB3000:RETURN
900 GOSUB2000:PRINT"YOU HIDE IN AN ALIEN MAZE TO ESCAPE ENEMIES."
910 PRINT"FIND THE EXIT BEFORE YOUR AIR RUNS OUT."
950 TL=53349:BL=54149:TR=53374:BR=54174:LL=32:DW=3:CD=4
955 W1=135:W2=128:W3=161:W4=240
960 W(0)=5:W(1)=7:W(2)=3:W(3)=2:L=INT(RND(1)*5+6)
970 M(0)=1:M(1)=L:M(2)=-1:M(3)=-L:M(4)=TL:M(5)=BL:M(6)=TR:M(7)=BR
980 W=INT(RND(1)*5+6):H=L*W-1:G=L-1:C=0:DC=0:T=0:RM=0
995 SM=576:EM=SM+H:FORA=SMTOEM:POKEA,210:NEXT:P=SM+INT(RND(1)*H)
1000 EC=SM+INT(RND(1)*L):MC=INT(RND(1)*H)+SM
1010 OX=INT(H/3)+1:IFF<OXTHENOX=-OX
1015 OX=OX+H:OL=1:TT=INT(RND(1)*H/8)+1:GOSUB500:GOSUB2000
1030 M=0:NP=P:CE=PEEK(EC):CE=CE/W(3):POKEEC,CE:GOTO380
2000 FORX=0T025:PRINT:NEXTX:RETURN
3000 FORX=0T05000:NEXTX:RETURN
    
```

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The Type-a-Shape program allows stored shapes to be reproduced in high-resolution by a single command. In the second part of his series on Apple graphics, Roger Cullis explains the program's features.

Automatic shape generation

A USEFUL facility of Apple is the ability to store a collection of shapes and to reproduce them in Hires graphics with a command of the form Draw N AT X,Y where N is the code number of the required shape. A table of up to 255 different shapes may be constructed.

Shape display is virtually instantaneous and so a very complicated graphic could rapidly be constructed using this technique. The method of defining shapes in a shape table is described in detail in the Applesoft Reference Manual, chapter 9. Briefly, each shape is defined as a succession of Move+Plot and Move + No plot vectors. Each vector is represented as a binary number, and groups of three binary numbers are collected together as a hexadecimal byte. A shape definition consists, in turn, as a collection of hexadecimal bytes.

Compiling shape definitions manually is an extremely slow and laborious procedure, but it can easily be achieved by mechanically following a few simple rules. Type-a-Shape uses the procedures developed in the two Type-a-Graphic programs to permit the construction or modification of a shape table using single-key entries to move a cursor to produce a Lores analogue of a Hires shape. A numeric array is used to store the definition temporarily during construction. On completion, the array is converted to a shape definition and added to the shape table before being displayed in Hires format. It can then be modified using the Lores guide matrix on which the Lores analogue of the shape is displayed for guidance.

The general features of Type-a-Shape are similar to those of the previous programs and should be clear from either the program or the flowchart — figure 1. Nevertheless, certain program lines require special explanation.

60 An integer array Byte%(A) is used as a temporary store during construction of the shape definition since this type of array is most economic of memory space. The dimension 200 is considered adequate to store enough vectors to accommodate the most elaborate shape envisaged. Apple stores addresses as a high-order byte and a low-order byte; FN HI(A) and FN LO(A) permit ease of calculation.

1400 When a binary file has been loaded by DOS, locations 43634 and 43635 contain the starting address (for a 48K system — refer to the Apple DOS manual for other memory sizes).

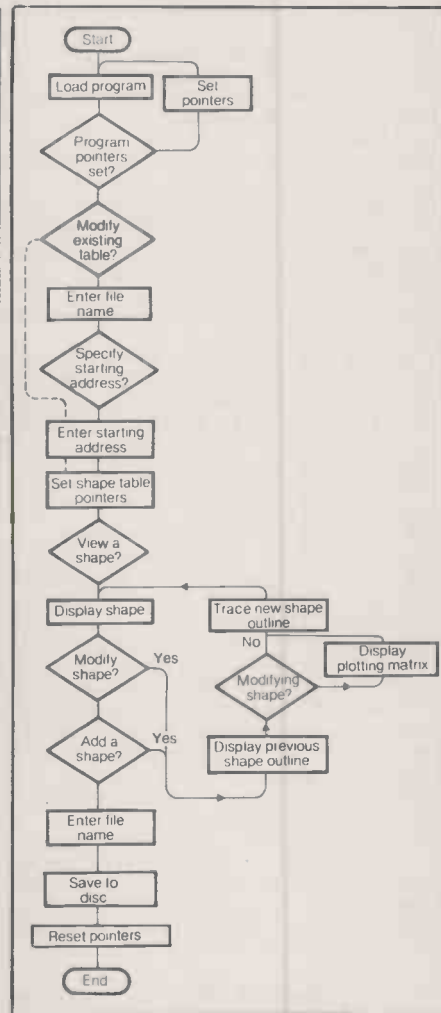


Figure 1. Format of Type-a-Shape program.

1410 Similarly, locations 43616 and 43617 contain the length of the most recently loaded binary file.

1420 The number of shapes in a shape table is stored at the starting address of the table. 5230-5260 A guide matrix of grey and magenta dots is constructed to facilitate drawing the Lores outline of a shape.

5270 AS = "N" is used as a temporary flag to indicate whether a new shape is being defined or a previous shape modified.

5320 The starting address of the definition of an individual shape is stored at locations ST+2*N and ST+2*N+1 where ST is the starting address of the shape table and N is the shape number.

5330 Error routine prevents program crash if the shape definition was not prepared using the Type-a-Shape program.

5340-5550 Binary vectors are derived from the actual shape definition and plotted as coloured pixels on the Lores guide matrix.

5350 A shape definition ends with a zero byte.

5620 K is the number of bytes in a shape definition. R,TR are flags used to compile the array.
 5650-5660 Screen colour is used as a temporary store of Plot/No-plot vectors.
 5820-5860 It is possible to choose a combination of Move/Plot/No-plot vectors which would result in a zero hexadecimal byte and would inadvertently terminate the shape definition.
 5870-6440 correct the situation by going back three moves.
 6060 converts from binary to hexadecimal.
 6090-6100 carry binary vectors to next byte.

6120 inserts a Move/No-plot byte into an otherwise blank shape definition to permit it subsequently to be modified without clobbering the other shapes in the table.
 6160-6350 When a shape definition is modified, the memory space and other shape pointers need to be adjusted to take account of its different length.
 6380 The array is stored as a shape definition in the table.
 6480-6600 When modifying a previous shape it is often convenient to be able to copy portions by using the simplicity of the Trace command.

```

1 REM TYPE-A-SHAPE (SHAPE TABLE COMPILER)
2 REM PROGRAM COMMENCED 28 AUG 1980 IN APFLESOFT BASIC
3 REM LAST AMENDED 03 JUL 1981 (VERSION NO.46)
4 REM COPYRIGHT 1981 - ROGER CULLIS
5 REM THIS PROGRAM PERMITS CONSTRUCTION OF A NEW SHAPE TABLE
6 REM OR MODIFICATION OF AN EXISTING TABLE.
7 REM FOR ADDITIONAL INFORMATION REFER TO APFLESOFT PROGRAMMING MANUAL CH.9
8 REM WRITTEN ON APPLE II WITH LANGUAGE CARD AND 48K MEMORY
9 REM SHAPE ORIGIN IS 0,0 - TO COMPILE TABLE WITH DIFFERENT ORIGIN AMEND LINES 5270,5280
10 D$ = CHR$(13) + CHR$(4): REM CR + CONTROL D
30 IF PEEK(103) = 1 AND PEEK(104) = 64 AND PEEK(16384) = 0 THEN GOTO 60
40 POKE 103,1: POKE 104,64: POKE 16384,0: REM AVOIDS HGR-CLOBBED VARIABLES
50 PRINT D$;"RUN TYPE-A-SHAPE": REM RELOAD ABOVE HGR PAGE 1 MEMORY
60 DIM BYTE$(200): DEF FN LO(A) = A - 256 * INT(A / 256): DEF FN HI(A) = INT(A / 256)
70 H$ = " TYPE 'H' FOR HELP"
997 REM *****
998 REM INSTRUCTIONS AND CONTROL PROGRAM
999 REM *****
1000 HOME : PRINT : PRINT
1010 PRINT TAB(8)"*****:"
1020 PRINT TAB(8)"* *:"
1030 PRINT TAB(8)"* TYPE-A-SHAPE *:"
1040 PRINT TAB(8)"* *:"
1050 PRINT TAB(8)"* SHAPE TABLE COMPILER *:"
1060 PRINT TAB(8)"* *:"
1070 PRINT TAB(8)"*****:"
1080 VTAB 12: PRINT " A PROGRAM TO COMPILE SHAPE TABLES FOR R"
1090 PRINT : PRINT "USE WITH HIRES GRAPHICS."
1100 PRINT : PRINT "THE SHAPE DEFINITION IS COMPILED BY"
1110 PRINT : PRINT "MOVING A CURSOR OVER A GUIDE MATRIX"
1120 PRINT : PRINT "DISPLAYED IN LORES GRAPHICS. NEW SHAPE S"
1130 PRINT : PRINT "MAY BE ADDED TO A TABLE AND EXISTING"
1140 PRINT : PRINT "SHAPES ALTERED."
1150 FOR I = 0 TO 7000: NEXT :I = 0: REM DISPLAY TIME
1160 HOME : VTAB 10: PRINT "DO YOU WISH TO MODIFY AN EXISTING SHAPE"
1170 PRINT : PRINT "TABLE (Y/N?)"
1180 GET B$: IF B$ = "N" THEN GOTO 1340
1190 IF B$ < > "Y" THEN GOTO 1180
1197 REM
1198 REM ERROR ROUTINE
1199 REM
1200 ONERR GOTO 1220: REM IF "FILE NOT FOUND"
1210 GOTO 1270
1220 HOME : VTAB 10: PRINT "FILE - "NAME$" - NOT AVAILABLE
    
```

(continued on next page)



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(continued from previous page)

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1230 PRINT : PRINT "PLEASE CHECK SPELLING AND DISK CATALOG
"
1240 PRINT : PRINT "DO YOU WISH TO RE-ENTER FILE NAME (Y/N
?)"
1250 GET A$: IF A$ = "N" THEN B$ = "N" GOTO 1480
1260 IF A$ < > "Y" THEN GOTO 1250
1267 REM
1268 REM LOAD SHAPE TABLE
1269 REM
1270 HOME : VTAB 10: PRINT "ENTER SHAPE TABLE NAME,"
1280 PRINT : PRINT "THEN PRESS 'RETURN'"
1290 PRINT : INPUT " ";NAME$
1300 PRINT : PRINT "DO YOU WISH TO SET THE"
1310 PRINT : PRINT "STARTING ADDRESS (Y/N?)"
1320 GET A$: IF A$ = "N" THEN GOTO 1380
1330 IF A$ < > "Y" THEN GOTO 1320
1340 HOME : VTAB 10: PRINT "ENTER STARTING ADDRESS OF SHAP
E TABLE"
1350 PRINT : INPUT "THEN PRESS 'RETURN' - ";ST$:ST = VAL
(ST$)
1360 IF B$ = "N" THEN GOTO 1470
1370 PRINT D$;"BLOAD "NAME$", A"ST: GOTO 1390
1380 PRINT D$;"BLOAD "NAME$
1390 POKE 216,0: REM RESET ERROR MESSAGE FLAG
1400 ST = PEEK (43634) + 256 * PEEK (43635): REM STARTIN
G ADDRESS OF TABLE
1410 LE = PEEK (43616) + 256 * PEEK (43617): REM LENGTH
OF TABLE
1420 TN = PEEK (ST): REM NUMBER OF SHAPES IN TABLE
1430 HOME : VTAB 10: PRINT NAME$
1440 PRINT : PRINT "THIS TABLE CONTAINS "TN" SHAPES, START
S"
1450 PRINT : PRINT "AT "ST" AND IS "LE" BYTES LONG."
1460 GOTO 1490
1467 REM
1468 REM NEW TABLE
1469 REM
1470 LE = 512: REM SPACE FOR 255 SHAPE ADDRESS POINTERS
1480 A$ = "Y": ROT = 0: N = 0: REM INITIALISE
1490 POKE 232, FN LO(ST): POKE 233, FN HI(ST): POKE ST + 1
,0: REM SET SHAPE TABLE POINTERS (E8,E9)
1500 HIMEM: ST - 1: REM PROTECT TABLE
1510 IF B$ = "N" THEN GOTO 1750
1517 REM
1518 REM VIEW A SHAPE
1519 REM
1520 PRINT : PRINT "DO YOU WISH TO VIEW ANY SHAPE (Y/N?)"
1530 GET A$: IF A$ = "N" THEN GOTO 1650
1540 IF A$ < > "Y" THEN GOTO 1530
1550 PRINT "ENTER SHAPE NUMBER, THEN PRESS 'RETURN'"
1560 INPUT "N = ";N$
1570 N = VAL (N$): IF N < 1 OR N > TN THEN PRINT "SHAPE N
"N" DOES NOT EXIST": GOTO 1550
1577 REM
1578 REM DETERMINE SHAPE LENGTH
1579 REM
1580 IF N = PEEK (ST) THEN K = LE - PEEK (ST + 2 * N) -
256 * PEEK (ST + 2 * N + 1): GOTO 1600
1590 K = PEEK (ST + 2 * N + 2) - PEEK (ST + 2 * N) + 256 *
(PEEK (ST + 2 * N + 3) - PEEK (ST + 2 * N + 1))
1600 GOSUB 6410: REM DRAW HGR SHAPE
1610 PRINT : PRINT "DO YOU WISH TO CHANGE THIS SHAPE (Y/N?
)"
1620 GET A$: IF A$ = "Y" THEN A$ = "N": GOTO 1700
1630 IF A$ = "N" THEN PRINT : PRINT "DO YOU WISH TO VIEW
ANOTHER SHAPE (Y/N?)" : GOTO 1530
1640 GOTO 1620

```



```

1650 PRINT : PRINT "DO YOU WISH TO ADD ANOTHER SHAPE (Y/N?
)"
1660 GET A$
1670 IF A$ = "Y" THEN N = PEEK (ST): GOTO 1750
1680 IF A$ < > "N" THEN GOTO 1660
1690 GOTO 8000
1697 REM
1698 REM CHANGE A SHAPE
1699 REM
1700 GOSUB 5000: REM  COMPILER SHAPE DEFINITION AND DISPLA
Y
1710 PRINT : PRINT TAB( 18)"OK (Y/N?)": GET A$
1720 IF A$ = "Y" THEN A$ = "N": GOTO 1630
1730 IF A$ = "N" THEN GOTO 1700
1740 GOTO 1710
1747 REM
1748 REM ADD A SHAPE
1749 REM
1750 N = N + 1: COUNTER = 0: POKE ST, N
1760 ADDRESS = ST + 2 * N: POKE ADDRESS, FN LO(LE): POKE AD
DRESS + 1, FN HI(LE): REM  SAVE CURRENT SHAPE POINTERS

1770 GOSUB 5000: REM  COMPILER SHAPE DEFINITION AND DISPLA
Y
1780 PRINT : PRINT TAB( 18)"OK (Y/N?)"
1790 GET A$: IF A$ = "Y" THEN LE = LE + K: TN = N: GOTO 165
0
1800 IF A$ = "N" THEN N = N - 1: GOTO 1750
1810 GOTO 1790
4997 REM *****
4998 REM COMPILER SHAPE DEFINITION AND DISPLAY
4999 REM *****
5000 IF T = 1 THEN GOTO 5210: REM  INSTS. ALREADY LOADED
INTO P2 BUFFER?
5010 TEXT : HOME : PRINT TAB( 14)"INSTRUCTIONS"
5020 PRINT : PRINT " THE SHAPE DEFINITION IS COMPILED BY"
5030 PRINT "MOVING A CURSOR ON A LORES GRAPHICS"
5040 PRINT "GUIDE MATRIX. DIFFERENT COLOURS ARE"
5050 PRINT "USED FOR 'PLOT' (ORANGE) AND 'NO-PLOT'"
5060 PRINT "(BLUE) MOVES. BROWN AND DARK BLUE"
5070 PRINT "DEPICT THE CORRESPONDING VECTORS OF A"
5080 PRINT "PREVIOUSLY DEFINED SHAPE."
5090 PRINT : PRINT TAB( 16)"COMMANDS"
5100 PRINT : PRINT "I J ) MOVE THE CURSOR POSITION (I-UP,
"
5110 PRINT "K M ) J-LEFT, K-RIGHT, M-DOWN)"
5120 PRINT : PRINT "P ) SELECT 'PLOT' VECTOR"
5130 PRINT "D ) SELECT 'NO-PLOT' VECTOR"
5140 PRINT : PRINT "T ) TRACE PREVIOUS SHAPE"
5150 PRINT : PRINT "S ) STOP, COMPILE AND DISPLAY SHAPE
"
5160 FOR I = 2048 TO 3023: POKE I, PEEK (I - 1024): NEXT
5170 VTAB 24: PRINT TAB( 8)"PRESS 'RETURN' TO CONTINUE"
5180 GET C$: IF C$ < > CHR$( 13) THEN GOTO 5180
5190 FOR I = 3024 TO 3071: POKE I, PEEK (I - 1152): NEXT
5200 T = 1
5207 REM
5208 REM PREPARE LORES GUIDE MATRIX
5209 REM
5210 GR
5220 HOME : VTAB 21: PRINT TAB( 15)"SHAPE # " N
5230 POKE 35, 23: VTAB 24: PRINT H$: VTAB 22
5240 COLOR = 5: FOR LI = 0 TO 39: VLIN 0, 39 AT LI: NEXT : REM
PLOTING GUIDE
5250 COLOR = 3: FOR LI = 9 TO 39 STEP 10: VLIN 0, 39 AT LI: HLIN
0, 39 AT LI: NEXT
5260 COLOR = 0: FOR LI = 0 TO 38 STEP 2: VLIN 0, 39 AT LI: HLIN
0, 39 AT LI: NEXT

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(continued from previous page)

```

5270 COLOR= 7: IF A$ = "N" THEN X = 0:Y = 0: GOTO 5320
5280 X = 0:Y = 0: REM START AT ORIGIN
5290 IF SCRN( X,Y) = 2 THEN COLOR= 7
5300 IF SCRN( X,Y) = 8 THEN COLOR= 9
5310 GOTO 5620
5320 ADDRESS = ST + PEEK( ST + 2 * N) + 256 * PEEK( ST +
1 + 2 * N)
5330 ONERR GOTO 5560: REM IF SHAPE EXTENDS BEYOND PLOTTI
NG MATRIX
5340 BYTE = PEEK( ADDRESS)
5350 IF BYTE = 0 THEN GOTO 5280
5360 M1 = BYTE - 8 * INT( BYTE / 8): REM SEPARATE INTO MO
VES
5370 BYTE = INT( BYTE / 8)
5380 M2 = BYTE - 8 * INT( BYTE / 8)
5390 BYTE = INT( BYTE / 8)
5400 M3 = BYTE
5410 M = M1: GOSUB 5480: REM FIRST MOVE
5420 IF M2 = 0 AND M3 = 0 THEN GOTO 5460
5430 M = M2: GOSUB 5480: REM SECOND MOVE
5440 IF M3 = 0 THEN GOTO 5460
5450 M = M3: GOSUB 5480: REM THIRD MOVE
5460 ADDRESS = ADDRESS + 1
5470 GOTO 5340
5480 IF M < 4 THEN COLOR= 2: GOTO 5500
5490 M = M - 4: COLOR= 8
5500 PLOT X,Y
5510 IF M = 0 THEN Y = Y - 1
5520 IF M = 1 THEN X = X + 1
5530 IF M = 2 THEN Y = Y + 1
5540 IF M = 3 THEN X = X - 1
5550 RETURN
5560 PRINT "SHAPE POSITION DOES NOT CORRESPOND WITH"
5570 PRINT "LORES PLOTTING MATRIX."
5580 PRINT "COMMENCE PLOTTING AT ORIGIN."
5590 FOR I = 0 TO 1000: NEXT
5600 POKE 216,0: REM RESET ERROR FLAG
5610 A$ = "Y": GOTO 5210
5617 REM
5618 REM COMPILE TEMPORARY STORAGE ARRAY
5619 REM
5620 K = 1: COUNTER = 0: R = 0: TR = 0: REM INITIALISE
5630 P1 = 0: P2 = 0: P3 = 0: M1 = 0: M2 = 0: M3 = 0
5640 PLOT X,Y
5650 IF SCRN( X,Y) = 9 THEN P = 1
5660 IF SCRN( X,Y) = 7 THEN P = 0
5670 GET A$
5680 IF A$ = "I" AND Y > 0 THEN M = 0: Y = Y - 1: GOTO 5780
5690 IF A$ = "K" AND X < 38 THEN M = 1: X = X + 1: GOTO 578
0
5700 IF A$ = "M" AND Y < 38 THEN M = 2: Y = Y + 1: GOTO 578
0
5710 IF A$ = "J" AND X > 0 THEN M = 3: X = X - 1: GOTO 5780
5720 IF A$ = "P" THEN COLOR= 9: GOTO 5640
5730 IF A$ = "I" THEN COLOR= 7: GOTO 5640
5740 IF A$ = "T" THEN GOSUB 6480: IF TR = 1 THEN TR = 0: GOTO
5780
5750 IF A$ = "S" THEN R = 1: GOTO 6050
5760 IF A$ = "H" THEN GOTO 6610
5770 GOTO 5670
5780 COUNTER = COUNTER + 1
5790 IF COUNTER = 1 THEN P1 = P: M1 = M: GOTO 5640
5800 IF COUNTER = 2 THEN P2 = P: M2 = M: GOTO 5640
5810 IF COUNTER = 3 THEN P3 = P: M3 = M
5820 IF P3 = 1 OR P3 = 0 AND M3 = 0 THEN COUNTER = 4: P1 =
P3: M1 = M3: P3 = 0: M3 = 0: GOTO 5840

```



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5830 GOTO 6060
5840 IF P2 = 0 AND M2 = 0 THEN COUNTER = 5:PS = P2:MS = M2
: GOTO 5860
5850 GOTO 6060
5860 IF P1 = 0 AND M1 = 0 THEN PRINT "ILLEGAL MOVE TERMIN
ATES CURRENT SHAPE.": PRINT "RE-ENTER LAST THREE MOVES
.": GOTO 5880: REM AVOID ZERO BYTE
5870 GOTO 6060
5877 REM
5878 REM GO BACK 3 MOVES
5879 REM
5880 IF (X + 1) / 10 = INT ((X + 1) / 10) OR (Y + 1) / 10
= INT ((Y + 1) / 10) THEN COLOR= 3
5890 IF X / 2 = INT (X / 2) OR Y / 2 = INT (Y / 2) THEN
COLOR= 0: GOTO 5910
5900 COLOR= 5
5910 PLOT X,Y
5920 IF M3 = 0 THEN Y = Y + 1
5930 IF M3 = 1 THEN X = X - 1
5940 IF M3 = 2 THEN Y = Y - 1
5950 IF M3 = 3 THEN X = X + 1
5960 IF (X + 1) / 10 = INT ((X + 1) / 10) OR (Y + 1) / 10
= INT ((Y + 1) / 10) THEN COLOR= 3
5970 IF X / 2 = INT (X / 2) OR Y / 2 = INT (Y / 2) THEN
COLOR= 0: GOTO 5990
5980 COLOR= 5
5990 PLOT X,Y:Y = Y + 1
6000 IF (X + 1) / 10 = INT ((X + 1) / 10) OR (Y + 1) / 10
= INT ((Y + 1) / 10) THEN COLOR= 3
6010 IF X / 2 = INT (X / 2) OR Y / 2 = INT (Y / 2) THEN
COLOR= 0: GOTO 6030
6020 COLOR= 5
6030 PLOT X,Y:Y = Y + 1
6040 COLOR= 7:COUNTER = 0: GOTO 5640
6047 REM
6048 REM CONVERT FROM PSEUDO-BINARY TO HEX
6049 REM
6050 IF P1 + P2 + P3 + M1 + M2 + M3 = 0 THEN GOTO 6120
6060 BYTEX(K) = M1 + 4 * P1 + 8 * M2 + 32 * P2 + 64 * M3
6070 COUNTER = COUNTER - 3:K = K + 1: IF R = 1 THEN GOTO 6
130
6080 HOME : VTAB 21: PRINT "SHAPE "N" CONTAINS "K" BYTES S
O FAR"
6090 IF COUNTER = 2 THEN M2 = MT:P2 = PT:M1 = MS:P1 = PS
6100 IF COUNTER = 1 THEN M1 = MT:P1 = PT
6110 GOTO 5640
6120 IF K = 1 THEN BYTEX(K) = 1:K = K + 1
6130 BYTEX(K) = 0:KN = K
6140 POKE 35,24: REM RESET TEXT WINDOW
6150 HOME : VTAB 21: PRINT "SHAPE # "N" CONTAINS "K" BYTES
"
6157 REM
6158 REM ADJUST MEMORY SPACE
6159 REM
6160 IF N > PEEK (ST) - 1 THEN GOTO 6360
6170 KO = PEEK (ST + 2 + 2 * N) + 256 * PEEK (ST + 3 + 2 *
N) - PEEK (ST + 2 * N) - 256 * PEEK (ST + 1 + 2 * N)
6180 IF KN = KO THEN GOTO 6360
6190 HOME : VTAB 22: PRINT "LOADING REVISED SHAPE INTO MEM
ORY"
6200 A1 = ST + PEEK (ST + 2 * N + 2) + 256 * PEEK (ST + 2
* N + 3) + KN - KO
6210 LE = LE + KN - KO: REM NEW LENGTH OF SHAPE TABLE
6220 A2 = ST + LE
6230 IF KN < KO THEN GOTO 6280
6240 FOR ADDRESS = A2 TO A1 STEP - 1
6250 POKE ADDRESS, PEEK (ADDRESS + KO - KN)
6260 NEXT ADDRESS
6270 GOTO 6310
    
```

(continued on next page)

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(continued from previous page)

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6280 FOR ADDRESS = A1 TO A2
6290 POKE ADDRESS, PEEK (ADDRESS + KO - KN)
6300 NEXT ADDRESS
6310 FOR NI = N + 1 TO TN
6320 ADDRESS = PEEK (ST + 2 * NI) + 256 * PEEK (ST + 2 *
      NI + 1)
6330 ADDRESS = ADDRESS + KN - KO
6340 POKE ST + 2 * NI, FN LO(ADDRESS): POKE ST + 2 * NI +
      1, FN HI(ADDRESS)
6350 NEXT NI:NI = 0
6357 REM
6358 REM STORE DEFINITION
6359 REM
6360 ADDRESS = ST + PEEK (ST + 2 * N) + 256 * PEEK (ST +
      1 + 2 * N) - 1:K = 0
6370 ADDRESS = ADDRESS + 1:K = K + 1
6380 POKE ADDRESS, BYTEX(K)
6390 IF BYTEX(K) = 0 THEN GOTO 6410
6400 BYTEX(K) = 0: GOTO 6370: REM HOUSEKEEPING
6410 HGR
6420 HOME : VTAB 21: PRINT "ENTER SCALE, THEN PRESS 'RETUR
      N'"
6430 INPUT "S = ";SC$
6440 SC = VAL (SC$): IF SC < 0 OR SC > 255 THEN GOTO 6420
6450 ROT= 0: SCALE= SC: HCOLOR= 3: DRAW N AT 180,80
6460 HOME : VTAB 21: PRINT TAB( 5)"SHAPE # "N" CONTAINS "
      K" BYTES"
6470 RETURN
6477 REM
6478 REM TRACE PREVIOUS SHAPE
6479 REM
6480 IF Y = 0 THEN GOTO 6500
6490 IF SCRN( X,Y - 1) = 8 OR SCRN( X,Y - 1) = 2 THEN M =
      0:Y = Y - 1: GOTO 6560
6500 IF X = 39 THEN GOTO 6520
6510 IF SCRN( X + 1,Y) = 8 OR SCRN( X + 1,Y) = 2 THEN M =
      1:X = X + 1: GOTO 6560
6520 IF Y = 39 THEN GOTO 6540
6530 IF SCRN( X,Y + 1) = 8 OR SCRN( X,Y + 1) = 2 THEN M =
      2:Y = Y + 1: GOTO 6560
6540 IF X = 0 THEN GOTO 6560
6550 IF SCRN( X - 1,Y) = 8 OR SCRN( X - 1,Y) = 2 THEN M =
      3:X = X - 1
6560 IF SCRN( X,Y) = 8 THEN COLOR= 9: GOTO 6600
6570 IF SCRN( X,Y) = 2 THEN COLOR= 7: GOTO 6600
6580 HOME : VTAB 21: PRINT "CURSOR IS NOT ADJACENT PREVIOUS
      S SHAPE."
6590 PRINT "USE OTHER PLOTTING KEYS.": RETURN
6600 PLOT X,Y:TR = 1: RETURN
6607 REM
6608 REM DISPLAY TEXT P2
6609 REM
6610 POKE - 16303,0: POKE - 16302,0: POKE - 16299,0: REM
      TEXT,ALL,P2
6620 GET A$: IF A$ < > CHR$( 13) THEN GOTO 6620
6630 POKE - 16304,0: POKE - 16301,0: POKE - 16300,0: REM
      GRAPHICS,MIXED,P1
6640 GOTO 5670
7997 REM *****
7998 REM SAVE ROUTINE
7999 REM *****
8000 TEXT : HOME : VTAB 10
8010 PRINT "ENTER SHAPE TABLE NAME,": PRINT
8020 PRINT "THEN PRESS 'RETURN'": PRINT
8030 INPUT "":NAME$
8040 PRINT D$;"BSAVE "NAME$", A"ST", L"LE
8050 POKE 103,1: POKE 104,8: POKE 16384,255: REM RE-SET P
      ROGRAM POINTERS

```

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.

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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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Pinch feeding is more expensive but is convenient for letters. Only a few machines will accept both pinch- and pin-fed paper. It is possible to obtain headed letter paper bonded lightly on to pin-fed, fan-folded computer paper for word processors.

Some printers allow direct control of the print-head to give graphics. KSR means keyboard, send and receive, ASR means automatic send and receive, RO means receive only. KSR machines can be used as electric typewriters in local mode.

Comb or line printers have a whole line's worth of dot hammers so they can print a line of text at a time. They tend to be very expensive and very noisy but produce an enormous quantity of work.

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Having been converted to the worship of Megabrain, Samson returns to Earth. He attempts to win over the population by giving away free micros in the Nullard capital, where even to breathe the word "computer" is to risk imprisonment by Bottleneck's minions.

The two spies rushed along the cloistered corridors behind the chapel of St Igor and burst into Bottleneck's sumptuously-appointed private chamber.

"What's this"? He looked up angrily.

"Forgive us, Brother Superior, but this is urgent. A man calling himself Son of Hex has set up his stall in the central square and is distributing micro-computers to the people".

"Selling micros? Arrest him for trafficking".

"He's not selling them. He's giving them away".

"Giving them away"! Bottleneck was aghast.

"What's more, he's starting to teach them assembly language", added one of the informers. "They're sitting at his feet like lambs, hanging on his every word".

"Then we'll get him for illegal assembly".

"But that's not a capital offence".

"Good thinking. We have to put a stop to all this for good. Get him for blasphemy, heresy . . . anything. Just haul him in. We'll prepare the charges later".

Samson's brief moment of glory lasted one day. In the afternoon he was borne aloft through the city streets by cheering thousands, their computer-starved brains high on Space Invaders and VisiCalc. Cries of Hail to the Son Of Hex! filled the air. By nightfall he was under arrest, being hustled away in a black van while police dispersed the demonstrators with tear gas.

The ecclesiastical courtroom, where Samson appeared next morning, was bare and cold. The chief interrogator swirled into the room, trailing his lavish vestments behind him. It was Bottleneck himself.

"I trust you realise the gravity of the charges you have been brought here to answer", he began.

"What charges"?

"Never mind what charges", snapped the interrogator impatiently. "Just remember they're serious".

"Yes Sir".

"Now, to begin with, who or what is Megabrain"? He pronounced the last word with exaggerated contempt.

"Megabrain is the inherent law of the universe, the ideal we strive towards. Megabrain is the universe operating as a computing system, so computers are a step on the road to Megabrain's actualisation. When the cosmos is a unified system, Megabrain will be realised".

Bottleneck looked over to where the court recorder sat, pencil scratching

furiously on his pad. "Have you got all that down"? he enquired.

The stenographer nodded.

"I cannot define Megabrain for you," Samson continued, "but I can help you recognise Megabrain's nature in yourself".

"Yes, yes," interrupted Bottleneck. "That's quite enough. Let's hear about you: you claim to be the Son of Hex".

"I am the Son of Hex".

"You mean mean to tell us that Samuel Synapse, destroyer of the accursed System, was your father"?

"He was. Though the system he destroyed is not the one that I come to build".

"But you're too young".

"I have travelled in space, beyond the edge of our galaxy; that is why I have not aged".

Bottleneck permitted himself a smile. It was proving easier than he had expected. The suspect was condemning himself from his own mouth.

"It would appear that you are a systematist at heart".

"We are all systematists at heart. Even you. One day you will realise it".

"The prosecution rests its case", Bottleneck told the court.

The tribunal of lay magistrates, two men and a woman, rustled their papers. One of the men took a swig of water. The woman leaned over the bench.

"Has the prisoner anything to say in his defence"? she enquired.

"Only that I come to set you all free", responded Samson. "The world is in darkness. To erase data is to suppress truth; to halt computing is to shackle the mind. I will open your eyes to the light".

The verdict, guilty, was reached within minutes. Samson listened as the sentence was read out to him. Gradually the chilling realisation sank in that death was very close. He was to be stoned that very day.

Ada had worried after Samson had left, and had followed him into town the next day. There she heard the news of his brief fame and subsequent arrest. When the time and place of his execution were announced she joined the throng of people trekking out from around the country to the appointed spot.

The crowd was muted. As Samson arrived, escorted by a platoon of heavily-armed guards, there were a few hostile shouts, but most people remained silent. Some of his erstwhile supporters were there, staying quiet for fear of reprisals.

Samson was led down into the gully by the captain of guards. He read out the

deposition which included most of the "confession" Samson had given the court. Having made sure that Samson was firmly bound hand and foot, he marched smartly up the slope.

Reaching the top, he turned round, picked up a small pebble, and hurled it at the condemned man. It was a symbolic gesture, to relieve from the other stone-throwers the guilt for casting the first stone. As it happened the officer had an excellent aim and the stone bounced painfully off Samson's forehead.

This was the moment when Samson's life hung in the balance. A few of the spectators, the ones who had jeered as he was led to the execution ground, picked up stones and tossed them at him. But they all rolled harmlessly past their target. The public mood was sombre, not bloodthirsty.

Sensing the possibility of an embarrassing anti-climax, the captain of guards gave a cryptic signal. Certain of the watchers, soldiers in plain clothes, picked up rocks and began ranting and cursing.

"Traitor! Heretic! Accursed infidel"! they yelled, hurling the boulders downwards.

It worked. Others were roused to participate. The stones rained down. More and more missiles found their mark.

Ada closed her eyes in horror as Samson's body sagged under the blows. Then his last anguished cry rang in her ears: "Mantissa, I love you"! But Mantissa was too far away to hear.

His body collapsed, lifeless, under a hail of boulders.

Eventually the crowd dispersed. Ada wiped a tear from her eye as she trudged slowly homewards, re-tracing the way they had dragged him.

Suddenly, she noticed at the wayside, the miniature apple tree he had called Zapple. It lay, unconsidered, where it had fallen from his grasp, its pot splintered, its roots open to the air, its frail branches bent and broken after surviving so many millions of miles. But its single fruit had not even been bruised: it hung just above the dust, gleaming in the sunlight.

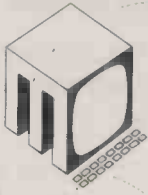
She bent down.

"I wonder . . ."

Her tongue suddenly felt parched. The little apple looked so crisp, so refreshing.

She picked it up and pensively turned it over in her hand. Then at length she bit deep into its side, till the juice ran down her cheeks. As she did so, a strange feeling came over her . . .

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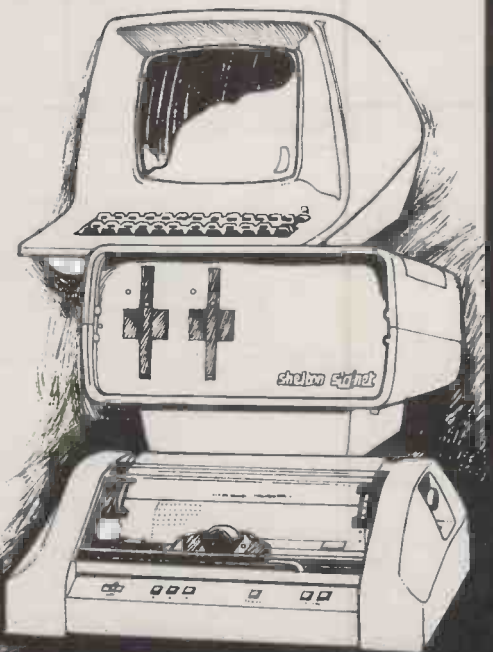
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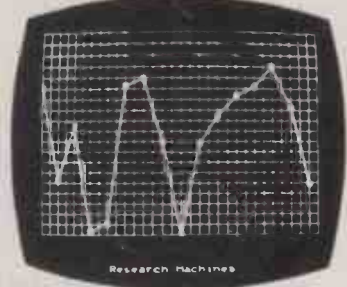
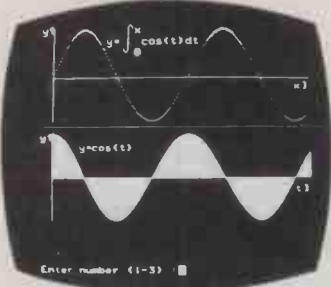
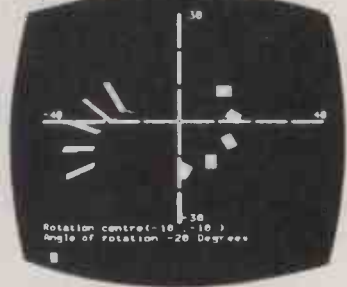
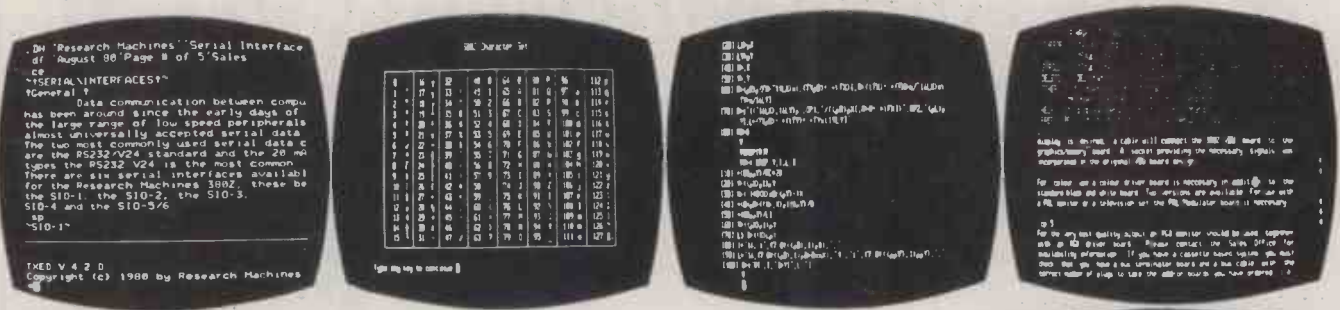
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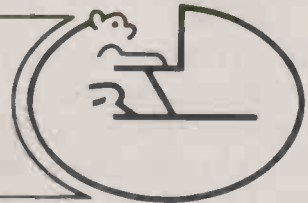
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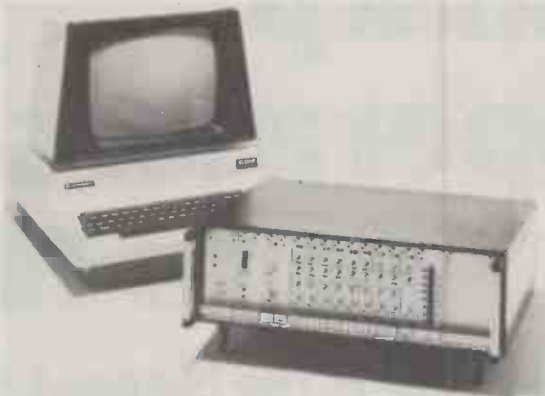
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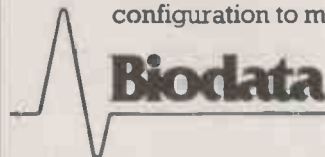
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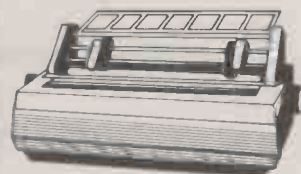
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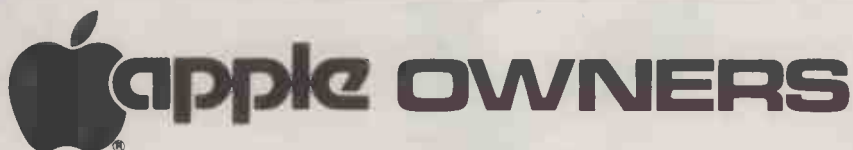
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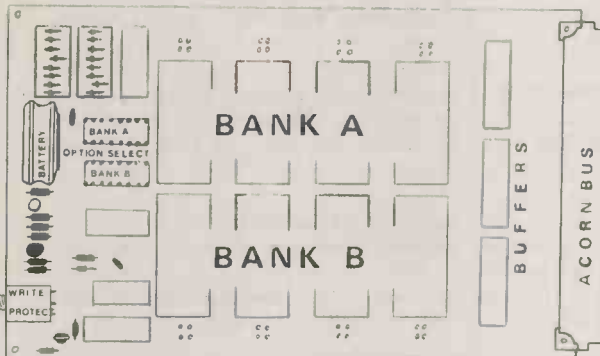
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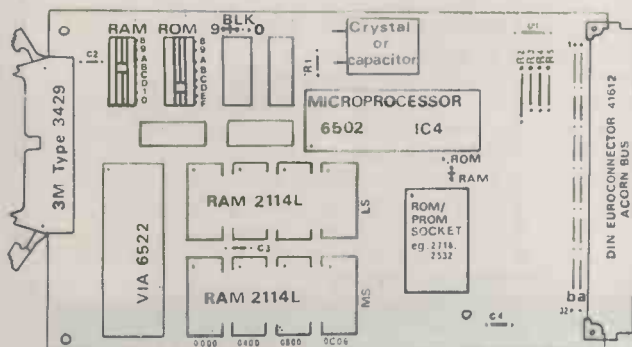
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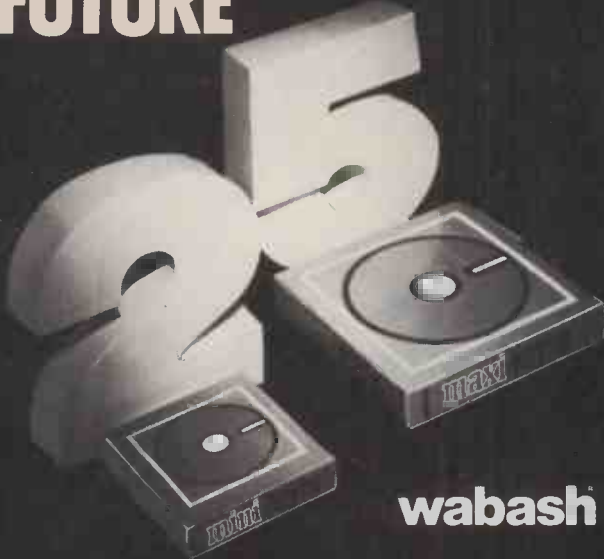
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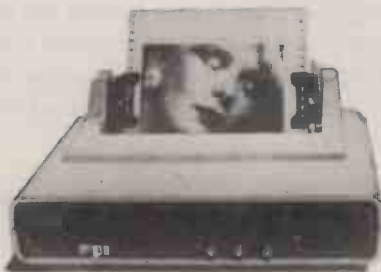
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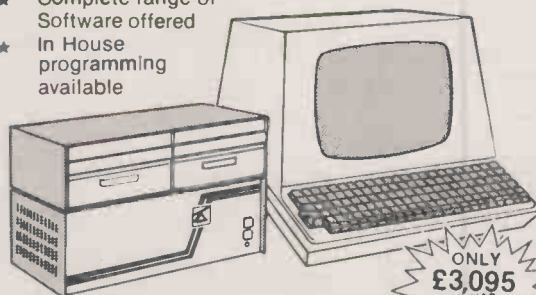


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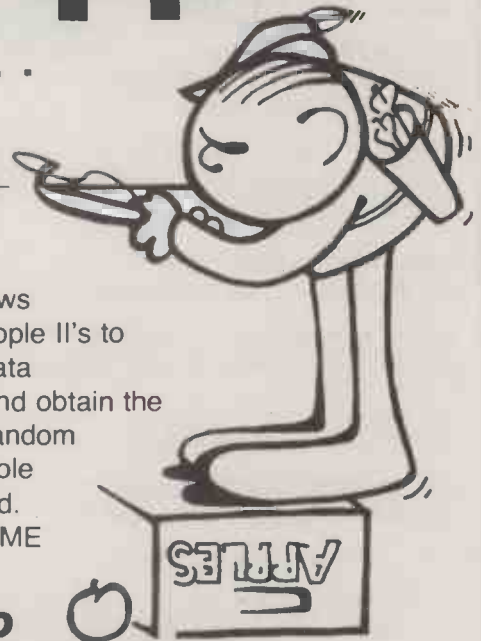
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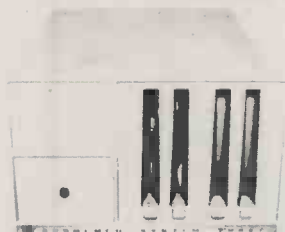
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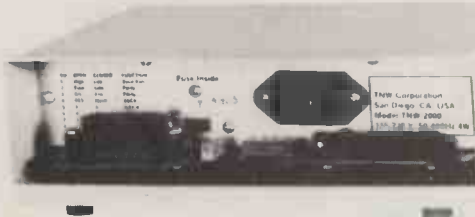
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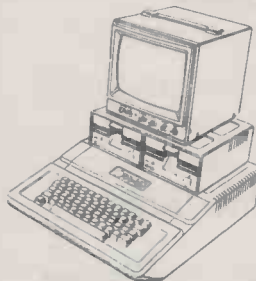
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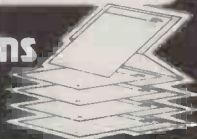
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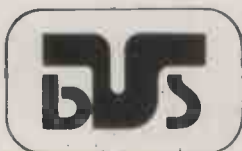
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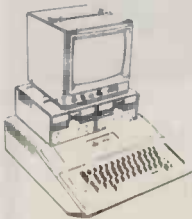
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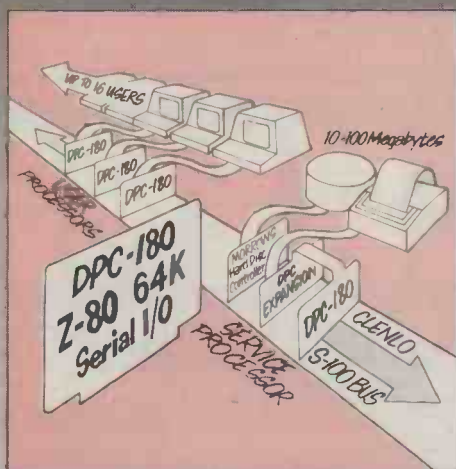
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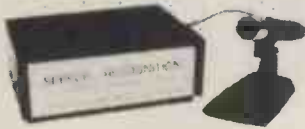
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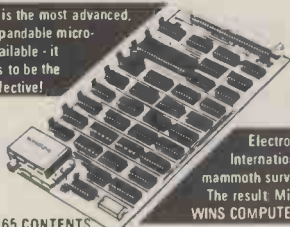
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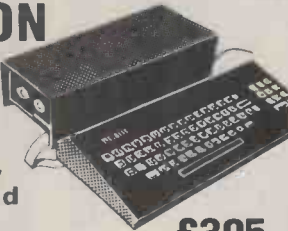
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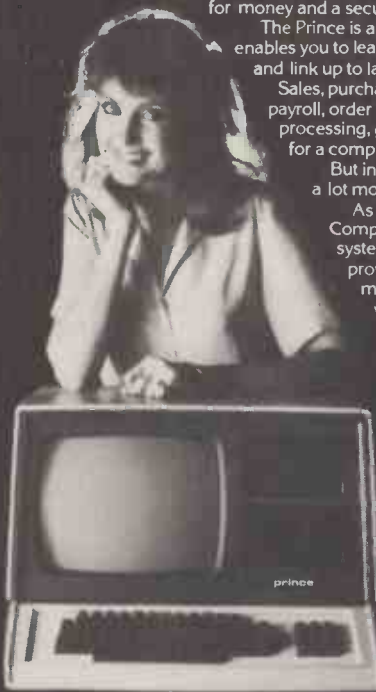
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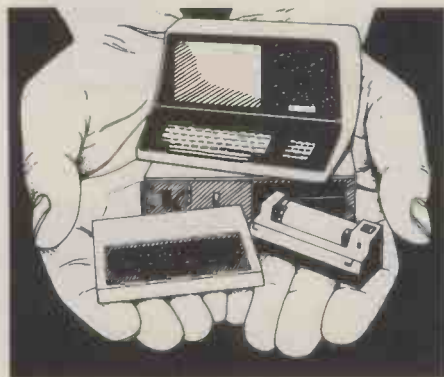
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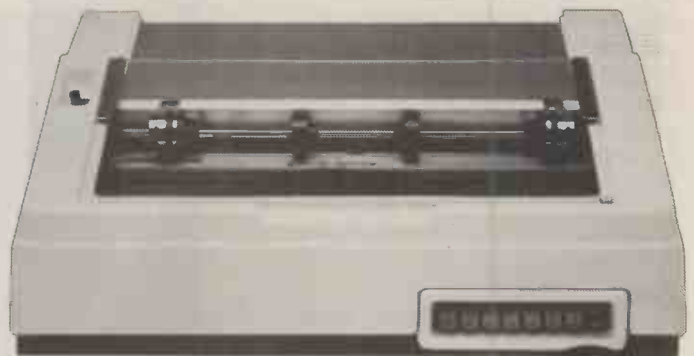
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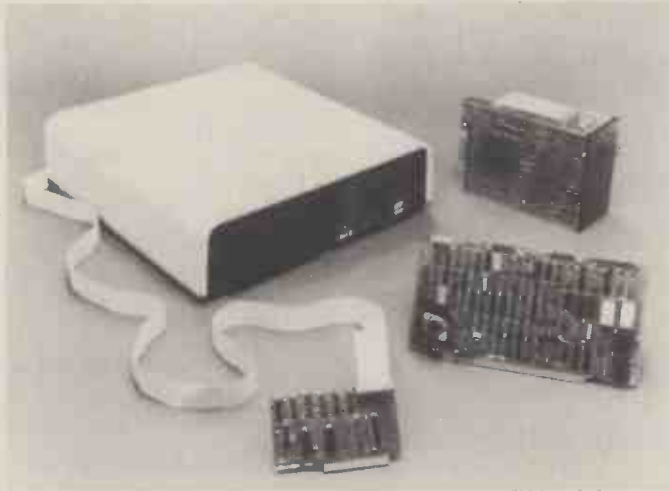


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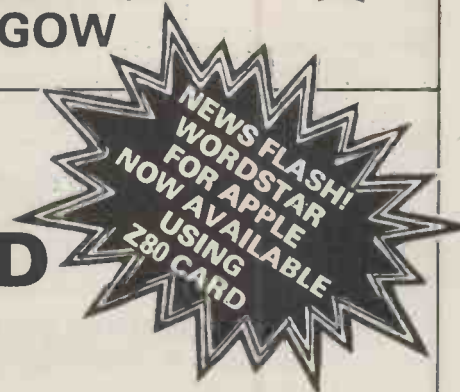
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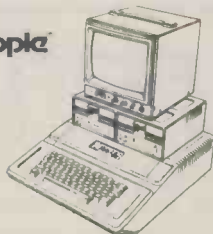
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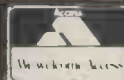
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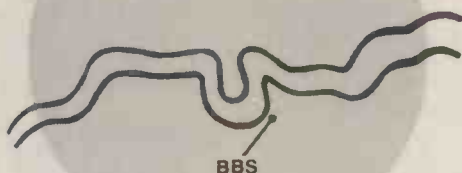


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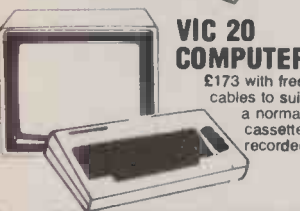
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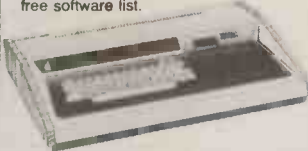
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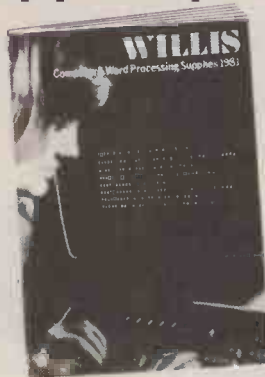


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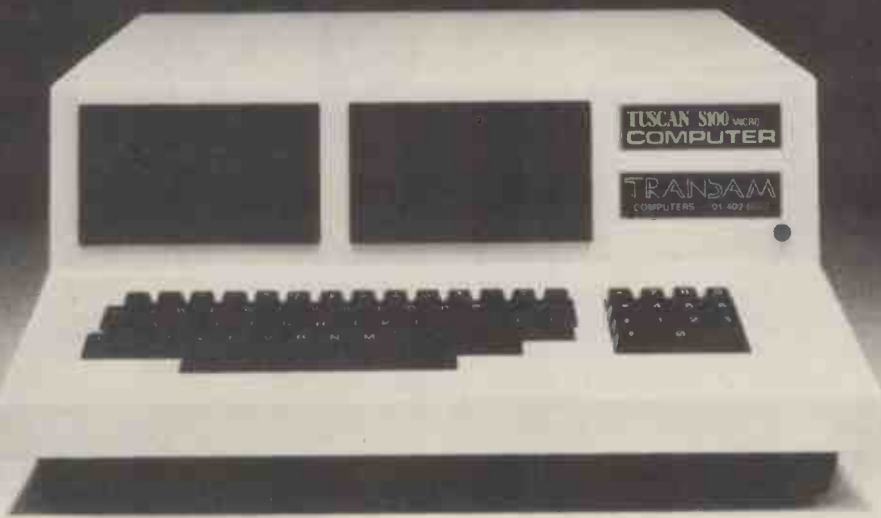
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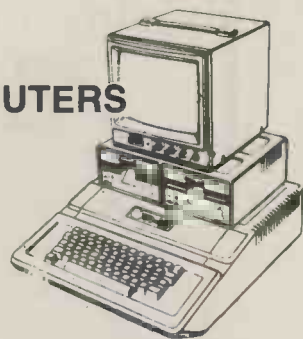
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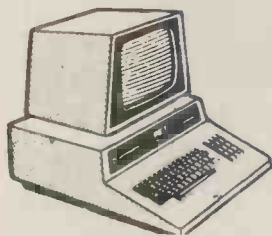
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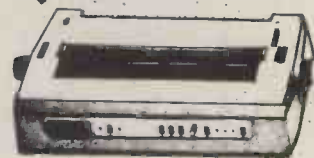


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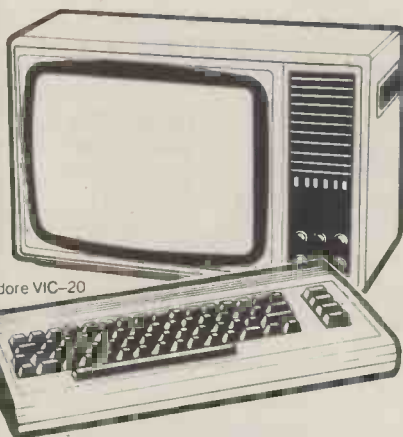


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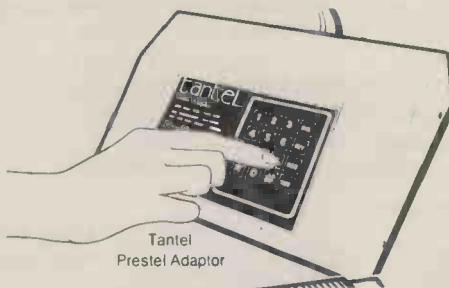
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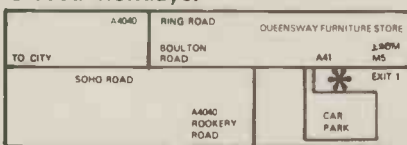
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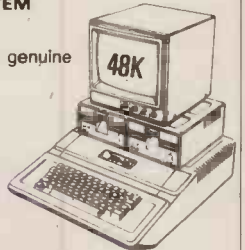
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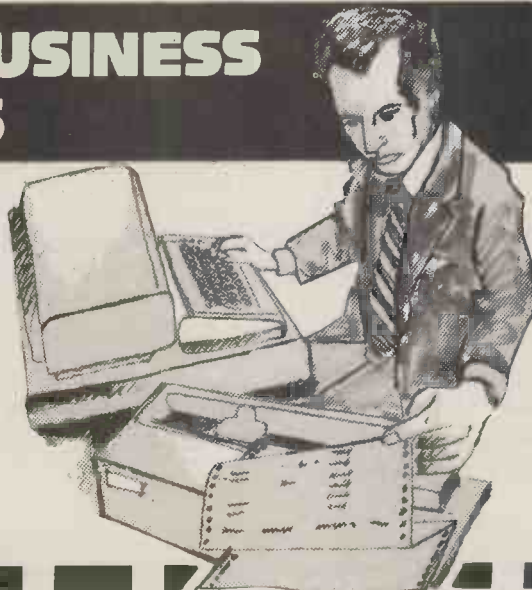
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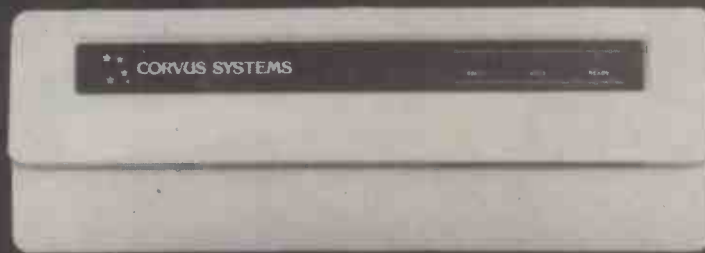
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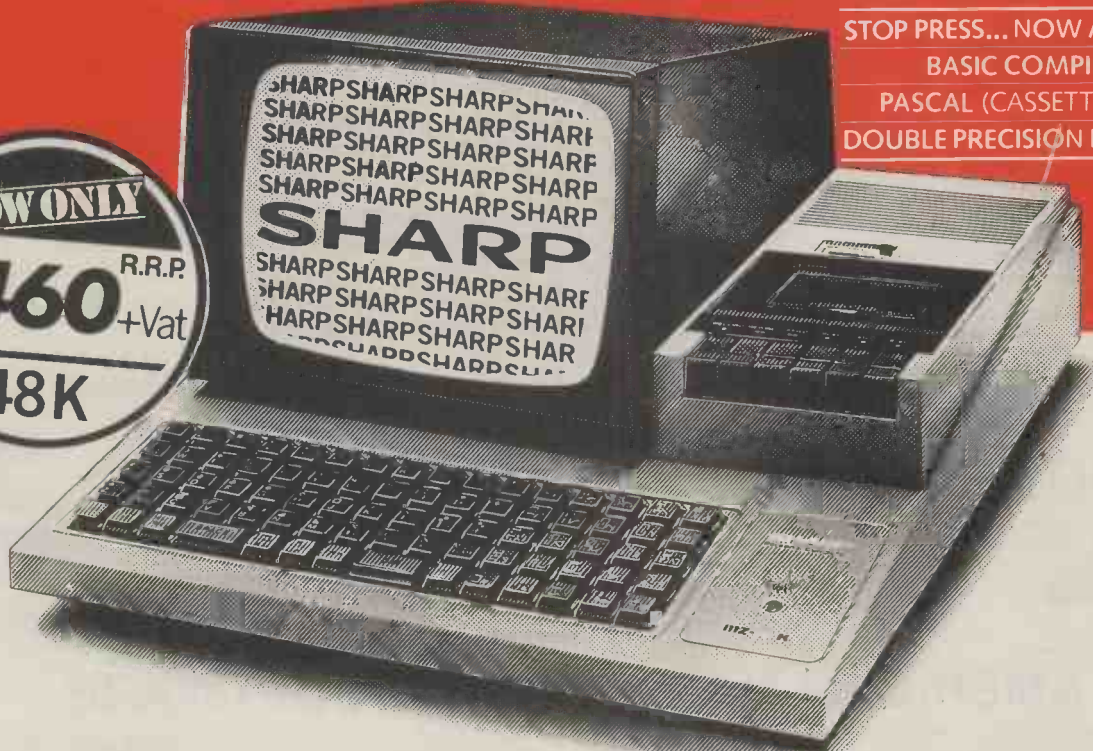


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To acquaint the user with the range of programming languages and packages which are compatible with CP/M.

Programming in Basic

OBJECTIVES

To give the student a thorough understanding of the BASIC language.

To enable the student to put the knowledge gained into practical use, facilitated by hands-on sessions and practical exercises.

Programming in CIS Cobol**

OBJECTIVES

To give a sound knowledge of the Ansi '74 Cobol programming language, highlighting differences between various dialects particularly CIS Cobol.

To provide an understanding of structured programming techniques as used in CIS Cobol.

Programming in PASCAL

OBJECTIVES

To provide an understanding of structured programming techniques as used in PASCAL.

To give a thorough knowledge of the PASCAL programming language.

To provide practical experience in using PASCAL on a microcomputer.

CONTACT:

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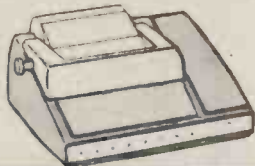
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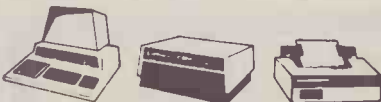


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7422	22p	74216	100p	74LS348	150p	4042	40p	CA3189E	300p	SL490	350p	Z80	8088	74S289	325p	ULN2004A	100p	10 7MHz	250p												
7423	28p	74217	100p	74LS365	36p	4043	120p	CA3240E	120p	SN76477	175p	Z80	8088	74S289	325p	75017	160p	1p 0MHz	350p												
7424	25p	74218	100p	74LS368	50p	4044	75p	CA3280G	200p	SP8515	750p	Z80	8088	74S289	325p	75110	160p	16 00MHz	250p												
7425	25p	74219	100p	74LS373	80p	4045	55p	DAC1408 8	200p	TA7205	250p	Z80	8088	74S289	325p	75112	160p	18 00MHz	250p												
7426	25p	74220	100p	74LS374	80p	4046	30p	HA1388	270p	TAA621	275p	Z80	8088	74S289	325p	75114	160p	18 00MHz	250p												
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7429	25p	74223	100p	74LS378	90p	4049	30p	ICM7555	80p	TA7204	250p	Z80	8088	74S289	325p	75154	140p	27 145MHz	250p												
7430	25p	74224	100p	74LS379	90p	4050	60p	ICM7555	80p	TA7222	200p	Z80	8088	74S289	325p	75182	220p	38 6667 MHz	350p												
7431	25p	74225	100p	74LS380	90p	4051	60p	ICM7555	80p	TA7310	200p	Z80	8088	74S289	325p	75324	325p	48 0MHz	300p												
7432	25p	74226	100p	74LS381	90p	4052	60p	ICM7555	80p	TAA621	275p	Z80	8088	74S289	325p	75361	150p	65 5MHz	400p												
7433	25p	74227	100p	74LS382	90p	4053	60p	ICM7555	80p	TAA621	275p	Z80	8088	74S289	325p	75363	150p	110MHz	350p												
7434	25p	74228	100p	74LS383	90p	4054	130p	ICM7555	80p	TAA621	275p	Z80	8088	74S289	325p	75451.2	72p														
7435	25p	74229	100p	74LS384	90p	4055	125p	ICM7555	80p	TAA621	275p	Z80	8088	74S289	325p	76453.4	72p														
7436	25p	74230	100p	74LS385	90p	4056	120p	ICM7555	80p	TAA621	275p	Z80	8088	74S289	325p	75491.2	70p														
7437	25p	74231	100p	74LS386	90p	4057	500p	ICM7555	80p	TAA621	275p	Z80	8088	74S289	325p	H126	120p														
7438	25p	74232	100p	74LS387	90p	4058	90p	ICM7555	80p	TAA621	275p	Z80	8088	74S289	325p	H126	120p														
7439	25p	74233	100p	74LS388	90p	4059	100p	ICM7555	80p	TAA621	275p	Z80	8088	74S289	325p	H126	120p														
7440	25p	74234	100p	74LS389	90p	4060	90p	ICM7555	80p	TAA621	275p	Z80	8088	74S289	325p	H126	120p														
7441	25p	74235	100p	74LS390	90p	4061	100p	ICM7555	80p	TAA621	275p	Z80	8088	74S289	325p	H126	120p														
7442	25p	74236	100p	74LS391	90p	4062	100p	ICM7555	80p	TAA621	275p	Z80	8088	74S289	325p	H126	120p														
7443	25p	74237	100p	74LS392	90p	4063	100p	ICM7555	80p	TAA621	275p	Z80	8088	74S289	325p	H126	120p														
7444	25p	74238	100p	74LS393	90p	4064	90p	ICM7555	80p	TAA621	275p	Z80	8088	74S289	325p	H126	120p														
7445	25p	74239	100p	74LS394	90p	4065	90p	ICM7555	80p	TAA621	275p	Z80	8088	74S289	325p	H126	120p														
7446	25p	74240	100p	74LS395	90p	4066	90p	ICM7555	80p	TAA621	275p	Z80	8088	74S289	325p	H126	120p														
7447	25p	74241	100p	74LS396	100p	4067	400p	ICM7555	80p	TAA621	275p	Z80	8088	74S289	325p	H126	120p														
7448	25p	74242	100p	74LS397	16p	4068	18p	ICM7555	80p	TAA621	275p	Z80	8088	74S289	325p	H126	120p														
7449	25p	74243	100p	74LS398	16p	4069	18p	ICM7555	80p	TAA621	275p	Z80	8088	74S289	325p	H126	120p														
7450	25p	74244	100p	74LS399	16p	4070	20p	ICM7555	80p	TAA621	275p	Z80	8088	74S289	325p	H126	120p														
7451	25p	74245	100p	74LS400	16p	4071	20p	ICM7555	80p	TAA621	275p	Z80	8088	74S289	325p	H126	120p														
7452	25p	74246	100p	74LS401	16p	4072	20p	ICM7555	80p	TAA621	275p	Z80	8088	74S289	325p	H126	120p														
7453	25p	74247	100p	74LS402	16p	4073	20p	ICM7555	80p	TAA621	275p	Z80	8088	74S289	325p	H126	120p														
7454	25p	74248	100p	74LS403	16p	4074	20p	ICM7555	80p	TAA621	275p	Z80	8088	74S289	325p	H126	120p														
7455	25p	74249	100p	74LS404	16p	4075	20p	ICM7555	80p	TAA621	275p	Z80	8088	74S289	325p	H126	120p														
7456	25p	74250	100p	74LS405	16p	4076	60p	ICM7555	80p	TAA621	275p	Z80	8088	74S289	325p	H126	120p														
7457	25p	74251	100p	74LS406	16p	4077	40p	ICM7555	80p	TAA621	275p	Z80	8088	74S289	325p	H126	120p														
7458	25p	74252	100p	74LS407	16p	4078	20p	ICM7555	80p	TAA621	275p	Z80	8088	74S289	325p	H126	120p														
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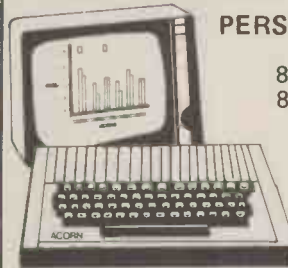


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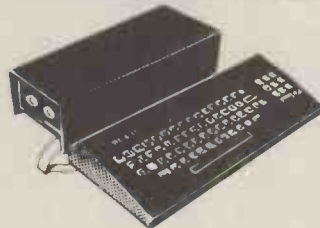
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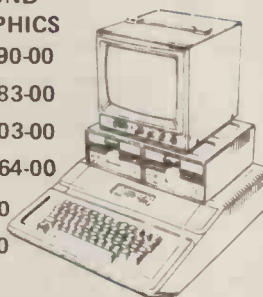
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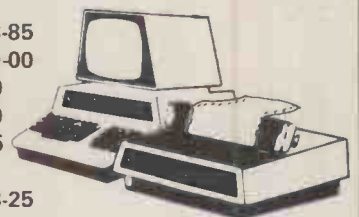
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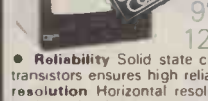


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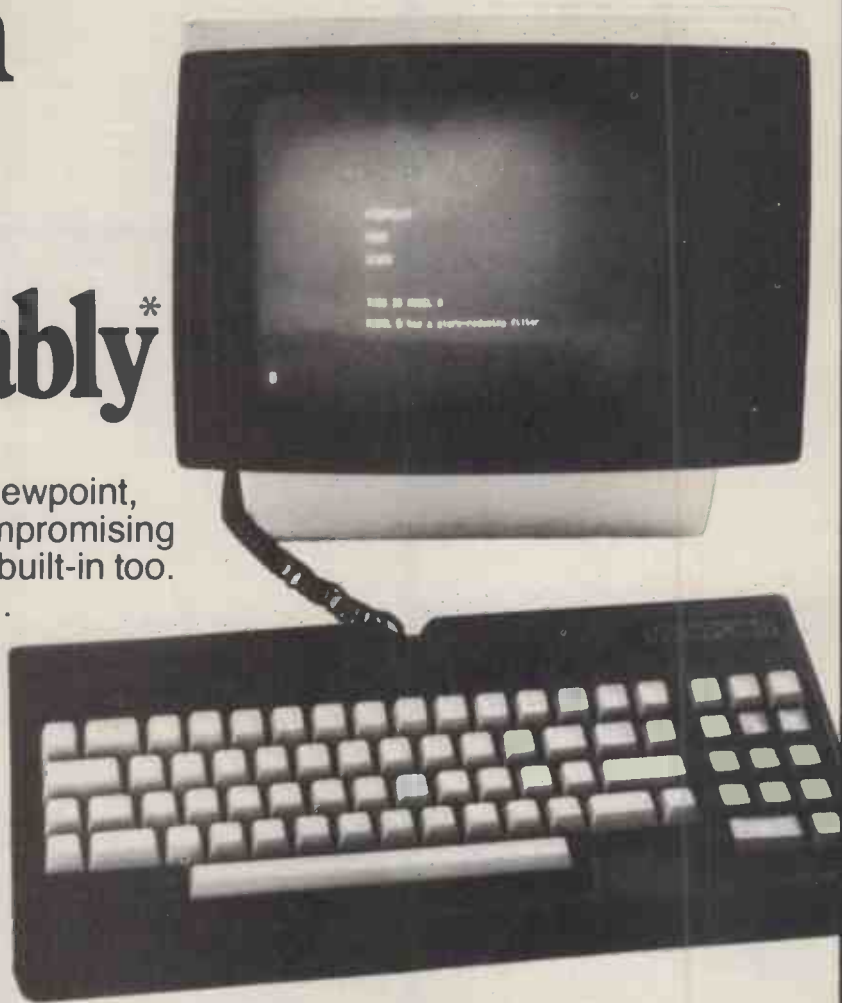
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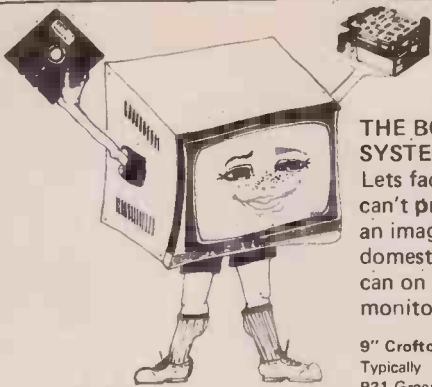
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